American River Basin

Attachment 7: Economic Analysis - Water Supply Costs and Benefits

Overview

The fifteen projects in this Proposal provide a broad array of benefits within the American River Basin (ARB) region and externally to the Sacramento-San Joaquin Delta (Delta). While some of these benefits may be quantified via an economic analysis, many benefits provided by the projects cannot be quantified due to their complex nature. This attachment provides an economic analysis of water supply benefits expected as a result of implementation of 12 of the 15 projects in this proposal (Project Numbers 2, 12 and 13 do not provide water supply benefits). In summary, the projects in this proposal include the following water supply benefits:

- Improved operational flexibility
- Increased water supply reliability
- Improved service to disadvantaged communities
- Improved firefighting capability
- Reduction in system losses
- Reduced dependence on the American River and Sacramento – San Joaquin Delta
- Increased groundwater sustainability
- Improved water use efficiency

Project 1: City of Roseville ASR Program – Phase 2

Summary

The Roseville Aquifer Storage and Recovery (ASR) Project is designed to increase water supply reliability through enhancing conjunctive use. The project will install well head equipment for two new groundwater extraction wells with surface water injection capabilities in the region near the City of Roseville, California. These new 1,500-2,000 gallon per minute (gpm) operational groundwater wells will be additions to the city's current groundwater and ASR program. The two wells will be used to inject 480 acre-feet per year (AFY) in the wet months of nearly all year types, and extract up to a maximum of 1,920 AFY during dry periods. On average, the wells will be operated such that there is no net increase of groundwater extraction from the basin. The project is being administered by the City of Roseville.

The City of Roseville has normally experienced constant growth rates of 4% to 7% per year; this growth rate is expected to resume after the current period of economic recession. Other recent impacts on water demand have included fluctuations in surface and groundwater supplies, increasing concern for environmental impacts, and ongoing and potential impacts to surface water quality and groundwater quality.

Current demand in the City of Roseville water service area is 31,000 AFY (2009) and is estimated to increase to 62,194 AFY at build-out, anticipated to occur in 2030. Of this 62,194 AFY build-out demand, 4,388 AFY will be met with recycled water, and 57,806 AFY of potable supplies will be required. In normal/wet years, pursuant to the Water Forum Agreement, the City can access 58,900 AFY from surface water sources. In dry years, surface water supplies are reduced to 39,800 AFY, resulting in a shortfall of 19,100 AFY. This shortfall is met by a planned 20% short-term reduction in demand (11,561 AFY) with the rest coming from groundwater (6,445 AFY). Increases in aquifer storage and recovery capabilities will allow the City to move closer to securing a reliable water supply for its customers now and in the future.

The City's fledgling ASR program, piloted in 2004 with the completion of the Diamond Creek Well, allows injection of surface water from Folsom Lake into the groundwater basin under Placer County. During the winter months (a period of low demand and excess surface water), water is injected and stored until it is needed during the summer months (a period of high demand). The new wells will allow for changes in the timing of the delivery of nearly 2,000 AFY of surface water. This project will provide a layer of supply reliability and protection against potential shortfalls, as well as alleviate pressures on surface water supplies in the summer.

A summary of all benefits and costs of the project are provided in Table 1. Project costs and water supply benefits are discussed in the remainder of this attachment.

Table 1: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$3.8 million
Monetized Benefits	
Water Supply Benefits	
Avoided Purchased Water Costs ($400/AF)	$2.6 million
Total Monetized Benefits	$2.6 million
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved operational flexibility for City of Roseville	++
Increased water supply reliability for customers	+
Water Quality and Other Benefits	
Manage the groundwater aquifer as a sustainable resource	++
Meet regional conjunctive use goals	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The project will have total capital costs of $4.4 million (2009 USD). Roseville plans to expend about 10% of the project's total capital costs in 2011, 80% in 2012, and the final 10% in 2013. The wells themselves have already been completed so they are sunk costs; the project will provide the above-ground infrastructure. The new wells will incur operation and maintenance (O&M) costs of $7,480 annually, as follows. Excess surface water will be treated and injected into the groundwater system, requiring annual costs of $960 (480 AF at $2/AF). This cost for injection is minimal because the injection wells are passive (e.g., rely on existing system pressure to inject) and the increased cost of operating the water treatment plant relative to the volumes already being treated are minimal. The stored water will need to be pumped to the distribution system to be re-chlorinated. This will cost $3,840 (480 AF at $8/AF extraction which is the net difference between the cost of the groundwater operation of $70/AF and the surface water operation of $78/AF) annually. Two hours of maintenance per well per month are assumed for an annual cost of $1,680. Finally, $500 per well per year for monitoring is assumed. Because the wells will be operated much less frequently than a typical production well, no replacement costs were assumed. This brings the present value cost of the project over the wells' 50-year lifetime to $3.8 million, as shown in Table 2.

Table 2: Annual Cost of Project (All costs in 2009 Dollars) Project: City of Roseville ASR Program – Phase 2									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2011	$443,751						$443,751	0.89	$394,937
2012	$3,550,010						$3,550,010	0.84	$2,980,657
2013	$443,751	$0	$4,800	$1,680		$1,000	$451,231	0.79	$357,417
2014	$0	$0	$4,800	$1,680		$1,000	$7,480	0.75	$5,589
2015	$0	$0	$4,800	$1,680		$1,000	$7,480	0.70	$5,273
2016	$0	$0	$4,800	$1,680		$1,000	$7,480	0.67	$4,975
2017	$0	$0	$4,800	$1,680		$1,000	$7,480	0.63	$4,693
2018	$0	$0	$4,800	$1,680		$1,000	$7,480	0.59	$4,427
2019	$0	$0	$4,800	$1,680		$1,000	$7,480	0.56	$4,177
2020	$0	$0	$4,800	$1,680		$1,000	$7,480	0.53	$3,940
2021	$0	$0	$4,800	$1,680		$1,000	$7,480	0.50	$3,717
2022	$0	$0	$4,800	$1,680		$1,000	$7,480	0.47	$3,507
2023	$0	$0	$4,800	$1,680		$1,000	$7,480	0.44	$3,308
2024	$0	$0	$4,800	$1,680		$1,000	$7,480	0.42	$3,121
2025	$0	$0	$4,800	$1,680		$1,000	$7,480	0.39	$2,944
2026	$0	$0	$4,800	$1,680		$1,000	$7,480	0.37	$2,778
2027	$0	$0	$4,800	$1,680		$1,000	$7,480	0.35	$2,621
2028	$0	$0	$4,800	$1,680		$1,000	$7,480	0.33	$2,472
2029	$0	$0	$4,800	$1,680		$1,000	$7,480	0.31	$2,332

Table 2: Annual Cost of Project
(All costs in 2009 Dollars)
Project: City of Roseville ASR Program – Phase 2

	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2030	$0	$0	$4,800	$1,680		$1,000	$7,480	0.29	$2,200
2031	$0	$0	$4,800	$1,680		$1,000	$7,480	0.28	$2,076
2032	$0	$0	$4,800	$1,680		$1,000	$7,480	0.26	$1,958
2033	$0	$0	$4,800	$1,680		$1,000	$7,480	0.25	$1,847
2034	$0	$0	$4,800	$1,680		$1,000	$7,480	0.23	$1,743
2035	$0	$0	$4,800	$1,680		$1,000	$7,480	0.22	$1,644
2036	$0	$0	$4,800	$1,680		$1,000	$7,480	0.21	$1,551
2037	$0	$0	$4,800	$1,680		$1,000	$7,480	0.20	$1,463
2038	$0	$0	$4,800	$1,680		$1,000	$7,480	0.18	$1,380
2039	$0	$0	$4,800	$1,680		$1,000	$7,480	0.17	$1,302
2040	$0	$0	$4,800	$1,680		$1,000	$7,480	0.16	$1,229
2041	$0	$0	$4,800	$1,680		$1,000	$7,480	0.15	$1,159
2042	$0	$0	$4,800	$1,680		$1,000	$7,480	0.15	$1,093
2043	$0	$0	$4,800	$1,680		$1,000	$7,480	0.14	$1,032
2044	$0	$0	$4,800	$1,680		$1,000	$7,480	0.13	$973
2045	$0	$0	$4,800	$1,680		$1,000	$7,480	0.12	$918
2046	$0	$0	$4,800	$1,680		$1,000	$7,480	0.12	$866
2047	$0	$0	$4,800	$1,680		$1,000	$7,480	0.11	$817
2048	$0	$0	$4,800	$1,680		$1,000	$7,480	0.10	$771

Table 2: Annual Cost of Project (All costs in 2009 Dollars) Project: City of Roseville ASR Program – Phase 2									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2049	$0	$0	$4,800	$1,680		$1,000	$7,480	0.10	$727
2050	$0	$0	$4,800	$1,680		$1,000	$7,480	0.09	$686
2051	$0	$0	$4,800	$1,680		$1,000	$7,480	0.09	$647
2052	$0	$0	$4,800	$1,680		$1,000	$7,480	0.08	$611
2053	$0	$0	$4,800	$1,680		$1,000	$7,480	0.08	$576
2054	$0	$0	$4,800	$1,680		$1,000	$7,480	0.07	$543
2055	$0	$0	$4,800	$1,680		$1,000	$7,480	0.07	$513
2056	$0	$0	$4,800	$1,680		$1,000	$7,480	0.06	$484
2057	$0	$0	$4,800	$1,680		$1,000	$7,480	0.06	$456
2058	$0	$0	$4,800	$1,680		$1,000	$7,480	0.06	$430
2059	$0	$0	$4,800	$1,680		$1,000	$7,480	0.05	$406
2060	$0	$0	$4,800	$1,680		$1,000	$7,480	0.05	$383
2061		$0	$4,800	$1,680		$1,000	$7,480	0.05	$361
2062		$0	$4,800	$1,680		$1,000	$7,480	0.05	$341
2063		$0	$4,800	$1,680		$1,000	$7,480	0.04	$322
2064		$0	$4,800	$1,680		$1,000	$7,480	0.04	$303
Project Life	50 years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									$3,826,701

The "Without Project" Baseline

In California, as in many other western states, water is often limited during times of greatest demand and in ample supply during times of lowest demand. One solution to this dilemma, as proposed in this project, is through underground water storage for later use. Without this project, the City would continue to rely on surface water for their primary supplies and use groundwater wells for back-up and emergency drought supplies. As demands on surface water supplies continue to increase, the City will be forced to use their groundwater wells more regularly and to purchase water from upstream purveyors to cover shortfalls. Increased extractions from groundwater wells without ASR will intensify pressure on limited groundwater supplies. Short-term water conservation programs, currently designed to temporarily reduce demand by up to 20%, could become more urgent; customer rationing would follow if needed. A final component to maintain adequate supplies for the service area would be to purchase water from upstream purveyors. Based on recent projects completed in the region, a typical cost for developing a next increment of water supply is around $400 per AF.

Water Supply Benefits

Avoided cost of purchased water

As noted above, potable water demand by City of Roseville customers currently averages 31,000 AFY, and this is expected to double by 2030. In wet years, nearly all of this can be met by surface water sources. In dry years, however, Roseville's allocation from the American River drops by 32%, resulting in a shortfall of 19,100 AFY that would be replaced by short-term water conservation programs and groundwater. The ASR program will add 14 groundwater wells to the City's water infrastructure. The two ASR wells in this project together will add up to 1,920 AFY of extraction for use during dry years. In the absence of this project, Roseville's options would include stronger short-term water conservation programming, water rationing, or water purchasing. While water purchases have not historically been included in Roseville's water supply planning, the current cost of developing additional supply in the region is around $400 per AF (2009 USD). The avoided cost of this purchase is $192,000 annually (480 AFY * $400). Over a 50 year project life, beginning when the wells become operational in 2013, the present value of this avoided cost is $2.6 million, as shown in Table 3.

Table 3: Present Value Benefits – Avoided Water Purchase
(All benefits in 2009 Dollars)
Project: City of Roseville ASR Program – Phase 2

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2013	avoided water purchase	AF	0	480	480	$400	$192,000	0.79	$152,082
2014	avoided water purchase	AF	0	480	480	$400	$192,000	0.75	$143,474
2015	avoided water purchase	AF	0	480	480	$400	$192,000	0.70	$135,352
2016	avoided water purchase	AF	0	480	480	$400	$192,000	0.67	$127,691
2017	avoided water purchase	AF	0	480	480	$400	$192,000	0.63	$120,463
2018	avoided water purchase	AF	0	480	480	$400	$192,000	0.59	$113,645
2019	avoided water purchase	AF	0	480	480	$400	$192,000	0.56	$107,212
2020	avoided water purchase	AF	0	480	480	$400	$192,000	0.53	$101,143
2021	avoided water purchase	AF	0	480	480	$400	$192,000	0.50	$95,418
2022	avoided water purchase	AF	0	480	480	$400	$192,000	0.47	$90,017
2023	avoided water purchase	AF	0	480	480	$400	$192,000	0.44	$84,922
2024	avoided water purchase	AF	0	480	480	$400	$192,000	0.42	$80,115
2025	avoided water purchase	AF	0	480	480	$400	$192,000	0.39	$75,580
2026	avoided water purchase	AF	0	480	480	$400	$192,000	0.37	$71,302
2027	avoided water purchase	AF	0	480	480	$400	$192,000	0.35	$67,266
2028	avoided water purchase	AF	0	480	480	$400	$192,000	0.33	$63,458
2029	avoided water purchase	AF	0	480	480	$400	$192,000	0.31	$59,867
2030	avoided water purchase	AF	0	480	480	$400	$192,000	0.29	$56,478
2031	avoided water purchase	AF	0	480	480	$400	$192,000	0.28	$53,281
2032	avoided water purchase	AF	0	480	480	$400	$192,000	0.26	$50,265
2033	avoided water purchase	AF	0	480	480	$400	$192,000	0.25	$47,420
2034	avoided water purchase	AF	0	480	480	$400	$192,000	0.23	$44,736

Table 3: Present Value Benefits – Avoided Water Purchase
(All benefits in 2009 Dollars)
Project: City of Roseville ASR Program – Phase 2

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2035	avoided water purchase	AF	0	480	480	$400	$192,000	0.22	$42,204
2036	avoided water purchase	AF	0	480	480	$400	$192,000	0.21	$39,815
2037	avoided water purchase	AF	0	480	480	$400	$192,000	0.20	$37,561
2038	avoided water purchase	AF	0	480	480	$400	$192,000	0.18	$35,435
2039	avoided water purchase	AF	0	480	480	$400	$192,000	0.17	$33,429
2040	avoided water purchase	AF	0	480	480	$400	$192,000	0.16	$31,537
2041	avoided water purchase	AF	0	480	480	$400	$192,000	0.15	$29,752
2042	avoided water purchase	AF	0	480	480	$400	$192,000	0.15	$28,068
2043	avoided water purchase	AF	0	480	480	$400	$192,000	0.14	$26,479
2044	avoided water purchase	AF	0	480	480	$400	$192,000	0.13	$24,980
2045	avoided water purchase	AF	0	480	480	$400	$192,000	0.12	$23,566
2046	avoided water purchase	AF	0	480	480	$400	$192,000	0.12	$22,232
2047	avoided water purchase	AF	0	480	480	$400	$192,000	0.11	$20,974
2048	avoided water purchase	AF	0	480	480	$400	$192,000	0.10	$19,787
2049	avoided water purchase	AF	0	480	480	$400	$192,000	0.10	$18,667
2050	avoided water purchase	AF	0	480	480	$400	$192,000	0.09	$17,610
2051	avoided water purchase	AF	0	480	480	$400	$192,000	0.09	$16,613
2052	avoided water purchase	AF	0	480	480	$400	$192,000	0.08	$15,673
2053	avoided water purchase	AF	0	480	480	$400	$192,000	0.08	$14,786
2054	avoided water purchase	AF	0	480	480	$400	$192,000	0.07	$13,949
2055	avoided water purchase	AF	0	480	480	$400	$192,000	0.07	$13,159
2056	avoided water purchase	AF	0	480	480	$400	$192,000	0.06	$12,414

Table 3: Present Value Benefits – Avoided Water Purchase (All benefits in 2009 Dollars) Project: City of Roseville ASR Program – Phase 2									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2057	avoided water purchase	AF	0	480	480	$400	$192,000	0.06	$11,712
2058	avoided water purchase	AF	0	480	480	$400	$192,000	0.06	$11,049
2059	avoided water purchase	AF	0	480	480	$400	$192,000	0.05	$10,423
2060	avoided water purchase	AF	0	480	480	$400	$192,000	0.05	$9,833
2061	avoided water purchase	AF	0	480	480	$400	$192,000	0.05	$9,277
2062	avoided water purchase	AF	0	480	480	$400	$192,000	0.05	$8,752
2063	avoided water purchase	AF	0	480	480	$400	$192,000	0.04	$8,256
2064	avoided water purchase	AF	0	480	480	$400	$192,000	0.04	$7,789
Total Present Value of Discounted Benefits (Sum of Column (j))									**$2,556,966**

Increased Water Supply Reliability

In addition to avoided water purchase costs, another primary benefit of the two additional wells for the Roseville ASR Project is their ability to assist in meeting the service area's projected demand, and further insulate potential shortfalls through increased storage capacity. The increased production and storage capacity from the wells will provide the service area increased supply reliability and will take some demand pressures off dry-season surface supplies that other communities rely on for primary supplies.

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed two ASR wells will allow the City to store excess surface water supplies for use in times of high demand and constrained surface water supplies. Although concern for water supply reliability is increasing (due to population growth, increasing water demands, and uncertainties over climate change impacts), only a few studies have directly attempted to quantify its value, primarily through non-market valuation studies. Results of these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $95 to $500 (in 2009 USD) per household for total reliability (i.e., a 0% probability of facing water restrictions in times of drought).

The challenge in applying these values to determine a benefits value for the project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay (WTP) to ensure complete reliability (zero drought-related use restrictions in the future), whereas this project will only enhance overall reliability but not guarantee 100% reliability (since the City's surface water supply is drought sensitive, two additional ASR wells will not fully mitigate this). Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

The project's value is a function of the increased production potential from the new wells, the related injection capacity of the new wells, the value of the new storage (scaled to reflect apportionment to overall reliability), and the number of households that will benefit from the increased reliability. The planned use of the wells, averaged across wet and dry years, is to inject approximately 480 AFY, when water and the off-peak plant facility are available, and to extract 480 AFY.

One approach to evaluating the project's impacts on supply reliability is to derive empirical estimates based on the above discussion. However, because of uncertainty in the application of the literature to this project context, and given that added reliability values may, to some degree, double-count benefits with the avoided costs of alternative supplies (as shown above), an empirical estimate was not included for increased water supply reliability values.

Improved operational flexibility for City of Roseville

By improving the City's ability to store excess water underground for later use, the ASR Program provides an equitable, cost-effective water resource management strategy for enhancing water supply reliability, and operational flexibility for water users of Folsom Lake, the lower American River, and the connected groundwater basin.

Distribution of project benefits, and identification of beneficiaries

The largest beneficiary of benefits from this project will be the City of Roseville and its water customers through improved water supply reliability. Another beneficiary would be Placer County (a regional beneficiary) through the avoidance of potentially negative impacts on the groundwater basin water levels. Also, other communities that rely on surface water for primary supplies in the summer months will benefit from reduced pressure on those supplies. A summary of key project beneficiaries is provided in Table 4. This project will also contribute to operational flexibility in meeting future needs to sustain flows into the American River and in the Sacramento-San Joaquin Delta, although that benefit is discussed in Attachment 8 rather than here.

Table 4: Project Beneficiaries Summary

Local	Regional	Statewide
Water Customers of Roseville	Placer County Water Agency service area customers	Delta

Project Benefits Timeline Description

It is expected that this project will become operational in mid-2013 and have a life of 50 years. Project benefits will begin accruing in 2013, when operation begins.

Potential Adverse Effects from the Project

This project is proposing to inject surface water in times of excess supply and off peak-times; therefore, the project should have negligible negative effects on surface water supplies for environmental purposes. ASR programs hold potential for introducing foreign contaminants found in surface water bodies into groundwater systems and impacting the basin and users of the basin. However, with proper monitoring, institutional controls, and treatment this threat is marginal.

Summary of Findings

The proposed ASR Project will allow the city to store excess surface water supplies for use during times of high demand and constrained surface water supplies, marginally increasing the city's reliability. The estimated monetized benefit of the project is based on the avoided costs of water purchases ($2.6 million), assuming an adequate supply of additional water is available for purchase. Although not quantified here, the project also brings significant increased water supply reliability to Roseville customers. These benefits are estimated in a conservative manner, and could be much higher.

Non-monetized benefits of the project include improved operational flexibility for the City of Roseville water managers, improved management of the groundwater aquifer as a sustainable resource, and compliance with regional conjunctive use goals.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases.

Table 5: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased level of reliability for customers	U/+	The project will increase water supply reliability for Roseville customers. We have not added an empirical estimate of the value of this added supply reliability and, therefore, may be understating the total water supply benefits of this project.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

Personal Communication (2010) *Cathy Lee, City of Roseville*

Project 3: E.A. Fairbairn Groundwater Well Project

Summary

The City of Sacramento grew by over 18% between 2000 and 2009 (California Department of Finance). The City's water supply is heavily dependent on the American and Sacramento Rivers, and just 10-15% is normally supplied by groundwater. Concern has been growing about the impacts of climate change on local water supplies. Climate change impacts already apparent in California include reduction in snow pack (used as seasonal storage for water supply) and more flash flows in the rivers during storm events. There is limited storage capacity on the two rivers, and it is considered unlikely that there will be significant future increases in surface storage in the state. Regionally, environmental policies have been focusing on maintaining and increasing flows in the Sacramento-San Joaquin Delta (Delta), and the American and Sacramento Rivers are primary feeders into the Delta. The City is increasingly vulnerable to changes (and reductions) in surface water supplies. The E. A. Fairbairn Well project will provide greater reliability for the City's water supply by reducing reliance on surface waters and increasing the abilities of the City to conjunctively manage their supplies.

The Fairbairn Well project will provide a new 2 MGD well and ancillary operational support facilities to support the City of Sacramento's conjunctive use program. The new infrastructure will add water supply quantity and greater reliability to the City's water supplies in driest years, and contribute to more environmentally-protective sustainable operations. At present, the City uses about 140,000 AF per year of water. During development of its latest Water Master Plan (to be completed in late 2011), the City identified that, in the driest of years, it could experience a surface water shortfall of up to 30,000 AF. The new well is part of the City's strategy to contribute to regional water supplies to meet the shortfall in dry and driest years.

In past operations, the City did not actively vary the extraction rate from its existing wells from year to year, but under its conjunctive use program, the City will utilize more groundwater to meet demand in drier year, leaving more water in the American and Sacramento Rivers to help sustain flows. The City will vary the extraction rates from their wells depending on American River hydrologic conditions, and more specifically, the projected unimpaired inflow into Folsom Reservoir from March to November. The well utilization will vary from 100% (2,250 AFY) in dry years, to 65% (1,462 AFY) in average years and 15% (337 AFY) in wet years.

A summary of all benefits and costs of the project are provided in Table 6. Project costs and water supply benefits are discussed in the remainder of this attachment.

Table 6: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$4.3 million
Monetizable Benefits	
Increase system reliability	$17.5 million
Water Quality and Other Benefits	None identified
Total Monetized Benefits	$17.5 million
Qualitative Benefit or Cost	Qualitative indicator*
Water Quality Benefits	
Allows system to voluntarily use groundwater when doing so will contribute to maintaining flows in the American River and in the Delta	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The project budget includes construction of a 2 MGD groundwater and ancillary facilities at the site of the existing E.A. Fairbairn Water Treatment Plant. This is a stand-alone project. The capital cost is $1.6M USD. Construction is expected to begin in August 2012, and the project will begin operation in January 2014.

Annual operations and maintenance cost is estimated at $240,000. Over the 50-year life of the project, the present value cost of capital, O&M and replacement total $4.3M USD. This is shown in Table 7.

