Urban Water Conservation Potential:

2003 Technical Update

Prepared for

California Urban Water Agencies

Prepared by

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FINAL REPORT

Foreword

California Urban Water Agencies
Board of Representatives

The 2001 CUWA study: *Urban Water Conservation Potential* (sometimes referred to as the "Phase 1 Study", available on CUWA's web site: http://www.cuwa.org) was initiated to generate an independent validation and update of CALFED estimates of agency-funded urban Best Management Practices (BMP) water conservation potential. Within a limited scope and budget, this study provided estimates of expected BMP-driven conservation savings under the California Urban Water Conservation Council's (CUWCC) *Memorandum of Understanding* and incorporated the key economic concept of cost-effective levels of BMP activity. The 2001 study was a good first step toward developing transparent, empirically grounded estimates of both practical conservation potential and the funding required to achieve these savings. The current study was motivated by a desire to address some of the data deficiencies and research needs identified in the 2001 study.

In addition to validating and improving the initial CUWA study, this study is intended to address some additional statewide planning needs that have emerged during the last several years. Both the DWR Bulletin 160 process and the CALFED Integrated Storage Investigations are conducting analyses that require forecasts of urban water demand and conservation potential through 2030. The modeling teams working on these projects expressed the desire to use common estimates of demand and conservation to the degree possible, and to use information that is more recent than demand and conservation estimates either from Bulletin 160-98 or from the CALFED Water Use Efficiency Technical Appendix.

Comments from CUWA agencies have previously identified several critical shortcomings of historical estimates of conservation potential. These include:

- Assumptions behind the estimates were not always transparent
- The methods behind the models were not always empirically well-grounded
- The assumptions used were not always based on the best empirically available data
- Estimates of conservation were not tied to activities needed to produce savings
- Estimated water conservation appeared unrealistically optimistic

STUDY RESULTS

Results support earlier CUWA research that substantial water savings will result from implementation of BMPs, as well as from naturally occurring conservation (where actions to conserve water are taken independent of incentive programs). Predicted water savings from BMP implementation decline over time in accordance with the water savings assumptions used by the CUWCC.

For historic measures (what the study calls "achieved conservation"), forecasted water savings by individual BMP reach a peak under current conditions, with savings attributed to agency conservation programs dropping off to very small amounts by 2030.

For forecasted savings from future implementation of current BMPs under several future funding scenarios, the potential water savings attributed to agency conservation programs reach their peak in 2020 and drop off by half by 2030. Table 2-14 from the report summarizes the results:

Table 2-14 Potential Conservation Savings
(AFY x1000)

	Year 2007		Year 2020		Year 2030	
Scenario	**Net**	**Gross**	**Net**	**Gross**	**Net**	**Gross**
Existing Conditions	379	767	454	1,073	236	1,004
Cost-Effective Implementation	433	820	581	1,200	313	1,080
Full Implementation	814	1,202	875	1,494	431	1,198

All assumptions are clearly delineated in the report. "Full implementation" means that additional funds are available beyond current sources to provide a greater level of cost sharing. "Net" conservation is that additional amount of water savings that results from implementation of active conservation programs. "Gross" conservation is the sum of net conservation, the savings resulting from naturally occurring conservation (e.g. plumbing code, changes in consumer preferences or conservation ethic, and technological change), and the savings resulting from "freeriders."

WHAT DOES THIS MEAN?

The attached study is an important addition to a number of studies of both water conservation potential and practical implementation that have either been completed or are under development. No one study currently depicts the full picture of what Californians can practically achieve with water conservation, but each study shows a piece of that puzzle. The attached study provides a solid update on water savings achieved from utility sponsored programs in the past, and the study forecasts future water savings from utilities implementing programs in the future. The programs evaluated are those that meet the requirements of the existing quantifiable BMPs. In addition, the study shows that the savings from water utility conservation programs will decline over time for both the "achieved conservation" from past programs and "potential conservation" from future programs. This forecasted decline in water savings is due in part to water savings decay (addressed in the report), and in part due to passive conservation efforts substituting for active conservation programs over time. For example, water savings from conservation programs that require behavior change from the participants are assumed to decay over time. A residential survey will teach a participant to manage landscape water more efficiently. However, as time passes after the survey, the customer is assumed to go back to old watering habits. For this reason, the savings for single-family surveys are assumed to decay at 15% each year. A good example of passive savings substituting for active is the ultra low flow toilet replacement programs. Since 1992 the plumbing code has required that replacement and new toilets meet the ULFT performance standards. This "passive" conservation will occur without the need for specific conservation programs. After the assumed 25-year life of the ULFT, water is still conserved, but the credit should not be attributed to utility-sponsored programs.

The drop off in forecasted conservation savings is striking in the graphs found in the attached report. Does this mean that conservation efforts ultimately don't save water? No. These forecasts are driven by life cycle and decay assumptions developed by the CUWCC, and in fact will drop to even lower levels if the analysis in our report were extended to 2040. We believe

that it is important for the CUWCC to revisit these assumptions, as well as address factors such as equipment maintenance and replacement in the context of the MOU's current BMPs.
As to the BMPs – the attached study forecasts water savings from only the existing BMPs, and only those specific BMPs that can currently be quantified. The list of BMPs and their provisions may change over time, which is likely to change any forecast of future water conservation savings.

ADDITIONAL COMMENTS

Earlier this year we asked several organizations to review a draft of this report. Their comments and the report responses are included as Appendix B to this report. There were a number of excellent suggestions for future opportunities for research in this important area. There were also several concerns about the scope of this study – that it was limited to existing BMPs that do not capture a full range of potential water use efficiency savings.

This study considers the existing set of BMPs because, following the logic of the Phase 1 study, our goal has been to develop an empirically grounded estimate of conservation potential available from these BMPs. This study kept as close as possible to accepted assumptions and to CUWCC's estimates of BMP-related savings. The existing BMPs have been CALFED's primary reference point for the amount of conservation that might be achieve through utility-funded programs, so it was an appropriate reference point. While there are new technologies that may eventually become BMPs, an important difference between a technology and a BMP is that BMPs include implementation schedules and coverage requirements. It is these additional characteristics, combined with information about the cost of program implementation, that make it feasible to assess the cost-effectiveness of a BMP--as distinct from the cost-effectiveness of a technology--for a set of utilities. But we agree that there are water savings measures that go beyond the existing Memorandum of Understanding, and in many cases are being implemented by water utilities and individual water users.

CUWA believes in investing in solid empirical assessments of water resource alternatives, including water use efficiency. The "*2003 Technical Update*" of the conservation potential study seeks to address current shortcomings by building upon the 2001 *CUWA Urban Water Conservation Potential* study. The main analytic work under this project was brought to a halt at the end of 2003 in the interest of getting this information out in a timely fashion. It does not, therefore, reflect any changes in assumptions that have occurred since that time. CUWA as an organization, and all of its member agencies, remain committed to making conservation work as an important water management and reliability tool. We recommend further that CUWA continue to be engaged in water conservation activities, particularly from the perspective of urban water utilities that have a dominant role in implementing real-world conservation programs.

Sincerely,

Steve Macaulay, Executive Director, on behalf of
CUWA Conservation Project Advisory Committee

Preface

Members of the Project Advisory Committee include:

Steve Macaulay	California Urban Water Agencies
Chris Dundon	Contra Costa Water District
Richard Harris	East Bay Municipal Utility District
Bill Jacoby	San Diego County Water Authority
Michael Hollis	Metropolitan Water District of Southern California
Hossein Ashktorab	Santa Clara Valley Water District

Mary Ann Dickinson, Executive Director of the California Urban Water Conservation Council, was an advisor to the study and the PAC at CUWA's request.

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Summary

Objectives of This Study

There are several objectives of this study:

1. To validate and refine the data, methods, and enactment of the original 2001 CUWA study: *Urban Water Conservation Potential*
2. To develop estimates of conservation potential that embed CALFED's current work on common storage analysis. This involves the use of CALFED-derived scenario analysis and an extended planning horizon from 2020 to 2030.
3. To collect and consistently estimate the amount of urban water savings attributable to historical water conservation programs pioneered by urban water agencies in California.
4. To develop modeling tools–tightly integrated and adaptable–to more readily support changes in the data and assumptions that drive estimates of historical or future water conservation.

Emphases of the CUWA Conservation Potential Studies

- **Field-tested and rigorously evaluated water savings estimates** are used where available.
- **Agency-specific data** is used where available, summarized to "hydrologic" regions employed in state planning efforts. (This is needed for applicability and policy relevance in statewide water resources decision-making.)
- **Water agency perspective:** As a work product of the California Urban Water Agencies this work takes a water agency perspective.
- **Methods and models consistent with the California Urban Water Conservation Council** (CUWCC) Best Management Practice (BMP) requirements. This is an estimate of what would be achieved under varying levels of BMP implementation from the agencies perspective.
- **Results summarized by BMP's**–the actions required to produce the water savings (this makes conservation real.)
- **A clean distinction between "active" and "passive" water conservation**. Active conservation programs need to be attached to *only* the additional increment of water savings they produce, over and beyond what would happen anyway (passive water conservation). This is the evaluation standard that publicly financed programs are held to: What are the additional benefits produced by a program over and beyond what would happen in its absence?
- **Focus on the economics of water conservation**–Analogous to the concept of an economic "leakage level" used in designing distribution system leak detection and repair programs, the objective is to find the economic level of water conservation.

This economic concept lies at the heart of defining cost-effective water conservation. (The focus on economics is important to inform discussions of who is to pay for water use efficiency, how much should be invested in WUE, and exactly where it should be spent.)

Results

This report supports the earlier CUWA research that indicated substantial conservation savings potential in California from the Best Management Practices (BMPs) implemented pursuant to the MOU and from naturally occurring conservation. The results of the updated analysis (Chapter 2) show 875,000 AFY of net conservation in the Year 2020 for a scenario that involves full implementation of the included BMPs. Net conservation is savings driven by BMP active conservation programs. The estimate of gross conservation savings in 2020 is 1,494,000 AFY for the full implementation scenario. Gross savings includes additional savings due to plumbing code, consumer preferences and conservation ethic, and technological change (naturally occurring conservation [NOC]). For the year 2030, the results show 431,000 AFY of net conservation—and 1,198,000 AFY of gross conservation—for the full implementation scenario.

Whereas Chapter 2 of this document contains estimates of conservation *potential* derived from BMPs, Chapter 3 contains estimates of *achieved* conservation. Conservation potential described in Chapter 2 is savings that result from the BMPs assuming their coverage goals and specified levels of implementation over their required term (e.g., from 1998 to the future year when the BMP is fulfilled.) In contrast, conservation achieved is that which has already been implemented to date and which can be documented empirically. In other terms, Chapter 3 documents some of the progress toward achieving California's conservation potential in practice. (Note that the results from Chapters 2 and 3 are not directly comparable because: 1) Chapter 3 contains only a subset of the BMPs included in Chapter 2 for which data could be collected, 2) Chapter 3 contains data from only 5 agencies, and 3) because Chapter 3 includes savings achieved from implementing conservation in years before the MOU was implemented.)

Observations about Results

The reader should note that the volume of conservation in Chapter 2 – Conservation Potential in 2030 is less than the level in 2020 for three reasons: (1) the water savings from BMPs have life spans and/or decay rates, (2) this report only examines an existing set of BMPs that define a fixed level of implementation (e.g. fixed coverage levels), and (3) this report does not estimate savings from potential BMPs (PBMPs) or as yet unforeseen future BMPs. Appendix A provides graphic illustrations of savings patterns over time.

The reader should also note a similar if not more pronounced pattern of water savings decay when examining the estimated water savings resulting from conservation programs that have been implemented in the past (Chapter 3 – Achieved Conservation). Because achieved conservation activity data stop in 2002, nearly all of the assumed savings life spans are exceeded by 2030 and the remaining net conservation is small. This is a direct consequence of the assumed savings life spans and decay rates.

Since the estimates are based on disaggregate summations of individual BMPs – each of which is associated with water savings assumptions, geographically different socio-demographic data, and coverage rates—there is no fixed relationship between net and gross conservation.

This report supports the earlier CUWA research that indicated substantial conservation savings potential in California from the Best Management Practices (BMPs) implemented pursuant to the MOU and from naturally occurring conservation. The results of this report cannot be validly interpreted to mean that no additional cost-effective conservation potential exists, that the existing BMP's could not be implemented at more or less cost effective level, or that no more cost-effective WUE investments exist. Rather, it is a detailed simulation of the water savings predicted to result from implementation of eight existing BMP's.

Important Caveats

The ability of water agencies to actually achieve the water savings summarized in this report depends critically on program implementation issues not accounted for by the study. The problematic reliability of existing information about water savings attributable to utility-funded conservation programs is generally recognized. While the best available data have been used in this study, existing data limitations directly affect the precision with which it is possible to estimate future water savings.

1. Introduction

Study Objectives

The California Urban Water Agencies (CUWA) previously supported a study of urban water conservation savings. In particular, the analysis documented in *Urban Water Conservation Potential: Final Report* [1] ("Phase 1") derived savings expected from the Best Management Practices (BMPs) as defined by the Memorandum of Understanding Regarding Urban Water Conservation in California (MOU). Estimates of the maximum potential savings from a subset of the BMPs were developed, and economic results were generated regarding questions of cost-effectiveness and financial contributions.

The analysis documented in this report ("Phase 2") provides technical updates, and assessment of follow-on questions that extend from the earlier work. In particular, the objectives of the analysis documented in this report include:

- Extend the earlier estimates of urban water conservation from an end date of 2020 to the Year 2030;
- Add a model of conservation savings for BMP 6 and the ULF toilets portion of BMP 9;
- Run three future scenarios regarding existing conditions, cost-effective BMP implementation, and full implementation of BMPs;
- Evaluate critically the avoided cost method used in the earlier study; and
- Attempt to estimate conservation achieved and documented to date.

In conducting these analyses, this work is intended to supplement rather than replace that summarized in the previous report. Phase 2 includes all of the BMPs included in Phase 1, and two additional BMPs have been added. Additionally, all spreadsheet models have been significantly revised to allow for tighter integration, easier implementation and better validation of model results.

The objectives of the Phase 1 study and this technical update differ from those of other recent studies of regional conservation in that they are statewide[2] and focused in particular on existing BMPs.

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[1] Fiske & Associates, et al., "California Urban Water Agencies Urban Water Conservation Potential," prepared for California Urban Water Agencies, June 2001, reprinted August 2003.
[2] E.g., BAWAC Conservation Study, URL: http://www.rmcengr.com/projects/wst/bawac.htm, February 10, 2004.

Scenario Definitions

The scenarios included in this analysis are defined as follows:

Scenario 1: Existing Conditions

- Not all agencies implement BMPs
- Not all BMPs implemented at agencies that implement (only BMPs locally cost-effective are implemented)
- Prop 204, 13, and 50 money used to cost share (improve local cost-effectiveness)

Scenario 2: Cost-Effective BMP Implementation

- All agencies implement BMPs
- All BMPs implemented if locally cost-effective
- Prop 204, 13, and 50 money used to cost share (improve local cost-effectiveness)

Scenario 3: Full Implementation

- All agencies implement BMPs
- All BMPs implemented fully (without consideration of cost), starting the first year of analysis
- Prop 204, 13, and 50 money used to cost share
- More money available from CALFED to cost share

For Scenario 1, "not all agencies" means signatories, and only signatories that actually implement the BMPs. For Scenarios 2 and 3, "all agencies" means all signatory and non-signatory agencies with greater than 20,000 customers.[3] Scenarios 1 and 2 are intended to match as closely as reasonably possible to Projection Levels 1, and 2 respectively listed in the CALFED memo dated Sept. 18 2003.[4] Scenario 3 reflects full implementation without regard to cost-effectiveness.

Limitations to this Analysis

Several general limitations apply to this study:

The various data sources used in this analysis each have significant limitations and corresponding uncertainty. The reader should bear in mind that when better information becomes available, the results could be presented with greater certainty. The results should be presented only with appropriate interpretation and caveats.

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[3] Some proposals that would require cost-effective BMP implementation would apply to agencies with greater than 20,000 customers and reporting only for those with between 3,000 and 20,000 customers.

[4] Mitchell, David, "Urban Water Use Efficiency Projection Levels for Comprehensive Review." Memorandum to Tom Gohring, Deputy Director, CBDA, September 18, 2003.

The unit of analysis is the hydrologic region. Estimates of savings, costs, and avoided costs are not meant to reflect the conditions of a single agency, but rather to be representative within the hydrologic region. This analysis is not intended to be applied to a single agency for planning or MOU implementation purposes.

This study is restricted to a subset of the BMPs. Thus, it does not represent the entire savings potential or achieved conservation as prescribed by the MOU. The term "full implementation" is used in this report to refer only to full implementation of the included BMPs.

The cost-effectiveness calculations were conducted from the perspective of the local supply agency. Neither wastewater avoided costs, other potential cost sharing arrangements (power, gas, etc.), or environmental benefits (internal or external) are included as they would for the purpose of a BMP exemption process pursuant to the MOU.

Additional more specific caveats are included at the end of each subsequent chapter.

2. Conservation Potential

Gross and Net Savings

As in the earlier CUWA analysis, the present work considers both "gross" and "net" conservation savings. "Net" savings is defined as only the additional savings derived from implementation of active conservation programs. Gross savings includes all savings related to a BMP—both those derived from naturally occurring conservation (e.g., plumbing code, changes in consumer preferences or conservation ethic, and technological change) and those derived from active conservation programs. This definition of "net" conservation accords with the evaluation practice of defining a program's impact as the difference between what would happen if the program is implemented and what would happen if the program is not implemented. Published estimates of water conservation are too often blurry on this basic conceptual distinction.

Table 2-1 provides further detail on the specific items included in gross and net savings for the BMPs included in this analysis. Note that BMP 6 net conservation includes the incremental savings from active conservation programs specified in the recent draft BMP.[5] BMPs 2, 6, and 14 also include natural replacement in their estimates of gross conservation savings. Forecasting natural replacement of high efficiency washers is difficult given the rapid technological change in high efficiency washers, which is in turn likely to be driven by regulatory changes in the energy efficiency code and/or the plumbing code. BMP 4 has been parsed into active conservation (retrofits) and meters in new growth areas that traditionally have been unmetered (assuming all new growth is metered and consumption is billed volumetrically).

Table 2-1 – Net and Gross Savings

BMP	Net Savings	Gross Savings
1	Savings from active survey programs	Savings from active survey programs
2	Savings from active showerhead programs	Savings from active showerhead programs plus plumbing code
3	Savings from system audits and leak detection	Savings from system audits and leak detection
4	Savings from retrofit meters only	Savings from retrofit meters and meters in new growth areas
5 (budget)	Savings from water budgets, dedicated meters	Savings from water budgets, dedicated meters
5 (survey)	Savings from surveys, mixed meters	Savings from surveys, mixed meters
6	Savings from active HE washer programs	Savings from active HE washer programs plus natural replacement
9 (surv)	Savings from active CII surveys	Savings from active CII surveys
9 (ULFT)	Savings from active ULFT programs	Savings from active ULFT programs plus plumbing code
14	Savings from active ULFT programs	Savings from active ULFT programs plus plumbing code

[5] BMP 6 Draft Revision, Version 2003H, October 2003.

Best Management Practices and Levels of Conservation Implementation

Scenario 1 includes existing conditions regarding the scope and scale of BMP implementation. This analysis defines the scope and scale of implementation to include suppliers who are signatories to the MOU and their existing level of BMP reporting.[6] Scenarios 2 and 3 assume that all signatory and non-signatory suppliers in California implement the BMPs as specified in the MOU. Scenario 2 starts with existing level of BMP reporting and quickly ramps up to full implementation; Scenario 3 assumes full implementation of BMP measures from the first year of analysis. The local cost-effectiveness exemption is still a constraint in Scenario 2. Scenario 3 does not include the cost-effectiveness exemption; implementation is full regardless of cost-effectiveness.

