SANTA CRUZ WATER DEPARTMENT
WATER CONSERVATION PLAN
FINAL REPORT

Prepared by:

Gary Fiske & Associates
Jennifer J. Stout – Water And Energy Consulting

February 2000

TABLE OF CONTENTS

Figures and Tables

List of Figures

List of Tables

EXECUTIVE SUMMARY

Plan Objectives

The purpose of this water conservation plan is to provide direction to the City of Santa Cruz for its water conservation efforts over the next ten years. This so-called "interim period" is the term over which it is unlikely that any new supply options could become operational. The plan evaluates alternative conservation practices and establishes an action plan to guide the efforts of the City in making optimum use of its existing water resources.

The programmatic and pricing options addressed in this conservation plan comprise one of the three components of the City's solution to its current and future water supply constraints. The other two are:

- Reducing water demand through emergency usage curtailment in drought years.
- Additional supplies.

These are being addressed in separate studies; all three components will be brought together in the City's upcoming integrated water plan (IWP).

The specific goals of this study were to:

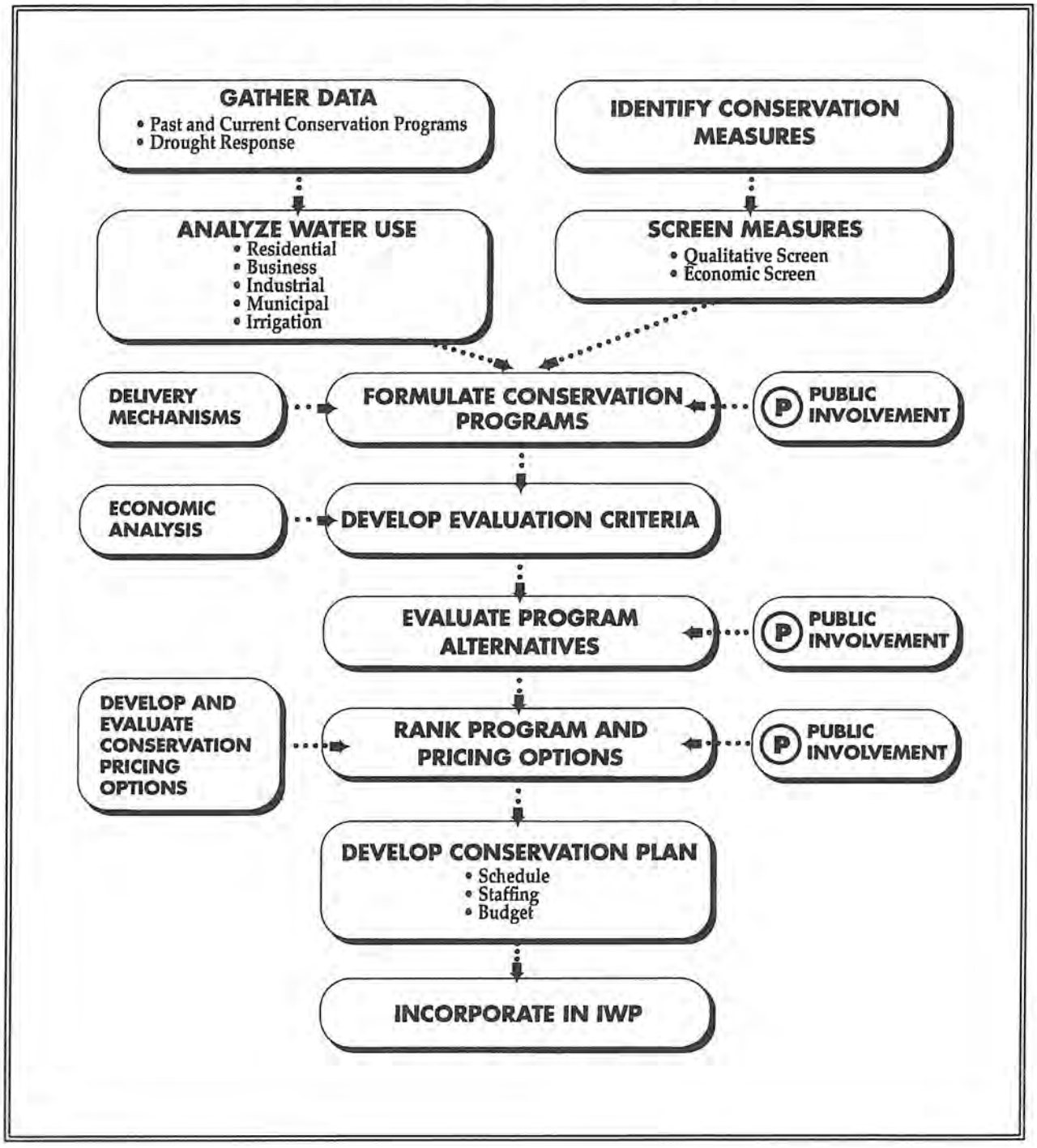
- Determine which conservation programs and practices are the most cost-effective and best-suited to the City's customer base.
- Identify the water savings those programs could achieve and the costs of implementation.
- Develop an action plan to provide direction to the Department in carrying out the interim period conservation programs.

Water Conservation Plan Development

The process of developing this plan involved several tasks. These tasks are illustrated in Figure ES-1 and include:

1. Analyzing water use in each customer category (e.g., residential, commercial, industrial, irrigation), and reviewing conservation actions already in place.
2. Identifying and screening possible new conservation measures for costs, water savings, and appropriateness to the Santa Cruz service area.

Figure ES - 1
WATER CONSERVATION PLANNING PROCESS



3. Formulating program alternatives by selecting the most promising water conservation measures and determining how they should best be delivered to water users.
4. Developing conservation pricing options.
5. Evaluating, selecting, and prioritizing the programmatic and pricing options.
6. Developing an interim-period action plan.

Conservation Measure Screening

A universe of 116 conservation measures was identified. Two successive screenings were then performed to eliminate measures that were clearly inappropriate for Santa Cruz. The qualitative screen looked at six criteria that addressed the City's need to achieve long-term, reliable water savings. The economic screen then compared the cost of the remaining measures to the estimated cost of new supplies.

The thirty-five measures passing both screens are displayed in Table ES-1.

Conservation Program Development

The measures that passed the screens were combined with appropriate delivery mechanisms to develop a set of conservation program alternatives. Possible delivery mechanisms include:

- Audits/Technical Assistance
- Financial Incentives
- Giveaways
- Direct Installation
- Regulation

The following conservation program alternatives emerged from this process.

Residential Programs

Conservation Kit Distribution. Through this program, the City will deliver indoor conservation kits to single-family and multi-family residential customers door-to-door. The kit program will provide customers with inexpensive conservation devices that can reduce indoor water use. These include:

Table ES - 1
MEASURES PASSING THE QUALITATIVE AND ECONOMIC SCREENS

RESIDENTIAL INDOOR MEASURES

- Low-flow showerheads and ultra low-flow showerheads
- Faucet aerators
- Fill cycle regulators
- Toilet leak detection and repair
- Ultra low-flush toilets (ULFTs): gravity flow type
- Horizontal-axis clotheswashers (new construction/natural replacement)
- Low-volume dishwashers (new construction/natural replacement)
- Individual multifamily unit submeters (assume 50 units) – Retrofit existing buildings
- Individual multifamily unit submeters (assume 50 units) – Install at time of construction

COMMERCIAL/INDUSTRIAL/INSTITUTIONAL INDOOR MEASURES

- Toilets: valve-type and gravity flow tank-type
- Toilet valve retrofit
- ULF urinal valve retrofit
- Faucet aerators
- Faucets
- Horizontal-axis clotheswashers for commercial coin-operated application:
  a) New construction/natural replacement only
- Commercial dishwashers:
  a) New recycling instead of standard
  b) Early retirement of 6.0 gal/load; replace w/ recycling unit
- Air-cooled drinking fountains:
  a) New construction/natural replacement
  b) Early retirement of water-cooled
- Air-cooled icemakers:
  a) New construction/natural replacement
  b) Early retirement of water-cooled
- HVAC:
  a) Purchase new air-cooled unitary system instead of water-cooled
  b) Purchase new air-cooled chiller instead of water-cooled
- Early retirement of single-pass; replace with water-cooled or air-cooled
- Improved O&M practices: water-cooled condenser and ozonation of cooling tower water
- Site-specific industrial processes:
  a) Industrial washers and rinsers
  b) Industrial solenoid and automatic control valves
  c) Industrial waste stream separation to facilitate reclamation
  d) HVAC measures applied in industrial setting

OUTDOOR CONSERVATION MEASURES — ALL SECTORS

- Combined drip/sprinkler system instead of all-sprinkler in new installation
- Rain Sensors
- Improve existing sprinkler systems
- Convert quick coupler system to automated systems
- Computerized weather stations
- Irrigation scheduling reminders

- Leak detection tablets, instructions for performing leak detection tests, and repair devices;
- Fill cycle regulators;
- Faucet aerators; and
- Low-flow showerheads.

Indoor/Outdoor Water Use Review and Measure Installation. These will target the top water users. The indoor review will identify areas where water is being wasted, fix toilet and faucet leaks, install low-cost indoor water savings measures (low-flow showerheads, faucet aerators, and fill cycle regulators), and offer information to improve water use efficiency. The outdoor review will check and reprogram irrigation equipment as needed, and offer customers a customized lawn irrigation schedule and watering tips if watering is done manually. The program will also offer an average rebate of $300 toward irrigation equipment retrofits.

Retrofit on Resale Ordinance. In this program, the City will adopt an ordinance requiring residential properties to meet efficiency standards for plumbing fixtures whenever a property changes ownership. The ordinance will require that toilets and showerheads be replaced with water-efficient fixtures, faucet aerators be installed, and leaking toilets repaired as necessary.

Ultra-Low-Flush Toilet (ULFT) Rebates. This program offers rebates to existing residential customers to replace their inefficient toilets with ULFTs. This program will essentially continue the Santa Cruz Water Department's ("SCWD" or "Department") existing rebate program, but with increased emphasis on marketing to multifamily accounts. The initial rebate offered would continue at $75 per toilet.

Efficient Clotheswasher Rebates. This program will offer $100 rebates to residential customers who replace their existing clotheswashers with approved water- and energy-efficient horizontal axis machines.[1]

Apartment Building Submeter Rebates. This program provides a rebate to apartment owners to encourage the installation of submeters in existing apartment units. Submeters measure individual dwelling unit water use where a master meter already exists, allowing the cost of water to be billed to individual apartment dwellers. This raises customers' awareness and provides them with an economic incentive to conserve. It also helps building owners and managers identify units where there may be leaks. The program will target the top 20% of multifamily customers.

New Construction Ordinance. This program will establish regulations for all future residential dwelling units constructed in the City's water service area to minimize the quantity of water

[1] The City Council has approved this program and has ordered the Water Department to begin implementation in early 2000.

needed to serve new development. Plumbing codes currently in effect provide that new residential construction be equipped with water-saving toilets, shower heads, and faucets, as well as a pressure reducing valve. As currently envisioned,[2] the new regulations would be in addition to the plumbing code requirements, and would require new residential construction to include a water-efficient clotheswasher and water-efficient irrigation equipment and plant materials. Meters for individual dwelling units would be required in new multi-family construction, where feasible.

Non-Residential Programs

ULFT Rebate. The Department will offer large commercial, institutional, and industrial customers, including UC Santa Cruz, incentives for the early retirement of non-conserving toilets. Both tank and valve toilets will be covered. Participants who replace a tank-type toilet will receive a $75 rebate; participants who replace a valve-type toilet will receive a $140 rebate.

Indoor Water Use Review, Measure Installation, and Rebates. This program targets the highest water-using commercial customers, as well as UC Santa Cruz. The review includes on-site installation as appropriate of faucet aerators and toilet and urinal valve retrofit kits. The program also offers rebates of up to $1,000 per customer for water-saving equipment such as air cooled drinking fountains and ice makers, water recycling dishwashers, and horizontal axis clotheswashers. Customers can also participate in the toilet rebate program.

Large Landscape Water Use Review. This program is directed at dedicated business, residential, and golf irrigation accounts. Department staff will identify and contact the sites. Professional landscape auditors will perform and initial review to evaluate each irrigation system's design, operating condition, and current overall efficiency. Auditors will identify low-cost improvements such as aligning sprinkler heads, replacing broken heads, and trimming grass that disrupts spray patterns. Once these improvements are made, technicians will proceed with a detailed irrigation audit to develop a base irrigation schedule, provided in a brief written report to the site manager, showing weekly watering times for every month. Follow-up checks will assess implementation and satisfaction, and adjust schedules as needed.

Parks Water Use Review. This water use review, for city and county parks, is similar to the large landscape review, but is geared to the types of current irrigation systems in parks.

Tables ES-2 and ES-3 summarize the expected savings and costs of these programs.

---

[2] The contents of the new construction ordinance are still under discussion.

Table ES - 2

SUMMARY OF ESTIMATED PROGRAM COSTS AND SAVINGS – RESIDENTIAL PROGRAMS

PROGRAM	INITIAL UTILITY COST PER PARTICIPANT				INITIAL PARTICIPANT COST[b]		WATER SAVINGS PER PARTICIPANT (GAL/YR)		MAXIMUM ANNUAL SAVINGS (MG)[e]
	INCENTIVE		OTHER VARIABLE COSTS[a]						
	SINGLE FAMILY	MULTI-FAMILY[f]	SINGLE FAMILY	MULTI-FAMILY[f]	SINGLE FAMILY	MULTI-FAMILY[f]	SINGLE FAMILY	MULTI-FAMILY[f]	
1. Kit Distribution	N/A	N/A	$11	$11	$0	$0	3,650	1,825[d]	18.9
2. Water Use Review	$300[c]	$300[c]	$130	$130	$300[c]	$300[c]	11,972	93,732	33.6
3. Time of Resale	N/A	N/A	$50	$50	$400	$500	15,695	17,520	113.3
4. ULFT Rebate[g]	$75	$75	$15	$15	$65	$65	7,483	8,213	47.5
5. Washer Rebate[h]	$100	$100	$0	$0	$200	$200	5,100	5,100	22.9
6. Apartment Submeter Rebate	N/A	$1,575	N/A	$100	N/A	$4,725	N/A	93,732	2.8
7. New Construction Ordinance[i]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

a Some programs may also have recurring costs that are not shown in this table. They are reflected in the budgetary cost estimates in Section IX.

b Participant cost is net of utility incentive.

c For those who elect to retrofit or upgrade their irrigation systems.

d Savings shown are per multifamily unit, not per account.

e The maximum annual savings are not additive as different programs will achieve maximum savings in different years.

f Costs and savings are per multifamily account, not per dwelling unit, unless otherwise indicated.

g Savings and cost per toilet replaced, not per account.

h Savings and cost per washer replaced, not per account.

i Information is not provided for New Construction Ordinance because the specific program components have yet to be determined.

Table ES - 3

SUMMARY OF ESTIMATED PROGRAM COSTS AND SAVINGS – NON-RESIDENTIAL PROGRAMS

PROGRAM	INITIAL UTILITY COST PER PARTICIPANT		INITIAL PARTICIPANT COST [b]	WATER SAVINGS PER PARTICIPANT (GAL/YR)	MAX. ANNUAL SAVINGS (MG) [d]
	INCENTIVE	OTHER VARIABLE COSTS [a]			
8. Commercial ULFT Rebate [e]	$120	$25	$210	11,607	13
9. Commercial Water Use Review	Bus.: $2,500 UCSC: $12,500	$40 per customer	Bus.: $2,500 UCSC: $12,500	Bus.: 145,008 UCSC: 2,281,250	32.2
10. Large Landscape Water Use Review	Res.: $300 [c] Bus.: $750 c Golf: $2,000 [c]	Res.: $200 Bus.: $300 Golf: $5,000	Res.: $300 [c] Bus.: 750 c Golf: $2,000 [c]	Res.: 25,466 Bus.: 29,104 Golf: 2,675,000	8.6
11. Parks Water Use Review	$5,000 [c]	$2,500	$10,000 [c]	N/A	6.5

a Some programs may also have recurring costs that are not shown in this table. They are reflected in the budgetary cost estimates in Section IX.

b Participant cost is net of utility incentive.

c For those who elect to retrofit or upgrade their irrigation systems.

d The maximum annual savings are not additive as different programs will achieve maximum savings in different years.

e Savings and cost per toilet replaced, not per account.

Conservation Pricing Options

At the direction of the City Council, the plan was expanded to include conservation pricing options. The assessment focused on three rate structures:

- **Fixed inverted blocks**, essentially an expansion and/or modification of the City's current 3-tier increasing block structure for its single-family residential customers.
- **Seasonal differentials**. This alternative would institute summer/winter rate differentials for one or more classes.
- **Budget-based inverted blocks.** Under this alternative, one or more classes would face an increasing block rate with block sizes based on customer-specific attributes.

Ranking of Alternatives

The programmatic and pricing alternatives were rated against a series of evaluation criteria, which included:

- Conservation savings
- Program cost
- Implementation feasibility
- Public acceptability
- Shortage management impacts

Based on these ratings, the City's Water Commission adopted the recommendations of its Conservation Committee, and grouped the alternatives into the following four priority classes:

First Priority:

- Residential ULFT Rebate (Single & Multi-family)
- Commercial ULFT Rebate
- Residential Retrofit on Resale Ordinance (Single & Multi-family)
- Commercial Indoor Review

Second Priority:

- Multi-Family Indoor/Outdoor Review
- Single Family Conservation Kit Distribution

Third Priority:

- Large Landscape Water Audit
- Large Landscape Budget-Based Pricing
- Single-Family Indoor/Outdoor Review
- Residential New Construction Ordinance

Fourth Priority:

- Multi-Family Submetering
- UCSC Indoor Review

Note that the only pricing alternative in this list is the budget-based block pricing for large landscape customers. Based on the recommendation of its Conservation Committee, the Water Commission decided to include seasonal rates for all classes and budget-based rates for single-family and commercial/industrial customers in the Department's next rate study.

Interim-Period Conservation Plan

The recommended water conservation implementation plan for the period through 2010 is based on the following factors:

- The Water Commission's program groupings.
- The need to implement programs as quickly as possible.
- Synergies among the programs, including similarities among programs in terms of measures, delivery approaches, and targeted classes, as well as opportunities for program cross-marketing.
- Staffing and budgetary implications, e.g., the speed at which the budget or the conservation staff would need to be increased.

- The September 1999 order by the City Council to immediately implement the efficient clotheswasher rebate program.

Table ES-4 summarizes the proposed implementation schedule. The schedule assumes continuation of the existing residential ULFT rebate program and start-up of the efficient clotheswasher rebate program in early calendar year 2000. Plan highlights for the succeeding fiscal years include:

Fiscal 2000-2001

The Department will begin to plan and implement the following new programs in fiscal year 2000-01:

- Commercial ULFT Rebate
- Single Family Kit Distribution
- Single and Multifamily Retrofit on Resale Ordinance. Planning begins in the last half of 2000-2001; the ordinance goes into effect in 2001-02.

During this fiscal year, a program supervisor and a program administrator are hired.

Fiscal Year 2001-2002

In fiscal year 2001-2002, the clotheswasher and ULFT rebate programs continue. The retrofit on resale ordinance will go into effect the first quarter of this year. A second full-time program administrator will be hired to implement the retrofit on resale ordinance.

In the third quarter, planning will begin for the following four water use review programs:

- Indoor Water Use Review – Business
- Indoor Water Use Review – UC Santa Cruz
- Indoor/Outdoor Water Use Review – Single Family
- Indoor/Outdoor Water Use Review – Multifamily

Fiscal Year 2002-2003

In this fiscal year, the four review programs listed above will be implemented in the field and begin to yield savings. In addition, planning for the new construction ordinance will begin. Planning would also begin for the following programs:

Table ES - 4
PROPOSED CONSERVATION PLAN

PROGRAM	FY 2000-01				FY 2001-02				FY 2002-03				FY 2003-04			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Clotheswasher Rebate Program	X[a]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→[d]
ULFT Rebate – Single Family	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→
ULFT Rebate – Multifamily[c]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→
ULFT Rebate – Business	P[b]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→
Kit Distribution – Single Family		P	P	X	X											
Retrofit on Resale – Single & Multifamily		P	P	P	X	X	X	X	X	X	X	X	X	X	X	X→
Indoor Water Use Review – Business							P	P	X	X	X	X	X	X	X	X→
UCSC Indoor Review							P	P	X	X	X	X	X	X	X	X→
Water Use Review – Multifamily							P	P	X	X	X	X	X	X	X	X→
Water Use Review – Single Family							P	P	X	X	X	X	X	X	X	X→
New Construction Ordinance									T[e]	T	T	T	T	T	T	T→
Budget-Based Rates									P	P	P	P	X	X	X	X→
Landscape Review – Golf											P	P	X	X	X	X→
Landscape Review – Bus.											P	P	X	X	X	X→
Landscape Review – Res.											P	P	X	X	X	X→
Parks Review – City and County											P	P	X	X	X	X→
Multifamily Submetering													P	P	X	X→

a "X" denotes quarters in which savings are expected.

b "P" denotes quarters in which activities to prepare for program implementation occur. During these quarters, there are no savings attributable to the program.

c These programs are ongoing from the previous year. (The washer program is in the planning stages now, so will be fully implemented by the start of FY 2000-01.)

d An arrow means the program continues in subsequent years.

e "T" is used because the components of the new construction ordinance are yet to be determined.

- Large Landscape Review - Golf
- Large Landscape Review - Business
- Large Landscape Review – Residential
- Parks Water Use Review – City and County
- Budget-Based Rates for Large Landscape Customers

A third program administrator will be hired. The supervisor will also focus on planning the large landscape and parks review program, and the budget-based rates program.

Fiscal Year 2003-04

In fiscal year 2003-2004, the large landscape and parks review programs will be implemented in the field, and the budget-based rates will go into effect. The rates and review programs will be mutually reinforcing. In addition, the submetering rebate program for multifamily customers will be implemented.

Estimated Conservation Savings

Based on the foregoing program schedule, Table ES-5 shows the expected annual conservation savings through fiscal year 2009-2010.

Summary of Staffing Requirements

The required new staffing by fiscal year is as follows:

- FY 2000-01: Hire 1 program supervisor and 1 program administrator.
- FY 2001-02: Hire 1 additional program administrator.
- FY 2002-03: Hire a third program administrator.

It is likely that new office space will be required to house this additional staff.

Estimated Budgetary Requirements

Table ES-6 shows estimated annual costs to implement the recommended conservation plan. All costs shown are real dollars, that is, they do not reflect inflation. The incremental staffing and other costs for the recommended programs are shown first. These are then added to the current conservation budget to estimate the total estimated conservation budget in 1998 dollars.

Table ES - 5
ANNUAL CONSERVATION SAVINGS (MG)

YEAR	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10
Clotheswasher Rebate	0.8	2.4	4.3	6.5	8.9	11.5	14.0	16.6	19.1	21.7
ULFT Rebate										
Single Family	4.5	9.0	13.3	17.5	21.6	25.6	29.5	31.5	33.4	34.4
Multi-Family	0.9	2.6	4.3	5.9	7.5	9.1	10.6	11.7	12.3	12.8
C/I/I	0.4	1.3	2.3	3.4	4.7	5.9	7.0	8.8	11.2	13.7
Single Family Kit Distribution	4.0	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Retrofit on Resale										
Single Family		8.2	18.8	29.2	39.4	49.3	58.9	68.3	77.5	86.5
Multifamily		1.3	3.1	4.8	6.4	8.1	9.6	11.2	12.7	14.1
Indoor Review										
Business			1.0	4.0	9.0	16.0	24.9	29.9	29.9	29.9
UCSC			0.8	1.5	2.3	2.3	2.3	2.3	2.3	2.3
Indoor/Outdoor Review										
Multifamily			1.2	4.1	7.7	12.4	18.3	21.3	21.3	21.3
Single Family			0.5	2.1	4.1	6.7	10.3	12.4	12.4	12.4
Large Landscape Review										
Golf			2.7	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Business			0.1	0.2	0.6	1.0	1.5	1.8	1.8	1.8
Residential			0.0	0.2	0.4	0.7	1.1	1.4	1.4	1.4
Parks Review										
City			0.9	2.6	4.4	5.4	5.4	5.4	5.4	5.4
County			0.2	0.6	0.9	1.1	1.1	1.1	1.1	1.1
Multi-Family Submetering				0.1	0.6	0.8	1.0	1.3	1.5	1.8
Total Annual Savings (mg)	10.6	40.6	69.2	104.0	139.7	176.9	216.9	246.0	264.4	281.7

Table ES - 6
ANNUAL COSTS

YEAR	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10
(A) STAFFING COSTS (from Table IX-3)	$68,000	$136,000	$174,000	$174,000	$174,000	$174,000	$174,000	$174,000	$174,000	$174,000
Other Costs:										
Clotheswasher Rebate	$16,250	$35,000	$40,000	$45,000	$50,000	$52,500	$52,500	$52,500	$52,500	$52,500
ULFT Rebate										
Single Family	$84,988	$84,988	$84,988	$84,988	$84,988	$84,988	$84,988	$53,848	$53,848	$38,278
Multi-Family	$18,107	$36,215	$36,215	$36,215	$36,215	$36,215	$36,215	$29,330	$22,445	$22,445
C/I/I	$17,845	$35,689	$38,254	$42,719	$44,619	$44,619	$44,619	$57,349	$71,314	$74,354
Single Family Kit Distribution	$195,983	$0	$0	$0	$0	$0	$0	$0	$0	$0
Retrofit on Resale										
Single Family		$25,995	$34,660	$34,660	$34,660	$34,660	$34,660	$34,660	$34,660	$34,660
Multifamily		$3,810	$5,080	$5,080	$5,080	$5,080	$5,080	$5,080	$5,080	$5,080
Indoor Review										
Business			$24,110	$68,488	$109,022	$150,929	$194,209	$107,924	$0	$0
UCSC			$14,167	$14,167	$14,167		$0	$2,000		$0
Indoor/Outdoor Review										
Multifamily			$10,986	$27,367	$32,762	$48,137	$66,112	$41,956	$25,200	$48,786
Single Family			$15,112	$41,874	$53,525	$70,353	$104,010	$70,775	$31,068	$66,892
Large Landscape Review										
Golf			$6,011	$6,011	$0	$1,000	$1,000	$0	$1,000	$7,011
Business			$3,779	$10,393	$16,063	$22,363	$29,293	$18,269	$5,040	$11,339
Residential			$2,069	$5,398	$7,918	$10,798	$14,038	$8,909	$2,880	$6,389

Cont.

YEAR	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10
Parks Review										
City			$15,000	$30,000	$32,500	$19,000	$3,000	$3,250	$3,250	$3,000
County			$5,000	$10,001	$7,501	$3,000	$1,000	$750	$750	$1,000
Budget-Based Rates		$10,890	$21,780	$0	$0	$0	$0	$0	$0	
Multi-Family Submetering				$2,765	$5,529	$5,529	$5,529	$5,529	$5,529	$5,529
(B) TOTAL OTHER COSTS	$333,173	$232,587	$357,211	$465,125	$534,548	$589,171	$676,252	$492,129	$314,564	**$377,263**
(C) TOTAL COST OF CONS. PROGRAMS [(C) = (A)+(B)]	$401,173	$368,587	$531,211	$639,125	$708,548	$763,171	$850,252	$666,129	$488,564	**$551,263**
(D) CURRENT SCWD CONSERVATION BUDGET2	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	**$200,000**
(E) TOTAL PROPOSED CONS. BUDGET [(E) = (C)+(D)]	$601,173	$568,587	$731,211	$839,125	$908,548	$963,171	$1,050,252	$866,129	$688,564	**$751,263**

1 Note: Costs are in constant 1998 dollars; they do not reflect inflation.

I. INTRODUCTION

This water conservation plan has been prepared to provide direction to the City of Santa Cruz in planning and implementing programs that result in the conservation and efficient use of local water resources over the next ten years. The plan evaluates alternative conservation practices and establishes an action plan to guide the efforts of the City in making optimum use of its existing water resources.

Background and Purpose

The City of Santa Cruz is facing a water supply crisis. The City's water system is highly vulnerable to shortage in drought years when the San Lorenzo River and coastal sources run low. The water system is capable of meeting current demands in normal and wet years. In critically dry or extended dry periods, through, there is insufficient water available from the City's various supply sources to satisfy the community's needs. The storage capacity of Loch Lomond Reservoir is limited and insufficient to carry the system for extended periods of time. This deficiency is expected to worsen over time, with shortages becoming more frequent and more severe, as demand for water increases due to continued population growth in the service area. By the year 2020, the City could experience supply shortfalls in three out of four years; shortages would occur even under average rainfall and runoff conditions.

The Santa Cruz Water Department ("SCWD" or "Department") has identified three potential complementary approaches to addressing the City's current and future water supply needs:

- Enhanced water conservation efforts.
- Reducing water demand through emergency usage curtailment in drought years.
- Additional supplies.

The Department is currently engaged in a water supply study to identify and evaluate supply alternatives. A study of curtailment alternatives will follow this conservation plan. Thus, the programmatic and pricing options addressed in this conservation plan represent one of the three components of the City's solution to its current and future water supply constraints.

This conservation plan focuses on long-term conservation programs. This plan does not examine the actions that the City will take in the event of severe drought emergency. It also does not explicitly address general public information and education programs. Drought contingency planning and public information and education are handled separately by the Department.

The main emphasis of this conservation plan is the so-called "interim period" between now and 2010, the period during which it is unlikely that any new supply options could become operational. It also considers the degree to which the savings associated with any conservation

program can be expected to persist beyond this period. Conservation alternatives for the longer term will be addressed again in the Department's upcoming integrated water plan (IWP). At that point, the supply and curtailment studies will also be complete, and the Department will be able to directly compare and make tradeoffs among the different alternatives.

Because of the urgency of the City's water supply challenges, it is essential for the Department to implement a wide range of effective conservation programs as quickly as possible. The purpose of this plan is to guide those near-term conservation activities.

The specific goals of this study were to:

- Determine which conservation programs and practices are the most cost-effective and best-suited to the City's customer base.
- Identify the water savings those programs could achieve and the costs of implementation.
- Develop an action plan to provide direction to the Department in carrying out the interim period conservation programs.

Conservation Plan Components

The work of the Conservation Plan began in early 1997. The key components of the plan are described in the report sections that follow:

Research Study Area Characteristics. Section II summarizes data collected and analyzed for the SCWD service area. The analysis helped guide program design and savings estimation by providing data on overall customer class water usage, water use of the top customers within each class, indoor versus outdoor usage, and estimated baseline fixture efficiencies.

Identify and Screen Conservation Measures. A conservation measure is defined as a water saving technology or management practice. In this step, described in Section III, measures were screened to determine which were eligible for integration into conservation programs. A qualitative screen eliminated measures inappropriate to Santa Cruz based on six criteria. An economic screen then eliminated measures clearly not cost-effective to the area.

Formulate Conservation Programs. Section IV describes how a set of possible conservation programs was developed for Santa Cruz. These were based on the characteristics of the SCWD service area and the screening of the universe of conservation measures. A conservation *program* combines an appropriate conservation measure or group of measures for a particular customer class or end use with one or more delivery mechanisms to encourage the adoption or application of the measure(s).

Develop Approach to Economic Analysis. There are several criteria against which we evaluated the conservation program alternatives. Of particular importance is cost. Dollars are a "common

currency" to compare conservation programs to one another and, in the upcoming IWP, to compare conservation and supply alternatives.

It is difficult to make those comparisons because of the differing time patterns of cost incidence and savings/production among different alternatives. Because of the importance and difficulty of the economic analysis, a significant portion of the conservation plan was devoted to this topic. That analysis is described in Section V.

Evaluate Program Alternatives. Section VI describes the criteria that were used to evaluate the programs, the scales that were developed to assess each program against these criteria, and the manner in which each program was rated against the criteria.

Develop and Evaluate Pricing Options. At its February 1999 meeting, the City Council instructed the Department to consider conservation pricing options as well as programmatic options in its conservation plan. As a result, the original scope of work was expanded to include an examination of alternative conservation rate structures. This portion of the study is described in Section VII.

Rank Programmatic and Pricing Options. The options were placed into priority categories by the Water Commission's Conservation Committee. The rankings were then reviewed and largely adopted by the full Commission. Section VIII describes the Conservation Committee's ranking process and the resulting recommended prioritization and then addresses the Commission's action on those recommendations.

Recommend Water Conservation Plan. Based on the Commission's priorities, Section IX recommends conservation implementation schedules, staffing needs, and budgetary requirements for the 2000-2010 interim period.

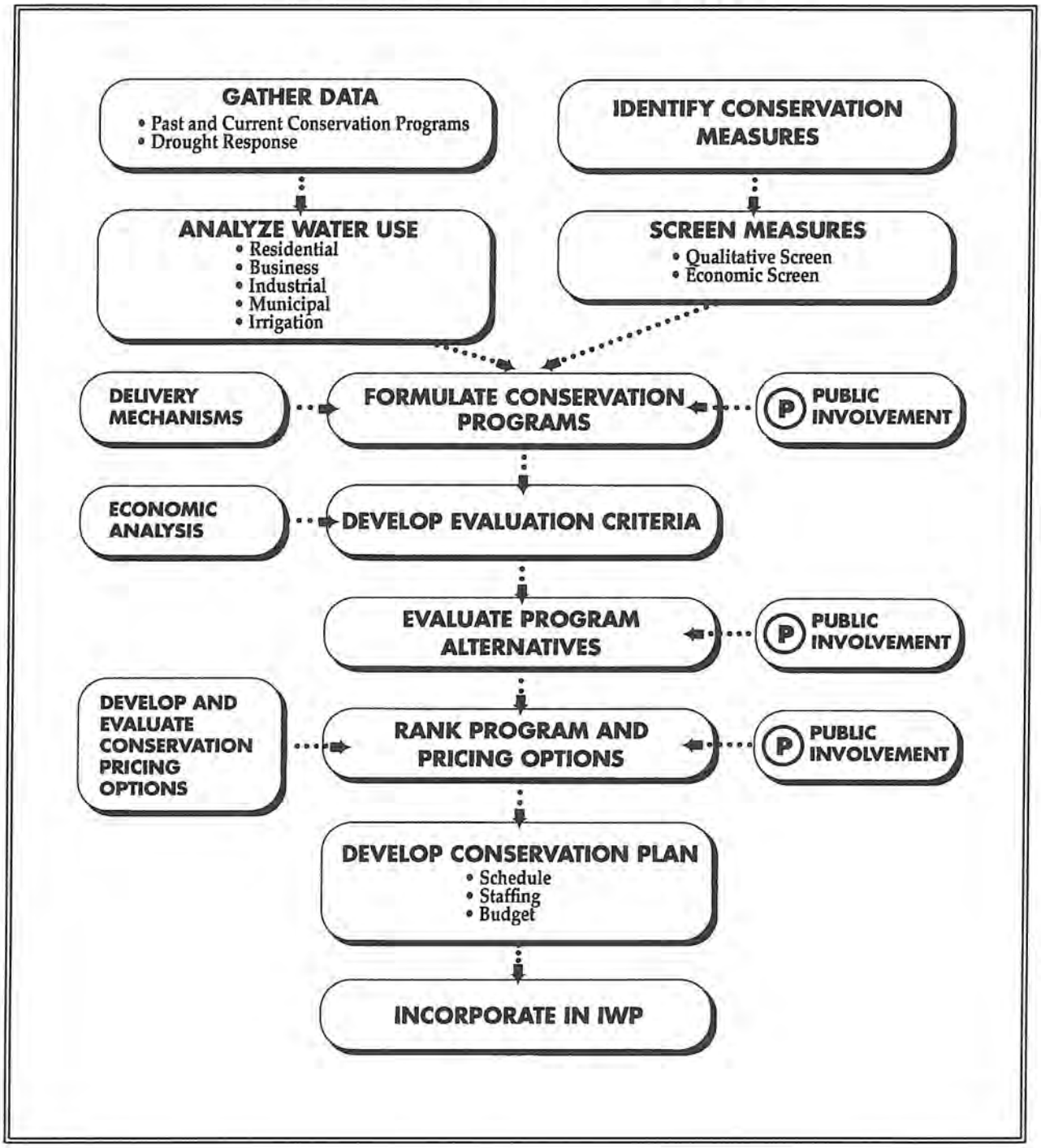
Next Steps. Section X discusses next steps, particularly how conservation will be considered in the context of the IWP.

The steps involved in developing the water conservation plan are illustrated in Figure I-1.

Public and Stakeholder Involvement

Throughout the conservation planning process, SCWD staff worked closely with the Water Commission's conservation committee, and sought input from key stakeholders and the public at large. Following is a chronology of the meetings, workshops, and public hearings that were undertaken to ensure that the plan reflected the needs and requirements of these constituencies.

Figure I - 1
WATER CONSERVATION PLANNING PROCESS



Water Conservation Committee Meetings:

January 1997	Discuss conservation measures and screening criteria
July 1997	Review screening results
August 1997	Review analysis of water use
April 1998	Review program descriptions
July 1998	Approve program descriptions, review economic analysis
August 1998	Workshop re: economic analysis
April 1999	Review revised program descriptions
June 1999	Discuss schedule, review econ. analysis, discuss evaluation criteria, ranking method, new construction ordinance
July 1999	Discuss preliminary pricing study
October 1999	Workshop to discuss evaluation results and prioritize programs

Meetings with Stakeholders:

October 1997	Santa Cruz Area Chamber of Commerce, Economic Development Committee
October 1997	Santa Cruz Lodging Association
January 1999	Santa Cruz Area Association of Realtors, Local Government Relations Committee
May 1999	Santa Cruz Area Chamber of Commerce, Environmental Affairs Committee
October 1999	Santa Cruz Area Association of Realtors, Executive Board

General Public Meetings:

September 1997	Brainstorming workshop to solicit ideas and feedback about potential measures and delivery mechanisms
June 1999	Water Comm. meeting to obtain feedback on specific conservation program proposals and priorities
October 1999	Water Comm. meeting to involve public before formulating final recommendations to City Council

All public meetings were noticed in the local newspaper and in the City's utility newsletter. Direct notices were sent to over 200 groups and individuals, including:

- Government officials
- Local water agencies and state resource and regulatory agencies
- Business organizations and trade associations

- Neighborhood associations
- Landscape contractors/retailers/architects
- Environmental organizations
- Plumbing suppliers and contractors
- Property managers, realtors, and housing organizations
- Construction companies
- U.C. Santa Cruz and local school districts
- Interested citizens
- Coast irrigation customers

Acknowledgements

The following members of the Santa Cruz Water Commission served on the Water Conservation Committee and helped to oversee this project. The members devoted much time and effort to ensure that this plan reflected the needs, interests, and desires of the greater Santa Cruz community.