Table 7: Annual Cost of Project (All costs should be in 2009 Dollars) Project: E.A. Fairbairn Groundwater Well Project									
	Initial Costs	**Operations and Maintenance Costs [(1)]**						**Discounting Calculations**	
	(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**
YEAR	**Grand Total**	**Admin**	**Operation**	**Maintenance**	**Replacement**	**Other**	**Total Costs (a) +…+ (f)**	**Discount Factor**	**Discounted Costs(g) x (h)**
2012	$361,919	$0	$0	$0	$0		$361,919	0.84	$303,874
2013	$1,216,535	$0	$0	$0	$0		$1,216,535	0.79	$963,610
2014		$2,000	$198,000	$40,000	$0		$240,000	0.75	$179,342
2015		$2,000	$198,000	$40,000	$0		$240,000	0.70	$169,191
2016		$2,000	$198,000	$40,000	$0		$240,000	0.67	$159,614
2017		$2,000	$198,000	$40,000	$0		$240,000	0.63	$150,579
2018		$2,000	$198,000	$40,000	$5,000		$245,000	0.59	$145,015
2019		$2,000	$198,000	$40,000	$0		$240,000	0.56	$134,015
2020		$2,000	$198,000	$40,000	$0		$240,000	0.53	$126,429
2021		$2,000	$198,000	$40,000	$0		$240,000	0.50	$119,273
2022		$2,000	$198,000	$40,000	$0		$240,000	0.47	$112,521
2023		$2,000	$198,000	$40,000	$15,000		$255,000	0.44	$112,787
2024		$2,000	$198,000	$40,000	$0		$240,000	0.42	$100,144
2025		$2,000	$198,000	$40,000	$0		$240,000	0.39	$94,475
2026		$2,000	$198,000	$40,000	$0		$240,000	0.37	$89,127
2027		$2,000	$198,000	$40,000	$0		$240,000	0.35	$84,083
2028		$2,000	$198,000	$40,000	$5,000		$245,000	0.33	$80,976
2029		$2,000	$198,000	$40,000	$0		$240,000	0.31	$74,833
2030		$2,000	$198,000	$40,000	$0		$240,000	0.29	$70,597
2031		$2,000	$198,000	$40,000	$0		$240,000	0.28	$66,601

Table 7: Annual Cost of Project (All costs should be in 2009 Dollars) Project: E.A. Fairbairn Groundwater Well Project									
	Initial Costs	Operations and Maintenance Costs [(1)]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2032		$2,000	$198,000	$40,000	$0		$240,000	0.26	$62,831
2033		$2,000	$198,000	$40,000	$35,000		$275,000	0.25	$67,919
2034		$2,000	$198,000	$40,000	$0		$240,000	0.23	$55,920
2035		$2,000	$198,000	$40,000	$0		$240,000	0.22	$52,754
2036		$2,000	$198,000	$40,000	$0		$240,000	0.21	$49,768
2037		$2,000	$198,000	$40,000	$0		$240,000	0.20	$46,951
2038		$2,000	$198,000	$40,000	$105,000		$345,000	0.18	$63,672
2039		$2,000	$198,000	$40,000	$0		$240,000	0.17	$41,786
2040		$2,000	$198,000	$40,000	$0		$240,000	0.16	$39,421
2041		$2,000	$198,000	$40,000	$0		$240,000	0.15	$37,190
2042		$2,000	$198,000	$40,000	$0		$240,000	0.15	$35,085
2043		$2,000	$198,000	$40,000	$15,000		$255,000	0.14	$35,167
2044		$2,000	$198,000	$40,000	$0		$240,000	0.13	$31,225
2045		$2,000	$198,000	$40,000	$0		$240,000	0.12	$29,458
2046		$2,000	$198,000	$40,000	$0		$240,000	0.12	$27,790
2047		$2,000	$198,000	$40,000	$0		$240,000	0.11	$26,217
2048		$2,000	$198,000	$40,000	$5,000		$245,000	0.10	$25,249
2049		$2,000	$198,000	$40,000	$0		$240,000	0.10	$23,333
2050		$2,000	$198,000	$40,000	$0		$240,000	0.09	$22,013
2051		$2,000	$198,000	$40,000	$0		$240,000	0.09	$20,767

Table 7: Annual Cost of Project (All costs should be in 2009 Dollars) Project: E.A. Fairbairn Groundwater Well Project									
	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2052		$2,000	$198,000	$40,000	$0		$240,000	0.08	$19,591
2053		$2,000	$198,000	$40,000	$35,000		$275,000	0.08	$21,177
2054		$2,000	$198,000	$40,000	$0		$240,000	0.07	$17,436
2055		$2,000	$198,000	$40,000	$0		$240,000	0.07	$16,449
2056		$2,000	$198,000	$40,000	$0		$240,000	0.06	$15,518
2057		$2,000	$198,000	$40,000	$0		$240,000	0.06	$14,640
2058		$2,000	$198,000	$40,000	$5,000		$245,000	0.06	$14,099
2059		$2,000	$198,000	$40,000	$0		$240,000	0.05	$13,029
2060		$2,000	$198,000	$40,000	$0		$240,000	0.05	$12,292
2061		$2,000	$198,000	$40,000	$0		$240,000	0.05	$11,596
2062		$2,000	$198,000	$40,000	$0		$240,000	0.05	$10,940
2063		$2,000	$198,000	$40,000	$0		$240,000	0.04	$10,320
Project Life	50 years					$0		…	
Total Present Value of Discounted Costs (Sum of Column (i))									$4,308,689

The "Without Project" Baseline

Without this project, the City of Sacramento will continue to rely disproportionately on surface water supplies from the American and Sacramento Rivers. With pressures on those supplies increasing from climate change impacts, state environmental policies to sustain flow levels into the Sacramento-San Joaquin Delta (Delta), and population growth, the City would find itself increasingly unable to guarantee water deliveries.

Water Supply Benefits

Increased reliability of water supply through increased productive capacity and conjunctive use

The primary benefit of the E.A. Fairbairn Well project is the increase in the reliability of the city's water supply, particularly during the driest years. The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. In the driest years, the City could face a shortfall of about 30,000 AF from surface supplies. The addition of the Fairbairn Well's 2 MGD to the City's water supply will partially make up for that shortfall.

Although concern for water supply reliability is increasing (due to population growth, increasing water demands, and uncertainties over climate change impacts), only a few studies have directly attempted to quantify its value, through non-market valuation studies. Results of these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $95 to $500 (in 2009 USD) per household for total reliability (i.e., a 0% probability of facing water restrictions in times of drought). Appendix A of this attachment (Attachment 7 – Economic Analysis – Water Supply Costs and Benefits) provides a detailed review of this empirical literature and discusses issues related to its interpretation for projects such as the one described here (and other similar projects in this Attachment).

The challenge in applying these values to determine a benefits value for the project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay (WTP) to ensure complete reliability (zero drought-related use restrictions in the future), whereas this project will only enhance overall reliability but not guarantee 100% reliability (since the City's surface water supply is drought sensitive, one additional well will not fully mitigate this). Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

The value of the reliability that the Fairbairn well will add to the City's water supply was calculated by taking the production from the well in a dry year (2,250 AF) and dividing it by the potential water shortfall in a dry year (30,000 AF) for a proportionate 7.5% contribution to reliability. Using the low end of the reliability value from stated preferences studies noted above ($95), the annual benefit per household is (0.075 * 95) is $7.13. Multiplying this by the number of households in the service area (197,000) provides an annual value of this reliability of $1,403,625 per year. Over the 50 year life of the well, the total value of this reliability, in present value, is $17.5 million. Table 8 summarizes these calculations.

Table 8: Present Value Benefits: #3 Fairbairn Well
(All benefits in 2009 Dollars)
Project: E.A. Fairbairn Groundwater Well Project

YEAR	Benefit a			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2012			$0			$0			$0	$0	0.84	$0
2013			$0			$0			$0	$0	0.79	$0
2014	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.75	$1,048,870
2015	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.70	$989,500
2016	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.67	$933,491
2017	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.63	$880,652
2018	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.59	$830,803
2019	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.56	$783,777
2020	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.53	$739,412
2021	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.50	$697,559
2022	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.47	$658,074
2023	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.44	$620,825
2024	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.42	$585,684
2025	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.39	$552,532
2026	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.37	$521,256
2027	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.35	$491,751
2028	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.33	$463,916
2029	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.31	$437,657
2030	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.29	$412,884
2031	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.28	$389,513
2032	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.26	$367,465

Table 8: Present Value Benefits: #3 Fairbairn Well
(All benefits in 2009 Dollars)
Project: E.A. Fairbairn Groundwater Well Project

YEAR	Benefit a			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2033	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.25	$346,665
2034	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.23	$327,043
2035	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.22	$308,531
2036	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.21	$291,067
2037	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.20	$274,591
2038	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.18	$259,048
2039	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.17	$244,385
2040	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.16	$230,552
2041	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.15	$217,502
2042	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.15	$205,191
2043	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.14	$193,576
2044	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.13	$182,619
2045	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.12	$172,282
2046	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.12	$162,530
2047	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.11	$153,330
2048	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.10	$144,651
2049	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.10	$136,463
2050	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.09	$128,739
2051	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.09	$121,452
2052	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.08	$114,577
2053	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.08	$108,092

Table 8: Present Value Benefits: #3 Fairbairn Well (All benefits in 2009 Dollars) Project: E.A. Fairbairn Groundwater Well Project												
YEAR	Benefit a			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2054	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.07	$101,973
2055	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.07	$96,201
2056	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.06	$90,756
2057	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.06	$85,619
2058	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.06	$80,773
2059	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$76,201
2060	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$71,887
2061	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$67,818
2062	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$63,979
2063	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.04	$60,358
Total Present Value of Discounted Benefits (Sum of Column (l))												**$17,524,076**

Distribution of project benefits, and identification of beneficiaries

This project primarily benefits the population served by the City of Sacramento water system who will have increased reliability in their water supply even as changing conditions create greater vulnerabilities in surface water sources such as the American and Sacramento Rivers, which are the major sources of Sacramento's water supply. Table 9 identifies the distribution of project benefits. This project will also contribute to operational flexibility in meeting future needs to sustain flows into the American and Sacramento Rivers and the Sacramento-San Joaquin Delta, although that benefit is discussed in Attachment 8 rather than here.

Table 9: Project Beneficiaries Summary

Local	Regional	Statewide
City of Sacramento	Regional water suppliers and other stakeholders reliant on or valuing Sacramento and American River flows	Delta

Project Benefits Timeline Description

The E. A. Fairbairn Well is expected to give 50 years of service. Benefits will accrue as soon as the well becomes operational in 2014. The benefits have been calculated to have an annual value of $1.4 million per year. Over the life of the project, the present value of total benefits is $17.5 million. These figures form the basis of the present value benefits presented in Table 8.

Potential Adverse Effects from the Project

The primary adverse effect from the E.A. Fairbairn Well Project could be the potential contribution to groundwater overdraft resulting from additional groundwater extractions. These effects will be mitigated, however, through the varied use of the well, local in-lieu groundwater banking (e.g. using more surface water in normal and wet years; switching to groundwater in dry years), and through local groundwater basin management under the Central Sacramento County Groundwater Management Plan.

Summary of Findings, Tables

The Fairbairn Well project is intended to provide greater reliability to the City of Sacramento's water supply. Approximately 85% to 90% of the City's water supply is from surface water sources; these sources are becoming increasingly vulnerable to the impacts of climate change, through the reduction in the snowpack that feeds the American and Sacramento Rivers, limited storage on the rivers, and changes in storm hydrology. Given the unlikelihood of building additional surface storage, the City is responding to this vulnerability by increasing potential use of groundwater, both for seasonal use annually as well as for more significant use during dry years.

The capital cost for this project is $1.6 million. With operations, maintenance, and routine replacement costs over the operational life of the well, the present value cost of this project is $4.3 million. The benefits far exceed these costs. Calculated as the proportional addition of this well's production capacity to water supply reliability in the City's system, and the value of this supply to Sacramento households, the benefit of water supply reliability contributed by this project is $1.4 million per year, or in present value over the life of the well, $17.5 million.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the estimation of willingness-to-pay (WTP) values for household valuation of water reliability. The monetization of these values relies on WTP surveys in the literature, which can vary widely, but in this analysis the most conservative values were used. An additional uncertainty in this area is the apportionment of the well's partial contribution to overall water reliability, which was estimated at 7.5%. This issue is listed in Table 10.

Table 10: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased level of reliability for water customers of the City of Sacramento	U	The WTP values in the literature vary widely. The wide range in WTP values reflects the fact that the results of the studies are specific to situations asked to the respondents. Consequently, there is a level of uncertainly in the transfer of these values. Benefits (scaled to 7.5% of literature-based WTP values) were adjusted to reflect that the project does not ensure 100% reliability. This 7.5% could be inaccurate and further analysis would be needed to refine this scaling factor.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

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Project 4: Shasta Park Reservoir and Well Project

Summary

The City of Sacramento grew by over 18% between 2000 and 2009 (California Dept. of Finance). The City's water supply is heavily dependent on the American and Sacramento Rivers, and just 10-15% is normally supplied by groundwater. Concern has been growing about the impacts of climate change on local water supplies. Climate change impacts already apparent in California include reduction in snow pack (used as seasonal storage for water supply) and more flash flows in the rivers during storm events.

There is limited storage capacity on the two rivers, and it is considered unlikely that there will be future increases in surface storage in the state. Regionally, environmental policies have been focusing on maintaining and increasing flows in the Sacramento-San Joaquin Delta (Delta), and the American and Sacramento Rivers are primary feeders into the Delta. The City is increasingly vulnerable to changes (and reductions) in surface water supplies. The Shasta Park Reservoir and Groundwater Well Project will provide greater reliability for the City's water supply, particularly during droughts when surface water supplies are likely to be curtailed.

The Shasta Park Reservoir and Groundwater Well Project consists of a new 2 million gallon per day (MGD) well, a 4 million gallon (MG) reservoir, booster pump station and ancillary operational support facilities to support the City of Sacramento's conjunctive use program. The new infrastructure will add water supply quantity and reliability to the City's water supplies, and contribute to more environmentally-protective operations. The well and reservoir will serve a disadvantaged area of the City by improving water pressure in that area during the summer months. While the water pressure has always met state standards, it has limited economic development. The new supply will also strengthen firefighting capabilities in the area.

A summary of all benefits and costs of the project are provided in Table 11. Project costs and water supply benefits are discussed in the remainder of this attachment.

Table 11: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$16.3 million
Monetized Benefits	
Increase system reliability	$17.5 million
Water Quality and Other Benefits	None identified
Total Monetized Benefits	$17.5 million
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Increased water pressure during summer months in a disadvantaged area of the City	++
Adds to firefighting capability	+
Water Quality Benefits	
Allows system to voluntarily use groundwater when doing so will contribute to maintaining flows in the Delta	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The project budget includes construction of a 2 MGD groundwater well adjacent to the Cosumnes River, a 4 MG reservoir, a booster pump station, and ancillary facilities to support operations. The project requires a land purchase for all facilities. This is a stand-alone project; the capital cost is $13.6 million. Annual operations and maintenance cost is estimated at $397,000. Over the 50-year life of the project, the present value costs of capital, O&M and replacement total $16.3 million. Construction is expected to begin in August 2012, and the project will begin operation in January 2014. The cost information is summarized in Table 12.

Table 12: Annual Cost of Project (All costs in 2009 Dollars) Project: Shasta Park Reservoir and Well Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2011	$1,044,400	$0	$0	$0	$0		$1,044,400	0.89	$1,044,400
2012	$6,552,685	$0	$0	$0	$0		$6,552,685	0.84	$5,501,761
2013	$6,012,608	$0	$0	$0	$0		$6,012,608	0.79	$4,762,549
2014		$4,000	$323,000	$70,000	$0		$397,000	0.75	$296,661
2015		$4,000	$323,000	$70,000	$0		$397,000	0.70	$279,869
2016		$4,000	$323,000	$70,000	$0		$397,000	0.67	$264,028
2017		$4,000	$323,000	$70,000	$5,000		$402,000	0.63	$252,220
2018		$4,000	$323,000	$70,000	$0		$397,000	0.59	$234,984
2019		$4,000	$323,000	$70,000	$0		$397,000	0.56	$221,683
2020		$4,000	$323,000	$70,000	$0		$397,000	0.53	$209,135
2021		$4,000	$323,000	$70,000	$0		$397,000	0.50	$197,297
2022		$4,000	$323,000	$70,000	$15,000		$412,000	0.47	$193,162
2023		$4,000	$323,000	$70,000	$0		$397,000	0.44	$175,593
2024		$4,000	$323,000	$70,000	$0		$397,000	0.42	$165,654
2025		$4,000	$323,000	$70,000	$0		$397,000	0.39	$156,278
2026		$4,000	$323,000	$70,000	$0		$397,000	0.37	$147,432
2027		$4,000	$323,000	$70,000	$5,000		$402,000	0.35	$140,838
2028		$4,000	$323,000	$70,000	$0		$397,000	0.33	$131,214
2029		$4,000	$323,000	$70,000	$0		$397,000	0.31	$123,786
2030		$4,000	$323,000	$70,000	$0		$397,000	0.29	$116,780

Table 12: Annual Cost of Project (All costs in 2009 Dollars) Project: Shasta Park Reservoir and Well Project									
	Initial Costs	Operations and Maintenance Costs [(1)]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2031		$4,000	$323,000	$70,000	$0		$397,000	0.28	$110,170
2032		$4,000	$323,000	$70,000	$35,000		$432,000	0.26	$113,096
2033		$4,000	$323,000	$70,000	$0		$397,000	0.25	$98,050
2034		$4,000	$323,000	$70,000	$0		$397,000	0.23	$92,500
2035		$4,000	$323,000	$70,000	$0		$397,000	0.22	$87,265
2036		$4,000	$323,000	$70,000	$0		$397,000	0.21	$82,325
2037		$4,000	$323,000	$70,000	$205,000		$602,000	0.20	$117,769
2038		$4,000	$323,000	$70,000	$0		$397,000	0.18	$73,269
2039		$4,000	$323,000	$70,000	$0		$397,000	0.17	$69,122
2040		$4,000	$323,000	$70,000	$0		$397,000	0.16	$65,209
2041		$4,000	$323,000	$70,000	$0		$397,000	0.15	$61,518
2042		$4,000	$323,000	$70,000	$15,000		$412,000	0.15	$60,229
2043		$4,000	$323,000	$70,000	$0		$397,000	0.14	$54,751
2044		$4,000	$323,000	$70,000	$0		$397,000	0.13	$51,652
2045		$4,000	$323,000	$70,000	$0		$397,000	0.12	$48,728
2046		$4,000	$323,000	$70,000	$0		$397,000	0.12	$45,970
2047		$4,000	$323,000	$70,000	$5,000		$402,000	0.11	$43,914
2048		$4,000	$323,000	$70,000	$0		$397,000	0.10	$40,913
2049		$4,000	$323,000	$70,000	$0		$397,000	0.10	$38,597
2050		$4,000	$323,000	$70,000	$0		$397,000	0.09	$36,412

Table 12: Annual Cost of Project (All costs in 2009 Dollars) Project: Shasta Park Reservoir and Well Project									
	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2051		$4,000	$323,000	$70,000	$0		$397,000	0.09	$34,351
2052		$4,000	$323,000	$70,000	$35,000		$432,000	0.08	$35,264
2053		$4,000	$323,000	$70,000	$0		$397,000	0.08	$30,573
2054		$4,000	$323,000	$70,000	$0		$397,000	0.07	$28,842
2055		$4,000	$323,000	$70,000	$0		$397,000	0.07	$27,210
2056		$4,000	$323,000	$70,000	$0		$397,000	0.06	$25,669
2057		$4,000	$323,000	$70,000	$5,000		$402,000	0.06	$24,521
2058		$4,000	$323,000	$70,000	$0		$397,000	0.06	$22,846
2059		$4,000	$323,000	$70,000	$0		$397,000	0.05	$21,552
2060		$4,000	$323,000	$70,000	$0		$397,000	0.05	$20,333
2061		$4,000	$323,000	$70,000	$0		$397,000	0.05	$19,182
2062		$4,000	$323,000	$70,000	$1,300,000		$1,697,000	0.05	$18,096
Project Life	50 years				$1,625,000			…	
Total Present Value of Discounted Costs (Sum of Column (i))									$16,315,221

The "Without Project" Baseline

Sacramento has historically relied on surface water from the American and Sacramento Rivers for most of its water supply. In dry years, Sacramento's share from those sources drops by 12,000 acre-feet. With increasing demand from a growing population, and with potentially less or greater variance in supply due to climate change impacts on the snowpack and snowmelt that supplies these rivers, the City faces a challenge to the reliability of its water supply, particularly during drought. Without this project, the City of Sacramento will continue to rely disproportionately on surface water supplies from the American and Sacramento Rivers, and have less opportunity to advance its conjunctive use program.

Water Supply Benefits

The primary benefit of the Shasta Park Reservoir and Well Project is the increase in the reliability of the city's water supply, particularly during the driest years. Additional benefits include improving water pressure during summer months that has limited economic development in a disadvantaged area of the city. Firefighting capabilities are also expected to be enhanced.

Increased reliability of water supply through increased productive capacity and conjunctive use

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. In the driest years, the City could face a shortfall of up to 30,000 AF from surface supplies. The addition of the Shasta Park well's 2 MGD to the City's water supply will partially make up for that shortfall. The City expects to vary the extraction rate depending on American River hydrologic conditions (and addition of the 4 MG reservoir increases operational flexibility), but under its conjunctive use program, the City would utilize more groundwater to meet demand in drier years. Well utilization will vary from 100% (2,250 AFY) in dry years to 65% (1,462 AFY) in average years, and 15% (337 AFY) in wet years. This additional reliability can be estimated quantitatively.

Although concern for water supply reliability is increasing (due to population growth, increasing water demands, and uncertainties over climate change impacts and pending regulatory changes), only a few studies have directly attempted to quantify its value, primarily through non-market valuation studies. Results of these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $95 to $500 (in 2009 USD) per household for total reliability (i.e., a 0% probability of facing water restrictions in times of drought). Appendix A of this attachment (Attachment 7 – Economic Analysis – Water Supply Costs and Benefits) provides a detailed review of this empirical literature and discusses issues related to its interpretation for projects such as the one described here (and other similar projects in this Attachment).

The challenge in applying these values to determine a benefits value for the project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay (WTP) to ensure complete reliability (zero drought-related use restrictions in the future), whereas this project will only enhance overall reliability but not guarantee 100% reliability (since the city's surface water supply is drought sensitive, one additional well will not fully mitigate this). Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

The value of the reliability that the Shasta Park well will add to the City's water supply was calculated by taking the production from the well in a dry year (2,250 AF) and dividing by the potential water shortfall in a dry year (30,000 AF), for a proportionate 7.5% contribution to reliability. Using the low end of the reliability value from the stated preferences studies noted above ($95), the annual benefit per household is $7.13 (0.075 * 95). Multiplying this by the number of households in the service area (197,000) provides an annual value of this reliability of $1,403,625 per year. Over the 50 year life of the well, the total value of this reliability, in present value, is $17.5 million, as shown in Table 13.

Improved Service to a Disadvantaged Area of the City

The Shasta Park Reservoir and Well Project will improve water supply service in a disadvantaged area of the city. Water pressure in summer months has been difficult to sustain at the same level as other months, which has been a factor in discouraging economic development in that area.

Improved Local Firefighting

This project will enhance local firefighting capabilities in the part of Sacramento around Shasta Park, providing a local source of water and by improving the water pressure in summer months.

Table 13: Present Value Benefits (All benefits in 2009 Dollars) Project: Shasta Park Reservoir and Well Project												
YEAR	Benefit a			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2011			$0			$0			$0	$0	0.89	$0
2012			$0			$0			$0	$0	0.84	$0
2013			$0			$0			$0	$0	0.79	$0
2014	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.75	$1,048,870
2015	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.70	$989,500
2016	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.67	$933,491
2017	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.63	$880,652
2018	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.59	$830,803
2019	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.56	$783,777
2020	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.53	$739,412
2021	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.50	$697,559
2022	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.47	$658,074
2023	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.44	$620,825
2024	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.42	$585,684
2025	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.39	$552,532
2026	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.37	$521,256
2027	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.35	$491,751
2028	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.33	$463,916
2029	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.31	$437,657
2030	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.29	$412,884
2031	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.28	$389,513

Table 13: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Shasta Park Reservoir and Well Project

YEAR	Benefit a			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2032	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.26	$367,465
2033	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.25	$346,665
2034	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.23	$327,043
2035	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.22	$308,531
2036	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.21	$291,067
2037	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.20	$274,591
2038	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.18	$259,048
2039	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.17	$244,385
2040	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.16	$230,552
2041	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.15	$217,502
2042	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.15	$205,191
2043	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.14	$193,576
2044	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.13	$182,619
2045	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.12	$172,282
2046	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.12	$162,530
2047	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.11	$153,330
2048	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.10	$144,651
2049	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.10	$136,463
2050	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.09	$128,739
2051	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.09	$121,452
2052	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.08	$114,577

Table 13: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Shasta Park Reservoir and Well Project

YEAR	Benefit a			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2053	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.08	$108,092
2054	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.07	$101,973
2055	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.07	$96,201
2056	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.06	$90,756
2057	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.06	$85,619
2058	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.06	$80,773
2059	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$76,201
2060	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$71,887
2061	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$67,818
2062	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.05	$63,979
2063	197,000	$7.13	$1,403,625			$0			$0	$1,403,625	0.04	$60,358
Total Present Value of Discounted Benefits (Sum of Column (l))												**$17,524,076**

Distribution of project benefits, and identification of beneficiaries

This project primarily benefits the population served by the City of Sacramento water system who will have increased reliability in their water supply even as changing conditions create greater vulnerabilities in surface water sources such as the American and Sacramento Rivers, which are the major sources of Sacramento's water supply. Table 14 identifies the distribution of project benefits. This project will also contribute to operational flexibility in meeting future needs to sustain flows into the American and Sacramento Rivers and the Sacramento-San Joaquin Delta, although that benefit is discussed in Attachment 8 rather than here.

Table 14: Project Beneficiaries Summary

Local	Regional	Statewide
City of Sacramento – system as a whole Shasta Park disadvantaged area	Regional water suppliers and other stakeholders reliant on or valuing Sacramento and American River flows	Delta

Project Benefits Timeline Description

The Shasta Park reservoir and well are expected to give 50 years of service. Benefits will accrue as soon as the well becomes operational in 2014. The benefits have been calculated to have an annual value of $1.4 million per year. Over the life of the project, the present value of total benefits is $17.5 million. These figures form the basis of the present value benefits presented in Table 13.

Potential Adverse Effects from the Project

The primary adverse effect from the Shasta Park Reservoir and Well Project could be the potential contribution to groundwater overdraft resulting from additional groundwater extractions. These effects will be mitigated, however, through the varied use of the well, local in-lieu groundwater banking (e.g. using more surface water in normal and wet years; switching to groundwater in dry years), and through local groundwater basin management under the Central Sacramento County Groundwater Management Plan.

Summary of Findings, Tables

The Shasta Park Reservoir and Well Project is intended to provide greater reliability to the City of Sacramento's water supply. Approximately 85% to 90% of the City's water supply is from surface water sources; these sources may become increasingly vulnerable to the impacts of climate change, through the reduction in the snowpack that feeds the American and Sacramento Rivers, limited storage on the rivers, and changes in storm hydrology. Given the unlikelihood of building additional surface storage, the City is responding to this vulnerability by increasing potential use of groundwater, both for annual seasonal use as well as more significant use during dry years.

The capital cost for this project is $13.6 million. With operations, maintenance, and routine replacement costs over the operational life of the well, the present value cost of this project is $16.3 million. The benefits far exceed these costs. Calculated as the proportional addition of this well's production capacity to water supply reliability in the city's system and the value of this supply to Sacramento households, the benefit of water supply reliability contributed by this project is $1.4 million per year, or in present value over the life of the well, $17.5 million.

Qualitative water supply benefits include increased water pressure in an area of the City that has been disadvantaged by this, and greater availability of local water for firefighters. These qualitative benefits are summarized in Table 15.

Table 15: Qualitative Benefits Summary – Water Supply

Benefit	Qualitative Indicator
Increased water pressure during summer months in a disadvantaged area of the City	++ ++
	+
Adds to firefighting capability	+

Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the estimation of willingness-to-pay (WTP) values for household valuation of water reliability. The monetization of these values relies on WTP surveys in the literature, which can vary widely, but in this analysis the most conservative values were used. An additional uncertainty in this area is the apportionment of the well's partial contribution to overall water reliability, which was estimated at 7.5%. This issue is listed in Table 16.