To model the effects of BMP implementation and its impact on conservation statewide, parameters were specified to depict the assumed scale and scope of BMP implementation (Table 2-2) across the three scenarios. Table 2-2 contains columns for each of the three scenarios and rows to represent the extent of BMP implementation by year (before cost-effectiveness criteria are applied). Equal levels of implementation are assumed for each BMP in a given year. The parameter values in the table represent the percent implementation, where full implementation is as defined in Scenarios 3—all signatory and non-signatory agencies implementing all the included BMPs.

To illustrate, the Existing Conditions Scenario 1 includes percentage values that represent the level of implementation with existing conditions. The percentages from 1999 to 2002 were derived by looking at the proportion of the state population[7] served by water agencies that are MOU signatories (as indicated by CUWCC BMP Reporting Units that submit BMP reports).[8]

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[6] BMP reporting is assumed to be a proxy for BMP implementation. Considering there is not a complete correspondence between the two, the analysis uses this assumption as a placeholder in lieu of better information. Scenario 1, for example, specifies that not all BMPs are necessarily implemented by agencies that implement the MOU; however resource and data constraints prevented the development of a parameter based on empirical evidence.

[7] Potential requirements for cost-effective BMP implementation are likely to have a small agency reporting threshold—perhaps 20,000 customers or less. The proportions here are calculated as a share of total state population rather than a proportion of the state population served by agencies with greater than 20,000 customers. Thus, the percentages in the table are smaller than they would be if calculated as a share only of population served by agencies with greater than 20,000 customers. Due to data and budget constraints, this analysis did not refine these estimates.

[8] The same limitation of the correspondence between BMP reporting and implementation applies here as described previously.

Table 2-2 Estimated Coverage Parameters:
Scale and Scope of Implementation (Population Weighted)

Year	Existing Conditions	Cost-Effective BMP Implementation	Full Implementation
1998	49%	49%	100%
1999	50%	50%	100%
2000	51%	51%	100%
2001	53%	53%	100%
2002	54%	54%	100%
2003	56%	56%	100%
2004	57%	57%	100%
2005	59%	59%	100%
2006	60%	100%	100%
2007	62%	100%	100%
2008	63%	100%	100%
2009	65%	100%	100%
2010	66%	100%	100%
2011	68%	100%	100%
2012	69%	100%	100%
2013	71%	100%	100%
2014	72%	100%	100%
2015	74%	100%	100%
2016	75%	100%	100%
2017	77%	100%	100%
2018	78%	100%	100%
2019	80%	100%	100%
2020	81%	100%	100%
2021	83%	100%	100%
2022	84%	100%	100%
2023	86%	100%	100%
2024	87%	100%	100%
2025	89%	100%	100%
2026	90%	100%	100%
2027	92%	100%	100%
2028	93%	100%	100%
2029	95%	100%	100%
2030	96%	100%	100%

Notes: 1999 to 2002 based on the proportion of population in BMP Reported service areas to state population as per CA DOF. Calculated proportions are understated in that implementation to cost-effective levels may be required only of suppliers with greater than 20,000 customers. Subsequent years increase by 1.5 percent.

Subsequent growth in implementation is assumed to be 1.5 percent per year—which achieves 96% by 2030—a placeholder assumption in lieu of other information. In contrast, Scenario 2 assumes cost-effective BMP implementation is fully effective in 2006.[9] Scenario 3 assumes full implementation over the entire period of analysis. Table 2-2 represents the estimated coverage levels before considering cost-effectiveness. When the cost-effectiveness criterion is applied in Scenarios 1 and 2, a BMP is not implemented in the model for any region for which it is not cost-effective.

Note that Phase 1 analyses assumed the full scope and scale of implementation (before cost-effectiveness criteria were applied) for the entire period of analysis (consistent with Phase 2's Scenario 3).

Demographic Data Update

Data on the number of single family and multiple households was updated in the analysis using Census 2000 data as available from the California Department of Finance. Table 2-3 shows the map of associations between California counties and hydrologic regions used to assign county-level figures to the hydrologic region. Tables 2-4 and 2-5 show the separate results for single-family and multi-family housing units. Single-family units are comprised of detached houses. Multi-family is comprised of attached and those with 2 or more units. Mobile homes and "other" are not included.

[9] As of the writing of this document, 2006 is the best estimate of when cost-effective BMP implementation may be required, according to PAC sources.

Table 2-3 Counties to Hydrologic Regions

COUNTY	HYDROLOGIC REGION
Alameda	San Francisco Bay
Alpine	North Lahonton
Amador	San Joaquin River
Butte	Sacramento River
Calaveras	San Joaquin River
Colusa	Sacramento River
Contra Costa	San Francisco Bay
Del Norte	North Coast
El Dorado	Sacramento River
Fresno	Tulare Lake
Glenn	Sacramento River
Humboldt	North Coast
Imperial	Colorado River
Inyo	South Lahonton
Kern	Tulare Lake
Kings	Tulare Lake
Lake	Sacramento River
Lassen	North Lahonton
Los Angeles	South Coast
Madera	San Joaquin River
Marin	San Francisco Bay
Mariposa	San Joaquin River
Mendocino	North Coast
Merced	San Joaquin River
Modoc	Sacramento River
Mono	South Lahonton
Monterey	Central Coast
Napa	San Francisco Bay
Nevada	Sacramento River
Orange	South Coast
Placer	Sacramento River
Plumas	Sacramento River
Riverside	South Coast
Sacramento	Sacramento River
San Benito	Central Coast
San Bernardino	South Coast
San Diego	South Coast
San Francisco	San Francisco Bay
San Joaquin	San Joaquin River
San Luis Obispo	Central Coast
San Mateo	San Francisco Bay
Santa Barbara	Central Coast
Santa Clara	San Francisco Bay
Santa Cruz	Central Coast
Shasta	Sacramento River
Sierra	Sacramento River
Siskiyou	North Coast
Solano	Sacramento River
Sonoma	North Coast
Stanislaus	San Joaquin River
Sutter	Sacramento River
Tehama	Sacramento River
Trinity	North Coast
Tulare	Tulare Lake
Tuolumne	San Joaquin River
Ventura	South Coast
Yolo	Sacramento River
Yuba	Sacramento River

Table 2-4 Single Family Housing Stock by Hydrologic Region

Year	Central Coast	San Francisco Bay	Sacramento River	San Joaquin River	Tulare Lake	South Coast	South Lahonton
1990	266,967	1,028,814	640,669	303,265	362,347	3,075,716	6,874
1991	270,584	1,042,093	658,636	312,666	374,740	3,142,027	6,879
1992	274,837	1,060,146	672,693	320,212	386,340	3,207,511	6,915
1993	276,085	1,072,975	681,765	325,891	392,990	3,235,964	7,001
1994	276,146	1,081,008	687,413	329,836	399,119	3,265,880	7,084
1995	278,792	1,089,006	694,109	333,745	405,701	3,292,634	7,073
1996	280,389	1,105,401	700,640	337,888	411,769	3,318,631	6,970
1997	287,680	1,128,090	711,031	343,856	417,512	3,376,884	6,984
1998	293,651	1,146,924	725,968	351,805	424,752	3,431,041	6,999
1999	299,012	1,163,970	742,823	360,557	432,819	3,487,664	7,037
2000	304,384	1,180,384	760,559	369,989	441,111	3,546,357	7,093
2001	310,286	1,197,156	778,747	379,615	450,680	3,602,904	7,152
2002	316,135	1,213,185	796,711	389,208	460,298	3,658,487	7,205
2003	322,040	1,228,599	814,807	398,928	470,113	3,712,924	7,261
2004	328,077	1,242,651	832,428	408,395	479,791	3,764,729	7,320
2005	333,662	1,254,007	849,309	417,500	488,811	3,809,773	7,387
2006	339,341	1,263,984	864,868	426,732	497,959	3,855,724	7,445
2007	345,512	1,275,881	881,214	436,576	508,013	3,908,124	7,503
2008	351,807	1,287,675	897,687	446,573	518,272	3,960,700	7,569
2009	358,195	1,299,359	914,139	456,690	528,787	4,013,523	7,641
2010	364,889	1,310,683	930,484	466,757	539,457	4,066,372	7,704
2011	371,074	1,317,997	944,621	475,683	549,143	4,111,636	7,762
2012	377,339	1,325,164	958,720	484,658	558,953	4,157,821	7,816
2013	383,743	1,332,398	972,896	493,724	568,978	4,205,715	7,874
2014	390,250	1,339,608	987,065	502,864	579,160	4,255,009	7,929
2015	397,690	1,350,444	1,003,191	513,068	590,806	4,316,923	8,000
2016	405,013	1,360,834	1,018,666	523,037	602,708	4,382,659	8,071
2017	412,511	1,371,392	1,034,303	533,143	614,805	4,449,386	8,139
2018	420,157	1,382,100	1,050,093	543,419	627,107	4,516,920	8,216
2019	427,924	1,392,873	1,065,934	553,780	639,575	4,584,982	8,287
2020	435,763	1,403,796	1,081,764	564,210	652,303	4,652,862	8,363
2021	443,686	1,414,718	1,097,615	574,709	665,169	4,721,395	8,432
2022	451,683	1,425,611	1,113,478	585,278	678,165	4,790,330	8,507
2023	459,776	1,436,492	1,129,337	595,924	691,299	4,859,735	8,582
2024	467,946	1,447,284	1,145,228	606,663	704,577	4,929,580	8,660
2025	476,209	1,458,020	1,161,162	617,491	718,017	4,999,859	8,733
2026	484,558	1,468,644	1,177,076	628,388	731,609	5,070,508	8,808
2027	492,963	1,479,113	1,192,935	639,386	745,340	5,141,307	8,886
2028	501,466	1,489,454	1,208,862	650,451	759,227	5,212,386	8,967
2029	510,062	1,499,665	1,224,830	661,638	773,285	5,283,879	9,046
2030	518,765	1,509,771	1,240,860	672,924	787,543	5,355,858	9,127

Notes: (1) Assumes constant ratio between SF population and total population. This ratio is estimated for each county from Census 2000 data. (2) Assumes constant SF PPH. SF PPH is estimated for each county from Census 2000 data.

Table 2-5 Multi-Family Housing Stock by Hydrologic Region

Year	Coast	Francisco	River	River	Tulare Lake	South Coast	Lahonton
1990	134,867	914,177	250,399	90,175	129,026	2,507,791	2,400
1991	136,785	924,302	257,174	92,846	133,447	2,555,912	2,397
1992	138,928	938,799	262,287	94,997	137,582	2,605,284	2,419
1993	139,413	950,378	265,462	96,532	139,974	2,624,804	2,472
1994	139,286	956,371	267,386	97,676	142,105	2,647,693	2,512
1995	140,528	961,189	269,558	98,933	144,493	2,666,309	2,502
1996	141,184	977,480	272,304	100,213	146,801	2,685,864	2,476
1997	144,904	995,749	276,201	101,955	148,804	2,731,922	2,480
1998	147,716	1,010,713	281,477	104,275	151,308	2,771,085	2,487
1999	150,210	1,023,830	287,487	106,809	154,064	2,812,059	2,506
2000	152,696	1,036,070	293,754	109,528	156,876	2,854,507	2,534
2001	155,485	1,048,309	300,265	112,335	160,171	2,893,392	2,566
2002	158,254	1,059,727	306,714	115,137	163,482	2,931,329	2,594
2003	161,054	1,070,411	313,216	117,978	166,859	2,968,029	2,622
2004	163,907	1,079,915	319,533	120,748	170,189	3,002,695	2,650
2005	166,529	1,086,791	325,545	123,382	173,282	3,031,582	2,681
2006	169,229	1,092,594	331,151	126,131	176,411	3,060,892	2,709
2007	172,187	1,100,321	337,079	129,074	179,863	3,095,557	2,736
2008	175,208	1,107,954	343,048	132,062	183,387	3,130,244	2,768
2009	178,292	1,115,465	349,031	135,082	186,997	3,164,881	2,801
2010	181,522	1,122,678	354,986	138,097	190,662	3,199,449	2,830
2011	184,524	1,126,201	360,169	140,785	193,972	3,227,455	2,857
2012	187,570	1,129,599	365,348	143,487	197,325	3,256,189	2,883
2013	190,689	1,133,022	370,564	146,222	200,752	3,286,214	2,911
2014	193,868	1,136,417	375,788	148,979	204,233	3,317,326	2,937
2015	197,530	1,143,202	381,794	152,069	208,232	3,358,738	2,969
2016	201,167	1,149,651	387,611	155,099	212,332	3,402,758	3,002
2017	204,894	1,156,228	393,483	158,173	216,498	3,447,381	3,031
2018	208,697	1,162,907	399,421	161,299	220,732	3,492,421	3,065
2019	212,567	1,169,622	405,381	164,452	225,020	3,537,720	3,096
2020	216,477	1,176,397	411,348	167,625	229,408	3,582,601	3,129
2021	220,434	1,183,146	417,328	170,820	233,841	3,627,862	3,158
2022	224,433	1,189,869	423,314	174,038	238,314	3,673,271	3,190
2023	228,484	1,196,558	429,308	177,279	242,832	3,718,882	3,222
2024	232,578	1,203,170	435,313	180,549	247,394	3,764,666	3,255
2025	236,721	1,209,703	441,335	183,844	252,009	3,810,617	3,286
2026	240,912	1,216,129	447,356	187,162	256,673	3,856,674	3,316
2027	245,135	1,222,420	453,344	190,506	261,381	3,902,646	3,348
2028	249,410	1,228,558	459,370	193,872	266,138	3,948,639	3,380
2029	253,736	1,234,549	465,418	197,273	270,950	3,994,757	3,412
2030	258,119	1,240,426	471,481	200,705	275,827	4,041,063	3,443

Notes: (1) Assumes constant ratio between SF population and total population. This ratio is estimated for each county from Census 2000 data. (2) Assumes constant SF PPH. SF PPH is estimated for each county from Census 2000 data.

Depiction of Potential State and Federal Funding

Our analysis depicts state and federal funds as an offset to the costs born by local water agencies; this increases the cost-effectiveness of conservation activities from the local water agency perspective. (There are also caveats listed at the end of this section pertaining to the modeling of these funds). For Scenarios 1 and 2, the state funds included in the analysis are derived from funds granted pursuant to Propositions 204, 13, and 50. The PAC provided guidance for this assumption: lacking a better assumption, future funding was assumed to reflect historical allocation priorities to provide a base case. Proposition 50 funding is intended to be about $15 million per year[10]. Scenario 3 is defined as full implementation without regard to cost-effectiveness. One may realistically assume that actual implementation of Scenario 3 wouild include future CALFED funding. (This report does not analyze the sufficiency of this or other future funding levels.)

For the purpose of this analysis, Propositions 204 and 13 grant funds already allocated were assigned a BMP category and tabulated by BMP and by Hydrologic Region (Table 2-6). Table 2-6 values were used to derive the historical allocation of funds across regions and BMPs (Table 2-7). These historical shares were then used to estimate the possible future allocation of Proposition 50 funds and of planned future CALFED funding (Table 2-8). Note that Table 2-8 allocates only 75 percent of the funds because 25 percent is slated for uses other than the BMPs examined in this analysis.

Table 2-9 shows Propositions 204 and 13 funds assumed evenly distributed over two analysis years (2001 and 2002). The even distribution in historical funds displayed over two years was assumed because only dates of grant allocation have been collected; the dates of actual implementation have not been collected. Proposition 50 funds are also assumed evenly distributed over two analysis years (2004 and 2005). Future planned CALFED funding is assumed to be at annual levels similar to the Proposition 50 annual levels (not distributed over two years) and to continue through 2015.[11] CALFED allocations for the other regions can be found in the working spreadsheets.

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[10] *Op. cit*., pages 9 and 10. If the actual level of CALFED funding turns out to be less, savings from active conservation will be reduced accordingly.

[11] These allocation assumptions are the author's interpretation of the PAC discussion and consensus of a reasonable depiction of a possible future outcome based on their knowledge of the CALFED process. Other reasonable interpretations exist.

Table 2-6 Tabulation of Propositions 204 and 13 Grants by BMP and Hydrologic Region

	Analysis BMPs							
Analysis Hydro Regions	1	3	4	5	6	9	14	Total
San Francisco Bay	$50,000	$0	$0	$506,000	$1,750,875	$185,000	$150,000	$2,641,875
Central Coast	$0	$959,029	$0	$0	$0	$0	$0	$959,029
Sacramento River	$0	$1,066,310	$49,000	$150,000	$0	$0	$60,000	$1,325,310
South Lahontan	$0	$0	$0	$0	$0	$0	$70,000	$70,000
Tulare Lake	$0	$1,925,000	$0	$0	$0	$0	$0	$1,925,000
North Coast	$0	$0	$0	$0	$0	$0	$0	$0
San Joaquin River	$0	$0	$0	$0	$0	$0	$44,000	$44,000
South Coast	$43,470	$0	$0	$146,278	$1,649,000	$1,375,779	$0	$3,214,527
Total	$93,470	$3,950,339	$49,000	$802,278	$3,399,875	$1,560,779	$324,000	$10,179,741

Notes: BMP 4 funds are included for Sacramento River, San Joaquin River, and Tulare Lake only. Other regions grant funds are omitted for BMP 4 pending PAC decision to expand BMP 4 beyond Sacramento River, San Joaquin River, and Tulare Lake. Assumes that Sacramento Valley and Delta comprise Sacramento River category. BMP assignment approximated from project descriptions in the data base. Projects not associated with the BMPs included in this analysis have been excluded.

Table 2-7 Historical Distribution Shares

	Analysis BMPs							
Analysis Hydro Regions	1	3	4	5	6	9	14	Total
San Francisco Bay	0.49%	0.00%	0.00%	4.97%	17.20%	1.82%	1.47%	25.95%
Central Coast	0.00%	9.42%	0.00%	0.00%	0.00%	0.00%	0.00%	9.42%
Sacramento River	0.00%	10.47%	0.48%	1.47%	0.00%	0.00%	0.59%	13.02%
South Lahontan	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.69%	0.69%
Tulare Lake	0.00%	18.91%	0.00%	0.00%	0.00%	0.00%	0.00%	18.91%
North Coast	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
San Joaquin River	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.43%	0.43%
South Coast	0.43%	0.00%	0.00%	1.44%	16.20%	13.51%	0.00%	31.58%
Total	0.92%	38.81%	0.48%	7.88%	33.40%	15.33%	3.18%	100.00%

Table 2-8 Prop 50 and Subsequent Calfed Funding ($/yr)

Analysis Hydro Region:	Analysis BMPs 1	3	4	5	6	9	14	Total
San Francisco Bay	$ 55,257	$ -	$ -	$ 559,199	$ 1,934,955	$ 204,450	$ 165,770	$ 2,919,632
Central Coast	$ -	$ 1,059,858	$ -	$ -	$ -	$ -	$ -	$ 1,059,858
Sacramento River	$ -	$ 1,178,418	$ 54,152	$ 165,770	$ -	$ -	$ 66,308	$ 1,464,648
South Lahontan	$ -	$ -	$ -	$ -	$ -	$ -	$ 77,360	$ 77,360
Tulare Lake	$ -	$ 2,127,387	$ -	$ -	$ -	$ -	$ -	$ 2,127,387
North Coast	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
San Joaquin River	$ -	$ -	$ -	$ -	$ -	$ -	$ 48,626	$ 48,626
South Coast	$ 48,040	$ -	$ -	$ 161,657	$ 1,822,370	$ 1,520,423	$ -	$ 3,552,490
Total	$ 103,297	$ 4,365,663	$ 54,152	$ 886,626	$ 3,757,325	$ 1,724,873	$ 358,064	$11,250,000

Table 2-9 - Example of State and Federal Funds Model Allocation (San Francisco Bay)

Prop 204, 13, and 50 Funds

	BMP 1 (SF)	BMP 1 (MF)	BMP 2 (SF)	BMP 2 (MF)	BMP 3	BMP 4	BMP 5 (Bud)	BMP 5 (Surv)	BMP 6	BMP 9 (surv)	BMP 9 (ulft)	BMP 14 SF (Reb)	BMP 14 MF (Reb)
1999	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2000	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2001	$ 25,000	$ -	$ -	$ -	$ -		$ 126,500	$ 126,500	$ 875,438	$ 92,500	$ -	$ 37,500	$ 37,500
2002	$ 25,000	$ -	$ -	$ -	$ -		$ 126,500	$ 126,500	$ 875,438	$ 92,500	$ -	$ 37,500	$ 37,500
2003	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2004	$ 27,628	$ -	$ -	$ -	$ -		$ 139,800	$ 139,800	$ 967,478	$ 102,225	$ -	$ 41,443	$ 41,443
2005	$ 27,628	$ -	$ -	$ -	$ -		$ 139,800	$ 139,800	$ 967,478	$ 102,225	$ -	$ 41,443	$ 41,443
2006	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2007	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2008	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2009	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2010	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -

Note: BMP 14 allocation splits SF and MF 50/50, and uses only one delivery mechanism at a time (Reb, Dir, or Ord). BMP 5 splits budgets and surveys 50/50. Other comibinations are possible with further data development.

