Attachment 8

Benefits and Cost Analysis

Implementation Grant, Round 2

Coachella Valley IRWM
Implementation Grant Proposal

Attachment

8

Coachella Valley Integrated Regional Water Management Implementation Grant Proposal – Round 2

Benefits and Cost Analysis

Attachment 8 consists of the following items:

- ✓ **Project Costs and Benefits**

The body of this attachment provides an overview of the costs and benefits of this proposed funding package, as well as the benefits associated with each individual project.

- ✓ **Appendix 8-1**

Appendix 8-1 includes a detailed discussion of the estimated avoided future imported water costs that would accrue from developing local supplies in the Coachella Valley IRWM Region.

- ✓ **Appendix 8-2**

Appendix 8-2 includes detailed tables that provide information regarding how all of the costs and benefits included in this attachment were calculated.

This attachment contains estimations of the costs and benefits of each project contained within this *Coachella Valley IRWM Implementation Grant Proposal – Round 2*. The following section provides an overview of the costs and benefits associated with the entire proposal; the subsequent sections provide specific information regarding the benefits and costs associated with each individual project included in this proposal.

Proposal Benefits and Costs Summary

Because several projects are being proposed with multiple benefits, Table 8-1 below contains a summary of the costs and benefits for all projects included in this proposal.

Table 8-1: Proposal Benefits and Costs Summary (PSP Table 20)

Proposal: Coachella Valley IRWM Implementation Grant, Round 2 **Agency: Coachella Valley Water District**							
Project	**Project Proponent**	**Total Present Value Project Costs (1)**	**Total Present Value Project Benefits**			**Section D2 Briefly Describe Main Non-monetized Benefits**	**Benefit-Cost Ratio***
			Section D3 Monetized (2)	**Section D4 Flood Damage Reduction (3)**	**Total**		
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f) = (d) + (e)**	**(h)**	**(i)**
Non-Potable Water Use Expansion Program	Coachella Valley Water District	$24,626,275	$119,098,794	N/A	$119,098,794	*E. Provide Social Recreation or Access Benefits* – Program will provide non-potable water to golf course users, reducing costs and increasing aesthetics. *F. Help Avoid, Reduce, or Resolve Various Public Water Resources Conflicts*- Program will help meet Recycled Water Policy mandates. *G. Reduce Demand for Net Diversions from the Delta*- Program will help reduce future imported water demands and will therefore reduce net diversions from the Bay-Delta *H. Provide a Long-Term Solution*- Program will facilitate source substitution, a method of long-term groundwater management *I. Improve Water Supply Reliability* –Program will provide local water (non-potable water and offset the use of less reliable imported water. *J. Avoid Fertilizer Application*- Program will provide recycled water, which has nutrients and can reduce fertilizer application *K. Improve Water Quality*- Program will reduce groundwater pumping and overdraft, which can cause water quality issues.	5:1
Coachella Valley Salt & Nutrient Management Program	Coachella Valley Water District on behalf of the CVRWMG	$707,985	$52,024,312	N/A	$52,024,312	*D Provide Social Recreation or Access Benefits* – Program will provide recycled water to golf course users, reducing costs and increasing aesthetics. *E. Help Avoid, Reduce, or Resolve Various Public Water Resources Conflicts*- Program will help meet Recycled Water Policy mandates. *F. Improve the Overall, Long-term Management of California Groundwater Resources* – Program will	73:1