Table 16: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased level of reliability for water customers of the City of Sacramento	U	The WTP values in the literature vary widely. The wide range in WTP values reflects the fact that the results of the studies are specific to situations asked to the respondents. Consequently, there is a level of uncertainly in the transfer of these values. Benefits (scaled to 7.5% of literature-based WTP values) were adjusted to reflect that the project does not ensure 100% reliability. This 7.5% could be inaccurate and further analysis would be needed to refine this scaling factor.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

State of California, Department of Finance. 2009. E-4 Population Estimates for Cities, Counties and the State, 2001-2009, with 2000 Benchmark. Sacramento, California. As viewed at http://www.dof.ca.gov/research/demographic/reports/estimates/e-4_2001-07/. *May.*

Project 5: Antelope Creek Water Efficiency and Flood Control Improvement Project

The Antelope Creek Water Efficiency and Flood Control Improvement Project (Project 5) is a multi-benefit project being proposed by the Placer County Flood Control and Water Conservation District and Placer County Water Agency (PCWA). The goal of the water efficiency component of this project is to eliminate or reduce the amount of water leakage from the Antelope Canal or from the area between the canal and natural waterway. This will be done by installing energy dissipaters and/or other features to reduce leakage at the canal release points and by increasing the height of the canal walls in those locations where there is a potential of overtopping. Gunite, a cement and sand mixture that is "shot in place" with compressed air, will be used to create the desired feature at the canal outlets and to increase the height of the canal walls. To achieve the greatest amount of effectiveness and reduce leakage from the canal, both sides and the floor of the canal will be gunited in the identified reaches of the canal.

This project will reduce water system losses, preserving current water supplies. Table 17 provides an overview of the costs and benefits presented in Attachment 7 and 9. The remainder of this attachment discusses the project costs and water supply benefits, as directed for Attachment 7.

Table 17: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$1.33M
Monetized Benefits	
Water Supply Benefits	
Avoided Water Costs	$184,034
Flood Control Benefits	
Expected Flood Benefits (Phase 1)	$95,000
Total Monetized Benefits	$279,034
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved Water Supply Reliability	+
Improved Operational Flexibility for Placer County Water Agenc7	+
Water Quality and Other Benefits	
Reduced sediment loading to canal water.	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

As documented in Attachment 4, the budgetary estimate for this Project is $1,667,227. Included in the project budget are the initial costs associated with project implementation. The full costs of implementing Phase 1 of the Antelope Creek Water Efficiency and Flood Control Improvement Project are included in the budget.

The total present value of the project is based on a 50-year project life cycle, which is consistent with the life cycle assumed in the flood damage reduction benefit analysis. Construction is expected to begin in May 2013, and the project will begin operation in November 2014. The cost information is summarized in Table 18.

Table 18: Annual Cost of Project (All costs in 2009 Dollars) Project: Antelope Creek Water Efficiency and Flood Control Improvement Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010							$0	0.943	$0
2011	$24,907						$24,907	0.890	$22,167
2012	$218,950						$218,950	0.840	$183,918
2013	$694,223						$694,223	0.792	$549,825
2014	$729,147			$1,250	$1,250		$731,647	0.747	$546,540
2015				$1,250	$1,250		$2,500	0.705	$1,763
2016				$1,250	$1,250		$2,500	0.665	$1,663
2017				$1,250	$1,250		$2,500	0.627	$1,568
2018				$1,250	$1,250		$2,500	0.592	$1,480
2019				$1,250	$1,250		$2,500	0.558	$1,395
2020				$1,250	$1,250		$2,500	0.527	$1,318
2021				$1,250	$1,250		$2,500	0.497	$1,243
2022				$1,250	$1,250		$2,500	0.469	$1,173
2023				$1,250	$1,250		$2,500	0.442	$1,105
2024				$1,250	$1,250		$2,500	0.417	$1,043
2025				$1,250	$1,250		$2,500	0.394	$985
2026				$1,250	$1,250		$2,500	0.371	$928
2027				$1,250	$1,250		$2,500	0.350	$875
2028				$1,250	$1,250		$2,500	0.331	$828
2029				$1,250	$1,250		$2,500	0.312	$780

Table 18: Annual Cost of Project
(All costs in 2009 Dollars)
Project: Antelope Creek Water Efficiency and Flood Control Improvement Project

	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2030				$1,250	$1,250		$2,500	0.294	$735
2031				$1,250	$1,250		$2,500	0.278	$695
2032				$1,250	$1,250		$2,500	0.262	$655
2033				$1,250	$1,250		$2,500	0.247	$618
2034				$1,250	$1,250		$2,500	0.233	$583
2035				$1,250	$1,250		$2,500	0.220	$550
2036				$1,250	$1,250		$2,500	0.207	$518
2037				$1,250	$1,250		$2,500	0.196	$490
2038				$1,250	$1,250		$2,500	0.185	$463
2039				$1,250	$1,250		$2,500	0.174	$435
2040				$1,250	$1,250		$2,500	0.164	$410
2041				$1,250	$1,250		$2,500	0.155	$388
2042				$1,250	$1,250		$2,500	0.146	$365
2043				$1,250	$1,250		$2,500	0.138	$345
2044				$1,250	$1,250		$2,500	0.130	$325
2045				$1,250	$1,250		$2,500	0.123	$308
2046				$1,250	$1,250		$2,500	0.116	$290
2047				$1,250	$1,250		$2,500	0.109	$273
2048				$1,250	$1,250		$2,500	0.103	$258
2049				$1,250	$1,250		$2,500	0.097	$243
2050				$1,250	$1,250		$2,500	0.092	$230

Table 18: Annual Cost of Project (All costs in 2009 Dollars) Project: Antelope Creek Water Efficiency and Flood Control Improvement Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2051				$1,250	$1,250		$2,500	0.087	$218
2052				$1,250	$1,250		$2,500	0.082	$205
2053				$1,250	$1,250		$2,500	0.077	$193
2054				$1,250	$1,250		$2,500	0.073	$183
2055				$1,250	$1,250		$2,500	0.069	$173
2056				$1,250	$1,250		$2,500	0.065	$163
2057				$1,250	$1,250		$2,500	0.061	$153
2058				$1,250	$1,250		$2,500	0.058	$145
2059				$1,250	$1,250		$2,500	0.054	$136
2060				$1,250	$1,250		$2,500	0.051	$128
2061				$1,250	$1,250		$2,500	0.048	$121
2062				$1,250	$1,250		$2,500	0.046	$114
2063				$1,250	$1,250		$2,500	0.043	$108
2064				$1,250	$1,250		$2,500	0.041	$101
Project Life	50 years								
Total Present Value of Discounted Costs (Sum of Column (i))									$1,331,903

Comments: Both the water efficiency and flood control improvements that will be implemented are passive projects that do not have regular administrative or operational costs.
Maintenance and replacement costs for are included because the ALERT-type stream level and precipitation gauges that will be installed as part of the flood control improvements will require periodic maintenance and replacement after 10 year. The National Weather Service's Weather Service Hydrology Handbook No. 2 notes that maintenance and life-cycle replacement costs each run around 10% of capital investment per year. For these calculations, 5% of the capital investment associated with the gauges is attributed to maintenance and the other 5% to replacement.

The "Without Project" Baseline

Without the lining of the Antelope Canal, PCWA will continue to provide water to meet higher overall demand due to distribution systems loss. This will result in lower water supply reliability, and limit PCWA's operational flexibility. Additionally, the quality of water transmitted by the canals will continue to be degraded by sediment erosion and turbidity.

Water Supply Benefits

This section describes the water supply benefits generated by the Antelope Creek Water Efficiency and Flood Control Project, including avoided water supply costs, increased water supply reliability, and improved operational flexibility for wholesale suppliers.

Avoided Water Supply Costs

It is estimated that the reconstruction of all of the spills on the Antelope Canal and the gunite lining of the canal will conserve up to 125 AF of water per year. The marginal water supply for the project canals is the American River. This water must be pumped from the American River into the Auburn Tunnel, and then pumped from the Auburn Tunnel into PG&E's South Canal. The average cost of pumping American River Water into the project canals assumed to be $125 per acre foot.

To calculate the avoided costs of water over time, the amount of avoided water is multiplied by the estimated cost of marginal supply (currently $125 per AF of water). Over the 50-year life of the proposed project, use of 6,250 AF will be avoided. Implementation of all these programs will result in an avoided cost of $184,034 in present value 2009 dollars. The present value of benefits (water supply cost savings) is shown in Table 19.

Table 19: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Antelope Creek Water Efficiency and Flood Control Improvement Project

YEAR	Water Savings (due to Canal Lining)			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# AFY	$/AF	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2009			$0			$0			$0	$0	1.00	$0
2010			$0			$0			$0	$0	0.94	$0
2011			$0			$0			$0	$0	0.89	$0
2012			$0			$0			$0	$0	0.84	$0
2013			$0			$0			$0	$0	0.79	$0
2014			$0			$0			$0	$0	0.75	$0
2015	125	$125.00	$15,625			$0			$0	$15,625	0.70	$11,015
2016	125	$125.00	$15,625			$0			$0	$15,625	0.67	$10,392
2017	125	$125.00	$15,625			$0			$0	$15,625	0.63	$9,803
2018	125	$125.00	$15,625			$0			$0	$15,625	0.59	$9,248
2019	125	$125.00	$15,625			$0			$0	$15,625	0.56	$8,725
2020	125	$125.00	$15,625			$0			$0	$15,625	0.53	$8,231
2021	125	$125.00	$15,625			$0			$0	$15,625	0.50	$7,765
2022	125	$125.00	$15,625			$0			$0	$15,625	0.47	$7,326
2023	125	$125.00	$15,625			$0			$0	$15,625	0.44	$6,911
2024	125	$125.00	$15,625			$0			$0	$15,625	0.42	$6,520
2025	125	$125.00	$15,625			$0			$0	$15,625	0.39	$6,151
2026	125	$125.00	$15,625			$0			$0	$15,625	0.37	$5,803
2027	125	$125.00	$15,625			$0			$0	$15,625	0.35	$5,474
2028	125	$125.00	$15,625			$0			$0	$15,625	0.33	$5,164
2029	125	$125.00	$15,625			$0			$0	$15,625	0.31	$4,872
2030	125	$125.00	$15,625			$0			$0	$15,625	0.29	$4,596

Table 19: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Antelope Creek Water Efficiency and Flood Control Improvement Project

YEAR	Water Savings (due to Canal Lining)			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# AFY	$/AF	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2031	125	$125.00	$15,625			$0			$0	$15,625	0.28	$4,336
2032	125	$125.00	$15,625			$0			$0	$15,625	0.26	$4,091
2033	125	$125.00	$15,625			$0			$0	$15,625	0.25	$3,859
2034	125	$125.00	$15,625			$0			$0	$15,625	0.23	$3,641
2035	125	$125.00	$15,625			$0			$0	$15,625	0.22	$3,435
2036	125	$125.00	$15,625			$0			$0	$15,625	0.21	$3,240
2037	125	$125.00	$15,625			$0			$0	$15,625	0.20	$3,057
2038	125	$125.00	$15,625			$0			$0	$15,625	0.18	$2,884
2039	125	$125.00	$15,625			$0			$0	$15,625	0.17	$2,720
2040	125	$125.00	$15,625			$0			$0	$15,625	0.16	$2,566
2041	125	$125.00	$15,625			$0			$0	$15,625	0.15	$2,421
2042	125	$125.00	$15,625			$0			$0	$15,625	0.15	$2,284
2043	125	$125.00	$15,625			$0			$0	$15,625	0.14	$2,155
2044	125	$125.00	$15,625			$0			$0	$15,625	0.13	$2,033
2045	125	$125.00	$15,625			$0			$0	$15,625	0.12	$1,918
2046	125	$125.00	$15,625			$0			$0	$15,625	0.12	$1,809
2047	125	$125.00	$15,625			$0			$0	$15,625	0.11	$1,707
2048	125	$125.00	$15,625			$0			$0	$15,625	0.10	$1,610
2049	125	$125.00	$15,625			$0			$0	$15,625	0.10	$1,519
2050	125	$125.00	$15,625			$0			$0	$15,625	0.09	$1,433
2051	125	$125.00	$15,625			$0			$0	$15,625	0.09	$1,352
2052	125	$125.00	$15,625			$0			$0	$15,625	0.08	$1,275

Table 19: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Antelope Creek Water Efficiency and Flood Control Improvement Project

YEAR	Water Savings (due to Canal Lining)			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# AFY	$/AF	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2053	125	$125.00	$15,625			$0			$0	$15,625	0.08	$1,203
2054	125	$125.00	$15,625			$0			$0	$15,625	0.07	$1,135
2055	125	$125.00	$15,625			$0			$0	$15,625	0.07	$1,071
2056	125	$125.00	$15,625			$0			$0	$15,625	0.06	$1,010
2057	125	$125.00	$15,625			$0			$0	$15,625	0.06	$953
2058	125	$125.00	$15,625			$0			$0	$15,625	0.06	$899
2059	125	$125.00	$15,625			$0			$0	$15,625	0.05	$848
2060	125	$125.00	$15,625			$0			$0	$15,625	0.05	$800
2061	125	$125.00	$15,625			$0			$0	$15,625	0.05	$755
2062	125	$125.00	$15,625			$0			$0	$15,625	0.05	$712
2063	125	$125.00	$15,625			$0			$0	$15,625	0.04	$672
2064	125	$125.00	$15,625							$15,625	0.04	$634
Total Present Value of Discounted Benefits (Sum of Column (l))												**$184,034**

Increased Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. By reducing water losses from the canal and avoiding the transfer of this water into the canal, the Antelope Creek Water Efficiency and Flood Control Project will improve water supply reliability within the service areas of the various agencies.

Although interest in water supply reliability is increasing (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through non-market valuation studies). The results from these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay $95 to $500 per household per year (in 2009 USD) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought). Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables. However, it is provided here to give an idea of the potential magnitude of this benefit.

Improved Operational Flexibility for Placer County Water Agency (PCWA)

By avoiding the use of imported water, the project will marginally help PCWA in their supply efforts by allowing for longer shutdowns, deferring capital improvements, and improving reliability in a vulnerable part of the system. The value of this increased operational flexibility is not monetized in the benefit tables.

Improved Water Quality

Water quality benefits will also be achieved as the raw water will no longer be in contact with bare earth, resulting in reduced sediment load, turbidity and exposure to other soil contaminants and organics. These benefits will also be transferred to Antelope Creek and other creeks where spill waters during high flows from the canal are directed

Distribution of project benefits, and identification of beneficiaries

In terms of water supply benefits, the Antelope Creek Water Efficiency and Flood Control Improvement Project will benefit stakeholders at the regional and state level, as is summarized in Table 20. At the local level, PCWA will benefit due to avoided water supply costs, increased reliability of supply, and improved operational flexibility. The project also helps meet a statewide water use efficiency goal of 20% reduction in per capita water use by 2020.

Table 20: Project Beneficiaries Summary

Local	Regional	Statewide
PCWA	Placer County Water Agency, Cities of Lincoln and Roseville	Statewide Water Use Efficiency Goal

Project Benefits Timeline Description

This project will be implemented over a four-year period, beginning in 2011 and ending in 2014. A water savings lifespan of 50 years has been identified for the gunite lining of the Antelope Canal and therefore project benefits are expected to extend over this same period. Water savings will begin after project completion, starting in 2015 and ending in 2064.

Potential Adverse Effects from the Project

There are no adverse effects anticipated from this project.

Summary of Findings, Tables

The monetized water supply benefit from the proposed project is the avoided cost of potable water supplies. Non-monetized benefits of the project include increased water supply reliability in the area and improved operational flexibility for Placer County Water Authority. These benefits are listed again in Table 21.

The Antelope Creek Water Efficiency and Flood Control Project will cost roughly $1,667,227 in present value terms, and it will avoid the loss of 6,250 AF of potable water over 50-year lifetime period, through 2064. The present value of avoided costs associated with this water amount is over $184,034.

Table 21: Qualitative Benefits Summary – Water Supply

Benefit	Qualitative Indicator
Increased Water Supply Reliability	+
Improved Operational Flexibility for Placer County Water Agency (PCWA)	+

In addition, this project will convey water quality benefits as the raw water transported in the canal will no longer be in contact with bare earth, resulting in reduced sediment load, turbidity and exposure to other soil contaminants and organics. These benefits will also be transferred to Antelope Creek and other creeks where spill waters during high flows from the canal are directed.

Table 22: Qualitative Benefits Summary – Water Quality

Benefit	Qualitative Indicator
Reduced sediment loading and turbidity in canal water	+

Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. These issues are listed in Table 23.

Table 23: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided costs of purchased water	U	The projected avoided costs are based on current costs, which are based on a range of factors that may vary over time.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

Project 6: Regional Water Meter Retrofit Acceleration Project

Summary

The Regional Water Meter Retrofit Acceleration Project will install 840 additional residential meters in the service areas of three of the largest local public water suppliers in the Sacramento region: the City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency. In complying with California Urban Water Conservation Council (CUWCC) Best Management Practices (BMP) and California law, the greater Sacramento Region has made tremendous progress toward metering its water service connections (just over 30% metered in 2001 compared to over 50% metered by the end of 2007). However, there are in excess of 100,000 meters to install in the region by the year 2025, so there are significant opportunities to accelerate the installation of meters to realize water savings well in advance of the 2025 state mandate. The participating agencies have a combined estimated number of installations of about 15,000 in the final year of their programs. This meter installation program will install about 6% of that amount on a significantly accelerated schedule.

The Regional Water Meter Retrofit Acceleration Project will demonstrably improve water management through direct measurement of consumption using meters. In 2004, the CUWCC published the *BMP Cost and Savings Study* confirming that meters, combined with commodity-based water rates (or volumetric pricing on amount used by the customer), are effective in driving consumer behavior to improved water management by reducing their water consumption. The CUWCC estimated 20 percent savings associated with installing meters, which is the basis for the savings calculation in this application.

While the 20% water savings realized by water-using by customers is a key benefit for any conservation program, a program that installs or upgrades meters has the important added benefit of enabling utilities to better manage all of the water within the metered area. This is because additional measures beyond regular volumetric pricing can be instituted to manage extreme dry conditions. For example, agencies can adopt aggressive tiered pricing structures to encourage further savings and track progress during voluntary or mandatory cutback periods. Metering is also a key component in the American Water Works Association (AWWA) Water Audits Loss Control Programs, allowing a utility to better recognize and control water loss in the distribution system. Appreciable water savings may be realized where metering enables a utility to detect an area where there is a significant volume of unaccounted-for water.

An overview of the expected costs and benefits of the program is provided in Table 24.

Table 24: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$900,051
Monetized Benefits	
Water Supply Benefits	
Avoided water treatment costs	$650,104
Avoided wastewater treatment costs	$39,244
Total Monetized Benefits	$758,338
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Effectively implement a water loss control program	++
Water Quality and Other Benefits	
Reduced carbon footprint	++

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The present value cost of $900,051, as shown in Table 25, is for purchase and installation of 840 water meters. Total capital expenditures will be $968,785, with $486,756 expended in 2011 and $482,029 expended in 2012.

Costs for maintenance and replacement of meters were included in Table 25. Based on past experience, it was assumed that five out every 100 meters installed would require a site visit to inspect faulty readings, requiring 1/2 hour of labor at a rate of $50 per hour or $1,050 per year for the 25 year lifetime of the meters. Replacement of electronic parts or meter boxes would be required for three out of every 100 meters per year requiring a 1 hour visit at $50 per hour labor rate plus material fee of $125 per site. Replacement costs of $4,410 per year were included in Table 25.

Table 25: Annual Cost of Project
(All costs in 2009 Dollars)
Project: Regional Water Meter Retrofit Acceleration Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.00	$0
2010							$0	0.94	$0
2011	$486,756						$486,756	0.89	$433,211
2012	$482,029			$1,050	$4,410		$487,489	0.84	$409,305
2013				$1,050	$4,410		$5,460	0.79	$4,325
2014				$1,050	$4,410		$5,460	0.75	$4,080
2015				$1,050	$4,410		$5,460	0.70	$3,849
2016				$1,050	$4,410		$5,460	0.67	$3,631
2017				$1,050	$4,410		$5,460	0.63	$3,426
2018				$1,050	$4,410		$5,460	0.59	$3,232
2019				$1,050	$4,410		$5,460	0.56	$3,049
2020				$1,050	$4,410		$5,460	0.53	$2,876
2021				$1,050	$4,410		$5,460	0.50	$2,713
2022				$1,050	$4,410		$5,460	0.47	$2,560
2023				$1,050	$4,410		$5,460	0.44	$2,415
2024				$1,050	$4,410		$5,460	0.42	$2,278
2025				$1,050	$4,410		$5,460	0.39	$2,149
2026				$1,050	$4,410		$5,460	0.37	$2,028
2027				$1,050	$4,410		$5,460	0.35	$1,913

Table 25: Annual Cost of Project
(All costs in 2009 Dollars)
Project: Regional Water Meter Retrofit Acceleration Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2028				$1,050	$4,410		$5,460	0.33	$1,805
2029				$1,050	$4,410		$5,460	0.31	$1,702
2030				$1,050	$4,410		$5,460	0.29	$1,606
2031				$1,050	$4,410		$5,460	0.28	$1,515
2032				$1,050	$4,410		$5,460	0.26	$1,429
2033				$1,050	$4,410		$5,460	0.25	$1,349
2034				$1,050	$4,410		$5,460	0.23	$1,272
2035				$1,050	$4,410		$5,460	0.22	$1,200
2036				$1,050	$4,410		$5,460	0.21	$1,132
Project Life	25 years								
Total Present Value of Discounted Costs (Sum of Column (i))									**$900,051**
Comments: Estimated meter replacement rate , 25 years. For maintenance, assumed 5 out every 100 meters installed would require a site visit to inspect faulty readings requiring 1/2 hour at labor rate of $50 per hour. For replacement, assumed that 3 out of every 100 meters would require replacement of electronic parts or meter boxes assuming 1 hour per visit at $50 per hour labor rate plus material fee of $125 per site.									

The "Without Project" Baseline

The Regional Water Meter Retrofit Acceleration Project is designed to reduce water demand by driving consumer behavior through the direct measurement of water consumption combined with volumetric pricing. The direct relationship between use and cost will encourage water conservation. Without this project, water supply demand will continue to remain 126 AF/year higher than with this project. Without this project, the 840 meters identified in this project would not be installed until 2025. This project would accelerate installation of these meters by 13 years, saving 1,640 AF in the interim and 3,150 AF for the lifetime of meters.

Water Supply Benefits

This section describes the water supply benefits generated by the Regional Water Meter Retrofit Installation Acceleration Project, including avoided water treatment costs, avoided wastewater treatment cost, and being able to effectively implement a water loss control program.

Avoided water treatment costs

Water supply demands are expected to decrease by 126 AF/year as consumers see the direct relationship between use and month water charges. Savings are based on the following assumptions and background calculations:

- Average demand for Sacramento County is 261 gallons per capita per day (GPCD) according to the recently published USGS Water Use Report (2008).
- The total persons per household according to the California Department of Finance is 2.5 for Sacramento County.
- Multiplying the aforementioned two parameters results in 653 gallons per day (gpd) per residential connection.
- Estimated water savings per meter installation is 20 percent according to the CUWCC's *Best Management Practice (BMP) Cost and Savings Study* (October 2004).
- Multiplying 653 gpd per connection by the anticipated 20 percent savings provides a total estimated savings per connection of 131 gpd, which is 47,700 gallons (0.15 AF) of water conserved by each account on an annual basis.
- Multiplying 0.15 AF savings by total of 840 accelerated metered connections within the region provides 126 AF savings per year, or more than 1,890 AF over the assumed 15-year lifespan of a meter.

The full savings from conservation efforts will begin one year after meters are installed (i.e. 2013). For the first year, after the meters are installed the utilities will use a comparative billing program, where consumers are charged the current flat rate and are provided the metered rate. This will allow consumers time to implement water conservation tactics or install water saving devices to avoid significant increases in monthly water bills. Therefore, for the first year after installation, we assume that only 25% of the water conservation benefits will be observed as consumers become aware of the new pricing structure and begin to implement water conserving measures.

The value for treatment, pumping and delivery of potable water is approximately $400 per acre foot in the Sacramento region for the utilities involved in this project. Therefore the present value benefits (costs avoided) in water supply treatment and delivery are $541,670. Calculations are shown in Table 26.

Reduce wastewater treatment costs

Minimizing water usage will also reduce wastewater treatment costs. The cost of wastewater collection, treatment and discharge is also approximately $400 per acre foot. However, since only 40% of treated water is used indoors (as opposed to outdoors for irrigation), the cost savings in wastewater treatment is approximately $160 per acre foot of water conserved. Therefore the present value benefits (costs avoided) in wastewater treatment are approximately $216,668 (see Table 26).

Effectively implement a water loss control program

Accurate metering of residential usage is essential for conducting a program to reduce water losses in the distribution system. Water losses can occur from leaks, main breaks, and unauthorized consumption of water. In a water audit and leak detection study conducted at 47 California water utilities, average water loss was 10 percent, with a range of 5 to 30 percent.

Water loss programs often start with a water audit program such as proposed by the AWWA in *Manual M36, Water Audits Loss Control Programs*. The water audit conducts a water balance by identifying and measuring known sources of water consumption and subtracting that from the total input of water into the system. Once losses are known, programs can be conducted to reduce leakage and other sources of water loss. Reducing water losses is important for conserving water and reducing energy consumption.

While difficult to quantify for this project, obtaining accurate residential use information through metering is essential in quantifying water losses during a water audit. This can lead to significant benefits in reducing water loss and achieving water conservation goals.