CALFED Funds

	BMP 1 (SF)	BMP 1 (MF)	BMP 2 (SF)	BMP 2 (MF)	BMP 3	BMP 4	BMP 5 (Bud)	BMP 5 (Surv)	BMP 6	BMP 9 (surv)	BMP 9 (ulft)	BMP 14 SF (Reb)	BMP 14 MF (Reb)
2004	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2005	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
2006	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2007	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2008	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2009	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2010	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2011	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2012	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2013	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2014	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885
2015	$ 55,257	$ -	$ -	$ -	$ -		$ 279,599	$ 279,599	$ 1,934,955	$ 204,450	$ -	$ 82,885	$ 82,885

Cost Assumptions

Table 2-10 shows the BMP program implementation cost assumptions used in the analysis. These cost estimates are based on the best available information about typical implementation costs. The actual costs incurred by individual agencies could differ substantially from these estimates.[12]

Savings Assumptions

Table 2-11 shows most of the savings assumptions used to calculate savings for the included BMPs. As with program cost estimates, the numbers used in this table represent the best available empirical estimates of water savings attributable to the BMP program interventions. Actual water savings could differ significantly between agencies. Likewise, the savings achieved by a particular BMP program intervention could vary widely over time for a given agency.

The savings estimates were selected by using savings from the latest CUWCC Savings Memo[13] when available in a manner consistent with Phase 1, and the Phase 1 estimates otherwise. BMPs 3, 5, and 9 were treated as they were in Phase 1. Procedures to avoid double counting savings analogous to Phase 1 were applied to this analysis, including:

- For BMP 1, only outdoor savings were included to avoid double counting with BMP 2;
- BMP 2 includes savings from showerheads and aerators, but not toilet displacement devices to avoid double counting with BMP 14;
- The same savings estimates as Phase 1 were used for BMPs 5 and 9 to replicate the procedure and to avoid double counting landscape savings.
- BMP 9 Survey Option was used to calculate savings, whereas in Phase 1 the average of Survey and Performance Options was used. Since the performance option includes survey savings and other CII savings, using the Survey Option more directly controlled double counting.
- In addition, since both BMP 5 surveys and budgets are included in this Phase 2 analysis, a 20 percent double counting factor was applied to BMP 5 savings as a placeholder until further analysis is conducted.

[12] Cost figures are different from Phase 1 because recent experience by PAC members indicates revisions, and because of adjustment to Year 2003 dollars.
[13] Mitchell, D., "Calculation of water savings from BMP report data," Memorandum prepared for the Research and Evaluation Committee of the California Urban Water Conservation Council, Dec. 8, 2002.

Table 2-10 BMP Cost Assumptions
(Year 2003 Dollars)

BMP	Units	Direct Costs	Administration Unit	Administration Real Escalation	Incentives Unit	Incentives Real Escalation	Total (Yr. 1)
1 (SF)	$ per survey	$ 109.27	$ 27.32	4%	$ -	0%	$ 136.59
1 (MF)	$ per survey (per HH unit)	$ 65.56	$ 27.32	4%	$ -	0%	$ 92.88
2 (SF)	$ per household	$ 12.02	$ 1.09	4%	$ -	0%	$ 13.11
2 (MF)	$ per household	$ 5.46	$ 1.09	4%	$ -	0%	$ 6.56
3	$ per AF annual savings	$ 1,809.56	$ -	0%	$ -	0%	$ 1,809.56
4	$ per meter installed	$ 743.05	$ -	0%	$ -	0%	$ 743.05
5 (budget)	$ per acre	$ 54.64	$ 10.93	0%	$ -	0%	$ 65.56
5 (survey)	$ per survey	$ 327.82	$ 218.55	4%	$ 819.55	4%	$ 1,365.91
6	$ per rebate	$ -	$ 27.32	0%	$ 81.95	0%	$ 109.27
9 (surv)	$ per survey/device/activity	$ 1,092.73	$ 27.32	4%	$ -	0%	$ 1,120.05
9 (ULFT)	$ per toilet installed	$ 116.92	$ 27.32	4%	$ -	0%	$ 144.24
14 (SF) Ordinance	$ per toilet installed	$ -	$ 10.93	1%	$ 54.64	1%	$ 65.56
14 (SF) Direct Distribution	$ per toilet installed	$ 89.60	$ 27.32	2%	$ -	0%	$ 116.92
14 (SF) Simple rebate	$ per toilet installed	$ -	$ 27.32	4%	$ 81.95	4%	$ 109.27
14 (MF) Ordinance	$ per toilet installed	$ -	$ 10.93	1%	$ 54.64	0%	$ 65.56
14 (MF) Direct Distribution	$ per toilet installed	$ 89.60	$ 27.32	2%	$ -	0%	$ 116.92
14 (MF) Simple rebate	$ per toilet installed	$ -	$ 27.32	4%	$ 81.95	4%	$ 109.27

Note: Costs are from Phase 1, adjusted to 2003 dollars, and from revisions based on program experience developed by PAC review and concensus.

Table 2-11 - BMP Savings Assumptions					
BMP	**Savings Units**	**Savings[2]**	**Decay Rate**	**Savings Life Span[1]**	**Free Riders[3]**
1 (SF) Surveys	gpd	14.0	15%	30	
1 (MF) Surveys	gpd	8.8	15%	30	
2 (SF) Showerhead+Aerator	gpd	7.00	25%	30	0%
2 (MF) Showerhead+Aerator	gpd	7.00	25%	30	0%
3	System losses reduced to 10 percent or less.				
4	Savings equal to 20 percent of pre-meter use.				
5 (budget)	percent of use	19%	3%	10	
5 (survey)	percent of use	15%	10%	10	
6	gpd	14.4	0%	14	25%
9 (surv)	AFY	1.27	0%	12	
9 (ULFT)	gpd, average	25.6	0%	25	0%
14 (SF) Ordinance	gpd, average	23.6	0%	25	0%
14 (SF) Direct Distribution	gpd, average	23.6	0%	25	0%
14 (SF) Simple rebate	gpd, average	23.6	0%	25	0%
14 (MF) Ordinance	gpd, average	43.1	0%	25	0%
14 (MF) Direct Distribution	gpd, average	43.1	0%	25	0%
14 (MF) Simple rebate	gpd, average	43.1	0%	25	0%

(1) If a decay rate is specified, but not a life span, life span is set to the model's maximum of 30 years.
(2) All savings figures from CUWCC Memo, December 8, 2002, "Calculation of water savings from BMP report data" with the following exceptions: BMP 3 savings figures come from the Phase I analysis; BMP 5 survey savings figures come from the Phase I analysis; BMP 5 budget savings and decay figures come from the Phase I analysis; and BMP 9 surveys savings and life span come from Phase 1. BMP 1 includes outdoor savings only, and BMP 2 includes showerhead and aerator; not toilet displacement devices per double counting discussion explained in the text.
(3) Freerider adjustment is listed as zero if the freerider effect has already been accounted for in the empirical savings estimate (net savings estimates).

Table 2-12 BMP 5 Conservation Potential Assumptions

Hyrdologic Region	AF per Acre Before Budget	Total Acres	Percent with Budgets	Survey Savings	Budget Savings
Central Coast	2.8	6,520	90%	15%	19%
San Francisco Bay	3.3	16,711	90%	15%	19%
Sacramento River	4.2	15,108	90%	15%	19%
San Joaquin River	4.3	6,892	90%	15%	19%
Tulare Lake	4.3	10,519	90%	15%	19%
South Coast	4.0	93,207	90%	15%	19%
South Lahontan	6.0	4,478	90%	15%	19%

Notes: 90% objective is per BMP 5 for budgets by 2007 for a typical agency. AF per year figures and total acres are from Phase 1 and are assumed to be use before surveys and budgets. Savings figures are from the CUWCC Memo (2002).

Table 2-12 shows additional detail regarding the assumptions that are behind BMP 5 calculations.

Cost-Effectiveness

Implementing Scenarios 1 and 2 requires a determination of the cost-effectiveness of BMP activity from the retail agency's perspective. To address this need, avoided cost estimates were developed for each of the hydrologic regions. The local cost-effectiveness of individual BMPs was then determined by comparing the cost per acre-foot of achieving an acre-foot of BMP savings to the cost per acre-foot avoided by these savings.

Avoided cost figures and methods used in the Phase 1 analysis have been updated and revised. These revisions were enacted in a manner consistent with the Phase 1 conceptual framework. For example, Phase 2 follows the Phase 1 convention of defining avoided costs as the costs avoided by the agency responsible for implementation of conservation activities. Also consistent with Phase 1, avoided water costs are included but not avoided wastewater costs.[14]

The avoided cost figures used in this Phase 2 analysis differ from the Phase 1 numbers in the following ways:

[14] One of the MOU's exemption criteria is based on "supplier perspective with cost sharing." Cost sharing could potentially include wastewater or other avoided costs. However, the MOU also specifies the agency is required to apply a "good faith effort" and not necessarily to cost share in every case. Further the cost sharing provision has not yet achieved widespread use. The PAC provided direction to base avoided costs on water supply costs exclusive of wastewater costs as the most logical depiction of the CUWA supplier perspective.

- Local supply cost data from agencies in the San Francisco Bay and South Coast Regions have been updated.
- Figures for the avoided costs in later years (2020 and later) for the Bay Area and South Coast have been updated with agency-provided data when available. Phase 1 figures remain otherwise.
- Tulare Lake Hydrologic Region avoided costs have been corrected so they are a weighted average of Fresno and Bakersfield, not just Fresno.
- All avoided costs have been adjusted to real Year 2003 dollars.

Table 2-13 contains the revised avoided costs by region.

In years when the benefits (avoided costs) per acre-foot exceed the costs per acre-foot, the model sums savings for Scenarios 1 and 2. CALFED and Proposition grants are modeled to decrease the cost, and thus improve local cost-effectiveness of BMP program implementation represented in the analysis. For Scenario 3, the full scope and scale of implementation is summed in terms of conservation savings regardless of the calculated cost-effectiveness.[15]

[15] The way the cost-effectiveness criterion was implemented here differs from that of the current BMP certification proposal. Under that proposal, a successful exemption would apply for the full term of the BMP reporting period, which is now two years. Although the models could be modified to account for a two-year exemption, applying the exemption criterion on an annual basis was—in our opinion—the most reasonable strategy to balance model transparency and complexity at this stage of analysis.

Table 2-13 Implementing Agency Avoided Cost (Phase 2 Analysis)
Real Year 2003 Dollars per AF

Year	Bay Area	Central Coast	Sacramen-to	San Joaquin	South Coast	South Lahontan	Tulare
2000	$265	$154	$45	$133	$639	$58	$128
2001	$274	$152	$45	$133	$621	$58	$129
2002	$278	$152	$45	$134	$603	$58	$130
2003	$241	$148	$45	$135	$651	$59	$130
2004	$279	$153	$46	$136	$642	$349	$131
2005	$296	$148	$46	$137	$643	$342	$132
2006	$299	$149	$46	$138	$653	$345	$132
2007	$364	$154	$46	$139	$669	$345	$133
2008	$366	$156	$47	$139	$683	$348	$133
2009	$388	$156	$47	$140	$691	$349	$134
2010	$425	$156	$47	$141	$697	$350	$135
2011	$459	$172	$47	$142	$693	$352	$135
2012	$495	$191	$47	$143	$682	$353	$136
2013	$488	$212	$48	$144	$671	$359	$137
2014	$501	$238	$48	$145	$674	$365	$137
2015	$486	$269	$48	$146	$677	$369	$138
2016	$502	$305	$48	$147	$681	$370	$139
2017	$519	$347	$49	$148	$684	$372	$139
2018	$540	$397	$49	$149	$688	$373	$140
2019	$564	$456	$49	$150	$692	$374	$141
2020	$937	$1,341	$49	$151	$696	$373	$141
2021	$937	$1,341	$50	$152	$700	$375	$142
2022	$938	$1,341	$50	$153	$704	$376	$143
2023	$938	$1,341	$50	$154	$708	$378	$144
2024	$938	$1,341	$50	$155	$713	$379	$144
2025	$939	$1,341	$51	$156	$718	$381	$145
2026	$940	$1,341	$51	$157	$722	$382	$146
2027	$940	$1,341	$51	$158	$727	$382	$146
2028	$941	$1,341	$51	$159	$733	$384	$147
2029	$941	$1,341	$52	$160	$738	$386	$148
2030	$942	$1,341	$783	$161	$743	$386	$148
2031	$1,051	$1,341	$783	$162	$749	$388	$149
2032	$1,051	$1,341	$783	$164	$755	$390	$150
2033	$1,051	$1,341	$783	$165	$761	$390	$151
2034	$1,051	$1,341	$783	$166	$767	$392	$151
2035	$1,051	$1,341	$783	$167	$773	$394	$152
2036	$1,051	$1,341	$783	$168	$779	$395	$153
2037	$1,051	$1,341	$783	$169	$786	$397	$154
2038	$1,051	$1,341	$783	$171	$792	$398	$154
2039	$1,051	$1,341	$783	$172	$799	$400	$155
2040	$1,051	$1,341	$783	$173	$806	$401	$156

BMP 6 - HE Washers

Models for estimating savings for BMP 6 and 9 (CII toilets) were developed as part of the Phase 2 study. The following sections summarize the assumptions and logic used in developing these models.

CUWCC has recently circulated a revised draft BMP 6 that is being considered for potential adoption.[16] Phase 2 includes a model of the coverage goals in this version of BMP 6, in addition to natural replacement. If the changes in the energy efficiency code and/or the plumbing code require all new sales to be HE washers in the future, the natural replacement model can be adjusted to reflect the higher rate that would result.

The coverage goal is "based on the total quantity of dwelling units (single-family and multi-family) in each agency's service territory." An agency determines its CG by the following calculation (numerical values below are from the Council's draft proposal):

CG = Total Dwelling Units x 80% x 6.67% x 12% x 3 x 2.5

Where: CG = Coverage Goal
Dwelling Units = total SF and MF dwelling units in agency service territory
80% = percentage of all dwelling units with in-home clothes washers
6.67% = percentage of washers requiring replacement each year
12% = Average HEW market share when no incentives exist
3 = tripling non-incentive market share
2.5 = years of program activity from July-2004 to January-2007

Simplified Formula: CG = Total Dwelling Units x 0.048

The BMP 6 model in this Phase 2 analysis replicates this logic and calculates the coverage goal in terms of washers and the resulting savings.

BMP 9 CII ULF Toilets

The coverage requirements for this BMP and how they may evolve over time required interpretation and PAC guidance to implement in the Phase 2 model. The model uses the following sequence of calculations: First, the BMP 9 ULF toilet requirements are calculated for a 10-year savings potential. Then, the 10-year savings potential is assumed to be phased in over 10 years—not just the 3-year interim program that exists presently in the BMP. This implementation schedule reflects a likely outcome of the BMP modification process.

[16] BMP 6 Draft Revision, Version 2003H, October 2003.

Table 2-14 Potential Conservation Savings
(AFY x1000)

	Year 2007		Year 2020		Year 2030	
Scenario	**Net**	**Gross**	**Net**	**Gross**	**Net**	**Gross**
Existing Conditions	379	767	454	1,073	236	1,004
Cost-Effective Implementation	433	820	581	1,200	313	1,080
Full Implementation	814	1,202	875	1,494	431	1,198

This analysis assumes these goals are met with average savings replacements—toilets with average savings (the average of the categories in the CII study)—and it calculates the corresponding number of ULF toilets. This is assumed to be the number of ULF toilets needed to satisfy BMP's assumed coverage requirement. Finally, the full life span savings are calculated for those ULF toilets—assuming a 25-year life. It is an open question as to what will be required of the BMP after the 3-year interim program. Again, the model assumes that the 10 year implementation as a likely outcome, per discussion with PAC. Since the current MOU expires in 2008, the assumption of a 10-year program life assumes the MOU will be extended to at least 2011.

Also, the assumption that the ULF toilet installations will have average savings may not be what happens in practice. Selectively targeting CII toilet retrofit programs to sectors where per device savings are maximized could result in a higher level of savings than result from the assumptions used in this study. Presupposing the feasibility and success of this type of targeting, however, would be at odds with what is currently known about the implementation obstacles faced by CII toilet retrofit programs

To estimate the inventory of CII ULF toilets in each category, the model utilizes a version of the CII ULFT Database developed by CUWCC. With these data, ULFTs were distributed to the hydrologic region in proportion to the total number of CII accounts located in each region.

Model Results

Table 2-14 summarizes the results of the analysis for the three scenarios in terms of both net and gross savings. The updated analysis shows 875,000 AFY of net conservation in the Year 2020 for the Full Implementation Scenario; gross conservation savings in 2020 is 1,494,000 AFY. For the Cost-Effective BMP Implementation Scenario, net conservation is 581,000 AFY and gross conservation is 1,200,000 AFY. For the Existing Conditions Scenario, net conservation is 454,000 AFY and gross conservation is 1,073,000 AFY. The updated analysis also shows 431,000 AFY of net conservation and 1,198,000 AFY of gross conservation in the Year 2030 for the Full Implementation Scenario. For the Cost-Effective BMP Implementation Scenario, net conservation is 313,000 AFY and gross conservation is 1,080,000 AFY. For the Existing Conditions Scenario, net conservation is 236,000 AFY and gross conservation is 1,004,000 AFY.

Table 2-15 Savings Potential by Hydro Region (AFY)

	Net			Gross		
	Existing Conditions	Cost-Effective Implemen-tation	Full Implemen-tation	Existing Conditions	Cost-Effective Implemen-tation	Full Implemen-tation
Central Coast						
2007	13,237	15,088	27,157	26,618	28,470	40,539
2020	17,768	22,906	29,812	37,275	42,412	49,319
2030	7,524	10,206	11,888	30,156	32,837	34,520
San Francisco Bay						
2007	57,771	65,703	118,009	125,879	133,811	186,117
2020	73,030	92,744	124,873	169,197	188,910	221,040
2030	27,357	37,602	43,991	135,754	145,999	152,388
Sacramento River						
2007	35,827	41,300	92,450	84,215	89,688	140,838
2020	43,393	55,773	103,268	132,325	144,706	192,200
2030	37,796	47,959	68,271	156,706	166,869	187,181
San Joaquin River						
2007	28,299	32,450	62,221	58,053	62,204	91,974
2020	36,071	45,686	73,605	98,479	108,094	136,013
2030	29,301	37,062	51,884	119,221	126,982	141,804
Tulare Lake						
2007	25,037	29,860	108,458	60,247	65,071	143,668
2020	38,766	53,647	128,337	113,823	128,705	203,394
2030	25,112	34,873	82,745	134,549	144,310	192,182
South Coast						
2007	207,906	235,376	385,285	398,515	425,984	575,893
2020	229,835	290,842	390,008	502,052	563,060	662,225
2030	99,404	132,986	157,636	410,080	443,661	468,311
South Lahontan						
2007	11,356	13,039	20,753	13,282	14,965	22,678
2020	14,897	19,641	24,953	19,453	24,197	29,509
2030	9,462	12,083	14,273	17,205	19,827	22,016

Table 2-15 shows the results by hydrologic region. The reader is cautioned to be careful in interpreting Table 2-15, in that these hydrologic region-specific estimates are not directly comparable to any agency-specific estimates of conservation.