Proposal: Coachella Valley IRWM Implementation Grant, Round 2 Agency: Coachella Valley Water District							
Project	**Project Proponent**	**Total Present Value Project Costs (1)**	**Total Present Value Project Benefits**			**Section D2 Briefly Describe Main Non-monetized Benefits**	**Benefit-Cost Ratio***
			Section D3 Monetized (2)	**Section D4 Flood Damage Reduction (3)**	**Total**		
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f) = (d) + (e)**	**(h)**	**(i)**
						provide recycled water to golf course users, reducing costs and increasing aesthetics. *G. Reduce Demand for Net Diversions from the Delta*- Program will help reduce future imported water demands and will therefore reduce net diversions from the Bay-Delta *H. Provide a Long-Term Solution*- Program will create a standards-compliant Salt and Nutrient Management Program, which will facilitate long-term use of recycled water. *I. Improve Water Supply Reliability* –Program will provide local water (recycled water) and offset the use of less reliable imported water. *K. Promote Social Health and Safety*- Program will provide recycled water, which has nutrients and can reduce fertilizer application *L. Improve Groundwater Quality*- Program will address nutrient and salt loading, and will therefore improve groundwater quality.	
Groundwater Quality Protection Program – Subarea D2	Mission Springs Water District	$3,715,196	$9,467,779	N/A	$9,467,779	*B. Reduce Demand for Net Diversions from the Delta*- Program will help reduce future imported water demands and will therefore reduce net diversions from the Bay-Delta *C. Improve Water Supply Reliability* –Program will provide local water (wastewater for future recycling) and offset the use of less reliable imported water. *F. Avoid Groundwater Treatment*- Program will remove a source of contaminants (septic tanks) and prevent future groundwater treatment to address such contaminants. *G. Provide Social Recreation Benefits* – Program will facilitate the long-term use of the Desert Hot Springs spa	3:1

Proposal: Coachella Valley IRWM Implementation Grant, Round 2 Agency: Coachella Valley Water District							
Project	**Project Proponent**	**Total Present Value Project Costs (1)**	**Total Present Value Project Benefits**			**Section D2 Briefly Describe Main Non-monetized Benefits**	**Benefit-Cost Ratio***
			Section D3 Monetized (2)	**Section D4 Flood Damage Reduction (3)**	**Total**		
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f) = (d) + (e)**	**(h)**	**(i)**
						industry. *H. Promote Social Health and Safety*- Program will remove septic systems and potential contamination that could potentially come into contact with people using untreated hot aquifer water. *I. Avoided Losses in Spa Economy*- Program will protect the spa economy of Desert Hot Springs *J. Benefit Wildlife or Habitat* – Program will remove a source of contaminants from the Region, including the Salton Sea Transboundary Watershed. *K. Improve Groundwater Quality and Protect Beneficial Uses*- Program will protect the quality of groundwater and associated beneficial uses in the Desert Hot Springs and Mission Creek aquifers. *L. Improve the Overall, Long-term Management of California Groundwater Resources* – Program will provide future wastewater flows for source substitution. *M. Provide a Long-Term Solution*- Program will permanently remove a source of water quality contamination.	
San Antonio del Desierto DAC Sewer Extension Project	Pueblo Unido Community Services Corporation	$1,676,119	$1,683,927	N/A	$1,683,927	*B. Reduce Demand for Net Diversions from the Delta*- Program will help reduce future imported water demands and will therefore reduce net diversions from the Bay-Delta *C. Improve Water Supply Reliability* –Program will provide local water (wastewater for future recycling) and offset the use of less reliable imported water. *D. Promote Social Health and Safety*- Program will remove wastewater lagoons that are in close proximity to residents of a mobile home park. *E. Other Social Benefits Associated with Displacing*	1:1

Proposal: Coachella Valley IRWM Implementation Grant, Round 2 Agency: Coachella Valley Water District							
Project	**Project Proponent**	**Total Present Value Project Costs (1)**	**Total Present Value Project Benefits**			**Section D2 Briefly Describe Main Non-monetized Benefits**	**Benefit-Cost Ratio***
			Section D3 Monetized (2)	**Section D4 Flood Damage Reduction (3)**	**Total**		
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f) = (d) + (e)**	**(h)**	**(i)**
						DACs- Program will help facilitate obtainment of a permit for a mobile home park that serves a DAC. This program will help avoid displacement of mobile home park residents. *F. Benefit Wildlife or Habitat* – Program will remove a source of pollutants from entering the Torres-Martinez Wetlands and the Salton Sea. *G. Improve Groundwater Quality and Protect Beneficial Uses*- Program will protect the quality of groundwater and associated beneficial uses in the eastern Coachella Valley. *H. Provide a Long-Term Solution for DACs*- Program will provide a permanent connection to a municipal wastewater system for a DAC.	
Torres-Martinez Avenue 64 Water Supply Connection Project	Torres-Martinez Desert Cahuilla Indians	$220,280	N/A	N/A	N/A	*A. Increase in Drinking Water Health and Safety*-This project will provide connection to a municipal water system to a tribal DAC, which will provide a safe and reliable drinking water source to the tribe. *B. Improve Water Supply Reliability* –Project will provide a reliable water supply to a tribal DAC, and replace the tribe's existing unreliable water supply system. *C. Increase in Water Supply Adequacy*- Project will provide an adequate municipal water supply in place of the tribe's existing water system, which has been deemed inadequate by the USEPA. *D. Provide a Long-Term Solution*- Project will provide a permanent connection to a municipal wastewater system for a DAC, which will resolve the tribe's drinking water supply and O&M issues on a long-term basis. *E. Decrease in Hazardous Physical Conditions*-Project will provide long-term O&M for the water supply project through CVWD, and will decrease existing hazardous	N/A