Table 26: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Regional Water Meter Retrofit Acceleration Project

YEAR	A) Avoided Water Supply Costs			B) Avoided Wastewater Treatment Costs			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2010			$0			$0			$0	$0	1.00	$0
2011			$0			$0			$0	$0	0.94	$0
2012			$0			$0			$0	$0	0.89	$0
2013	31.5	$400.00	$12,600	12.6	$400.00	$5,040			$0	$17,640	0.84	$14,811
2014	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.79	$55,890
2015	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.75	$52,727
2016	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.70	$49,742
2017	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.67	$46,926
2018	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.63	$44,270
2019	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.59	$41,764
2020	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.56	$39,400
2021	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.53	$37,170
2022	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.50	$35,066
2023	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.47	$33,081
2024	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.44	$31,209
2025	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.42	$29,442
2026	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.39	$27,776
2027	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.37	$26,203
2028	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.35	$24,720
2029	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.33	$23,321
2030	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.31	$22,001
2031	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.29	$20,756

Table 26: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Regional Water Meter Retrofit Acceleration Project

YEAR	**A)** Avoided Water Supply Costs			B) Avoided Wastewater Treatment Costs			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2032	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.28	$19,581
2033	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.26	$18,472
2034	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.25	$17,427
2035	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.23	$16,440
2036	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.22	$15,510
Total AF saved	126.0	$400.00	$50,400	50.4	$400.00	$20,160			$0	$70,560	0.21	$14,632
Total Present Value of Discounted Benefits (Sum of Column (l))												**$758,338**

Distribution of project benefits, and identification of beneficiaries

The benefits for this project will occur in the Sacramento region and impact consumers of the City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency. Additionally decrease water usage will reduce demand on the Sacramento-San Joaquin Delta and will help the State meet its overall per capita water consumption targets as set forth in its 20x2020 Plan.

Table 27: Project Beneficiaries Summary

Local	Regional	Statewide
City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency	Sacramento Region	Sacramento-San Joaquin Delta California - water conservation goals

Project Benefits Timeline Description

The project build-out and capital costs will be incurred in 2011 and 2012. Project benefits will begin to be fully realized in 2013 and will continue for the expect 25 year lifetime of the water meters.

Potential Adverse Effects from the Project

There is no evidence to suggest that the project will result in any adverse effects in the future. The biggest challenge will occur with customers adjusting to the new rate structure.

Summary of Findings, Tables

The monetized water supply benefits from the proposed project of $758,338 (present value) include the avoided costs of potable water treatment and wastewater treatment based on an estimated water conservation saving of 20% following the implementation of volumetric pricing. The estimated present value cost is $900,051. While monetized benefits are less than the costs, there also are significant benefits that are not quantified in this analysis and which could have a significant impact on these values. These non-quantified benefits include the opportunities offered by meters in gaining accurate customer usage information that can be used in water auditing programs to identify and control water loss in the distribution systems, helping the region and state meet targeted reductions in per capita water use as required under SBx7-7, and through reducing energy use and the associated carbon footprint of the water and wastewater treatment facilities.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits: the project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 28.

Table 28: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided water treatment costs	+	The monetized avoided costs are based on current estimates of the cost of water being $400/AF. Additional demands on the water system could require the system to utilize additional sources of water that could significantly increase the cost of treated water. Also, changes in energy prices, treatment costs, etc. cost impact this estimate.
Avoided wastewater treatment costs	+	The monetized avoided costs are based on current estimates of the cost of wastewater treatment being $400/AF. Changes in energy prices, treatment costs, etc. cost impact this estimate.
Project costs	U	The calculation of the present value of costs is a function of the timing of capital outlays and a number of other factors and conditions. Changes in these variables will change the estimate of costs.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

California Urban Water Conservation Council. 2004. *Best Management Practice (BMP) Cost and Savings Study*. October.

Project 7: Regional Indoor and Outdoor Water Efficiency Project

Summary

The goal of the Regional Indoor and Outdoor Efficiency Project is to save an estimated 9,615 acre-feet (AF) of water over the life of the program. This program will be managed by the Regional Water Authority of Sacramento and will be implemented within some of their member service areas and the Cosumnes River Watershed area. RWA members include Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Roseville, City of Sacramento, El Dorado Irrigation District, Orange Vale Water Company, Placer County Water Agency, Rancho Murieta Community Services District, Sacramento County Water Agency, Sacramento Suburban Water District and San Juan Water District.

For the Regional Indoor and Outdoor Water Efficiency Project, four separate water conservation components will be implemented as follows:

Interior Conservation Retrofits

Complete interior water conservation retrofits will be provided to 1,098 households in the Greater Sacramento Area. A portion of the project will target disadvantaged customers as typically, disadvantaged customers do not participate in water conservation rebates and programs. Reasons for this include a greater proportion of rentals, a higher number of multi-family dwelling units, limited ability to finance the required repairs or improvements, and cultural barriers to participating with governmental agencies.

Under this component of the project, interior water use surveys will be conducted in each household selected for implementation. Interior water use surveys will follow recommendations made by the California Urban Water Conservation Council in their Memorandum of Understanding (MOU, CUWCC, June 9, 2010). Following the survey, direct, no-cost installation of indoor efficiency devices will be completed, including low-flow toilets, showerheads, and faucet aerators. In addition, hose-end shut-off valves will be provided for exterior hose bibs. This effort is expected to save 1,735 AF of water over its lifetime.

Exterior Residential Water Use Surveys and Upgrades

This component of the proposed project will build upon and expand current programs implemented by several purveyors to conserve water used for urban landscaping. Up to 285 exterior water use surveys will be conducted for single-family accounts. Residential exterior water surveys will meet the criteria established by the CUWCC in the 2010 MOU. In addition, incentives (rebates) worth up to $500 will be offered to customers to upgrade their existing irrigation systems to improve system performance and efficiency. The expected lifetime conservation of this portion of the project is 140 AF of water.

Exterior Large Landscape Water Use Surveys and Upgrades

The goal of this project component is to reduce outdoor water use for large landscapes by commercial, institutional, and industrial (CII) customers and residential agricultural customers. This component will also build upon and expand current programs offered by several purveyors to conserve water used for large landscapes by offering up to 76 exterior water use surveys for these high-use accounts. Exterior surveys would meet the criteria established by the CUWCC as described in their 2010 MOU. In addition, incentives (rebates) worth up to $1,500 will be offered to customers to upgrade their existing irrigation systems to improve system performance and efficiency. The expected lifetime conservation of this portion of the project is 446 AF of water.

Landscape Water Use Budgets

The greater Sacramento region has over 5,600 dedicated landscape meters. The current approach to preparing water budgets is for each agency to independently perform this service. In addition, many of the existing water budgets have not been prepared utilizing the criteria established in the State's current Model Water Efficient Landscape Ordinance. This project component will create up to 404 landscape budgets following the Model Water Efficient Landscape Ordinance, and prepared in a consistent manner utilizing current data and information. In addition to the landscape water use budgets, this project component will educate local water conservation managers on landscape water use and includes funding to provide training on outreach to customers. The water budgets prepared as part of this component will be provided to the water agencies for follow-up; agency staff will provide a service call to assist the property owner in implementing the budget. In addition, if the property owner and agency staff feels that a landscape water use survey is required, the agency will conduct a survey. The expected lifetime conservation of this portion of the project is 7,294 acre-feet of water.

Table 29: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$837,742
Monetized Benefits	
Water Supply Benefits	
Water conservation for disadvantaged customers	$568,841
Water conserved through residential exterior surveys and upgrades for single-family homes	$29,433
Water conserved through CII exterior surveys and upgrades for CII accounts	$93,767
Water conservation through large landscape water use budgets	$1,070,880
Total Monetized Benefits	$1,762,921
Qualitative Benefit or Cost	Qualitative indicator*
Water Quality and Other Benefits	
Reduced energy use and carbon footprint	++
Public Education	++

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The present value costs for this project amount to $837,742, as shown in Table 30. These project costs cover water surveys, residential retrofits with water conserving devices, residential and CII irrigation system upgrades/rebates, preparation of water budgets for large landscape users, and three workshops to promote irrigation efficiency. There are no annual costs associated with these projects.

Total capital cost for this project is $1,000,000; $400,000 is budget for Interior Conservation Retrofits with $100,000 to be spent in 2011 and $300,000 in 2012. For the Exterior Residential Water Use Surveys and Upgrades component and the Exterior Large Landscape Water Use Surveys and Upgrades component, $300,000 is budgeted with $37,500 to be spent in 2011, $150,000 in 2012, and $112,500 in 2013. And finally, for the Landscape Water Use Budgets component, $300,000 is budgeted with $37,500 to be spent in 2011, $150,000 in 2012, and $112,500 in 2013.

Table 30: Annual Cost of Project (All costs in 2009 Dollars) Project: Regional Indoor and Outdoor Water Efficiency Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.00	$0
2010							$0	0.94	$0
2011	$175,000						$175,000	0.89	$155,749
2012	$600,000						$600,000	0.84	$503,772
2013	$225,000						$225,000	0.79	$178,221
2014							$0	0.75	$0
Project Life	25 years								
Total Present Value of Discounted Costs (Sum of Column (i))									$837,742
Comments: Capital and other initial costs are the sum of all programs. The DAC Interior Conservation Makeovers will be conducted in 2011 and 2012. Urban Water Use Surveys and Incentives, Agricultural Irrigation Water Use Surveys and Incentives, Landscape Water Use Budgets will be conducted in 2011-2013.									

The "Without Project" Baseline

This project is designed to promote water conservation through implementation of the Regional Indoor and Outdoor Efficiency Project. Without this project, over 9,615 AF of water would be wasted through inefficient water use practices. One target of this project is disadvantaged customers who, without financial assistance, either lack the resources or face other constraints that make them less likely to implement water conserving measures. As water becomes more expensive, and more affluent customers address water conservation, a greater financial burden will occur to disadvantaged communities who, without water conservation, will be paying for more and higher-priced water.

This project also addresses residential and CII customers with large landscapes through exterior water use surveys and through the provision of incentives for system upgrades. Without both components (survey and incentives), consumers will either be unaware of possible savings or lack the incentive to make the changes to promote water conservation. The combination of surveys and incentives is needed to both identify the opportunities for savings and to provide the economic incentives to drive implementation of water conserving methods.

Similar to the exterior water use described above, a consistent approach is needed for developing large landscape water use budgets to promote irrigation efficiency. Without this project component, each agency will continue to independently perform this service, leading to inconsistent adoption of the State's current Model Water Efficient Landscape Ordinance. Additionally, without the budget development, consumers will likely be unaware of possible savings that can be made to promote water conservation and fiscal savings to large water users.

Water Supply Benefits

This section describes the water supply benefits generated through implementation of the Regional Indoor and Outdoor Water Efficiency Project. The present value calculations for these benefits are provided in Table 31.

Table 31: Present Value Benefits (All benefits in 2009 Dollars) Project: Regional Indoor and Outdoor Water Efficiency Project												
YEAR	B) Indoor Conservation			B) Residential and CII Outdoor Surveys and Upgrades			C) Large Area Landscape Water Use Budgets			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (AF)	$/unit	Value (a)*(b)	# units (AF)	$/unit	Value (d)*(e)	# units (AF)	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2010			$0			$0			$0	$0	0.94	$0
2011			$0			$0			$0	$0	0.89	$0
2012	83	$700.00	$58,123	89	$300.00	$26,842	382	$300.00	$114,729	$199,694	0.84	$167,667
2013	80	$700.00	$56,185	76	$300.00	$22,816	374	$300.00	$112,200	$191,201	0.79	$151,449
2014	78	$700.00	$54,538	65	$300.00	$19,394	367	$300.00	$110,100	$184,032	0.75	$137,519
2015	76	$700.00	$53,139	55	$300.00	$16,485	359	$300.00	$107,700	$177,323	0.70	$125,006
2016	74	$700.00	$51,949	47	$300.00	$14,012	352	$300.00	$105,600	$171,561	0.67	$114,098
2017	73	$700.00	$50,937	40	$300.00	$11,910	344	$300.00	$103,200	$166,048	0.63	$104,180
2018	72	$700.00	$50,078	34	$300.00	$26,842	337	$300.00	$101,100	$178,020	0.59	$105,370
2019	70	$700.00	$49,347	29	$300.00	$8,605	329	$300.00	$98,700	$156,652	0.56	$87,474
2020	70	$700.00	$48,726	24	$300.00	$7,314	322	$300.00	$96,600	$152,640	0.53	$80,409
2021	69	$700.00	$48,198	21	$300.00	$6,217	314	$300.00	$94,200	$148,615	0.50	$73,857
2022	68	$700.00	$47,749	18	$300.00	$5,285	307	$300.00	$92,100	$145,134	0.47	$68,044
2023	68	$700.00	$47,368	15	$300.00	$4,492	299	$300.00	$89,700	$141,560	0.44	$62,612
2024	67	$700.00	$47,044	13	$300.00	$3,818	292	$300.00	$87,600	$138,462	0.42	$57,775
2025	67	$700.00	$46,768	11	$300.00	$3,245	284	$300.00	$85,200	$135,214	0.39	$53,226
2026	66	$700.00	$46,534	9	$300.00	$2,759	277	$300.00	$83,100	$132,392	0.37	$49,166
2027	66	$700.00	$46,335	8	$300.00	$2,345	269	$300.00	$80,700	$129,380	0.35	$45,327
2028	66	$700.00	$46,166	7	$300.00	$1,993	262	$300.00	$78,600	$126,759	0.33	$41,895
2029	66	$700.00	$46,022	6	$300.00	$1,694	254	$300.00	$76,200	$123,916	0.31	$38,638
2030	66	$700.00	$45,899	5	$300.00	$1,440	247	$300.00	$74,100	$121,439	0.29	$35,722
2031	65	$700.00	$45,795	4	$300.00	$1,224	239	$300.00	$71,700	$118,719	0.28	$32,945

Table 31: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Regional Indoor and Outdoor Water Efficiency Project

YEAR	B) Indoor Conservation			B) Residential and CII Outdoor Surveys and Upgrades			C) Large Area Landscape Water Use Budgets			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (AF)	$/unit	Value (a)*(b)	# units (AF)	$/unit	Value (d)*(e)	# units (AF)	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2032	65	$700.00	$45,707	3	$300.00	$1,040	232	$300.00	$69,600	$116,348	0.26	$30,459
2033	65	$700.00	$45,632	3	$300.00	$884	224	$300.00	$67,200	$113,716	0.25	$28,086
2034	65	$700.00	$45,568	3	$300.00	$752	217	$300.00	$65,100	$111,420	0.23	$25,961
2035	65	$700.00	$45,514	2	$300.00	$639	209	$300.00	$62,700	$108,853	0.22	$23,927
2036	65	$700.00	$45,468	2	$300.00	$543	202	$300.00	$60,600	$106,611	0.21	$22,108
Total AF saved	1,735			586			7,294					
Total Present Value of Discounted Benefits (Sum of Column (l))												**$1,762,921**

Value in water and wastewater treatment costs avoided through conservation

The value for treatment, pumping and delivery of water is approximately $300 per acre-foot in the relevant portion of the Sacramento region. The cost of wastewater collection, treatment and discharge also is approximately $300 per acre-foot. Thus, for projects that reduce indoor water consumption, the total cost avoided is $700 per acre-foot.

Water conservation for residential (including disadvantaged) customers

This project component will provide complete interior water use surveys and retrofits to residential (including disadvantaged) customers. Typically, disadvantaged customers do not participate in water conservation rebates and programs. Reasons for this include a greater proportion of rentals, a higher number of multi-family dwelling units, limited ability to finance the required repairs or improvements, and cultural barriers to participating with governmental agencies. Interior water conservation retrofits will be conducted for 1,098 households in the greater Sacramento area. Each retrofit will include a standard survey of interior water use, and no-cost installation of indoor water efficient devices including low-flow (WaterSense) toilets, showerheads, and faucet aerators. Water savings of 1,735 AF have been estimated for this project using the assumptions shown in Table 32.

Table 32: Water Savings Assumptions for Interior Water Conservation Retrofits

Item	Quantity (units installed)	Daily Savings/unit (gal/day)	Unit Savings (AF/yr)	Life (years)	Unit Lifetime Savings (AF)	Total Savings (AF)
Surveys	1,098	15	0.017	*	0.1	121
Low-flow Toilets	1,648	35	0.039	25	1.0	1,615
Total Water Savings (AF over project lifetime, 25 years) * Savings from the water surveys are expected to decay by 15% per year.						1,735

Water conserved through residential exterior surveys and upgrades for single- family homes

Exterior water use surveys would be completed on 285 single-family accounts. These surveys would meet criteria established by the CUWCC in their 2010 MOU. In addition to the surveys, monetary incentives, such as rebates, will be offered to customers to upgrade their existing irrigation systems to improve system performance and efficiency. For single-family accounts, 285 exterior water use surveys will be conducted and incentives of up $500 will be offered for irrigation system upgrades for single-family homes. The expected lifetime conservation of this portion of the project is 140 AF of water and was determined using the assumptions below in Table 33.

Table 33: Water Savings Assumptions for Exterior Residential Water Use Surveys and Upgrades

Item	Quantity	Daily Savings/unit (gal/day)	Unit Savings (AF/yr)	Life (years)	Unit Lifetime Savings (AF)	Total Savings (AF)
Surveys	285	90	0.101	*	1.0	140
* Savings from the water surveys are expected to decay by 15% per year over the 25 year program life.						

Water conserved through exterior water use surveys and upgrades for large landscape accounts

In this project component, exterior water use surveys would be completed on commercial, institutional, and industrial (CII) sector and residential accounts with large landscapes. As with the single-family water use surveys, survey methods will be selected using the criteria established by the CUWCC in their 2010 MOU. In addition, monetary incentives (e.g. rebates) will be offered to customers to upgrade their existing irrigation systems to improve system performance and efficiency. Up to 76 exterior water use surveys will be conducted and up to $1,500 will be provided in incentives for irrigation system upgrades The expected lifetime conservation of this portion of the project is 446 AF of water and was determined using the assumptions below in Table 34.

Table 34: Water Savings Assumptions for Exterior Large Landscape Water Use Surveys and Upgrades

Item	Quantity	Daily Savings/unit (gal/day)	Unit Savings (AF/yr)	Life (years)	Unit Lifetime Savings (AF)	Total Savings (AF)
Surveys	76	500	0.560	*	5.6	446
* Savings from the water surveys are expected to decay by 15% per year over the 25 year program life.						

Water conservation through large landscape water use budgets

The greater Sacramento region has over 5,600 dedicated landscape meters. The current approach to preparing water budgets is for each agency to independently perform this service. In addition, many of the existing budgets have not been prepared utilizing the criteria established in the State's current Model Water Efficient Landscape Ordinance. This project component will create up to 404 landscape budgets that follow the Model Water Efficient Landscape Ordinance, are consistent with recommendations by the CUWCC in their 2010 MOU, and that are prepared in a consistent manner utilizing current data and information. This project is estimated to provide a water savings of 7,294 AF and was calculated using the assumptions below in Table 35.

Table 35: Water Savings Assumptions for Landscape Water Use Budgets

Item	Quantity	Daily Savings/unit (gal/day)	Unit Savings (AF/yr)	Life (years)	Unit Lifetime Savings (AF)	Total Savings (AF)
Large Landscape Budgets	404	500	0.56	20	11.2	7,294

Distribution of project benefits, and identification of beneficiaries

The benefits for this project will occur in the Sacramento region and impact consumers of RWA member agencies. Table 36 provides a summary of these beneficiaries.

Table 36. Project Beneficiaries Summary

Local	Regional	Statewide
Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Roseville, City of Sacramento, El Dorado Irrigation District, Orange Vale Water Company, Placer County Water Agency, Sacramento County Water Agency, Sacramento Suburban Water District, San Juan Water District, and Cosumnes Resource Conservation District	Sacramento Region American River Watershed Cosumnes River Watershed	Sacramento-San Joaquin Delta California – water conservation goals California – reduced energy use and carbon footprint

Project Benefits Timeline Description

The project build-out and capital costs will be incurred in 2011, 2012 and 2013. Project benefits will begin to be fully realized in 2013 and will continue for the expected 25 year lifetime (although the savings value of some components will decrease with time, as reflected in the benefits estimates for those components).

Potential Adverse Effects from the Project

There is no evidence to suggest that the project will result in any adverse effects in the future.

Summary of Findings, Tables

The monetized water supply benefits from the proposed project have a present value of $1.76 million. They include the avoided costs of potable water treatment and wastewater treatment based on water conservation. The estimated present value cost is $837,742.

The benefit to cost ratio is 2.1. Several additional benefits are not quantified in this analysis and could have a significant impact on these values. These non-quantified benefits include reducing the carbon footprint of the water and wastewater treatment facilities and improved public education.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits: the project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 37.

Table 37: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided water treatment costs	+	The monetized avoided costs are based on current estimates of the cost of water being $300/AF. Additional demands on the water system could require the system to utilize additional sources of water that could significantly increase the cost of treated water. Also, changes in energy prices, treatment costs, water availability and other factors impact this avoided cost estimate and are likely to increase this value in the future.
Avoided wastewater treatment costs	+	The monetized avoided costs are based on current estimates of the cost of wastewater treatment being $300/AF. Changes in energy prices, treatment costs, discharge limits (Permits, TMDLs) will all impact this estimate, and probably result in higher avoided costs in the future.
Project costs	U	The calculation of the present value of costs is a function of the timing of capital outlays and a number of other factors and conditions. Changes in these variables will change the estimate of costs.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

California Urban Water Conservation Council. 2010. *Memorandum of Understanding Regarding Urban Water Conservation in California*. June 9.

Project 8: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project

Summary

Between 2000 and 2009, the population of Sacramento County increased by 14.5%. Population pressures on traditional surface and ground water supplies have prodded many water providers to seek alternative sources. One of these is recycled water, which has been successfully used in California for a century. Recycled water has become an increasingly important source of water supply for irrigation of agricultural crops and landscapes, industrial uses such as cooling towers at thermal generation plants, and habitat restoration/protection.

The Sacramento Regional County Sanitation District (SRCSD) initiated efforts in the late 1980's to explore the possibility of using recycled water within their service areas to meet the demands of a growing region, reduce impacts to the community from occasional droughts, and to potentially minimize the imposition of more stringent discharge requirements. SRCSD currently produces secondary and tertiary recycled water at the Sacramento Regional Wastewater Treatment Plant (SRWTP) and its Water Reclamation Facility (WRF), respectively. In 2004, the SRCSD Board of Directors decided to evaluate the possibility of increasing the delivery of recycled water from 5 million gallons per day (MGD) to 30-40 MGD over the next 20 years.

The proposed SRCSD/ Sacramento Power Authority Recycled Water Project will provide recycled water for the cooling towers of the Campbell Soup Cogeneration Plant, owned by Sacramento Power Authority (SPA). The recycled water will be provided by the existing Water Reclamation Facility and will replace approximately 1,000 acre-feet per year (AFY) or approximately 1 MGD of potable water currently provided by the City of Sacramento. The SRCSD/ SPA Recycled Water Project will provide design and construction of recycled water transmission facilities and required associated modifications to pumping and piping systems to allow the transmission of recycled water for industrial use at the Cogeneration Plant. The Sacramento Power Authority is partnering with SRCSD, which will produce the recycled water in its Water Reclamation Facility. The WRF has a current treatment capacity of 5 MGD, and can handle the 1 MGD requirements of the Cogeneration Plant. A future plan will expand the WRF's treatment capacity to 10 MGD.

A summary of all benefits and costs of the project is provided in Table 38. Project costs and water supply benefits are discussed in the remainder of this attachment.

Table 38: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$9.4 million
Monetized Benefits	
Water Supply Benefits	
Avoided costs in development of new water supplies	$4.6 million
Avoided O&M costs of wastewater treatment	$3.0 million
Total Monetized Benefits	$7.6 million
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Increased reliability and local control	++
Reduced groundwater pumping and overdraft	+
Water Quality and Other Benefits	
Reduced groundwater pumping and overdraft	++
Reduced wastewater discharge	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The capital costs for the project are $8.4 million, which will cover the pipeline and some piping modifications at the Cogeneration Plant and the WRF. Capital construction is planned for the period between 2013 and 2015; operations will commence in mid-2015. Operation and maintenance costs are $261,582 per year. The estimated remaining project life for the water reclamation facility (WRF) is 40 years, and for the pipeline is at least 50 years. Over 40 years, the present value total for capital and O&M combined is $9.4 million, as shown in Table 39.

Table 39: Annual Cost of Project

(All costs in 2009 Dollars)

Project: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2011	$494,713					$0	$494,713	0.89	$440,293
2012	$1,050,925					$0	$1,050,925	0.84	$882,377
2013	$1,420,297					$0	$1,420,297	0.79	$1,125,008
2014	$4,176,406					$0	$4,176,406	0.75	$3,120,854
2015	$1,239,000	$12,520	$59,136	$59,136		$0	$1,369,791	0.70	$965,649
2016	$2,448	$25,040	$118,271	$118,271		$0	$264,030	0.67	$175,595
2017		$25,040	$118,271	$118,271		$0	$261,582	0.63	$164,120
2018		$25,040	$118,271	$118,271		$0	$261,582	0.59	$154,830
2019		$25,040	$118,271	$118,271		$0	$261,582	0.56	$146,066
2020		$25,040	$118,271	$118,271		$0	$261,582	0.53	$137,798
2021		$25,040	$118,271	$118,271		$0	$261,582	0.50	$129,998
2022		$25,040	$118,271	$118,271		$0	$261,582	0.47	$122,640
2023		$25,040	$118,271	$118,271		$0	$261,582	0.44	$115,698
2024		$25,040	$118,271	$118,271		$0	$261,582	0.42	$109,149
2025		$25,040	$118,271	$118,271	$206,600	$0	$468,182	0.39	$184,298
2026		$25,040	$118,271	$118,271		$0	$261,582	0.37	$97,142
2027		$25,040	$118,271	$118,271		$0	$261,582	0.35	$91,644
2028		$25,040	$118,271	$118,271		$0	$261,582	0.33	$86,456
2029		$25,040	$118,271	$118,271		$0	$261,582	0.31	$81,563

Table 39: Annual Cost of Project
(All costs in 2009 Dollars)
Project: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project

	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2030		$25,040	$118,271	$118,271		$0	$261,582	0.29	$76,946
2031		$25,040	$118,271	$118,271		$0	$261,582	0.28	$72,590
2032		$25,040	$118,271	$118,271		$0	$261,582	0.26	$68,481
2033		$25,040	$118,271	$118,271		$0	$261,582	0.25	$64,605
2034		$25,040	$118,271	$118,271		$0	$261,582	0.23	$60,948
2035		$25,040	$118,271	$118,271	$206,600	$0	$468,182	0.22	$102,911
2036		$25,040	$118,271	$118,271		$0	$261,582	0.21	$54,244
2037		$25,040	$118,271	$118,271		$0	$261,582	0.20	$51,173
2038		$25,040	$118,271	$118,271		$0	$261,582	0.18	$48,277
2039		$25,040	$118,271	$118,271		$0	$261,582	0.17	$45,544
2040		$25,040	$118,271	$118,271		$0	$261,582	0.16	$42,966
2041		$25,040	$118,271	$118,271		$0	$261,582	0.15	$40,534
2042		$25,040	$118,271	$118,271		$0	$261,582	0.15	$38,240
2043		$25,040	$118,271	$118,271		$0	$261,582	0.14	$36,075
2044		$25,040	$118,271	$118,271		$0	$261,582	0.13	$34,033
2045		$25,040	$118,271	$118,271	$206,600	$0	$468,182	0.12	$57,465
2046		$25,040	$118,271	$118,271		$0	$261,582	0.12	$30,289
2047		$25,040	$118,271	$118,271		$0	$261,582	0.11	$28,575
2048		$25,040	$118,271	$118,271		$0	$261,582	0.10	$26,957

Table 39: Annual Cost of Project (All costs in 2009 Dollars) Project: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project									
	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2049		$25,040	$118,271	$118,271		$0	$261,582	0.10	$25,432
2050		$25,040	$118,271	$118,271		$0	$261,582	0.09	$23,992
2051		$25,040	$118,271	$118,271		$0	$261,582	0.09	$22,634
2052		$25,040	$118,271	$118,271		$0	$261,582	0.08	$21,353
2053		$25,040	$118,271	$118,271		$0	$261,582	0.08	$20,144
2054		$25,040	$118,271	$118,271		$0	$261,582	0.07	$19,004
Project Life	40 years								
Total Present Value of Discounted Costs (Sum of Column (i))									$9,444,591

The "Without Project" Baseline

Without this project, the Cogeneration Plant uses approximately 1,000 AFY of potable water for a purpose that does not require water of such high quality. At the same time, the SRCSD Water Reclamation Facility has uncommitted current capacity which is sufficient to supply recycled water to the Cogeneration plant.