Figure 2-1 shows the sum total of net conservation savings each year for thirty years of analysis. Figure 2-2 shows gross conservation. Figure 2-3 shows net and gross conservation savings for each of the included BMPs.

These graphs plot the *annual* savings from the *cumulative* installation of conservation devices. That is, the savings one would achieve in a given year from the devices installed in that year and installed in all previous years.

Figure 2-1 - Net Conservation Savings

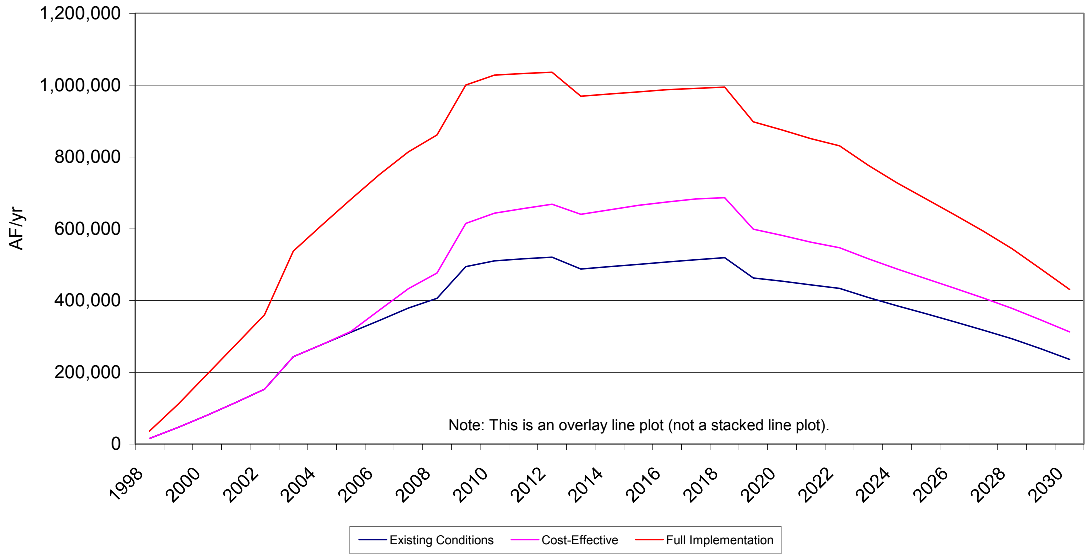
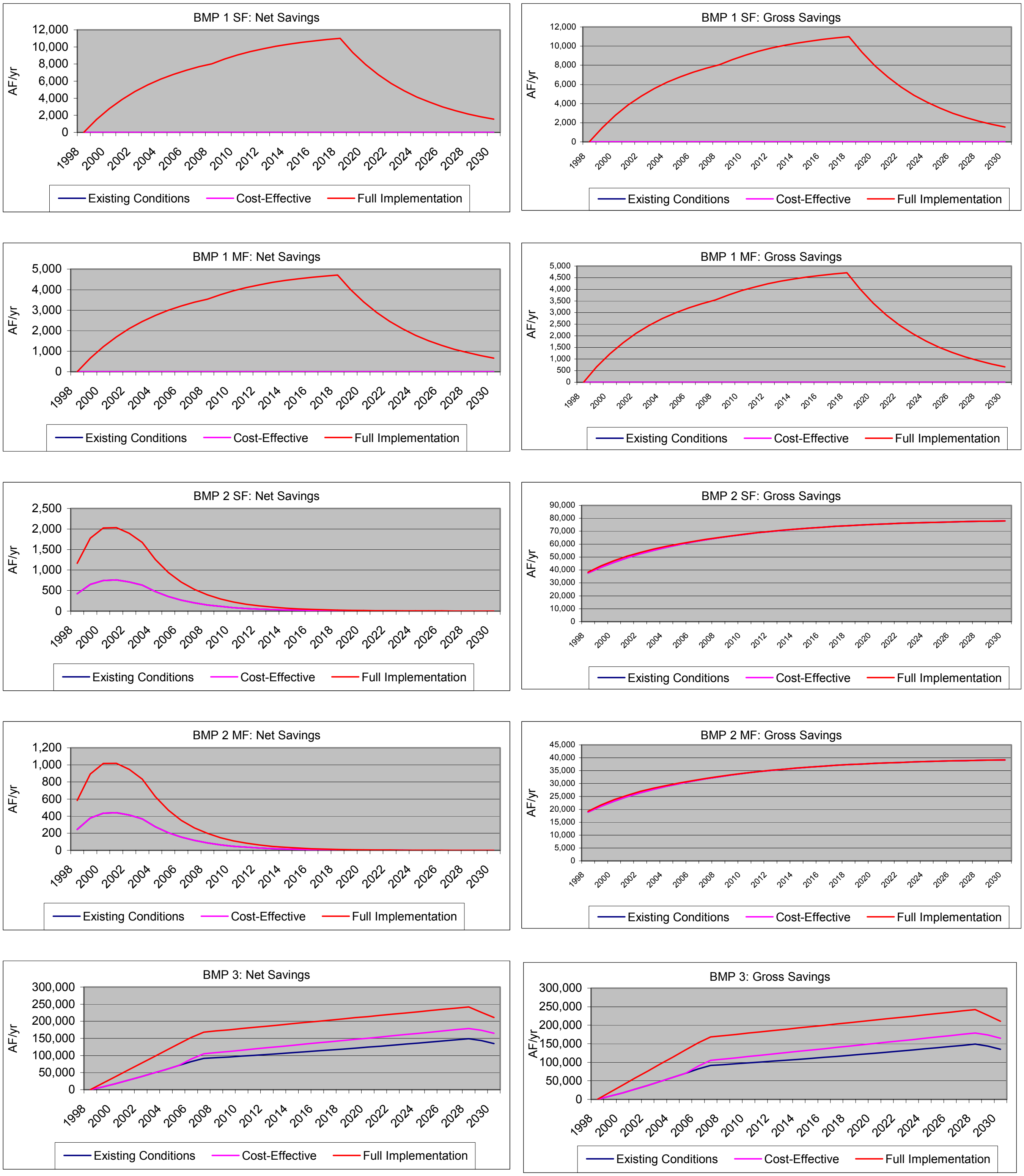
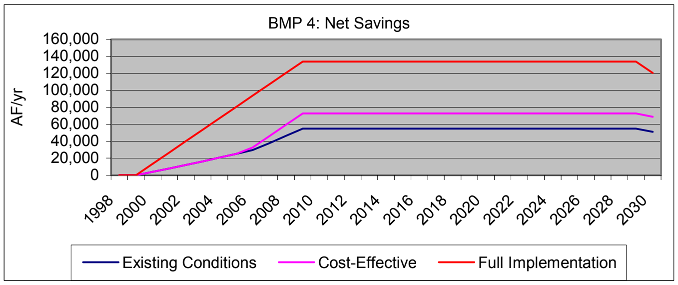
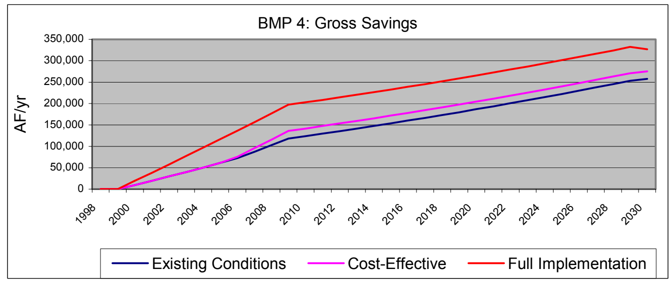


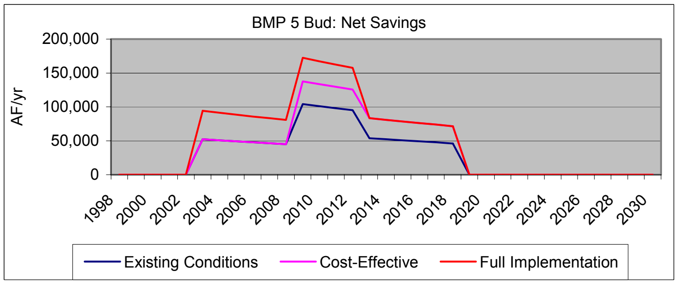
Figure 2-2 Gross Conservation Savings

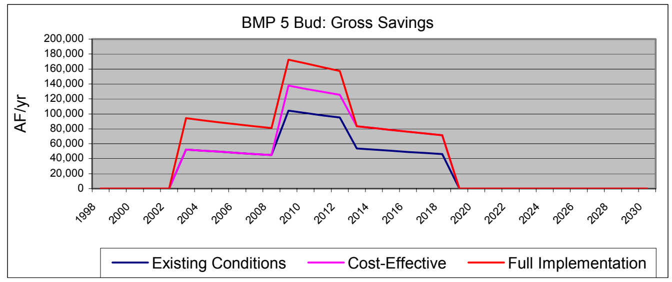
Figure 2-3 Savings by BMP

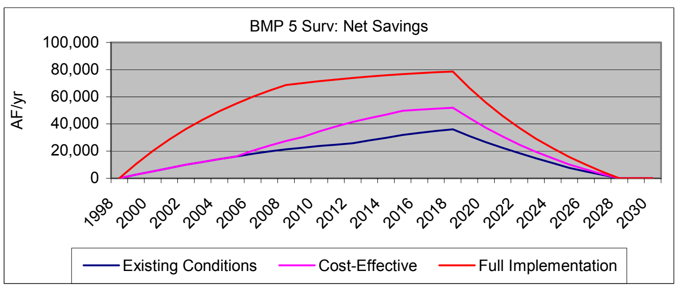


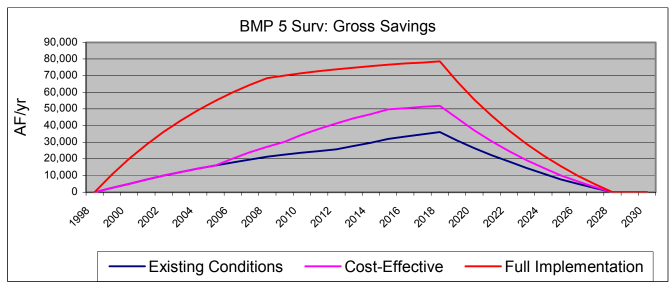

BMP 4: Net Savings
AF/yr
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

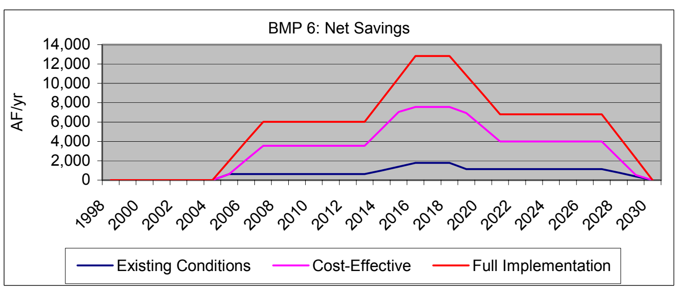

BMP 4: Gross Savings
AF/yr
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

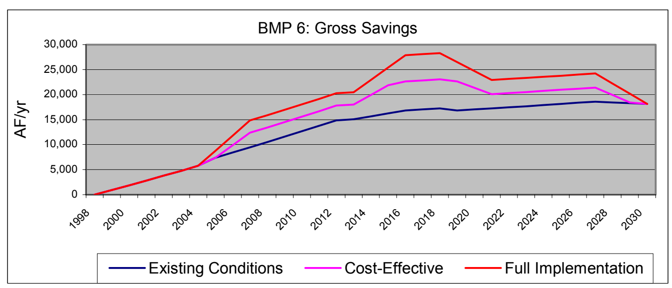

BMP 5 Bud: Net Savings
AF/yr
200,000
150,000
100,000
50,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

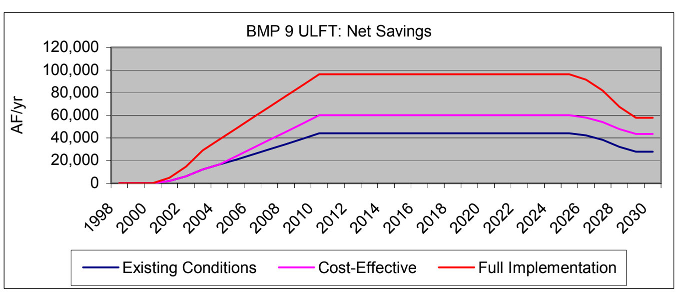

BMP 5 Bud: Gross Savings
AF/yr
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

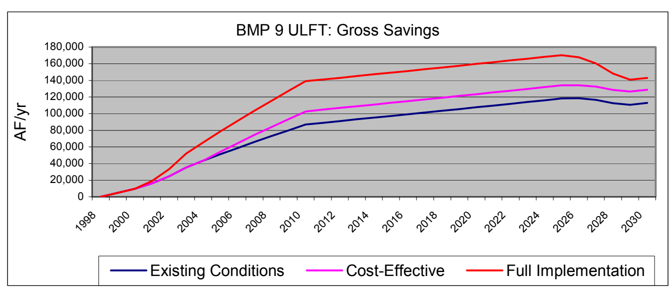

BMP 5 Surv: Net Savings
AF/yr
100,000
80,000
60,000
40,000
20,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

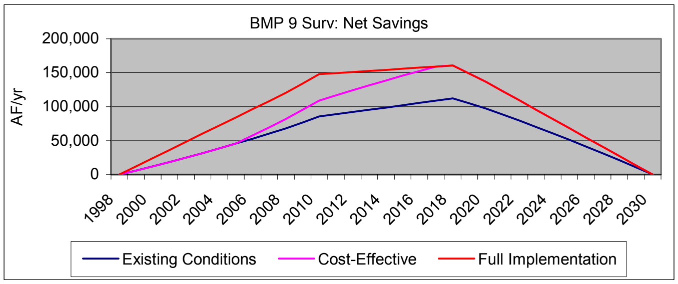

BMP 5 Surv: Gross Savings
AF/yr
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

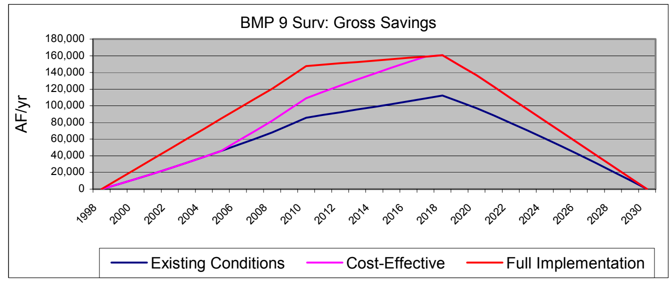

BMP 6: Net Savings
AF/yr
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

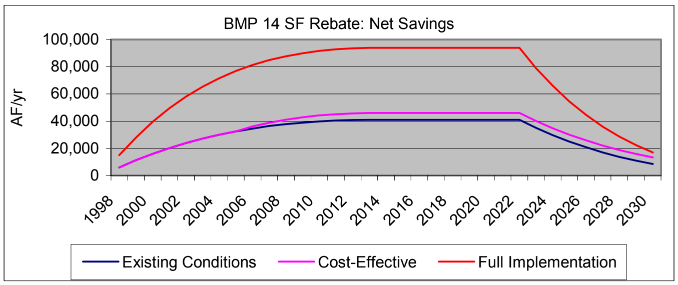

BMP 6: Gross Savings
AF/yr
30,000
25,000
20,000
15,000
10,000
5,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

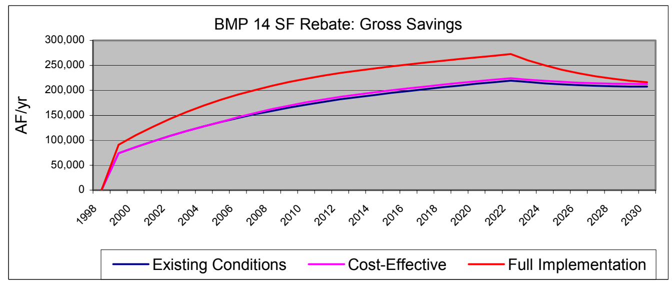

BMP 9 ULFT: Net Savings
AF/yr
120,000
100,000
80,000
60,000
40,000
20,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

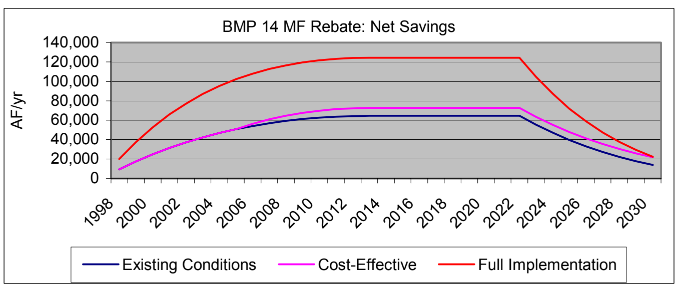

BMP 9 ULFT: Gross Savings
AF/yr
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030
Existing Conditions
Cost-Effective
Full Implementation

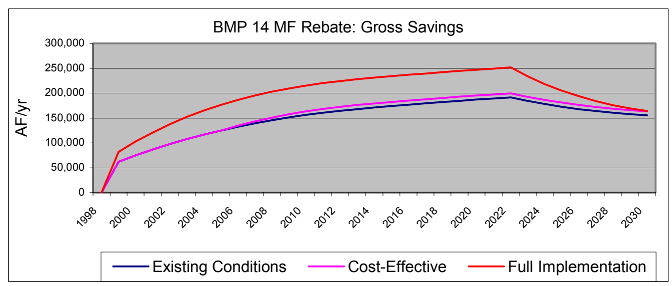

BMP 9 Surv: Net Savings
AF/yr
Existing Conditions
Cost-Effective
Full Implementation


BMP 9 Surv: Gross Savings
AF/yr
Existing Conditions
Cost-Effective
Full Implementation


BMP 14 SF Rebate: Net Savings
AF/yr
Existing Conditions
Cost-Effective
Full Implementation


BMP 14 SF Rebate: Gross Savings
AF/yr
Existing Conditions
Cost-Effective
Full Implementation


BMP 14 MF Rebate: Net Savings
AF/yr
Existing Conditions
Cost-Effective
Full Implementation


BMP 14 MF Rebate: Gross Savings
AF/yr
Existing Conditions
Cost-Effective
Full Implementation

Observations about Results

The reader should note that the volume of both net and gross conservation in 2030 is less than the level in 2020 for three reasons: (1) the water savings from BMPs have life spans and/or decay rates, (2) this report only examines an existing set of BMPs that define a fixed level of implementation (e.g. fixed coverage levels), and (3) this report does not estimate savings from potential BMPs (PBMPs) or as yet unforeseen future BMPs.

Since the estimates are based on disaggregate summations of individual BMPs – each of which is associated with water savings assumptions, geographically different socio-demographic data, and coverage rates—there is no fixed relationship between net and gross conservation.

All scenarios have some presumption of cost-effectiveness of BMP's—even Scenario 3 uses existing BMP's that originated with a presumption of cost-effectiveness. Thus, this work does not develop an estimate of technical conservation potential; that is, conservation potential constrained by technology without regard to cost. This result is a conscious policy decision and is embedded in the focus of this research.