- Lenne Bennett
- Dan Blunk
- Jeffry Fawcett
- Karsten Mueller
- Howard Whitney

II. STUDY AREA CHARACTERISTICS[3]

The Department serves an area of approximately 30 square miles which includes the entire City of Santa Cruz, adjoining unincorporated areas to the north and east of the City, a small portion of the City of Capitola, and several agricultural connections along Highway 1 to the west of the City. The estimated population of the service area is about 89,000.

Customer Classification System

SCWD divides its customers into nine major classes, as follows:

- ***Single Family Residential***: individually metered residential unit (single family home or condominium)
- ***Multiple Residential Buildings***: residential accounts with more than one dwelling unit served by one water meter
- ***Business***: categorized into general, bakery, restaurant/caterer, food processor, funeral parlor, hotel/motel
- ***Industrial***: further classified as general (manufacturing and related accounts), Salz Leather, Lipton, Wrigleys, Easyflow, Community Hospital, UCSC, Silicon Systems
- ***Municipal Accounts***: City-owned facilities such as parks, wastewater treatment plant, medians, parking lots
- ***Residential Irrigation***: dedicated water service for landscape irrigation associated with large multifamily dwellings, homeowners associations, and commonly maintained areas
- ***Business Irrigation***: dedicated water service for landscape irrigation at commercial, industrial, and institutional sites, including cemeteries, schools, parks, median strips, etc.
- ***Coast Irrigation***: agriculture irrigation accounts on the north coast (untreated water)

---

[3] The material in this section is taken from:
City of Santa Cruz. *Urban Water Management Plan.* January 1996;
City of Santa Cruz. *Water Demand Investigation.* Prepared by Maddaus Water Management in association with The Weber Group. March 1998; and
Barakat & Chamberlin, Inc. *Santa Cruz Long-Term Water Conservation Plan Task 3 Water Demand Disaggregation Report.* July 1997.

- ***Golf Irrigation***

Table II-1 summarizes current water usage for each of these classes. For key classes, usage patterns were further broken down to better understand the conservation potential and guide program selection for these classes.

Data Collection

Data were collected on the water usage patterns and characteristics of the Department's water customers. These data included:

- Customer classification and historical demand;
- Customer demographics;
- Housing and business characteristics;
- Seasonal water use patterns;
- Landscaping characteristics;
- Drought response behavior; and
- Program penetration for conservation programs implemented by the Department.

Interviews with key customers were also conducted: three hotels and motels, one school, the University of California, two golf courses, two parks, one industrial customer (Silicon Systems), and two multifamily complexes. While this was not a statistically significant sample, it nevertheless yielded valuable information for program design and savings estimation.

Finally, secondary data were gathered to determine a "baseline" for the existing mix of plumbing fixture efficiencies in each customer class. In lieu of the Department conducting its own baseline study, the consultants recommended relying on data drawn from the East Bay Municipal Utility District Water Conservation Baseline Study conducted by Planning and Management Consultants, Ltd. (PMCL) in April 1995. After reviewing the report, it was concluded that by carefully selecting particular data points, and adjusting them as appropriate and necessary using data and information specific to Santa Cruz, a reliable proxy to Santa Cruz's baseline conditions could be created.[4] This saved the Department the considerable expense of conducting its own baseline study.

[4] The adjustments made to EBMUD's data are explained in detail in the technology profiles provided in the BCI Task 4 report.

Table II - 1
CURRENT WATER USE BY CUSTOMER CLASS

CUSTOMER CLASS	1998 NUMBER OF ACCOUNTS	AVERAGE ANNUAL USAGE (MILLIONS OF GALLONS)[1]	PERCENT OF TOTAL USAGE
Residential			
Single family	17,685	1,445	38%
Multifamily	2,563	891	24%
Business	1,880	713	19%
Industrial	55	400	11%
Municipal	209	91	2%
Irrigation			
Residential	147	45	1%
Business	180	64	2%
Coast Irrigation	28	29	1%
Golf Irrigation	6	103	3%
Other	271	4	--
Total	**23,024**	**3,785**	**100%**

1 For 1996-1998 period

Residential Class Water Use

The single family residential class is the largest customer category in terms of both the number of accounts and the total amount of water consumed. This group of customers uses nearly 1.5 billion gallons of water annually, representing 38% of system water use. The customer class consists of 17,685 accounts.

The multiple family residential class uses nearly 0.9 billion gallons annually, representing 24% of system water use. The class includes 2,563 accounts. The number of households per account ranges from 2 to 400. In total, there are over 16,000 separate dwelling units in the multiple family class.

Thus, the approximately 34,000 single and multi-family dwelling units combined use 62% of water supplied by the system.

Table II-2 shows the average amount of water used indoors and outdoors per-household by single and multi-family customers.

Table II - 2
RESIDENTIAL INDOOR AND OUTDOOR AVERAGE DAILY PER-HOUSEHOLD WATER USE

SERVICE CLASS	DAILY INDOOR WATER USE (GALLONS)	DAILY OUTDOOR WATER USE (GALLONS)	TOTAL DAILY USE (GALLONS)
Single Family	179	63	242
Multifamily[1]	123	34	157

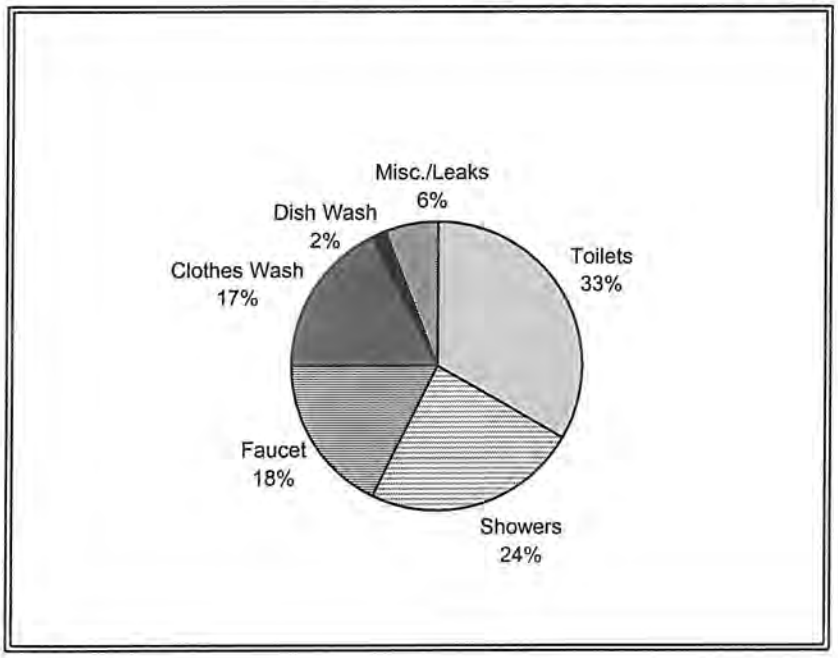
1 Based on an average of 6.3 dwelling units per multifamily account.

The average single-family home uses 242 gallons per day. Of this amount, 179 gallons or about 74% is consumed indoors. with the remaining 63 gallons used outdoors. On a per-person basis, daily indoor usage is about 60 gallons.

The average multi-family household uses 157 gallons per day, of which 123 gallons, or 78%, is used indoors and the remaining 34 gallons is used outdoors. Per-person daily indoor usage is about 55 gallons.

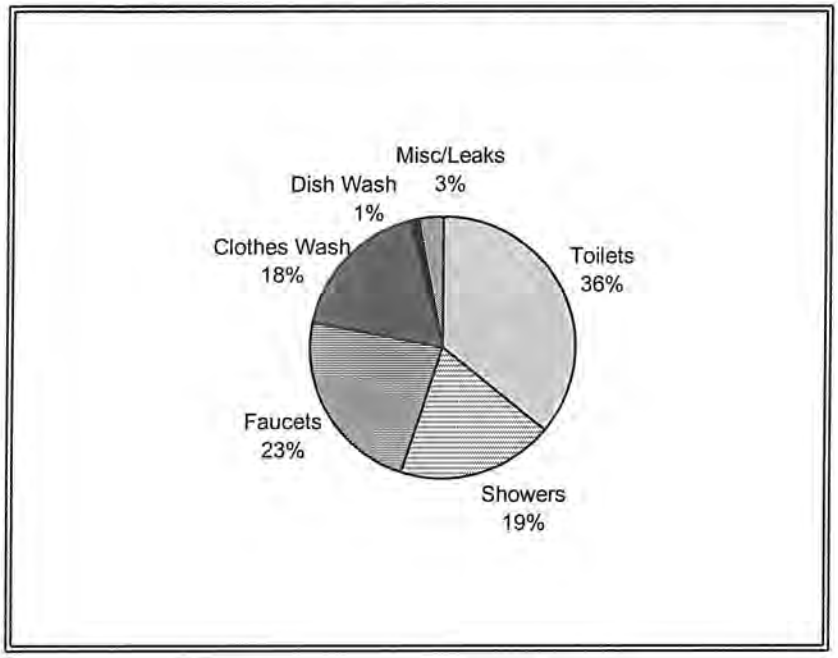
Indoor usage for the single family and multi-family classes are broken down by end-uses in Figures II-1 and II-2.

Figure II - 1
SINGLE FAMILY INDOOR WATER USE BREAKDOWN



End Use	GPD/hh
Toilet	60
Shower	43
Faucets	32
Clotheswasher	31
Dishwasher	3
Misc./Leaks	10
Total	**179**

Figure II - 2
MULTI-FAMILY INDOOR WATER USE BREAKDOWN



End Use	GPD/hh
Toilet	44
Shower	23
Faucets	28
Clotheswasher	22
Dishwasher	1
Misc./Leaks	4
Total	**123**

Business and Industrial Water Use

Table II-3 shows a detailed water use breakdown for the business and industrial customer classes based on data provided by the SCWD.

Table II - 3
DETAILED WATER USE DATA FOR BUSINESS AND INDUSTRIAL CLASSES

CUSTOMER CLASS	1998 NUMBER OF ACCOUNTS	AVERAGE ANNUAL USAGE (MILLION GALLONS) [1]	PERCENT OF TOTAL USAGE
Business			
Hotel/Motel	61	64	10%
Restaurant	107	52	7%
General	1,690	585	82%
Bakery	15	5	1%
Food Processor	6	2	< 1%
Funeral	1	< 1	< 1%
Total Business	1,880	713	100%
Industrial			
Silicon Systems	2	170	42%
UCSC	8	190	48%
Wrigley's	2	2	< 1%
Salz	5	14	4%
Hospital	2	2	< 1%
General1	34	21	5%
Total Industrial	50	400	100%

1 For 1996-1998 period.

Distribution of Account Usage

In each customer class, a relatively small number of large accounts constitutes a large percentage of demand. The data on large accounts is summarized in Table II-4. As shown, the top 10% of single family customers use twice as much as an average customer. The top 10% of multifamily and business customers use almost six times as much as average customers in those classes.

Table II - 4
AVERAGE ANNUAL USE FOR THE TOP ACCOUNTS

CUSTOMER CLASS	AVERAGE DAILY USAGE (GALLONS)[1]			AVERAGE ANNUAL USE (% TOTAL CLASS USE)	
	AVERAGE CUSTOMER	TOP 10% ACCOUNTS	TOP 20% ACCOUNTS	TOP 10% ACCOUNTS	TOP 20% ACCOUNTS
Single family residential	244	486	410	22.2%	37.4%
Multiple family residential	970	5,258	3,210	56.5%	69.0%
Business	1,026	5,844	3,833	56.9%	74.7%
Municipal	1,486	11,066	6,657	72.1%	86.8%
Irrigation	1,008	4,792	3,333	46.4%	65.0%

1 *Note: the average consumption in this table is slightly higher than reported elsewhere in this memorandum because accounts with no consumption during the year are not counted.*

Projected Population and Water Demand

The population projections through buildout for the separate jurisdictions of the service area are shown in Table II-5.

Table II - 5
SANTA CRUZ WATER DEPARTMENT SERVICE AREA POPULATION PROJECTIONS

PORTION OF SERVICE AREA	1990 ACTUAL POPULATION	2000 PROJECTED POPULATION	2010 PROJECTED POPULATION	2020 PROJECTED POPULATION	BUILDOUT POPULATION
City	49,040	55,232	63,563	64,386	68,000
Unincorporated	29,804	32,373	33,072	36,779	40,400
Capitola	1,141	1,270	1,322	1,362	1,600
TOTAL	79,985	88,880	97,957	102,527	110,000

The projected annual service area population growth rate between 1990 and 2020 is less than 1%.

Table II-6 shows projected total water requirements (including unaccounted-for water) through buildout. The figures in Table II-6 reflect Santa Cruz' historical conservation efforts and projected savings due to natural fixture replacement. These forecasts do not reflect potential additional conservation to be undertaken by the Department.

Table II - 6
PROJECTED TOTAL WATER REQUIREMENTS (MILLIONS OF GALLONS)

YEAR	2000	2010	2020	BUILDOUT
Projected Demand	4,637	5,029	5,157	5,490

Past and Current Conservation Activities

The City of Santa Cruz has a long history of water conservation efforts. As was the case with many California water agencies, the 1976-77 and 1987-1993 droughts signaled the importance of conservation, not only to deal with the immediate drought crisis, but also as a longer-term resource. Following are brief summaries of the SCWD conservation efforts to date:

Water Waste Prohibition. The City has had an ordinance prohibiting water waste since 1981. The uses of water that constitute waste or abuse under this ordinance include unauthorized use of water from a fire hydrant, irrigation runoff and overspray, allowing leaks to go unrepaired, outdoor washing without the use of an automatic shut-off nozzle, non-recirculating fountains and car washes, and indiscriminate running of water.

This ordinance is enforced by field service representatives and water conservation staff. In non-drought years, effort is made to educate customer through direct contact or written notification. Repeat violations may be subject to disconnection of water service.

Water/Energy Doctor Program. In conjunction with PG&E, the Department contracted with DMC Energy, Inc. in 1987 to conduct a one-year pilot program to install energy and water saving devices and conduct energy audits for residential customers. Free water conservation items included choice of efficient showerheads or faucet aerators; toilet dye tablets and toilet dams were also distributed.

HUD/Community Development Block Grant Project. In 1989, the City obtained HUD Title 24 funds to provide for installation of ULF toilets, low-flow showerheads and faucet aerators in low-income single family homes, and showerheads, toilet dams and aerators in low-income multiple family homes. Eighty-five toilets were installed in single family homes. One-hundred-two multifamily housing units in 12 complexes were retrofitted.

Retrofit Requirements for Existing Commercial, Industrial, and Large Multi- Family Residential Customers. In 1989, the City adopted an ordinance requiring all commercial, industrial and large multifamily accounts (defined as 10 or more dwelling units) to meet the following performance standards for specified plumbing fixtures by July 7, 1989:

- Showerheads: 2.75 gallons per minute (gpm)
- Wash basin faucets: 2.5 gpm

- Tank Toilets: 3.5 gallons per flush (gpf)
- Urinals: 3.5 gpf

Customers were given 150 days to check fixtures and make necessary improvements. Inspection was required by a licensed plumbing contractor or by City staff. Businesses were told that they would reduce their chances of drought-induced water rationing if they made required changes. The ordinance was subsequently amended to exempt multifamily customers where housing units were individually owned.

Adoption of Water Conservation Standards for New Construction and Major Building Renovations. Since 1990, the City has had plumbing efficiency standards for new construction and major renovations. New construction must include the following equipment:

- 2.5 gpm showerheads
- 1.6 gpf toilets
- 1.0 gpf urinals
- kitchen and lavatory faucet aerators
- limited flow commercial lavatory fixtures
- pressure reducing valve set at 60 pounds per square inch (psi)

These fixtures are also required to be retrofitted when renovations, remodels, or additions increase a property's market value by 30% or more. These water conservation standards are enforced by the City's Building Inspection Division.

Landscape Water Conservation Ordinance. Since 1993, the City has had a landscape water conservation ordinance that applies to commercial, industrial, public, and multi-family residential development projects. Single family residences are exempt from this ordinance. The ordinance is based on criteria contained in the State's model landscape ordinance, and includes provisions for plant selection, landscape design, irrigation equipment, and watering schedules to promote outdoor water use efficiency.

Under the ordinance, landscapes larger than 5,000 square feet are required to be metered separately. SCWD conservation staff reviews proposed landscape plans to ensure that any new and rehabilitated landscaping conforms with the City ordinance. In the portions of unincorporated Santa Cruz County and the City of Capitola within the SCWD service area, irrigation design review is conducted by conservation staff, but the authority to enforce landscaping requirements lies mainly with the Planning Departments of the respective jurisdictions.

Toilet Rebate Program. The City has operated a rebate program to promote the installation of ultra-low-flush (1.6 gallon) toilets since 1995. The program features a $75 rebate as a financial incentive for customers to remove their older, high-volume toilets and replace them with ULF models. Over 4,500 toilets have been replaced in residences and businesses, including hotels and motels, since the program began, generating annual savings estimated at 35 millions gallons. This successful program was adopted by other water agencies around the Monterey Bay area.

County Retrofit on Resale Ordinance. In 1986, Santa Cruz County enacted an ordinance requiring installation of low flow showerheads and toilet displacement devices at time of sale of any residential, commercial or industrial property. This ordinance applies to the unincorporated portion of the SCWD service area.

Distribution System Water Audit. Since 1997, the Water Conservation section has conducted water audits of the City's distribution system. The purpose of the audit is to evaluate how much water is lost through underground leaks, to track the cost to the Water Department of water losses, and to identify appropriate steps to minimize system losses and improve the operational efficiency of the water system. The City currently has a low 3-4% leakage rate. Following the initial audit, the City initiated a service line replacement program to eliminate polybutylene service lines and prevent future leakage events.

Metering and Conservation Pricing. The City water system is fully metered and charges for water are based on the amount of water consumed. The City adopted an inclining block rate structure for single-family residential accounts in 1995. The inclusion of a third tier (a "conservation surcharge") is intended to discourage excessive consumption by high-end users. Revenues raised by the surcharge are dedicated to funding conservation programs.

Public Information. Public information activities are ongoing but have been scaled back from the levels previously necessary during drought years. The Department publishes a utility newsletter, called the "SCMU Review", which includes news and information about conservation topics. Home water audit kits and information on water conservation practices are provided to the public upon request. New customers are also given a brochure that includes instructions on how to read a water meter, detect leaks, and save water.

The Department distributes a variety of landscape conservation brochures and participates in the California Water Awareness campaign during the month of May. Detailed information and a graph showing trends in water use are provided on utility bills. The Water Department also works with local school districts to provide educational materials, classroom presentations, and teacher workshops.

Implications for Program Design

The foregoing study area characteristics resulted in a set of key conclusions regarding conservation program design in Santa Cruz:

- ***Target the residential class.*** The residential customer class uses the majority of water in Santa Cruz (62%), therefore conservation programs should target this class.

- ***Target multifamily customers. Santa Cruz has many multifamily households (about 50% of total households).*** Therefore, more than in many other jurisdictions, programs should target multifamily customers, and marketing and delivery mechanisms should be tailored accordingly.

- ***Target the top 20% of single-family, multifamily, and business customers.*** These are the customers that have the largest conservation potential. In Santa Cruz, however, the single-family demand is not as skewed toward these larger customers as it is in many other jurisdictions. Therefore, it is recommended that, if the programs are performing well, Santa Cruz should consider extending the programs to capture single-family customers beyond the top 20%.

- ***Target toilet, faucet, shower, and laundry use in both the residential and nonresidential customer classes.*** Based on the indoor water use analysis for the residential class, these three end-uses account for 92% of single-family and 96% of multifamily indoor water use. Toilet and faucet use should also be targeted in the nonresidential customer classes as these are common end-uses.

- ***Based on estimates of fixture efficiency in Santa Cruz, there is still a large population of inefficient toilets in both the residential and nonresidential classes.*** Inefficient toilets still comprise over 85% of units in both the residential and nonresidential customer classes.

- ***Many faucets and showerheads are already efficient in both the residential and nonresidential customer classes; therefore, savings estimates for programs targeting these end-uses should be adjusted downward accordingly.*** Based on our estimates of faucet efficiencies both among residential and nonresidential customers, more units are efficient, particularly in the nonresidential customer classes and among multifamily customers.

- ***UC Santa Cruz has already implemented process water savings measures.*** The university has also just recently converted all of its top-loading washing machines to water-efficient front-loading models. Therefore, the focus will be on toilet, urinal, and other sanitary water use.

- ***Silicon Systems, by far the largest customer in the industrial class, is already implementing substantial water-saving measures projected to reduce process water***

use by 25%.[5] ***Therefore, this customer will not be targeted through a program.*** The remaining customers classified as industrial have very little process water.

- ***There is potential to reduce outdoor water use, particularly among large outdoor users.*** Programs aimed at reducing outdoor water use should target large users to achieve the most cost-efficient savings. Large outdoor users include the top 20% of residential customers, large landscape accounts, and public parks. The best way to achieve savings is through landscape "review" programs coupled with rebates to upgrade inefficient irrigation equipment. Rebates for low water use landscaping are not recommended. Landscaping programs are difficult and costly to administer and deliver.

[5] The remaining customers classified as industrial are relatively small in terms of usage, so a separate program will not be developed for them. Instead, these customers will be approached through the commercial facility review program.

III. IDENTIFICATION AND SCREENING OF CONSERVATION MEASURES

In this step, individual conservation measures were screened to determine which were eligible for integration into conservation programs. The first step was to compile a comprehensive "universe" of measures. This list of 116 measures was developed from the literature, project reports from other water utilities, and the consultant's knowledge and experience with conservation program planning and implementation. The universe of measures is shown in Table III-1 below.

Two successive screenings were then performed. These screens sought to eliminate measures that were clearly inappropriate for the Santa Cruz Water Department. The screens applied were:

1. Qualitative Screen
2. Economic Screen

Detailed results of these screens are presented in Appendix A.

Qualitative Screen

The qualitative screen applied a series of criteria specifically tailored to Santa Cruz' objective of developing a plan to achieve long-term, reliable water savings. The criteria were:

- ***Nonquantifiable Savings:*** Water conservation measures were eliminated if their savings could not be reliably quantified. Measure savings may be difficult to quantify simply because their impacts cannot be readily measured, or because of a lack of field studies. Measure savings may also be highly site-specific and, therefore, not accurately quantifiable for a larger population of customers.

- ***Behavior-Dependent Savings:*** Measures driven largely by changes in human behavior were eliminated because they are not reliable on a long-term basis. An example would be encouraging residential customers to only irrigate during certain times of the day.

- ***Technological/Market Maturity:*** The technology was eliminated if it was not commercially available or not supported by the necessary service industry. For example, Swedish 1-quart flush toilets were screened out because they are not yet commercially available in the United States.

Table III - 1
SANTA CRUZ LONG-TERM WATER CONSERVATION PLAN UNIVERSE OF CONSERVATION MEASURES

AREA OF APPLICATION	CONSERVATION MEASURE
INTERIOR RESIDENTIAL	
Residential Shower	Low-flow showerheads
	Ultra low-flow showerheads
	Showerflow restrictors
Residential Faucets	Low-flow faucets
	Low-flow faucet aerators
Residential Toilets	ULFT gravity-flow tank-type
	ULFT pressurized tank type
	ULFT special < 1 gallon flush models
Residential Toilet Retrofit	Displacement bags
	Displacement bottles
	Displacement dams
	Dual-flush devices
	Fill cycle regulators
	Early closure flappers
Leaks - Faucet	Faucet washers
Leaks - Toilet	New flapper valve
	New fill valve
Residential Clotheswashers	Lower use vertical axis clothes washer
	Horizontal axis clothes washer
Residential Dishwashers	Lower volume dishwashers
Residential Miscellaneous	Replace self-regenerating water softeners
	Point-of-use water heaters
	Recirculating hot water system devices
	Individual dwelling unit sub-meters
	Metering all accounts
	Water pressure regulator
	Cont.

AREA OF APPLICATION	CONSERVATION MEASURE
Exterior Residential	Hose control nozzles
	Garden hose timers
	Drip irrigation replacing sprinkler
	Bubbler/soaker irrigation systems
	Install new automatic sprinkler system
	Improve automatic sprinkler system
	Soil sensors
	Rain sensors
	Water efficient plant material
	Xeriscaping
	Turf reduction/replacement
	Irrigation scheduling
	Irrigation sub-meters
	Soil preparation/mulching
	Graywater systems
	Rainwater collector/cistern
	Swimming pool covers
Non-Residential Interior	
Commercial Toilets	Commercial valve-type ULFT
	ULFT gravity-flow tank-type toilet
	ULFT pressurized tank-type toilet
	ULFT valve replacement
	Ultra-low flush urinals
	Urinal valve replacement
Commercial Faucets	Replace manual faucet (w/aerator)
	Pressure-closing faucet (w/aerator)
	Spring loaded faucet (w/aerator)
	Infra-red activated faucet (w/aerator)
	Ultrasonic activated (w/aerator)
	Ultrasonic device only
	Foot pedal operated faucet (w/aerator)

Cont.

AREA OF APPLICATION	CONSERVATION MEASURE
Commercial Miscellaneous	Point-of-use water heaters
	Recirculating hot water system devices
	Water softeners - centralized regeneration
	Water softeners - meter-controlled flushing
Commercial Washers (including laundry and diaper service)	Horizontal Axis Laundry Machines
	Lower use vertical axis washer
	Batch washers
	Tunnel washers
	Ozonated washers
	Rinse water reclamation
Car Washes	Low volume car washes
	Recirculating car washes
Commercial HVAC*	Air-cooled chillers
	Air-cooled unitary system
	Air-cooled pumps and compressors
	Ozonation of cooling tower water
	Improve operations and maintenance practices of water-cooled
Other Air-cooled Machines	Air cooled ice-makers
	Cold-water drinking fountain
	Medical equipment
	Laboratory equipment
Food handling	Water efficient dishwasher
	Chemical sanitizer dishwashers
	Conveyor belt dishwashers
	Ultra-sound dishwashers
	Water-recycling dishwashers
	Warming tables with dry heat
	Garbage disposers using recycled water
	Garbage disposal - changes in practices
Heat exchangers	Closed loop
	Steam condensate heat exchanger

Cont.

AREA OF APPLICATION	CONSERVATION MEASURE
Industrial Misc.	Solenoid & other automatic control valves
	Improve industrial washers and rinsers
	High pressure/low volume spray nozzles
	HVAC measures (see above)
	Evaluate water recycling
	Waste stream separation & reclamation
	Operation and/or process modification
Large Landscapes Specifically: commercial buildings, apartments, institutional	Irrigation submeters
	Drip irrigation systems
	Bubbler/Soaker irrigation systems
	Convert quick-coupler to automatic syst.
	Improve existing automatic sprinkler syst.
	Timers
	Soil sensors
	Rain sensors
	Weather station/computer station hook-up
	Water efficient plant material
	Xeriscaping
	Turf reduction/Replacement
	Irrigation scheduling
	Soil preparation/mulching
	All weather artificial recreation surfaces
	Recirculating water feature
	Swimming pool covers
	Stormwater storage reservoir & pump
	Graywater systems
Water Distribution System	Leak detection and repair
	Periodic valve servicing and adjustment
	Periodic equipment servicing

* *Heating, Ventilation, and Air Conditioning*

- ***Poor Customer Acceptance:*** If customers are unwilling to implement a measure, penetration rates will be unacceptably low or customer incentives will be too costly.

For example, all-weather artificial turf was eliminated because of lack of public acceptance.

- ***Environmental or Health Concerns:*** The measure was screened out if it raised unacceptable concerns regarding health, safety, or environmental impacts. For example, gray water systems for commercial/industrial application were screened out because of potential health and safety problems.

- ***Poor Utility Match:*** The technology was not applicable to the climate, building stock, or equipment typical in the service territory. Alternatively, the measure was not feasible for the utilities to administer because its application was limited. For example, water-efficient medical and laboratory equipment was eliminated for this reason. A measure may also have been screened out because it has already been widely implemented.

The complete results of the qualitative screening are provided in Appendix A. Of the 116 measures in the universe of measures, 65 passed the qualitative screen.

Economic Screen

Measures passing the qualitative screen were then subjected to an economic screen to systematically eliminate measures whose costs exceed the marginal cost of new supply contained in the 1994 Water Supply Alternatives Study.[6] This marginal cost ($1,500 per acre foot) was used as a proxy as a new supply study is currently under way.

In screening the measures, only summer savings were valued (April through October). Measures were screened either based on their incremental cost compared to the less efficient alternative (e.g. a standard clotheswasher versus a horizontal-axis model), or based on their full cost (e.g. early replacement of a less efficient toilet with a 1.6 gallon per flush toilet). For landscaping measures, two prototype landscape sizes were generally used: one with 2,500 square feet of landscaping, and one with 5,000 square feet of landscaping. Both were assumed to have 50% turf and 50% shrub and plant material as the base case before water-efficient landscaping principles were applied.

Passing measures had a benefit-cost ratio of 1 or greater. That is, the measure passed if the present value of the avoided supply costs over the measure's lifetime equaled or exceeded the cost of the measure itself.

Table III-2 below provides a summary of the measures that passed both the qualitative and the economic screens. The detailed results of the economic screening are included in Appendix A.

---

[6] Camp Dresser & McKee, Inc. *Water Supply Alternatives Study*. January 1994.

Table III - 2
MEASURES PASSING THE QUALITATIVE AND ECONOMIC SCREENS

RESIDENTIAL INDOOR MEASURES

- Low-flow showerheads and ultra low-flow showerheads
- Faucet aerators
- Fill cycle regulators
- Toilet leak detection and repair
- Ultra low-flush toilets (ULFTs): gravity flow type
- Horizontal-axis clotheswashers (new construction/natural replacement)
- Low-volume dishwashers (new construction/natural replacement)
- Individual multifamily unit submeters (assume 50 units) – Retrofit existing buildings
- Individual multifamily unit submeters (assume 50 units) – Install at time of construction

COMMERCIAL/INDUSTRIAL/INSTITUTIONAL INDOOR MEASURES

- Toilets: valve-type and gravity flow tank-type
- Toilet valve retrofit
- ULF urinal valve retrofit
- Faucet aerators
- Faucets
- Horizontal-axis clotheswashers for commercial coin-operated application:
  a) New construction/natural replacement only
- Commercial dishwashers:
  a) New recycling instead of standard
  b) Early retirement of 6.0 gal/load; replace w/ recycling unit
- Air-cooled drinking fountains:
  a) New construction/natural replacement
  b) Early retirement of water-cooled
- Air-cooled icemakers:
  a) New construction/natural replacement
  b) Early retirement of water-cooled
- HVAC:
  a) Purchase new air-cooled unitary system instead of water-cooled
  b) Purchase new air-cooled chiller instead of water-cooled
- Early retirement of single-pass; replace with water-cooled or air-cooled
- Improved O&M practices: water-cooled condenser and ozonation of cooling tower water
- Site-specific industrial processes:
  a) Industrial washers and rinsers
  b) Industrial solenoid and automatic control valves
  c) Industrial waste stream separation to facilitate reclamation
  d) HVAC measures applied in industrial setting

OUTDOOR CONSERVATION MEASURES — ALL SECTORS

- Combined drip/sprinkler system instead of all-sprinkler in new installation
- Rain Sensors
- Improve existing sprinkler systems
- Convert quick coupler system to automated systems
- Computerized weather stations
- Irrigation scheduling reminders

IV. FORMULATION OF CONSERVATION PROGRAMS

A conservation *program* combines an appropriate conservation measure or group of measures for a particular customer class or end use with one or more delivery mechanisms to encourage the adoption or application of the measure(s). This section develops conservation programs and estimates their costs and savings. The section includes the following steps:

1. Identify possible delivery mechanisms;
2. Pair appropriate delivery mechanisms with each measure that passed the qualitative and economic screens;
3. Group measures or delivery mechanisms together where appropriate, to formulate programs; and
4. Estimate program costs, participation, and water savings.

Identify Possible Delivery Mechanisms

A "delivery mechanism" is the way that a conservation measure is presented or delivered to customers to encourage them to install or adopt the measure. Key delivery mechanisms include:

- ***Audits by Trained Professionals***: Audits or water use "reviews" of equipment and/or behaviors. Can also include workshops, hands-on training, and assistance in installing/implementing conservation measures.
- ***Financial Incentives***: Rebates, coupons, low-interest loans, and other financial incentives to customers, trade allies, or manufacturers to encourage implementation of a conservation measure.
- ***Giveaways:*** Products (e.g., toilet retrofit kits, showerheads, or faucet aerators) provided to customers free of charge.
- ***Direct Installation***: Water efficiency measures installed on-site by the Department or its authorized representatives.
- ***Regulation***: Codes or standards requiring the manufacture, purchase, installation, and/or use of certain water saving devices or practices.

Pair Appropriate Delivery Mechanisms With Conservation Measures

The delivery mechanisms described above were paired with the measures that passed the qualitative and economic screens to systematically build programs. Through this process, all

possible measure/delivery combinations were assessed. This process is detailed in Appendix B, which shows the measures that passed the qualitative and economic screens, the delivery mechanisms selected, the mechanisms not selected and the reasons they were rejected, and the resulting program concepts developed around a logical combination of measures and delivery mechanisms.

Group Measures/Delivery Mechanisms To Formulate Program Concepts

Tables IV-1 and IV-2 provide a summary of the residential and nonresidential programs formulated through the process detailed in Appendix B. The following section provides descriptions of each of these programs and their associated costs and savings.

The program formulation process resulted in a total of ten candidate programs, six targeting residential water users and four targeting non-residential users. Three other programs, a residential landscaping program, an industrial water conservation program, and a program specifically targeting UC Santa Cruz, were formulated and considered, but later rejected. The residential landscaping program was eliminated due to concerns about savings longevity, and perceived difficulties in both implementation, and in quantifying savings. The industrial water conservation program was eliminated because the largest industrial customer, Silicon Systems, began construction on its own water use reduction projects to cut back on consumption by 25%. The UCSC program was eventually combined with the Commercial Indoor Water Use Review program. An eleventh program, the Residential New Construction Ordinance, was added by the Water Commission during later public review.

Estimate Program Costs, Participation, And Water Savings

The final step in describing the programs was to estimate costs, participation, and water savings for each of the program concepts. For each program, the following were developed:

(1) Fixed Annual Utility Program Costs:

- Management staff
- Administrative staff
- Advertising and educational brochures – developing, printing, mailing
- Media advertising
- Direct marketing costs

(2) Variable Utility Program Costs, Including:

- Customer incentives
- Review and audit costs
- Pre- and post-installation inspection cost
- Device costs

(3) Variable Customer Costs of Equipment Purchase and/or Installation

(4) Participation Estimates Based on Several Different Sources:

- City of Santa Cruz' experience with similar programs
- Experience of other water utilities, where appropriate
- Information on customer demographics and fixture/equipment characteristics
- Expert judgment

(5) Unit (e.g., per customer or per-fixture) Savings Estimates Derived from the Technology Profiles, as well as from Additional Studies and Literature

These parameters are documented in the following summary program descriptions.[7]

[7] For more detailed program descriptions, please refer to the June 25, 1999 report *Task 5: Formulate and Refine Water Conservation Program Concepts.*

Table IV - 1
SUMMARY OF RESIDENTIAL CONSERVATION PROGRAM CONCEPTS

RESIDENTIAL PROGRAMS	MEASURE(S)	DELIVERY MECHANISM(S)	ELIGIBLE CUSTOMER CLASS[a]							END-USE	
			SF	MF	COM	INST	IND	IRR	PARK/ GOLF	INDOOR	OUTDOOR
Residential Conservation Kit Distribution	-Low-flow showerheads -Faucet aerators -Fill cycle regulators -Toilet leak detection/repair	-Product giveaway	✓	✓						✓	
Residential Indoor and Outdoor Water Use Review, and Measure Installation	-Low-flow showerheads -Faucet aerators -Fill cycle regulators -Toilet leak detection/repair -Irrigation equipment testing, scheduling, and owner education	-Audit/technical assistance -Direct installation -Financial incentives for irrigation equipment retrofit and repair	✓ (top 20%)	✓ (top 20%)						✓	✓
Plumbing Fixtures – Time of Resale Regulation	-Low-flow showerheads -Faucet aerators -ULFTs[b]	-Regulation	✓	✓						✓	
Residential ULFT Rebate	-ULFTs	-Financial incentives	✓	✓						✓	
Single and Multifamily Horizontal Axis Washing Machine Rebate	-Horizontal axis washing machines	-Financial incentives		✓						✓	
Submeter Rebate for Existing Apartment Buildings	-Submeters for apartments	- Financial incentives		✓						✓	

[a] SF = Single Family; MF = Multifamily; COM = Commercial; INST = Institutional; IND = Industrial; IRR= Businesses with separate irrigation accounts; Park/Golf = Parks or Golf Courses.

[b] Ultra low-flush toilets.