In the absence of this project, the City of would not have this opportunity to effectively add 1.0 MGD (approximately 1,000 AFY) to its potable water supply, and would seek to meet growing demand by different means such as higher cost surface water development (if available), groundwater development, leak detection, and/or water conservation programs.

Water Supply Benefits

Avoided Costs in Development of New Water Supplies

The recycled water provided through the SRCSD/SPA Recycled Water Project will offset approximately 1,000 AFY of potable water. The City of Sacramento currently supplies the water to the facility, so its costs of developing the next feasible supply option of $419 per acre-foot were used for this analysis.

Given the 40 year life of this project (factoring in the reclaimed water facility, rather than the longer-lived pipeline which is the focal point of this propose project), the present value of the avoided use of potable water amounts to roughly $4.6 million.

Avoided Wastewater Treatment Plant Upgrade and Operating Costs

In December 2010, the Central Valley Regional Water Quality Control Board adopted a new wastewater discharge permit for the SRCSD wastewater treatment plant (SRWTP) conducting tertiary treatment of wastewater effluent for production of recycled water for proposed use at the Cogeneration Plant's cooling towers. Among other things, the permit contains new mandates that require SRCSD to begin the process to plan, pilot test, design and build new treatment facility upgrades for ammonia removal, nitrate removal, filtration and disinfection. These new processes are very expensive to construct.

Based on preliminary cost estimates prepared by SRCSD in 2009, the estimated unit costs for one of the potential treatment trains evaluated to comply with the new discharge permit requirements is approximately $7.98 million per MGD of capacity (i.e., the capital outlay) and $1,070 per million gallons treated (the annual O&M expense). As this recycled water project reflect roughly a 1 MGD reduction in wastewater volume requiring this addition treatment prior to discharge, the project could be equivalent to a one-time offset of $7.98 million for future capital expenses, plus a $348,000 for annual operations and maintenance costs to treat the 1,000 acre-feet of raw wastewater per year. However, it is not envisioned that the water recycling project will significantly reduce the capital cost of the potential SRWTP upgrades, but the reduction of the main plant operational cost is more likely to be realized through this project. Given the likely timing of the capital outlays for the wastewater facility, and subsequent O&M expenses to comply with the new permit, the present value of the avoided O&M wastewater upgrade costs are $3.0 million, as shown in Table 40.

Increased Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The use of recycled water for the Cogeneration Plant provides reliability in several ways.

- For the Cogeneration Plant, this project will provide a water supply that is relatively insulated from the effects of drought and the threat of legal disagreements, such as the need for water for environmental flows. Currently, recycled water is secure in its availability because there is more wastewater available to be recycled than can be used, and no outside entities (e.g., state or federal agencies) have any direct control over how much reuse water the districts produce and use. For commercial and industrial activities, water is often crucial to production activity and drought may curtail or disrupt production, making reliability very important. Consequently, the few studies that have been conducted on these sectors indicate that commercial and industrial customers value supply reliability quite highly (Raucher et al., 2006).
- For the City of Sacramento, the use of recycled water from the SRCSD plant allows the City to, in effect, expand their water supply portfolio with an existing source that is devoid of water rights issues, drought limitations, or other potential restrictions that might be imposed by entities outside the region.
- The project will also benefit the service area's residential customers by narrowing the gap between normal water supply reliability and single and multiple dry water years, freeing up potable water supplies and thus increasing overall system reliability. The City can meet demand currently; however, in dry years, the water supply portfolio may require groundwater extraction greater than the long-term average use rate of the basin. Thus, the savings of 1,000 AFY of potable supply can provide a means to reduce stress on the groundwater basin.

Reduced Groundwater Pumping and Overdraft

The groundwater basin underlying Sacramento County covers about 880 square miles and is part of the Sacramento Valley Groundwater Basin, which covers 20,000 square miles. The Sacramento Valley Groundwater Basin, like many groundwater basins in California, has a long history of problems with overdraft and land subsidence. Development of increased volumes of recycled water to offset groundwater pumping can be a significant benefit to the region. Potential benefits from reduced levels of groundwater extraction include the prevention of increased costs to pump water, drill deeper wells, increase water treatment, and/or purchase of surface water.

Table 40: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project

YEAR	Benefit a – Potable Supply Water Offset			Benefit b – Wastewater Treatment Offset (Capital Expenses)			Benefit c – Wastewater Treatment Offset (O&M Expenses)			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2011			$0			$0			$0	$0	1.00	$0
2012			$0			$0			$0	$0	0.94	$0
2013			$0			$0			$0	$0	0.89	$0
2014			$0			$0			$0	$0	0.75	$0
2015	500.0	$419.00	$209,500			$0			$0	$209,500	0.70	$147,689
2016	1,000.0	$419.00	$419,000			$0			$0	$419,000	0.67	$278,659
2017	1,000.0	$419.00	$419,000			$0			$0	$419,000	0.63	$262,886
2018	1,000.0	$419.00	$419,000			$0			$0	$419,000	0.59	$248,005
2019	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.56	$428,627
2020	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.53	$404,365
2021	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.50	$381,477
2022	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.47	$359,884
2023	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.44	$339,513
2024	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.42	$320,295
2025	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.39	$302,165
2026	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.37	$285,062
2027	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.35	$268,926
2028	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.33	$253,704
2029	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.31	$239,343
2030	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.29	$225,795
2031	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.28	$213,015

Table 40: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project

YEAR	Benefit a – Potable Supply Water Offset			Benefit b – Wastewater Treatment Offset (Capital Expenses)			Benefit c – Wastewater Treatment Offset (O&M Expenses)			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2032	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.26	$200,957
2033	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.25	$189,582
2034	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.23	$178,851
2035	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.22	$168,727
2036	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.21	$159,177
2037	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.20	$150,167
2038	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.18	$141,667
2039	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.17	$133,648
2040	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.16	$126,083
2041	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.15	$118,946
2042	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.15	$112,213
2043	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.14	$105,862
2044	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.13	$99,870
2045	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.12	$94,217
2046	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.12	$88,884
2047	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.11	$83,852
2048	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.10	$79,106
2049	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.10	$74,628
2050	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.09	$70,404
2051	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.09	$66,419
2052	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.08	$62,659

Table 40: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project

YEAR	Benefit a – Potable Supply Water Offset			Benefit b – Wastewater Treatment Offset (Capital Expenses)			Benefit c – Wastewater Treatment Offset (O&M Expenses)			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2053	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.08	$59,113
2054	1,000.0	$419.00	$419,000			$0	325.80	$1,070	$348,606	$767,606	0.07	$55,767
Total Present Value of Discounted Benefits (Sum of Column (l))												**$7,580,209**

Distribution of project benefits, and identification of beneficiaries

Benefits will accrue locally to the City of Sacramento through avoided costs of purchasing surface water and to regional customers by improving overall system reliability and local control. Beneficiaries of improved water supply will be local, regional, and perhaps statewide.

Table 41: Project Beneficiaries Summary

Local	Regional	Statewide
Customers of the SRCSD and City of Sacramento service areas	Residents of Central Valley overlaying CV groundwater basin	Delta

Project Benefits Timeline Description

Infrastructure from this project is expected to last 40 years. Capital construction is anticipated to be accomplished by 2015. Benefits from the project will begin to accrue upon completion of the project.

Potential Adverse Effects from the Project

SRCSD will implement appropriate mitigation measures (as identified in the Environmental Impact Report) to ensure that the project does not result in significant impacts.

Summary of Findings, Tables

The SRCSD/ SPA Recycled Water Project will generate monetized benefits from the avoided cost to develop equivalent potable water supply. The amount of water supply created as a result of this project, as well as the avoided cost from developing alternative source of supply, is summarized in Table 38.

The project will also generate important local and regional water supply benefits from improved supply reliability and reductions in groundwater pumping and overdrafts. Though the net present value of costs is larger than monetized benefits, it is important to point out that significant benefits will be derived from reliability, general improvements in water quality, and protection of critical aquatic habitats (see Attachment 8). If the benefit categories were able to be monetized, the monetized value of the project would increase considerably. A qualitative benefits summary is provided in Table 42.

Table 42: Qualitative Benefits Summary – Water Supply

Benefit	Qualitative Indicator
Increased water supply reliability	++ ++
Reduced groundwater pumping and overdraft	++

Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the values of increased reliability to water customers and the impacts of reduced groundwater pumping that are directly attributable to this project. These issues are listed in Table 43.

Table 43: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased reliability and local control	++	Increased recycled water use that offsets potable water supply results in improvements in the Agency's ability to deliver reliable water supplies to its customers (it is an increase in capacity). As previously noted, residential and industrial (i.e., urban) customers seem to value water supply reliability quite highly. If information was available to monetize the value of reliability, monetized benefits would increase.
Reduced groundwater pumping and overdraft	+	Information on the potential impact of the project on groundwater levels in the area is not known to the authors at this time. However, reducing any level of groundwater pumping from an over drafted system will result in positive benefits.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. **-** = Likely to decrease benefits. **--** = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

Raucher, R.S., J. Henderson, and J. Rice. 2006. *An Economic Framework for Evaluating the Benefits and Costs of Water Reuse.* WateReuse Foundation. Arlington, VA.

Sacramento Regional County Sanitation District. 2011. *Sacramento Regional County Sanitation District (SRCSD)/Sacramento Power Authority (SPA) Recycled Water Project to Serve the SPA Cogeneration Facility at the Campbell Soup Plant, Feasibility Study*. January 5.

Project 9: North Antelope Booster Pump Station Project

Summary

The North Antelope Booster Pump Station Project consists of a new booster pump station adjacent to the existing Antelope Reservoir in Sacramento Suburban Water District's (SSWD) North Service Area (NSA). This pump station will pump groundwater from the NSA into the Antelope and Cooperative Transmission Pipelines for conveyance to various San Juan Water District (SJWD) retail customers. All SJWD retailers, with the exception of SSWD, rely on surface water for the majority of their supply, with some of the supply coming from local groundwater wells. In essence, this project will provide for the reversal of flow in the Antelope and Cooperative Transmission Pipelines thereby allowing SSWD to export conserved and excess groundwater to the other agencies connected to the pipeline. This will relieve regional pressure on surface water sources, especially in dry years.

This project will enable retail surface water customers to use more groundwater, thereby greatly enhancing regional opportunities for expanding the conjunctive use of groundwater and surface water within and beyond the Sacramento Groundwater Authority's area of authority. This will be accomplished by extending the service area that can be supplied by groundwater. Expanding the opportunity for conjunctive use will have both regional and statewide benefits during dry years and other times when supplies are limited.

Other benefits of the North Antelope Booster Pump Station Project include sustaining flows in the lower American River during dry years by providing groundwater to the surface water users, thereby reducing their demand on the river. In addition, this project will provide a secondary source of supply for retail customers in the SJWD service area in the event the capacity of the Peterson surface water treatment plant is limited due to conditions (such as seismic events) beyond the control of the SJWD; this addresses security concerns and ensures a reliable supply of water in the event of an emergency.

Cost and Benefit Summary

A summary of all benefits and costs for this project are provided in Table 44. Present value project costs over the 40 year life of the project are $837,400. Monetized project benefits include a willingness to pay estimate for enhanced water supply reliability for SJWD customers, which may amount to over $3.2 million (M) over the 40 year project life.

Additional significant qualitative benefits of the project include water supply flexibility and conjunctive uses, increases in water supply for downstream American River users due to decreases in withdrawals by SJWD, and increases in in-stream flow (and attendant benefit to fish and wildlife and ecosystems in the River and through the Delta) due to reduced extraction levels.

Project costs and water supply benefits are discussed in the remainder of this attachment. Water quality and other qualitative benefits are discussed in Attachment 8.

Table 44: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$837,400
Monetized Benefits	
Water Supply Benefits	
Increased Water Supply Reliability for SJWD Customers	$3.2 million
Total Monetized Benefits	$3.2 million
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved operational flexibility for SSWD & SJWD	++
SSWD groundwater (reduction in current excess supply)	-
Water Quality and Other Benefits	
Sustaining flows in American River in Dry Years	++
Meet regional conjunctive use goals	++
Wildlife and other in-stream uses	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The primary cost of the project is construction of the Booster Pump. Construction costs of $918,412 begin with award of the project in November of 2012 and continue with project completion in 2013. Operational costs begin in 2014 when construction is completed, and will continue for the 40 year project life. Table 45 provides an illustration of costs and the total discounted cost for the project.

Table 45: Annual Cost of Project
(All costs in 2009 Dollars)
Project: North Antelope Booster Pump Station Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	$0	$0	$0	$0	$0	$0	$0	1.000	$0
2010	$0	$0	$0	$0	$0	$0	$0	0.943	$0
2011	$41,835	$0	$0	$0	$0	$0	$41,835	0.890	$37,233
2012	$113,253	$0	$0	$0	$0	$0	$113,253	0.840	$95,133
2013	$763,324	$900	$6,300	$700	$0	$0	$771,224	0.79	$610,882
2014	$0	$900	$6,300	$700	$0	$0	$7,900	0.75	$5,903
2015		$900	$6,300	$700			$7,900	0.70	$5,569
2016		$900	$6,300	$700			$7,900	0.67	$5,254
2017		$900	$6,300	$700			$7,900	0.63	$4,957
2018		$900	$6,300	$700			$7,900	0.59	$4,676
2019		$900	$6,300	$700			$7,900	0.56	$4,411
2020		$900	$6,300	$700			$7,900	0.53	$4,162
2021		$900	$6,300	$700			$7,900	0.50	$3,926
2022		$900	$6,300	$700			$7,900	0.47	$3,704
2023		$900	$6,300	$700			$7,900	0.44	$3,494
2024		$900	$6,300	$700			$7,900	0.42	$3,296
2025		$900	$6,300	$700			$7,900	0.39	$3,110
2026		$900	$6,300	$700			$7,900	0.37	$2,934
2027		$900	$6,300	$700			$7,900	0.35	$2,768

Table 45: Annual Cost of Project
(All costs in 2009 Dollars)
Project: North Antelope Booster Pump Station Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2028		$900	$6,300	$700			$7,900	0.33	$2,611
2029		$900	$6,300	$700			$7,900	0.31	$2,463
2030		$900	$6,300	$700			$7,900	0.29	$2,324
2031		$900	$6,300	$700			$7,900	0.28	$2,192
2032		$900	$6,300	$700			$7,900	0.26	$2,068
2033		$900	$6,300	$700			$7,900	0.25	$1,951
2034		$900	$6,300	$700			$7,900	0.23	$1,841
2035		$900	$6,300	$700			$7,900	0.22	$1,736
2036		$900	$6,300	$700			$7,900	0.21	$1,638
2037		$900	$6,300	$700			$7,900	0.20	$1,545
2038		$900	$6,300	$700			$7,900	0.18	$1,458
2039		$900	$6,300	$700			$7,900	0.17	$1,375
2040		$900	$6,300	$700			$7,900	0.16	$1,298
2041		$900	$6,300	$700			$7,900	0.15	$1,224
2042		$900	$6,300	$700			$7,900	0.15	$1,155
2043		$900	$6,300	$700			$7,900	0.14	$1,090
2044		$900	$6,300	$700			$7,900	0.13	$1,028
2045		$900	$6,300	$700			$7,900	0.12	$970
2046		$900	$6,300	$700			$7,900	0.12	$915

Table 45: Annual Cost of Project (All costs in 2009 Dollars) Project: North Antelope Booster Pump Station Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2047		$900	$6,300	$700			$7,900	0.11	$863
2048		$900	$6,300	$700			$7,900	0.10	$814
2049		$900	$6,300	$700			$7,900	0.10	$768
2050		$900	$6,300	$700			$7,900	0.09	$725
2051		$900	$6,300	$700			$7,900	0.09	$684
2052		$900	$6,300	$700			$7,900	0.08	$645
2053		$900	$6,300	$700			$7,900	0.08	$608
Project Life	40 years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									$837,400

The "Without Project" Baseline

In California and many other western states, water is often limited during times of greatest demand and is in ample supply during times of lowest demand. One solution to this dilemma, as proposed in this project, is increasing the flexibility of water delivery. Currently, the SJWD and their retail customers receive the majority of their water from surface waters while SSWD receives the majority of their water from groundwater. This project would allow SSWD to send groundwater to SJWD to use instead of surface water, especially in dry years. This opportunity to provide conjunctive use of groundwater and surface water would allow the two water districts to work together to maximize the beneficial use of available supply under a variety of water year types. In dry years, surface water supplies are limited due to the need to sustain flows in the lower American River, and with completion of this project, groundwater use can be expanded regionally to reduce stress on limited American River supplies.

Without this project, water supplies will be limited for SJWD customers during dry years and benefits to the entire lower American River of shifting to alternatives water supply sources will be unavailable. Further, without this project, SJWD customers will be solely reliant upon one source of water – and in the event of a catastrophic event to the Peterson water treatment plant, would have no alternative source for water supplies.

Without this project, all users downstream of this project (including SJWD customers and all Delta water users), as well as in-stream environmental needs for the lower American River, will not have the dry year buffer supplied by this project.

Water Supply Benefits

Increased Water Supply Reliability

The primary benefit of the North Antelope Booster Pump Station Project is the ability to supply neighboring districts with access to groundwater in dry years, thereby increasing regional conjunctive use of both surface and groundwater supplies. The increased flexibility will provide both the SSWD service area and the SJWD service area increased supply reliability and will take some demand pressures off dry season surface water supplies that other communities rely on as their primary source. In essence, this project diversifies the water supply portfolio for SJWD by adding another source of supply, a source (local groundwater) that can be used to maintain overall supply reliability because its yield counter-balances the periodic reduced availability of surface water.

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. Although concern for water supply reliability is increasing (due to population growth, increasing water demands, and uncertainties over climate change impacts), only a few studies have directly attempted to quantify its value, primarily through non-market valuation studies. Results of these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $95 to $500 (in 2009 USD) per household for total reliability (i.e., a 0% probability of facing water restrictions in times of drought) (e.g., Raucher et al., 2005, 2006). The challenge in applying these values is to determine a benefits value for the project that recognizes how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay (WTP) to ensure complete reliability (zero drought-related use restrictions in the future). Whereas this project will only enhance overall reliability but not guarantee 100% reliability, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project. Appendix A of this attachment (Attachment 7 – Economic Analysis – Water Supply Costs and Benefits) provides a detailed review of this empirical literature and discusses issues related to its interpretation for projects such as the one described here (and other similar projects in this Attachment).

The project's value is a function of the increase in available water, the value of the new flexibility to use groundwater as an alternative or supplement to surface waters in years when such surface water is limited (scaled to reflect apportionment to overall reliability), and the number of households that will benefit from the increased reliability. The planned use of the booster pump, averaged across wet and dry years, is to convey approximately 1,600 AFY to 5,000 AFY of conserved groundwater for either storage in the Antelope Reservoir or use by SJWD users. SSWD currently plans to use the 1,600 AFY to 5,000 AFY of groundwater to provide flexibility and meet drought condition/emergency needs of SJWD. Emergency use water suggests either a shortfall in surface water supplies or a catastrophic event to the sole water treatment facility (either by terrorism, earthquake or other catastrophic event).

During wet and average years, SJWD has a contract to divert up to 82,200 AF from the American River. This contract is reduced to 54,200 AFY during the driest years. Based on this contract, SJWD has to curtail use of American River water by up to 28,000 AFY in driest years, and perhaps by half that in dry years. To develop a conservative estimate of the increase in water supply reliability provided by the North Antelope Booster Pump Station Project, we evaluate the project using the highest potential shortfall and the lowest likely contribution from the pump station. In this scenario, the SJWD has a shortfall of about 28,000 AFY and the booster pump provides 1,600 AFY or 5.7% of the anticipated supply shortfall (1,600/28,000).

One approach to developing a monetized value for the project's impacts on supply reliability is to derive empirical estimates based on the above discussion. SJWD provides water service for approximately 265,000 people in their retail and wholesale areas (SJWD home page), and serves a total of about 49,500 accounts (Rob Swartz, personal communication). Some of these accounts are likely to be multi-family accounts; hence the 49,500 figure is likely to be a conservative estimate of the number of households served.

Next, we assume explicitly that the annual WTP values from the literature are scaled to 5.7% to reflect the extent to which this project contributes to total supply reliability (i.e., from $95 to $500 per year per household, 5.7% becomes $5.42 to $28.50 per year). This adjustment is used to reflect an assumed apportionment of how large a share of the value of absolute water supply reliability can be attributed to the fractional gain in overall reliability provided by the planned program as enhanced by the project. Then, a rough monetary estimate would suggest that the benefit of increased reliability and drought reduction potential from this project may be in the range of about $268,290 to about $1.4 million per year (e.g., $5.42 to $28.50/household per year, over 49,500 households). Using a very conservative estimate of a zero percent increase in the number of households per year and the low end of the value per household range ($5.42), the present value of this benefit over the 40-year life of the project is over $3.2 million (see Table 46).

The present value of customers' willingness to pay for the increase in water supply reliability that results from this project supplying 5.7% of the drought year need is between $3.2 million and $16.9 million over the 40-year life of the project. Because of uncertainty regarding the applicability of this literature, we only use the lower bound estimate to be conservative.

Table 46: Present Value Benefits (All benefits in 2009 Dollars) Project: North Antelope Booster Pump Station Project												
YEAR	Benefit a – Willingness to Pay for Reliability*			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2009	0	$5.42	$0								1.00	
2010	0	$5.42	$0								0.94	$0
2011	0	$5.42	$0								0.89	$0
2012	0	$5.42	$0								0.84	$0
2013	0	$5.42	$0								0.79	$0
2014	49500	$5.42	$268,290								0.75	$200,482
2015	49500	$5.42	$268,290								0.70	$189,134
2016	49500	$5.42	$268,290								0.67	$178,428
2017	49500	$5.42	$268,290								0.63	$168,328
2018	49500	$5.42	$268,290								0.59	$158,800
2019	49500	$5.42	$268,290								0.56	$149,812
2020	49500	$5.42	$268,290								0.53	$141,332
2021	49500	$5.42	$268,290								0.50	$133,332
2022	49500	$5.42	$268,290								0.47	$125,785
2023	49500	$5.42	$268,290								0.44	$118,665
2024	49500	$5.42	$268,290								0.42	$111,948
2025	49500	$5.42	$268,290								0.39	$105,611
2026	49500	$5.42	$268,290								0.37	$99,633
2027	49500	$5.42	$268,290								0.35	$93,994
2028	49500	$5.42	$268,290								0.33	$88,673
2029	49500	$5.42	$268,290								0.31	$83,654

Table 46: Present Value Benefits
(All benefits in 2009 Dollars)
Project: North Antelope Booster Pump Station Project

YEAR	Benefit a – Willingness to Pay for Reliability*			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2030	49500	$5.42	$268,290								0.29	$78,919
2031	49500	$5.42	$268,290								0.28	$74,452
2032	49500	$5.42	$268,290								0.26	$70,238
2033	49500	$5.42	$268,290								0.25	$66,262
2034	49500	$5.42	$268,290								0.23	$62,511
2035	49500	$5.42	$268,290								0.22	$58,973
2036	49500	$5.42	$268,290								0.21	$55,635
2037	49500	$5.42	$268,290								0.20	$52,486
2038	49500	$5.42	$268,290								0.18	$49,515
2039	49500	$5.42	$268,290								0.17	$46,712
2040	49500	$5.42	$268,290								0.16	$44,068
2041	49500	$5.42	$268,290								0.15	$41,574
2042	49500	$5.42	$268,290								0.15	$39,220
2043	49500	$5.42	$268,290								0.14	$37,000
2044	49500	$5.42	$268,290								0.13	$34,906
2045	49500	$5.42	$268,290								0.12	$32,930
2046	49500	$5.42	$268,290								0.12	$31,066
2047	49500	$5.42	$268,290								0.11	$29,308
2048	49500	$5.42	$268,290								0.10	$27,649
2049	49500	$5.42	$268,290								0.10	$26,084
2050	49500	$5.42	$268,290								0.09	$24,607

Table 46: Present Value Benefits
(All benefits in 2009 Dollars)
Project: North Antelope Booster Pump Station Project

YEAR	Benefit a – Willingness to Pay for Reliability*			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2051	49500	$5.42	$268,290								0.09	$23,214
2052	49500	$5.42	$268,290								0.08	$21,900
2053	49500	$5.42	$268,290								0.08	$20,661
2054	49500	$5.42	$268,290								0.07	$19,491
Total Present Value of Discounted Benefits (Sum of Column (l))												**$3,216,992**

Distribution of project benefits, and identification of beneficiaries

The largest beneficiary of benefits from this project will be SJWD and its water customers through improved water supply reliability. Another beneficiary will be downstream users of the American River (a regional beneficiary) through the increase in water supply availability due to the lack of withdrawal by SJWD. In-stream users of American River (fish and wildlife habitats, etc) will also benefit by having additional in-stream flows.