Caveats

The savings reported in this document result from data and assumptions described herein, which we have sought to explain in explicit detail for transparency. The quality of available data was constrained by the time and budget available. Additional assessment of the empirical evidence of conservation savings for the purpose of validation or calibration would be a worthy future investment.

The PAC discussed the challenges of implementation and the impact on costs and savings. CCWD, for example, did not reach as many high use sites (restaurants and retail) as expected in their CII ULF toilet program. CCWD's documentation of implementation hurdles is instructive to this analysis.[17] The salient conclusion is that the actual costs of BMP program implementation could differ substantially from what has been assumed for purposes of this analysis. The cost-effectiveness of individual BMPs and associated levels of achieved water savings would vary accordingly.

All future investment in conservation funded with the grant programs described herein is subject to considerable uncertainty. More research is needed to model alternative investment strategies and how they should be reflected in the choice of which BMPs to implement and how to implement them. The model results regarding cost-effectiveness

[17] "CCWD Challenges To Implementation: CII ULFT Program- FY 02 and 03," Discussion Paper, October 2003. See also, "Water Conservation: FY 2003 End of Year Report," Contra Costa Water District.

do not currently reflect the potentially most cost-effective solution. To illustrate this point, consider that if an agency allocates additional resources to targeting a conservation program, it may expect greater savings. Different program designs may result in different cost-effectiveness outcomes. Further caveats include:

- This assessment of conservation potential was constrained deliberately to examine existing urban water conservation BMPs. Thus, by construction, the results do not speculate about the conservation potential of new and emerging technologies or conservation practices.
- Because the cost-effectiveness of conservation programs can often be improved by increasing their scale and other design parameters, readers should be careful drawing inferences about the cost of additional total conservation potential based on the unit cost ($/AF) of individual BMPs.
- Also, because the cost-effectiveness of conservation programs can often be diminished as saturation of the conservation device or activity increases, readers should be careful drawing inferences about the cost of additional conservation potential based on the unit cost ($/AF) of individual BMPs.
- Actual costs and savings depend on the strategy and effectiveness of implementing programs.

3. Achieved Conservation

Introduction

This chapter examines sources of data that record actual water conservation actions in California—in contrast to the conservation potential examined in the previous chapter. Models are constructed to estimate achieved savings given a set of assumptions regarding device and activity savings.

Conservation Devices and Activities

The California Urban Water Conservation Council (CUWCC) maintains a database of conservation activities reported by participating signatory agencies. The advantage of this database is that it is collected in a relatively uniform manner throughout the state among those that participate. Participation in the MOU process and BMP reporting is not complete, however. Further, reporting of historical data (1999 and earlier) is not widespread in the database. Limitations to the data for the purpose of this analysis include the following:

- Not all agencies are signatories;
- Not all signatories implement all of the BMPs;
- Not all signatories that implement BMPs report their activity; and
- Even signatories that report their activity do not necessarily report all their conservation activity.

Table 3-1 includes tabulation of the device counts, by BMP and hydrologic region, using data extracted from CUWCC's BMP Reporting Data base.

The other type of data we examine comes from agencies involved in this study that provided historical BMP activity data. The advantage of these data sources is that they provide the earlier historical record and that they can be associated with particular program delivery mechanisms. Although the agencies that have provided data are key suppliers in their respective regions, the collective data set is not as wide reaching as the BMP Reporting data base. The five agencies include:

- Metropolitan Water District of Southern California
- Contra Costa Water District
- Santa Clara Valley Water District
- East Bay Municipal Utility District
- San Francisco Public Utilities Commission

Table 3-2 includes a tabulation of the device counts from all of the suppliers who provided data. A BMP has been assigned to each of the devices and activities as indicated in the Column labeled "BMP."

Table 3-1 Tabulation of Data from BMP Reports

BMP 1 SF Surveys	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	1,269	1,213	3,879	3,747
Sacramento River	290	220	982	2,156
San Francisco Bay	10,216	9,651	13,969	12,580
San Joaquin River	1,200	800	77	95
South Coast	31,955	45,249	38,870	25,829
South Lahonton	-	-	-	-
Tulare Lake	384	67	11,750	11,970
BMP 1 MF Surveys	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	244	440	269	273
Sacramento River	-	1	6	375
San Francisco Bay	10,146	6,263	15,815	18,127
San Joaquin River	76	125	4	5
South Coast	22,095	56,285	31,743	3,704
South Lahonton	-	-	-	-
Tulare Lake	81	-	-	20
BMP 2 SF Showerheads+Aerators	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	2,887	3,005	19,386	2,353
Sacramento River	2,462	2,555	2,943	7,753
San Francisco Bay	13,945	34,275	7,868	10,237
San Joaquin River	2,285	2,310	101	250
South Coast	51,354	61,707	51,045	46,430
South Lahonton	-	-	-	-
Tulare Lake	840	726	1,488	1,580
BMP 2 MF Showerheads+Aerators	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	3,001	3,151	514	2,133
Sacramento River	180	1,642	4	481
San Francisco Bay	9,796	8,454	3,838	2,735
San Joaquin River	205	205	-	-
South Coast	26,223	42,125	30,640	13,356
South Lahonton	-	-	-	-
Tulare Lake	-	500	-	-
BMP 4 Meter Retrofits	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	-	-	-	-
Sacramento River	926	883	2,868	7,328
San Francisco Bay	-	21	15	23
San Joaquin River	-	-	-	-
South Coast	-	-	-	-
South Lahonton	-	-	-	-
Tulare Lake	-	-	-	-
BMP 5 Irrigation Budgets	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	244	256	847	859
Sacramento River	-	2	2	379
San Francisco Bay	1,277	2,521	2,853	3,385
San Joaquin River	-	-	-	-
South Coast	6,970	8,017	7,064	7,818
South Lahonton	-	-	-	-
Tulare Lake	-	-	-	12
BMP 5 Landscape Surveys	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	12	34	31	13
Sacramento River	25	45	30	89
San Francisco Bay	2,015	958	311	636
San Joaquin River	16	18	-	-
South Coast	213	401	442	368
South Lahonton	-	-	-	-
Tulare Lake	-	-	-	-

Table 3-1 Tabulation of Data from BMP Reports (Continued)

BMP 6 HE Washer Rebates	Data from BMP Reports			
Hydro Region	1999	2000	2001	2002
Central Coast	-	102	687	817
Sacramento River	1	-	-	217
San Francisco Bay	6,744	9,018	7,101	10,757
San Joaquin River	-	-	-	3
South Coast	3,667	5,609	6,469	12,200
South Lahonton	-	-	-	-
Tulare Lake	-	-	-	81
BMP 9 Performance Option (AF)	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	7	9	320	350
Sacramento River	-	-	-	-
San Francisco Bay	5,669	6,116	3,460	4,099
San Joaquin River	1	1	1	1
South Coast	5,877	5,866	11,701	14,435
South Lahonton	-	-	-	-
Tulare Lake	-	-	-	-
BMP 9 Surveys	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	78	154	80	48
Sacramento River	33	60	15	128
San Francisco Bay	537	903	407	939
San Joaquin River	-	575	-	-
South Coast	534	1,084	847	771
South Lahonton	-	-	-	-
Tulare Lake	-	8	-	16
BMP 9 CII ULFTs	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	-	-	13	1
Sacramento River	-	-	-	-
San Francisco Bay	-	-	-	144
San Joaquin River	-	-	-	-
South Coast	-	-	-	-
South Lahonton	-	-	-	-
Tulare Lake	-	-	6	-
BMP 14 SF ULFTs	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	1,694	1,425	2,375	2,055
Sacramento River	115	116	147	864
San Francisco Bay	14,152	7,870	6,452	8,357
San Joaquin River	-	-	-	51
South Coast	83,980	102,895	93,033	83,843
South Lahonton	-	-	-	-
Tulare Lake	33	36	49	79
BMP 14 MF ULFTs	**Data from BMP Reports**			
Hydro Region	1999	2000	2001	2002
Central Coast	556	1,237	896	362
Sacramento River	-	6	-	15
San Francisco Bay	18,817	22,684	6,912	4,856
San Joaquin River	-	-	-	4
South Coast	63,776	45,914	41,477	43,289
South Lahonton	-	-	-	-
Tulare Lake	-	-	-	-

Note: The accounting delineation between BMP 9 Performance and Survey Options is not always completely evident from observing the BMP reports and the above summary table.

Table 3-2 Agency Reported Conservation Activity Tabulation

Agency	Activity/Device Name	BMP	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
EBMUD	SF Audits	1	200	250	240	325	760	491	276	1,229	1,006	1,250	957	1,750	1,375	820
EBMUD	MF Audits	1	25	30	35	10	15	22	1,310	184	218	330	275	740	754	264
EBMUD	SF Showerheads	2	37,000	23,000	8,000	4,500	3,500	2,000	3,000	4,000	6,000	3,000	4,000	1,700	27,000	8,000
EBMUD	MF Showerheads	2	24,500	19,500	4,000	5,800	3,600	2,700	3,200	2,000	5,250	3,000	4,000	5,000	4,300	17,500
CCWD	SF Residential Surveys	1	-			1,821	1,062	1,131	471	498	500	416	644	899	568	496
CCWD	Multi-Family Interior Surveys	1	-			2,000	2,000	100	1,847	1,900	1,900	1,000	4,250	1,986	3,408	2,604
CCWD	Large Landscape Surveys	5	-			50	50	50	62	113	111	143	147	92	103	82
CCWD	CII Surveys	9	-			50	50	49	82	110	118	226	227	101	124	80
CCWD	SF ULFT Retrofit	14	-			-	-	-	3,000	2,972	2,840	4,000	2,367	2,063	1,216	878
CCWD	MF ULFT Retrofit	14	-			-	-	-	-	-	-	-	-	1,987	1,987	2,063
CCWD	CII ULFT Retrofit	9	-			-	-	-	-	-	-	-	-	-	12	5
CCWD	SF Washer Rebates	6	-			-	-	-	-	-	-	-	-	-	89	766
CCWD	CII and MF Washer Rebates	9	-			-	-	-	-	-	-	-	-	-	5	15
CCWD	Pre-Rinse Spray Nozzles	9	-			-	-	-	-	-	-	-	-	-	-	-
CCWD	CII Urinals	9	-			-	-	-	-	-	-	-	-	-	7	47
CCWD	CII Faucets	9	-			-	-	-	-	-	-	-	-	-	34	27
CCWD	CII Irrigation Upgrade	5	-			-	-	-	10	10	10	10	10	10	10	10
CCWD	SF ET Clocks	5	-			-	-	-	-	-	-	-	-	-	-	-
CCWD	CII ET Clocks	5	-			-	-	-	-	-	-	-	-	-	-	-
MWDSC	CII Analyst Survey I	9	-	-	-	-	-	-	-	10	258	118	-	-	-	-
MWDSC	CII Analyst Survey II	9	-	-	-	-	-	-	-	-	116	-	-	-	-	-
MWDSC	CII High-Efficiency Washers	9	-	-	-	-	-	-	-	-	-	-	39	943	1,120	1,577
MWDSC	CII Pre-Rinse Spray Head	9	-	-	-	-	-	-	-	-	-	1	8	2	-	-
MWDSC	CII ULF Toilets - Dual Flush	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MWDSC	CII ULF Toilets - Flush Valve	9	-	-	-	-	-	1,793	-	334	1,452	671	287	321	330	335
MWDSC	CII ULF Toilets - Tank Type	9	-	-	-	3	301	104	7	137	194	750	2,919	3,018	3,051	6,915
MWDSC	CII ULF Urinals	9	-	-	-	-	-	6	2	39	169	171	26	36	53	106
MWDSC	CII Walkthru Survey	9	-	-	-	-	-	-	-	-	6	-	-	-	-	-
MWDSC	CII Water Management Study	9	-	-	-	-	-	-	-	4	24	14	-	-	-	-
MWDSC	CII X-Ray Processor	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MWDSC	LAND Audits	5	-	-	-	-	-	88	90	230	205	106	157	210	296	225
MWDSC	LAND Central Controllers	5	-	-	-	-	-	-	0	1	2	1	1	0	1	1
MWDSC	LAND ET Controllers	5	-	-	-	-	-	-	-	-	-	-	-	-	-	138
MWDSC	LAND Irrigation Controllers	5	-	-	-	-	-	-	0	1	17	26	0	0	1	0

Table 3-2 Agency Reported Conservation Activity Tabulation (Continued)

MWDSC	RES Aerators	2	-	-	-	-	-	-	-	-	-	306	4,780	593	2,263	6,679
MWDSC	RES Flappers Replaced w/Survey	1	-	-	-	-	-	-	-	-	-	35	752	294	281	183
MWDSC	RES High-Efficiency Washers	6	-	-	-	-	-	-	-	147	81	111	1,023	5,063	3,754	7,492
MWDSC	RES Multi-Family Surveys	1	-	-	-	-	-	-	39	522	177	242	427	243	181	160
MWDSC	RES Showerheads	2	-	-	2,073	2,497	35,503	17,089	26	500	17	1,322	4,423	1,535	1,809	2,302
MWDSC	RES Showerheads - Distributed	2	-	-	8,813	1,267,412	1,413,883	107,214	46,138	11,749	232	-	-	-	-	-
MWDSC	RES Surveys, Single Family	1	-	-	-	-	-	-	-	2,885	1,496	3,246	8,500	4,590	3,861	4,202
MWDSC	RES ULF Toilets - Distribution	14	-	-	-	530	5,092	20,595	79,645	90,089	142,720	61,062	108,803	108,970	120,056	101,366
MWDSC	RES ULF Toilets - Rebate	14	-	-	666	5,775	103,570	115,257	164,537	121,710	147,482	57,388	66,351	74,156	64,835	61,710
SCVWD	Cooling tower ozonation.	9	-			1										
SCVWD	Cooling tower ozonation.	9	-				1									
SCVWD	Closed loop re-circulation cooling system for liquid ring	9	-				1									
SCVWD	Cooling Tower Ozonation - tower 3	9	-				1									
SCVWD	Conversion of 68 lavatory faucets from a manual whell	9	-				1									
SCVWD	Cooling tower ozonation	9	-				1									
SCVWD	Reduce waste water leaving the two cooling towers. 3	9	-				1									
SCVWD	Replacement of two large condensers from water coole	9	-				1									
SCVWD	Install a 70 gpm (expandable to 170 gpm) electodialysi	9	-					1								
SCVWD	Rebate for installation of new water-saving commercial	9	-					1								
SCVWD	Modify piping to remove most of the building from wate	9	-					1								
SCVWD	Installation of a Reclaim System for Plating shop rinsew	9	-					1								
SCVWD	Replace 3 watercool after coolers with 3 Air cooled afte	9	-					1								
SCVWD	Installed a new air cooled chiller for 96000 sq.ft. office	9	-					1								
SCVWD	Water Softener for building 028 cooling	9	-					1								
SCVWD	BLANK (Unspecified)	9	-					1								
SCVWD	Water Efficient Washers (2)	9	-					1								
SCVWD	Hot rinse water reuse system for laundry washers	9	-					1								
SCVWD	Change clean up system for dry fruit process area. Cu	9	-					1								
SCVWD	Teltec will installl close loop cooling, rinse water timers	9	-						1							
SCVWD	Replace three existing hydro flow washers with three w	9	-						1							
SCVWD	In this water conservation project, flow from two water	9	-							1						
SCVWD	#1 Condense recovery for Boiler Feedwater (make up)	9	-									1				
SCVWD	#5 Excess water loss on main evaporator taken out of	9	-									1				
SCVWD	#2 Nozzle upgrade for elevator sprays and can washer	9	-									1				
SCVWD	#3 Primary stage Flume Water recovery, closed loop s	9	-									1				
SCVWD	Reuse of reject water by use of a Reverse Osmosis (R	9	-									1				
SCVWD	Installation of Low Flow fluid heads. New DES Line, Cl	9	-									1				
SCVWD	Ammoniacal Etchant Regeneration System- Solvent ex	9	-									1				
SCVWD	Installation of Automated Cuposit Line	9	-										1			
SCVWD	Installation of Closed Loop Cooling System	9	-										1			
SCVWD	Water recycling system for new passivation line.	9	-										1			
SCVWD	Permanent installation of pilot water treatment system:	9	-										1			
SCVWD	Closed loop laser cooling system (for Laser #1) ****N	9	-										1			
SCVWD	Cooling tower process closed loop system upgrade an	9	-										1			
SCVWD	Will replumb and pump to use 6 gpm of treated wastew	9	-										1			
SCVWD	Phase 3: Caustic injection to acid scrubbers to control	9	-										1			
SCVWD	Phase 2: Caustic injection to acid scrubbers to control	9	-										1			
SCVWD	Phase 1: Caustic injection to acid scrubbers to control	9	-										1			
SCVWD	Replacement of 11 comm'l washers with high efficiency	9	-											1		

Note: The conservation activities labeled SCVWD also include activities conducted by its retail agencies

Table 3-2 Agency Reported Conservation Activity Tabulation (Continued)

SCVWD	Secondary reuse of RO reject water & recyc of DI wate	9	-											1		
SCVWD	Recycling acid waste neutralization effluent into exhau	9	-											1		
SCVWD	New IX system with higher recovery rate. Allows 70%	9	-											1		
SCVWD	Reduction in scrubber water use by changing feed to D	9	-											1		
SCVWD	Upgrade to DI Water System and increase capacity on	9	-											1		
SCVWD	Reuse of RO Reject to Cooling Towers	9	-											1		
SCVWD	Reduction of DI water within Fab process sinks. Includ	9	-												1	
SCVWD	Filtration/Ion Exchange system to recycle on plating lin	9	-												1	
SCVWD	Diverting basement dewatering from sanitary drain to s	9	-												1	
SCVWD	New DES line with great rinse efficiency via multi-stage	9	-												1	
SCVWD	In-tool reuse of selected rinsewaters for media washers	9	-												1	
SCVWD	Automatic screen developer to replace manual rinsing.	9	-													1
SCVWD	Replacing water-cooled ice cream machine with air-coo	9	-													1
SCVWD	Modify DES Line #3 rinse lines to minimize needed gpr	9	-													1
SCVWD	Modify DES Line #4 rinse lines to minimize needed gpr	9	-													1
SCVWD	Modify DES Line #5 rinse lines to minimize needed gpr	9	-													1
SCVWD	Purchasing closed loop chiller to replace single pass c	9	-													1
SCVWD	Replacing dishwasher with a lower water use model.	9	-													1
SCVWD	Water Reclaim System. Includes reuse of RO Reject i	9	-													1
SCVWD	Reuse of reject from RO/DI system in cooling towers.	9	-													1
SCVWD	Augmenting current starch cooling kettles with closed l	9	-													1
SCVWD	Install and Operate a Point Source Water Recycling Sy	9	-													
SCVWD	Replace current process vacuum system that uses wat	9	-													
SCVWD	Treat Industrial Wastewater from AWN thru RO system	9	-													
SCVWD	Liquid Ring Vacuum Retrofit	9	-													
SCVWD	Liquid Ring Vacuum Retrofit	9	-													
SCVWD	SF Residential Surveys	1	-											6,352	1,502	1,743
SCVWD	MF Residential Surveys	1	-											2,768	1,000	575
SCVWD	Showerheads	2	-				28,000	13,071	8,785	7,286	5,429	4,762	14,688	7,366	7,243	13,696
SCVWD	Aerators	2									3,040	6,393	4,540	6,548	3,388	9,190
SCVWD	HE Washers Residential	6	-								21	306	2,541	5,345	4,889	5,011
SCVWD	Large Landscape Surveys	5									75	75	67	75	72	52
SCVWD	CII ULFTs	9	-				-	34	-	159	749	1,080	2,554	1,325	635	891
SCVWD	CII MF HE Washers Residential	9	-												11	63
SCVWD	SF ULFTs	14	-				2,073	5,802	12,279	15,730	24,307	14,441	28,806	18,084	11,231	17,621
SCVWD	MF ULFTs	14	-				7,936	3,669	3,920	4,478	17,134	10,463	18,367	7,875	3,906	4,514
SCVWD	Pre-Rinse Spray Nozzles	9														
SFPUC	SF Surveys	1				-	-	175	2	481	518	3,920	3,114			
SFPUC	MF Surveys	1				-	-	348	228	3,996	13,176	4,430	1,358			
SFPUC	Land Surveys Follow	5				116	-	16	5	12	-	8	83			
SFPUC	Land Surveys No Follow	5				-	-	16	-	12	21	2	-			
SFPUC	CII Surveys Comm Follow	9				8,980	-	-	116	92	2	-	5			
SFPUC	CII Surveys Comm No Follow	9				-	-	725	359	92	50	51	1,066			
SFPUC	CII Surveys Ind Follow	9				123	-	-	5	-	-	-	-			
SFPUC	CII Surveys Ind No Follow	9				-	-	7	-	-	-	-	15			
SFPUC	CII Surveys Comm Follow	9				-	-	-	-	-	-	-	19			
SFPUC	CII Surveys Comm No Follow	9				-	-	-	-	-	60	-	1			
SFPUC	CII ULFTs Manufacturing	9				25,789	-	-	-	-	-	-	2,261			
SFPUC	SF ULFTs	14				25,879	-	-	-	1,834	5,432	6,333	2,586			
SFPUC	MF ULFTs	14				17,309	-	-	-	735	4,149	5,598	3,879			