Table IV - 2
SUMMARY OF NON-RESIDENTIAL PROGRAM CONCEPTS

NON-RESIDENTIAL PROGRAMS	MEASURE(S)	DELIVERY MECHANISM(S)	ELIGIBLE CUSTOMER CLASS[a]							END-USE	
			SF	MF	COM	INST	IND	IRR	PARK/ GOLF	INDOOR	OUTDOOR
Commercial ULFT Rebate	-ULFTs	-Financial incentives			✓	✓	✓			✓	
Commercial Indoor Water Use Review, Measure Installation, and Rebates	-Toilet valve retrofit -ULF urinal valve retrofit -Faucet aerators -Horizontal axis clothes washers for coin-operation -Commercial dishwashers -Air-cooled drinking fountains -Air-cooled ice makers -HVAC equipment -Improved HVAC O&M[b]	-Audit/technical assistance -Direct installation (first 3 measures) -Financial incentives (clothes and dishwashers, air cooled drinking fountains and ice makers, HVAC equipment)			✓ (top 20%)					✓	
Large Landscape Water Use Review	-Irrigation equipment testing, scheduling, and personnel training -Rain sensors -Improve existing sprinkler system or convert quick-coupler	-Audit/technical assistance -Financial incentives						✓			✓
Parks Water Use Review and System Upgrade	(same as above)	-Audit/technical assistance -Financial incentives							✓		✓

[a] SF = Single Family; MF = Multifamily; COM = Commercial; INST = Institutional; IND = Industrial; IRR = Separate irrigation accounts; Park/Golf = Parks or Golf Courses.

[b] Operations and Maintenance.

Residential Program Descriptions

Below are descriptions of each of the residential conservation programs. Following the descriptions is a summary table (Table IV-3) of the key cost and savings characteristics of each program.

1. Residential Conservation Kit Distribution

Through this program, the City of Santa Cruz will deliver indoor conservation kits to single-family and multifamily residential customers door-to-door. The kit program will provide customers with inexpensive conservation devices that can reduce indoor water use. These include:

- Leak detection tablets, instructions for performing leak detection tests, and repair devices;
- Fill cycle regulators;
- Faucet aerators; and
- Low-flow showerheads.

Hangers will be placed on customers' doors one week prior to distributing the kits. The kits, including instructions, will then be placed on doorsteps. In addition, newspaper and other media advertisements will be used to increase awareness of the program and increase kit installation rate.

All single-family homes will receive the kits. It is projected that 25% of residents will install the kits and achieve the full estimated savings. It is estimated that among multifamily households, 75% will *receive* the kits due to delivery challenges, and 15% of the kits will be installed.

Program savings estimates are fairly conservative because the measures are self-installed. Single-family program savings are estimated at 10 gallons per day[8] per household and multifamily savings at 5 gallons per day per household.

[8] Maddaus, pp. 42-43. The estimates for kit savings for North Marin Water District (NMWD), San Jose, California, and Aurora, Colorado are used. The kit contents are very similar to those proposed for Santa Cruz's program. Also see Frank Gradilone III, *Using Survey Research and Automatic Meter Reading in the Design and Implementation of a Water Conservation Program*, published in the American Water Resource Association Proceedings, pp. 439-448.

2. Residential Indoor and Outdoor Water Use Review and Measure Installation

Residential water use reviews, or audits, are a service in which a trained conservation representative performs a voluntary inspection of the customer's plumbing fixtures and irrigation equipment, evaluates household water use practices, and makes site-specific recommendations of actions that can be taken to conserve water inside and outside the home. To maximize potential water savings, the program will be targeted at the top20% of residential water users.

If the programs are going well, Santa Cruz might want to run the programs longer and capture customers beyond the top 20%. Trained staff or an outside contractor will perform the water use reviews. The first indoor and outdoor review of the customer's property and home will be more lengthy and include indoor measure installation. Subsequent visits every three years will involve checking to make sure equipment is still in place and functioning properly, noting if any additional measures have been installed, and talking to the customer. The program will also offer an average rebate of $300 towards irrigation equipment changes such as the installation of rain sensors, the upgrade of controllers and sprinkler heads, and the conversion of sprinkler to drip irrigation.

This program will target the top 20% of single- and multifamily accounts. It is assumed that participation will ramp up to 20% per year of these top single-family customers, and 30% per year of the top multifamily customers.[9] These participation rates are then maintained through the end of the program. It is further assumed that among those participating, 50% will take action. Among those who take action, 10% are assumed to receive the rebate for the retrofit or upgrade of irrigation equipment.

Various studies have shown that an average of 10% water use savings can be achieved as a result of water use reviews that include measure installation.[10] [11] It is conservatively assumed that this program will save 8% given that customers in Santa Cruz have already implemented some efficiency measures.

3. Plumbing Fixtures–Time of Resale Regulation

In this program, the City of Santa Cruz will adopt an ordinance requiring residential properties to meet efficiency standards for residential plumbing fixtures whenever a property changes ownership. The following measures would be required: toilet replacement, showerhead replacement, aerator installation, and repair of leaking toilets as necessary.

---

[9] Nelson, John O. "Water Audit Encourages Residents to Reduce Consumption." JAWWA, October, 1992.

[10] Based on the literature, savings from audits vary. Audits conducted by the Contra Costa Water District yielded savings of 9.7% indoor and 18.7% outdoor. (Whitcomb, John B. *Water Reductions from Residential Audits.* September/October 1991) Audits conducted by the North Marin Water District yielded savings of 6.9% (Nelson, John Olaf. *Residential Water Audit (A Detailed Case Example.)* 1991 Annual Conference Proceedings. American Water Works Association.)

[11] Time Skeel and Suzan Hill, *Evaluation of Savings from Seattle's "Home Water Saver" Apartment/Condominium Program.* Published in the 1995 American Water Resources Association 1995 proceedings, pp. 449-456.

While the program will not need to be "marketed" per se, the public will have to be informed, as well as real estate agencies and title companies. Based on County records, the turnover in housing is about 4% per year. It is assumed that the multifamily accounts most likely to turn over are condominiums and duplexes.

An average of 43 gallons per household per day is assumed to be saved for single-family properties, and 24 gallons per household per day for multifamily properties. These savings are derived from the recent demand forecast prepared by Maddaus Water Management.[12]

4. Residential ULFT Rebate

This program offers rebates to existing residential customers to motivate them to replace their inefficient toilets with ultra low-flush toilets (ULFTs). Customers are responsible for having the toilets installed. This program is essentially a continuation of the Department's existing rebate program, but with increased emphasis on marketing to multifamily accounts. The rebate offered would be the same as the existing program at $75 per toilet. If program participation fails to meet projections, the rebate could be increased to $100 per toilet.

It is assumed that approximately 5,200 inefficient single-family toilets and 1,800 inefficient multifamily toilets will be replaced through the rebate program. The total number of toilets replaced is equivalent to a 5% per annum replacement rate among single-family customers, dropping down to 3% in 2006 and 2% in 2008. Among multifamily customers, the replacement rate is 2% per annum, dropping down to 1% per annum in 2006. The lower participation rates for multifamily customers are assumed because this is a difficult customer class to market to.

These participation numbers do not account for freeridership which is estimated to be 30%. This assumption is reflected in the program unit-cost analysis. "Freeriders" are customers who would have done the toilet replacement anyway. These participation estimates are based on the experience of the Santa Cruz Water Department (SCWD) and other water departments.

Program savings are calculated using per-fixture savings. For single-family toilet replacements, those savings are estimated to be 20.5 gallons per toilet per day. For multifamily replacements, the estimate is 22.5 gallons per toilet per day. These savings were derived from calculating a weighted average of the gallons per day used by the remaining inefficient stock of toilets in the Santa Cruz area, and assuming replacement with a 1.6 gpf toilet. The breakdowns of fixture efficiencies are provided in the Technology Profiles in the Task 4 report.

---

[12] Reference

5. Single and Multifamily Horizontal Axis Washer Rebate Program

There are two basic designs for clothes washing machines: the vertical axis top-loading washer and the horizontal axis front-loading washer. The capacity of horizontal axis washers is smaller, although they are still more efficient than vertical axis machines per pound of laundry. On average they use 33% less water and 58% less energy.[13] This program offers rebates for horizontal axis machines.

Since the consultants originally developed the plan for the washer rebate program, Pacific Gas & Electric decided to discontinue its customer rebate program in 2000, although it will offer dealers a $25 incentive for each efficient machine sold. Therefore, it is assumed that the City will operate its customer rebate program independently. The rebate level will be $100.

For the service area covered by the Santa Cruz Water Department, 350 rebates are assumed in the first year, with the number increasing by 50 each year, leveling off at 500 per year.[14] These are based on four previous years of participation data from PG&E's program for the Santa Cruz Water Department's Service area.

Projected savings from the replacement of a vertical axis washer with a horizontal axis washer are 5,100 gallons per year. These savings are derived from the High Efficiency Laundry Market Assessment (THELMA), a study of water savings and washing machine load frequencies.[15]

6. Submeter Rebate for Existing Apartment Buildings

This program provides a rebate to apartment owners to encourage the installation of submeters in existing apartment units. Submeters measure individual dwelling unit water use, so the cost of water can be billed to individual apartment dwellers. This raises customers' awareness and provides them with an economic incentive to conserve. The program would target the top 20% of multifamily customers. These customers have, on average, 21 apartment units per building.

Participation estimates are intentionally conservative given the expense and relative difficulty of the undertaking. It is estimated that, among the 504 "top 20%" apartment buildings, 0.5% will participate per year, for a total of about three.

The literature cites savings ranging from 5 to 10% for actual field studies of submetering in existing apartment buildings.[16] For Santa Cruz, savings of 8% are assumed.

---

[13] Laird, Colin. Rocky Mountain Institute. *Water Efficient Technologies: A Catalog for the Residential/Light Commercial Sector,* 1991.

[14] Based on data provided by the Association of Home Appliance Manufactures, in Santa Cruz County in 1998, rebated washing machines represent 16% of all machines sold. Al Dieteman of the Seattle Water Department which has a similar program, reports a 17% market share in 1998, the third year of the program, and projects market share to increase to 25% or more over time. The participation rates for Santa Cruz reflect these assumptions.

[15] A.D. Little, Inc. "The High Efficiency Laundry Market Assessment – Laboratory Testing Phase." January, 1995.

7. Residential New Construction Ordinance[17]

While the Council has asked that a new construction ordinance be considered, the specific components and characteristics of that ordinance will be the product of further discussion. Specific staffing needs, and program savings and costs also remain to be determined. Council and Commission discussions to date have covered the following potential requirements for new residential development:

- Installation of water efficient clotheswashers;
- Installation of efficient irrigation equipment, specifically drip irrigation systems; and
- Individual meters on all multiple family dwelling units, where feasible.

Non-Residential Program Descriptions

Below are descriptions of each of the non-residential conservation programs. Following the descriptions is a summary table (Table IV-4) of the key cost and savings characteristics of each program.

8. Commercial ULFT Rebate

This program offers rebates to commercial, industrial, and institutional customers for the early retirement of non-conserving toilets. Customers targeted will include UC Santa Cruz. This program expands on the Department's existing toilet rebate program by providing higher rebates for replacing valve-type toilets. Additional programs should also be marketed to customers through the ULFT rebate program as sequencing allows, such as the water use review program.

For all business customers except UC Santa Cruz, it is assumed that approximately 900 inefficient toilets are replaced over the life of the program. This represents yearly participation rates of 1% ramping up to 3% by the end of the program period. The toilets targeted at UC Santa Cruz will be those in residential apartments of which there are about 1,000. Five hundred are assumed to be replaced over the course of the program. These participation estimates are based on the experience of the Santa Cruz Water Department and other water departments.

Water savings impacts associated with the installation of ULFTs are based on the incremental difference between 3.5 GPF toilets and ULFTs. Studies of commercial building have found savings of 38 gallons per day per toilet replaced. For UC Santa Cruz, because the toilets are

---

[16] Dietemann.

[17] The new construction ordinance was not considered in the early phases of the Conservation Plan, due to the small anticipated future growth in Santa Cruz. The Water Commission recommended that it be examined and, on September 14, 1999, the City Council instructed staff to include it in the Conservation Plan.

being installed in residential apartments, the savings estimates for single family homes are used, 20.5 gallons per toilet per day. Taking a weighted average (using 900 residential toilets and 500 university toilets) yields savings of 31.8 gallons per toilet per day.

9. Commercial Indoor Water Use Review, Measure Installation, and Rebates

Commercial, industiral, and institutional water reviews (or audits) are a service in which a trained conservation professional performs a complete review of all water fixtures, processes, and water use practices on a non-residential site and makes recommendations on specific actions that can be taken to improve water use efficiency at the property. This program targets the top 20% of commercial customers, as well as UC Santa Cruz. These top customers account for about 75% of the total water use for the class. If the program is going well, Santa Cruz might want to consider extending it to capture customers beyond the top 20%.

The review includes on-site measure installation as appropriate (faucet aerators, and toilet and urinal valve retrofit kits). For commercial customers, the program also offers rebates of up to $2,500 per customer for water-saving equipment such as air cooled drinking fountains and ice makers, water recycling dishwashers, and horizontal axis washers. Customers can also participate in the toilet rebate program. For UC Santa Cruz, the program will provide rebates of up to $12,500 for all the equipment above except horizontal axis washers. The University recently replaced all their top-loading washers using 35 gallons per load (Whirlpool) with front-loading machines using 19.6 gallons per load (Speed Queen Horizon).

In this analysis, it is assumed that over a 3-year period, cumulative participation will be 75% of the targeted customers,[18] and of those participating, 75% will implement the recommended changes. UC Santa Cruz would also participate. Customers are re-audited after three years during the entire program period to assure that savings are maintained.

For commercial customers, a 10% indoor water savings is assumed for the sites.[19] [20] For UC Santa Cruz, the only water savings are non-sanitary, since sanitary water use is targeted through the toilet rebate program. The non-sanitary water savings are estimated at 5% of current non-sanitary usage of about 125,000 gallons per day.[21] This figure is conservative since the University already has facility managers actively working on water conservation.

---

[18] Estimated participation is derived from the California Best Management Practices Memorandum of Understanding, September 1991 as amended February 10, 1993.

[19] Kingsley Blease, Proctor & Redfern Limited, *Institutional, Commercial, and Industrial Water Audits – The Need for, Methods, and Results*, Proceedings of Conserve '93, December 12-16, 1993, pp. 519-531. Potential savings were found to be in the 15-35% range. We estimate 10% for two reasons: we are targeting only commercial customers whereas this study included institutional and industrial customers. Second, Santa Cruz implemented a commercial retrofit ordinance in 1989 which achieved a high implementation rate.

[20] Pimentel, Paul. *Does ICI Conservation Really Work?* 1995 Annual Conference Proceedings, American Water Works Association, pp. 719-728. Savings from 151 audits of different types of customers were found to be 14% on average.

[21] Conversation with Toby Goddard, Santa Cruz Water Department, April 14, 1999.

10. Large Landscape Water Use Review

This program is designed to improve irrigation efficiency and watering practices among dedicated business, residential, and golf irrigation accounts. The Department staff will identify and contact the sites. Professional landscape auditors will perform an initial review of each irrigation system's design, operating condition, and current overall efficiency.

Auditors would identify low-cost improvements such as aligning sprinkler heads, replacing broken heads, and trimming grass that disrupts spray patterns. After the customer made these improvements, the irrigation technicians would proceed with a detailed irrigation audit to determine precipitation rate, distribution uniformity, grass type, root depth, and soil type. Follow-up checking would be done every three years to assess implementation and satisfaction, and to adjust schedules as needed.

A 75% participation rate is assumed (25% per year to ramp up to 75% after three years). Among those participating in Santa Cruz, it is assumed that 50% will take action and save the projected amount.

To err on the conservative side given the characteristics of Santa Cruz, savings of 15% for business and residential irrigation accounts[22] and 5% for golf courses are assumed. The latter estimate is based on surveys that found that both golf courses are already fairly efficient.

11. Parks Water Use Review and System Upgrade Program

Water use reviews would also be offered to City and County parks. This program is similar to the large landscape review but different in several ways. Irrigation systems in parks are usually more antiquated than those of other commercial customers. It is not uncommon to have a "hose and coupler" system where hoses are moved manually from site to site without any central control or automated timing mechanisms. Because of this, both the costs for equipment retrofit and replacement, and the resulting savings, are higher than those generally found at commercial sites. Savings will also last longer because of these extensive equipment changes.

All parks are assumed to receive a review. The program is estimated to save 15% of irrigation water.[23] Because it is assumed that permanent changes are made to the equipment during the program, savings are projected to last 15 years.

---

[22] Other sources that confirm this estimate: Glen Dobbs, Conservation Technologies, Inc. "Residential Water Savings with Improved Irrigation Controls – A Sense of Magnitude," August, 1991. Lynne Hulme and Virginia Porter, "Larger Turf Irrigation Audits – Marin Municipal Water District," from conference proceedings for Managing Limited Urban Water Supplies, Conference for California Water Agencies, November 1989.

[23] Joseph Bourg and John Olaf Nelson, *Results of Irrigation Audits/Scheduling of the Parks and Playing Fields of Novato California*, Proceedings of Conserve '93, December 12-16, 1993, pp. 1019-1024. Also see Lynne Hulme and Virginia Porter, "Larger Turf Irrigation Audits – Marin Municipal Water District," from conference proceedings for Managing Limited Urban Water Supplies, Conference for California Water Agencies, November 1989.

Tables IV-3 and IV-4 summarize key program cost and savings characteristics.

Detailed tables describing the programs are provided in Appendix C.

Table IV - 3
SUMMARY OF ESTIMATED PROGRAM COSTS AND SAVINGS – RESIDENTIAL PROGRAMS

PROGRAM	INITIAL UTILITY COST PER PARTICIPANT				INITIAL PARTICIPANT COST[b]		WATER SAVINGS PER PARTICIPANT (GAL/YR)		MAXIMUM ANNUAL SAVINGS (MG)[e]
	INCENTIVE		OTHER VARIABLE COSTS[a]						
	SINGLE FAMILY	MULTI-FAMILY[f]	SINGLE FAMILY	MULTI-FAMILY[f]	SINGLE FAMILY	MULTI-FAMILY[f]	SINGLE FAMILY	MULTI-FAMILY[f]	
1. Kit Distribution	N/A	N/A	$11	$11	$0	$0	3,650	1,825[d]	18.9
2. Water Use Review	$300[c]	$300[c]	$130	$130	$300[c]	$300[c]	11,972	93,732	33.6
3. Time of Resale	N/A	N/A	$50	$50	$400	$500	15,695	17,520	113.3
4. ULFT Rebate[g]	$75	$75	$15	$15	$65	$65	7,483	8,213	47.5
5. Washer Rebate[h]	$100	$100	$0	$0	$200	$200	5,100	5,100	22.9
6. Apartment Submeter Rebate	N/A	$1,575	N/A	$100	N/A	$4,725	N/A	93,732	2.8
7. New Construction Ordinance[i]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

a Some programs may also have recurring costs that are not shown in this table. They are reflected in the budgetary cost estimates in Section IX.

b Participant cost is net of utility incentive.

c For those who elect to retrofit or upgrade their irrigation systems.

d Savings shown are per multifamily unit, not per account.

e The maximum annual savings are not additive as different programs will achieve maximum savings in different years.

f Costs and savings are per multifamily account, not per dwelling unit, unless otherwise indicated.

g Savings and cost per toilet replaced, not per account.

h Savings and cost per washer replaced, not per account.

i Information is not provided for New Construction Ordinance because the specific program components have yet to be determined.

Table IV - 4
SUMMARY OF ESTIMATED PROGRAM COSTS AND SAVINGS – NON-RESIDENTIAL PROGRAMS

PROGRAM	INITIAL UTILITY COST PER PARTICIPANT		INITIAL PARTICIPANT COST [b]	WATER SAVINGS PER PARTICIPANT (GAL/YR)	MAX. ANNUAL SAVINGS (MG) [e]
	INCENTIVE	OTHER VARIABLE COSTS [a]			
8. Commercial ULFT Rebate [e]	$120	$25	$210	11,607	13
9. Commercial Water Use Review	Bus.: $2,500 UCSC: $12,500	$40 per customer	Bus.: $2,500 UCSC: $12,500	Bus.: 145,008 UCSC: 2,281,250	32.2
10. Large Landscape Water Use Review	Res.: $300 [c] Bus.: $750 c Golf: $2,000 [c]	Res.: $200 Bus.: $300 Golf: $5,000	Res.: $300 [c] Bus.: 750 c Golf: $2,000 [c]	Res.: 25,466 Bus.: 29,104 Golf: 2,675,000	8.6
11. Parks Water Use Review	$5,000 [c]	$2,500	$10,000 [c]	N/A	6.5

a Some programs may also have recurring costs that are not shown in this table. They are reflected in the budgetary cost estimates in Section IX.

b Participant cost is net of utility incentive.

c For those who elect to retrofit or upgrade their irrigation systems.

d The maximum annual savings are not additive as different programs will achieve maximum savings in different years.

e Savings and cost per toilet replaced, not per account.

V. ECONOMIC ASSESSMENT OF CONSERVATION OPTIONS

As will be discussed below (see Section VI), there are several criteria against which we evaluated the foregoing conservation program alternatives. Of particular importance is cost. Dollars are a "common currency" to compare conservation programs to one another and, in the upcoming integrated water plan, to compare conservation and supply alternatives. It is, however, difficult to make those comparisons, primarily because of the differences in the pattern over time of costs and water savings/production associated with different conservation programs and supply projects.

The purpose of this section is to describe the approach used to develop consistent conservation program *unit costs*, which are summary measures that can be used to compare the cost of water saved through various conservation programs to one another and to the cost of water produced by supply projects.

Unit Costs of Conservation Programs

Unit costs can be better understood by considering the comparison of the economic costs to the economic benefits of any resource alternative. The traditional "cost-benefit ratio" is expressed as follows:

$$Cost\ Benefit\ Ratio = \frac{PV(Annual\ Costs)}{PV(Annual\ Benefits)} \quad (1)$$

where "PV" signifies the economic present value of a time series. Equivalently, this fraction can be expressed as the ratio of two levelized values, as follows:

$$Cost\ Benefit\ Ratio = \frac{Levelized(Annual\ Costs)}{Levelized(Annual\ Benefits)} \quad (2)$$

where the levelized value of a time series is the annual annuity value over a specific term that will yield the desired present value. The most familiar example of such levelized values are the monthly payments made on a mortgage or any other amortized loan. Thus, for example, the present value of the stream of 360 $729 monthly payments on a 30-year, $100,000 mortgage at an 8% annual interest rate is precisely $100,000.

The annual benefits in the denominator of Equation (2) can be further broken down as follows:

$$Annual\ Benefits = Annual\ Production * Unit\ Benefit \quad (3)$$

In other words, the annual benefits of any resource addition are proportional to the "production" in that year. "Production," which can be expressed either in terms of total annual volume (mg) or

average annual capacity (mgd), is either water produced by a supply or saved by a conservation program. The production is multiplied by a dollar "unit benefit" figure, often estimated as the marginal cost of supply. If all costs are expressed in real (i.e. non-inflated) terms, it is then reasonable to assume that the unit benefit is constant over time. If the expression on the right side of Equation (2) is then multiplied by this constant unit benefit, we end up with what we call the unit cost:

$$Unit\ Cost = \frac{Levelized(Annual\ Costs)}{Levelized(Annual\ Production)} \quad (4)$$

Comparisons to Supply Options

The 1994 *Water Supply Alternatives Study*[24] expressed the unit cost of supply options as follows:

$$Unit\ Cost_{SUPPLY} = \frac{Annual\ Cost_{SUPPLY}}{Yield} \quad (5)$$

where:

Annual Cost$_{SUPPLY}$ is the annual revenue requirement associated with the supply, including debt service and operating and maintenance expenses.

Yield is the critical period annual production, expressed in millions of gallons (mg). (In the current supply planning effort, the unit costs will be expressed as dollars per mgd of capacity, rather than per million gallons of volume.)

The annual cost in Equation (5) includes the annual debt service and O&M cost. The debt service is constant from year to year and is, by definition, a levelized cost. The *Water Supply Alternatives Study* assumed a 4% annual escalation rate for O&M expenses and levelized those costs to express them on an annual basis. The sum of the debt service and the levelized O&M expenses is then the total levelized annual cost of the supply alternative. Thus, what Equation (5) calls "annual cost" is really a levelized annual cost.

The denominator of Equation (5) is the constant critical-period yield of the supply. As common sense would dictate, the levelized value of any stream of constant values is simply that constant value. Thus, what Equation (5) calls "yield" is also a levelized annual value.

We can therefore conclude that Equation (5) is a special case of the more general expression for unit cost in Equation (4). With some refinements, Equation (4) forms the basis of calculating the unit cost of conservation programs.

---

[24] Camp Dresser & McKee Inc., January 1994.

Seasonal Unit Costs of Conservation Programs

The discussion thus far has not distinguished between summer and winter season savings. It makes intuitive sense that peak-season savings are more valuable to Santa Cruz than non-peak season savings. Let us therefore split the annual benefit of Equation (3) into its component parts:

$$\begin{aligned} \textit{Annual Benefit} = {} & \textit{Summer Production} * \textit{Summer Unit Benefit} + \\ & \textit{Winter Production} * \textit{Winter Unit Benefit} \end{aligned} \quad (6)$$

It is tempting to assign a value of zero to the winter unit benefit, in which case the annual benefit, and thus the unit cost would simply depend on summer production. In some future years (i.e. those that are cooler and wetter), it is indeed true that winter savings will have almost no value.[25] In those years, Loch Lomond reservoir is likely to spill prior to the start of the summer season. Winter savings will therefore have no impact on the ability to serve demands in the following summer, and will therefore not permit the avoidance or deferral of future capacity additions.

In any future demand year, winter savings will only have value if the following conditions hold:

1. Loch Lomond does not spill that winter;

AND EITHER

2a. The conserved water increases seasonal carryover storage in Loch Lomond to reduce a summer shortage;

OR

2b. The conserved water directly reduces a winter shortage.

- Condition 2a holds in any winter month in which Loch Lomond is depleted, but only if there is to be a shortage the following summer.
- Condition 2b holds in any winter month (November-March) in which there is a shortage.

Results from the Linsley, Kraeger Associates hydrologic/operational model of the City's water supply system were used to compute the following winter adjustment factor for future demand years 2000, 2010, 2020, and 2050. This factor, which is based on the foregoing conditions, is multiplied by projected winter water savings to calculate the "credit" to be given for winter conservation in each future demand year.

---

[25] Strictly speaking, winter production always has a non-zero value, since variable operating costs are always avoided. Santa Cruz variable operating costs are very small compared to avoided capacity costs. This analysis therefore ignores these avoided operating costs.

$$WinAdj_i = P(NS)_i * \frac{\sum_{j=1}^{n} [FracDepMo_{i,j} * SumShort_{i,j} + FracWinShortMo_{i,j}]}{n} \quad (7)$$

where:

$WinAdj_i$ is the adjustment multiplier to be applied to winter savings in demand year i.

$P(NS)_i$ is the probability that demand year i is a non-spill year, based on the forecast demand for year i and the 60-year period of hydrologic record.

j is an index that ranges over all of the historical hydrologic years for which demand year i is a non-spill year.

n is the number of hydrologic years that are non-spill years in demand year i.

$FracDepMo_{i,j}$ is the fraction of months in demand year i and hydrologic year j in which Loch Lomond is depleted.

$SumShort_{i,j}$ is a dummy variable indicating whether there is a summer shortage in demand year i and hydrologic year j (0 if no summer shortage, 1 if summer shortage).

$FracWin\ ShortMo_{i,j}$ is the fraction of winter months in demand year i and hydrologic year j in which there is a shortage.

For future demand years between those that were computed by the model, linear interpolation was used to calculate the multiplier.

The results are displayed in the attached Table V-1. As expected, the value of winter conservation in the early years is small, but it increases fairly quickly as system demands increase. In the year 2000, a unit of winter conservation is worth 12% of the value of a unit of summer conservation. By 2010, this jumps to 24%. By the end of the planning period (2050), the multiplier is 47%.

Additional Adjustments for Comparison to Supply Options

As pointed out above, these unit costs are intended to serve two functions, namely to compare the economic value of different conservation programs and to compare conservation programs to supply alternatives. Unit costs are appropriate for both purposes so long as the unit costs of the options being compared are calculated in a correct and consistent manner.

The unit costs of Santa Cruz supply options are being computed in the present supply study as:

$$Unit\ Cost = \frac{Levelized\ Cost}{Capacity} \quad (8)$$

where:

LevelizedCost is the levelized annual debt service and O&M costs associated with the supply.

Capacity is the maximum daily production capacity of the supply, expressed in mgd.

This formulation, while simple, cannot be directly compared to the conservation unit costs described above for two reasons:

- Equation (8) does not account for seasonal differences in value. Just as conservation savings have less value in the winter, so do supplies. Assuming that the supply has the same nominal capacity throughout the 50-year planning period, the value of the supply is overstated and the unit cost is understated by the following factor:

$$SupplyAdj = Levelized_{50\,years}[\frac{214 + 151 * AnnWinAdj}{365}] \quad (9)$$

where:

SupplyAdj is the factor by which supply unit cost is understated due to seasonal considerations

214 is the number of days in the summer season

151 is the number of days in the winter season

AnnWinAdj are the annual winter adjustment factors, shown in Table V-1, over the 50-year planning period.

The value of this expression is 0.71.

- To avoid misstating the unit cost of a resource option, both the numerator (the costs) and the denominator (the production capacity) of the unit cost must be levelized over the same period. For conservation programs, the ***ConEAST*** model (see below) ensures that is the case. The calculation of the unit cost of a supply option in the current supply study, as expressed in Equation (8), does not. The cost numerator is based on the amortization period of the capital financing. However, since the underlying assumption is that any supply source will be available for the entire 50-year planning horizon, the capacity denominator is implicitly based on a 50-year period. The mismatch between the cost numerator and the capacity denominator tends to *overstate* the unit cost by a factor which depends on the financing period:

20-year financing:	1.73
30-year financing:	1.31

Rather than complicating the intuitive and simple calculation of supply unit costs, it is recommended that a simple scaling adjustment be made to the conservation unit cost to ensure comparability to supply options. Assuming that the supply option has the same summer and winter nominal delivery capacity and provides service for the entire planning period, the conservation unit cost must be multiplied by the scaling factors shown in Table V-2.

The ***ConEAST*** model, described below, incorporates these scaling factors.

The *ConEAST* Model

ConEAST (Conservation Economic Analysis and Screening Tool) is an Excel® spreadsheet designed to calculate conservation costs, savings, and unit costs. The model has been tailored to Santa Cruz, and performs unit cost calculations as described above. Conservation program savings are calculated net of so-called free riders and natural fixture replacement. A description of the Santa Cruz ***ConEAST*** model is attached as Appendix D.

ConEAST Example

The following simple example will illustrate the manner in which unit costs are compared. The ***ConEAST*** model was used to derive the conservation program results, based on the approach described above. The assumptions for the conservation program are based on the actual program design for the City of Santa Cruz. The supply program assumptions are hypothetical.

Conservation Program: Single-Family ULFT Retrofit

- Average summer savings per participant: 20.5 gallons per day (gpd)
- Average winter savings per participant: 20.5 gpd
- Utility cost per participant: $90 ($75 rebate + $15 inspection)
- Utility fixed annual cost: $7,048
- Savings duration: 25 years
- Annual natural turnover rate: 2.5%

Table V - 1
WINTER CONSERVATION MULTIPLIERS

Year	Multiplier
1999	0.10
2000	0.12
2001	0.13
2002	0.14
2003	0.15
2004	0.17
2005	0.18
2006	0.19
2007	0.20
2008	0.22
2009	0.23
2010	0.24
2011	0.25
2012	0.25
2013	0.26
2014	0.27
2015	0.27
2016	0.28
2017	0.28
2018	0.29
2019	0.30
2020	0.30
2021	0.31
2022	0.31
2023	0.32
2024	0.32
2025	0.33
2026	0.34
2027	0.34
2028	0.35
2029	0.35
2030	0.36
2031	0.36
2032	0.37
2033	0.37
2034	0.38
2035	0.39
2036	0.39
2037	0.40
2038	0.40
2039	0.41
2040	0.41
2041	0.42
2042	0.42
2043	0.43
2044	0.43
2045	0.44
2046	0.45
2047	0.45
2048	0.46
2049	0.46
2050	0.47

Hypothetical Supply

- Capacity: 1 mgd
- Capital cost $20,000,000
- Financing period: 30 years
- Annual debt service: $990,000
- Annual O&M cost: $100,000

Table V - 2
CONSERVATION UNIT COST SCALING FACTORS TO ENSURE SUPPLY OPTION COMPARABILITY

FINANCING PERIOD (YEARS)	SEASONAL VALUE ADJUSTMENT (1)	AMORTIZATION ADJUSTMENT (2)	SCALING FACTOR 1)X(2)
20	0.71	1.73	1.24
30	0.71	1.31	0.94

The unit cost results are displayed in Table V-3. The unit cost comparison indicates that the single-family ULFT rebate is somewhat less costly than the hypothetical supply.

Table V - 3
SAMPLE COMPARISON OF UNIT COSTS

RESOURCE	UNIT COST ($/MGD)
Single Family ULFT Rebate	$892,436
Hypothetical Supply	$1,090,000

VI. EVALUATION OF CONSERVATION PROGRAMS

Evaluation Criteria

This section describes the manner in which the conservation programs described in Section IV were evaluated and compared. This work began by specifying a set of clear evaluation criteria and associated measures. Department staff and the Water Commission undertook a process to define those criteria. That process resulted in five key criteria:

Criterion 1: Conservation Savings. Maximize potential water savings

Criterion 2: Cost. Minimize the cost to the Santa Cruz Water Department and its ratepayers

Criterion 3: Implementation Feasibility. Minimize the administrative, staffing, billing, institutional, and political difficulties associated with implementing conservation

Criterion 4: Public Acceptability. Maximize the acceptance by the Santa Cruz public of conservation

Criterion 5: Shortage Management. Minimize interference with SCWD ability to manage future water shortages

Following are discussions of the issues considered to develop specific measuring scales for each criterion.

Criterion 1: Conservation Savings

Maximize Potential Water Savings

Each conservation program has its own unique time pattern of conservation savings. It is therefore difficult to develop measures that summarize these savings. Three such measures were selected:

Scale 1.1: Maximum annual savings achieved during interim period. This is a measure of the level to which program savings "ramp up" before reaching a steady state. Savings are net of the savings due to natural replacement that would have occurred in the absence of the program and of so-called "free riders" who take advantage of a program to undertake actions that would have been taken in any case.

Scale 1.2: Total savings achieved during interim period (1999-2010). Over the interim period, this measure indicates the total volume conserved as a result of this measure, again net of natural replacement and free riders.

Scale 1.3: Measure life in years. The physical life of the savings associated with the technology or behavior change helps SCWD determine at what point it might have to re-start the program to maintain savings.

Criterion 2: Cost

Minimize the cost to the Santa Cruz Water Department and its ratepayers

As described above in Section V, the scales used to compare the costs of conservation programs to each other and, ultimately, to supply costs, are *unit costs*. One of the key distinctions between conservation programs and supply options is that, depending on the specific program design, a portion of the conservation program costs may be assumed by the participating customer. Thus, while the utility's revenue requirements associated with either type of resource are recovered from all customers through water rates, customers who participate in particular conservation programs face an additional out-of-pocket cost for equipment purchases, etc.[26]

To reflect utility revenue requirements and participant out-of-pocket costs, we distinguish between *utility* and *societal* unit costs. Both are computed as described in Section V. Utility unit costs include only utility revenue requirements. Societal unit costs include both utility revenue requirements and participating customers' out-of-pocket costs.

The distinction between the two types of unit cost can be important for those programs for which a large portion of the costs are paid directly by customers. In particular, regulatory programs (e.g. ordinances) generally will have a low utility unit cost, but may exhibit a much higher societal unit cost.

Scale 2.1: Utility unit cost expressed in dollars per million gallons per day (mgd).

Scale 2.2: Societal unit cost expressed in dollars per mgd.

Figure VI-1 compares the utility unit costs of the conservation programs.

Criterion 3: Implementation Feasibility

Minimize the administrative, staffing, billing, institutional, and political difficulties associated with implementing conservation

Implementation feasibility is measured in two ways, one quantitative and one qualitative.

[26] Of course, the customer's cost is net of any incentive provided by the utility.

Scale 3.1: Number of additional full-time-equivalent staff positions required during interim period. "Staffing up" is difficult and costly. Thus, more required staff not only indicates the expected difficulty of the program, but is also difficult in and of itself.

Scale 3.2: Qualitative scale of implementation difficulty, ranging from "very easy" to "very difficult."

Criterion 4: Public Acceptability

Maximize the acceptance by the Santa Cruz public of conservation

Scale 4.1: Qualitative scale of public acceptance, ranging from "excellent" to "poor."

Criterion 5: Shortage Management

Minimize interference with SCWD ability to manage future water shortages

An important, but often misunderstood, impact of conservation programs is their effect on the water agency's ability to respond to future droughts. This relationship is normally discussed in terms of the "demand hardening" impacts of the conservation programs. Hardening is normally thought of as a limitation on a water utility's ability to curtail demand in a drought. More precisely, *conservation programs harden demand to the extent that the costs that drought curtailments impose on customers are higher than what they otherwise would have been.* These customer cost increases could be manifested in increased cash outlays, decreased quality of life, more inconvenience, etc. These increased costs may, in turn, make it less likely that customers will respond to utility calls for water use reductions during a drought.

Scale 5.1: Qualitative scale of degree to which conservation program hinders future shortage management, ranging from "little impact" to "substantial impact."

Rating Programs Against Criteria

The next step was to rate each conservation program against the foregoing measures. Table VI-1 shows these ratings. The table separates each program into its component parts. Thus, the single family and multi-family reviews were considered two separate "programs." This permitted SCWD to look separately at these components and, if desired, make independent implementation decisions.