Proposal: Coachella Valley IRWM Implementation Grant, Round 2 Agency: Coachella Valley Water District							
Project	**Project Proponent**	**Total Present Value Project Costs (1)**	**Total Present Value Project Benefits**			**Section D2 Briefly Describe Main Non-monetized Benefits**	**Benefit-Cost Ratio***
			Section D3 Monetized (2)	**Section D4 Flood Damage Reduction (3)**	**Total**		
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f) = (d) + (e)**	**(h)**	**(i)**
						physical conditions for the tribal operator. *F. Avoid Pump Station Rehabilitation and Deeper Drilling of Current Well*-This project will avoid an alternative project, which would involve potentially drilling a deeper well or rehabilitating the onsite water system. These alternatives would not resolve long-term O&M issues. *G. Avoid Additional Treatment Necessary to Address Water Quality Concerns*-This project will avoid an alternative project, which would involve onsite treatment to address perchlorate, arsenic, and other constituents such as chromium. This alternative project would not resolve water supply inadequacy, reliability, or O&M issues. *H. Avoid Ongoing O&M of Tribal Water System*- This project will replace the current onsite potable water system with a long-term connection to the CVWD municipal water system. Therefore, the project will avoid current O&M required for the existing onsite system.	
	TOTAL	**$30,945,855**	**$182,274,812**	**N/A**	**$182,274,812**	See above	**6:1**
TOTAL Without Project #5		**$30,725,575**	**$182,274,812**	**N/A**	**$182,274,812**	See above	**6:1**
** A benefit-cost ratio greater than 1 indicates that benefits are greater than costs.*							

Project 1: Non-potable Water Use Expansion Program

Introduction

This attachment presents the economic analysis for the *Non-Potable Water Use Expansion Program*. The following sections provide a brief description of the program and a summary table of the program costs and benefits. Sections outlined in the PSP are then presented, including: Non-Monetized Benefits Analysis (Section D2 in the Proposal Solicitation Package), Monetized Benefit Analysis (Section D3 in the Proposal Solicitation Package), and Project Benefits and Costs Summary (Section D5 in the Proposal Solicitation Package).This program does not serve a disadvantaged community and does not provide flood protection benefits. Therefore, Proposal Solicitation Package Sections D1 and D4 are not included in this Attachment.

Abstract

The proposed *Non-Potable Water Use Expansion Program* is a form of source substitution - the delivery of an alternate source of water to users who currently depend on groundwater pumping. The substitution of an alternate non-potable water source will reduce groundwater extraction, allowing groundwater to remain in storage, thus reducing the need to import additional water for groundwater recharge purposes. It also matches source to use by providing untreated Colorado River water (Canal water) and recycled water for outdoor irrigation in lieu of higher quality groundwater.

Canal water and recycled water are significant existing local resources that are underutilized for agricultural and golf course irrigation. Backbone distribution systems exist to deliver non-potable water, but funding is needed to connect potential customers to existing non-potable water distribution systems.

In the eastern portion of the Coachella Valley (generally east of Washington Street), the Coachella Canal (Canal) and its adjacent irrigation distribution system have delivered Canal water to the agricultural community since 1950. However, this system has not been fully utilized. In the western portion of the Coachella Valley, the backbone of the area's non-potable water system, the Mid-Valley Pipeline (MVP), was completed in 2008. It has the capacity to serve approximately 50 golf courses.