Table 47: Project Beneficiaries Summary

Local	Regional	Statewide
Water Customers of SJWD	Region-wide water supply agencies and customers (improved planning, coordination, and conjunctive use)	Delta users and ecosystem (added flow in American River and, hence, the Delta, in dry years)

Project Benefits Timeline Description

It is expected that this project will become operational in 2014 and have a life of 40 years. Project benefits will begin accruing in 2014, when operations begin.

Potential Adverse Effects from the Project

There are no potential adverse affects attributable to his project.

Summary of Findings, Tables

Consumers are willing to pay an additional amount to ensure they have adequate water supplies at all times. Utilizing the willingness to pay literature allows us to determine the value to SJWD customers of having an additional source of water that can be used to increase their supply reliability. If SJWD customers have a 5.7% increase in the reliability of their water supply due to this project, then using the values provided in literature, they are willing to pay $3.2 million or more for the level of water supply reliability provided by this project.

Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the estimation of willingness-to-pay (WTP) values for household valuation of water reliability. The monetization of these values relies on WTP surveys in the literature, which can vary widely, but in this analysis the most conservative values were used. This issue is listed in Table 48.

Table 48: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased level of reliability for customers	U/+	The WTP values in the literature vary widely. The wide range in WTP values reflects the fact that the results of the studies are specific to situations asked to the respondents. Consequently, there is a level of uncertainly in the transfer of these values. Benefits (scaled to 5.7% of literature-based WTP values) were adjusted to reflect that the project does not ensure 100% reliability. This 5.7% could be inaccurate and further analysis would be needed to refine this scaling factor. Using only the lower bound value for WTP suggests the benefits estimate is possibly understated.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

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Project 10: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project

Summary

Sacramento Suburban Water District (SSWD) serves a population of about 160,000, and is one of the largest groundwater users in the Sacramento Groundwater Authority (SGA) Groundwater Management Plan (GWMP) area. However, SSWD does rely significantly on purchased surface water supplies to augment its groundwater supplies. In 2008, groundwater supplied 61% (23,500 AF) of SSWD's water supply, with the other 39% (15,000 AF) drawn from surface water. There is some uncertainty as to the guaranteed availability of surface water supplies in the future, as supplies may not be available on the market and as the reliability of surface water becomes uncertain due to future climate changes and regulatory-driven changes in the downstream Sacramento-San Joaquin Delta.

As groundwater levels steadily dropped in the last half of the 1900s, SSWD initiated an in-lieu groundwater recharge program. Starting in 1998, SSWD offset potable use of groundwater with surface water, allowing groundwater that would otherwise be withdrawn to remain 'banked' in the groundwater basin. Since then, SSWD has banked in excess of 150,000 AF. Additionally, SSWD has made significant investments to put surface water supply and conjunctive use facilities in place, allowing it to flexibly manage its supply portfolio to ensure the sustainability of both resources. This infrastructure and regional water resources has placed SSWD in a key position to help support regional conjunctive use efforts in addition to meeting its own needs.

SSWD's Master Plan, prepared in 2009, stated that the North Service Area (NSA) is low on reserve capacity and, due to the age of the existing groundwater infrastructures, additional groundwater sources would be required. Additional groundwater sources will be added in the next five to ten years to provide more reliability to the system as required. The Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project proposes the construction of two new wells with pump and treatment facilities in the SSWD's North Service Area (NSA). The selected locations for the new wells and pump stations are intended to prevent and avoid interactions with regional groundwater contamination plumes near the southern portion of the district. The Coyle Avenue Well will have a pumping capacity of 2,250 acre-feet per year (1,400 gpm), as documented in the *Coyle Avenue Exploration Summary and Well Design Recommendations Technical Memorandum* (Luhdorff and Scalmanini, January 2010) while the Roseview Park Well will have a capacity of 3,500 acre-feet per year (2,200 gpm). These additional extraction facilities, combined with previously banked groundwater, will allow SSWD to increase groundwater use during dry periods, leaving additional surface water in the American River for habitat protection and to meet water quality objectives.

Summary of Costs and Benefits

A summary of the benefits and costs for the project is provided in Table 49. Total present value costs for this project are $6.1 million (M) and are illustrated in Table 50. Total capital costs for this project are $5,735,537, however, $72,390 of the total project costs have been incurred in calendar year 2010. Because these are "sunk costs," they are not used in calculating the net present value of all costs associated with this project.

Construction on the two wells will start in 2011 and be complete by 2012, with a total capital cost of $5.7M. With annual O&M costs of approximately $68,000 and periodic replacement costs, the present value cost is $6.1M. Construction at the Coyle Avenue site will begin in early 2011, with will be completed by mid-2012. Construction at the Roseview Park site will begin in mid-2011 and will be completed by late 2012.

Table 49: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$6.1M
Monetized Benefits	
Water Supply Benefits	
Increased water supply reliability	$11.3M
Total Monetized Benefits	$11.3M
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Conjunctive use in alignment with WFA and regional conjunctive water management objectives.	++
Water Quality and Other Benefits	
Expands water supply and reliability in an area of the district away from a regional groundwater contamination plume.	+
Supports regional objective of maintaining sufficient surface water in American River for habitat protection.	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Table 50: Annual Cost of Project (All costs in 2009 Dollars) Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2010		$0	$0	$0	$0	$0	$0	0.94	$0
2011	$1,173,945	$0	$0	$0	$0	$0	$1,173,945	0.89	$1,044,807
2012	$4,489,202	$4,396	$19,782	$1,539	$0	$0	$4,514,919	0.84	$3,790,813
2013		$7,693	$54,950	$5,495	$0	$0	$68,138	0.79	$53,972
2014		$7,693	$54,950	$5,495	$0	$0	$68,138	0.75	$50,917
2015		$7,693	$54,950	$5,495	$0	$0	$68,138	0.70	$48,035
2016		$7,693	$54,950	$5,495	$0	$0	$68,138	0.67	$45,316
2017		$7,693	$54,950	$5,495	$0	$0	$68,138	0.63	$42,751
2018		$7,693	$54,950	$5,495	$0	$0	$68,138	0.59	$40,331
2019		$7,693	$54,950	$5,495	$0	$0	$68,138	0.56	$38,048
2020		$7,693	$54,950	$5,495	$0	$0	$68,138	0.53	$35,894
2021		$7,693	$54,950	$5,495	$175,840	$0	$243,978	0.50	$121,250
2022		$7,693	$54,950	$5,495	$0	$0	$68,138	0.47	$31,946
2023		$7,693	$54,950	$5,495	$0	$0	$68,138	0.44	$30,138
2024		$7,693	$54,950	$5,495	$0	$0	$68,138	0.42	$28,432
2025		$7,693	$54,950	$5,495	$0	$0	$68,138	0.39	$26,822
2026		$7,693	$54,950	$5,495	$0	$0	$68,138	0.37	$25,304
2027		$7,693	$54,950	$5,495	$0	$0	$68,138	0.35	$23,872
2028		$7,693	$54,950	$5,495	$0	$0	$68,138	0.33	$22,520
2029		$7,693	$54,950	$5,495	$0	$0	$68,138	0.31	$21,246

Table 50: Annual Cost of Project
(All costs in 2009 Dollars)
Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project

	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2030		$7,693	$54,950	$5,495	$0	$0	$68,138	0.29	$20,043
2031		$7,693	$54,950	$5,495	$175,840	$0	$243,978	0.28	$67,705
2032		$7,693	$54,950	$5,495	$0	$0	$68,138	0.26	$17,838
2033		$7,693	$54,950	$5,495	$0	$0	$68,138	0.25	$16,829
2034		$7,693	$54,950	$5,495	$0	$0	$68,138	0.23	$15,876
2035		$7,693	$54,950	$5,495	$0	$0	$68,138	0.22	$14,977
2036		$7,693	$54,950	$5,495	$703,360	$0	$771,498	0.21	$159,984
2037		$7,693	$54,950	$5,495	$0	$0	$68,138	0.20	$13,330
2038		$7,693	$54,950	$5,495	$0	$0	$68,138	0.18	$12,575
2039		$7,693	$54,950	$5,495	$0	$0	$68,138	0.17	$11,864
2040		$7,693	$54,950	$5,495	$0	$0	$68,138	0.16	$11,192
2041		$7,693	$54,950	$5,495	$175,840	$0	$243,978	0.15	$37,806
2042		$7,693	$54,950	$5,495	$0	$0	$68,138	0.15	$9,961
2043		$7,693	$54,950	$5,495	$0	$0	$68,138	0.14	$9,397
2044		$7,693	$54,950	$5,495	$0	$0	$68,138	0.13	$8,865
2045		$7,693	$54,950	$5,495	$0	$0	$68,138	0.12	$8,363
2046		$7,693	$54,950	$5,495	$0	$0	$68,138	0.12	$7,890
2047		$7,693	$54,950	$5,495	$0	$0	$68,138	0.11	$7,443
2048		$7,693	$54,950	$5,495	$0	$0	$68,138	0.10	$7,022
2049		$7,693	$54,950	$5,495	$0	$0	$68,138	0.10	$6,625

Table 50: Annual Cost of Project (All costs in 2009 Dollars) Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project									
	Initial Costs	Operations and Maintenance Costs [(1)]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2050		$7,693	$54,950	$5,495	$0	$0	$68,138	0.09	$6,250
2051		$7,693	$54,950	$5,495	$175,840	$0	$243,978	0.09	$21,111
2052		$7,693	$54,950	$5,495	$0	$0	$68,138	0.08	$5,562
2053		$7,693	$54,950	$5,495	$0	$0	$68,138	0.08	$5,247
2054		$7,693	$54,950	$5,495	$0	$0	$68,138	0.07	$4,950
2055		$7,693	$54,950	$5,495	$0	$0	$68,138	0.07	$4,670
2056		$7,693	$54,950	$5,495	$0	$0	$68,138	0.06	$4,406
2057		$7,693	$54,950	$5,495	$0	$0	$68,138	0.06	$4,156
2058		$7,693	$54,950	$5,495	$0	$0	$68,138	0.06	$3,921
2059		$7,693	$54,950	$5,495	$0	$0	$68,138	0.05	$3,699
2060		$7,693	$54,950	$5,495	$0	$0	$68,138	0.05	$3,490
2061		$7,693	$54,950	$5,495	$0	$0	$68,138	0.05	$3,292
Project Life	50 years								
Total Present Value of Discounted Costs (Sum of Column (i))									$6,058,750
Comments: Replacement costs were derived from a comparable ASR project. 50-Year project									

The "Without Project" Baseline

In California and many other western states, water is often limited during times of greatest demand and is in ample supply during times of lowest demand. One solution to this dilemma, as proposed in this project, is through underground storage of surplus water for later use. SSWD has established a conjunctive use program to implement this strategy. Without this program, SSWD would continue to use aging wells with increasing risks to reliability, or replace the supply currently provided by aging wells with water purchases SSWD would continue to rely on purchases of increasingly uncertain surface water to meet demand, with reliability dropping steadily as the purveyors retain supplies for their own requirement. As demands on surface water supplies continue to increase, SSWD will be forced to use their groundwater wells more regularly, intensifying pressure on limited groundwater supplies and potentially increasing overdraft conditions.

Water Supply Benefits

The primary benefit of the two additional wells is the increased ability to assist in meeting the service area's projected demand, and to further insulate potential shortfalls through increased storage capacity. The increased production and storage capacity from the wells will provide the service area increased supply reliability and will take some demand pressures off dry season surface water supplies that other communities also rely on for primary supplies.

The planned use of the wells, averaged across wet and dry years, is to extract approximate 2,000 AFY of previously in-lieu banked groundwater when needed in dry seasons. The monetized benefit of the additional 2,000 AFY stored and extracted is significant, as described below. Other benefits, not monetized here, include increased supply reliability to customers, avoided costs of surface storage, and avoided cost of treating supplies from existing wells that are proximate to a regional groundwater contamination plume. To avoid potential double-counting of benefits, only the value of the avoided costs of developing an additional 2,000 AFY of supply is monetized here. Qualitative benefits of this water supply also include strengthening conjunctive management to meet the District's projected future needs and improving conjunctive management capacity for water exports to neighboring districts.

Avoided cost of purchased water

If the 2,000 AFY were to be supplied by surface water sources, the only alternative to groundwater sources in the SSWD service area, the water would be purchased from and treated by City of Sacramento and transmitted to SSWD. The cost for this currently is $400.37 per AF. On an annual basis in current terms, that water would cost SSWD approximately $0.8 million per year. In present value terms, over the 50-year life of the proposed wells, the avoided cost of this purchase is $11.3 million, as shown in Table 51.

Conjunctive use in alignment with WFA and regional conjunctive water management objectives

A second significant benefit of the project, while not monetized, is the contribution of the new wells to SSWD's conjunctive use program, which is in alignment with the Water Forum Agreement and regional conjunctive management objectives. The entire region is moving towards conjunctive management to meet goals for water storage of the seasonal winter surpluses. This project advances SSWD's program and the Water Forum's objectives in a cost-effective way.

Table 51: Present Value Benefits (All benefits in 2009 Dollars) Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2011					0		$0	0.89	$0
2012	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.84	$671,695
2013	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.79	$633,675
2014	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.75	$597,807
2015	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.70	$563,968
2016	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.67	$532,046
2017	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.63	$501,930
2018	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.59	$473,519
2019	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.56	$446,716
2020	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.53	$421,430
2021	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.50	$397,575
2022	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.47	$375,071
2023	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.44	$353,841
2024	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.42	$333,812
2025	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.39	$314,917
2026	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.37	$297,092
2027	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.35	$280,275
2028	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.33	$264,410
2029	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.31	$249,444
2030	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.29	$235,324
2031	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.28	$222,004
2032	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.26	$209,438

Table 51: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2033	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.25	$197,583
2034	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.23	$186,399
2035	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.22	$175,848
2036	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.21	$165,894
2037	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.20	$156,504
2038	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.18	$147,645
2039	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.17	$139,288
2040	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.16	$131,404
2041	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.15	$123,966
2042	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.15	$116,949
2043	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.14	$110,329
2044	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.13	$104,084
2045	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.12	$98,193
2046	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.12	$92,635
2047	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.11	$87,391
2048	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.10	$82,444
2049	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.10	$77,778
2050	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.09	$73,375
2051	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.09	$69,222
2052	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.08	$65,304
2053	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.08	$61,607
2054	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.07	$58,120

Table 51: Present Value Benefits (All benefits in 2009 Dollars) Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2055	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.07	$54,830
2056	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.06	$51,727
2057	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.06	$48,799
2058	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.06	$46,037
2059	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.05	$43,431
2060	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.05	$40,972
2061	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.05	$38,653
2062	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.05	$36,465
2063	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.04	$34,401
2064	avoided water purchase	AF	0	2000	2000	$400	$800,000	0.04	$32,454
Total Present Value of Discounted Benefits (Sum of Column (j))									**$11,325,720**

Distribution of project benefits, and identification of beneficiaries

The key benefit of increased water supply reliability will accrue to the population served by the SSWD, particularly in their North Service Area where reliability challenges are greatest.

Additional beneficiaries include regional stakeholders who are implementing conjunctive use programs and value the efforts of all regional water systems who are proactively implementing this strategy. A third benefit, also regional, is the increase in water management flexibility to be able to support dry season flows to maintain habitat protection in the American River.

Table 52: Project Beneficiaries Summary

Local	Regional	Statewide
Population served by SSWD	Regional stakeholders for conjunctive use programs and American River habitat protection	Reduced pressure on surface supplies that ultimately impact the Delta

Project Benefits Timeline Description

It is expected that this project will become operational in two stages, with one well coming on line in early 2012 and the other beginning operation later that year. The pumps are expected to have a life of 50 years. Project benefits will begin accruing in 2012, when operation begins.

Potential Adverse Effects from the Project

It is expected that this project will become operational in two stages, with one well coming on line in early 2012 and the other beginning operation later that year. The pumps are expected to have a life of 50 years. Project benefits will begin accruing in 2012, when operation begins.

Summary of Findings, Tables

The proposed Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project will allow SSWD to extract groundwater stored via in-lieu during periods of high demand and constrained surface water supplies, marginally increasing the water supply reliability. The estimated monetized benefit of the project is based on the value of the additional 2,000 AFY that the new wells will be able to recover, above the pumping capacity of the two wells they will replace. This benefit is estimated to be approximately $11.3 million over the life of this project, representing the avoided costs of this volume of water purchased from a neighboring district.

Additional benefits include improved cost-effective conjunctive management of the groundwater aquifer for SSWD's supply reliability, improved water supply reliability, and enhanced capacity to export water to neighboring systems during dry and driest years.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties include the projected avoided costs of purchased surface water supplies, and impacts of demand management efforts on demand during dry and driest years. These issues are listed in Table 53.

Table 53: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided costs of purchased water	U	The projected avoided costs are based on current costs, which are based on a range of factors that may vary over time.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

Luhdorff and Scalmanini. 2010. *Coyle Avenue Exploration Summary and Well Design Recommendations Technical Memorandum.* January.

Sacramento Suburban Water District. 2009. *Water System Master Plan*. July.

Project 11: Willow Hill Pipeline Rehabilitation Project

Summary

The City of Folsom's System Operation Review (SOR) Program's primary objective is to optimize the City's water distribution system to maximize conservation and minimize system losses from unaccounted water. It is taking a sequenced, multi-pronged approach to achieve a high level of system efficiency. One area targeted in the SOR Program is unaccounted water. The SOR Program's Water Audit identified unaccounted system-wide water loss of over 17 percent (as compared to an industry standard of 10 percent). In this project, the City seeks to minimize water losses within its transmission and distribution system.

This application focuses on focuses on Willow Hill Pipeline Rehabilitation Project. Preliminary data indicate that the Willow Hill System loses on average 1,100 AFY. The City's SOR Program's *System Improvements and Water Systems Upgrades* review identified this as a critical project to maximize use of its water supply. Further, water saved through implementation of the Willow Hill Pipeline Rehabilitation Project will be available for conjunctive use, water banking and water marketing, and/or will delay the need for future water supply projects.

A summary of all benefits and costs of the Willow Hill Pipeline Rehabilitation Project are provided in Table 54. Project costs and water supply benefits are discussed in the remainder of this attachment.

Table 54: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$6.45 million
Monetized Benefits	
Water Supply Benefits	
Avoided cost of purchase water to replace water lost through leakage	$5.95 million
Avoided loss of costs of production of unaccounted water	$7.5 million
Total Monetized Benefits	$13.45 million
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Increased reliability	++
Potential surplus to market to other districts	++

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

The capital costs of rehabilitating the Willow Hill transmission pipelines are $7.7M USD. Some planning costs will be covered in 2011, but the remainder of capital costs will be spent in November 2011. The pipeline system will be operational at that time. As this project will be rehabilitating an existing pipeline system, no additional O&M costs (including replacement costs) are included in this project. The present value total for this project is $6.45M USD, as shown in Table 55.

Table 55: Annual Cost of Project (All costs in 2009 Dollars) Project: Willow Hill Pipeline Rehabilitation Project									
	Initial Costs	Operations and Maintenance Costs [(1)]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2010	$0						$0	0.89	$362,230
2011	$7,677,000						$7,677,000	0.84	$6,448,680
Project Life	50 years								
Total Present Value of Discounted Costs (Sum of Column (i))									$6,448,680
Comments: The proposed Willow Hill Rehabilitation Project is not expected to contribute to any additional or incremental O&M costs than what is currently incurred with the present pipeline system. Dollars are expressed in 2010 dollars.									

The "Without Project" Baseline

Without this project, the City of Folsom is projected to be water short of approximately 1,000 acre-feet per year starting in the year 2015. This includes and reflects ongoing aggressive additional water conservation efforts on the order of 25% on a City-wide basis. The City is faced with the need to secure an additional 1,000 acre-feet per year to meet projected future demands in 2015 and beyond. The City does not have groundwater resources that it can use to make up the difference and therefore would need to acquire additional water supplies from other entities. Based on numerous discussions with other water purveyors in and around the region over the last several years, the City would be looking at purchasing these additional water supplies at a cost of approximately $400 per acre-feet per year to purchase, convey, treat, and distribute that water back to the City for its needs. Moreover, due to the Water Forum Agreement, limited opportunities exist to acquire additional supplies of that magnitude and reliability from the lower American River. As a result, the City is currently looking for additional water supplies from the Sacramento River system, which would be diverted at the Freeport Regional Water Project intake and conveyed back 30 miles to the City. Conveyance would entail constructing a pipeline from the end of the Freeport Regional Water Project intake, back to the City.

In addition to the need to acquire new, expensive water to meet near-term future demands, the City would continue to pay for treating and distributing that portion of its current potable supply that is lost due to the existing leaks.

Water Supply Benefits

The proposed Willow Hill Pipeline Rehabilitation Project is estimated to save approximately 1 million gallons per day, which equates to approximately 1,120 acre-feet of water per year. A primary benefit of the project is thus the avoided cost of securing this volume of water through other means, most likely a long-term water purchase. As noted above, the most conservative estimate of this cost would be $400 per acre foot per year, or $448,000 per year. The present value cost of this benefit (avoided water purchase) over the 50-year project life is $5.95 million.

In addition to the savings in water supply resulting from the Willow Hill Pipeline Rehabilitation Project, the treatment and transmission costs of the existing losses will be recouped. Currently, it is estimated that it costs the City $450 per acre-foot ($1,351 per MG) for its current water supply, operations, and conveyance for each acre-foot (AF) of treated water through the Willow Hill System. These funds will no longer go to waste, saving the City $504,000 per year (= 1,120 AF * $450/AF). The present value of this benefit is roughly $7.5 million.

Together, the present value benefits for the Willow Hill Pipeline Rehabilitation Project are $13.45 million. These benefits are shown in Table 56.

The project also conveys several qualitative benefits. Water utility customers will benefit from increased reliability in their future water deliveries, and the water utility itself may also benefit in the future from revenues earned from the sale of surplus supplies, or from banking the surplus and using it as part of a conjunctive use program. Additionally, implementation of the project will help both the City of Folsom and the State achieve its water conservation goals as stated in its *20x2020 Water Conservation Plan*

(February 2010). And finally, other water districts will benefit from the project implementation in that the City of Folsom will not be competing for additional scarce water supplies on the Sacramento River as, alternatively, they can make more efficient use of current resources. In the future, if the City does not require their full water supply allocation, they can bank or market the surplus, benefiting other water districts in need of temporary additional supplies and relieving additional pressures on key surface water bodies supply the Sacramento-San Joaquin Delta.

Table 56: Present Value Benefits (All benefits in 2009 Dollars) Project: Willow Hill Pipeline Rehabilitation Project												
YEAR	Avoided Cost of Purchased Water			Recaptured Value of Production Costs			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2011			$0			$0			$0	$0	0.89	$0
2012			$0			$0			$0	$0	0.84	$0
2013	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.79	$801,979
2014	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.75	$756,584
2015	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.70	$713,758
2016	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.67	$673,357
2017	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.63	$635,242
2018	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.59	$599,285
2019	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.56	$565,364
2020	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.53	$533,362
2021	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.50	$503,172
2022	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.47	$474,690
2023	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.44	$447,821
2024	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.42	$422,473
2025	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.39	$398,559
2026	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.37	$375,999
2027	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.35	$354,716
2028	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.33	$334,638
2029	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.31	$315,696
2030	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.29	$297,826
2031	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.28	$280,968
2032	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.26	$265,064

Table 56: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Willow Hill Pipeline Rehabilitation Project

YEAR	Avoided Cost of Purchased Water			Recaptured Value of Production Costs			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2033	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.25	$250,061
2034	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.23	$235,906
2035	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.22	$222,553
2036	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.21	$209,956
2037	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.20	$198,072
2038	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.18	$186,860
2039	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.17	$176,283
2040	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.16	$166,305
2041	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.15	$156,891
2042	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.15	$148,011
2043	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.14	$139,633
2044	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.13	$131,729
2045	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.12	$124,273
2046	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.12	$117,238
2047	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.11	$110,602
2048	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.10	$104,342
2049	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.10	$98,436
2050	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.09	$92,864
2051	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.09	$87,607
2052	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.08	$82,648
2053	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.08	$77,970
2054	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.07	$73,557

Table 56: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Willow Hill Pipeline Rehabilitation Project

YEAR	Avoided Cost of Purchased Water			Recaptured Value of Production Costs			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units (Households)	$/unit	Value (a)*(b)	# units	$/unit	Value (d)*(e)	# units	$/unit	Value (g)*(h)	Total Benefits (c+ f+ i…)	Discount Factor	Discounted Benefits (j÷k)
2055	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.07	$69,393
2056	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.06	$65,465
2057	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.06	$61,760
2058	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.06	$58,264
2059	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.05	$54,966
2060	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.05	$51,855
2061	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.05	$48,919
2062	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.05	$46,150
2063	1,120	$400.00	$448,000	1,120	$504	$564,480			$0	$1,012,480	0.04	$43,538
Total Present Value of Discounted Benefits (Sum of Column (l))												**$13,442,660**

Distribution of project benefits, and identification of beneficiaries

The key beneficiaries Willow Hill Pipeline Rehabilitation Project will be the City of Folsom water utility customers who will benefit from avoided costs of water purchases as well as recapturing costs for the production and conveyance of formerly unaccounted water. Future beneficiaries will include neighboring water districts who may need to purchase water that the City is able to bank or market and/or the Sacramento-San Joaquin Delta.

Table 57: Project Beneficiaries Summary

Local	Regional	Statewide
City of Folsom water customers	Other water districts	Delta

Project Benefits Timeline Description

The pipeline rehabilitation will be completed and operational by February 2013. The pipeline is expected to have a useful life of 50 years.

Potential Adverse Effects from the Project

No adverse effects are anticipated as the project is a pipeline rehabilitation project (a ministerial project) and not new construction.

Summary of Findings, Tables

The City of Folsom's Willow Hill Pipeline Rehabilitation Project is expected to reduce water losses, thereby avoiding the cost of water purchases as well as regaining the use of water which has already been produced and transmitted, thereby avoiding the cost of producing and transmitting unaccounted water. These avoided costs in present value dollars add up to $13.45, significantly exceeding the project present value cost of $6.45M.

Table 58 presents benefits that are not easily monetized at this time. Qualitatively, the water utility customers will benefit from increased reliability in their future water deliveries. The water utility may benefit in the future from revenues earned from the sale of surplus supplies, or from banking the surplus and using it as part of a conjunctive use program. Additionally, other utilities in the region may benefit by having access to an additional supply of water on the market. And finally, both the City and the State will benefit from project implementation by furthering reductions in per capita water use towards meeting local and state targets as set forth in the State's *20x2020 Water Conservation Plan*.