Note: The conservation activities labeled SCVWD also include activities conducted by its retail agencies

Table 3-3 Savings Assumptions

BMP	gpd Savings[2]	Savings Life Span[1]	Annual Savings Decay Rate	Free Riders[4]
1 SF Audits[3]	14.0	30	15%	
1 MF Audits	8.8	30	15%	
2 SF Showerheads	5.5	30	25%	0%
2 MF Showerheads	5.5	30	25%	0%
2 Aerators	1.5	30	50%	
2 Flappers	2.0	30	20%	
6 SF Washers	14.4	14	0%	25%
5 ET Controllers	37	10	0%	
9 CII Surveys	1,133	12	0%	
9 Pre-Rinse Spray Valves	250	10	0%	
9 Urinals	20	25	0%	
9 Faucets	10	25	0%	
9 X-Ray Processor	1,000	10	0%	
14 SF ULFT Retrofit	23.6	25	0%	0%
14 MF ULFT Retrofit	43.1	25	0%	0%
9 CII ULFT Retrofit	25.6	25	0%	0%

(1) If a decay rate is specified, but not a life span, life span is set to the model's maximum of 30 years.
(2) All savings figures from CUWCC Memo, December 8, 2002, "Calculation of water savings from BMP report data" with the following exceptions: BMP 9 surveys savings and life span from Phase 1; BMP 5 ET Controllers savings from IRWD "ET Controller Study" (2001); BMP 9 pre-rinse spray valves and x-ray processors savings from the Draft First Revision to the CUWCC Cost and Savings Study, and BMP 9 urinals and faucets from the CUWCC cost and savings study for a typical application.
(3) BMP 1 includes outdoor savings only.
(4) Freerider adjustment is listed as zero if the freerider effect has already been accounted for in the empirical savings estimate (net savings estimtaes).

Savings Assumptions

Table 3-3 provides most of the savings assumptions used for calculating achieved conservation. These figures were used to calculate conservation separately for both data sources. The remaining savings assumptions are found in Tables 3-4 and 3-5. The savings factors were developed based on a CUWCC summary of up-to-date figures when available, and Phase 1 otherwise. The savings factors actually used by the individual agencies for calculating water savings could differ substantially from those shown in Tables 3-3 through 3-5. The following provides additional description of savings figures used in the analysis:

- BMP 4 – Meter retrofits. The savings rate from CUWCC was used as a percent of pre-metered use. Pre-metered use was determined by dividing urban use by urban connections for the Sacramento River Region.
- BMP 5 – Surveys. Average use estimates were used from the Phase 1 analysis and percent savings from CUWCC.
- BMP 5 – Budgets. Average use, savings life, and decay estimates were used from the Phase 1 analysis. Percent savings is from CUWCC.
- BMP 9 Performance Option savings from the BMP Reporting Database is assumed to decay by 5% per year from the reported savings (AFY reported from activities since 1991). The BMP Reporting Database includes both the BMP 9 Performance Option and Survey Option, with the potential for double counting.

Table 3-4 Savings Assumptions for Agency-Reported Activity

Agency	Activity/Device Name	gpd Savings
SCVWD	Cooling tower ozonation.	4,666
SCVWD	Cooling tower ozonation.	15,360
SCVWD	Closed loop re-circulation cooling system for liquid ring vacuum pump.	79,452
SCVWD	Cooling Tower Ozonation - tower 3	27,123
SCVWD	Conversion of 68 lavatory faucets from a manual whell type valve to automatic shut off.	1,174
SCVWD	Cooling tower ozonation	4,287
SCVWD	Reduce waste water leaving the two cooling towers. 3.5 Million gallons per year	7,535
SCVWD	Replacement of two large condensers from water cooled to air cooled (ice machines)	3,119
SCVWD	Install a 70 gpm (expandable to 170 gpm) electodialysis reversal (EDR) water purificauon systen	62,596
SCVWD	Rebate for installation of new water-saving commercial Ice Machines.	2,820
SCVWD	Modify piping to remove most of the building from water softener. It will save back flushing of wa	10,247
SCVWD	Installation of a Reclaim System for Plating shop rinsewater.	8,218
SCVWD	Replace 3 watercool after coolers with 3 Air cooled after coolers on 3 Air compressors.	17,280
SCVWD	Installed a new air cooled chiller for 96000 sq.ft. office building . Air cooled chiller replace old wa	7,378
SCVWD	Water Softener for building 028 cooling	1,029
SCVWD	BLANK (Unspecified)	4,420
SCVWD	Water Efficient Washers (2)	7,398
SCVWD	Hot rinse water reuse system for laundry washers	1,764
SCVWD	Change clean up system for dry fruit process area. Currently steam hoses and regular hoses ar	3,580
SCVWD	Teltec will installl close loop cooling, rinse water timers, rinse water reuse pumps, and will installl	12,808
SCVWD	Replace three existing hydro flow washers with three water efficient washers.	11,097
SCVWD	In this water conservation project, flow from two water streams, namely groundwater and reverse	16,895
SCVWD	#1 Condense recovery for Boiler Feedwater (make up). (see sheets) for calculations.	2,447
SCVWD	#5 Excess water loss on main evaporator taken out of circulating (see Flow Measurement sheet	3,945
SCVWD	#2 Nozzle upgrade for elevator sprays and can washers. (see nozzle upgrade calculartion sheet	7,826
SCVWD	#3 Primary stage Flume Water recovery, closed loop system. (see Flow Measurement sheet for	12,146
SCVWD	Reuse of reject water by use of a Reverse Osmosis (R/O) Unit.	1,172
SCVWD	Installation of Low Flow fluid heads. New DES Line, Closed loop on the scubbers, New etcher	10,247
SCVWD	Ammoniacal Etchant Regeneration System- Solvent extraction and electrowinning to recover co	18,366
SCVWD	Installation of Automated Cuposit Line	32,799
SCVWD	Installation of Closed Loop Cooling System	8,890
SCVWD	Water recycling system for new passivation line.	19,727
SCVWD	Permanent installation of pilot water treatment system: Filter press and Filter Cake Dryer	7,043
SCVWD	Closed loop laser cooling system (for Laser #1) ****NOTE****:App for Laser #2 folded into this	5,480
SCVWD	Cooling tower process closed loop system upgrade and chemical treatment, eliminating the nee	4,142
SCVWD	Will replumb and pump to use 6 gpm of treated wastewater in their chemical fume scrubber.	5,701
SCVWD	Phase 3: Caustic injection to acid scrubbers to control pH of scrubbers where city water was pre	34,560
SCVWD	Phase 2: Caustic injection to acid scrubbers to control pH of scrubbers where city water was pre	23,040
SCVWD	Phase 1: Caustic injection to acid scrubbers to control pH of scrubbers where city water was pre	46,081
SCVWD	Replacement of 11 comm'l washers with high efficiency units	1,264
SCVWD	Secondary reuse of RO reject water & recyc of DI water by filtering and resupplying bulk DI tank	40,451
SCVWD	Recycling acid waste neutralization effluent into exhaust scrubber and cooling towers.	27,436
SCVWD	New IX system with higher recovery rate. Allows 70% recovery versus 50% in current system.	22,176
SCVWD	Reduction in scrubber water use by changing feed to DI vs City water. Reuse of clean water fro	13,855
SCVWD	Upgrade to DI Water System and increase capacity on reclaim holding tank.	18,776
SCVWD	Reuse of RO Reject to Cooling Towers	85,016
SCVWD	Reduction of DI water within Fab process sinks. Includes flow restrictors and controls to minimiz	37,279
SCVWD	Filtration/Ion Exchange system to recycle on plating lines.	1,699
SCVWD	Diverting basement dewatering from sanitary drain to storm drain. See R Warnars for more info	42,199
SCVWD	New DES line with great rinse efficiency via multi-stage rinses and pump vs high volume for spra	26,465
SCVWD	In-tool reuse of selected rinsewaters for media washers and substrate washers	56,641
SCVWD	Automatic screen developer to replace manual rinsing.	244
SCVWD	Replacing water-cooled ice cream machine with air-cooled one.	488
SCVWD	Modify DES Line #3 rinse lines to minimize needed gpm flowrate and reuse Developer rinse in S	24,586
SCVWD	Modify DES Line #4 rinse lines to minimize needed gpm flowrate and reuse Developer rinse in S	26,446
SCVWD	Modify DES Line #5 rinse lines to minimize needed gpm flowrate and reuse Developer rinse in S	26,780
SCVWD	Purchasing closed loop chiller to replace single pass cooling in processes.	570
SCVWD	Replacing dishwasher with a lower water use model.	424
SCVWD	Water Reclaim System. Includes reuse of RO Reject into cooling towers and scrubbers	45,317
SCVWD	Reuse of reject from RO/DI system in cooling towers. RO/DI system is currently used for reuse	27,895
SCVWD	Augmenting current starch cooling kettles with closed loop cooling systems	24,225
SCVWD	Install and Operate a Point Source Water Recycling System (Memtek). This will recover and reu	14,026
SCVWD	Replace current process vacuum system that uses water in pump seals with closed loop system	4,308
SCVWD	Treat Industrial Wastewater from AWN thru RO system for use in cooling towers and scrubbers	16,194
SCVWD	Liquid Ring Vacuum Retrofit	4,468
SCVWD	Liquid Ring Vacuum Retrofit	2,041

Notes: The conservation activities labeled SCVWD also include activities conducted by its retail agencies. This table includes savings figures supplied by the agency. Since savings life and decay rates were not provided, the analysis assumes the model's maximum savings life of 30 years without savings decay.

Table 3-5 Achieved Conservation Year 2002

Hyrdologic Region	AF per Acre Before Budget	Surveys	Budgets	Acres per Account	Survey Savings	Budget Savings
Central Coast	2.8	13	859	1.25	15%	19%
San Francisco Ba	3.3	636	3,385	1.25	15%	19%
Sacramento River	4.2	89	379	1.25	15%	19%
San Joaquin River	4.3	-	-	1.25	15%	19%
Tulare Lake	4.3	-	12	1.25	15%	19%
South Coast	4.0	368	7,818	1.25	15%	19%
South Lahontan	6.0	-	-	1.25	15%	19%

Notes: Savings are for the first year of implementation for Year 2002 (no decay yet). AF per year figures and total acres are from Phase 1 and are assumed to be use before surveys and budgets. Acres per account and savings figures are from the CUWCC Memo (2002). A place holder assumption of 20% double counting is applied in the model to surveys and budgets.

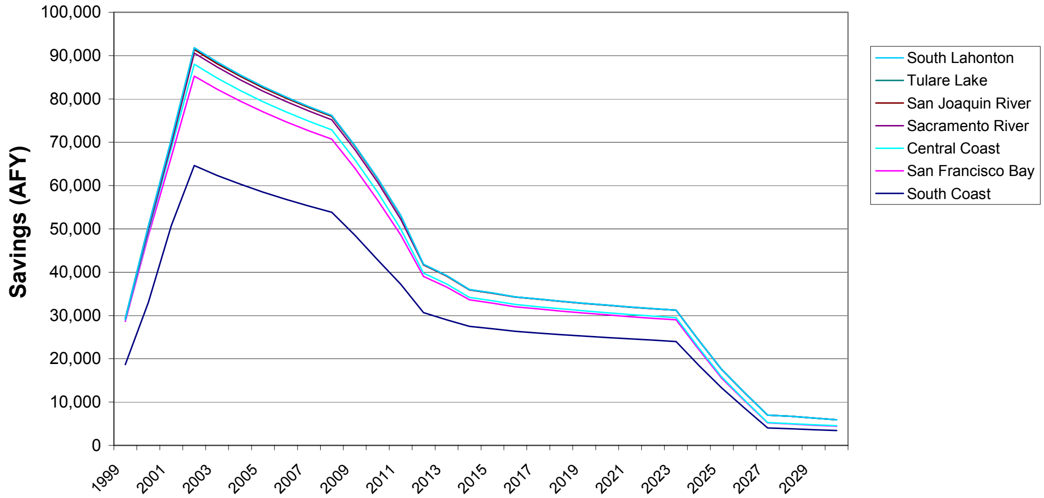
Results

Figure 3-1 shows—using data from CUWCC's BMP Reporting Data Base—that total savings attributable to BMP implementation exceeded 90,000 AFY at their maximum during this historical period for the subset of agencies considered by the analysis. South Coast has the largest quantified savings among the Hydrologic Regions depicted in Figure 3-1. Figure 3-2 shows the same savings by BMP, rather than by hydrologic region.

Interpretation note: These are stacked line graphs indicating the annual sum of savings achieved as a result of the cumulative installation of devices in all previous years. Thus, the uppermost line of Figures 3-1 and 3-2 have the same profile because they are both total savings. The other lines in these two figures show the composition of total savings by hydrologic region and by BMP respectively.

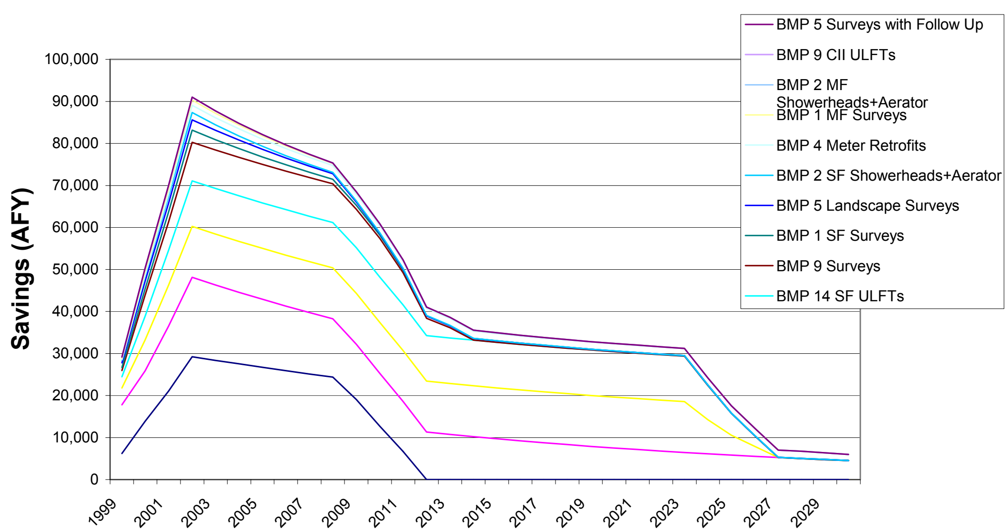
Figure 3-3 shows savings using data submitted directly from the 5 agencies participating in this study. The savings devices and activities data submitted went back to 1991. These agencies are large and represent a significant subset of California's urban water population—albeit a different subset than represented in the BMP Reporting Data. Figure 3-3 shows savings close to 90,000 AFY at their peak.

Figure 3-1 - Achieved Active BMP Conservation



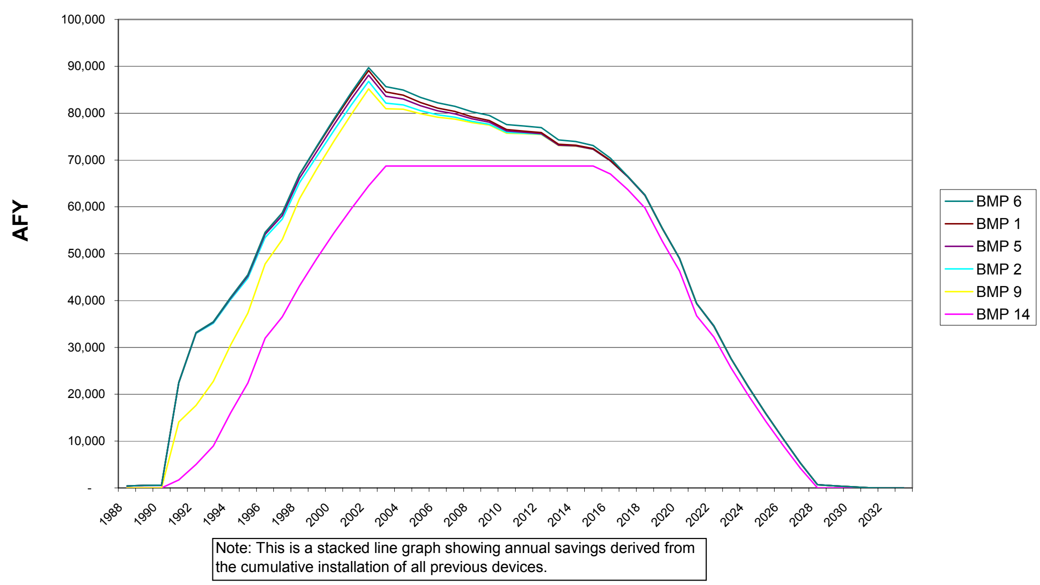
Note: This is a stacked line graph of the annual savings from the cumulative installation of all previous conservation devices.

Figure 3-2 - Achieved Active Conservation by BMP



Note: This is a stacked line graph of the annual savings from the cumulative installation of all previous conservation devices.

Figure 3-3 - Achieved Net Conservation (5 Suppliers)



Observations about Results

The reader should note a similar if not more pronounced pattern of water savings decay than observed in Chapter 2 – Conservation Potential. Because the achieved conservation activity data end in 2002, the effect of water savings assumptions can be seen to the end of their life spans by the Year 2030. With life spans exceeded or after years of savings decay, conservation eventually approaches zero. This is a direct consequence of the assumptions of finite savings life and/or savings decay. This does not imply that water use will necessarily increase. Devices from historical urban water agency programs will be replaced over time, likely with equally or more efficient devices. But savings from replacements are not attributable to these earlier programs.

The results documented in this chapter are an incomplete picture of conservation accomplishments. They nonetheless represent important first steps in defining conservation achievements.

Caveats

Although theoretically these two sources could be combined into a single database, the very time consuming task of assuring that no double counting is taking place is beyond the scope of this project. Further, looking at the results separately and side by side provides one means of relative validation and method comparison.

Assigning a BMP category to each of the reported conservation devices and activities involved making assumptions regarding the nature of the activity based solely on the descriptive labels assigned by the utilities. More information and a dialog with the agencies could improve this process. Further, there exists some ambiguity regarding how to assign BMPs in a consistent fashion. For example, should ET controllers in residential settings be included or excluded from the analysis because this is not an official BMP, although arguably relevant to BMPs 1, 2, and 5?[18]

Likewise, the savings figures assigned to the devices and activities were based only the listed titles in the data sources. Clearly, there have been many different delivery mechanisms that have resulted in different savings at different agencies and at different times

All of the activity data were self reported by agencies, and have not been independently verified.