The ***ConEAST*** model was used to compute the values of the savings and cost measures, based on the assumptions discussed in Section V. Staffing estimates were based on the specific tasks that would be required to implement each program, combined with the prior experience of Santa Cruz and other water supply agencies. The ratings on the three qualitative scales (Implementation Feasibility, Public Acceptability, and Shortage Management) were based on staff and consultant judgment. Following is a discussion of these qualitative ratings:

Figure VI - 1
COMPARISON OF UTILITY UNIT COSTS

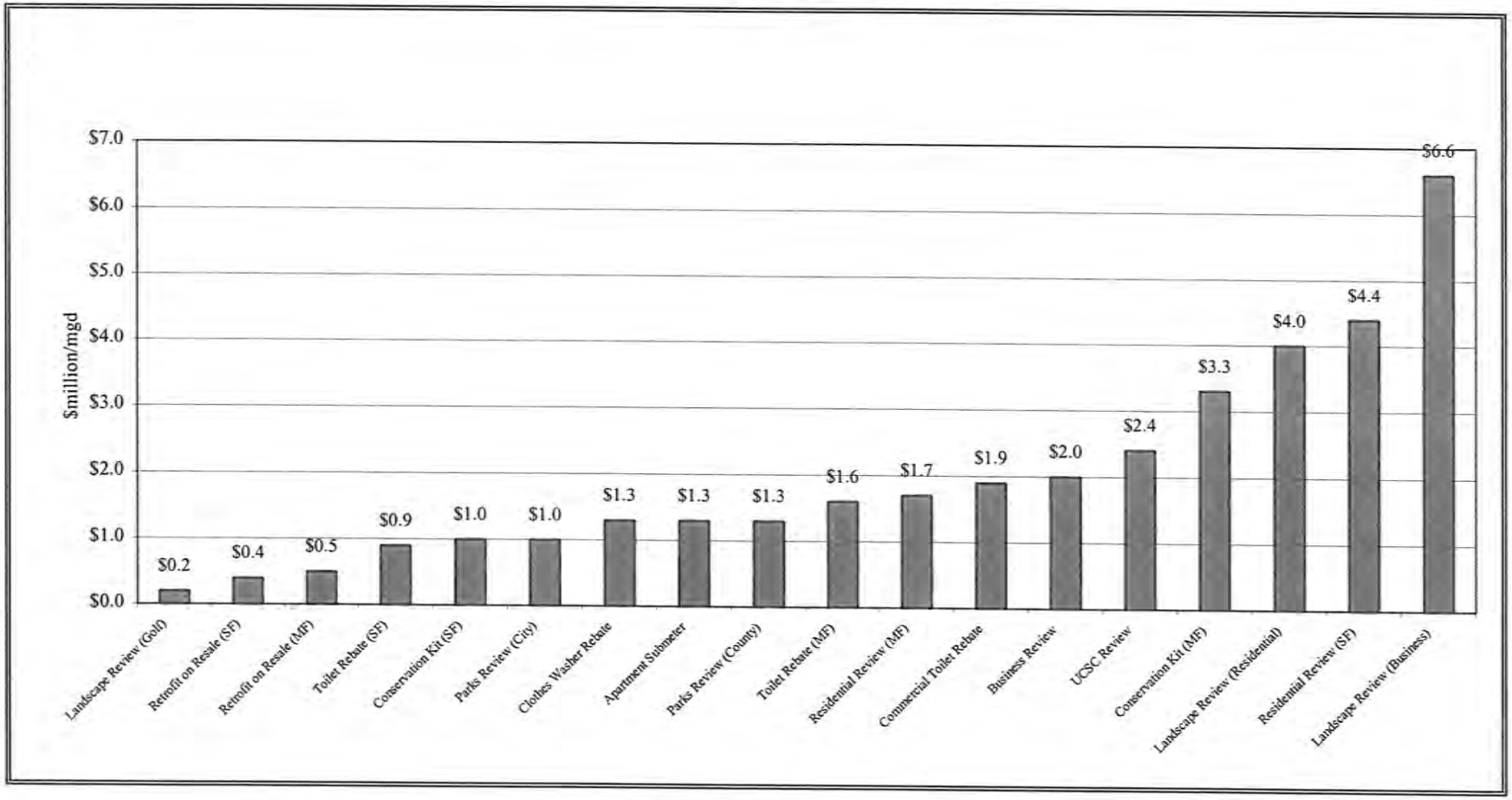


Table VI - 1

SANTA CRUZ WATER DEPARTMENT CONSERVATION PROGRAM EVALUATION RATINGS

PROGRAM	ANNUAL SAVINGS		MEASURE LIFE (YRS)	UNIT COST ($MILLION/MGD)		IMPLEMENTATION:		PUBLIC ACCEPTABILITY	SHORTAGE MANAGEMENT
	MAXIMUM (MG)	TOTAL 2000-2010 (MG)		UTILITY	SOCIETY	STAFFING (FTE)	FEASIBILITY OVERALL DIFFICULTY		
Residential:									
Cons. Kit Dist.									
Single Family	15.8	174	10	1.0	1.0	0.11	Very Easy	Excellent	Some impact
Multi-Family	3.1	34	10	3.3	3.3	0.11	Average	Excellent	Some impact
Indoor, Outdoor Rev.									
Single Family	12.4	104	7	4.4	4.7	0.32	Average	Excellent	Some/substantial impact
Multi-Family	21.3	182	7	1.7	1.8	0.14	Somewhat difficult	Good	
Retrofit on Resale									
Single Family	97.3	651	20	0.4	1.8	1.28	Somewhat difficult	Fair	Some impact
Multi-Family	15.9	106	20	0.5	2.0	0.23	Very difficult	Poor	Some impact
ULFT Rebate ($75)									
Single Family	34.4	254	25	0.9	1.3	0.00	Very Easy	Excellent	Some impact
Multi-Family	13.1	97	25	1.6	2.0	0.48	Very Easy	Excellent	Some impact
H. Axis Washers ($50)	22.9	140	14	0.7	3.5	0.08	Very Easy	Excellent	Little/some impact
H. Axis Washers ($100)	22.9	140	14	1.3	3.5	0.08	Very Easy	Excellent	
MF Submetering	2.8	18	50	1.3	2.7	0.18	Average	Average	Little impact
New Const. Ordinance									
Clotheswashers	8.8	66	14	$0.3	$5.9	0.1	Somewhat difficult	Poor	Little impact
Landscape	2.3	17	15	$1.6	$8.8	0.25	Very difficult	Fair	Little impact
Submetering	1.5	11	50	$0.0	$34.8	0	Average	Average	Little impact

Cont.

PROGRAM	ANNUAL SAVINGS		MEASURE LIFE (YRS)	UNIT COST ($MILLION/MGD)		IMPLEMENTATION:		PUBLIC ACCEPTABILITY	SHORTAGE MANAGEMENT
	MAXIMUM (MG)	TOTAL 2000-2010 (MG)		UTILITY	SOCIETY	STAFFING (FTE)	FEASIBILITY OVERALL DIFFICULTY		
C/I/I:									
ULFT Rebate	15.0	81	25	1.9	2.6	0.35	Somewhat easy	Excellent	Little/some impact
Indoor Rev.									
Business	29.9	249	10	2.0	3.3	0.25	Somewhat difficult	Good	Little impact
UCSC	2.3	25	10	2.4	2.8	0.18	Average	Excellent	Little impact
Large Landscape									
Business	1.8	15	7	6.6	7.2	0.19	Average	Good	Substantial impact
Residential	1.4	11	7	4.0	4.8	0.06	Average	Excellent	Substantial impact
Golf	5.4	59	7	0.2	0.3	0.01	Somewhat easy	Excellent	Substantial impact
Parks									
County	1.1	11	15	1.3	2.6	0.02	Very Easy	Excellent	Substantial impact
City	5.4	54	15	1.0	1.9	0.08	Very Easy	Excellent	Substantial impact

(1) Societal unit cost for horizontal axis washer rebate program excludes $100 PG&E rebate. The true societal cost, including that rebate, is $4.6 million/mgd.

Public Acceptability

Factors Considered: *The anticipated public perception of the program. This includes the public in general, but it gives more weight to potential participants, who are likely to express their opinions more vocally.*

Conservation Kit Distribution for Single and Multifamily: It is anticipated that this program will be very well accepted and was therefore rated "excellent". Customers will receive kits of free devices, delivered to their home, which they can install, or not, as they choose. The kits will be delivered to all customers.

Single Family Review: It is anticipated that this program will also be very well received and is rated excellent. Customers can volunteer to participate in the program, through which they will receive a free audit including device installation, and advice on how to reduce their outdoor watering.

Multifamily Review: It is anticipated that the multi-family residential review will not be quite as well accepted as the single-family program; thus its public acceptability is rated "good". This is because the tenants do not own the building, and are therefore not the party who volunteer for the audit. Tenants also generally do not pay the water bill, so they have less interest in an audit. Also, access to tenant units may be perceived as a problem.

Business Review: The commercial indoor review is also rated good, since, although voluntary, it could be perceived by building occupants as somewhat intrusive and disruptive. In addition, the building management may differ from the building ownership.

UCSC Review: UCSC was rated as "excellent" for public acceptability. The University is already working on water conservation projects and so are receptive to the idea; they know the City's conservation program staff as well. The university community (students, faculty, staff) are likely to favor the idea.

Parks Review: This program was rated as "excellent" for public acceptability. These customers should be highly motivated to be good members of the community, and "walk the walk" in terms of conservation.

Large Landscape Review: Businesses are expected to be somewhat less accepting of a large landscape review than either residential or golf course customers; the program was assigned a rating of "good" for business customers and "excellent" for residential and golf course customers.

For business customers, the building management, landscape maintenance, and property ownership may differ from one another. Therefore, arranging the review will be a more involved process than for a single family large landscape customer. Golf courses are very visible water users, and their primary expense is water. Therefore, they should be highly motivated to accept this free service.

ULFT Rebate (Residential and Commercial) and Horizontal Axis Rebate Programs: All three programs are rated "excellent." Santa Cruz already has a ULFT rebate program, which is very well received. Pacific Gas & Electric has had a washer rebate program in place for several years. A number of water agencies are partnering in this program.

Multifamily Submetering Program: The multifamily submetering program received an "average" rating. It is complex and costly for apartment owners, and so will have few participants. It is also not a program that is likely to generate particular enthusiasm among the general public.

Retrofit on Resale: The lowest scores were assigned to the two ordinances. The retrofit on resale program is mandatory and adds costs and complexity to the home-selling transaction. The real estate community would view the ordinance as costly, unfair, and intrusive. We expect that apartment owners will be even more unhappy about this program than single-family customers.

New Construction Ordinance: The requirement to install efficient clotheswashers in newly-constructed homes will not be well received by either the developer community or the home-buying public. Many home-buyers bring their own clotheswashers to a new home, and would view a requirement to discard that unit as unduly burdensome. The landscaping requirements would also be seen as overly burdensome and infringing on the prerogatives of a home buyer. The submetering requirement will probably elicit some opposition from multi-family developers.

Implementation Feasibility

Factors Considered: *The ease with which the Santa Cruz Water Department could administer the program, including billing, staffing, institutional, and political considerations.*

Several programs are considered "very easy" to implement, including:

Single-Family Conservation Kit Program. The program is characterized by little direct interaction with customers, straightforward delivery, and quick completion.

Single Family and Multi-Family ULFT Program. Santa Cruz already has a program in place, with all the associated forms and procedures.

Horizontal Axis Washer Rebate Program. The program will "piggy back" on the existing program run by Pacific Gas & Electric.

City and County Park Review Program. City conservation staff already knows the parks staff; the City is likely to be very responsive.

The following programs received a slightly lower rating of "somewhat easy":

Commercial ULFT Rebate Program. The physical issues involved in the retrofit are more difficult than the residential ULFT program.

Golf Course Large Landscape Review. For this program, it will be easy to identify the correct staff contact; site and equipment complexity make implementation somewhat more difficult. Also, given the prior water efficiency retrofits done by area courses, it will be challenging to find additional savings opportunities.

Implementation of the following programs is expected to entail "average" difficulty:

Single-Family Indoor/Outdoor Review Program. This program requires a multi-step process to contact potential participants, set up appointments, coordinate contract reviewers, and do required follow-ups.

Residential Large Landscape Review. The considerations here are similar to those for the business landscape review program.

Business Large Landscape Review. This program will involve contacting facility managers, coordinating site visits with appropriate staff, and interacting with landscape contractors.

Multifamily Conservation Kit Program. This program is notably more difficult than the single-family program, as it involves contacting property managers, obtaining permission to distribute kits, and obtaining building access.

UCSC Indoor Review. While facility-manager contact issues will be fairly easy, the facilities are extensive and have varied equipment.

Multi-Family Submetering Program. This program will be of average difficulty for the City to implement as it only involves marketing the program and offering a rebate.

New Construction Submetering Ordinance. This portion of the new construction ordinance should not be unusually difficult to implement. It will require plan review and development of equitable waiver criteria.

The following programs are expected to be "somewhat difficult" to implement:

Single Family Retrofit On Resale. The retrofit on resale program will require developing and passing an ordinance, tracking changes in ownership, data management, written correspondence, telephone contact, verification, and inspection. It will also require coordinating with other jurisdictions (County and City of Capitola) to have ordinances adopted.

Multi-Family Indoor/Outdoor Review Program. In addition to the implementation steps discussed above for the single-family program, the multi-family program adds more complexity because of the potential involvement of property managers, owners, tenants, and maintenance staff. Also, access to residences for the indoor portion of the review may be problematic.

Indoor Business Review. Working inside a customer's business premises may be viewed as intrusive and be resisted by business owners. This may lead to scheduling difficulties, as well as difficulties in securing business owner cooperation.

New Construction Clotheswasher Ordinance. Most home builders do not currently install clotheswashers in new homes. Many, if not most, home buyers currently bring their own machines. This ordinance would impose a fundamental change in the home buying transaction, and would require the City to work with developers, the real estate community, and new home buyers to implement this change.

Finally, two programs are expected to be "very difficult" to implement:

Multi-family retrofit on resale. The single-family difficulties described above are compounded for multi-family dwellings.

New construction landscape ordinance. Achieving consensus to develop such an ordinance will be very challenging. If an ordinance is enacted, the inspection, plan review, inter-departmental coordination, and appeal requirements will be extremely complex.

Shortage Management

Factors Considered: *The degree to which the program hardens demand by increasing the monetary and non-monetary costs that customers must incur during a water shortage to achieve a given level of usage reduction. A program will harden demand if:*

1. ***The program itself is largely behavioral in nature and therefore leaves little room for further behavioral change during a shortage.*** Behavioral changes are precisely those that are least costly and therefore most readily implemented during a drought.

2. ***Actions encouraged by the program could also be readily implemented during a shortage.*** This type of conservation program will also be removing a relatively inexpensive drought-management option. The utility and its customers will then have to turn to more costly options.

3. ***The program focuses on equipment retrofits which will reduce the savings associated with the particular behavioral changes most likely during a shortage.*** For example, toilet-flushing behavior is fairly easily modified during a drought emergency. The savings associated with reduced flushing frequency is much smaller for ULF toilets than for higher flow fixtures.

4. ***The program focuses on retrofits which will increase the costs associated with the behavioral changes that are most likely during a shortage.*** Homeowners may be more reluctant to sacrifice more valuable "xeriscape" plant material than to sacrifice a lawn that is fairly inexpensively replaced.

All of the programs have some adverse impact on managing future shortages. The ***multi-family submetering program*** is intended to encourage apartment-dwellers to reduce their indoor usage, perhaps by taking advantage of other SCWD programs focusing on indoor end-uses. While indoor usage reductions can have a behavioral component, they are more likely to involve hardware retrofits. Thus, there is "little impact."

The two ***non-residential indoor review programs (business and UCSC)*** also are judged to have "little impact". For these programs, a large portion of the savings are anticipated to be equipment-related. A portion of these savings will come from sanitary fixtures, but a significant part will come from process and other non-sanitary end uses that are less likely to overlap with drought event behavioral changes.

All three components of the ***new construction ordinance*** will also have "little impact," since their focus is on replacement of equipment. Clothes washing behaviors are not those that would be greatly modified in a drought. While the landscape portion of the ordinance will make further reductions in outdoor watering during a drought more difficult, the small number of new homes to be constructed over the next ten years make this impact minimal.

The ***single-family and multi-family ULFT rebate programs*** have "some impact". Toilet flushing behaviors are among the most likely to change during a drought. The savings from this behavioral change is substantially less with a 1.6 gallon toilet than with higher-volume units.

The ***Commercial ULFT rebate program*** has slightly less impact than the residential program. We expect that commercial toilet flushing will not change as much during a drought as will residential flushing.

Also judged to have slightly less impact than the residential ULFT rebate programs is the residential ***horizontal axis washer rebate program.*** Clothes washing behaviors are likely to be less responsive during a drought than toilet flushing.

The ***single-family and multi-family kit distribution programs*** are assumed to have "some impact". These programs focus on actions that could be quickly implemented in time of shortage, which increases the demand-hardening impacts. However, expected drought behavioral changes are generally not associated with the devices distributed through this program; the program is therefore not expected to significantly reduce behavioral savings during a drought.

Also assumed to have "some impact" are the ***single and multi-family retrofit on resale ordinances***. The indoor fixtures to be replaced under these ordinances are for the end uses for which behavioral change is most likely to occur during shortage.

The ***single family and multi-family indoor and outdoor reviews*** have somewhat more impact, and lie between the programs that affect primarily indoor end uses and those that are directed at outdoor end uses.

Finally, the ***large landscape and parks programs*** have a relatively more substantial behavioral component than the other programs. This cuts into the potential additional behavioral change during a shortage. They therefore have "substantial impact".

VII. DEVELOPMENT AND EVALUATION OF PRICING OPTIONS

As a result of the City Council's direction to the Department to consider conservation pricing options as well as programmatic options in its conservation plan, a conservation pricing study was undertaken that included the following components:

1. Develop and conduct a telephone survey of water providers in the western U.S. who have implemented various forms of conservation rate design.

2. Conduct a literature search to identify potential conservation rate structures, understand the experience of other providers that have applied these structures, and review studies of water savings impacts of these structures.

3. Screen the conservation rate structures identified to ascertain their appropriateness for the City of Santa Cruz.

4. Evaluate and rank the remaining rate options along with the programmatic conservation options.

The full report of the telephone survey and literature search results is included as Appendix E.

What is a "Conservation Rate Structure"?

The meaning of the term "conservation rate structure" varies considerably. In general, a rate structure that encourages customers to save water can be dubbed a "conservation rate." For a particular agency, a new rate design may be called a "conservation rate" if it encourages less usage than a prior rate design.

For the purposes of this assessment, a "conservation rate structure" is one that actively attempts to reduce overall water consumption or alter the shape of the utility's demands. Such a rate structure will incorporate one or more of the following components:

- ***Increasing Blocks*** (also called inverted or inclining blocks or tiers). The per unit rate for water usage increases with increasing consumption. Often, the rate in the highest block (the "tail block") is based on the utility's marginal supply cost.

- ***Seasonal Rates.*** The water rates discourage usage during the peak season (typically summer) through a higher per-unit water rate in the peak season and/or structural differences (e.g. different block sizes) between the peak and off-peak seasons. The higher summer rates reflect the higher cost to provide summer service: the need for additional capacity is often driven by peak-season demands.

- ***Seasonal Surcharges.*** Summer water usage above a threshold is charged a surcharge in addition to a "base rate." The threshold is often based on some measure of winter usage (perhaps with an added quantity for "reasonable" additional summer use). It can be fixed, in which case the surcharge is really a seasonal increasing block structure. It can also be based on customer-specific water budgets.

- ***Variable Reliability.*** Usually available to larger customers, who are given the option of choosing a non-standard (usually lower) level of drought or emergency reliability in exchange for a non-standard (usually lower) rate. These are often called curtailable, interruptible, or "priority" rates. The rate discount reflects the reduced contribution the customer is making to the need for new capacity.

- ***Water Budgets.*** Increasing blocks or surcharges with customer-specific thresholds or break points that are based on prior usage, specific customer characteristics (e.g. household size, landscaped area, end uses. etc.), or a combination of the two.

As the foregoing discussions indicate, these rate structures are often justified on the basis of cost of service, as well as the desire to encourage conservation. Economic principles and conservation principles may therefore support and reinforce each other.

Key Considerations for Santa Cruz

The survey and literature search revealed a variety of key points that should guide the SCWD as it attempts to determine the role of structural rate changes in its water conservation efforts. These include:

Conservation rate designs will save water. The amount is uncertain. The vast majority of anecdotal and empirical evidence says that there are real savings associated with conservation rate designs. There is, however, little consistency regarding savings estimates. This is due, in part, to the analytical difficulty in isolating conservation rate savings; it is also due to the relative newness of water conservation rates.

Thus, implementing a conservation rate design will be an inherently uncertain proposition for Santa Cruz. This uncertainty is not qualitatively different from that associated with conservation programs. Even structurally-based programs have a great deal of uncertainty associated with them. Conservation programs are, for the most part, voluntary and depend on actions by customers. The response of Santa Cruz customers may or may not be similar to those responses seen in other jurisdictions.

Two indicators in Santa Cruz bode well for the effectiveness of a conservation rate design:

- The environmental awareness and concern of Santa Cruz residents is generally high.

- Santa Cruz water bills are a somewhat higher percentage of income than is the case in other jurisdictions. The 1998 Raftelis rate survey (Raftelis Environmental Consulting

Group, 1998) found that the mean of water charges as a percentage of median household income for a household that consumes 10 ccf per month is 0.58%. The median of this percentage is 0.53%. For Santa Cruz, the comparable figure is 0.67%. A higher percentage will generally mean that water bills are more "noticed" and that rate changes will matter more to customers.

Savings will be greatly affected by the manner in which the new rate is marketed. The fact that Santa Cruz implements a conservation rate design at all may be more important than the details of the rate design itself. Moreover, the economic signals may be less important than other signals to which customers respond. Irvine Ranch Water District found that calling the upper rate block "abusive" elicited a large savings response, simply because people did not want that label. The Pekelney and Chesnutt study (1997) of water budgets estimates savings that are far in excess of what would be predicted based purely on price elasticity.

Just as is the case with conservation programs, conservation rate structures must be effectively marketed. Effective marketing includes at least:

- Extensive customer education and outreach.
- A structure that is perceived to be fair.
- Linkage to a water supply crisis. The supply crisis in Santa Cruz is very real; a rate change that is effectively tied to this crisis will have greater impact.
- Complementary programmatic conservation. This point is critical and will be discussed in detail below.

Synergies between conservation rates and programs must be exploited. Conservation rate designs are generally not and generally should not be implemented by themselves. Water providers such as Santa Cruz that consider conservation rates also tend to implement a variety of programmatic conservation. The literature is very supportive of such joint implementation and points out that the effectiveness of a conservation rate structure can be enhanced by complementary programs, and *vice versa*.

Thus, Santa Cruz must view a conservation rate structure in the context of the conservation programs that will be implemented. The joint impacts of conservation rates and conservation programs may well be greater than the sum of the parts. For example, a tiered rate based in part on an indoor water budget and a horizontal axis rebate program will be mutually enhancing. One way to think of a conservation rate is as a potentially-very-effective tool to market conservation programs.

Customer acceptance of a water rate design is in large part a function of perceived fairness. Perceived fairness is driven by at least three factors:

- ***Customer Understanding***. A public that is well-educated regarding the logic of any rate structure will see it as more fair.

- ***Type of Rate***. Certain types of rate structures seem to be perceived as more equitable. Block rates based on personalized water budgets are seen as much less arbitrary than rates based on fixed blocks. Rate structures that generate excess revenues are seen as more fair if that excess revenue is assigned to a specific purpose (e.g. conservation programs).

- ***Method of Implementation***. Sudden changes in water bills ("rate shocks") should be avoided. Such shocks can be minimized by timing the changeover correctly and/or by phasing in a rate change where necessary.

Any change in rate structure must recognize the "lifeline" needs of customers. Virtually all of the inclining block structures began with a below-cost first tier that covered estimated "basic" needs. In many jurisdictions, this is a prerequisite to public and political acceptance.

Conservation rates will tend to increase revenue uncertainty. The degree to which this is a significant problem will depend on the specific rate design and the manner in which Santa Cruz customers respond to the rate change. SCWD must consider this issue as it looks more closely at alternative rate structures.

Evaluation of Rate Options

Based on the telephone survey and the literature search, as well as discussions with the Conservation Committee, the evaluation of rate options focused on the following three structures:

- ***Fixed Inverted Blocks***. Santa Cruz currently has a 3-tier increasing block structure for its single-family residential customers, and a uniform rate for other customer classes. Under this alternative, the structure for single-family customers would be made more stringent (by modifying the rates and/or the block sizes) and/or the rate structure for one or more other classes would become an increasing block. Under this alternative, block sizes are fixed by class of service, and are not customer-specific.

- ***Seasonal Differentials***. This alternative would institute summer/winter rate differentials for one or more classes. These differentials could be in reflected in higher summer than winter rates or in structural differences between the two seasons (e.g. increasing blocks in summer, uniform in winter or an additional block in summer). This category also includes "seasonal surcharges" in which only summer usage above a fixed threshold is charged the higher summer rate.

- ***Budget-Based Inverted Blocks.*** Under this alternative, one or more classes would face an increasing block rate with block sizes based on customer-specific attributes.

Table VII - 1
SANTA CRUZ WATER DEPARTMENT SCREENING OF CONSERVATION PRICING ALTERNATIVES

CRITERION	PRICING ALTERNATIVES											
	FIXED INVERTED BLOCKS				SEASONAL DIFFERENTIALS				BUDGET-BASED INVERTED BLOCKS			
	SINGLE-FAMILY	MULTI-FAMILY	LARGE LAND-SCAPE	COMM/ INDUST	SINGLE-FAMILY	MULTI-FAMILY	LARGE LANDS-CAPE	COMM/ INDUST	SINGLE-FAMILY	MULTI-FAMILY	LARGE LANDS-CAPE	COMM/ INDUST
Santa Cruz "Match"	4	FF	FF	FF	5	3	4	1	4	1	5	3
Customer Acceptance	4	2	2	1	3	3	2	1	4.5	1	3	3
Ease of Administration	5	4	4	4	3.5	3.5	3.5	3.5	2	FF	3	1
Revenue Stability	2	4	1	3	2	4	1	3	3	5	2	4
Expected Savings	FF	2.5	3.5	3	3	2.5	4	3.5	4.5	3.5	5	4
Savings Reliability	2	2.5	3	3.5	2	2.5	3	3.5	3	3.5	4	4.5
Savings Longevity	1.5	2.5	3	3.5	1.5	2.5	3	3.5	2.5	3.5	4	4.5
Program Synergies												

Scale: 1 is worst, 5 is best

Table VII-1 presents the qualitative screening of these three conservation pricing options, as applied to each class of service. A score of 1 through 5 has been assigned for each of 7 criteria, with 1 being the worst, and 5 the best. In some cases, where it has been determined that there is a "fatal flaw" (denoted by FF), particular options for particular classes of service have been eliminated.

Following is a discussion of the logic used to arrive at these ratings. Each evaluation criterion will be discussed separately. The discussions will first define the factors considered, and then explain the ratings.

Criterion P1: Santa Cruz "Match"

Factors Considered: *The "match" is determined by considering the Santa Cruz climate, supply system constraints, and history, and the demographics and other characteristics of the customer class.*

In general, given the highly seasonal nature of the Santa Cruz supply constraints, seasonal rates were deemed to be a better match than block rates. All of these rate designs are least appropriate for multi-family customers because most of these customers are master metered. Large landscape customers, due to their size, and dedicated metering, seem particularly suitable for budget-based rates.

Fixed block rates were determined to be fatally flawed for the multi-family, large landscape, and commercial/industrial classes due to the wide variability in demands and end uses.

Seasonal rates may also be problematic for particular commercial sectors that are highly-dependent on seasonal tourism-based demands. Such rates could be construed as having adverse economic impacts on Santa Cruz. This rate is not, however, deemed to be fatally flawed.

Criterion P2: Customer Acceptance

Factors Considered: *The degree to which customers in each class are likely to accept the rate structure.*

The literature indicates that, in general, customers are more accepting of customer-specific budget-based blocks than of arbitrary fixed blocks. The literature also points out that seasonal rates are more easily-understood and accepted by customers than fixed blocks. Thus, in general, for any customer class, it is assumed that budget-based rates will be most readily accepted, and fixed blocks least accepted. The one exception is that, since single-family customers are already experiencing fixed blocks, they will be somewhat more likely to tolerate changes in that block structure.

It is assumed that commercial/industrial customers will be least accepting of the fixed inverted block and seasonal rate structures. This is largely due to the economic factors discussed under

Criterion P1. Large landscape customers are likely to be somewhat more comfortable with these rates, although some resistance can be expected. Multi-family customers will also resist, although less so for the seasonal rate, since most of the seasonal demand is likely to be under the landlord's or building manager's control.

A well-run and well-marketed program of budget-based blocks are likely to be most acceptable to single-family customers and least acceptable to multi-family customers. Commercial and industrial customers will be much more accepting of a block structure that is specifically tailored to their demand patterns and flexible enough to accommodate production-driven changes in demand.

Criterion P3: Ease of Administration

Factors Considered: *The ease with which the Santa Cruz Water Department could administer the rate structure.*

It is assumed that fixed inverted blocks, particularly for single-family customers who already have them, will be fairly easy to administer. Seasonal rates will probably require at least minor administrative or billing modifications. Budget-based rates are more complex to administer; for multi-family customers, this difficulty is deemed a fatal flaw, and this structure is therefore eliminated for this class. Of all the classes of service, budget-based rates are least difficult to administer for large landscape customers.

Criterion P4: Revenue Stability

Factors Considered: *The expected year-to-year variation in revenues from a particular class of service due to demand volatility in that class. The general principle is that class revenues will be less stable if a greater fraction of class revenue results from demands that are more volatile.*

In general, revenues will be more stable under a budget-based than a fixed block structure. This conclusion is supported by the following reasoning:

Larger customers, who generally have more outdoor watering, will have more volatile demands. Under a fixed block structure, a larger fraction of these customers' demands are more likely to be in the upper blocks, which would therefore lead to more revenue variability.

Under budget-based blocks, these customers would tend to have larger block sizes, which would reduce the likelihood of consuming in an upper block. Revenues would therefore be more stable.

Conversely, budget-based blocks would increase the likelihood of smaller customers consuming in the more expensive blocks relative to a fixed-block structure. However, the demands of smaller customers are generally less volatile (less outdoor) so that the increase in upper-tier consumption would increase revenue variability less than the reduced revenue variability associated with the larger customers.

The revenue stability impacts of seasonal rates depend on how the seasons are defined and how volatile demand is during those seasons. Much of the demand volatility will occur in the shoulder (i.e. late spring and early fall) months. The Santa Cruz long (April-October) summer likely means that most of the demand volatility is captured in the summer, meaning that revenues under a seasonal rate structure would be more volatile than under a non-seasonal rate. In the absence of any detailed analysis, it is assumed that the stability impacts of a seasonal design are comparable to the stability impacts of a fixed block structure.

For each rate structure, the stability ratings are correlated with the proportion of class demand that is assumed to be outdoor (more weather-dependent and therefore more volatile). Thus, large landscape customers are assumed to have the most adverse impact on revenue stability. Multi-family customers are assumed to have the least adverse impact due both to the relative predominance of indoor end uses and the presumed smaller savings impacts due to master metering.

Criterion P5: Expected Savings

Factors Considered: *The expected class-specific peak-season dry-year savings relative to the base demands of that class during the 10-year interim period.*

The savings that result from any conservation rate design is a function of many factors, one of which is the specifics of the rates themselves. In the context of this conservation plan, we are not attempting to actually design rates. Rather, we are comparing ranges of savings under typical rate structures in three categories. The conclusions about relative savings therefore do not apply to extreme applications of any of the 3 structures.

The literature indicates that customers respond most to budget-based blocks and least to fixed blocks, with seasonal rates falling between. The greater efficacy of seasonal rates relative to fixed blocks is enhanced by the easily-understood seasonal constraints faced by Santa Cruz.

In general, expected savings for each rate structure are assumed to be a function of two factors:

- The potential savings that are under the direct control of and achievable by the customer. It is assumed that this level is greatest for large landscape customers, followed by commercial/industrial customers, which are assumed to have large sanitary and process savings potential. Single-family customers are next, followed by multi-family customers.

- The extent to which customers in the class respond to economic incentives. It is assumed that commercial/industrial customers respond the most, followed in order by multi-family, large landscape, and single-family customers.

Fixed blocks for single-family customers were deemed to be fatally flawed. The incremental savings expected as a result of enhancement of the existing inverted block structure would be

considerably smaller than those associated with a more fundamental structural change. These savings are simply too low to provide much assistance during the interim (2000-2010) period. [27]

Based on the literature, budget-based rates are assumed to have a larger savings potential for single-family customers than for commercial/industrial customers.

Criterion P6: Savings Reliability

Factors Considered: *The degree to which Santa Cruz can count on the peak-season dry-year savings during the 10-year interim period.*

It is assumed that the savings associated with budget-based rates are more reliable than under either of the other rate structures. This is due to the increased opportunity that rate structure gives the water department to communicate on an ongoing basis with its customers. In addition, the perceived fairness of this structure may contribute to more reliable savings.

For each rate structure, the reliability is assumed to be related to the degree to which the customers in each class will invest in structural efficiency improvements. Commercial and industrial customers are assumed to have the highest likelihood of making such investments, followed in order by large landscape, multi-family, and single-family customers, who rely more on behavioral changes.

Criterion P7: Savings Longevity

Factors Considered: *The likelihood of conservation savings continuing beyond the 10-year interim period.*

The considerations here are similar to those discussed for Criterion 6. Budget-based rates are assumed to offer the best opportunity for reinforcing the conservation message and thereby maintaining savings over the long-term.

As is the case with savings reliability, longevity is related to structural efficiency improvements. The relative rankings within each rate design are therefore the same. The numerical ratings differ somewhat, with single-family customers assumed to have relatively less savings longevity due to the expected turnover of residents. As houses are sold, at least some of the behaviorally-based conservation savings are lost.

---

[27] This does not preclude SCWD from modifying the block structure in the future if circumstances warrant.

Observations

As expected, no single rate structure stands out as superior for any class of service. Some observations on the key tradeoffs that are illustrated in the evaluation matrix are, however, useful:

- Fixed blocks are only deemed to be appropriate for single-family customers. The expected additional savings from modifying the current block structure and/or rate levels is modest. These modest savings can, however, be achieved with minimal administrative costs and with the expectation of a high level of customer acceptance.

- For all classes, seasonal rates are less difficult to administer than budget-based rates, but result in smaller, less reliable, and shorter-lived savings.

- Other than a potential concern about revenue stability impacts, budget-based rates appear to have the best fit for large landscape customers. The fit for single-family customers is tempered by increased administrative difficulties. These difficulties are more acute for commercial/industrial customers.

VIII. OVERALL PRIORITY GROUPING OF CONSERVATION ALTERNATIVES

Table VIII-1 is a modified version of Table VI-1. It includes the pricing as well as the program options. It also includes the two criteria which apply only to pricing options. Finally, it expresses all ratings as ordinal values on a 1 (worst) to 5 (best) scale.

The options were placed into priority groupings by the Water Commission's Conservation Committee. The groupings were then reviewed and largely adopted by the full Commission. The following discussion will first describe the Conservation Committee's ranking process and then address the Commission's action on those recommendations.

Conservation Committee Grouping Process

At its September 14, 1999 meeting, the City Council ordered the Department to implement the efficient clotheswasher rebate program as soon as possible. At its October 18, 1999 meeting, the Department described its proposed program to the Commission. The program follows the description in Section IV, with a $100 SCWD rebate to supplement the current $100 PG&E rebate. Because of this directive, it is assumed that this program will move forward immediately.

On October 4, 1999, staff, members of the consultant team, and the Water Conservation Committee met to determine which programs should be included in the City's interim conservation plan and the order in which they should be undertaken. The Committee recommended that the Department implement all but one of the possible conservation programs. The one exception was the multi-family conservation kit distribution. This program was eliminated on the basis of low yield and relatively high unit cost compared to the single family program.

The process followed by the Committee to prioritize the remaining programs first considered each customer class separately, and then merged the rankings across classes. The conservation alternatives were assigned to one of four priorities. The ranking process included no formal weighting of the evaluation criteria; however, the Committee's ratings did give highest weight to the savings criterion. Table VIII-2 shows the Committee's groupings, along with ratings against several key criteria.

The Committee chose to include a single rate option as a strategic part of the interim plan, namely the budget-based rates for large landscape customers. Seasonal rates for all classes and budget-based rates for single-family and commercial/industrial customers were recommended for inclusion in the Department's next rate study, which must await decisions on potential major capital investments that may emerge from the ongoing water supply plan. The Committee asked that this matter be brought up again for discussion no later than October 2000.

The Committee declined to make a recommendation on the proposed new construction ordinance.

Table VIII - 1

SANTA CRUZ WATER DEPARTMENT CONSERVATION PROGRAM EVALUATION RATINGS: SCALED

PROGRAM	SAVINGS LONGEVITY	TOTAL ANNUAL SAVINGS 1999-2010 *	UNIT COST		IMPLEMENTATION:		PUBLIC ACCEPT-ABILITY	SHORTAGE MANAGE-MENT	SANTA CRUZ "MATCH"	REVENUE STABILITY
			UTILITY	SOCIETY	STAFFING	OVERALL FEASIBILITY				
Residential:										
Cons. Kit Dist.										
Single Family	2	3	3	4	4	5	5	3		
Multi-Family	2	1	1	2	4	3	5	3		
Indoor, Outdoor Rev.										
Single Family	1	2	1	1	2	3	5	2.5		
Multi-Family	1	3	3	4	4	2	4	2.5		
Retrofit on Resale										
Single Family	4	5	5	4	1	2	2	3		
Multi-Family	4	3	5	4	3	1	1	3		
ULFT Rebate ($75)										
Single Family	5	4	4	4	5	5	5	3		
Multi-Family	5	3	3	4	1	5	5	3		
H. Axis Washers ($50)	3	3	4	2	5	5	5	3.5		
H. Axis Washers ($100)	3	3	3	2	5	5	5	3.5		
MF Submetering	5	1	3	3	3	3	3	4		
New Const. Ordinance										
Clotheswashers	3	2	5	1	5	1	1	4		
Landscape	3	1	3	1	3	1	2	4		
Submetering	5	1	5	< 1	5	3	3	4		
SF Pricing:										
Seasonal	1.5	2.5				3.5	3		5	2
Budget-Based Blocks	2.5	3.8				2	4.5		4	3
MF Pricing:										
Seasonal	2.5	2.5				3.5	3		3	4

Cont.