Table 58: Qualitative Benefits Summary – Water Supply

Benefit	Qualitative Indicator
Increased reliability	+
Potential revenues from marketing surplus	+
Water availability for other utilities	+
Help meet local, regional and State per capita water use goals	+

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. These issues are listed in Table 59.

Table 59: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased reliability	++	There is uncertainty about the value of this to Folsom's customers, as no current information exists based on revealed or stated preferences.
Potential revenues for Folsom for marketing surplus	U/+	Future water demands within the district could mean that Folsom fully uses its water supply, or chooses to bank any excess for later use.
More water available on regional water market for purchase by other districts	+	Folsom may not have surpluses currently anticipated, depending on future population, water demand, and preferences for water banking over water marketing.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

California Department of Water Resources, *et al*. 2010. *20x2020 Water Conservation Plan.* February.

Project 14: OHWD / Rancho Murieta Groundwater Recharge Project

Summary

The OHWD/Rancho Murieta Groundwater Recharge Project is a regional conjunctive use project that will divert 4,000 acre-feet per year (AFY) of available water owned by Rancho Murieta Community Services District (RMCSD) to spreading basins in the Omochumne-Hartnell Water District (OHWD) service area to allow recharge of the groundwater aquifer. This project will benefit RMCSD by allowing the recovery of some of the stored water during dry years to meet water supply shortages, while also benefiting OHWD by increasing groundwater levels in the aquifer that is utilized by land owners in the OHWD service area. The project may also enhance regional salmon migration, as the project will assist in the reconnection of the groundwater with the Cosumnes River baseflow; this connection is necessary to establish and maintain Fall river flows for salmon migration.

Currently, RMCSD's only water supply is a surface water diversion from the Cosumnes River during November through May. Water is currently stored in three surface water reservoirs for year-round use. The benefits conveyed by the proposed project are two-fold: first, the project will supply water in years when the river flows do not allow full diversions, providing a reliable water supply; and second, the project expands supply options should there be a catastrophic failure at the water plant (e.g., due to wildfire) or if reservoir supplies become contaminated.

A summary of all benefits and costs for this project are provided in Table 60. Discounted project costs over the 40 year life of the project are about $2.53 million. Monetized project benefits using an avoided-cost methodology estimate that the next cheapest option for providing 100% water supply reliability results is at a present value cost of $3.43 million. Additional qualitative water supply benefits include water supply flexibility in case of a catastrophic event and the benefit to land owners utilizing wells by raising the water table.

Project costs and water supply benefits are discussed in the remainder of this attachment. The water quality benefits of reconnecting the aquifer to the Cosumnes River, and thereby increasing salmonoid migration and spawning, are discussed in Attachment 8.

Table 60: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$2.53 million
Monetized Benefits	
Water Supply Benefits	
Avoided cost of construction of recycled water infrastructure	$3.43 million
Total Monetized Benefits	$3.43 million
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved operational flexibility in case of catastrophic event	++
Increased supply reliability to local well users	++
Water Quality and Other Benefits	
Increased Salmon fisheries	++

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

Costs related to this project include, for Phase 1, the construction of a new pump station and intake on the Cosumnes River, a spreading basin, and a conveyance structure to connect the inflow to the spreading basin. Costs for Phase 2 include the construction of a 500 to 600-foot deep groundwater well capable of producing between 500 and 600 gallons per minute (gpm) and a transmission pipeline to convey the extracted groundwater to RMCSD's existing distribution system. Phase 1 & 2 will be developed concurrently. Additional costs are related to administration, design, and compliance. The capital cost of this project is $2.47M USD. Construction is expected to begin in July 2012 with the project becoming operational in June 2013.

Annual operations and maintenance costs for the project include well operation and maintenance and assume periodic wellhead removal and servicing every tenth year. There are also $25,000 in annual lease costs for the spreading basin property. While the anticipated lease for this property is for an initial 10-year period with an option for an additional 10-years, the project facilities can be operational for a much longer period, and therefore a 40 year project life is considered in this economic analysis. Given these assumptions, the present value cost of capital, O&M and replacement for this project total $2.53M USD. This is shown in Table 61.

Table 61: Annual Cost of Project
(All costs in 2009 Dollars)
Project: OHWD / Rancho Murieta Groundwater Recharge Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009								1.00	
2010								0.94	
2011	$279,799						$279,799	0.89	$249,020
2012	$1,203,367					$25,000	$1,228,367	0.84	$1,031,361
2013	$985,680		$15,000	$2,400		$25,000	$1,028,080	0.79	$814,336
2014			$15,000	$2,400		$25,000	$42,400	0.75	$31,684
2015			$15,000	$2,400		$25,000	$42,400	0.70	$29,890
2016			$15,000	$2,400		$25,000	$42,400	0.67	$28,198
2017			$15,000	$2,400		$25,000	$42,400	0.63	$26,602
2018			$15,000	$2,400		$25,000	$42,400	0.59	$25,096
2019			$15,000	$2,400		$25,000	$42,400	0.56	$23,676
2020			$15,000	$2,400		$25,000	$42,400	0.53	$22,336
2021			$15,000	$2,400		$25,000	$42,400	0.50	$21,072
2022			$15,000	$12,400		$25,000	$52,400	0.47	$24,567
2023			$15,000	$2,400		$25,000	$42,400	0.44	$18,754
2024			$15,000	$2,400		$25,000	$42,400	0.42	$17,692
2025			$15,000	$2,400		$25,000	$42,400	0.39	$16,691
2026			$15,000	$2,400		$25,000	$42,400	0.37	$15,746
2027			$15,000	$2,400		$25,000	$42,400	0.35	$14,855

Table 61: Annual Cost of Project
(All costs in 2009 Dollars)
Project: OHWD / Rancho Murieta Groundwater Recharge Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2028			$15,000	$2,400		$25,000	$42,400	0.33	$14,014
2029			$15,000	$2,400		$25,000	$42,400	0.31	$13,221
2030			$15,000	$2,400		$25,000	$42,400	0.29	$12,472
2031			$15,000	$2,400		$25,000	$42,400	0.28	$11,766
2032			$15,000	$12,400			$27,400	0.26	$7,173
2033			$15,000	$2,400			$17,400	0.25	$4,297
2034			$15,000	$2,400			$17,400	0.23	$4,054
2035			$15,000	$2,400			$17,400	0.22	$3,825
2036			$15,000	$2,400			$17,400	0.21	$3,608
2037			$15,000	$2,400			$17,400	0.20	$3,404
2038			$15,000	$2,400			$17,400	0.18	$3,211
2039			$15,000	$2,400			$17,400	0.17	$3,030
2040			$15,000	$2,400			$17,400	0.16	$2,858
2041			$15,000	$2,400			$17,400	0.15	$2,696
2042			$15,000	$12,400			$27,400	0.15	$4,006
2043			$15,000	$2,400			$17,400	0.14	$2,400
2044			$15,000	$2,400			$17,400	0.13	$2,264
2045			$15,000	$2,400			$17,400	0.12	$2,136
2046			$15,000	$2,400			$17,400	0.12	$2,015

Table 61: Annual Cost of Project (All costs in 2009 Dollars) Project: OHWD / Rancho Murieta Groundwater Recharge Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2047			$15,000	$2,400			$17,400	0.11	$1,901
2048			$15,000	$2,400			$17,400	0.10	$1,793
2049			$15,000	$2,400			$17,400	0.10	$1,692
2050			$15,000	$2,400			$17,400	0.09	$1,596
2051			$15,000	$2,400			$17,400	0.09	$1,506
2052			$15,000	$12,400			$27,400	0.08	$2,237
2053			$15,000	$2,400			$17,400	0.08	$1,340
Project Life	40 years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									$2,526,087
Comments: In column c, operations costs of $50 per AF, with an assumed 300 AFY production, yields $15,000 per year. In column d, maintenance costs based on 4 hours per month at $50 labor, yielding $2400 per year. In addition, in column d, $10,000 is added every 10 years for pulling the wellhead to perform maintenance. The well operation is limited enough to not warrant replacement costs. Column f reflects long-term lease costs as will be required for access to recharge basin land.									

The "Without Project" Baseline

Without this project, unused water allocations during wet years will not be stored for use during dry years and in the event of a catastrophe (e.g. earthquake, terrorism, reservoir contamination); no backup water supply option will be available.

The 2010 Master Plan for RMCSD identified a water supply shortfall during times of drought. Three options were identified to increase supplies to meet this potential shortfall; groundwater recharge of excess supply during wet years was identified as the most cost-effective. The other two options – development of a recycled water infrastructure or the purchase and construction of an additional reservoir -- are significantly more expensive. Without this project, RMCSD will be forced to either expand recycled water service, with a cost of $5 million to $15 million in infrastructure, or purchase additional surface water storage, with an associated cost of $15 million.

Water Supply Benefits

Increased Water Supply Reliability, Avoided Water Recycling Costs

In California and many other western states water is often limited during times of greatest demand, and in ample supply during times of lowest demand. One solution to this dilemma, as proposed in this project, is by increasing the flexibility of water delivery. The primary benefit of this project is the ability to store unused allotments from the Cosumnes River during times of ample supply for use during dry conditions.

This project provides for the diversion of 4,000 AFY of available water rights from Rancho Murieta Community Services District (RMCSD) for storage underground for use in dry periods or during peak demand periods. For the 2010 RMCSD planning document, a model was run to determine water supply reliability. The study concluded that:

- An additional water supply on the order of 300 acre-ft will be needed under severe drought conditions. Under these conditions, all three reservoirs are expected to reach dead storage. The 300 acre-ft supply includes a safety factor approximately equal to one peak month demand (200 acre-ft/yr) or approximately two months of average demand (122 acre-ft) in addition to the estimated drought shortfall (89 acre-ft/yr).

- In order to have more abundant supply to help mitigate any potential impacts of future climate change, an additional 300 acre-ft may be considered for a total contingency storage of 600 acre-ft. Given the economies of scale for developing supplemental wells or surface water supply at a volume of 300 acre-ft versus 600 acre-ft, the RMCSD may consider adding this larger amount of contingency storage for the incremental cost increase.

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. This project provides for an increase in water supply reliability during drought by storing excess wet year allocation for use during droughts. The project is expected to result in 100% supply reliability.

One way to provide the monetized benefit for this project is to identify the avoided cost for implementation of the next lowest price option for meeting supply reliability. The next lowest price alternative to provide a 100% supply reliability is construction of recycled water infrastructure. This option is estimated to cost between $5 and $15 million in capital outlays alone (no O&M costs have been estimated). Conservatively, using the lower capital cost estimate of $5 million and no O&M costs (due to a lack of estimates) the present value cost of constructing a recycled water infrastructure over the expected 40 project life is about $3.43 million (assuming the facility is constructed in 2015 and 2016). The present value analysis is provided in Table 62.

Table 62: Annual Costs of Avoided Projects (All avoided costs should be in 2009 dollars) Project: OHWD / Rancho Murieta Groundwater Recharge Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
YEAR	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Discount Factor	Discounted Costs (e) x (f)
2009				0	1.000	$0
2010				0	0.943	$0
2011				0	0.899	$0
2012				0	0.839	$0
2013				0	0.792	$0
2014				0	0.747	$0
2015	$2,500,000			$2,500,000	0.705	$1,762,401
2016	$2,500,000			$2,500,000	0.665	$1,662,643
Project Life				0	…	
Total Present Value of Discounted Costs (Sum of Column (g))						$3,425,044
(%) Avoided Cost Claimed by Project						100%
Total Present Value of Discounted Avoided Project Costs Claimed by alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						$3,425,044

Other Water Supply Benefits

Creating a 100% reliability for water supply is the primary benefit of this project. A monetized analysis using avoided cost methodology is outlined above. An additional projected water supply benefit of this project relates to residents utilizing groundwater wells in the area. The benefit to landowners with wells is outlined qualitatively below.

Increase in Groundwater Levels

Wells outside the influence of the Cosumnes River declined from the mid- 1960s to about 1980 on the order of 20 to 30 feet. From 1980 through 1986, water levels recovered on the order of five to 10 feet. During the 1987 through 1992 drought, water levels once again declined by 10 to 15 feet. From 1993 through 2000, much of the basin recovered by 15 to 20 feet, leaving water levels at the about the same elevation or slightly higher than they were in the mid-1980s (California's Groundwater Bulletin 118).

As groundwater levels fall, well users are forced to dig deeper, pump further, and/or resort to a different water source. This project is expected to raise the groundwater table and prevent the need for well users to require deeper drilling in order to reach potable supplies, both now and during future drought years.

Additional Water Source, Supply Diversification

Another important aspect of supply reliability is creating more than one supply source. This supply diversification ensures that in case of a catastrophic event, such as earthquake, terrorism, supply contamination, another water source is available. This project would diversify the RMCSD supply portfolio from solely surface water to include a groundwater source as well.

Summary of Water Supply Benefits

The potential water supply-related benefits for this project include the $3.43 million present value avoided cost of the construction of a recycled water infrastructure and the qualitative benefits to local well users of raising the water table, and the benefit to all users of diversifying water supply sources to include both surface waters but groundwater.

Water Quality and Other Benefits

Other benefits of this project include: increasing groundwater levels in the aquifer creating a reconnection of the groundwater with the Cosumnes River baseflow, enhancing regional salmon migration. This benefit is discussed in Attachment 8

Distribution of project benefits, and identification of beneficiaries

The largest beneficiary of benefits from this project will be RMCSD customers. A summary of beneficiaries is provided in Table 63.

Table 63: Project Beneficiaries Summary

Local	Regional	Statewide
RMCSD customers Well Users	Salmonoid fisheries	

Project Benefits Timeline Description

It is expected that this project will become operational in 2014 and have a life of 40 years. Project benefits will begin accruing in 2014, when operation begins.

Potential Adverse Effects from the Project

There are no potential adverse affects attributable to his project.

Potential Omissions, Uncertainties and Biases

All analyses rely to some extent on assumptions or otherwise include various uncertainties and omissions. A summary of key factors in this analysis are provided in Table 64.

Table 64: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided costs for project to provide equivalent increased level of reliability for customers	+	Avoided costs -- for construction for a recycled water infrastructure – are incomplete (omits O&M) and a lower bound estimate for capital outlays.
Increased level of reliability for well users	U/+	The magnitude of the change in groundwater levels due to groundwater recharge associated with this project is unknown, but should elevate levels and provide benefits (which are not included in the quantitative estimates).
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

References

California Department of Water Resources (DWR). 2003. *California*'s *Groundwater Bulletin 118*. Updated 2003. October.

Brown and Caldwell. 2010. *2010 Integrated Water Master Plan Update*. Prepared for Rancho Murieta Community Services District. October 18.

Project 15: Sleepy Hollow Detention Basin Retrofit Project

Summary

The Sleepy Hollow Detention Basin Retrofit Project will transform the existing 6.3-acre Sleepy Hollow Detention Basin into a multi-functional water resource feature. In addition to providing flood control, the upgraded basin will recharge the groundwater aquifer, reduce stormwater runoff into Laguna Creek, provide important habitat for birds and aquatic species, and serve as a recreational and educational space during non-flood periods.

Key components of the project include the planting of native vegetation within and around the basin to increase and improve aquatic and upland habitat and to enhance water quality treatment capabilities. Darcy Columns (dry wells) will also be evaluated for promoting the infiltration and percolation of stormwater into the underlying groundwater basin for basin recharge. This water can be recovered later as needed by local well users. Additionally, the project would add trails to provide recreational/aesthetic opportunities to the local community during non-flood and low-flow periods. And finally, with the natural resource and access improvements, the basin can become an ‘outdoor classroom’ for the five schools located within a two-mile radius of the project site and for the community.

The City of Elk Grove will serve as the lead implementation agency; however, this project will be implemented in coordination with the Laguna Creek Watershed Council (LCWC) and the Sheldon Community Association.

A summary of all benefits and costs of the project are provided in Table 65. Project costs and water supply benefits are discussed in the remainder of this attachment.

Table 65: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$837,742
Monetized Benefits	
Water Supply Benefits	
Water conservation for customers	$106,144
Total Monetized Benefits	$106,144
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved Water Supply Reliability	+
Water Quality and Other Benefits	
Improved surface water quality in Laguna Creek tributary	++
Improved upland habitat	++
Increased aesthetics, recreational and educational opportunities	++
Additional flood control benefits	+

O&M = Operations and Maintenance
* Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Costs

Capital costs for the project amount to $973,384 (2009 USD), as shown in Table 66. Construction-related activities (including construction, and construction administration and contingency) account for $377,515 or about 39%, of total capital costs. Environmental compliance and enhancement, and engineering and design are responsible for $357,500 (37%) and $143,226 (15%) of the capital budget, respectively. Project administration and other miscellaneous costs account for the remainder of total capital costs.

Project operations and maintenance (O&M) costs (including administrative, operations, and maintenance costs) will average about $4,000 per year. Assuming a 90% survival rate for native plants, the City will incur replacement costs of $32,000 in the fifth year of the project, and $15,000 in year 10 of the project.

Over the project's 50-year project life (through 2063 or 50 years after the project completion), the sum of present value capital and O&M costs will amount to $867,723. Pursuant to DWR guidelines, this assumes a discount rate of 6%.

Table 66: Annual Cost of Project
(All costs in 2009 Dollars)
Project: Sleepy Hollow Detention Basin Retrofit Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.00	$0
2010							$0	0.943	$0
2011	$168,136						$168,136	0.890	$149,641
2012	$100,065						$100,065	0.840	$84,055
2013	$705,183						$705,183	0.792	$558,505
2014		$1,000		$3,000			$4,000	0.747	$2,988
2015		$1,000		$3,000			$4,000	0.705	$2,820
2016		$1,000		$3,000			$4,000	0.665	$2,660
2017		$1,000		$3,000			$4,000	0.627	$2,508
2018		$1,000		$3,000	$32,000		$36,000	0.592	$21,312
2019		$1,000		$3,000			$4,000	0.558	$2,232
2020		$1,000		$3,000			$4,000	0.527	$2,108
2021		$1,000		$3,000			$4,000	0.497	$1,988
2022		$1,000		$3,000			$4,000	0.469	$1,876
2023		$1,000		$3,000	$15,000		$19,000	0.442	$8,398
2024		$1,000		$3,000			$4,000	0.417	$1,668
2025		$1,000		$3,000			$4,000	0.394	$1,576
2026		$1,000		$3,000			$4,000	0.371	$1,484
2027		$1,000		$3,000			$4,000	0.350	$1,400
2028		$1,000		$3,000			$4,000	0.331	$1,324
2029		$1,000		$3,000			$4,000	0.312	$1,248
2030		$1,000		$3,000			$4,000	0.294	$1,176
2031		$1,000		$3,000			$4,000	0.278	$1,112
2032		$1,000		$3,000			$4,000	0.262	$1,048
2033		$1,000		$3,000			$4,000	0.247	$988
2034		$1,000		$3,000			$4,000	0.233	$932
2035		$1,000		$3,000			$4,000	0.220	$880
2036		$1,000		$3,000			$4,000	0.207	$828
2037		$1,000		$3,000			$4,000	0.196	$784

Table 66: Annual Cost of Project (All costs in 2009 Dollars) Project: Sleepy Hollow Detention Basin Retrofit Project									
	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2038		$1,000		$3,000			$4,000	0.185	$740
2039		$1,000		$3,000			$4,000	0.174	$696
2040		$1,000		$3,000			$4,000	0.164	$656
2041		$1,000		$3,000			$4,000	0.155	$620
2042		$1,000		$3,000			$4,000	0.146	$584
2043		$1,000		$3,000			$4,000	0.138	$552
2044		$1,000		$3,000			$4,000	0.130	$520
2045		$1,000		$3,000			$4,000	0.123	$492
2046		$1,000		$3,000			$4,000	0.116	$464
2047		$1,000		$3,000			$4,000	0.109	$436
2048		$1,000		$3,000			$4,000	0.103	$412
2049		$1,000		$3,000			$4,000	0.097	$388
2050		$1,000		$3,000			$4,000	0.092	$368
2051		$1,000		$3,000			$4,000	0.087	$348
2052		$1,000		$3,000			$4,000	0.082	$328
2053		$1,000		$3,000			$4,000	0.077	$308
2054		$1,000		$3,000			$4,000	0.073	$292
2055		$1,000		$3,000			$4,000	0.069	$276
2056		$1,000		$3,000			$4,000	0.065	$260
2057		$1,000		$3,000			$4,000	0.061	$244
2058		$1,000		$3,000			$4,000	0.058	$232
2059		$1,000		$3,000			$4,000	0.054	$216
2060		$1,000		$3,000			$4,000	0.051	$205
2061		$1,000		$3,000			$4,000	0.048	$193
2062		$1,000		$3,000			$4,000	0.046	$182
2063		$1,000		$3,000			$4,000	0.043	$172
Project Life	50 years								
Total Present Value of Discounted Costs (Sum of Column (i))									$867,723

The "Without Project" Baseline

The Sleepy Hollow Detention Basin is located adjacent to the Sleepy Hollow Subdivision in the City of Elk Grove. The City of Elk Grove has experienced rapid growth over the last decade. In 2000, there were 59,984 people living in the City; however, by 2010, the population had increased to an estimated 143,885. In 2004 through 2005, Elk Grove was one of the fastest growing cities in the nation.

The Elk Grove Water District (EGWD) supplies water to about 16% of the City's residents through three deep groundwater wells. The Sacramento County Water Agency (SCWA) supplies about 55% of the City's total demand from a mix of groundwater and surface water sources. The remaining portion of the City is serviced by private groundwater wells.

The availability of SCWA surface water supplies varies based on weather conditions, infrastructure maintenance down-time, and California Department of Fish and Game (CDFG) regulations. In addition, according to the Laguna Creek Watershed Council Work Plan for May 2009 through 2011, the groundwater aquifer in the Laguna Creek watershed is currently being overdrafted (the Plan states that the aquifer under Laguna Creek is falling at a rate of about 1 foot per year). Due to significant growth, groundwater use in the region has increased in recent decades, while recharge of the aquifer has decreased.

Although the existing Sleepy Hollow Detention basin fulfills its original design intention (i.e., managing stormwater runoff and providing flood control), there is a tremendous potential for the basin to provide multi-functional water resource features. In terms of water supply, the project will increase the amount of groundwater available in future years through conjunctive use and groundwater recharge. This will result in increased water supply reliability within the City.

Water Supply Benefits

This section describes the water supply benefits generated by the proposed project, including augmentation of local groundwater supplies and improved water supply reliability. The present value calculations for the augmentation of local groundwater supplies are provided in Table 67.

Table 67: Present Value Benefits (All benefits in 2009 Dollars) Project: Sleepy Hollow Detention Basin Retrofit Project									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2014	Groundwater recharge	AF		50	50	$170	$8,500	0.747	$6,350
2015	Groundwater recharge	AF		50	50	$170	$8,500	0.705	$5,993
2016	Groundwater recharge	AF		50	50	$170	$8,500	0.665	$5,653
2017	Groundwater recharge	AF		50	50	$170	$8,500	0.627	$5,330
2018	Groundwater recharge	AF		50	50	$170	$8,500	0.592	$5,032
2019	Groundwater recharge	AF		50	50	$170	$8,500	0.558	$4,743
2020	Groundwater recharge	AF		50	50	$170	$8,500	0.527	$4,480
2021	Groundwater recharge	AF		50	50	$170	$8,500	0.497	$4,225
2022	Groundwater recharge	AF		50	50	$170	$8,500	0.469	$3,987
2023	Groundwater recharge	AF		50	50	$170	$8,500	0.442	$3,757
2024	Groundwater recharge	AF		50	50	$170	$8,500	0.417	$3,545
2025	Groundwater recharge	AF		50	50	$170	$8,500	0.394	$3,349
2026	Groundwater recharge	AF		50	50	$170	$8,500	0.371	$3,154
2027	Groundwater recharge	AF		50	50	$170	$8,500	0.350	$2,975
2028	Groundwater recharge	AF		50	50	$170	$8,500	0.331	$2,814
2029	Groundwater recharge	AF		50	50	$170	$8,500	0.312	$2,652
2030	Groundwater recharge	AF		50	50	$170	$8,500	0.294	$2,499
2031	Groundwater recharge	AF		50	50	$170	$8,500	0.278	$2,363
2032	Groundwater recharge	AF		50	50	$170	$8,500	0.262	$2,227
2033	Groundwater recharge	AF		50	50	$170	$8,500	0.247	$2,100
2034	Groundwater recharge	AF		50	50	$170	$8,500	0.233	$1,981
2035	Groundwater recharge	AF		50	50	$170	$8,500	0.220	$1,870

Table 67: Present Value Benefits
(All benefits in 2009 Dollars)
Project: Sleepy Hollow Detention Basin Retrofit Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2036	Groundwater recharge	AF		50	50	$170	$8,500	0.207	$1,760
2037	Groundwater recharge	AF		50	50	$170	$8,500	0.196	$1,666
2038	Groundwater recharge	AF		50	50	$170	$8,500	0.185	$1,573
2039	Groundwater recharge	AF		50	50	$170	$8,500	0.174	$1,479
2040	Groundwater recharge	AF		50	50	$170	$8,500	0.164	$1,394
2041	Groundwater recharge	AF		50	50	$170	$8,500	0.155	$1,318
2042	Groundwater recharge	AF		50	50	$170	$8,500	0.146	$1,241
2043	Groundwater recharge	AF		50	50	$170	$8,500	0.138	$1,173
2044	Groundwater recharge	AF		50	50	$170	$8,500	0.130	$1,105
2045	Groundwater recharge	AF		50	50	$170	$8,500	0.123	$1,046
2046	Groundwater recharge	AF		50	50	$170	$8,500	0.116	$986
2047	Groundwater recharge	AF		50	50	$170	$8,500	0.109	$927
2048	Groundwater recharge	AF		50	50	$170	$8,500	0.103	$876
2049	Groundwater recharge	AF		50	50	$170	$8,500	0.097	$825
2050	Groundwater recharge	AF		50	50	$170	$8,500	0.092	$782
2051	Groundwater recharge	AF		50	50	$170	$8,500	0.087	$740
2052	Groundwater recharge	AF		50	50	$170	$8,500	0.082	$697
2053	Groundwater recharge	AF		50	50	$170	$8,500	0.077	$655
2054	Groundwater recharge	AF		50	50	$170	$8,500	0.073	$621
2055	Groundwater recharge	AF		50	50	$170	$8,500	0.069	$587
2056	Groundwater recharge	AF		50	50	$170	$8,500	0.065	$553
2057	Groundwater recharge	AF		50	50	$170	$8,500	0.061	$519

Table 67: Present Value Benefits (All benefits in 2009 Dollars) Project: Sleepy Hollow Detention Basin Retrofit Project									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2058	Groundwater recharge	AF		50	50	$170	$8,500	0.058	$493
2059	Groundwater recharge	AF		50	50	$170	$8,500	0.054	$459
2060	Groundwater recharge	AF		50	50	$170	$8,500	0.051	$435
2061	Groundwater recharge	AF		50	50	$170	$8,500	0.048	$411
2062	Groundwater recharge	AF		50	50	$170	$8,500	0.046	$391
2063	Groundwater recharge	AF		50	50	$170	$8,500	0.043	$366
Total Present Value of Discounted Benefits (Sum of Column (j))									**$106,144**

Local groundwater supply augmentation

As a result of the Sleepy Hollow Detention Basin Retrofit project, an estimated 50 AFY of stormwater will be stored in the underlying groundwater aquifer and made available for use in future years. The Sleepy Hollow Detention Basin is located in an area that is currently served by SCWA. Thus, it is assumed that this groundwater will be used by SCWA via existing infrastructure to reduce reliance on surface water supplies. This will decrease water supply costs for the agency.