One motivation for compiling data on achieved conservation was to compare it to conservation potential—to provide a measure of actual progress toward the BMP's conservation potential. However, the reader is cautioned from comparing directly the results of Chapter 3 on achieved conservation to the results of Chapter 2 on conservation potential for the following reasons: 1) Chapter 3 contains only a subset of the BMPs included in Chapter 2 for which data could be collected, 2) Chapter 3 contains data from only 5 agencies, and 3) because Chapter 3 includes savings achieved from implementing conservation in years before the MOU was implemented. For these reasons and due to project resource constraints the analysis did not attempt a formal comparison of achievements to BMP potential.

[18] ET controllers are included and assigned to BMP 5 as a placeholder assumption.

4. Recommendations

Recommendations for Future Research

Beyond the continuous quality improvements to the data that drive the estimates of conservation potential, there are additional needs for future research into urban water conservation potential.

- **Empirical Verification -** The water savings potential projected in this report—and in any other for that matter—should be subjected to empirical testing to verify the assumptions used, the data used, and the forecast obtained.

- **Sensitivity analysis** – Some of the uncertainly within the input data can be reduced with additional work. Some kinds of uncertainty cannot realistically be reduced by additional work. What are the key driving forces that cause the greatest changes in the estimates of urban water conservation potential? A rigorous sensitivity analysis can tell decision makers which uncertainties matter.

- **Portfolio and System Effects** – The simplifying assumptions employed in the CUWA studies may lend them less useful to individual water agencies. For example the averaging by hydrologic region, while necessary to validate statewide planning, makes the results less meaningful to individual water agencies. The cost-effectiveness of water conservation programs can be directly affected by the program scale; the percentage effect of free riders can be reduced by frontloading water conservation programs. Most water managers at water agencies recognize the implementation difficulties that must be overcome to produce cost-effective water conservation programs. Additional research on cost-effective approaches to improving cost-effectiveness would be beneficial.

- **Estimating future avoided costs** – The research needs here are both conceptual and practical. What are accepted standards for avoided cost analysis? What are the differences in agency estimates of their avoided costs? Which are due to methodological differences and which are due to the costs of different water resource alternatives? What are the avoided costs beyond water supply and what do these suggest about potential funding partners?

- **Inclusion of additional conservation practices.** New technologies and approaches for improving water use efficiency within the BMPs included in this analysis are being developed continuously. There is a need to better understand the potential from new technologies and practices for the included BMPs.

- **Financing alternatives** – Even if the level of desirable water use efficiency has been determined, how should it be financed? Lacking viable options for sustainable financing of water conservation investments can produce less than socially desirable levels of water use efficiency.

- **Remaining conservation calculations.** One use of this analysis might be to subtract the achieved conservation from potential conservation to determine remaining savings that might be achieved in the future. The data available so far are not developed enough to make the comparison commensurate, however. Substantial challenges exist in mapping statewide level data to its corresponding BMP Reporting and agency level sources.

Appendix A. Savings Illustrations

This appendix shows in graphic terms how savings assumptions in Tables 2-11 and 3-3 are used to calculate BMP savings results.

Beginning with Figures A-1 and A-2, we show two ways to represent conservation savings. Figure A-1 represents the type of savings of a hypothetical conservation activity (e.g., a landscape survey). The conservation activity is assumed to take place and save water in Year 1. After the first year, savings decline by a percentage year over year. In the illustration there is no explicit savings life span; savings just decline each year indefinitely (practically to the end of the modeled period of analysis). Figure A-2, in contrast, does not include decaying savings; instead savings are assumed to stay steady for a finite life span—five years in this case.

The savings figures in Tables 2-11 and 3-3 include life span and savings decay assumptions that are appropriate to the particular conservation activity or device. Savings activities that have a large component of human behavior tend to be represented with decay rates unless ongoing program support is expected to maintain savings over time (e.g., irrigation controller adjustments). In contrast, devices that are mechanical in nature and long-lived are assumed to have a specific life span and a small or zero decay rate (e.g., HE washers).

Figure A-3 shows the aggregate savings from three years of program activities for a conservation activity with a savings decay over time. Note the three graphs to the left each show savings that result from one program year each. Figure A-3 contains the sum of savings across all three program years and the continuing savings from those program activities. Note the shape of the savings trend in Figure A-3 goes up as activities are implemented during Years 1, 2, and 3. Then, savings decline with decay over time.

Figure A-4 shows an example of three program years of conservation activity for devices that have relatively long savings life spans and no savings decay. The figure shows a 30-year period of analysis characterized by increasing savings during the first three years, then steady savings until the savings life spans are exceeded. The graphs shows decline in savings attributable to the conservation program in the later years—a fact that flows from the end of the assumed savings life span, not from saving decay as in Figure A-3. This does not imply that water use has increased. Devices will be replaced over time, likely with equally or more efficient devices. But savings from replacements are not attributable to the agency-sponsored programs conducted several decades earlier.

Figures A-5 and A-6 show two examples of conservation savings for two BMPs modeled in Chapter 2. Figure A-5 shows an example of conservation activities modeled with assumptions of savings that decay over time. Figure A-6 shows savings that accrue from program activity over 12 or more years for devices that have finite savings life spans but no savings decay.

Savings Assumptions: Graphic Illustrations

Fig. A-1 Long lifespan with savings that decay over time.

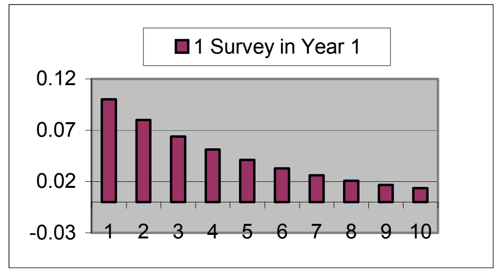


Fig. A-2 Short lifespan with no savings decay.

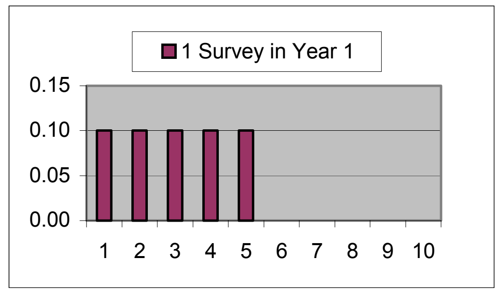
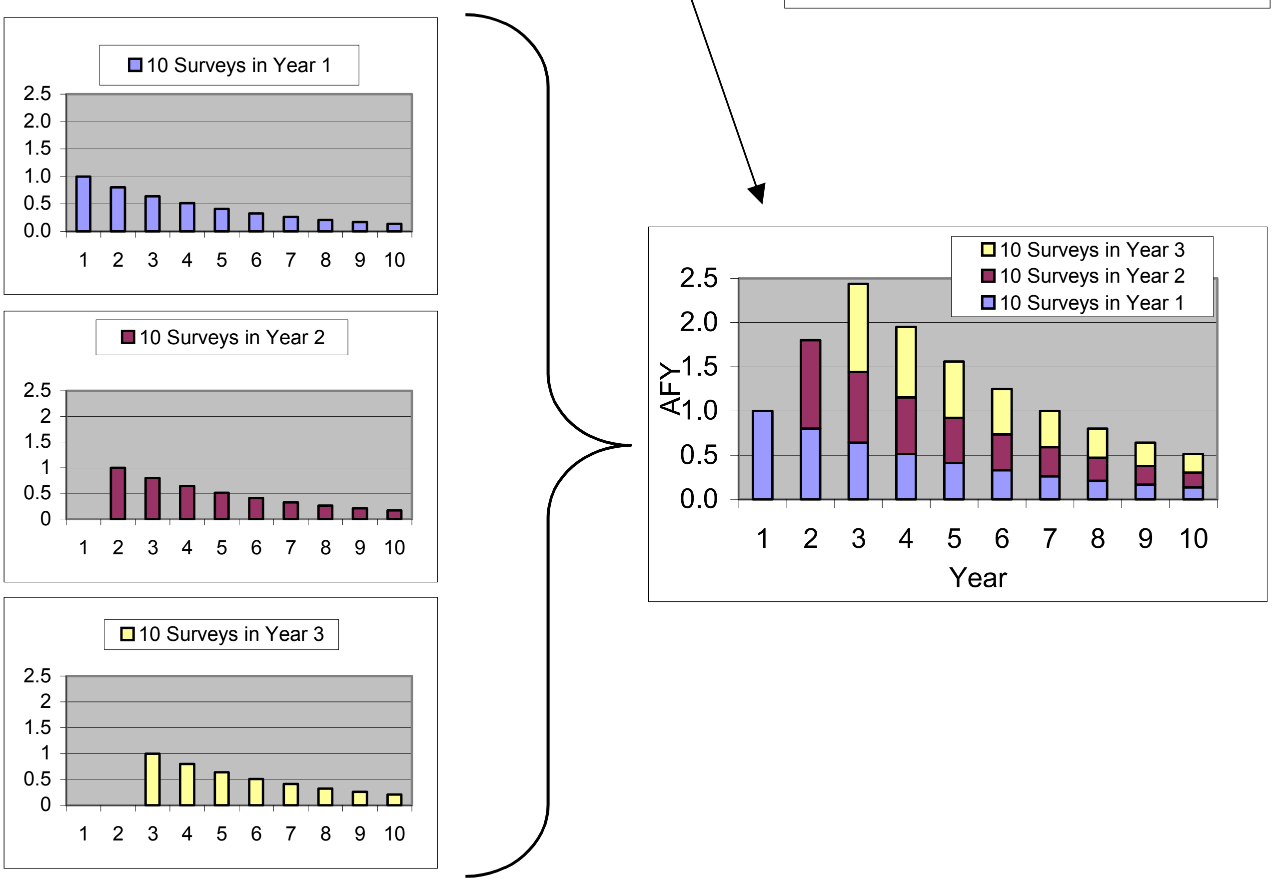
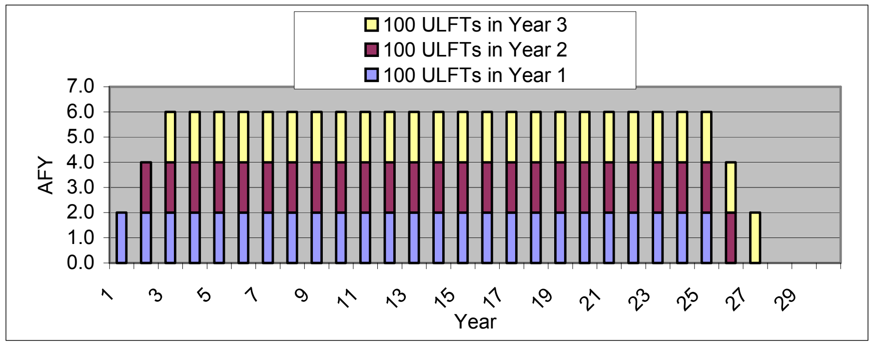


Fig. A-3 Combined savings for three program years.



Savings Assumptions: Graphic Illustrations Continued

Fig. A-4 Long lifespan with no savings decay: Three program years.



Savings Assumptions: Sample Model Results

Fig. A-5 Short life span with savings decay: BMP 2 Program Implementation

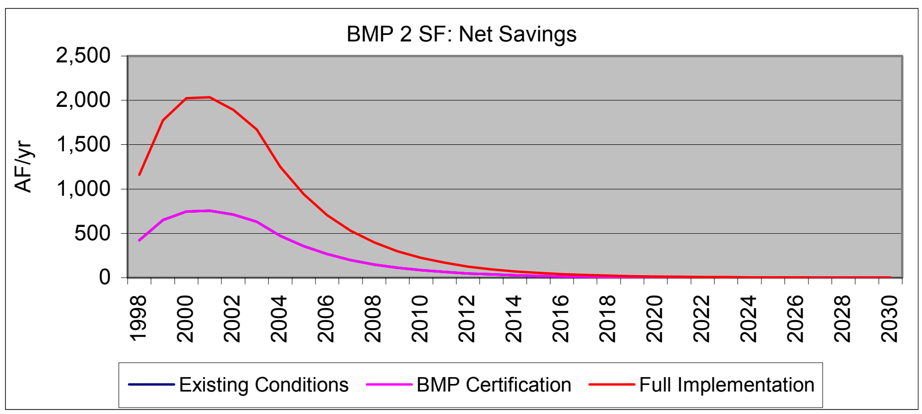
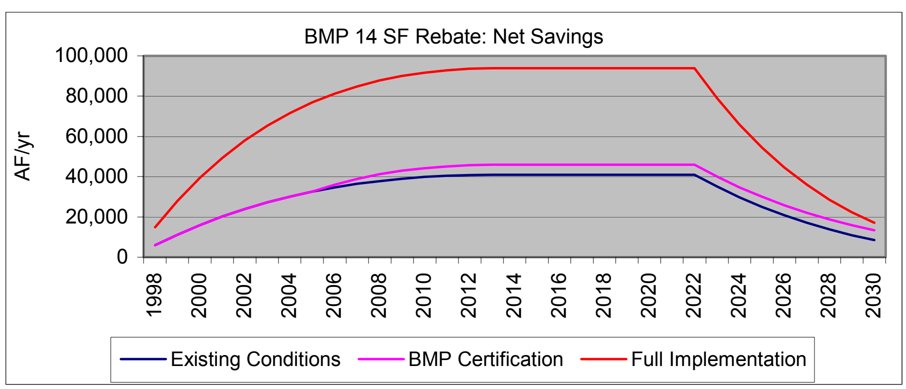


Fig. A-6 Long life span with no savings decay: BMP 14 Program Implementation



Appendix B. Comments to Draft Report and Responses

-----Original Message-----
From: Peter H. Gleick [mailto:pgleick@pipeline.com]
Sent: Wednesday, June 02, 2004 11:14 AM
To: Steve Macaulay; madinla@aol.com; maryann@cuwcc.org; patrick@calwater.ca.gov; lsnow@water.ca.gov; gwolff@pacinst.org
Subject: water conservation report comments

Steve,

I realize the deadline for comments on the CUWA report has passed, and we have not been able to complete a formal review. I do not expect that we will, given our current overcommitments.

But I wanted to send some very brief general thoughts to you.

First, the overall conclusions of the report seem appropriate: "substantial water savings will result from implementation of BMPs..." and we welcome the addition of this report to the growing field of conservation analyses. The short comments below should not detract from this positive thought.

There are significant differences between the approaches used to look at cost-effectiveness in your study and ours. As we noted in our urban conservation report, there are many ways of looking at cost-effectiveness, and few consistent agreed-upon approaches. This is an area ripe for some serious discussion and perhaps, as we discussed, a white paper. PI 1

Second, we have serious concerns about the assumptions of conservation "decay." These assumptions are based on very limited real data, yet they skew the results enormously. As you note in your cover letter, "This may be an area worthy of further work." Indeed. PI 2

Finally, as we discussed, it seems to us that an important next step is to try to come to some kind of agreement about some of the theoretical and technical issues remaining, perhaps in the form of analyses, discussions, and white papers. One of these could be the "cost-effectiveness" issue mentioned above. Another is the concept of "demand hardening," which confuses many people. Another is "new water/paper water/real water" related to differences in consumptive and non-consumptive conservation savings. Another is "conservation decay." Another is pricing/rate structures/ for conservation and efficiency. Another is technical advances in conservation: how to measure them, how to capture them, and ultimately how to move beyond the "BMPs," which no one can call "Best" anymore! Perhaps we can discuss how to move forward on these important pieces of work. PI 3

Peter Gleick

M.CUBED
POLICY ANALYSIS FOR THE PUBLIC AND PRIVATE SECTORS

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FX: 510-547-3002
MITCHELL@MCUBED-ECON.COM

June 18, 2004

To: Tom Gohring, BDA

From: David Mitchell

Re: Comments on CUWA draft report "Urban Water Conservation Potential: 2003 Technical Update."

Per your request I have completed a review of the above referenced draft report, which has resulted in the following comments. I have divided these comments into two categories: (1) comments that concern the report's interpretation and modeling of the WUE Program and the correspondence between the CUWA analysis and the conservation projections being developed by CALFED; and (2) technical assumptions and data.

These comments are focused on ways in which the report could be strengthened. As such, they focus almost entirely on the negative. It is important to note therefore that on balance the report is very strong. It provides a consistent and defensible methodology for forecasting potential water savings from implementation of the current BMPs; it documents its major assumptions and sources of data; and it summarizes most results in an accessible way.

<u>Modeling of WUE Program and Correspondence to Conservation Projections</u>

1. The report assumes that 75% of funds for urban conservation grants from Propositions 204, 13, and 50 will be used to cost share implementation of eight BMPs with quantifiable savings. In fact, state funds directed to urban conservation implementation projects are being used and will continue to be used to cost-share implementation of other BMPs as well as non-BMPs. Funding for ET-controller and dishwasher spray valve programs are two examples. BDA 1.1

2. Scenario 3: Full Implementation doesn't quite make sense. It starts by assuming that all BMPs are implemented fully without consideration of cost-effectiveness. It then states that money from Propositions 204, 13, and 50 will be used to increase local cost-effectiveness, which according to the starting premise is irrelevant to the assumed level of implementation. Given that the analysis constrains conservation activity by local agencies to the eight quantifiable BMPs according to the coverage requirements, it is unclear how state funds would leverage additional local investment in this scenario. BDA 1.2

3. The report states on page 13 that "[s]cenarios 1, 2, and 3 are intended to match as closely as reasonably possible to Projection Levels 1, 2, and 5 respectively listed in the CALFED memo dates Sept. 18 2003." While Scenarios 1 and 2 correspond with Projection Levels 1 and 2, Scenario 3 does not correspond with Projection Level 5. Projection Level 5 is based on implementation of BMPs that are locally cost-effective plus additional implementation leveraged through a state grant program. The CUWA Scenario 3, on the other hand, assumes full implementation of BMPs without regard to cost-effectiveness. As mentioned in a previous comment, it is unclear how state financial assistance would have a role in Scenario 3. BDA 1.3

4. Page 22 provides an incomplete and somewhat inaccurate statement of the funding assumptions being used by CALFED for its conservation Projections. Additionally, it remains unclear in the report why supplemental state funding would be relevant to Scenario 3. BDA 1.4

5. In the report, the allocation of state financial assistance is based on the pattern of past project funding. An alternative method that would better reflect WUE policy and practice would be to allocate state financial assistance according to benefits received by the CALFED Program. This would require an extension of the model to include statewide benefits derived by CALFED from alternative urban conservation investments. BDA 1.5

6. It is not clear from the report whether supplemental state funding was actually included in the scenario analysis. If supplemental funding was included, several issues remain obscure: (1) what was the timing and magnitude of state cost-sharing; (2) how much additional conservation resulted from supplemental state funding; (3) how does the supplemental funding assumed for the scenario analysis compare to the funding assumptions being used by CALFED for the conservation projections. The report would benefit from some tables addressing these points. BDA 1.6

<u>Technical Assumptions and Data</u>

1. Chapter 3 documents some of the progress toward BMP implementation by California water agencies. For years prior to 1999 Chapter 3 contains data from only 5 agencies whereas more than 150 have signed the MOU and are implementing BMPs in some fashion. There are several additional data sources that could expand the accounting of activity to make it more complete: (1) CUWCC data could substantially add to the accounting of BMP implementation for the period 1991 – 1998; (2) additionally, since the completion of the draft report, substantial reporting to the CUWCC has occurred; and (3) the CUWCC has recently completed a compilation of conservation activity reported in Urban Water Management Plans for agencies that have not signed the MOU. It seems likely that Chapter 3 will significantly understate the amount of BMP implementation that has occurred to date unless it is revised to include data from BDA 2.1

the three sources just listed.