PROGRAM	SAVINGS LONGEVITY	TOTAL ANNUAL SAVINGS 1999-2010 *	UNIT COST		IMPLEMENTATION:		PUBLIC ACCEPT-ABILITY	SHORTAGE MANAGE-MENT	SANTA CRUZ "MATCH"	REVENUE STABILITY
			UTILITY	SOCIETY	STAFFING	OVERALL FEASIBILITY				
Non-residential:										
ULFT Rebate	5	2	2	3	2	4	5	3.5		
Indoor Rev.										
Business	2	4	2	2	3	2	4	4		
UCSC	2	1	2	3	3	4	5	4		
Large Landscape										
Business	1	1	1	1	3	3	4	2		
Residential	1	1	1	1	5	3	5	2		
Golf	1	1	5	5	5	4	5	2		
Parks										
County	3	1	3	3	5	5	5	2		
City	3	2	4	4	5	5	5	2		
Large Landscape Pricing:										
Seasonal	3	3.5				3.5	2		4	1
Budgets	4	4.5				3	3		5	2
Comm/Industrial Pricing:										
Seasonal	3.5	3.5				3.5	1		1	3
Budgets	4.5	4.3				1	3		3	4

Scale:	Years **	Million gal **	$million/mgd	$million/mgd	FTE					
5	>20	>700	0-0.5	0-0.3	0-0.1	Very Easy	Excellent	No impact	Excellent	Very high
4	16-20	270-290	0.5-1.0	1.0-2.0	0.1-0.15	Somewhat easy	Good	Little impact	Good	Moderately high
3	11-15	110-170	1.0-2.0	2.6-3.0	0.15-0.25	Average	Average	Some impact	Average	Average
2	10	51-100	2.0-2.4	3.0-3.5	0.25-0.4	Somewhat difficult	Fair	Substantial impact	Fair	Moderately low
1	7	10-37	>3.4	>4.7	>0.4	Very difficult	Poor	Extreme impact	Poor	Very low

* *Savings ratings for pricing options reflect both expected savings and savings reliability.*

** *Quantified savings longevity and total savings do not apply to pricing options. These options only received qualitative ratings.*

Table VIII - 2
CONSERVATION COMMITTEE PRIORITY GROUPING OF CONSERVATION PROGRAMS

CONSERVATION PROGRAMS	MAX. ANNUAL SAVINGS (MG)	UNIT COST ($MILLION/MGD)		IMPLEMENTATION FEASIBILITY
		UTILITY	SOCIETAL	
First Priority:				
Res. Toilet Rebate (Single & Multi-family)	47.5	1.1	1.5	Very easy
Comm. Toilet Rebate	15.0	1.9	2.6	Somewhat easy
Retrofit on Resale (Single & Multi-family)	113.3	0.5	1.8	Somewhat difficult
Commercial Indoor Review	29.9	2.0	3.3	Somewhat difficult
Second Priority:				
Multi-Family Indoor/Outdoor Review	21.3	1.7	1.8	Somewhat difficult
Single Family Conservation Kit Dist.	15.8	1.0	1.0	Very easy
Third Priority:				
Large Landscape Water Audit	15.0	1.6	2.2	Somewhat easy
Large Landscape Budget Pricing	n/a	n/a	n/a	Average
Single-Family Indoor/Outdoor Review	12.4	4.4	4.7	Average
Fourth Priority:				
Multi-Family Submetering	2.8	1.3	2.7	Average
UCSC Indoor Review	2.3	2.4	2.8	Average

Water Commission Recommendation

At its October 18, 1999 meeting, the Commission, after taking public comment and input, considered and adopted the Committee's program priorities. The Commission also considered the new construction ordinance, and adopted the following resolution:

- The Commission recommends that the City consider a new construction ordinance; the specific components and characteristics of that ordinance will be the product of further analysis, and may or may not resemble the type of ordinance discussed above.

- The new construction ordinance should be placed in priority group 3.

The program implementation plan that follows is based on the Commission-adopted prioritization. Due to its uncertainty, no specific implementation plan was formulated for the new construction ordinance.

IX. RECOMMENDED INTERIM WATER CONSERVATION PLAN

This section describes the recommended interim water conservation plan. The plan contains the following components:

- A discussion of the approach used to derive the proposed plan.
- An overview of the recommended conservation plan, including:
  - A description of the proposed sequencing of conservation programs, and a discussion of the logic behind that sequencing; and
  - A discussion of annual savings, staffing, and budget requirements.
- Detailed implementation plans for each of the individual conservation programs.

Approach

The approach considered the following factors:

- The Water Commission's program groupings, as described in Section VIII.
- The need to implement programs as quickly as is practically possible.
- Synergies among the programs. These include similarities among programs in terms of measures, delivery approaches, and targeted classes, as well as opportunities for program cross marketing.
- Staffing and budgetary implications, e.g., the speed at which the budget or the conservation staff would need to be increased.
- The September 1999 order by the City Council to immediately implement the efficient clotheswasher rebate program.

While the Council has asked that a new construction ordinance be implemented, the specific components and characteristics of that ordinance will be the product of further discussion. Given this uncertainty, the implementation plan includes only the point at which the planning for this ordinance would begin. Detailed implementation steps for the new construction ordinance are not presented.

Overview Of Proposed Conservation Plan

Program Scheduling

Table IX-1 below summarizes the proposed conservation program implementation schedule. Although the table begins with fiscal year 2000-2001, the clotheswasher and ULFT rebate programs will already be ongoing by that point.

Table IX - 1
PROPOSED CONSERVATION PLAN

PROGRAM	FY 2000-01				FY 2001-02				FY 2002-03				FY 2003-04			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Clotheswasher Rebate Program	X[a]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→[d]
ULFT Rebate – Single Family	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→
ULFT Rebate – Multifamily[c]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→
ULFT Rebate – Business	P[b]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X→
Kit Distribution – Single Family		P	P	X	X											
Retrofit on Resale – Single & Multifamily		P	P	P	X	X	X	X	X	X	X	X	X	X	X	X→
Indoor Water Use Review – Business							P	P	X	X	X	X	X	X	X	X→
UCSC Indoor Review							P	P	X	X	X	X	X	X	X	X→
Water Use Review – Multifamily							P	P	X	X	X	X	X	X	X	X→
Water Use Review – Single Family							P	P	X	X	X	X	X	X	X	X→
New Construction Ordinance									T[e]	T	T	T	T	T	T	T→
Budget-Based Rates									P	P	P	P	X	X	X	X→
Landscape Review – Golf											P	P	X	X	X	X→
Landscape Review – Bus.											P	P	X	X	X	X→
Landscape Review – Res.											P	P	X	X	X	X→
Parks Review – City and County											P	P	X	X	X	X→
Multifamily Submetering													P	P	X	X→

a "X" denotes quarters in which savings are expected.

b "P" denotes quarters in which activities to prepare for program implementation occur. During these quarters, there are no savings attributable to the program.

c These programs are ongoing from the previous year. (The washer program is in the planning stages now, so will be fully implemented by the start of FY 2000-01.)

d An arrow means the program continues in subsequent years.

e "T" is used because the components of the new construction ordinance are yet to be determined.

The schedule is as aggressive as possible while still reflecting manageable and rational staffing and sequencing. A detailed discussion of the schedule follows.

Fiscal Year 2000-2001

As shown in Table IX-1, the following programs will already have begun as this fiscal year begins:

- Clotheswasher Rebate Program
- ULFT Rebate Program – Single Family
- ULFT Rebate Program – Multifamily

Implementation of the clotheswasher rebate program is scheduled to begin early in calendar year 2000. In fiscal year 2000-01, this program will be fully under way. The single family ULFT rebate program is ongoing, as is the multifamily program, although the latter will involve increased targeted marketing particularly to large multifamily complexes. The residential ULFT programs and washer program should be cross-marketed.

It is assumed that the Department will begin to plan and implement the following new programs in fiscal year 2000-01:

- ULFT Rebate Program – Business
- Kit Distribution – Single Family
- Retrofit on Resale – Single and Multifamily (note in Table IX-1 that planning begins in the last half of 2000-01 and the ordinance goes into effect in 2001-02)

It is recommended that the Department implement the business ULFT program for the following reasons:

- Media outreach can be combined with the residential ULFT program, allowing for cost efficiencies and helping create momentum in the community.
- Similarities in program tasks will help create a coherent staffing approach.
- The business ULFT program will build relationships with the business sector, laying the groundwork for future programs such as indoor and outdoor reviews.
- This program will add a nonresidential program in the first implementation year, which is important to foster a perception of shared burden.
- This program can be implemented in City facilities, demonstrating the seriousness with which the City views water conservation.

It is also recommended that the kit distribution program for single-family customers be implemented in the first year. This effort will generally increase awareness of the Department's conservation efforts, and be an excellent vehicle for marketing the washer and ULFT rebate programs. Also, because the kit distribution program is a one-year effort, the necessary staff can be hired and then transitioned into other programs in the following years.

During the latter half of fiscal year 2000-01, the Department will begin work on the retrofit on resale ordinance. Because of its high annual savings, it is desirable to bring this program on-line as soon as possible. However, because of its implementation difficulty and public acceptability concerns, it seems reasonable to expect actual implementation of the ordinance in fiscal 2001-2002.

The staffing plan is discussed in detail later in this section. At the beginning of this fiscal year, one program administrator is hired to handle the clotheswasher rebate program, the multifamily and business toilet rebate programs, and the kit distribution program. The single family toilet rebate program will continue to be administered by existing Department staff. A full-time program supervisor will also be hired. This supervisor will be responsible for program development, oversight, and performance evaluation. In the first year, the supervisor will provide oversight on the programs mentioned above, and also focus on planning the retrofit on resale program. It should be noted at this point that new office space will need to be secured to house the additional staff to be hired for program implementation.

Fiscal Year 2001-2002

In fiscal year 2001-2002, the clotheswasher and ULFT rebate programs continue. The retrofit on resale ordinance will go into effect the first quarter of this year as well. A second full-time program administrator will be hired to implement the retrofit on resale ordinance.

In the third quarter the program supervisor will begin planning for the following four water use review programs:

- Indoor Water Use Review – Business
- Indoor Water Use Review – UC Santa Cruz
- Indoor/Outdoor Water Use Review – Single Family
- Indoor/Outdoor Water Use Review – Multifamily

Fiscal Year 2002-2003

In this fiscal year, the four review programs listed above be implemented in the field begin to yield savings. In addition, planning for the new construction ordinance will begin. As noted earlier, the specific components of the ordinance remain to be determined, and a detailed implementation plan has not been included. Specific staffing needs, and program savings and

costs also remain to be determined. Council and Commission discussions to date have covered the following potential requirements for new residential development:

- Installation of water efficient clotheswashers;
- Installation of exterior landscape efficient irrigation equipment, specifically drip irrigation systems; and
- Individual meters on all multiple family dwelling units, where feasible.

Planning would also begin for the following programs:

- Large Landscape Review - Golf
- Large Landscape Review - Business
- Large Landscape Review – Residential
- Parks Water Use Review – City and County
- Budget-Based Rates for Large Landscape Customers

It is anticipated that there will be substantial overlap in tasks and also in the contractors hired to conduct the reviews. A third program administrator will be hired in fiscal 2002-03 to handle the review programs planned in 2001-02 (business, UCSC, multifamily, and single family) and to help the program supervisor as needed in planning the large landscape and parks review programs.

In this year, the supervisor will also focus on planning the large landscape and parks review program, and the budget-based rates program.

Fiscal Year 2003-04

In fiscal year 2003-2004, the large landscape and parks review programs will be implemented in the field, and the budget-based rates will go into effect. The rates and review programs will be mutually reinforcing.

In this fiscal year, the submetering rebate program for multifamily customers will also be implemented. This program is implemented in the fourth year because its estimated savings are relatively modest (2.0 million gallons per year by 2009) and the program does not have particularly strong synergies with the others in the plan. Further, the suite of programs for fiscal year 2002-03 is already fairly complex. Because it is essentially a rebate program, the submetering program will be run by the same administrator hired to conduct the other rebate programs.

Estimated Conservation Savings

Based on the foregoing program schedule, Table IX-2 shows the expected annual conservation savings through fiscal year 2009-2010.

Staffing Plan

The economic analysis described in Section V above was based in part on nominal supervisorial and administrative staffing levels for each program, based on the number of hours per week required to implement the program. Those nominal staffing requirements are shown in the upper portion of Table IX-3.

The lower portion of Table IX-3 converts those nominal requirements into an actual hiring plan for SCWD. New conservation staff will be hired as needed to oversee and administer the new programs. It is assumed that only full time positions will be hired to supplement the existing Department staff.

The staffing plan is summarized as follows. (These staff are assumed to be *additive* to the existing Department staff.)

The total *additional* staffing to be sustained throughout the plan is 1 supervisor and 3 program administrators. These are additive to the Department's existing staff of 1 program manager and one-half administrator. Each of the program administrators will focus on a different type of program, as shown in Table IX-4:

- The first administrator will concentrate on rebate programs.
- The second administrator will be responsible for the retrofit on resale ordinance.
- The third administrator will operate all of the indoor and outdoor review programs.

Each administrator will have a unique set of skills consistent with the program set for which he or she will be responsible.

The required new staffing by fiscal year is as follows:

- *FY 2000-01:* Hire 1 program supervisor and 1 program administrator.
- *FY 2001-02:* Hire 1 additional program administrator.
- *FY 2002-03:* Hire a third program administrator.

This staffing pattern attempts to ensure that the staffing requirements of the programs scheduled to be implemented are met, while minimizing "slack time" for newly-hired staff. In some cases, this means that, in the short-term, some responsibilities will be traded off between the program administrators and the supervisor.

Table IX - 2
ANNUAL CONSERVATION SAVINGS

YEAR	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10
	ANNUAL SAVINGS (MG)									
Clotheswasher Rebate	0.8	2.4	4.3	6.5	8.9	11.5	14.0	16.6	19.1	21.7
ULFT Rebate										
Single Family	4.5	9.0	13.3	17.5	21.6	25.6	29.5	31.5	33.4	34.4
Multi-Family	0.9	2.6	4.3	5.9	7.5	9.1	10.6	11.7	12.3	12.8
C/I/I	0.4	1.3	2.3	3.4	4.7	5.9	7.0	8.8	11.2	13.7
Single Family Kit Distribution	4.0	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Retrofit on Resale										
Single Family		8.2	18.8	29.2	39.4	49.3	58.9	68.3	77.5	86.5
Multifamily		1.3	3.1	4.8	6.4	8.1	9.6	11.2	12.7	14.1
Indoor Review										
Business			1.0	4.0	9.0	16.0	24.9	29.9	29.9	29.9
UCSC			0.8	1.5	2.3	2.3	2.3	2.3	2.3	2.3
Indoor/Outdoor Review										
Multifamily			1.2	4.1	7.7	12.4	18.3	21.3	21.3	21.3
Single Family			0.5	2.1	4.1	6.7	10.3	12.4	12.4	12.4
Large Landscape Review										
Golf			2.7	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Business			0.1	0.2	0.6	1.0	1.5	1.8	1.8	1.8
Residential			0.0	0.2	0.4	0.7	1.1	1.4	1.4	1.4

Cont.

YEAR	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10
Parks Review										
City			0.9	2.6	4.4	5.4	5.4	5.4	5.4	5.4
County			0.2	0.6	0.9	1.1	1.1	1.1	1.1	1.1
Budget-Based Rates										
Multi-Family Submetering				0.1	0.6	0.8	1.0	1.3	1.5	1.8
Total Annual Savings (mg)	10.6	40.6	69.2	104.0	139.7	176.9	216.9	246.0	264.4	281.7

Table IX - 3
ANNUAL STAFFING

YEAR	FY 2000-01		FY 2001-02		FY 2002-03		FY 2003-04		FY 2004-05		FY 2005-06		FY 2006-07		FY 2007-08		FY 2008-09		FY 2009-10	
	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN
NOMINAL STAFFING LEVELS (FTE)																				
Clotheswasher Rebate	0.03	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.03	0.11
ULFT Rebate																				
Single Family	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multi-Family	0.10	0.38	0.10	0.38	0.10	0.38	0.10	0.38	0.10	0.38	0.10	0.38	0.10	0.38	0.10	0.38	0.10	0.38	0.10	0.38
C/I/I	0.10	0.25	0.10	0.25	0.10	0.25	0.10	0.25	0.10	0.25	0.10	0.25	0.10	0.25	0.10	0.25	0.10	0.25	0.10	0.25
Single Family Kit Distribution	0.03	0.08																		
Retrofit on Resale																				
Single Family	0.42		0.42	0.9	0.42	0.9	0.42	0.9	0.42	0.9	0.42	0.9	0.42	0.9	0.42	0.9	0.42	0.9	0.42	0.9
Multifamily	0.08		0.08	0.2	0.08	0.2	0.08	0.2	0.08	0.2	0.08	0.2	0.08	0.2	0.08	0.2	0.08	0.2	0.08	0.2
Indoor Review																				
Business					0.04	0.21	0.04	0.21	0.04	0.21	0.04	0.21	0.04	0.21						
UCSC					0.09	0.09	0.09	0.09	0.09	0.09										
Indoor/Outdoor Review																				
Multifamily					0.04	0.10	0.04	0.10	0.04	0.10	0.04	0.10	0.04	0.10	0.04	0.10	0.04	0.10	0.04	0.10
Single Family					0.09	0.23	0.09	0.23	0.09	0.23	0.09	0.23	0.09	0.23	0.09	0.23	0.09	0.23	0.09	0.23
Large Landscape Review																				
Golf					0.002	0.003	0.002	0.003	0.002	0.003	0.002	0.003	0.002	0.003	0.002	0.003	0.002	0.003	0.002	0.003
Business					0.08	0.11	0.08	0.11	0.08	0.11	0.08	0.11	0.08	0.11	0.08	0.11	0.08	0.11	0.08	0.11
Residential					0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03

Cont.

YEAR	FY 2000-01		FY 2001-02		FY 2002-03		FY 2003-04		FY 2004-05		FY 2005-06		FY 2006-07		FY 2007-08		FY 2008-09		FY 2009-10	
	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN	MGMT.	ADMIN
Parks Review																				
City					0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06
County					0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02
Budget-Based Rates			0.1		0.1	0.25	0.05	0.25	0.05	0.25	0.05	0.25	0.05	0.25	0.05	0.25	0.05	0.25	0.05	0.25
Multi-Family Submetering							0.05	0.13	0.05	0.13	0.05	0.13	0.05	0.13	0.05	0.13	0.05	0.13	0.05	0.13
Total Nominal Staffing	0.76	0.82	0.83	1.74	1.22	2.84	1.22	2.97	1.22	2.97	1.13	2.88	1.13	2.88	1.09	2.67	1.09	2.67	1.09	2.67
ACTUAL STAFFING ADDITIONS:																				
Cumulative Requirements	1	1	1	2	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
New Hires Each Year	1*	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Staffing Cost	$68,000		$136,000		$174,000		$174,000		$174,000		$174,000		$174,000		$174,000		$174,000		$174,000	

Table IX - 4
PROPOSED PROGRAM ADMINISTRATOR RESPONSIBILITIES

PROGRAM	FY 2000-01	FY 2001-02		FY 2002-03			FY 2003-04		
	ADMIN 1*	ADMIN 1	ADMIN 2	ADMIN 1	ADMIN 2	ADMIN 3	ADMIN 1	ADMIN 2	ADMIN 3
Clotheswasher Rebate Program	X	X		X			X		
ULFT Rebate – Single Family**									
ULFT Rebate – Multifamily	X	X		X			X		
ULFT Rebate – Business	X	X		X			X		
Kit Distribution – Single Family	X								
Retrofit on Resale – Single & Multifamily			X		X			X	
Indoor Water Use Review – Business						X			X
UCSC Indoor Review						X			X
Water Use Review– Multifamily						X			X
Water Use Review – Single Family						X			X
Budget-based rates									X
Landscape Review – Golf									X
Landscape Review – Business									X
Landscape Review – Residential									X
Parks Review – City and County									X
Multifamily Submetering							X		

* *Denotes Program Administrators 1, 2 and 3*

** *Handled by the existing administrator.*

Estimated Budgetary Requirements

Table IX-5 shows estimated annual costs to implement the recommended conservation plan. All costs shown are real dollars; they do not reflect inflation. The incremental costs for the recommended programs are shown first. These are then added to the current conservation budget to estimate the total estimated conservation budget in 1998 dollars.

Table IX - 5
ANNUAL COSTS

YEAR	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10
(A) STAFFING COSTS (from Table IX-3)	$68,000	$136,000	$174,000	$174,000	$174,000	$174,000	$174,000	$174,000	$174,000	$174,000
Other Costs:										
Clotheswasher Rebate	$16,250	$35,000	$40,000	$45,000	$50,000	$52,500	$52,500	$52,500	$52,500	$52,500
ULFT Rebate										
Single Family	$84,988	$84,988	$84,988	$84,988	$84,988	$84,988	$84,988	$53,848	$53,848	$38,278
Multi-Family	$18,107	$36,215	$36,215	$36,215	$36,215	$36,215	$36,215	$29,330	$22,445	$22,445
C/I/I	$17,845	$35,689	$38,254	$42,719	$44,619	$44,619	$44,619	$57,349	$71,314	$74,354
Single Family Kit Distribution	$195,983	$0	$0	$0	$0	$0	$0	$0	$0	$0
Retrofit on Resale										
Single Family		$25,995	$34,660	$34,660	$34,660	$34,660	$34,660	$34,660	$34,660	$34,660
Multifamily		$3,810	$5,080	$5,080	$5,080	$5,080	$5,080	$5,080	$5,080	$5,080
Indoor Review										
Business			$24,110	$68,488	$109,022	$150,929	$194,209	$107,924	$0	$0
UCSC			$14,167	$14,167	$14,167		$0	$2,000		$0
Indoor/Outdoor Review										
Multifamily			$10,986	$27,367	$32,762	$48,137	$66,112	$41,956	$25,200	$48,786
Single Family			$15,112	$41,874	$53,525	$70,353	$104,010	$70,775	$31,068	$66,892

Cont.

YEAR	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	FY 2009-10
Large Landscape Review										
Golf			$6,011	$6,011	$0	$1,000	$1,000	$0	$1,000	$7,011
Business			$3,779	$10,393	$16,063	$22,363	$29,293	$18,269	$5,040	$11,339
Residential			$2,069	$5,398	$7,918	$10,798	$14,038	$8,909	$2,880	$6,389
Parks Review										
City			$15,000	$30,000	$32,500	$19,000	$3,000	$3,250	$3,250	$3,000
County			$5,000	$10,001	$7,501	$3,000	$1,000	$750	$750	$1,000
Budget-Based Rates		$10,890	$21,780	$0	$0	$0	$0	$0	$0	
Multi-Family Submetering				$2,765	$5,529	$5,529	$5,529	$5,529	$5,529	$5,529
(B) TOTAL OTHER COSTS	**$333,173**	**$232,587**	**$357,211**	**$465,125**	**$534,548**	**$589,171**	**$676,252**	**$492,129**	**$314,564**	**$377,263**
(C) TOTAL COST OF CONS. PROGRAMS [(C) = (A) + (B)]	**$401,173**	**$368,587**	**$531,211**	**$639,125**	**$708,548**	**$763,171**	**$850,252**	**$666,129**	**$488,564**	**$551,263**
(D) CURRENT SCWD CONSERVATION BUDGET[2]	**$200,000**	**$200,000**	**$200,000**	**$200,000**	**$200,000**	**$200,000**	**$200,000**	**$200,000**	**$200,000**	**$200,000**
(E) TOTAL PROPOSED CONS. BUDGET [(E) = (C) + (D)]	**$601,173**	**$568,587**	**$731,211**	**$839,125**	**$908,548**	**$963,171**	**$1,050,252**	**$866,129**	**$688,564**	**$751,263**

1 *Note: Costs are in constant 1998 dollars; they do not reflect inflation.*

2 *To avoid double-counting "Current SCWD Conservation Budget" does not include ULF toilet rebate amounts. These are included in the Single Family ULFT program.*

Detailed Program Implementation Plans

The plans below provide further implementation details for each program. Each plan provides a summary program description followed by a table showing sequential program tasks and their scheduling by quarter.

Single and Multifamily Clotheswasher Rebate Program

Since the consultants developed the plan for the washer rebate program, Pacific Gas & Electric decided to discontinue its customer rebate program in 2000, although it will offer dealers a $25 dealer incentive for each efficient machine sold. Therefore, the City will operate its customer rebate program independently. Planning is already under way, and implementation will begin in January 2000. The rebate level will still be $100. Because the customer rebate program will now be implemented by the Santa Cruz Water Department, staff has been increased accordingly. SCWD staff will cross-market other programs to customers as sequencing allows.

Table IX - 6
CLOTHESWASHER REBATE PROGRAM IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2000-01				FISCAL YEAR 2001-02			
	I	II	III	IV	I	II	III	IV
Send all outreach materials (sent once per year)		X				X		
Conduct quarterly spot checks at appliance stores to make sure program materials are readily available	X	X	X	X	X	X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)	X							
Perform periodic inspections to verify purchase	X	X	X	X	X	X	X	X→
Process rebate requests	X	X	X	X	X	X	X	X→

Note that some planning and implementation activities will have already been completed by the start of FY 2000-01.

Single and Multifamily ULFT Rebate Program

This program offers rebates to existing single and multifamily residential customers to motivate them to replace their inefficient toilets with ultra low-flush toilets (ULFTs). This program is essentially a continuation of the Department's existing rebate program, but with increased emphasis on marketing to multifamily accounts. Additional programs should also be marketed to customers as sequencing allows, such as the horizontal axis washer rebate and the water use review programs.

Table IX - 7
SINGLE AND MULTIFAMILY ULFT REBATE IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2000-01				FISCAL YEAR 2001-02			
	I	II	III	IV	I	II	III	IV
Send all outreach materials including letter to multifamily owner and manager (sent once per year)		X				X		
Make direct marketing calls to multifamily	X	X	X	X	X	X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)	X							
Perform installation inspections	X	X	X	X	X	X	X	X→
Process rebate requests	X	X	X	X	X	X	X	X→

Note that some planning and implementation activities will have already been completed by the start of FY 2000-01.

Commercial ULFT Rebate

This program offers rebates to commercial, industrial, and institutional customers for the early retirement of non-conserving toilets. Customers targeted will include UC Santa Cruz.

This program expands on the Department's existing toilet rebate program by providing higher rebates for replacing valve-type toilets. Additional programs should also be marketed to customers as sequencing allows, such as the water use review programs.

Table IX - 8
COMMERCIAL ULFT REBATE IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2000-01				FISCAL YEAR 2001-02			
	I	II	III	IV	I	II	III	IV
Hold meetings with customers, stakeholders, and trade allies to explain program and gain support	X							
Design general marketing materials[28] (bill stuffers, radio announcements, press releases).	X							
Design and print marketing letter(s) to building owners, managers, tenants, plumbing contractors, wholesalers/ dealers, trade associations, etc.	X							
Send all media outreach and marketing materials (sent once per year), including rebate forms to trade allies.		X						
Make direct marketing calls to large customers		X	X	X	X	X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)	X							
Perform installation inspection		X	X	X	X	X	X	X→
Process rebate requests		X	X	X	X	X	X	X→

[28] Marketing material design and media outreach should be coordinated with the residential ULFT rebate program as sequencing allows.

Conservation Kit Distribution

In this program, the City of Santa Cruz will deliver indoor conservation kits to single family residential customers door-to-door. Kits will contain toilet leak detection tablets, repair devices, fill cycle regulators, faucet aerators, and low-flow showerheads. Residents will install the kits themselves. Additional programs should also be marketed to customers as sequencing allows, such as the toilet rebate program.

Table IX - 9
CONSERVATION KIT DISTRIBUTION IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2000-01				FISCAL YEAR 2001-02			
	I	II	III	IV	I	II	III	IV
Hire kit delivery contractors		X	X					
Select and purchase kit components including delivery bags		X	X					
Design and print door hangers and kit instructions		X						
Assemble kits into bags with instructions			X					
Prepare press release, public service announcements, and other media outreach		X						
Send all media outreach material			X					
Design program evaluation (methodology, data collection protocols, sample and control groups)		X						
Put up door hangers				X	X			
Deliver kits door-to-door				X	X			

Retrofit on Resale Ordinance

The City of Santa Cruz will adopt an ordinance requiring residential properties to meet efficiency standards for residential plumbing fixtures whenever a property changes ownership. The Water Department will need to work with other jurisdictions (Santa Cruz County and the City of Capitola) to have them adopt similar ordinances, and to obtain authorization for the City of Santa Cruz to enforce the ordinance outside its jurisdiction. The following measures would be required if not already implemented: ULFT toilet, low-flow showerheads, faucet aerators, and repair of leaking toilets as necessary.

Table IX - 10
RETROFIT ON RESALE IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2000-01				FISCAL YEAR 2001-02			
	I	II	III	IV	I	II	III	IV
Develop ordinance (work with other City & County departments including legal counsel to develop draft language)		X	X	X				
Involve Committee, the public, and stakeholders in ordinance development process			X	X				
Develop detailed implementation, tracking, and enforcement procedures			X	X				
Obtain approval from Water Commission and City Council				X				
Design program evaluation (methodology, data collection protocols, sample and control groups)			X					
Public notification (public meetings, press releases, other announcements)				X	X			
Implementation of ordinance including tracking and enforcement					X	X	X	X→

Indoor Water Use Review, Measure Installation, and Rebates – Business Customers and UC Santa Cruz

This program targets the top 20% of commercial customers in terms of water use, as well as UC Santa Cruz. The review includes on-site measure installation as appropriate (faucet aerators, and toilet and urinal valve retrofit kits). The program also offers rebates of up to $1,000 per customer for water-saving equipment. Subsequent visits every three years will involve checking to make sure equipment is still in place and functioning properly, noting if any additional measures have been installed, and talking to the customer. Additional programs should also be marketed to customers as sequencing allows, such as the toilet rebate program.

Table IX - 11
INDOOR WATER USE REVIEW, MEASURE INSTALLATION, AND REBATES IMPLEMENTATION PLAN – BUSINESS CUSTOMERS AND UC SANTA CRUZ

ACTIVITY	FISCAL YEAR 2001-02				FISCAL YEAR 2002-03			
	I	II	III	IV	I	II	III	IV
Develop program specifications and solicit contractor bids for conducting reviews and installing measures (coordinate with UCSC review if possible in terms of skills needed)			X					
Select and hire contractor			X	X				
Design and print marketing letter for top 20% of business customers			X					
Send marketing letter to appropriate business decision makers (sent once per year)				X				X
Make follow-up calls to business customers and visit with the largest directly to market program				X	X	X	X	X→
Contact and meet with appropriate UCSC personnel				X	X			
Arrange site reviews					X	X	X	X→
Conduct site reviews[29]					X	X	X	X→
Purchase and install equipment					X	X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)			X					
For any equipment installed for rebate, perform installation inspection					X	X	X	X→
Process rebate requests					X	X	X	X→

[29] Site visits are repeated every three years to maintain savings.

Residential Indoor and Outdoor Water Use Review and Measure Installation

Residential water use reviews will target the top 20% of single-family and multifamily water users. The first review of the customer's property and home will be lengthier than subsequent reviews, and include measure installation. Subsequent visits every three years will involve checking to make sure equipment is still in place and functioning properly, noting if any additional measures have been installed, and talking to the customer. The program also offers rebates for irrigation equipment changes. Additional programs should also be marketed to customers as sequencing allows, such as the toilet rebate program.

Table IX - 12
SINGLE AND MULTIFAMILY RESIDENTIAL INDOOR AND OUTDOOR WATER USE REVIEW AND MEASURE INSTALLATION IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2001-02				FISCAL YEAR 2002-03			
	I	II	III	IV	I	II	III	IV
Develop program specifications and solicit contractor bids for conducting reviews and installing measures (coordinate needs for single and multifamily reviews)			X					
Select and hire contractor			X	X				
Work with contractor to prepare review protocols and train review staff (coordinate single and multifamily reviews)				X				
Select and purchase measures for installation				X				
Design and print marketing letter			X					
Send marketing letter to top 20% (sent once per year)				X				X
Make direct calls to managers and owners of large multifamily complexes to arrange reviews; meet with owners and managers of largest complexes as necessary				X	X	X	X	X→
Arrange site reviews				X	X	X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)			X					
Conduct site visits and install measures[30]					X	X	X	X→
Process rebate requests					X	X	X	X→

[30] Site visits are repeated every three years to maintain savings

Budget-Based Rates For Large Landscape Customers

This section describes the steps necessary to implement budget-based rates for large landscape customers. These are defined as customers served by a dedicated irrigation meter, and are comprised of the following accounts: parks (24 accounts); golf courses (6 accounts); business (168 accounts); and, residential (144 accounts).

During the year before the budget-based rate is implemented, budgets must be estimated for the large landscape accounts of which there are 342 total. Because the sites are diverse, it is assumed that each must be visited to gather data for water budget estimation. Data gathered will include total landscaped area, percentage turf, percentage plants, plant types, whether an automated irrigation system is used, and type of system (drip, sprinkler, etc.). It is assumed that each residential account takes 2.5 hours on average including travel time, each business account takes 3.5 hours on average, each golf course 6.5 hours on average, and each park 4.5 hours on average. This totals about 1,100 hours in the first year or about $33,000 assuming $30 per hour for an outside contractor.

Table IX - 13
BUDGET-BASED RATES FOR LARGE LANDSCAPE CUSTOMERS IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2002-03				FISCAL YEAR 2003-04			
	I	II	III	IV	I	II	III	IV
Select and hire contractor to conduct landscape water budget estimates; conduct estimates	X							
Conduct landscape budget estimates		X	X	X				
Design specific rate structure	X	X	X					
Involve Committee, the public, and stakeholders in rate development process		X	X					
Obtain approval from Commission and City Council			X	X				
Design program evaluation (methodology, data collection protocols, sample and control groups)		X						
Public notification (public meetings, press releases, other announcements)				X	X			
Implementation of rate including tracking usage to identify overages, and billing customers accordingly					X	X	X	X→

Large Landscape Water Use Review

This program reduces peak demand by improving irrigation efficiency and watering practices among dedicated business, residential, and golf irrigation accounts. The Department staff will identify and contact the sites. Professional landscape auditors will perform the initial review to identify low-cost improvements, develop an irrigation schedule, and suggest other improvements.

Table IX - 14
LARGE LANDSCAPE WATER USE REVIEW IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2002-03				FISCAL YEAR 2003-04			
	I	II	III	IV	I	II	III	IV
Develop program specifications and solicit landscape contractor bids for conducting reviews			X					
Select and hire contractor			X	X				
Design and print marketing letter			X					
Send marketing letter to decision makers at top 20% of businesses (sent once per year)				X				
Make follow-up calls to customers and visit with the largest directly to discuss program as necessary				X	X	X	X	X→
Arrange site reviews				X	X	X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)			X					
Conduct site visits[31]					X	X	X	X→

[31] Site visits are repeated every three years to maintain savings

Parks Water Use Review and System Upgrade Program

This program targets City and County parks. It is similar to the large landscape review, but different in several ways. Irrigation systems in parks are usually more antiquated than those of other commercial customers. Because of this, both the costs for equipment retrofit and replacement, and the resulting savings are higher than those generally found at commercial sites.

Table IX - 15
PARKS WATER USE REVIEW AND SYSTEM UPGRADE PROGRAM IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2002-03				FISCAL YEAR 2003-04			
	I	II	III	IV	I	II	III	IV
Develop program specifications and solicit landscape contractor bids for conducting reviews			X					
Select and hire landscape contractor to conduct reviews			X	X				
Contact and meet directly with appropriate City/County Parks and Recreation staff			X	X	X	X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)			X					
Conduct site visits					X	X	X	X→
Work with staff to arrange equipment installation					X	X	X	X→
Work with staff to arrange rebate					X	X	X	X→

Submeter Rebates for Existing Apartment Buildings

This program provides a rebate to apartment owners to encourage the installation of submeters in existing apartment units. Submeters measure individual dwelling unit water use, allowing the cost of water to be billed to individual apartment dwellers. This raises customers' awareness and provides them with an economic incentive to conserve. It also helps building owners and managers identify units where there may be leaks. The program targets the top 20% of multifamily customers which have 21 units on average.

Table IX - 16
SUBMETER REBATE FOR EXISTING APARTMENT BUILDINGS
IMPLEMENTATION PLAN

ACTIVITY	FISCAL YEAR 2003-04			
	I	II	III	IV
Research and design program	X	X		
Design and print marketing letter to owners and managers of top 20% of complexes	X			
Send marketing letter (once per year)		X		
Conduct marketing calls; meet in person as necessary		X	X	X→
Work with multifamily customers if necessary to help arrange meter installation		X	X	X→
Design program evaluation (methodology, data collection protocols, sample and control groups)	X			
Perform installation inspection				X→
Process rebate requests				X→

X. NEXT STEPS

Even as the Department implements this interim water conservation plan, it will be undertaking the integrated water plan. The IWP is scheduled to begin in early 2001. The IWP will be the place where the Department considers alternative long-term resource strategies, each of which consists of different combinations of conservation, supply, and curtailment options. Each of these strategies will be evaluated against a set of criteria that address their performance over the long-term.

For example, in the economic arena, the IWP will allow direct comparisons between the cost of conservation programs and supply options. As described above in Section V, the conservation program unit costs will be directly comparable to the unit supply costs, expressed in dollars per mgd of capacity. To the extent that the water supply study identifies a single preferred supply source, benefit-cost ratios for each conservation program based on the avoided cost of that supply can be estimated.

The IWP will also allow direct comparisons of different options with regard to other evaluation criteria. Thus, the public acceptability of supply development, conservation programs, and increases in the frequency and magnitude of future shortages can be compared.

The essence of the IWP will be to systematically consider these comparisons and explicitly make the difficult tradeoffs that will inevitably be required. This conservation plan, along with the supply and curtailment plans, set the stage for this challenging, but essential, process for the City of Santa Cruz.