To calculate the value of this benefit, it is assumed that SCWA can pump, treat, and distribute groundwater in this area at a cost of about $250 per AF. Alternatively, it currently costs SCWA $420 to supply surface water to its customers. Thus, for every AF of groundwater recharged, SCWA will save $170 ($8,500 in savings per year). Assuming these savings begin in 2014, the total present value benefits associated with increased groundwater supply will amount to $106,144.

Improved Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. As noted above, the availability of SCWA surface water supply varies based on weather conditions, infrastructure maintenance downtime, and CDFG regulations. Groundwater, which is not subject to rapid fluctuations like surface water, can be a more dependable supply if sustainably managed. The proposed project will increase supply reliability for SCWA customers by increasing the amount of groundwater available in the future.

Although interest in water supply reliability is increasing (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through non-market valuation studies). The results from these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay $95 to $500 per household per year for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought). In most cases, this is the amount customers would be willing to pay in addition to their current water bill.

The challenge for use of these values to determine a value of increased reliability as a result of the project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay per household to ensure complete reliability (zero drought-related use restrictions in the future), whereas the Sleepy Hollow Detention Basin Retrofit Project only enhances overall reliability, but does not guarantee 100% reliability. Thus, if applied directly to the number of households within Elk Grove, the dollar values from the studies would overstate the reliability value provided by the proposed project. Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables.

Distribution of project benefits, and identification of beneficiaries

In terms of water supply, the Sleepy Hollow Detention Basin Retrofit Project will benefit stakeholders at the local and regional level. SCWA and its customers within the City of Elk Grove and throughout Sacramento County will benefit due to reduced water supply costs, increased reliability of supply, and reduced groundwater overdraft.

Project Benefits Timeline Description

The Sleepy Hollow Detention Basin Retrofit Project will be completed in 2013, and will begin providing benefits in 2014. A 50-year useful life is assumed for the project; thus, benefits and costs are calculated through 2063 (50 years after the project comes online).

Potential Adverse Effects from the Project

This project is proposing to percolate stormwater into the underlying groundwater basin. Program that directly introduce stormwater into a groundwater basin hold the potential for introducing pollutants found in stormwater into groundwater systems and impacting the basin and users of the basin. However, with appropriate system design and operation (i.e. placing the wells in locations not receiving first-flush water combined with soil-aquifer treatment), the potential for introduction of pollutants can be avoided. This project will utilize soil-aquifer treatment (or SAT) as a means of treating recharging stormwater. In general, the vadose zone, and in some cases the aquifer itself, act as natural, slow filters, reducing the concentration of various pollutants due to physical, chemical, and microbiological processes. Suspended solids are filtered out; biodegradable organic compounds are decomposed; microorganisms are adsorbed, strained out, or die because of competition with other soil microorganisms; nitrogen concentrations are reduced by denitrification; synthetic organic compounds are adsorbed and/or biodegraded; and phosphorous, fluoride, and heavy metals are adsorbed, precipitated, or otherwise immobilized. In summary, soil-aquifer treatment is a recognized method for treating stormwater for reuse, and along with proper monitoring and institutional controls, the potential impact is marginal and can be managed.

Summary of Findings, Tables

The monetized water supply benefits from the proposed project include the value of increased groundwater supplies made available through groundwater recharge. Based on the cost to SCWA for providing groundwater compared to surface water within the City of Elk Grove, the value of these savings amount to $170 per AF of groundwater. Assuming the basin recharges 50 AFY of stormwater, the total present value of this benefit amounts to $106,144 over the 50-year life of the project.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits: the project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 68.

Table 68: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased water supply reliability	+	The potential benefit of increased water supply reliability as a result of the project has not been included due to uncertainties to applying values from the literature to a partial improvement in water supply reliability in this specific setting and circumstance.
Local groundwater supply augmentation	U	It is uncertain how much water will be stored in the groundwater aquifer each year. In some years, more than 50 AF of stormwater may be available for recharge, in some years it may be less. Benefits will vary accordingly.
Project costs	U	The calculation of the present value of costs is a function of the timing of capital outlays and a number of other factors and conditions. Changes in these variables will change the estimate of costs.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. **-** = Likely to decrease benefits. **--** = Likely to decrease net benefits significantly. U = Uncertain, could be + or **-**.		

Appendix A – Assigning Value to Enhanced Water Supply Reliability

Appendix A: Assigning Value to Enhanced Water Supply Reliability

Introduction

Many water projects can enhance the reliability of a local water supply system. There is some evidence (from empirical research, and from casual observation of political impacts) that water users place a fairly high value on having a water supply that reliably provides them the quantity and quality of water they desire, on an uninterrupted basis. The challenge is to interpret the existing evidence (using the guiding principles of "benefits transfer" as per Desvousges et al., 1992), so that one can reasonably deduce some monetary value that added reliability generates for water users.

This appendix provides a summary of the issues and literature related to valuing water supply reliability enhancements. It is intended to support the use of reliability-related water supply benefits as applied in the economic analyses for some of the projects in this grant submittal. The material summarized in this appendix is based on prior work prepared for the AWWA Research Foundation (Raucher et al., 2005), the WateReuse Foundation (Raucher et al., 2006), and the Bureau of Reclamation (Kasower et al., 2007).

Types of Reliability

One of the complications is describing or monetizing the benefits of enhanced water supply reliability is that the term "reliability" can apply to a wide range of circumstances or sources of uncertainty in supply. For our purposes, we can think of at least 3 general types of reliability enhancement contexts that may apply to regional water supply projects:

1. ***Periodic adverse events, such as droughts (moderate probability, moderate consequence risk)*.** Droughts are fairly common events, occurring periodically over the span of several decades. The frequency and severity of droughts may vary considerably over time and across locations, but most water customers (e.g., residential users) have some direct experience with drought years and associated impacts such as the imposition of water use restrictions in some drought periods. As described below, there is a reasonably extensive and consistent body of published empirical research on household willingness to pay (WTP) to avoid drought-type water use restrictions. These studies can be used to value the benefits of enhanced water supply reliability in the context of projects that reduce the likelihood of periodic drought-related impacts. This is the context applied for several of the American River region projects in Attachment 7.
2. ***Episodic, catastrophic events, such as earthquakes (low probability, high consequence risk)*.** Water supply reliability also can be enhanced in the context of what might happen in the aftermath of a somewhat extreme (low probability, high consequence) event such as a major earthquake, flood, levee failure, or terrorist attack. If and when such extreme events occur in the future, some local water projects may prove invaluable because they provide some level of water service when the usual imported supplies might be cut-off, perhaps for extended periods of time. For example, the earthquake-induced loss of a major feeder line from MWD to a wholesale customer (or the loss of CVP or SWP waters in general, due to some event like levee failure in the Bay-Delta) might mean the loss of up to 100% of the available imported water in a region for days, weeks, or even months or years (Harder, *Southwest Hydrology*, March/April 2006). Under

such extreme, but plausible scenarios, having a local supply may mean the difference between having some water service available for basic human needs, fire suppression, etc. (as contrasted to having no water (or virtually no water) available locally at all. In such cases, the value of reliability to the region's residents would be extremely high (but hard to predict empirically, given that existing research has focused on the lower consequence but more frequent event of periodic drought).

3. ***Quasi-routine inconvenient events, such as infrastructure repair (moderate probability, low consequence risks).*** The infrastructure conveying water to customers, such as finished water transmission mains between a water treatment plant and the customer, are another source of reliability risk. Water main breaks create unscheduled disruptions in water service to some customers; and even scheduled efforts to replace or rehabilitate distribution lines disrupt service. Treatment plant shutdowns, as may be needed for periodic scheduled (or unanticipated) events, also may disrupt water deliveries. Most water users periodically experience these events, and the impacts typically are limited to temporary inconveniences associated with no water for hours (or perhaps a few days), and street and parking disruption. These event are not frequent, but they also are not uncommon. There is some evidence that households have a positive WTP to having less frequent, shorter duration events and, in particular, value efforts to have scheduled events (e.g., announced, planned repairs) rather than unscheduled events (an emergency response to a main break) (Damodaran et al., 2005).

How IRWMP may provide benefits by improving reliability

Water projects can improve reliability (i.e., help manage the risk of water service disruption or water use restrictions) in different ways, depending on the type of project and local circumstances. The type(s) of reliability enhancement a project provides, and the extent to which it enhances reliability, will depend on site- and project-specific circumstances. Nonetheless, a few general observations often apply to various classes or types of IRWMP projects.

- **Projects that generate local water and/or diversify the local water utility's water supply portfolio**, especially in parts of the region that rely exclusively or predominantly on one supply source (e.g., surface waters extracted from the American River). In such cases, providing additional water from another independent source (e.g., augmenting a surface supply with a groundwater option, and/or adding storage capacity such as through an aquifer storage and retrieval (ASR) project) is likely to provide reliability benefits for both periodic risks such as droughts, as well as infrequent but potentially catastrophic events such as earthquakes. Drought protection may arise because the additional local supplies diversify the water supply portfolio (e.g., the drought impacts may be more severe on the surface water source than the newly tapped local groundwater source), plus the added local source provides additional total capacity. Catastrophic risks are likely to be reduced because when a single supply is cut off or severely curtailed because of seismic or other event, the additional local source may remain available.
- **Projects that enable importation of water**, especially in regions that rely exclusively or predominantly on local supplies, also provide reliability benefits for both periodic drought and potential catastrophic events. As in the case above, the diversification and overall expansion of the water supply portfolio provides value across several circumstances.

- **Projects that include reclamation or desalination**, or otherwise make productive use out of waters previously considered unsuitable for use (e.g., by using advanced treatments to render low quality waters potable or fit for irrigation use) also tend to provide reliability benefits for both drought and catastrophic events. Drought protection arises because the new sources are not drought-sensitive, and thus their yields have low or zero covariance with yields from the traditional water supplies the area uses (see portfolio theory discussion, below). In addition, because reuse or desalination projects provide added capacity, and are local sources, they provide reliability benefits in the event of catastrophic events.
- **Projects that replace or upgrade treatment or distribution infrastructure** tend to generate the third type of reliability value, described above (i.e., reduce the risk of unscheduled short-term service disruptions). They also may provide some drought protection insofar that infrastructure renewal probably reduces the volume of water lost to leaks, thereby enabling more end use from the existing supplies (in effect, increasing overall system capacity in terms of delivered water).

Units of measurement (for quantifying the outcomes)

Values for reliability are often given in dollars per household per year for stated preference studies, and in dollars per acre-foot (or similar measure of water volume) for revealed preference studies. These values per specified unit of measurement should then be applied to the appropriate quantity. If values are cited in per household per year, then one needs to apply this value to the geographically appropriate total number of households.

Monetizing the outcomes

Although interest in water supply reliability is increasing, a limited studies have directly attempted to quantify its value. The studies that have attempted to quantify the value of reliability used “stated preference” and “revealed preference” methods to examine reliability values for residential customers. Stated preference methods determine estimates for reliability on the analysis of responses to hypothetical choices in surveys. Revealed preference infers the value of reliability from data obtained from choices and decisions made in the marketplace. For example, expenditures made to obtain higher levels of reliability (i.e., to avert potential shortages) sometimes can be used to infer the value of reliability.

Stated preference studies

Several studies have determined values of water supply reliability using the stated preference method. Values for reliability are usually defined as WTP to avoid a particular shortfall event. Water supply shortfall events are usually defined in different ways across studies. Factors that may be used to describe a shortfall event include the percent of water available compared to the amount fully demanded (the shortfall amount), the frequency with which this condition may occur (e.g., 1 in 10 years), and the probability of a single event. In other studies, respondents are questioned on their WTP to reduce the probability of an event, not avoid it.

- In 1987, a contingent valuation study was conducted for the Metropolitan Water District (MWD) of Southern California in an effort to determine the economic value for changes in the reliability of water supply among residents in Southern and Northern California. A reliable water supply is defined in the paper as “one without the threat of periodic shortages and mandatory rationing”

(Carson and Mitchell, 1987, p. 1). In the study, four scenarios of reductions in reliability are investigated and households' WTP to alleviate the threat of those reductions in reliability is determined. Reductions in reliability are defined in terms of magnitude and frequency.

- In 1993, the California Urban Water Agencies (CUWA, 1994) retained Barakat and Chamberlin, Inc. to design, conduct, and analyze the results of a contingent valuation survey to estimate the value to residential users of water supply reliability in 10 California water districts. More specifically, they sought to estimate how much residents are willing to pay to avoid water shortages of varying magnitude and frequency. Shortage magnitudes ranged from 10 to 50% and frequencies ranged from once every 3 years to once every 30 years.

- Griffin and Mjelde (2000) conducted a stated preference study in seven Texas cities. Their first objective was to investigate the value of current water supply shortfalls (existing shortages of known strength and duration). Second, the study attempted to determine the value of future shortfalls, probabilistic shortages of differing strength duration and frequency.

- A study conducted by Howe and Smith (1994) attempts to formulate a framework for determining the optimal level of water supply reliability. The study uses contingent valuation survey methods to measure customers' WTP for improved reliability and willingness to accept (WTA) lower water costs for reduced reliability.

- Michelsen et al. (1998) estimated the annual WTP for avoiding a 5% reduction in water consumption levels for several southwestern cities. WTP was $321 per household for Albuquerque, $330 per household for El Paso, and $257 per household for Las Cruces.

Table 1 summarizes the results of these studies. The studies are unique to each location and situation, and it is probably ill-advised to use any single value for the transfer of benefits to other situations. However, it appears the majority of households value water supply reliability in excess of $100 per year, and the values given below may help to formulate a range of possible values that could be used to transfer benefits (note that all $ values stated here are in 2003$s, unless otherwise specified).

Table 1: Summary table of reliability results from stated preference studies (2003 USD)

Source	Shortfall amount	Frequency	Probability	Annual WTP/ household
Carson and Mitchell (1987)	10% to 15%	1 in 5 years	20%	$135
Carson and Mitchell (1987)	10% to 15%	2 in 5 years	10%	$248
CUWA (1994)	20%	1 in 30 years	3.3%	$143
Carson and Mitchell (1987)	30% to 35%	1 in 5 years	20%	$186
Carson and Mitchell (1987)	30% to 35%	2 in 5 years	10%	$421
CUWA (1994)	50%	1 in 10 years	5%	$253
Griffen and Mjelde (2000)	Na	Na	Na	$109
Griffen and Mjelde (2000)	Na	Na	Na	$125
Howe and Smith (1994)[a]	0.16% to 9.2%[b]	Na	Na	$80[c]
Howe and Smith (1994)	0.23% to 12.2%[b]	Na	Na	$92[d]

na = not applicable.

a. Howe and Smith (1994) also estimated WTA values for decreases in reliability. Mean annual WTA results per household for approximately a 0.7% to 11% decrease in reliability, depending on the city, ranged from $68 to $166. Mean annual WTA results for approximately a 1.7% to 40% decrease in reliability, depending on the city, ranged from $81 to $241.

b. This percentage range does not represent the magnitude of the shortfall, as is the case in the other studies. Rather, this range represents the increased probability over the base probabilities of the SASE. The actual percentage increase is dependent on the city. The associated dollar values are the annual WTP per respondent for an increase over their current reliability.

c. Value represents the average of the WTP range given in the study ($70 to $90 per year). If “no” respondents for this increased probability range are included into the data set (respondents’ WTP = $0), the WTP range is from $16/year to $28/year per respondent.

d. Value represents the average of the WTP range given in the study ($64 to $119 per year). If “no” respondents for this increased probability range are included into the data set, the WTP range is from $15/year to $29/year per respondent.

Limitations to stated preference studies

While stated preference approaches have been applied to the valuation of nonmarket goods for many years, the method has limitations that need to be acknowledged and considered. For example, Griffen and Mjelde (2000) note that one difficulty with stated preference studies for water reliability is the notion of the "birthright" perspective. It is not uncommon for respondents to view water as an inalienable right. Consequently, while they highly value water reliability, the notion that water should be free can lead to a reduction in their stated WTP for reliability. However, if the limitations are acknowledged and efforts are made to perform the studies in an appropriate manner, stated preference studies can yield informative results.

Drawing inferences about the reliability value for residential water[1]

Despite the body of empirical research reviewed in the preceding section regarding water reliability values, there is a general lack of direct empirical evidence about how much residential customers of water utilities value the water they receive on a per AF (or per 1,000 gallon) basis. This leaves open the key question of "how much are households willing to pay for the water provided by their community water system?" In this section, the research team applies a series of simple assumptions to interpret the available empirical evidence on reliability values, in a manner that provides some insight on the more basic issue of the WTP for reliable deliveries of residential water. In addition, the few studies that directly estimate WTP for residential water are reviewed.

For example, Griffin and Mjelde (2000) evaluated a "current shortfall" scenario of 20%, lasting for 3 weeks. To estimate how much water is at stake in this scenario, consider that the average U.S. household uses approximately 0.5 AF per year [172 gallons per capita per day (based on Mayer et al., 1999), times 2.6 persons per household, times 365 days per year, which equals over 163,000 gallons per household per year, or about 50% of the 325,850 gallons in an AF). The shortfall scenario used by Griffin and Mjelde thus may amount to about 0.0058 AF of water (3 weeks out of 52 weeks being 5.77% of the year, times a 20% shortfall, times 0.5 AF per year, which equals 0.0058 AF). Given the estimated WTP to avoid such a shortfall was $32.04 per household per year, the implied value per at risk AF is $5,553 ($32.04 divided by 0.00577 AF).

Several caveats are required in evaluating a value estimate derived from this process. First, the assumptions applied to estimate the volume of water at stake might be in error. For example, if the water shortfall occurred in summer (which is likely), and the water use in summer is 2.4 times higher than in winter (the ratio of typical total use to indoor use only, as per Mayer et al., 1999), then the implied quantity of the water shortfall is understated. If the outdoor water use season in California (the study location) is assumed to be roughly one-half the year, then the 0.5 AF used per home per year comprises roughly 0.15 AF used in the winter months and 0.35 AF per household used in the six months in which outdoor irrigation occurs. The 3-week shortfall of 20% is thus equivalent to 0.008 AF (3 of 26 weeks of the outdoor watering season, times 20%, times 0.35 AF). Then, the implied residential customer WTP is $4,005 per AF ($32.04 divided by 0.008 AF).

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[1]. This text is based on work developed for and provided in an AWWARF report on the value of water (Raucher et al., 2005).

Second, the reliability-based WTP values obtained by the original researchers reflect not just the value of the water per se, but also some degree of the residential customers' aversion to risk and uncertainty. In other words, the WTP values from the reliability studies undoubtedly embody some risk avoidance premium as well as the value held for the quantity of water at risk. This implies that the inferred WTP estimate would overstate the value of the water alone. This may be particularly true for the studies that value eliminating the risk of shortfalls, rather than reducing their likelihood or severity.

Third, the WTP estimates reflect values at the margin for the households' lowest valued current uses of the water (e.g., a portion of their outdoor irrigation). As more and more water is withheld from the households, the water uses that would be affected would be of increasing importance and value to the residential customers. Therefore, the WTP estimates inferred above might be understated compared to the WTP for water used for more highly valued purposes in the home (e.g., drinking, cleaning).

Finally, the reliability estimates we are interpreting are based on stated preference surveys of households. Given the hypothetical nature of some of the survey questions and the difficulty some respondents may have had with probability-based scenarios of water shortfalls and reliability, it may be the case that the results from the original research are skewed in one direction or the other.

Based on the above caveats, the values derived here need to be interpreted with considerable caution. There are reasons why the estimates may be under- or overstated relative to the true WTP of households for utility-supplied water. With these caveats in mind, by applying the general assumptions and procedures described above to the applicable reliability value estimates, the following illustrative WTP estimates for reliability of residential water are inferred:

- Griffin and Mjelde's (2000) current shortfall scenario implies a WTP for residential water on the order of $4,005 per AF.
- Carson and Mitchell's (1987) scenarios for the MWD imply a possible WTP for residential water of between $4,675 and $7,714 per AF.
- The Barakat and Chamberlin study for CUWA (1994) implies a possible WTP of over $14,500 per AF.

As noted, these value estimates may be overstated for water use at the margin (i.e., for modest cutbacks in current outdoor uses), for reasons described above. In particular, the results based on Carson and Mitchell (1987) and CUWA (1994) may be overstated because they are based on certainty equivalents of eliminating future shortfalls. However, these estimates may be on target, or possibly understated, for more essential water uses.

Revealed preference and cost-based studies

A few studies have used the revealed preference method to determine values for water supply reliability.

- Fisher et al. (1995) explored how price can be used as a tool to reduce demand during a drought. Using estimated price elasticities for residential customers, the loss of surplus was computed with a price-induced cutback of 25% in consumption in the East Bay Municipal Utility District (EBMUD, California) service area.

- In 2002, the California Recycled Water Task Force was established to investigate specific recycled water issues. The economic group of the task force was charged with identifying economic impediments to enhancing water recycling statewide. The report uses a case study of the Ground Water Replenishment System (GWRS) in Orange County as an illustration for the importance of economic feasibility analysis. The GWRS was designed to recycle an estimated 70,000 AF/year of effluent and inject it into the Orange County Aquifer.

- Varga (1991) investigated the role of local projects and programs in the City of San Diego to enhance imported water supply and improve reliability. The MWD provides water to San Diego from the Colorado River and Northern California, based on availability. To encourage the use of existing local reservoir capacities and improve the reliability and yield of the imported water system, the MWD and California introduced water rate credits for serviced cities.

- Thomas and Rodrigo (1996) measured the benefits of nontraditional water resource investments. The focus of the study was on the MWD and its member agencies. They investigated the benefits (expected yields and cost savings) of developing additional resources in the region through several alternatives: increased imported supplies (base case), the addition of significant conjunctive storage of local groundwater basins (groundwater case), and the implementation of recycled water and groundwater recovery projects (preferred case). To determine the value of recycled water and conjunctive use storage, the savings attributable to each of these resources were compared to the yield associated with the resource.

An overview of the value of reliability inferred from results of revealed preference and cost-based approaches is provided in Table 2. These results ($/AF) are considerably lower than those based on WTP from the stated preference studies, as summarized in Table 1 (where the results imply values of perhaps $4000/AF and up). This may reflect the fact that many of the results shown in Table 2 reflect artificial measures such as rate structures applied by MWD. Thus, the stated preference results are designed to reflect the real *value* (i.e., WTP) of water supply reliability, whereas the *cost*-differential based results that make up most of Table 2 are simply reflective of agency pricing decisions that are not likely to reflect any WTP considerations.

Table 2: Water supply reliability values inferred from revealed preference or cost and price differential results (2003 USD/AF)

Source	Value ($/AF)	Basis
Fisher et al. (1995)	$51 to $230	Welfare loss per AF due to a price induced reduction in water consumption of 25%
Recycled Water Task Force (2002)	$179 to $256	The value (AF/year) of drought proofing based on drought penalties and rate increases for customer
NRC (1997)	$331	The difference in cost of local groundwater supplies versus the MWD non-interruptible rate (AF/year)
Varga (1991)	$60	The rate per AF that MWD credits local water retailers to store imported water in the local reservoir to increase reliability of imported supplies (AF/year)
Varga (1991)	$111	The rate per AF that MWD credits local water retailers to seasonally store imported water to increase capacity and yield of imported water system (AF/year)
Thomas and Rodrigo (1996)	$353	The benefit per AF of conjunctive use storage to ensure greater reliability

Portfolio Theory Implications

Water supply options that are drought-resistant (such as desalination or water reclamation) may provide a special type of reliability value-added, compared to other, more traditional (and drought-sensitive) water supply options. Recent work sponsored by the federal Bureau of Reclamation, and also explored elsewhere, has helped explain how the concept of "portfolio theory" -- as originally devised and applied to financial assets by Nobel Prize winner Harry Markowitz -- can be constructively applied to water supply portfolio choices.

The central premise, long recognized and applied by financial managers, is to jointly maximize expected returns (water yields) while also reducing the overall variance in portfolio yield, by minimizing the covariance in yield risks across the assets held in a portfolio (Markowitz, 1950). As shown in Kasower et al. (2007), and Wolfe (2008), a simple and plausible numeric illustration reveals that a manager should be willing to pay a considerable premium for drought-resistant supply options (perhaps justifying paying several hundreds of dollars per AF more for a reuse or desalination option that to expand use of a more traditional surface water supply).

Commercial Values for Reliability Also May be Significant

Note that the reliability values above pertain essentially to residential customers. Commercial, industrial, and institutional customers (CII) may also place a high value on reliable supplies. Businesses that rely on water as a key part of their production process do not want to have their production levels curtailed, disrupted, or subject to uncertainty because of potential limits on water use. While no empirical estimates are available at this time on CII reliability values for water supply, reuse may provide appreciable value in this manner to a utility's CII customers. This in turn can have associated beneficial impacts in terms of retaining or attracting businesses to the region, with attendant local economic impacts such as stability or growth in income, employment, and tax revenues.

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