2. The report would benefit from a discussion of the unit cost and cost escalation assumptions embedded in the analysis. For several key BMPs, the analysis assumes the real cost of implementation will increase significantly each year. For BMP 1, for example, the analysis assumes the real cost to administer residential survey programs will increase by 4% per year. Likewise, for BMP 14 rebate programs the real cost of both administration and rebates increases by 4% annually. This increase in cost is not due to inflation. The analysis is in constant dollars. The effects of these cost escalators are significant and may have a large impact on the model's cost-effectiveness determinations. To give one example, the starting cost of a toilet rebate program for single-family residences is $109.27 per toilet. In ten years, the real (inflation-adjusted) cost is assumed to be $161.75, and in twenty years it is $239.42. One straightforward addition to the report would be to include a sensitivity analysis showing how the cost-escalation assumptions affect the projected levels of conservation. BDA 2.2

3. The third bullet on page 39 seems inconsistent with the cost escalation assumptions used for the analysis. The analysis rapidly escalates the unit costs of several of the key conservation actions over time. It would therefore seem the analysis has built in the assumption of higher search and other costs that may in part be a function of increasing saturation levels. It seems reasonable to note, however, that given the relatively low coverage requirements for BMPs, the reasonableness of the assumption of significantly increasing unit costs over time warrants at minimum more discussion in the report. BDA 2.3

4. The treatment of free-ridership effects on net program savings discussed in footnote 3 to Table 2-11 merits additional discussion. The assertion is that free-rider effects have been accounted for in the empirical savings estimates for BMP 14. It is difficult to see how this could be the case. While the analysis does adjust the net savings caused by the effect of natural replacement, the effect of free-riders on BMP 14 could go well beyond this, as was demonstrated by the CUWCC's free-ridership study. BDA 2.4

5. Table 2-2 is initially difficult to understand. BDA 2.5

6. The study assumes a 1-to-1 correspondence between counties and hydrologic regions. In actuality, some counties are contained in more than one hydrologic region. It is possible to use DWR data to allocate county population to hydrologic regions to better reflect how state population falls within the hydrologic region boundaries. This would enable a better mapping of conservation activity to regions. BDA 2.6

STATE OF CALIFORNIA – THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, Governor
DEPARTMENT OF WATER RESOURCES
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SACRAMENTO, CA 94236-0001
(916) 653-5791

RECEIVED
JUN 23 2004

JUN 22 2004

Mr. Steve Macaulay, Executive Director
California Urban Water Agencies
455 Capitol Mall, #705
Sacramento, California 95814

Dear Mr. Macaulay:

This is in response to your e-mail of April 16, 2004 regarding the Department of Water Resources' (DWR) review comments on the California Urban Water Agencies (CUWA) sponsored report titled, *Urban Water Conservation Potential: 2003 Technical Update - Draft Final Report*.

We appreciate the efforts of the CUWA and its cooperators to undertake this study to further develop and refine estimates of urban water savings. The savings estimates and related information in the Draft Report are helpful to DWR in its efforts to quantify and evaluate future urban water savings for the California Water Plan Update, and in DWR's Water Use Efficiency Technical and Financial Assistance programs.
More specific review comments from DWR staff are enclosed for your consideration.

If you have any questions, you may contact Manucher Alemi of DWR's Office of Water Use Efficiency at (916) 651-9662.

Sincerely,

Lester A. Snow
Director

Enclosure

Review Comments
On
Urban Water Conservation Potential:
2003 Technical Update-Draft Final Report

DWR Specific Review Comments on CUWA Urban Water Conservation Potential: 2003 Technical Update - Draft Final Report

1. The Report is well written. The scope, methods and results are clearly described. The section on recommendations contains several detailed and highly relevant suggestions for additional research into water savings potential. The report makes a clear distinction between active and passive water conservation and includes caveats regarding limitations of the analyses and how results should be interpreted and used. The estimates of achieved conservation are probably less robust than future savings potential due to data limitations. DWR 1

2. The memo cited as "latest CUWCC Savings Memo" (footnote 12 on page 25) is out of date. The most recent version is dated April 28, 2003. We don't have a copy of the cited document, so are unsure whether substantive changes were made between versions. DWR 2

3. Use of the terms *savings decay* and *decay rate* is inconsistent with other relevant literature. The report states that decay rates are assigned to savings activities that have a large component of human behavior, while devices that are mechanical in nature are assumed to have a specific life span and a small or zero decay rate. However, the April 28, 2003 memo cited above uses *decay rates* to both define persistence assumptions for BMPs with a large component of human behavior (e.g., BMP 1, Residential Water Surveys) and to define useful life for BMPs that are mechanical in nature (e.g., toilet flappers in BMP 2, shower head [and other devices] distribution). This inconsistency is non-trivial, and the report should explicitly address the difference and clearly state the meaning of the terms in the current work. DWR 3

4. There are numerous references to the Phase 1 study, making it necessary to have a reference copy of that study on hand in order to fully review the current report. The Phase 1 study should be made readily available to all reviewers and readers of the current report. DWR 4

5. It would be useful also to include potential savings with no saving decay in Chapter 2 to give indications of what may be possible under such scenario. An illustration of the scenario is provided in Appendix A of the Draft Report. DWR 5

6. Numerous assumptions are made to determine the level of water savings. In order to verify the water savings, the report should recommend to verify the DWR 6

assumptions or take the necessary steps to achieve the assumed conditions such as assumed level of funding and percentage of coverage of BMPs.

7. The actual costs or implementation levels by various agencies could differ from the estimates assumed in the Report. It may be useful to present the range of the actual costs and implementation levels and savings associated with the ranges. DWR 7

8. The sources of data underlying the study's BMP cost estimates are not clearly identified. The footnote to Table 2-10 says that the "costs are from Phase 1, adjusted to 2003 dollars, and from revisions based on program experience developed by PAC review and consensus. However, that leaves open the question of where the data in Phase 1 came from, and the basis of the experience-based revisions. DWR 8

9. The five participating water agencies that provided data for the Report are among the largest in the State. It is possible that the agencies were able to take advantage of economies of the scale in implementing their programs and that the average cost figures cited in the report may underestimate the cost to smaller agencies for BMP implementation. If such information is available, it could be used to calculate the level of financial assistance that would be required to "level the playing field" for the smaller agencies. DWR 9

10. The existing, cost-effective, and full implementation scenarios described in the Report are aimed at the levels the Urban MOU signatories have agreed to carry out. Full implementation in the Report is the full implementation at the coverage levels identified in the MOU. However, the implementation section of each BMP contains the statement "Implementation shall consist of at least the following actions..." Thus, innovative approaches to BMP implementation can alter the cost-effectiveness ratio. DWR 10

11. Cost-effective implementation beyond the coverage levels can also produce additional water savings. DWR 11

12. We anticipate using the Report as a reference in our efforts to identify and improve urban water use analytical tools for the Water Plan Update. DWR 12

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July 19, 2004

Mr. Steve Macaulay
Executive Director
California Urban Water Agencies
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Dear Steve:

It is with great pleasure that I submit comments to you on CUWA's report, *Urban Water Conservation Potential: 2003 Technical Update.* The Council had urged the California Bay Delta Authority to consider using the Phase I version of this CUWA report in their analysis of water use efficiency potential under CALFED. Since CALFED's estimates would be based on a 2030 time frame, it was necessary to adjust the CUWA study to provide an extended forecast. We are very grateful that the CUWA Board agreed to this revision and undertook the expense necessary to make it happen. It is a significant contribution to the body of water conservation research.

This report provides a useful comparison with the Pacific Institute report, *Waste Not Want Not*, which estimates urban conservation potential from an end use perspective and carries a different interpretation of conservation cost-effectiveness. In addition, the California Bay Delta Authority will be releasing a Comprehensive Evaluation that will provide yet a third perspective. Each one of these efforts has differing assumptions and therefore differing outcomes in the estimates reached.

It is important that the reader understand the importance that the beginning assumptions make in the CUWA analysis. The Foreword in the *2003 Technical Update* does address this issue, but I would suggest that the underlying assumptions be made even more clear, as they greatly influence and even skew a true water conservation potential analysis. Here are some examples:

1. An analysis was attempted for only those Best Management Practices (BMPs) which are considered "quantifiable" by the Council at this time. Unfortunately, this eliminates several important BMPs, such as conservation rate structures and water conservation ordinances. No one would argue that these practices don't save water; for that reason they are BMPs to begin with. One could even reasonably argue that

these two save more water than some of the other, more quantifiable BMPs. The reason a BMP is classified currently as not "quantifiable" is purely due to the difficulty in providing a general metric for measuring them. The Council will move to remedy this soon, hopefully with the aid of Prop 50 water use efficiency research funding. But there are indeed a few California studies showing the extraordinary impact that rate structures combined with conservation programs can have on a water agency's service area (e.g. Irvine Ranch Water District's recent evaluation). A study of true urban conservation potential which lacks an analysis of rate structures or local codes and ordinances is therefore missing a significant chunk of future potential. I understand that there was a limited amount of funding for this project and this extended analysis could not be undertaken at this time. I raise this issue only because it should probably be more clear in the report itself that this major area of potential is not covered.

CUWCC 1

2. Conservation potential estimates were provided only for measures that are currently BMPs in the Memorandum of Understanding. This already leaves out a number of programs which water agencies are now doing (dual flush toilets, spray valves, ET controllers, hot water units) which are above and beyond the BMP list at this time. I fear that even the report's analysis of BMP 6 potential does not include the new BMP 6 revision adopted this year by the Council and therefore its increased conservation potential.

   Again, it would seem logical that an analysis of potential conservation to 2030 would investigate measures beyond an already old and very tired list of BMPs. However, I am well aware of the cost of adding this kind of analysis, and recognized early on that this was not part of the original project scope. This too should be made more clear in the report, and by doing so will help to explain the gap between the CUWA estimates and those of the Pacific Institute's report, *Waste Not Want Not*, which does consider these items.

CUWCC 2

3. A cost per acre foot within each of the BMP programs was not developed in the report, unless I missed it somewhere. The unit cost of various conservation programs was indeed included, but the total program cost was not then translated into cost per acre foot of water saved. This is an unfortunate omission, one which I hope can sometime be rectified. Cost per acre foot is a very useful metric for water agency planning, as well as for CALFED program funding purposes.

CUWCC 3

Further research issues were raised in the report: defining free ridership in all BMP programs, and quantifying decay rates in a more comprehensive way.

Both issues have been looked at by the Council. In December 2002 we published a report entitled *Freeriders in ULFT Programs*. Decay rates are being looked at in our continuing updates on BMP Costs and Savings. There is no question that these issues would benefit by additional research. The identification and reinforcement of this need in the CUWA report is most helpful.

Finally, I want to express my appreciation not only for this report but for the forthright spirit of cooperation which was extended to the Council during the preparation of this document. I became fully aware of the significant time commitment made not only by the consultant, but by the project advisory committee members from the water agencies as well as CUWA staff. Your effort was well spent. You have provided an excellent work product of great significance to the water conservation community. We encourage your continued efforts in this area.

Sincerely yours,

Mary Ann Dickinson

Mary Ann Dickinson
Executive Director

cc: Council Steering Committee Members

Response to Comments on CUWA 2003 Conservation Potential

Response to Pacific Institute (PI) Comments:

PI-1 We agree that the PI report and the CUWA report take different approaches. The PI report *Waste Not Want Not* constructs a definition of technically possible water conservation—the difference between current levels of water use and levels of water use that are technically possible with a select number of existing, working, and currently available end use technologies. The CUWA analysis of Urban Water Conservation Potential examines a subset of the existing Best Management Practices for their water savings potential. This BMP focus is appropriate for CUWA as its member agencies are committed to implementing the Urban Water Conservation BMPs that are predicated on cost-effectiveness. The PI report also conducts it's cost-effectiveness analysis from the customer point-of-view, which is uninformative to the question of who should pay for conservation programs. The CUWA analysis examines the point-of-view of water utilities.

PI-2 We strongly agree that the persistence of water savings—also referred to as water savings decay—from active conservation programs is a topic in need of additional empirical analysis.

PI-3 The additional topics in need of further research are duely noted.

Response to Department of Water Resources (DWR) Comments:

DWR-1 Thank you.

DWR-2 We believe the point is well taken. The CUWCC 4/28/03 memo does include some different and additional savings factors compared to the 12/8/02 memo that was provided to the study team. These differences between the savings factors used in the CUWA study and those in 4/28/03 memo include the following:

- SF Surveys—gpd differences. The CUWA savings table uses 14.0 gpd. The 4/28/03 memo uses 21 gpd citing CUWCC's 2000 BMP Cost and Savings study ("savings for untargeted intensive home surveys", p. 2-20).
- SF&MF aerators—decay rate differences. The CUWA study uses 25% while the 4/28/03 memo uses 50% (the mid-point of the range given in Table 1 of the Cost and Savings study).
- Landscape budgets—decay rate. The CUWA study uses 3%. The 4/28/03 memo assumes no decay ("Savings for budgets are assumed to persist for as long as the water supplier maintains the budget program.")

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- HE washers—freerider difference. CUWA study uses 25%. The 4/28/03 memo uses 10% (described as a "placeholder value").
- CII Survey—decay rate difference. CUWA study uses 0% based on the models used in the CUWA Phase 1 study. The 4/28/03 memo uses a 10% savings decay rate assumption.

The 12/8/02 memo was provided to us by CUWCC as the latest at the time of the research.

DWR-3 The report is incorrectly paraphrased in these comments. We agree that savings decay can be due to human or mechanical causes. The report and the analysis use the term decay to refer to both reasons for decay as does the CUWCC memo.

We believe the commenter is referring to the appendix with simple numerical illustrations where we state, "Savings activities that have a large component of human behavior tend to be represented with decay rates unless ongoing program support is expected to maintain savings over time (e.g., irrigation controller adjustments)." This statement does not exclude mechanical failure as a potential source of savings decay. Further, we state, "In contrast, devices that are mechanical in nature and long-lived are assumed to have a specific life span and a small or zero decay rate (e.g., HE washers)." The second statement refers specifically only to long-lived devices and it provides an example to illustrate (not flappers or showerheads). Neither of these statements is inconsistent with the mainstream of conservation literature. However, the Foreword has been revised to distinguish between human behavior and device performance.

DWR-4 Phase 2 was a supplement to, not a replacement for, Phase 1. Phase 1 is available from CUWA through their web site: http://www.cuwa.org

DWR-5 Other assumptions can easily be tested in any subsequent analyses.

DWR-6 We agree that it would be a good recommendation to verify the water savings projected in this and any analysis that forecasts future savings. This has been added to the report recommendations, found in Chapter 4.

DWR-7 We agree that costs may differ from the estimates in the report and state this in the report. Sensitivity analyses of these and other values used in the study would be a worthwhile undertaking in future research.

DWR-8 The commenter is referred to the Phase 1 document and to PAC members for further information.

DWR-9 – 11 Agreed.

DWR-12 Good.

Response to Bay Delta Authority (BDA) Comments:

BDA-1.1

The study used information that was available during the winter of 2003 to make reasonable and documented assumptions about future funding. As the study currently notes, actual allocations could well differ, causing savings to likewise differ. We would like to make the following points.

1. The 75 percent allocation of funds is for Proposition 50 and subsequent CALFED only, not for 204 and 13. See text on pg 23 and table 2-8.
2. The Proposition 204 and 13 funds included are only those for the BMPs in the analysis.
3. The text also notes that the 25 percent is for things other than the BMPs included in the analysis. This was the PAC's description of a likely outcome.
4. It is worth noting that ET controllers and spray valves can potentially count toward fulfillment of BMP 9 even if they do not yet possess dedicated BMPs.

BDA-1.2 The CUWA Project Advisory Committee shaped the scenarios. The additional state funds do not move the model to a higher level of implementation in the third scenario--as is correctly noted in the comments--because the cost-effectiveness criterion is not binding. The language of the text has been changed to better reflect this fact.

BDA-1.3 The PAC discussed Scenario 3 extensively and decided to go with its definition as "full implementation". The sentence on page 13 has been revised with regard to Projection 5. Though we attempted to parallel CALFED's assumptions to the extent they were sufficiently explicit and available by the year 2003 cut-off, readers should refer to CALFED work for the documentation of CALFED assumptions.

BDA -1.4 This was the PAC's interpretation of CALFED projections. It is reasonable to conclude that state funding would contribute to the objective of full implementation.

BDA -1.5 The PAC determined the specific implementation of state funding. Absent information about future CALFED grant funding allocations, the PAC decided to rely on historical patterns.

BDA -1.6

Issue 1: This detail is in Table 2-8, 2-9, and at the bottom of pg. 23. Detail for the other hydro regions (Table 2-9 is the SF Bay only) is in the model files.

Issue 2: This was not a research question in the Phase 2 analysis. See Phase 1 for this type of analysis.

Issue 3: Since this study was conducted independently of CALFED, the assumptions reflect the best judgment of the PAC members. The reader should not be surprised that the data and assumptions used in the CUWA analysis differ from those used in other analyses.

BDA -2.1 Chapter 3 did not include CUWCC data because it was considered less consistently reported than the more recent data and because of project resource constraints. Reporting CUWA members do constitute a significant proportion of urban water use in the state. As noted in the text, the chapter is not intended as a complete statewide accounting. Rather, the results should be viewed as a limited attempt to develop a lower-limit estimate of water savings achieved by past activity.

BDA -2.2 The cost figures are documented as being from Phase 1, with revisions by the PAC. We agree sensitivity analyses would be informative but were beyond the limited scope of this project.

BDA -2.3 We agree with the comment that cost assumptions are a worthy source of additional scrutiny. The report caveat may lead readers to mistakenly conclude that there are no adjustments for saturation/search costs included in the analysis.

BDA -2.4 We are aware that the cost-effectiveness of ULFT programs is affected by freeriders and we are also aware of CUWCC's study on this topic. But as the CUWCC study shows, the incidence of freeriders is program specific and can vary significantly. The BMP models allow for freerider parameters; the savings table (Table 2-11) provides the free rider assumptions used. While it is possible that these assumptions underestimate the free-rider effect, it is also possible that they overestimate the effect. (Early implementing water utilities can stimulate demand in other utilities; early adapting customers can create similar spillover effects by inducing others to try more efficient water-using technologies.) Conducting a sensitivity analysis of the effects of freeriders on program economics would be another item worth running sensitivity analysis on. While this was beyond the scope of the current study, the spreadsheet model allows for this type of analysis.

BDA -2.5 It has been a challenge to develop and communicate a model of the scale and scope of implementation. Any additional comments for clarifying language would be welcome.

BDA -2.6 We agree; this is also beyond the scope of this report.

Response to Calif. Urban Water Conservation Council (CUWCC) Comments:

CUWCC-1 The Forward to the report has been revised. The report clearly states that it constitutes an incomplete summary of future conservation potential. We agree with the summary of omitted areas—including synchronistic combinations of rate structures with conservation outreach—that the analysis did not attempt to quantify.

CUWCC-2 Fundamentally, we do not believe the results of the CUWA analysis are comparable with the Pacific Institute analysis. The CUWA report examines a subset of existing BMP's under differing implementation conditions. The Pacific Institute report constructs one definition of technical conservation potential. The two reports define different objects of measure. Hence, the two quantities cannot be meaningfully compared. The CUWA report clearly focuses on current statewide institutional commitments and cost-effectiveness from the point-of-view of implementing agencies; The Pacific Institute analysis does not.

CUWCC-3 No unit cost analyses were conducted within the scope of this report. We believe that unit cost estimates are often incorrectly compared and are prone to misuse. Specifically, they are a cost-effectiveness measure that may be meaningfully compared across alternatives only when the alternatives are identical in attributes. Since the attributes of conservation alternatives differ from other water resource alternatives, unit cost can be a very misleading metric. Interested readers can refer to the project spreadsheets to conduct any additional analyses.