APPENDICES

APPENDIX A

MEASURE SCREENING RESULTS

APPENDIX A

SANTA CRUZ LONG-TERM WATER CONSERVATION PLAN
QUALITATIVE SCREENING

		Qualitative Screening Criteria An 'X' indicates that the measure is eliminated; numbered notes below explain reason for elimination						
End-Use	**Conservation Measure**	**Savings Non-Quantifiable or Short-Lived**	**Savings Behavior-Dependent**	**Techno-logical/Market Maturity**	**Poor Utility Match**	**Poor Customer Acceptance**	**Environmental or Health Concerns**	**Continue to be Considered?**
Res. Shower	Low-flow showerheads							Yes
	Ultra low-flow showerheads							Yes
	Showerflow restrictors					X[1]		No
Res. Faucets	Low-flow faucets							Yes
	Low-flow faucet aerators							Yes
Res. Toilets	ULFT gravity-flow tank-type							Yes
	ULFT pressurized tank type							Yes
	ULFT special < 1 gallon flush models			X[2]				No
Toilet Retrofit	Displacement bags	X[3]				X[4]		No
	Displacement bottles	X[3]				X[4]		No
	Displacement dams	X[3]				X[4]		No
	Dual-flush devices	X[3]						No
	Fill cycle regulators							Yes
	Early closure flappers	X[3]						No
Leaks - Faucet	Faucet washers							Yes
Leaks - Toilet	New flapper valve							Yes
	New fill valve							Yes
Res. Washers	Lower use vertical axis clothes washer				X[4a]			No
	Horizontal axis clothes washer							Yes
Res. Dish Washers	Lower volume dishwashers							Yes
Res. Misc	Replace self-regenerating water softeners	X[5]						No
	Point-of-use water heaters					X[6]		No
	Recirculating hot water system devices		X[7]				X[8]	No
	Individual dwelling unit sub-meters							Yes
	Metering all accounts				X[9]			No
	Water pressure regulator				X[10]			No
Res. Outdoor	Hose control nozzles	X[11]			X[12]			No
	Garden hose timers	X[11]						No
	Drip irrigation replacing sprinkler							Yes
	Bubbler/Soaker irrigation systems	X[11]						No
	Install new automatic sprinkler system	X[13]						No
	Improve automatic sprinkler system							Yes
	Soil sensors			X[14]				No
	Rain sensors							Yes
	Water efficient plant material							Yes
	Xeriscaping							Yes
	Turf reduction/replacement							Yes
	Irrigation scheduling							Yes
	Irrigation sub-meters							Yes
	Soil preparation/mulching	X[11]						No
	Graywater systems							Yes
Res. Outdoor	Rainwater collector/cistern	X[11]						No

SANTA CRUZ LONG-TERM WATER CONSERVATION PLAN
QUALITATIVE SCREENING

		Qualitative Screening Criteria An 'X' indicates that the measure is eliminated; numbered notes below explain reason for elimination						
End-Use	Conservation Measure	Savings Non-Quantifiable or Short-Lived	Savings Behavior-Dependent	Techno-logical/Market Maturity	Poor Utility Match	Poor Customer Acceptance	Environmental or Health Concerns	Continue to be Considered?
	Swimming pool covers	X[11]						No
Comm. Toilets	Commercial valve-type ULFT							Yes
	ULFT gravity-flow tank-type toilet							Yes
	ULFT pressurized tank-type toilet							Yes
	ULFT valve replacement							Yes
	Ultra-low flush urinals							Yes
	Urinal valve replacement							Yes
Comm. Faucets	Replace manual faucet (w/aerator)							Yes
	Pressure-closing faucet (w/aerator)							Yes
	Spring loaded faucet (w/aerator)							Yes
	Infra-red activated faucet (w/aerator)							Yes
	Ultrasonic activated (w/aerator)							Yes
	Ultrasonic device only							Yes
	Foot pedal operated faucet (w/aerator)							Yes
Comm. Misc.	Point-of-use water heaters				X[6]			No
	Recirculating hot water system devices		X[7]				X[8]	No
	Swimming pool covers	X[11]						No
	Water softeners - centralized regeneration				X[5]			No
	Water softeners - meter-controlled flushing				X[5]			No
Comm. Washers (including laundry and diaper service)	Horizontal Axis Laundry Machines							Yes
	Lower use vertical axis washer	X[4a]						No
	Batch washers	X[14a]						No
	Tunnel washers	X[14a]						No
	Ozonated washers			X[14]				No
	Rinse water reclamation						X[15]	No
Car Washes	Low volume car washes							Yes
	Recirculating car washes							Yes
Comm. HVAC	Air-cooled chillers							Yes
	Air-cooled unitary system							Yes
	Air-cooled pumps and compressors	X[14a]						No
	Ozonation of cooling tower water							Yes
	Improve O&M practices of water-cooled							Yes
Other Air-cooled Machines	Air cooled ice-makers							Yes
	Cold-water drinking fountain							Yes
	Medical equipment				X[17]			No
	Laboratory equipment				X[17]			No
Food handling	Water efficient dishwasher							Yes
	Chemical sanitizer dishwashers					X[18]		No
	Conveyor belt dishwashers					X[19]		No
	Ultra-sound dishwashers			X[14]				No
	Water-recycling dishwashers							Yes
	Warming tables with dry heat				X[20]			No
Food handling	Garbage disposers using recycled water	X[16]				X[21]		No

SANTA CRUZ LONG-TERM WATER CONSERVATION PLAN
QUALITATIVE SCREENING

		Qualitative Screening Criteria An 'X' indicates that the measure is eliminated; numbered notes below explain reason for elimination						
End-Use	**Conservation Measure**	**Savings Non-Quantifiable or Short-Lived**	**Savings Behavior-Dependent**	**Techno-logical/Market Maturity**	**Poor Utility Match**	**Poor Customer Acceptance**	**Environmental or Health Concerns**	**Continue to be Considered?**
	Garbage disposal - changes in practices		X[22]			X[21]		No
Heat exchangers	Closed loop	X[14a]						No
	Steam condensate heat exchanger	X[14a]						No
Industrial Misc.	Solenoid & other automatic control valves							Yes
	Improve industrial washers and rinsers							Yes
	High pressure/low volume spray nozzles							Yes
	HVAC measures (see above)							Yes
	Evaluate water recycling							Yes
	Waste stream separation & reclamation							Yes
	Operation and/or process modification							Yes
Large Landscapes Specifically: comm bldgs apartments institutional	Irrigation submeters							Yes
	Drip irrigation systems							Yes
	Bubbler/Soaker irrigation systems	X[11]						No
	Convert quick-coupler to automatic syst.							Yes
	Improve existing automatic sprinkler syst.							Yes
	Timers							Yes
	Soil sensors			X[14]				No
	Rain sensors							Yes
	Weather station/computer station hook-up							Yes
	Water efficient plant material							Yes
	Xeriscaping							Yes
	Turf reduction/Replacement							Yes
	Irrigation scheduling							Yes
	Soil preparation/mulching	X[11]						No
	All weather artificial recreation surfaces					X[23]		No
	Recirculating water feature				X[24]			No
	Stormwater storage reservoir & pump					X[25]		No
	Graywater systems						X[26]	No
Distribution system	Leak detection and repair							Yes
	Periodic valve servicing and adjustment				X[27]			No
	Periodic equipment servicing				X[27]			No
Number of initial measures:								116
Number of measures passing:								65

Screening Rationale

[1] Flow restrictors alter flow pattern and quality and so are not as well-accepted by customers as showerhead replacement.They are also easily removed.

[2] 1.6 GPF toilets are less expensive and more commercially available. In addition, one quart toilets do not have the demonstrated track record through large scale utility promotion.

[3] Short-lived. Better suited for short-term emergency water reduction.

SANTA CRUZ LONG-TERM WATER CONSERVATION PLAN
QUALITATIVE SCREENING

		Qualitative Screening Criteria An 'X' indicates that the measure is eliminated; numbered notes below explain reason for elimination						
End-Use	**Conservation Measure**	**Savings Non-Quantifiable or Short-Lived**	**Savings Behavior-Dependent**	**Techno-logical/Market Maturity**	**Poor Utility Match**	**Poor Customer Acceptance**	**Environmental or Health Concerns**	**Continue to be Considered?**

[4] Not well-suited to 3.5 GPF toilets so may result in poor performance and thus poor customer acceptance.
[4a] Most high volume vertical axis washers will have already been replaced with low volume; horizontal axis washers are a better measure.
[5] Not known how extensively water softeners are being used in Santa Cruz; therefore this measure is difficult to quantify.
[6] Point of use water heaters have limited capacity so may not deliver the volume of hot water demanded by the customer.
[7] Manual systems require that the customer use a switch to turn them on and thus depend on customer behavior.
[8] Systems that operate continuously waste energy.
[9] All customer accounts are already metered.
[10] Recommended for water utilities with leaks in excess of an acceptable level. Not true for the City of Santa Cruz.
[11] Savings are difficult to quantify accurately.
[12] The City of Santa Cruz already requires that hoses be equipped with nozzles for exterior washing as part of an ordinance prohibiting water waste.
[13] Studies have shown that homes with automatic sprinkler systems actually use more water than homes with manual irrigation systems.
[14] Technology has not been adequately tested for residential or commercial application. There are also few manufacturers.
[14a] Data not available to accurately quantify savings for this measure.
[15] Potential health concerns regarding water-borne pathogens.
[16] Savings and costs are site-specific and therefore cannot be accurately quantified for a larger population.
[17] Limited applicability because of low water use.
[18] May be perceived to be inadequate for cleaning. Also poses potential operational concerns due to handling of bleach.
[19] Conveyor belt dishwashers are not interchangeable with door-type washers. Their capacities differ.
[20] Limited applicability because water waste due to evaporation is minimal.
[21] Poor customer acceptance because of perceived higher labor cost in implementing measure.
[22] Changes in practices rely on human behavior by definition.
[23] All-weather artificial recreational surfaces may be aesthetically unacceptable.
[24] The City of Santa Cruz' water waste ordinance already requires landscape water features to be recirculating.
[25] Would require the construction of a large storage and pumping facility which may not be readily accepted by customers.
[26] The use of commercial graywater may pose health and safety concerns.
[27] Measure is not really a conservation measure, but rather an operation and maintenance issue.

ECONOMIC SCREENING RESULTS FOR INDOOR MEASURES

8% disc.
5% inflat.
$1,500/AF

End Use	Candidate Measure	Pass Qual Screen?	Pass Econ Screen?	Description (Base Case)	Incr. Cost (1997$)	Incr. Savings (GPD)	Av. Life (Years)	Lifetime Benefits (1997$)	B/C Ratio
PASSED BOTH SCREENS									
RESIDENTIAL									
Low-Flow Showerhead	Single family 1.7 gpm low-flow showerhead (retail price)	YES	YES	Early retire s.h. w/ 3.3 gpm observed flow	12.00	13	10	103	8.61
	Multifamily 1.7 gpm low-flow showerhead (retail price)	YES	YES	Early retire s.h. w/ 3.0 gpm observed flow	12.00	14	10	113	9.43
Ultra Low-Flow Showerhead	Single family: 1.3 gpm ULF showerhead (retail price)	YES	YES	Early retire s.h. w/ 3.3 gpm observed flow	12.00	16	10	129	10.76
	Multifamily: 1.3 gpm ULF showerhead (retail price)	YES	YES	Early retire s.h. w/ 3.0 gpm observed flow	12.00	19	10	148	12.34
Faucet Aerators	Single family: 1.7 gpm faucet aerator (retail price)	YES	YES	Install aerator on 3.2 gpm faucet	2.00	5	15	51	25.72
	Multifamily: 1.7 gpm faucet aerator (retail price)	YES	YES	Install aerator on 3.5 gpm faucet	2.00	8	15	83	41.62
Gravity Flow ULF Toilets (SF) (Assume 2 toilets per hh; cost incl. 2 hrs labor @ $40/hr)	ULFT gravity-flow tank type (1.6 GPF) (Comparison at retail price)	YES	YES	Early retire 3.5 GPF toilet - 1 toilet repl.	185.00	19	25	286	1.55
		YES	YES	Early retire 5.5 GPF toilet - 1 toilet repl.	185.00	24	25	358	1.93
		YES	YES	Early retire 3.5 GPF toilet - 2 toilet repl.	370.00	33	25	501	1.35
		YES	YES	Early retire 5.5 GPF toilet - 2 toilet repl.	370.00	41	25	626	1.69
Gravity Flow ULF Toilets (MF) (Assume 1.2 toilets per hh; cost incl. 2 hrs. labor @ $40/hr)	ULFT gravity-flow tank type (1.6 GPF) (Comparison at retail price)	YES	YES	Early retire 3.5 GPF toilet - 1 toilet repl.	185.00	31	25	475	2.57
		YES	YES	Early retire 5.5 GPF toilet - 1 toilet repl.	185.00	38	25	584	3.16
		YES	YES	Early retire 3.5 GPF toilet - 1.2 toilet repl.	222.00	36	25	540	2.43
		YES	YES	Early retire 5.5 GPF toilet - 1.2 toilet repl.	222.00	44	25	676	3.04
Pressurized Tank ULF Toilets (SF)	ULFT pressurized tank type (1.6 GPF) in single family	YES	YES	Early retire 5.5 GPF toilet - 1 toilet repl.	350.00	24	25	358	1.02
Pressurized Tank ULF Toilets (MF)	ULFT pressurized tank type (1.6 GPF) in multifamily	YES	YES	Early retire 3.5 GPF toilet - 1 toilet repl.	350.00	31	25	475	1.36
		YES	YES	Early retire 5.5 GPF toilet - 1 toilet repl.	350.00	38	25	584	1.67
		YES	YES	Early retire 3.5 GPF toilet - 1.2 toilet repl.	420.00	36	25	540	1.29
		YES	YES	Early retire 5.5 GPF toilet - 1.2 toilet repl.	420.00	44	25	676	1.61
Toilet Retrofit	Fill-cycle regulators - single family	YES	YES	Install regulator in 3.5 or 5.5 GPF toilet	0.10	4	10	28	276.04
	Fill-cycle regulators - multifamily	YES	YES	Install regulator in 3.5 or 5.5 GPF toilet	0.10	6	10	43	433.78
Toilet Leak Detection	(Assumes 1 hr. labor @ $40/hr)	YES	YES	Av. loss from leaking toilet	60.00	20	7	120	2.00
Horizontal Axis Clothes Washer	SF Residential (incl. 1/2 hr labor @ $40/hr)	YES	NO	Purchase new horiz instead of new vert.	450.00	12	12	106	0.24
	MF Residential (incl. 1/2 hr labor @ $40/hr)	YES	YES	New horiz instead of new vertical	450.00	56	12	506	1.12
Residential Dishwashers	Lower volume/optional cycle dishwashers	YES	YES	Purchase new low instead of med. vol.	5.00	1	7	7	1.48
Residential Miscellaneous	Unit submeters on new apartment buildings	YES	YES	50 unit building at $250/unit; 15% savings	12500.00	953	50	15922	1.27
	Unit submeters on existing buildings	YES	YES	50 unit building at $400/unit; 20% savings	20000.00	1490	50	24893	1.24
CI&I									
Commercial valve-type toilets (Assume 2 hrs labor @ $40/hr)	ULF valve-type toilet (1.6 GPF) (retail price + $80 installation cost)	YES	YES	Early retire 4.5 GPF valve-type toilet	290.00	58	25	883	3.04
		YES	YES	Early retire 3.5 GPF valve-type toilet	290.00	38	25	578	1.99
Commercial tank-type toilets (Assume 2 hrs labor @ $40/hr)	ULFT tank-type toilet (1.6 GPF) (retail price + $80 plumbing cost)	YES	YES	Early retire 5.5 GPF tank-type toilet	185.00	39	25	594	3.21
		YES	YES	Early retire 3.5 GPF tank-type toilet	185.00	19	25	289	1.56
	ULFT pressurized tank-type (1.6 GPF; retail + $80)	YES	YES	Early retire 5.5 GPF tank-type toilet	350.00	39	25	594	1.70
Commercial Toilet Valve Retrofit	Valve retro (incl. 0.5 hr @ $40/hr)	YES	YES	Retrofit 4.5 GPF to 3.5 GPF	30.00	20	10	158	5.26
Urninal Valve Retrofit	Valve retro (incl. 0.5 hr @ $40/hr)	YES	YES	Retrofit 1.5 GPF to 1.0 GPF	30.00	5	10	39	1.31
Commercial faucets	Manual low-flow faucet	YES	YES	Early retirement of 2.0 gpm faucet	110.00	12	15	127	1.16
	Same	YES	YES	Early retirement of 3.3 gpm faucet	110.00	22	15	235	2.14

ECONOMIC SCREENING RESULTS FOR INDOOR MEASURES

8% disc.
5% inflat.
$1,500/AF

End Use	Candidate Measure	Pass Qual Screen?	Pass Econ Screen?	Description (Base Case)	Incr. Cost (1997$)	Incr. Savings (GPD)	Av. Life (Years)	Lifetime Benefits (1997$)	B/C Ratio
	Pressure closing faucet	YES	YES	Early retirement of 3.3 gpm faucet	140.00	22	15	235	1.68
	Foot-pedal operated faucet	YES	YES	Early retirement of 3.3 gpm faucet	190.00	22	15	235	1.24
	Spring-loaded faucet (w/aerator)	YES	YES	Early retire 3.3 gpm faucet	190.00	22	15	235	1.24
Commercial Clothes Washing	Coin-operated front-loading machine	YES	YES	Purchase front-load instead of av. vertical	800.00	108	11	916	1.14
Commercial Dish Washing	Water recycling dishwasher (restaurants/institutions)	YES	YES	Purchase recyc. instead of standard new	300.00	105	10	828	2.76
	Same	YES	YES	Early retire 6.0 gal per load standard	2600.00	360	10	2839	1.09
Commercial HVAC measures	Purchase new air-cooled unitary system	YES	YES	Purchase new water-cooled unitary	4559.00	1849	20	24242.63	5.32
	Purchase new air-cooled chiller	YES	YES	Purchase new water-cooled chiller	1931.00	1849	20	24242.63	12.55
	Early retire. of single pass	YES	YES	Replace with water-cooled	23859.00	3512	15	37517.73	1.57
	Early retire. of single pass	YES	YES	Replace with air-cooled	25552.00	3699	15	39515.4	1.55
	Impr. O&M practices of water-cooled conden.	YES	YES	Continue with poor O&M practices	1.00	11880	20	155761.2	155761.19
	Ozonation of cooling tower water	YES	YES	Good O&M practices	10028.00	9558	20	125317	12.50
Commercial Miscellaneous	Air-cooled ice-makers - natural replacement	YES	YES	Water cooled, produce 465 lb ice	1.00	730	10	5757.447	5757.45
	Air-cooled ice-makers - early retire existing machine	YES	YES	Water cooled, produce 465 lb ice	2400.00	730	10	5757.447	2.40
	Air-cooled drinking fountains (16 gal/hr.) - nat'l repl.	YES	YES	Av. installed water-cooled fountains	100.00	960	15	10255.42	102.55
	Air-cooled drinking fountains (16 gal/hr.) - early retire	YES	YES	Av. installed water-cooled fountains	980.00	960	15	10255.42	10.46
OTHER									
System water use	Leak detection and repair - estim. save 2% system water	YES	YES	Conduct systematic detection and repair	55000.00	400000	5	1867286	33.95
MEASURES APPROPRIATE FOR SITE-SPECIFIC ANALYSIS THROUGH AUDITS									
Industrial Miscellaneous (Some commercial application as well)	HVAC measures (see above)	YES	N/A	Must be evaluated on a site-specific basis					
	Improve industrial washers and rinsers	YES	N/A	Must be evaluated on a site-specific basis					
	Install solenoid and automatic control valves	YES	N/A	Must be evaluated on a site-specific basis					
	Eval. water recycling	YES	N/A	Must be evaluated on a site-specific basis					
	Eval. waste stream separation	YES	N/A	Must be evaluated on a site-specific basis					
FAILED ECONOMIC SCREEN									
RESIDENTIAL									
Low-flow faucet	Single family: 1.7 gpm (retail price + $40 install)	YES	NO	Early retire 3.2 gpm observed flow	100.00	5	15	51	0.51
	Multifamily: 1.7 gpm (retail price + $40 install)	YES	NO	Early retire 3.5 gpm observed flow	105.00	8	15	83	0.79
Leaking Faucet	Install new seat, washer, cartridge	YES	NO	Install to correct 60 drips per minute	50.00	4	3	11	0.22
Pressurized Tank Toilet	ULFT pressurized tank type (1.6 GPF) in single family	YES	NO	Early retire 3.5 GPF toilet - 1 toilet repl.	350.00	19	25	286	0.82
	ULFT pressurized tank type (1.6 GPF) in single family	YES	NO	Early retire 3.5 GPF toilet - 2 toilet repl.	700.00	33	25	501	0.72
	ULFT pressurized tank type (1.6 GPF) in single family	YES	NO	Early retire 5.5 GPF toilet - 2 toilet repl.	700.00	41	25	626	0.89
Horizontal Axis Clothes Washer	SF Residential (incl. 1/2 hr labor @ $40/hr)	YES	NO	Early retire vertical axis	970.00	12	12	106	0.11
	MF Residential (incl. 1/2 hr labor @ $40/hr)	YES	NO	Early retire vertical axis	970.00	56	12	506	0.52
Residential Dishwashers	Lower volume/optional cycle dishwashers	YES	NO	Early retire high volume machine	475.00	2	7	13	0.03
	Same	YES	NO	Early retire medium volume machine	475.00	1	7	7	0.02

8% disc.

5% inflat.

$1,500/AF

ECONOMIC SCREENING RESULTS FOR INDOOR MEASURES

End Use	Candidate Measure	Pass Qual Screen?	Pass Econ Screen?	Description (Base Case)	Incr. Cost (1997$)	Incr. Savings (GPD)	Av. Life (Years)	Lifetime Benefits (1997$)	B/C Ratio
CI&I									
Commercial Toilets	ULF valve-type toilet (1.6 GPF)	YES	NO	Early retire 4.5 GPF valve-type toilet	910.00	58	25	883	0.97
	(retail price + $700 install)	YES	NO	Early retire 3.5 GPF valve-type toilet	910.00	38	25	578	0.64
Commercial Toilets	ULFT pressurized tank-type (1.6 GPF; retail + $80 install)	YES	NO	Early retire 3.5 GPF tank-type toilet	350.00	19	25	289	0.83
Urinals	ULF urinals (comparison at retail price)	YES	NO	Early retire 1.5 GPF	370.00	7	25	107	0.29
(Assume 3 hrs labor @ $40/hr)	ULF urinals (comparison at wholesale price)	YES	NO	Early retire 1.5 GPF	345.00	7	25	107	0.31
Commercial faucets	Pressure closing faucet	YES	NO	Early retire 2.0 gpm faucet	140.00	12	15	127	0.91
	Foot-pedal operated faucet	YES	NO	Early retire 2.0 gpm faucet	190.00	12	15	127	0.67
	Spring-loaded faucet (w/aerator)	YES	NO	Early retire 2.0 gpm faucet	190.00	12	15	128	0.67
	Ultrasonic activated faucet	YES	NO	Early retirement of 2.0 gpm faucet	250.00	12	15	128	0.51
	Ultrasonic activated faucet	YES	NO	Early retirement of 3.3 gpm faucet	250.00	22	15	235	0.94
	Infrared activated	YES	NO	Early retire 2.0 gpm faucet	300.00	12	15	127	0.42
	Infrared activated	YES	NO	Early retire 3.3 gpm faucet	300.00	22	15	235	0.78
Commercial Clothes Washing	Coin-operated front-loading machine	YES	NO	Early retire average vertical axis	1600.00	144	11	1221	0.76
Commercial Dish Washing	Water-efficient dishwashers (restaurants/instititions)	YES	NO	Early retire 6.0 gal per load	2300.00	255	10	2011	0.87
Car Washes	Recirculating car washes	YES	NO	Replace closed loop w/ open loop system	32500.00	4000	10	31548	0.97
FAILED QUALITATIVE SCREEN									
RESIDENTIAL									
Residential shower	Shower-flow restrictors	NO	N/A	Alter flow pattern so not as well-accepted; easily removed.					
Residential toilets	ULFT special < 1 gallon flush models	NO	N/A	1.6 GPF toilets less expensive, more commercially available.					
Toilet Retrofit Devices	Displacement bags	NO	N/A	Short-lived; not well-suited to 3.5 GPF toilets.					
	Displacement bottles	NO	N/A	Same as for toilet bags.					
	Displacement dams	NO	N/A	Same as for toilet bags.					
	Early closure flapper valve	NO	N/A	Same as for toilet bags.					
	Dual flush devices	NO	N/A	Same as for toilet bags.					
Residential Misc.	Repl. self-gener. water softeners	NO	N/A	Difficult to quantify; not known how prevalent in SCWD.					
	Point-of-use water heaters	NO	N/A	Limited capacity; may not deliver sufficient volume.					
	Recirculating hot water system dev	NO	N/A	Manual syst. depend on behavior; continual systems waste energy.					
	Metering all accounts	NO	N/A	All customer accounts are already metered.					
	Water pressure regulator	NO	N/A	Leaks not in excess in SCWD so not recommended.					
CI&I									
Commercial Misc.	Point-of-use water heaters	NO	N/A	Limited capacity; may not deliver sufficient volume.					
	Recirculating hot water system dev	NO	N/A	Manual syst. depend on behavior; continual systems waste energy.					
	Swimming pool covers	NO	N/A	Savings are difficult to quantify accurately.					
	Water softeners - centralized regeneration	NO	N/A	Difficult to quantify; not known how prevalent in SCWD.					
	Water softeners - meter-controlled flushing	NO	N/A	Same as above.					
Commercial Washers	Ozonated washers	NO	N/A	Technology not adequately tested; few manufacturers.					
	Rinse water reclamation	NO	N/A	Potential health concerns regarding water borne pathogens.					
	Batch washers	NO	N/A	Difficult to quantify; not known how prevalent in SCWD.					
	Tunnel washers	NO	N/A	Difficult to quantify; not known how prevalent in SCWD.					

8% disc.
5% inflat.
$1,500/AF

ECONOMIC SCREENING RESULTS FOR INDOOR MEASURES

End Use	Candidate Measure	Pass Qual Screen?	Pass Econ Screen?	Description (Base Case)	Incr. Cost (1997$)	Incr. Savings (GPD)	Av. Life (Years)	Lifetime Benefits (1997$)	B/C Ratio
Air-cooled machines	Medical equipment	NO	N/A	Limited applicability because of low water use.					
	Laboratory equipment	NO	N/A	Same as above.					
Dishwashing	Chemical sanitizer dishwashers	NO	N/A	May be perceived as inadequate for cleaning. Bleach handling prob.					
	Conveyor belt dishwashers	NO	N/A	Not interchangeable with door-type; capacities differ.					
	Ulta-sound dishwashers	NO	N/A	Not been adequately tested for commercial application.					
	Warming tables with dry heat	NO	N/A	Water waste due to evaporation is minimal.					
Food handling	Garbage disposers using recycled water	NO	N/A	Savings/cost site specific; cannot be quantified for larger population.					
	Garbage disposal - change in practices	NO	N/A	Same as above.					
Heat exchangers	Closed loop	NO	N/A	Same as above.					
	Steam condensate heat exchanger	NO	N/A	Same as above.					
Commercial HVAC measures	Steam condensate return system heat exch.	NO	N/A	Data N/A to characterize measure potential.					
	Air-cooled pumps and compressors	NO	N/A	Data N/A to characterize measure potential.					
Distribution system	Periodic valve servicing and adjustment	NO	N/A	Measure is O&M issue rather than conservation measure.					
	Periodic equipment servicing.	NO	N/A	Same as above.					

ECONOMIC SCREENING RESULTS FOR OUTDOOR MEASURES

8% disc.
5% inflat.
$1,500/AF

End Use	Pass Qual Scrn?	Pass Econ Scrn?	Candidate Measure	Description	Incr. Cost (1997$)	Incr. Savings (GPD)	Av. Life (Years)	Lifetime Benefits (1997$)	B/C Ratio
PASSED BOTH SCREENS									
Drip System vs. Sprinkler System	YES	YES	Mtls. & labor ($2,883 spr. vs $2,646 drip)	1,250 sq.ft. plantings/1,250 sq. ft. turf	1.00	4	15	55	55.44
INCREMENTAL COST	YES	YES	Mtls. & labor ($4,317 spr. vs $4,168 drip)	2,500 sq.ft. plantings/2,500 sq.ft. turf	1.00	10	15	124	123.97
Rainsensors	YES	YES	Mtls. only	2,500 sq.ft. landscaped area	25.00	11	10	99	3.95
(Install with automatic sprinkler;	YES	YES	Mtls. & Labor	Same	60.00	11	10	99	1.65
assumed to be hard-wired to	YES	YES	Mtls. only	5,000 sq.ft. landscaped area	25.00	24	10	221	8.83
controller)	YES	YES	Mtls. & Labor	Same	60.00	24	10	221	3.68
Water effic. lndscping vs. non-eff	YES	YES	Mtls. only	50/50 vs. 20/80 turf to plant ratio (2,500 sq.ft.)	152.00	36	20	577	3.80
INCREMENTAL COST	YES	YES	Mtls. & labor	Same	325.00	36	20	577	1.78
	YES	YES	Mtls. only	50/50 vs. 20/80 turf to plant ratio (5,000 sq.ft.)	346.00	81	20	1291	3.73
	YES	YES	Mtls. & labor	Same	302.00	81	20	1291	4.28
Eff. plants vs. non-eff.	YES	YES	Mtls. & labor (costs for efficient and	1,250 sq.ft. of plants	0.01	5	20	81	8083.97
INCREMENTAL COST	YES	YES	non-effic. plants are the same)	2,500 sq.ft of plants	0.01	11	20	181	18076.65
Turf replacement	YES	YES	Mtls. only (Note: no labor costs included)	750 sq.ft. turf relandscaped to plants	286.00	32	20	508	1.78
50/50 to 20/80 at FULL COST	YES	YES	Mtls. only (Note: no labor costs included)	1,500 square ft. turf relandscaped to plants	572.00	71	20	1136	1.99
Irrigation scheduling	YES	YES	Educational materials only	Any landscape size	1.00	7	1	9	9.46
Convert quick-coupler system	YES	YES	Mtls. & labor	Install autom. valves & controllers; one-acre site	5000.00	626	15	8034	1.61
Improve existing sprinkler system	YES	YES	Mtls. & labor	Upgrade to high effic. heads; 5,000 sq. ft. site	500.00	40	15	517	1.03
Computerized weather station	YES	YES	Minimum savings per site to pass	One site hookup	5000.00	500	20	8020	1.60
	YES	YES	Case Study: Aurora Colorado	One site hookup	10697.00	3665	20	58785	5.50
	YES	YES	Case Study: Vancouver, WA	One site hookup	6000.00	1300	20	20852	3.48
Irrigation Submeters	YES	YES	Install irrigation submeter	Install w/ backflow device on typcal bus. accnt.	500.00	1000	20	16040	32.08
FAILED ECONOMIC SCREEN									
New Drip Irrigation System:	YES	NO	Mtls. only	1,250 sq.ft. of plants	985.00	4	15	55	0.06
Drip System	YES	NO	Mtls. & labor	Same	772.00	5	15	67	0.09
	YES	NO	Mtls. only	2,500 sq.ft. of plants	815.00	10	15	124	0.15
	YES	NO	Mtls. & labor	Same	2072.00	24	15	308	0.15
Water-effic. plants replacing	YES	NO	Mtls. only	1,250 sq.ft. of plants	465.00	5	20	81	0.17
non-effic. plants (incl. $100 per	YES	NO	Mtls. & labor	Same	1247.00	5	20	81	0.06
500 sq.ft. for clearing) FULL COST	YES	NO	Mtls. only	2,500 sq.ft of plants	930.00	11	20	181	0.19
	YES	NO	Mtls. & labor	Same	3948.00	11	20	182	0.05
Turf replacement	YES	NO	Mtls. & labor	1,250 sq.ft. of plants	740.00	32	20	508	0.69
50/50 to 20/80 at FULL COST	YES	NO	Mtls. & labor	2,500 sq.ft of plants	1480.00	71	20	1136	0.77

ECONOMIC SCREENING RESULTS FOR OUTDOOR MEASURES

8% disc.
5% inflat.
$1,500/AF

End Use	Pass Qual Scrn?	Pass Econ Scrn?	Candidate Measure	Description	Incr. Cost (1997$)	Incr. Savings (GPD)	Av. Life (Years)	Lifetime Benefits (1997$)	B/C Ratio
Drip Irrigation System:	YES	NO	Mtls. only - timer included	1,250 sq.ft. of plants	320.00	4	10	39	0.12
Homeowner-installed	YES	NO	Mtls. only - no timer	Same	250.00	4	10	39	0.16
FULL COST	YES	NO	Mtls. only - timer included	2,500 sq.ft. of plants	570.00	10	10	88	0.15
	YES	NO	Mtls. only - no timer	Same	800.00	24	10	219	0.27
Residential gray water system	YES	NO	Low-tech syst/55 gal drum (incl. backflow)	Applic. through buried drip irrig - no leach field	950.00	39	20	626	0.66
	YES	NO	High-tech system	Applic. through buried drip or leach field	2500.00	114	20	1829	0.73

FAILED QUALITATIVE SCREEN

RESIDENTIAL MEASURES			Reason
Hose control nozzles	NO	N/A	Savings difficult to quantify accurately; already required by Santa Cruz.
Garden hose timers	NO	N/A	Savings difficult to quantify accurately.
Bubbler/soaker irrig. system	NO	N/A	Same as above.
Autom. sprinkler syst. (res only)	NO	N/A	Studies show homes w/ auto. systems use more water than homes w/ manual systems.
Soil sensors	NO	N/A	Technology has not been adequately tested.
Soil preparation/mulching	NO	N/A	Savings difficult to quantify accurately.
Rainwater collector/cistern	NO	N/A	Same as above.
Swimming pool covers	NO	N/A	Same as above.

COMMERCIAL MEASURES			Reason
Bubbler/soaker irrig. system	NO	N/A	Savings difficult to quantify accurately.
Soil sensors	NO	N/A	Technology has not been adequately tested.
Soil preparation/mulching	NO	N/A	Savings difficult to quantify accurately.
Artific. recreation surfaces (instit)	NO	N/A	All-weather recreational surfaces may be aesthetically unacceptable.
Recirculating water feature	NO	N/A	City of Santa Cruz water/wastewater ordinance already requires this.
Stormwater storage	NO	N/A	Size of reservoir required would be unmanageable
Grey water (C&I only)	NO	N/A	May pose health and safety concerns.
Soil polymer (res, C&I))	NO	N/A	Technology has not been proven effective in the field.
Subsurface turf irrigation	NO	N/A	Technology has not been proven effective in the field.

APPENDIX B

PAIRING OF MEASURES WITH DELIVERY MECHANISMS AND FORMULATION OF PROGRAM CONCEPTS

PAIRING OF MEASURES WITH DELIVERY MECHANISMS AND FORMULATION OF PROGRAM CONCEPTS

MEASURE PASSING BOTH SCREENS	DELIVERY MECHANISMS SELECTED	DELIVERY MECHANISMS NOT SELECTED AND WHY	PROGRAM CONCEPTS FOR COST-EFFECTIVENESS SCREENING
RESIDENTIAL INDOOR MEASURES			
1. Low-flow showerheads and ultra low-flow showerheads **2. Faucet aerators** **3. Fill cycle regulators** **4. Toilet leak detection and repair**	Product giveaway Audit/technical assistance Direct installation Regulation	Financial incentives: measures are sufficiently inexpensive that other delivery options would be more appropriate and effective	We combined the four measures listed (showerheads, faucet aerators, fill cycle regulators, toilet leak detection and repair), and the delivery options to form the following program concepts: Conservation Kit Distribution: Targets both single and multifamily customers. Residential Indoor Water Use Review and Measure Installation: (Note: this program would be combined with outdoor water review – see outdoor programs below.) Targets the top 20% of single and multifamily water users. Would include other elements such as meter testing, adjustment of toilet tank arms, etc. Plumbing Fixtures – Time of Resale Regulation: Requires retrofit of showerheads and faucets, and replacement of toilets when single-family homes and multifamily complexes are sold. (NOTE: Program includes measure #5, low-flow toilets, from next page)
			Cont.

MEASURE PASSING BOTH SCREENS	DELIVERY MECHANISMS SELECTED	DELIVERY MECHANISMS NOT SELECTED AND WHY	PROGRAM CONCEPTS FOR COST-EFFECTIVENESS SCREENING
5. Ultra low-flush toilets (ULFTs): Gravity flow tank-type ***(NOTE: ULFTs also included in time of resale regulation)***	Financial incentives	Audit/technical assistance: toilet replacement too costly and cumbersome Product giveaway: too many models to stock feasibly Direct install: Dept. has concerns about liability if do installation Regulation: Regulation at time of resale program covers this.	Residential ULFT Rebate: Financial incentives for the replacement of inefficient toilets.
6. Single and multifamily horizontal-axis clotheswashers (new construction/ natural replacement)	Financial incentives	Audit/technical assistance: measure too costly and cumbersome Product giveaway: too many models to stock feasibly Direct install: Not a practical delivery mechanism for this measure Regulation: politically infeasible due to involvement of leasing companies; customer preference and perception issues; and cost	Single and Multifamily Horizontal Axis Washing Machine Rebate: Financial incentives for the replacement of vertical axis washers with horizontal axis washers at time of equipment failure.

Cont.

MEASURE PASSING BOTH SCREENS	DELIVERY MECHANISMS SELECTED	DELIVERY MECHANISMS NOT SELECTED AND WHY	PROGRAM CONCEPTS FOR COST-EFFECTIVENESS SCREENING
7. Individual multifamily unit submeters: Retrofit existing buildings	Financial incentives	Audit/technical assistance: measure too costly and cumbersome to deliver separately. Could be included as part of an audit. Product giveaway: inappropriate mechanism for this measure Direct install: Not a practical delivery mechanism for this measure Regulation: politically infeasible due to cost	Submeter Rebate for Existing Apartment Buildings: Targets top 20% of multifamily customers which have about 21 units per building on average.
8. Low-volume dishwashers (new construction/natural replacement)	None selected. Even though passed the economic screen, savings are negligible, and given lifetime benefits of only $7, a cost-effective program cannot be developed.	N/A	N/A
9. Individual multifamily unit submeters (assume 50 units): Install at time of construction	None selected. Programs for this conservation plan address existing buildings and stock rather than new construction.	N/A	N/A
			Cont.

MEASURE PASSING BOTH SCREENS	DELIVERY MECHANISMS SELECTED	DELIVERY MECHANISMS NOT SELECTED AND WHY	PROGRAM CONCEPTS FOR COST-EFFECTIVENESS SCREENING
RESIDENTIAL OUTDOOR CONSERVATION MEASURES			
1. Irrigation equipment testing, scheduling, and homeowner education **2. Combined drip/sprinkler system instead of all-sprinkler in new installation** **3. Improve existing sprinkler system**	Measure 1: Audit/technical assistance Measures 2 and 3: Financial incentives	Measure 1: Financial incentives, product giveaway, and regulation do not make sense for this measure. Measures 2 and 3: Product giveaway: inappropriate Direct installation: impractical Regulation: politically infeasible.	Residential Outdoor Water Use Review: (Note: this program is combined with indoor review and measure installation – see indoor programs above.) Targets the top 20% of single and multifamily water users. Participants will also be offered an incentive for outdoor irrigation equipment replacement and upgrades.
COMMERCIAL/INDUSTRIAL/INSTITUTIONAL INDOOR MEASURES			
1. Toilets: Valve-type and gravity flow tank-type	Financial incentives	Audit/technical assistance: measure too cumbersome and costly to handle through an audit; auditor will refer customer to rebate program for replacement Product giveaway: measure too costly Direct install: Dept. has concerns about liability Regulation: politically unfeasible	Commercial ULFT Rebate: Financial incentives for the replacement of inefficient toilets.

Cont.

MEASURE PASSING BOTH SCREENS	DELIVERY MECHANISMS SELECTED	DELIVERY MECHANISMS NOT SELECTED AND WHY	PROGRAM CONCEPTS FOR COST-EFFECTIVENESS SCREENING
2. Toilet valve retrofit **3. ULF urinal valve retrofit** **4. Faucet aerators**	Audit/technical assistance Direct installation	Product giveaway: better handled through combined audit/direct install program Regulation: better handled through combined audit/direct install program. Financial incentives: inexpensive so Dept. can provide free of charge through a program.	These measures would be installed free of charge during the water use review.
5. Horizontal-axis clothes-washer for commercial coin-operated application **6. Commercial dishwashers** **7. Air-cooled drinking fountains** **8. Air-cooled icemakers** **9. HVAC equipment** **10. Improved HVAC O&M Practices**	Audit/technical assistance Financial incentives	Product giveaway: measures too expensive Direct install: not practical Regulation: politically infeasible because of variations in equipment and customer preference and perceptions	An average rebate of $1,000 would be provided for the customer to use for any of these measures identified inefficient through the water use review.[32]
			Cont.

[32] Note: Individual rebate programs were not built around measures 2 through 10 listed above for the commercial market. There are two reasons for this: 1) savings are sufficiently site specific it is better to roll the rebates in with a water use review and make some general, yet conservative, assumptions about estimated water savings (i.e., an overall percent savings estimate); 2) because a formal baseline study was not conducted for the area, we lack specific data equipment types and numbers.

MEASURE PASSING BOTH SCREENS	DELIVERY MECHANISMS SELECTED	DELIVERY MECHANISMS NOT SELECTED AND WHY	PROGRAM CONCEPTS FOR COST-EFFECTIVENESS SCREENING
NON-RESIDENTIAL OUTDOOR CONSERVATION MEASURES			
1. Irrigation equipment testing, and scheduling, and personnel training **2. Combined drip/sprinkler system instead of all-sprinkler in new installation** **3. Improve existing sprinkler system or convert quick coupler system to automated system**	Measure 1: Audit/technical assistance Measures 2 and 3: Financial incentives	Measure 1: The other delivery mechanisms do not make sense for this measure. Measures 2 and 3: Product giveaway: impractical Direct installation: impractical Regulation: cumbersome and impractical given expense and variations in equipment	Large Landscape Water Use Review: Targets dedicated residential and business irrigation accounts, and golf courses. Parks Water Use Review and System Upgrade Program: Targets city and county parks to conduct water use reviews and provide incentives for the replacement of aging irrigation equipment.

APPENDIX C

DETAILED CONSERVATION PROGRAM ASSUMPTIONS

PROGRAM DETAILS

Program Name: Residential Conservation Kit Distribution

Program Years: 1 year

Program Type: Distribution of conservation kits via direct canvassing:
* Leak detection tablets
* Fill cycle regulator
* Faucet aerators
* Low-flow showerheads

Savings Per Participant:	GPD for av. res. cust.	GPD Saved	Gal/yr Saved
Single Family	218	10	3,650
Multifamily average per unit	154	5	1,825

Cost to Customer: $0.00 because measures paid for by City

Fixed Yearly Costs:				Single	Multi	
	Staffing:	2.5/40 FTE for program management	$3,750.00	$1,875.00	$1,875.00	
		6.67/40 FTE for program administration	$6,336.50	$3,168.25	$3,168.25	
		Development cost for door hangers	$750.00	$375.00	$375.00	(Note: hanger printing and
		Media and other advertising	$10,000.00	$5,000.00	$5,000.00	distribution a variable cost)
		TOTAL	$20,836.50	$10,418.25	$10,418.25	

Variable Costs:	
Kit cost	$10.00
Cost per kit to deliver	$1.00

Physical Life: 10 years

Number of Participants:	**1999**
Single Family Households	17,328
	100%
Number of kits distributed	17,328
Assume of those, 25% installed	4,332
Multifamily Households (assume 6/accnt.)	15,240
	75%
Number of kits distributed	11,430
Assume of those, 15% installed by residents	1,715
Max. Summer Savings	11.1 MG
Max. Winter Savings	7.8 MG
TOTAL	18.9 MG

PROGRAM DETAILS

Program Name: Residential Indoor and Outdoor Water Use Review

(NOTE: Rereview costs are accounted for by the fact that max penetration is reached after 3 years and then the audit cycle begins again.)

Program Years: Ongoing - see details below

Program Type: Indoor and Outdoor Water Use Review for Top 20% of Residential Customers

Savings per Participant Based on the Following Calculations and Assumptions:

SINGLE FAMILY - TOP 20% 410 average daily usage over entire year, indoor and outdoor combined

	% Allocation Indoor vs. Outdoor*	Average Gallons Per Day**	% Saved	Gallons Saved per Day	Yearly Savings (214 days outdoor; 365 days indoor)
Indoor Use	70%	287	8%	23	8,380
Outdoor Use	30%	210	8%	17	3,592
				TOTAL	11,972

*Based on Task 3 Analysis

**Note: we assume all outdoor use occurs during the period of April - October, so average outdoor gallons per day is 410 gallons x 30% x 365 days / 214 days = 210 average daily summer outdoor use.
Indoor use, on the other hand, occurs throughout the year, so average indoor use is simply 410 gallons x 70% = 287

MULTIFAMILY - TOP 20% 3,210 average daily usage over entire year, indoor and outdoor combined

	% Allocation Indoor vs. Outdoor*	Average Gallons Per Day**	% Saved	Gallons Saved per Day	Yearly Savings (214 days outdoor; 365 days indoor)
Indoor Use	80%	2568	8%	205.44	74,986
Outdoor Use	20%	1095	8%	87.60	18,746
Total				TOTAL	93,732

*Based on Task 3 Analysis

**Note: we assume all outdoor use occurs during the period of April - October, so average outdoor gallons per day is 3,210 gallons x 20% x 365 days / 214 days = 1,095 average daily summer outdoor use.
Indoor use, on the other hand, occurs throughout the year, so average indoor use during the 214 day period is simply 3,210 gallons x 70% = 2,568

Cost to Customer:

$0.00 for measures paid by City
$300 per customer net of rebate for those who participate in the irrigation equipment rebate portion (rebate assumed to cover 50% of cost)

				Single	Multi
Fixed Yearly Costs:	Staffing:	1/8 FTE for program management	$7,500.00	5250	$2,250.00
		1/3 FTE for program admin.	$12,666.67	$8,866.67	$3,800.00
	Marketing	Ad. Broch. Print & mail ($1 each; 2x/yr)	$7,922.00	6733.7	$1,188.30
		Ed. Broch. Design, print for distrib.	$223.00	$189.55	$33.45
		TOTAL	$28,311.67	$21,039.92	$7,271.75

Variable Costs:

Review Cost:	$120 per review for initial review; $60 per review for follow-up reviews
Per customer marketing:	$10 per customer for follow-up calls and more intensive marketing to multifamily customers
Incentive:	$300 per customer for irrigation system retrofit or upgrade. 5% of those reviewed

are assumed to take advantage of the rebate.

Physical Life: 7 years (Savings last 7 years because of measures installed, but customers are re-reviewed every 3 years to make sure measures are still in place and functioning properly.)

Number of Participants: Note: Numbers below show six years of the program to illustrate how participation grows and peaks in year 2003. Participation is Participation is assumed to be maintained at 20% per year through end of program for single family and 30% through the end of the year for multifamily.

	1999	2000	2001	2002	2003	
Total Customers - Single Family Top 20%	3,452	3,452	3,452	3,452	3,452	
% Reviewed	5%	10%	10%	15%	20%	**Total**
Number Reviewed	173	345	345	518	690	2,071
50% of those reviewed yield the expected savings	50%	50%	50%	50%	50%	
Number yielding savings	86	173	173	259	345	1,036

	1999	2000	2001	2002	2003	
Total Customers - Multifamily Top 20%	504	504	504	504	504	
Percent Reviewed	10%	15%	15%	25%	25%	**Total**
Number Reviewed	50	76	76	126	126	454
50% of those reviewed yield the expected savings	50%	50%	50%	50%	50%	
Number yielding savings	25	38	38	63	63	227

Max. Summer Savings	23.0 MG
Max. Winter Savings	10.6 MG
TOTAL	33.6 MG

PROGRAM DETAILS

Program Name: Residential ULFT Rebate

Program Years: 1999-2008

Savings Per Toilet Replaced:

SF GPD Saved	Gal/yr	
20.5	7,483	(Savings based on Santa Cruz Water Department's existing toilet rebate program)

MF GPD Saved	Gal/yr
22.5	8,213

Cost to Participant Per Toilet Net of Rebate: $65.00 Total cost is estimated to be $140 ($100 plus $40 installation costs

Incentive Level: (per toilet) $75.00

Fixed Yearly Costs:

		Single	Multi
1/10 FTE for program mgt	$ 6,000	0	$ 6,000
3/8 FTE for program admin	$ 14,250	0	$ 14,250
Bill stuffers ($0.10 print & send - send 2/yr)	$ 3,933	3430.1905	$ 503
Media advertising	$ 5,000	2660.28	$ 2,340
Direct marketing to MF ($2/accnt)	$ 5,080		5080
In-store displays (6 @ $300 each)	$ 1,800	957.70081	$ 842
TOTAL	$ 36,063	$ 7,048	$ 29,015

Variable Costs: (per toilet) $15.00 for post-installation inspection

Physical Life: (years) 25

Number of Participants:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	**TOTAL TOILETS**
SF Accounts (assume 1 hh/account)	17,328	17,328	17,328	17,328	17,328	17,328	17,328	17,328	17,328	17,328	
% participation	5%	5%	5%	5%	5%	5%	5%	3%	3%	2%	
Toilets replaced	866	866	866	866	866	866	866	520	520	347	**7,449** Total incl. Freeriders
Non-freeriders	606	606	606	606	606	606	606	364	364	243	**5,214** Total w/o free riders
MF Accounts	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	
Households per account	6	6	6	6	6	6	6	6	6	6	
Total Households	15,240	15,240	15,240	15,240	15,240	15,240	15,240	15,240	15,240	15,240	
% Participation (assume 1 toilet replaced per household)	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%	
Toilets replaced	305	305	305	305	305	305	305	152	152	152	**2,591** Total incl. Freeriders
Non-freeriders	214	214	214	214	214	214	214	106	106	106	**1,814** Total w/o free riders

Max. Summer Savings 27.8 MG (max annual accounts for 30% free riders)
Max. Winter Savings 19.6 MG
47.5 MG

PROGRAM DETAILS

Program Name: Retrofit at time of resale

Program Years: 10 years starting in the year 1999

Savings Per Home Retrofitted Assumes toilets and showerheads are replaced at time of resale. No assumptions made about faucet savings.

	GPD Saved	Gal/yr saved
SF	43.00	15,695
MF	48.00 (2 units)	17,520

Cost to Customer: (per accnt.):

$ 400.00 SF (assumes 2 toilets replaced x $185 per toilet + $30 for showerheads)

$ 500.00 MF (assumes 2 units per account because smaller buildings more likely to sell, and $250 per unit because of fewer fixtures and economies of scale)

Fixed Yearly Costs:

1/2 FTE for program management		$30,000.00
1 FTE for program admin.		$38,000.00
	TOTAL	$68,000.00

Variable Costs: (per property) $50.00 for notification, inspection, and tracking

Physical Life: (years) 20 years (weighted average of lifetimes [weighted both by savings and relative number of SF versus MF participants])

Percent Turnover Each Year:

SF: Assume annual resale of 4%

MF: Assume annual resale of 4% and that those turning over average 2 units per account as condominiums and duplexes more likely to sell

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
SF Accounts	17,328	17,328	17,328	17,328	17,328	17,328	17,328	17,328	17,328	17,328	
% resale	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	**Total by 2008**
Homes retrofitted	693	693	693	693	693	693	693	693	693	693	6,930 homes
MF Accounts	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	2,540	
% resale	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	**Total by 2008**
Buildings retrofitted	102	102	102	102	102	102	102	102	102	102	1,020

Max. Summer Savings	66.4 MG
Max. Winter Savings	46.9 MG
	113.3 MG

PROGRAM DETAILS

Program Name: Submeter Rebate for Existing Apartments

Program Years: 1999-2009 (NOTE: May want to extend program length)

Program Type: Rebate program targeting top 20% of customers estimated to have average of 21 apartment units per building (3,210 gallons/149 gal/hh/day)

				21.5		
Savings Per Participant:		Top 20% GPD	% Saved	GPD Saved	Gal/Yr	
	Multifamily	3,210.00	8%	256.80	93,732.00	
Cost to Customer:	Submeters net of rebate	$ 4,725	Full cost is $300 per unit x 21 units or $6,300			
		$ 63	for meter reading and billing ($3 per unit x 21 units)			
Incentive Level (per customer):		$ 1,575	(25% of cost for 21 unit building)			
Variable Costs: (per building)		$ 50	marketing			
		$ 50	post-installation inspection			
Fixed Yearly Costs:	Staffing:	1/20 FTE for program management		$3,000.00		
		1/8 FTE for program admin		$4,750.00	$7,750.00	
	Marketing	Ad. Broch. Print & mail ($1 each)		$504.00		
		Direct marketing (see var. cost above)				
		TOTAL		$8,254.00		
Physical Life:		50 years				

Number of Participants:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Multifamily Top 20%	504	504	504	504	504	504	504	504	504	504	
0.5% participate each year	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	**Total**
Number participants	3	3	3	3	3	3	3	3	3	3	30

Max. Summer Savings	1.6 MG
Max. Winter Savings	1.2 MG
TOTAL	2.8 MG

PROGRAM DETAILS

Program Name:		Single and Multifamily Horizontal Axis Washer Rebate Program									
Program Years:		1999-2008									
Program Type:		Incentive program targeting residential customers									
Savings per Machine Replaced:		Gal/yr Saved 5,100									
Incremental Cost to Customer Net of Rebate:		$ 250.00 Full cost difference assumed to be $400									
Incentive Level (per machine):		$ 50.00 water utility rebate $ 100.00 PG&E rebate									
Fixed Yearly Costs:	Staffing:	2 hours per week for administration $2,000.00 1 hour per week for management $1,500.00 Marketing $2,500.00 TOTAL $6,000.00									
Physical Life:		14 years									
Participation	**Assumes a gradual increase in participation leveling off at 500 units per year**	1999 300	2000 350	2001 400	2002 450	2003 500	2004 500	2005 500	2006 500	2007 500	2008 500

Max. Summer Savings	13.4 MG
Max. Winter Savings	9.5 MG
TOTAL	22.9 MG

PROGRAM DETAILS

Program Name: Commercial ULFT Rebate (replacing either tank-type or valve-type)

Program Years: 1999-2008

Program Type: Indoor program targeting businesses and UC Santa Cruz

Savings/Toilet Replaced:

Gal/Day Saved	Gal/yr	
31.8	11,607	Note: Savings are from Technology Profile #C1 for replacing a 3.5 gpf toilet (to err on conservative side)

Customer Cost Net of Rebate: $ 210.00 Assume 2/3 tank and 1/3 valve for weighted average cost of $250 plus $80 for installation for a total cost of $330 before rebate.

Customer Incentive: $ 120.00 Assume 2/3 tank-type receiving a $140 rebate and 1/3 valve-type receiving a $75 rebate for weighted average rebate of about $120 (used for purposes of cost-effectiveness analysis)

Cost of Inspection: $ 25.00

Fixed Yearly Program Costs:

1/10 FTE for program management	$6,000.00	
1/4 FTE for program admin.	$9,500.00	$15,500.00
Advertising Brochures ($1 each to print & mail)	$2,139.00	
Advertising Brochure Development	$500.00	
Media advertising	$10,000.00	
Marketing to Trade Allies & Associations	$5,000.00	$17,639.00
TOTAL	$33,139.00	

Physical Life of Measure(s): 25 years

Participation Estimates:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	TOTAL	
Total Accnts (Bus + Ind + Munic.):	2,139	2,139	2,139	2,139	2,139	2,139	2,139	2,139	2,139	2,139		
Estimated # Toilets (assume 3/accnt. average):	5,454	5,454	5,454	5,454	5,454	5,454	5,454	5,454	5,454	5,454		
% Participation Each Year:	1%	1%	2%	2%	2%	2%	2%	4%	4%	4%		
Toilets replaced each year:	55	55	82	82	82	82	82	191	199	218	1,126	Total incl. Freeriders
Non-freeriders	44	44	65	65	65	65	65	153	159	175	901	Total w/o free riders
UC Santa Cruz Residental Apartments - assume 1 toilet each	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000		
% Participation Each Year:	4%	4%	4%	6%	6%	6%	6%	9%	9%	9%		
Toilets replaced each year:	40	40	40	60	60	60	60	85	90	90	625	Total incl. Freeriders
Non-freeriders	32	32	32	48	48	48	48	68	72	72	500	Total w/o free riders
TOTAL	76	76	97	113	113	113	113	221	231	247	1,401	

Max. Summer Savings	8.8 MG
Max. Winter Savings	6.2 MG
TOTAL	15.0 MG

PROGRAM DETAILS

Program Name: Commercial Indoor Water Use Review, Measure Installation, and Rebates

Program Years: Ongoing - see below

Program Type: Indoor program targeting top 20% of commercial customers

Savings per Participant:

	Average Consumption - Top 20%	% Saved	GPD Saved	Gal/yr
Business	3975	10%	398	145,088
UCSC	Non-sanitary water use 125,000	5%	6,250	2,281,250

Fixed Yearly Costs:

			Business	UCSC
Staffing:	1/8 FTE for program management	$7,500.00	2250	$5,250.00
	0.3 FTE for program admin.	$11,400.00	7980	$3,420.00
Marketing:	Ad. Brochures print and mail	$366.00	$366.00	
	Per customer $20	$7,320.00	$7,320.00	
	TOTAL	$26,586.00	$17,916.00	$8,670.00

Variable Cost:

Business review cost	$300	first review	$150 subsequent reviews
UCSC review	$10,000	first review	$2,000 subsequent reviews
Bus. Marketing:	$40	per account (marketing costs for UCSC embeded in management costs)	

Cost to Customer Net of Rebate:

Businesses:	$2,500	Total cost to customer assumed to be $5,000 on average before rebate.
UCSC:	$12,500	Total cost to customer assumed to be $25,000 on average before rebate.

Incentive: $ 2,500.00 Sm. Bus. Towards purchase of equipment appropriate to facility
12,500 UCSC

Physical Life: 10 years

Number of Participants: Assume 25% reviewed each year to maximum of 75% total customer class.
Review cycle begins again in year 4 and continues into the future.

	1999	2000	2001	2002	2003	
Top 20% of Commercial	366	366	366	366	366	**NOTE: Program conti**
Reviews Ramp up to 75% total after 3 years:	5%	10%	15%	20%	25%	**2008 with reaudits eve**
Number Reviewed	18	37	55	73	92	**Total savings reached after 3**
75% of those reviewed take action	75%	75%	75%	75%	75%	275
Number Taking Action	14	27	41	55	69	**Total**
						206

Max. Annual Water Savings (MG)*:

Max. Summer	18.9 MG
Max. Winter	13.3 MG
	32.2 MG

PROGRAM DETAILS

Program Name: Large Landscape Water Use Review

Program Years: Ongoing - see below

Program Type: Outdoor program targeting business irrigation accounts
(resid. Covered through res audit)

Savings Per Participant:

	Av. Outdr Use	% Savings	GPD Saved	Savings Over Peak Season (April-October 214 days)
Business irrig.	904	15%	136	29,104
Golf courses	250000	5%	12,500	2,675,000
Residential irrig.	794	15%	119	25,466

(NOTE: Golf course savings lower as have already instituted many changes)

Cost to Customer: $600 average for residential; $1,500 average for business; $4,000 average for golf courses.

Fixed Yearly Costs:

				Business	Res.	Golf
Staffing:	1/10 FTE for program management		$6,000.00	4,560	1,320	120
	0.15 FTE for program admin		$5,700.00	4,332	1,254	114
Marketing:	Ad brochures	Print and mail	$168.00	90	77	1.07
		Direct marketing $20/cust.	$3,360.00	1,798	1,541	21.40
		TOTAL	$15,228.00	$10,779.59	$4,191.94	$256.47

Variable Cost: Audit cost: First review: Residential - $200; Business - $300; Golf courses - $5,000
Follow-up: Residential - $100; Business - $150; Golf courses - $1,000

Incentives: Financial incentives: equal to 50% of customer costs

Physical Life: 7 years

Number of Participants: Assume 25% audited each year to maximum of 75% total customer class.
Audit cycle begins again in year 4 and continues into the future.

	1999	2000	2001	2002	2003	
Business Irrig. Cust.	168	168	168	168	168	**NOTE: Program continues through**
25% Audited Each Yr. Up to Max 75%	5%	10%	15%	20%	25%	**Total 2008 with reaudits every 3 yrs. but max**
Number Audited	8	17	25	34	42	126 **savings reached after 3 years.**
50% of those audited take action	50%	50%	50%	50%	50%	**Total**
Number Taking Action	4	8	13	17	21	63

	1999	2000	2001	2002	2001
Golf Course Irrig. Customers					
Both customers audited	2			**Total**	
Assume both yield savings	2			2	

	1999	2000	2001	2002	2003	
Residential Irrig. Customers	144	144	144	144	144	
25% Audited Each Yr. Up to Max 75%	5%	10%	15%	20%	25%	**Total**
Number Audited	7	14	22	29	36	108
50% of those audited take action	50%	50%	50%	50%	50%	**Total**
Number Taking Action	4	7	11	14	18	54

Max. Summer Savings 10.2 MG

PROGRAM DETAILS

Program Name: Parks Water Use Review and System Upgrade

Program Years: Ongoing - see below

Program Type: Program targeting city and county parks.

Savings Per Participant: (for all parks)

Park Type:	Gallons/yr	% Savings	Gallons Saved per Year
City Parks	36,000,000	15%	5,400,000
County	7,000,000	15%	1,050,000

Note: Savings estimates for system conversion or improvements is 25% in technology profiles. However, we assume a more conservative 15% as the condition of the parks' systems likely varies.

Average Cost to Each Park Net of Rebate: $10,000 $15,000 average total cost assumes major system overhaul on some, not on others

Incentive: $5,000 per park

Fixed Yearly Costs:

			County	City
Staffing:	1/40 FTE for program management	$1,500.00	333	1,166.67
	3/40 FTE for program admin	$2,850.00	633	2,216.67
	TOTAL	$4,350.00	$966.67	$3,383.33

Variable Cost:

Initial audit cost:	$	2,500
Follow-up audits:	$	500

Physical Life: 15 years

Number of Participants: Assume all parks are audited.

Max. Summer Water Savings (MG)*: 6.4 MG

*This is the highest savings that the program will achieve for all participants from all program years.

APPENDIX D

CONEAST MODEL DESCRIPTION

CONEAST MODEL DESCRIPTION

ConEAST is an easy-to-use MS Excel® spreadsheet that quickly estimates key water savings, cost, and economic benefit parameters associated with conservation programs. The model is designed to provide conservation professionals and financial managers with a common understanding of the economic and financial impacts of conservation on the utility and its ratepayers.

Users are asked to characterize each conservation program on a simple input sheet (see attached sample). Users provide:

- Annual participation rates and free ridership
- Seasonal per-participant daily water savings
- Expected savings duration
- Expected natural fixture turnover rate, if any
- Utility fixed annual and variable unit administrative costs
- Utility incentive payments to customers, if any
- Customer out-of-pocket costs, if any

Users must also specify a few basic economic parameters, including:

- Real discount rate
- Period over which to levelize costs and savings
- Marginal seasonal water rates
- Marginal sewerage rate

Based on these descriptors, the *ConEAST* model immediately computes an output sheet (see attached sample), which presents the following results:[33]

- Seasonal and annual water savings due to the program, expressed in mg and mgd.
- Adjusted winter savings to reflect value of those savings, expressed in mg and mgd.

---

[33] In addition to yearly values over the planning period, levelized values are also presented for all savings and cost outputs.

- Naturally-occurring conservation, expressed in mg and mgd.
- Annual utility and customer costs over the planning period.
- Customer annual water bill savings over the planning period. The water bill savings are also utility revenue losses.
- The simple payback period to the customer of any out-of-pocket expenditures.
- Scaled utility and societal unit costs, expressed in $/mgd. These are appropriate for comparison to supply options.

Figure D - 1
SAMPLE CONEAST INPUT SHEET (PARTIAL)

City of Santa Cruz Water Department
Conservation Economic
Analysis and Screening Tool
Program Inputs

Program Name:	SF ULFT Rebate								
Year		1999	2000	2001	2002	2003	2004	2005	2006
Gross Participants		866	866	866	866	866	866	866	520
Freeriders		260	260	260	260	260	260	260	156
Net Participants		606	606	606	606	606	606	606	364
Water Savings: (gpd per participant)									
Summer	20.50								
Winter	20.50								
Savings Life (yrs):	25								
Annual Natural Turnover Rate (%)	2.5								
Variable Utility Costs (Initial): ($ per participant)									
Administration	$15.00								
Incentive	$75.00								
Variable Utility Costs (Ongoing):									
Administration ($ per participant)	$0.00								
Interval (years)	0								
Fixed Annual Utility Administration Costs: ($ per year)	$49,813.00								
Variable Customer Costs: Net of Utility Incentive ($ per participant)	$65.00								

Figure D - 2
SAMPLE CONEAST OUTPUT SHEET (PARTIAL)

City of Santa Cruz Water Department
Conservation Economic
Analysis and Screening Tool
Program Annual Savings and Costs
and Unit Costs

Program Name: SF ULFT Rebate

Year	Levelized Annual	1999	2000	2001	2002	2003	2004	2005	2006
WATER SAVINGS (gallons)									
Programmatic									
Summer(April-October)	14,149,217	2,658,522	5,250,581	7,777,838	10,241,914	12,644,389	14,986,801	17,270,653	18,435,755
Unadjusted Winter (Nov-March)	9,983,793	1,875,873	3,704,849	5,488,101	7,226,771	8,921,975	10,574,799	12,186,302	13,008,406
UNADJUSTED ANNUAL	24,133,010	4,534,395	8,955,430	13,265,939	17,468,686	21,566,364	25,561,600	29,456,955	31,444,161
Adjusted Winter	2,389,903	194,421	430,468	706,528	1,021,040	1,372,497	1,759,445	2,180,478	2,490,800
ADJUSTED ANNUAL	16,539,120	2,852,943	5,681,049	8,484,366	11,262,954	14,016,886	16,746,246	19,451,130	20,926,555
Naturally Occurring									
UNADJUSTED ANNUAL	11,121,392	0	113,360	337,246	668,894	1,105,611	1,644,770	2,283,810	3,020,234
Total									
UNADJ. ANNUAL (Prog. + Natural)	35,254,402	4,534,395	9,068,790	13,603,185	18,137,580	22,671,975	27,206,370	31,740,765	34,464,395
WATER SAVINGS (mgd)									
Programmatic									
Summer (April-October)	0.07	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.09
Unadjusted Winter (Nov-March)	0.07	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.09
UNADJUSTED ANNUAL	0.07	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.09
Adjusted Winter	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
ADJUSTED ANNUAL	0.05	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06
Naturally Occurring									
UNADJUSTED ANNUAL	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Total									
UNADJ. ANNUAL (Prog. + Natural)	0.10	0.01	0.02	0.04	0.05	0.06	0.07	0.09	0.09
Cost to City ($)									
Santa Cruz Admin	$26,625	$62,803	$62,803	$62,803	$62,803	$62,803	$62,803	$62,803	$57,613
Santa Cruz Incentive	$24,729	$64,950	$64,950	$64,950	$64,950	$64,950	$64,950	$64,950	$39,000
SANTA CRUZ TOTAL	$51,354	$127,753	$127,753	$127,753	$127,753	$127,753	$127,753	$127,753	$96,613
Cost to Customers ($)	$14,998	$39,390	$39,390	$39,390	$39,390	$39,390	$39,390	$39,390	$23,660
Customer Bill Savings ($)									
Water (Utility Revenue Loss)	$58,397	$10,972	$21,670	$32,101	$42,270	$52,186	$61,854	$71,280	$76,088
Sewer	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL	$58,397	$10,972	$21,670	$32,101	$42,270	$52,186	$61,854	$71,280	$76,088
Customer Payback Period (yrs)	3.59								

APPENDIX E

WATER CONSERVATION PRICING TELEPHONE SURVEY AND LITERATURE SEARCH

GARY FISKE & ASSOCIATES
Jennifer J. Stout – Water and Energy Consulting

WATER CONSERVATION PRICING TELEPHONE SURVEY AND LITERATURE SEARCH

Telephone Survey

Purpose of Telephone Survey

Increasing numbers of water agencies are recognizing that water conservation is a key resource option and that pricing is an important tool to achieve conservation savings. The purpose of this survey was to learn from the experiences of water purveyors that have implemented one or another form of conservation rate design. The decisions that Santa Cruz ultimately makes on rate structures and other conservation alternatives must be based on the unique attributes of the demographics, housing stock, climate, and community values of Santa Cruz. Viewed in this context, the experiences of other agencies can inform the decision making process.

Survey Description and Respondents

The telephone survey consisted of informal 15-20 minute interviews with a staff member in each agency who was familiar with the current rate structure and its history. Areas covered included:

- Descriptions of conservation rate structures that are currently in place for different classes of service.
- Reasons that these structures were developed.
- Structures that were considered and not implemented.
- The public discussion over adopting conservation rates and the degree of public acceptance.
- Implementation challenges.
- Use of excess revenues, if any.
- Quantitative or qualitative results regarding conservation savings and longevity of those savings.
- Details of development and administration of rates.

In several cases, the discussions were supplemented by written materials sent by the respondent.

Responding agencies included:

- East Bay Municipal Utility District

- Marin Municipal Water District
- San Jose Municipal Water
- City of Palo Alto
- Otay Water District
- Capistrano Valley Water District
- Irvine Ranch Water District
- Tucson Water Department
- Seattle Public Utilities
- Medford, Oregon Water Commission

Each of these agencies was known in advance to have a conservation rate structure in place.

Survey Results

Each of the interviewed water agencies has adopted a rate structure that is tailored to its unique circumstances. Several respondents' rates incorporate more than one of the categories of conservation rates described in Section II. Table E-1 shows the key conservation features currently incorporated in the rates of the responding agencies for one or more customer classes. Almost all of the agencies have inverted block rates. Several of them have seasonal rates, and a surprising number have some form of customized water budgets.

Following are brief discussions of the conservation rates of each responding agency. These discussions are not intended to completely describe each provider's water rates, but only to focus on the conservation features of the commodity charge.

East Bay Municipal Utility District

EBMUD's commodity charge for single-family residential customers is a three-tier increasing block rate, as follows:

TIER	MONTHLY LIMITS	RATE ($/CCF)
1	0-7 ccf	$1.27
2	8-16 ccf	$1.58
3	> 16 ccf	$1.94

Multi-family and non-residential customers have uniform rates with no block structure. The agency has considered seasonal rates but has, to date, not adopted them. Rates have been a major point of controversy throughout the 1990s, due to major climatic and demographic differences among different portions of the EBMUD service area, and changes in the composition of the elected EBMUD Board. Earlier versions of the increasing-block rate had a fourth tier, with a very high rate based on the agency's marginal cost of supply. This was abandoned, due in large part to concern of the customers in the hotter, drier part of the service area ("east of the hills").

The initial break point (7 ccf) is based on the average monthly winter consumption across the service area. The second break point (16 ccf) is the average consumption east of the hills.

EBMUD is the only surveyed agency that has adopted a rate that distinguishes among reliability levels. Large customers have the option of purchasing reclaimed wastewater, which is priced at the same level as potable water. In return, these customers are guaranteed a supply in the event of a drought. Other EBMUD customers face a lower reliability level that has been adopted as Board policy.

Table E - 1
WATER CONSERVATION RATES CURRENTLY IN EFFECT

AGENCY NAME	INCREASING BLOCKS	SURCHARGES	SEASONAL RATES	VARIABLE RELIABILITY RATES	WATER BUDGETS
East Bay MUD	x			x	
Marin Municipal	x				x
San Jose Municipal	x				
City of Palo Alto	x				
Otay WD	x				x
Capistrano Valley WD	x				x
Irvine Ranch WD	x				x
Tucson Water Department		x	x		x
Seattle Public Utilities	x		x		
Medford Water Commission			x		

Marin Municipal Water District

Marin (or MMWD) has adopted one of the more interesting and more complex conservation rate structures in the state. MMWD residential customers face a sharply-increasing block structure:

TIER	MONTHLY LIMITS (SINGLE FAMILY/MULTIFAMILY)	RATE ($/CCF)
1	0-10.5 ccf / 0-6 ccf	$2.21
2	11-24 ccf / 7-11 ccf	$4.08
3	> 24 ccf / > 11 ccf	$7.83

The block sizes were set to mirror the mix of supplies coming from local reservoirs, the Russian River, and recycling. The rates are based on the costs of these alternative supplies.

Non-residential customers' rates are based on a water budget, which is intended to reflect efficient usage. The water budget for a particular customer can be based on one or more of the following:

1. Historical usage
2. Estimated current usage
3. Site audits
4. Area averages for similar services

Each customer can distribute his or her annual water budget over the 6 annual billing periods to suit the needs of his or her business. There are limits to how frequently these distributions can be changed.

Water budgets can be adjusted for "changes in character" or "increases in use" due to additional employees, increased production, etc. Each customer has a 3-tier rate, as follows:

TIER	PERCENT OF WATER BUDGET	RATE ($/CCF)
1	0-85%	$2.21
2	86-150%	$4.08
3	> 150%	$7.83

As is the case for many California water providers, MMWD implemented this rate structure as a result of the drought in the late 1980s and early 1990s. There was extensive public involvement, and a general perception that this rate structure, despite its complexity, is fair.

No rigorous evaluation of the effectiveness of the rate structure has been performed. In addition to this rate structure, Marin has implemented a number of conservation programs. Current per-customer usage is approximately 25% below pre-drought levels. Most customers' usage is such that they remain in the first tier.

San Jose Municipal Water

San Jose Municipal Water's residential customers pay an increasing-block rate, which is differentiated by pressure zone. For illustration, the Zone 1 (lowest elevation) customers pay the following rates:

TIER	MONTHLY LIMITS	RATE ($/CCF)
1	0-7 ccf	$1.13
2	8-14 ccf	$1.35
3	15-21 ccf	$1.55

The initial 7-unit block is intended to be the essential ("lifeline") usage for a typical household. The 7-unit block size is maintained for the remaining blocks. The rates are set to generate sufficient revenue for the following year without a "rate shock" for high-use customers. The rate spread is therefore fairly narrow.

Non-residential customers pay a flat $1.35/ccf commodity charge.

City of Palo Alto

Like San Jose Municipal, Palo Alto has an inverted-block rate for residential customers:

TIER	MONTHLY LIMITS	RATE ($/CCF)
1	0-7 ccf	$1.47
2	8-14ccf	$1.97
3	> 14ccf	$2.04

The 7-unit first tier is designed to meet "basic needs." The narrow rate spread, particularly between the second and third tiers, is partly based on the fact that most neighboring jurisdictions do not have steep block structures.

Palo Alto has had increasing block rates for many years. During the drought, a more severe rate design was imposed based, in part, on prior years' consumption. Usage during the drought decreased 41%. Since the drought, usage has remained fairly flat, with little rebound.

Otay Water District

This water district in San Diego County has implemented a relatively sophisticated rate structure. Its residential rate is a five-tier increasing block rate, as follows:

TIER	MONTHLY LIMITS	RATE ($/CCF)
1	0-5 ccf	$1.01
2	6-25 ccf	$1.67
3	26-35 ccf	$1.81
4	36-50 ccf	$2.13
5	> 50 ccf	$2.65

Customers whose monthly consumption exceeds 20 ccf are also penalized by losing their "lifeline" allowance; the initial 5 units are billed at the tier 2 rate of $1.67. The tier 2 rate or "standard" rate is the average cost of service. The District estimates that 85% of customers are billed at this rate. A portion of the excess revenues from the remaining "conservation" tiers subsidizes the first tier lifeline rate. The remainder (estimated at between $200,000 and $300,000 annually) are earmarked to fund conservation programs.

Non-residential customers are charged a uniform commodity rate of $1.78 per unit. Non-agricultural irrigation customers receive an annual allocation equivalent to 48 inches of water per year over the irrigated area.[34] The customer is responsible for providing accurate area measurements. A fixed distribution of this annual allocation over the months of the year is applied to all large landscape customers.

Otay's rate ordinance indicates that the annual allocation "was developed by a Task Force made up of professionals in the 'green industry' and District staff. This amount of water was determined to be more than adequate for the effective irrigation of virtually any plant material."

The first violation of the monthly allocation amount within a 12-month period results in a warning notice. The second violation results in a 100% surcharge on the excess; the third violation results in a 400% surcharge, and the fourth a subsequent violations an 800% surcharge. Customers are given a one-month "grace period" to offset all or a portion of the overage.

Finally, customers are allowed to "bank" unused allocation amounts (up to 12 inches) to be used in subsequent months.

While no rigorous analysis has been performed of the effectiveness of this rate design in promoting conservation, the fact that the penalty revenue for large landscape customers has decreased significantly is viewed as an indicator of effectiveness. On the other hand, residential per-customer usage has remained fairly static at pre-drought levels over the past 8 years.

[34] This allocation is reduced during droughts in stages based on the severity of a drought emergency declared by the Metropolitan Water District of Southern California.

Despite the apparent complexity of the rate structure and the modest size of the agency (33,000 connections, 150 employees), implementation and administration of this rate structure was not deemed particularly difficult.

The irrigation savings impacts of the Otay program, along with those of several other water-budget-based rate structures in southern California were recently evaluated in a study funded by the Metropolitan Water District of Southern California (Pekelney and Chesnutt, 1997). The evaluation report correctly points out that "[w]ater-budget-based rate structures were not created in a vacuum; by design, these rate structures integrated a horticulturally based water budget and required customer-specific follow-up for customers requesting assistance in improving their water efficiency." In other words, the savings realized are a function of the rate structure in concert with a number of complementary efforts. For Otay, the difference in landscape usage between the period before adoption of the water budget based rate and after its adoption is estimated at about 20%. This estimate is not adjusted for weather variation between the two periods.

Capistrano Valley Water District

This small (10,500 connections) water district in Orange County has one of the most complex rate structures in California. Residential customers face a three-tier increasing block rate based on a customer-specific water budget. The monthly indoor allocation for a single-family customer is 9 ccf. The outdoor budget for customers with small lots is fixed. For larger lots (about 50% of residential customers), the outdoor budget varies by landscaped area, month, days in the billing period, and actual recorded monthly evapo-transpiration (ET). The allowance assumes that the landscaped area is covered with turf, thereby providing a liberal amount of water for other plant material.

The residential rates are as follows:

TIER	PERCENT OF WATER ALLOCATION	RATE ($/CCF)
1	0-100%	$1.23
2	101-200%	$1.55
3	> 200%	$2.93

Non-residential customers pay a flat $1.23/ccf rate.

This rate structure, which was implemented toward the end of the drought, is thought to be more fair than a structure based on previous years' usage. Its implementation required some "legwork" on the part of staff and considerable education of customers. The irrigated areas were taken from a real-estate data base, rather than relying on self-reports, which staff views as a very good idea. The rates were not particularly controversial (in part because of the crisis atmosphere associated with the drought) and are now fairly well accepted and understood by customers.

Capistrano Valley's program was evaluated in detail in the MWD study. The analysis found a 35% reduction in irrigation-only customer usage between the period before adoption of the water budget based rate and after its adoption. Statistically controlling for weather variation and other parameters reduced this savings to about 22%.

Irvine Ranch Water District

The IRWD program is similar in many respects to that of Capistrano Valley, but extends the water budgeting process to commercial and industrial customers as well as residential and large landscape customers. Like the Capistrano Valley program, IRWD began its program in 1991 during the drought.

The indoor portion of the residential water budget is based on the household size. The daily indoor allowance is 65 gallons per capita. (For a household of four people, this is equivalent to just over 10 ccf per month.) The outdoor portion is based on the landscaped area. At the outset of the program, assumptions were made for household size (4) and the landscaped area (1500 square feet for a single family customer). These assumptions were then corrected (often by the customers themselves) as the program evolved.

The monthly outdoor allowance considers irrigated area, recorded ET, days in the billing period, micro-climate variations, and fixed monthly allocation factors. The five-tier rate is as follows:

TIER	PERCENT OF MONTHLY ALLOWANCE	RATE ($/CCF)
1 (Low Volume)	0-40%	$0.48
2 (Conservation Base)	41-100%	$0.64
3 (Penalty)	101-150%	$1.28
4 (Excessive)	151-200%	$2.56
5 (Wasteful)	> 200%	$5.12

The tier 2 rate represents the average cost of service. Excess revenues collected from the upper tiers subsidize the first tier and fund conservation programs.

As shown in the table, the tiers are also given names. These names were viewed as important to the program's success. The fifth tier was originally called "abusive". That word elicited a good deal of negative feedback from customers and was eventually changed to the less pejorative "wasteful". However, the discomfort over the word was an important factor in motivating customers to reduce water consumption.

The IRWD program is unusual in that it also applies customer-specific water budgets to commercial and industrial customers. The commercial/industrial water budgets initially used 1989-90 historical usage as a baseline. IRWD staff then worked individually with customers to refine these allowances. Industrial process water has presented the most difficult challenge.

Block sizes for commercial, industrial, and large landscape customers are much smaller than those of residential customers, with the "wasteful" rate being charged for all usage that exceeds 120% of the allowance.

Implementation of the program is reported as "not too hard." It required a 6-9 month effort, and some in-house programming. Maintenance is crucial, both for program improvements (e.g. recorded ET, billing days, etc.) and ongoing customer contact. In fact, IRWD staff seems to view the program as a key to maintaining close touch with customers; the program is seen as having contributed significantly to positive relations between the agency and its customers.

Since implementation of the program, outdoor water usage has decreased markedly. Staff estimates that the program has saved about 70,000 acre-feet of irrigation water. Irrigation rates have steadily fallen off from 4.4 acre-feet per acre (53 inches) prior to the program to 2.4 acre-feet per acre (29 inches) in 1997. The MWD-funded evaluation shows a non-weather-adjusted 37% reduction in irrigation-only usage.

Tucson Water Department

The Tucson Water Department was one of the first water agencies in the country to implement conservation rates, having begun its inclining block residential rate since 1976. There have been many changes in the rate structure since then. The current rate structure for single-family residential customers is as follows:

TIER	MONTHLY LIMITS	RATE ($/CCF)
1	0-3 ccf	$0.00 *
2	4-15 ccf	$1.62
3	16-30 ccf	$2.61
4	> 30 ccf	$3.29

** The initial 3 ccf is included in the monthly fixed charge.*

The 15-unit block size corresponds to a typical single-family customer's average monthly usage.

Multi-family and non-residential customers incur a two-tier summer surcharge for usage that exceeds the customer's previous winter average monthly usage. Thus, multi-family customers' summer rates are as follows:

TIER	MONTHLY LIMITS	RATE ($/CCF)
1	0-3 ccf	$0.00
2	> 3 ccf	$1.35
Surcharge 1	> 100% of allowance	$0.95
Surcharge 2	> 150% of allowance	$0.25
	Maximum rate	***$2.55***

Staff reports that the current rate structure is understood fairly well by customers. However, a recent survey indicates that some two-thirds of customers view the increasing block structure as unfair. Water rates have been a very controversial and visible issue over the years in Tucson, and the rate structure has changed many times. These conditions have probably contributed to some customer frustration and perhaps held down customer comprehension of the rates.

There have been some evaluation studies done of the impact of conservation rates in Tucson. Because of the frequent changes in the rate structure, those studies say little about the current rate design. A 1989 study (Cuthbert, 1989) estimated a 5-8% savings for single-family residential customers. A 1996 study (Cuthbert and Lemoine, 1996) estimated an overall 4.4% savings, but an 8.8% summer savings.

Seattle Public Utilities

Seattle residential customers face a uniform winter rate and a 2-tier increasing-block rate in the summer months:

TIER	MONTHLY LIMITS	RATE ($/CCF)
1	0-5 ccf (summer) All usage (winter)	$1.60
2	> 5 ccf (summer)	$2.53

The tier 2 summer rate reflects the marginal cost of new supplies. The winter and tier 1 summer rate is then set to collect revenues that reflect the costs allocated to this class of service.

Commercial customers face a uniform rate of $0.71/ccf in the winter months and $2.01/ccf in the summer months. The lack of a block structure for commercial customers appears to be a function of history and customer feedback to elected officials.

Seattle also has a fairly long history of conservation rates, and the structures have changed periodically. Some modifications to the current rate structures are being discussed, at least at the staff level, including the possibility of a "shoulder" season and some type of curtailable rate for large customers.

Medford, Oregon Water Commission

This mid-sized water provider (about 30,000 connections) has implemented a simple seasonal commodity charge of $0.36 per thousand gallons ($0.27/ccf) in the winter months and $0.41 per thousand gallons ($0.31/ccf) in the summer months. The agency has considered and rejected a higher rate for large users, and a larger spread between the summer and winter rates.

Staff believes that the extremely low rate levels make the rate structure less relevant to water savings. What is deemed to be more important is that the rates provide a message to customers that summer usage is to be discouraged. Thus, the seasonal rate differential is viewed as a tool to get that message out, rather than a way to provide an economic signal.

The Literature Search

This section reports the results of an extensive literature search that was conducted to gain an understanding of the "state of the art" in the water supply industry regarding conservation rate designs. The discussion is divided into the following segments:

- Use of conservation rates by water providers
- Observations about different conservation rate structures
- Demand elasticity results and their relevance to Santa Cruz
- Savings impacts of conservation rate structures
- Keys to successful conservation rate implementation

Use of Conservation Rates

The AWWA 1996 "WaterStats" survey of over 800 utilities nationwide found the following regional breakdown of residential block structures:

TYPE OF RATE STRUCTURE	WEST	MIDWEST	SOUTH	NORTHEAST	CANADA
Uniform	46%	34%	31%	46%	48%
Declining Block	3%	58%	40%	32%	10%
Increasing Block	36%	4%	27%	19%	10%
Other	15%	4%	2%	3%	32%

The regional differences are striking. Whereas residential declining block rates are used by only 3% of respondents from the western U.S., 58% of midwestern respondents use them. Conversely,

36% of western water providers use increasing block structures, as compared to 4% in the midwest.

The same survey compared the incidence of different block structures nationwide among customer classes. As the following graphic shows, residential rates are more likely to be increasing blocks than either commercial or industrial. Industrial customers are more likely to face a declining block structure. Seasonal rates were uncommon for all customer classes.

Figure E - 1
RESIDENTIAL WATER RATE STRUCTURES BASED ON 827 U.S. UTILITY RESPONSES

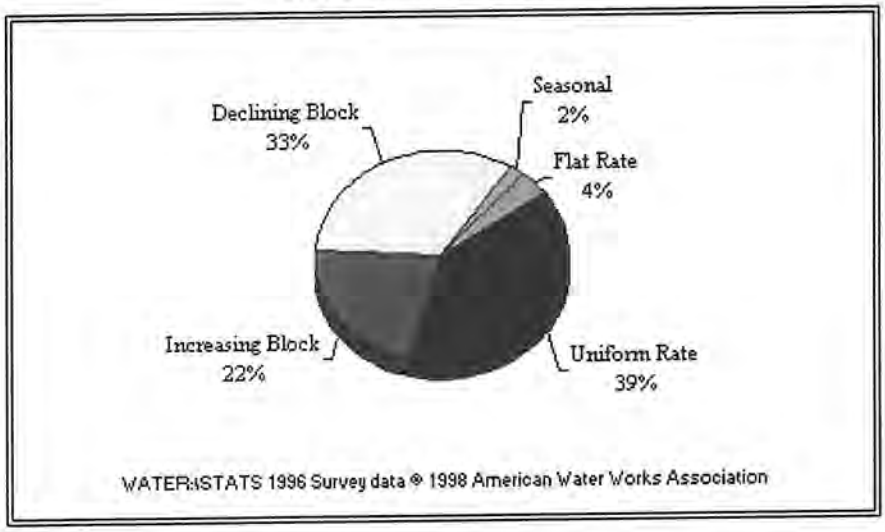


Table E-2, based on the annual rate survey done by Raftelis Environmental Consulting Group (Raftelis Environmental Consulting Group, Inc., 1998) reports an even split for residential customers among uniform, decreasing, and increasing blocks, with larger providers (Group A) more likely to have increasing blocks. Close to one-third of the smaller reporting utilities (Group C) have increasing blocks as well.[35]

The breakdown is somewhat different for non-residential customers, with much fewer increasing blocks, and much more uniformity among different-sized providers.

[35] Group A systems generally serve populations in excess of 500,000. Group C systems range between 10,000 and 150,000 population.

Table E - 2
WATER RATE BLOCK STRUCTURES IN THE U.S.

	UNIFORM	DECREASING	INCREASING	OTHER	TOTAL
RESIDENTIAL					
Group A					
Number	7	9	16	2	34
Percent	21%	26%	47%	6%	
Group B					
Number	18	21	12	3	54
Percent	33%	39%	22%	6%	
Group C					
Number	22	20	18	3	63
Percent	35%	32%	29%	5%	
Total					
Number	47	50	46	8	151
Percent	31%	33%	30%	5%	
NON-RESIDENTIAL					
Group A					
Number	15	12	6	1	34
Percent	44%	35%	18%	3%	
Group B					
Number	20	23	9	2	54
Percent	37%	43%	17%	4%	
Group C					
Number	25	22	14	2	63
Percent	40%	35%	22%	3%	
Total					
Number	60	57	29	5	151
Percent	40%	38%	19%	3%	

Information is also available for each of the three west coast states. In California, of the 436 providers surveyed, 42% had increasing block rates for residential customers (Black & Veatch, 1999):

Table E - 3
CALIFORNIA RESIDENTIAL WATER RATE STRUCTURES IN 1999

TYPE OF RATE STRUCTURE	PERCENT OF SERVICE AREAS
Increasing Block	42.4%
Uniform	45.0%
Declining Block	2.3%
Other	10.3%

In Oregon, increasing blocks for residential customers are not uncommon among 36 agencies surveyed, but they are not as frequently encountered as in California. Seasonal rates have been implemented occasionally (Oregon Environmental Council, 1998):

Table E - 4
OREGON RESIDENTIAL WATER RATE STRUCTURES IN 1998

TYPE OF RATE STRUCTURE	PERCENT OF SERVICE AREAS
Increasing Block	31%
Uniform	61%
Declining Block	8%
Seasonal	*8%*

* *Percentages do not add to 100% because agencies that have seasonal rates also utilize one of the other rate structures.*

The data for Washington is not as recent, being based on a 1995 survey sponsored by the Washington State Department of Health. The residential rate structures exhibited the following characteristics (Washington Water Utilities Council, 1995):

Table E - 5
WASHINGTON RESIDENTIAL WATER RATE STRUCTURES IN 1995

PROVIDER SIZE	PERCENT WITH INCREASING BLOCK RATES	PERCENT WITH SEASONAL RATES
Large (> 25,000 connections)	25%	43%
Medium (1,001 – 25,000 connections)	36%	7%
Small (< 1,001 connections)	15%	2%

Interestingly, the Washington survey also reported that agencies tend to set the first block between 5 and 10 ccf per month, which is consistent with most of the rate structures reported in the telephone survey.

The search revealed only one example of a water agency applying a curtailable rate. The Pennsylvania-American Water Company has such a rate for industrial customers that purchase at least 15 million gallons per month and have stored water equal to at least ten time the customer's average hourly usage. Curtailments are limited to a maximum of six continuous hours and may not exceed three per month or six per year. The curtailment applies to water used for industrial purposes. Sanitary usage is exempt. The customer is responsible for paying the cost of all necessary metering equipment. Participating customers receive a 12% discount on their commodity charge for all usage that exceeds 15 million gallons per month. There is no discount for usage below that level. (Pennsylvania-American (1997))

Observations

The literature on conservation rates makes many important general and specific observations about conservation rate structures. Following is a summary of the key points raised.

As mentioned earlier, rate structures deemed to be "conservation rates" are generally implemented for one of two reasons: to encourage usage changes (either reductions or shifts) and/or to better match prices charged to costs incurred. The two are often mutually-reinforcing: price signals attempt to encourage customers to conserve up to the point at which the cost to conserve reaches the marginal cost of new supply. As pointed out by Olstein (1993), "[t]he real problem facing the water rate designer is that water is generally priced to meet cost . . . [and] pricing to create surpluses is either not permitted or is very difficult to implement."

This need for revenue-neutrality means that not all water can be priced at the marginal cost of new supply, which, for many utilities, exceeds the average cost. Thus, in the increasing-block design, only some customers (i.e. those in the tail block) may face a price that reflects the marginal cost. Other customers face lower prices; those in the lower blocks face a price that is, in fact, lower than what they would have faced with a uniform rate.

Collinge (1996) points out that, because of this, there is little, if any, incentive for customers in the lower tiers to conserve. The underlying logic of this structure is that the price elasticity of customers consuming in the upper tiers is greater than those in the lower tiers; therefore, the reduction in usage by upper-tier customers will exceed any increased usage by lower tier customers.

Collinge advocates a "feebate" system, which is a uniform rate combined with fees for customers whose consumption exceeds a water-budget threshold and rebates for customers with usage below the threshold. The fees and rebates are set to maintain revenue neutrality. Under this system, all customers face the same marginal prices, which is consistent with principles of economic efficiency. The system is, however, complex to understand and administer, and could result in significant revenue uncertainty. It also does not have much of a track record.

The issue of revenue uncertainty was raised by several others in connection with conservation rates. Hagler-Bailly and Jordan (1998) found that the majority of respondents reported more difficulty in revenue forecasting and decreased revenue stability. Chesnutt et al (1996) used Monte Carlo simulation techniques to estimate the revenue volatility associated with different rate structures. While the volatility depended heavily on the details of the rate structure and the demand characteristics of the locality, it was found that both seasonal and increasing block rates can significantly increase revenue uncertainty.

Different rate structures are seen as having differing levels of fairness. While it is difficult to generalize, rates based on customer-specific water budgets are generally viewed as the most fair. Block rates are often seen as unfair due to the perceived arbitrariness of the rates and block sizes and the fact that different units of water are priced differently. The perceived fairness of seasonal rates is perhaps between these two.

The perceived fairness of a rate design cannot be separated from customers' ability to understand it. In spite of their complexity, a customer can tie a water-budget-based rate to his or her own family, landscape, and habits. It may also not be too difficult for most customers to understand that it is more expensive to provide service in the summer than in the winter. Inverted blocks may be harder to understand.

For any rate design, better education of, and communication with, customers will improve understanding and thereby increase perceived fairness.

Aside from ease of understanding, seasonal rates are seen by many as having several advantages. They are simple, and their tie to cost of service is clear, as is their tie to potential shortages. Many utilities face seasonal shortages, particularly in dry years. Supply and infrastructure additions are often driven by these seasonal needs. Seasonal rate differentials directly address these issues. Olstein (1993) says that seasonal rates "provide the right price signal at the right time."

Mitchell and Hanemann (1994) point out that, while seasonal rates may do a good job at reducing average summer demand, it is possible that the peak-day or peak-hour demand, which drive the need for new capacity, may remain unchanged. This phenomenon, known as "needle peaking," could be problematic, since it would not reduce the need for new capacity, but would erode revenues. Mitchell and Hanemann leave this as "largely an empirical question that must be answered with the hard hand of experience." Vista Consulting Group et al (1997) report some evidence that "peak-day usage or a short-term peak demand spike as occurs during particularly hot and dry stretches of weather is the most responsive to price changes . . . [although] more research is needed in this area."

Some feel that a seasonal surcharge is preferable to an overall seasonal rate differential. The surcharge will only be applied to usage that exceeds a fixed or customer-specific threshold. The advantages seen for this design are:

- It gives a "more pointed" message than a seasonal rate (Olstein, 1993)

- It is more fair, since "essential" usage is not subject to the higher summer rate.
- It is more efficient, since the "essential" usage is extremely inelastic and therefore would not respond to the higher rate.
- It combines the positive features of seasonal and water-budget-based rates.

Little has been written about variable-reliability ("priority") pricing in the water industry. This type of rate has a long history of successful use among energy utilities, where it has typically been applied to larger industrial customers, but is increasingly being applied to smaller customers as well. This rate design uses price as a way to ration supply in a period of scarcity.

Many water agencies have adopted shortage management plans to guide such rationing. The stages in these plans attempt to cut back lower-value uses before uses perceived as having higher value. Priority rates allow customers themselves to determine whether they are willing to be subject to more frequent and/or longer cutbacks. In the words of a former Chair of the Federal Energy Regulatory Commission, such rates help "allocate electricity supply to its most valuable uses when the amount demanded exceeds available supply." It allows customers to be "apprised of the cost consequences of different reliability levels and then be allowed to choose the level that suits their needs and pocketbooks." (Mitchell and Hanemann, 1994).

The concepts of priority pricing are equally applicable to the water supply industry. There are, however, some practical limitations. The one most often cited is monitoring and enforcement. Water customers almost universally have volumetric meters which are read at monthly or larger intervals. This combination of metering technology and read frequency would make it very difficult to monitor usage during a one- or two-day incident. While more sophisticated metering technology does exist, it is currently quite costly.

Mitchell and Hanemann (1994) cite another potential problems with this type of rate, namely that water utilities may have difficulty delivering on a contractually-committed level of reliability to a particular customer.

Finally, Olstein (1993) estimates the ratio of daily gallons saved to dollars of increased revenue associated with several different rate changes in New York City. The results are interesting:

TYPE OF RATE CHANGE	DAILY GALLONS SAVED / REVENUE INCREASE (GALLONS/$)
15% rate increase	0.0811
Eliminate minimum charge	0.0844
Seasonal rate	0.1009
Seasonal surcharge	0.2381
Inclining block	0.0854

The seasonal surcharge is estimated to be much more effective than other rate designs.

Demand Elasticity

The notion of elasticity is central to most discussions of the effects of prices on demand. The price elasticity of demand is defined as follows:

$$Price\ Elasticity = \frac{Percent\ Change\ in\ Demand}{Percent\ Change\ in\ Price}$$

The larger the (negative) elasticity, the more responsive demand is to price. Generally a commodity with an elasticity greater than 1 is termed "elastic." For those goods, a 1% increase in price will result in a greater-than-1% reduction in consumption. Commodities with smaller elasticities are termed "inelastic."

There have been many studies of the price elasticity of water demand. Not surprisingly, the results have varied. Analyzing the responsiveness of water demand to price is an inherently difficult empirical question. There are many other factors that influence demand other than price that are varying simultaneously (e.g. weather, conservation programs, changing housing stock, etc.). There are also different analytical methodologies, sample sizes, data quality, and price responsiveness across geographical locations, season, and customer class. Thus, the answer to the question: "what is the price elasticity of water demand?" is not a short or simple one.

There are substantial differences between so-called short-term and long-term elasticities. The short-term price elasticity can be thought of as measuring the demand response due largely to changes in behavior. The long-term elasticity measures the response over the long-term that reflects customers' ability to make structural changes (i.e. changes in appliances or equipment). Following are summary discussions of the research findings on short-term and long-term water price elasticity.

Short-Term Elasticity

Most of the research has focused on short-term elasticity. Vista Consulting Group et al (1997) provides an excellent summary of this research. Following are the key points of these findings:

Overall, demand for water is relatively price inelastic. At least in the short-run, outdoor demand is more elastic than indoor demand. The price elasticity for residential water demand is in the range of -0.15 to -0.40. Indoor usage has an elasticity in the range of -0.05 to –0.25. For outdoor usage, the range is –0.25 to –0.60.

Price elasticity is likely to be higher at higher rate levels. In other words, if water rates are already high (and water bills a greater portion of household income), customers are likely to respond more to a rate increase.

Commercial and industrial customers tend to be more responsive to price changes than residential customers.

It is unclear to which price variables customers respond. Some studies indicate that customers respond most to changes in the average price. Others say it is the marginal price. Still others say it is some combination of the two. Some say customers respond not only to the price level they face, but to the rate structure itself.

Price elasticity, particularly for summer usage, depends on region and local climate. Most studies seem to indicate that customers in the west and the south respond more strongly to price changes than in other regions of the country. Moreover, within each region, there are substantial variations, due in part to demographics, lot size, micro-climates, local "culture", etc.

Long-Term Elasticity

"We still do not know much about the long-term (greater than one year) price elasticity of water demand." (Vista Consulting Group et al, 1997). As difficult as it is to measure short-term elasticity, long-term elasticity is even harder to measure. However, some tentative findings include:

Residential winter demand is more elastic in the long-term than in the short-term. This makes intuitive sense, since, in the long-term, customers have the opportunity to replace plumbing fixtures with more efficient devices.

The relationship between long-term and short-term elasticity for residential summer demand varies. It may depend on the mix of outdoor watering methods used in a particular locality. The short-term watering behaviors of "hose draggers" may change in response to a price increase; these behavioral changes may erode over time. Customers who have automatic sprinkler systems may be more likely to permanently change the settings on those systems. All customers are ultimately more likely to upgrade their equipment in the long-term.

In general, commercial and industrial water demand is more elastic in the long-term than in the short-term. For many such customers, water demand reductions are achieved through structural changes involving changes in processes. By their nature, these take more time and are more permanent.

Generally, long-term elasticity will exceed short-term elasticity for those demands for which reductions depend more heavily on structural than behavioral changes.

How Important Is Elasticity?

Elasticity is a critical economic concept, and much good work has been done to estimate the price elasticity of water demand. It is important to recall, however, that even perfect knowledge of water price elasticity will provide limited help in estimating the responsiveness of customers to fundamental changes in the water pricing structure. Most customers will respond to more than simply the price (average or marginal) they are facing. They are likely to respond more to the simple fact that their water provider has taken the drastic action of changing the rate design. This

is particularly true if that change is accompanied by other actions that support and complement the rate change.

One category of action that is essential is communication with and education of customers. As alluded to above, this is important to ensure that customers understand the rate structure itself. But it is also important to make sure customers understand the reasons for the rate change and the benefits to the community, the environment, and themselves that will result from their responding. Pekelney and Chesnutt (1997) talk about motivating the program based on both economic and ethical arguments. Collinge (1996) points out that "calling attention to the monetary incentive to conserve . . . may itself increase conservation and demand elasticity." A rate program that is well-communicated and well-explained will yield more savings than the same program that is not.

Customer responses are influenced by more than an extensive and appropriate education program. Michelson et al (1998) refer to a possible synergistic effect of price and non-price conservation programs. Pekelney and Chesnutt (1997) hypothesize that ". . . complementary programs . . . are important to reduce financial impact on customers and to assist customers in meeting clear water conservation goals." Olstein (1993) points out the importance of making other forms of assistance (e.g. rebates) available along with the rate increase.

In short, it is not the rate change alone that will affect customer demands. It is the manner in which that change is packaged and delivered to customers that will have the largest impact.

Water Savings Resulting from Conservation Rates

Perhaps even more than is the case for programmatic conservation, the literature on savings due to conservation rates is sparse. The number of good analyses of savings impacts is even smaller. This is not surprising, given the relatively small number of conservation rates that have been implemented and the difficulty of rigorously evaluating the savings impacts.

The following discussion focuses on those results which appear to have some relevance to Santa Cruz. Just as is the case for conservation programs, the impacts of conservation rate designs will vary considerably from place to place. Thus, even analytically sound results in another jurisdiction are no guarantee of similar results in Santa Cruz.

Based on a survey of water agencies using some form of conservation rates, Hagler-Bailly and Jordan (1998) conclude that "rates, as part of a conservation program, can best be used to reduce peak demands. . . . Conservation rates may be less effective in reducing "base level" (indoor) water use. This suggests that perhaps the use of permanent or complex increasing rate structures is less effective than simple uniform rates with excess or seasonal charges. Such rates provide consumers with a direct and apparent economic charge for peak water use."

As part of their evaluation of water-budget-based rate structures, Pekelney and Chesnutt (1997) conducted a survey of customers of the four agencies that were the subjects of the evaluation. Key findings included:

Awareness was higher for water budget/allocation programs than for tiered rate structures.

Nearly 90% of customers reported that the water budget program encouraged conservation. Even more reported that they adjusted their irrigation timers in response to the water budget. More than half repaired their irrigation system and half reported upgrading their system.

56% of customers reported that the water budget influenced their conservation practices. This compares to 40% for the increasing block structure and 37% for the customer outreach/education programs.

In its 1995 survey of water agencies, the Washington State Department of Health (Washington Water Utilities Council et al, 1995) reported that, of those agencies that recently implemented some type of conservation rates:

- 27% estimated less than 5% savings
- 32% estimated 6-10% savings
- 22% estimated 11-20% savings
- 19% estimated more than 20% savings.

In addition to survey data, there are some studies that have analyzed actual usage data in an attempt to estimate savings.

The Tucson Water Department was one of the first water providers to implement a conservation rate structure. Cuthbert (1989) analyzed water usage during the first years of Tucson's seasonal inverted block rate structure. It found that annual per-customer weather-adjusted residential demand decreased 7% between 1982 and 1986. Winter consumption remained fairly constant, while summer usage declined 11%.

A subsequent study of Tucson usage by Cuthbert and Lemoine (1996) found that, between the 1978-80 and 1992-94 periods, per-customer residential usage summer declined by 8.8%, while winter usage actually increased by 2.0%, a net annual reduction of 4.4%. These figures were not adjusted for variations in weather.

This study also examined the impacts of conservation rates in Phoenix and Seattle. Like Tucson, Phoenix has had a series of conservation rate designs since 1977. Between 1975-77 and 1992-94, residential per-customer summer usage in Phoenix decreased 30%; winter usage declined close to 25%. The study concedes that much of this reduction is probably attributable to weather and socioeconomic changes. However, a more recent study is cited that concludes that the new three-season uniform charge rate structure adopted in 1990 resulted in average residential usage reductions of between 1.0 and 1.6% over the first three years it was in effect. (Kiefer, 1994)

In Seattle, which adopted a seasonal inverted block structure in 1989, average per-customer residential usage declined 4.5% during the summer months and 7.9% during the winter months between 1975-77 and 1990-91/1994.

The interpretation of the results of both of the above studies must recognize that the savings cited reflect not only changes in the rate structure, but also changes in the overall level of real prices, as well as conservation programs that were implemented over the period of analysis.

Several studies attempt to discern rate structure impacts on usage by performing cross-sectional analyses, with data aggregated by agency. The recent AWWARF-sponsored study by Michelson et al (1998) is an example of this. Two others were done by Stevens et al (1992) and Jordan and Elnagheeb (1993). In general, cross-sectional studies of this type are very difficult and the results are suspect for a variety of reasons, including:

Aggregate agency data tends to mask the extremes of customer usage, which are often a target of conservation rate designs.

It is difficult to capture the manner in which the rate design was implemented (e.g. the degree and type of public education) in the varying jurisdictions.

Demographic, lot size, and other differences among customers are also lost.

A "snapshot" of usage at one point in time cannot capture the differing dynamics of structural rate change in each agency.

Two of these three studies were able to detect little impact of rate structure. The other concluded that rate design did affect usage. These results should be used with extreme care.

A study performed by Jordan (1994) focuses on a small Georgia county that implemented an increasing block structure for both residential and commercial customers in 1991. Previously, both customer classes had had declining blocks. The study examined usage between the 1989-90 and 1991-93 periods. No other conservation programs were implemented during that period.

The study concluded that the rate structure resulted in statistically-significant per-connection usage reductions of 5% between the two periods. There were no significant weather differences between the periods. Moreover, it appears that the reductions were, in fact, due to the structural change in rates rather than an increase in the overall rate level.

Probably the most rigorous and defensible study to date on conservation rate effectiveness is that of Pekelney and Chesnutt (1997). This study examined four southern-California water providers that implemented water-budget-based rates to encourage conservation.[36] The study was cited above in descriptions of the programs of three of those four agencies.

---

[36] Usage analyses were only done for three of the four agencies.

The study first did a simple comparison of average annual irrigation water usage before and after implementation of the rate. The following table, reproduced from the report, summarizes those results:

PERIOD	AVERAGE ANNUAL SERVICE AREA IRRIGATION RATE (INCHES PER ACRE)		
	OTAY	IRVINE RANCH	CAPISTRANO VALLEY
Pre '88 – '90	28.71	52.16	28.35
Post '90	23.05	32.78	18.45
Difference	-5.66	-19.38	-9.90
Percent Change	-20%	-37%	-35%

These results, while striking, do not control for differences in weather or changing customer characteristics. A more detailed analysis was therefore done for one of the three agencies, the Capistrano Valley Water District. The result was that the weather-adjusted change in water use among customers of that agency who were present prior to the rate change was 18.6%.[37]

Discussion

Not surprisingly, these evaluation results are not conclusive. Many factors, analytical and otherwise, result in great variety and uncertainty in these results. That is the case for any effort to encourage customers to conserve water, whether that effort involves structural rate changes or toilet rebates. In both cases, the water provider is relying on actions on the customer's side of the meter. That is an inherently uncertain proposition.

There are many factors that may influence the effectiveness of conservation rates. Olstein (1993) presents (in David Letterman fashion) his "top 10" such factors, in reverse order of importance:

10. Level of per-capita water consumption
9. Housing distribution (single vs. multi-family)
8. Housing vintage
7. Extent of metering
6. Billing frequency
5. Other utilities included on the bill

[37] This may actually understate the impact of the rate structure, since it does not account for possible lower-water-using landscapes in new construction that result from to the new rate structure.

4. Availability of other conservation assistance
3. Socioeconomic level of customers
2. Public information programs
1. Size of water bill and relationship to household income

Olstein's point 4 emphasizes the point that conservation rates rarely are done in isolation, nor should they be. Analytically, this makes it almost impossible to separate the effects of the rate structure from other conservation programs or outreach efforts that occur simultaneously. The point, however, that Olstein makes is more than an analytical observation. He is saying that the effectiveness of conservation rates is enhanced by accompanying it with other types of conservation efforts. Others as well point out the potential synergies between conservation rates and complementary programs. (See, for example, Michelsen et al, 1998 and Pekelney and Chesnutt, 1997.)

Keys to Successful Conservation Rates

The literature provides suggestions that generally come from the experience of agencies that have implemented conservation rates. Following is a list of some keys that should not be ignored:

A conservation rate structure should be consistent with community characteristics. Olstein's "top 10 list" is particularly useful in this regard.

Conservation rates must be accompanied by strong and sustained customer education and outreach to facilitate customer acceptance and understanding. In fact, the customer outreach may be as important or more important than the details of the rate design itself.

Wherever possible, significant changes in rate structure should be implemented gradually through a phase-in over a period of years. (Cuthbert and Lemoine (1996))

Conservation rates and other conservation programs can reinforce each other if they are designed appropriately.

The timing of a new rate should be done strategically. For example, it may be a better idea to implement a rate whose effect will be most pronounced in the summer in the winter months. A crisis, such as that engendered by the California drought, is a particularly good time to put a major rate change into effect. (Pekelney and Chesnutt (1997))

For tiered rates, rate levels in the upper tiers should not be set too low or too high. Rates that are too low risk being ignored. If they are too high, the agency runs the risk of customers over-investing in conservation and a group of angry customers. (Pekelney and Chesnutt, 1997)

References

Ash, Tom. *Why a "Water Budget" Approach to Achieve Water Conservation Goals.* Irvine Ranch Water District. [Date unknown]

Black & Veatch Corporation. *California Water Charge Survey.* 1999

Chesnutt, Thomas W., Casey McSpadden, and John Christianson. "Revenue Stability Induced by Conservation Rates." Journal AWWA. January 1996

Chesnutt, Thomas W., Janice A. Beecher, Patrick C. Mann, Don M. Clark, W. Michael Hanemann, George A. Raftelis. *Designing, Evaluating, and Implementing Conservation Rate Structures.* California Urban Water Conservation Council. 1997

Collinge, Robert A. "Conservation Feebates". Journal AWWA. January 1996

Cuthbert, Richard W. "Effectiveness of Conservation-Oriented Water Rates in Tucson". Journal AWWA. March 1989

Cuthbert, Richard W. and Pamela R. Lemoine "Conservation-Oriented Water Rates". Journal AWWA. November 1996

Dziegielewski, Benedykt, Eva M. Opitz, Michael Hanemann, David L. Mitchell. *Urban Water Conservation Programs, Volume III: Experience and Outlook for Managing Urban Water Demands.* Planning and Management Consultants, Ltd. 1995

Hagler-Bailly and Jeffrey Jordan. *An Evaluation of Conservation Rate Structures: Final Report.* 1998

Jordan, Jeffrey L. "The Effectiveness of Pricing as a Stand-Alone Water Conservation Program". Water Resources Bulletin. October 1994

Jordan, Jeffrey L. and A.H. Elnagheeb. "Water Pricing in Georgia". Proceedings of 1993 Georgia Water Resources Conference. 1993

Michelson, Ari M., J. Thomas McGuckin and Donna M. Stumpf. *Effectiveness of Residential Water Conservation Price and Nonprice Programs.* AWWA Research Foundation. 1998

Mitchell, David L. and W. Michael Hanemann. *Setting Urban Water Rates for Efficiency and Conservation: A Discussion of Issues.* California Urban Water Conservation Council. 1994

Olstein, Myron. "Water Conservation Rate Structures". Proceedings of AWWA Annual Conference. San Antonio. 1993

Oregon Environmental Council. *Water Conservation: Is the Price Right?* 1998

Pekelney, David M. and Thomas W. Chesnutt. *Landscape Water Conservation Programs: Evaluation of Water Budget Based Rate Structures.* Prepared for Metropolitan Water District of Southern California. 1997

Pennsylvania-American Water Company. *Industrial Curtailment Rate Tariff Effective October 3, 1997.* 1997

Raftelis Environmental Consulting Group. *Water and Wastewater Rate Survey.* 1998

Stevens, T. H., Jonathan Miller, and Cleve Willis. "Effect of Price Structure on Residential Water Demand". Water Resources Bulletin. August 1992

Vista Consulting Group, Inc., Integrated Utilities Group, Inc., John Russell Associates, Inc. *Long-Term Effects of Conservation Rates.* AWWA Research Foundation and American Water Works Association. 1997

Washington Water Utilities Council, Washington State Department of Health, Economic and Engineering Services, Inc. *Conservation-Oriented Rates for Public Water Systems in Washington.* 1995