There are over 110 golf courses in the Coachella Valley that could potentially access non-potable water through the existing distribution system. CVWD has entered a standardized non-potable water use agreement with 43 of these golf courses that requires them to meet at least 80% of their demand with non-potable water. Of these 43 courses, 14 receive water from the MVP system and 29 receive water from the Canal distribution system.

This project would fund three west Valley golf course connections (connections to the MVP), one improvement to the L4 Pump station, and four east Valley golf course connections (to the Canal system) that are more or less shovel ready. Specific project components include:

Mid Valley Pipeline

1. *Desert Horizons Country Club* – this project extends the 24" distribution pipeline from the existing stub-out at the Coachella Valley Stormwater Channel to Fred Waring Drive and constructs a new pipeline and meter to the Desert Horizons Country Club.
2. *Indian Springs Country Club* – this project extends the 24" distribution pipeline from the existing stub-out at the Coachella Valley Stormwater Channel to Fiesta Drive and constructs a new pipeline and meter to the Indian Springs Country Club.
3. *The Lakes Country Club* – this project constructs two new sections of 12" pipeline and meters from the 24" high pressure pipeline and one new 12" pipeline and meter from the low pressure pipeline to the Lakes Country Club.

Canal System

4. *L4 Pump Station Improvements* – this project replaces the broken meter at Citrus Country Club and installs Variable Frequency Drives (VFDs) at the L4 Pump Station.
5. *L4 La Quinta Extensions* – this project extends Irrigation Lateral 120.8 from the relocated L4 Pump Station to Avenue 52 and includes three new meters for Canal water delivery to the La Quinta Country Club, the La Quinta Resort Mountain Course, and the La Quinta Resort Dunes Course.
6. *Indian Palms Golf Course* – this project extends the 12" Irrigation Lateral 117.8 from Monroe Street to the Indian Palms Golf Course.

Table 8-2 shows the breakdown of water use by golf course for the proposed MVP and Coachella Canal connections. Non-potable water provided via the MVP includes a mix of recycled water and Canal water (approximately 52% recycled water and 48% Canal water), and the water supply provided by the Coachella Canal is only Canal water.[1]

Table 8-2: Amount of Non-Potable Water Supplied by Conveyance Facility
Non-Potable Water Use Expansion Program

Facility and User	Amount Supplied (AFY)
Mid-Valley Pipeline	
Indian Springs	975
Desert Horizons	867
Lakes Country Club	2,308
Total	**4,150**
Coachella Canal	
La Quinta Country Club	975
La Quinta Resort Mountain Course	975
LA Quinta Resort Dunes Course	975
Indian Palms	975
Total	**3,900**

Summary Project Benefits and Costs

A summary of all benefits and costs of the program are provided in Table 8-3. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified benefits are described in Attachment 7. As shown in the table, this program would yield monetizable present value (PV) benefits that greatly exceed the PV costs, and would also provide important additional benefits that could not be reliably quantified and/or monetized.

Please note that the numbering associated with each benefit has been completed in accordance with the numbering presented in Attachment 7; therefore benefits described below may not be presented in numeric order.

[1] Coachella Valley Water District (CVWD). 2005. *Final Concept Paper: Mid-Valley Pipeline.* Page 10, Chart 4-2: Expanded Recycled Water Distribution System using a blend of Recycled and Canal Water.

Table 8-3: Benefit-Cost Analysis Overview
Non-Potable Water Use Expansion Program

	Present Value
Costs – Total Capital and O&M	**$24,626,275**
Monetizable Benefits	
A. Avoid Costs of Imported Water Purchases	$104,011,739
B. Avoid Groundwater Pumping	$5,546,288
C. Avoid Groundwater Replenishment	$7,966,326
D. Reduce Social Costs Associated with CO_2 Emissions	$1,574,441
Total Monetizable Benefits	**$119,098,794**
Qualitative Benefit or Cost	**Qualitative Indicator***
E. Provide Social Recreation or Access Benefits	+
F. Help Avoid, Reduce, or Resolve Various Public Water Resources Conflicts	+
G. Reduce Demand for Net Diversions from the Delta	+
H. Provide a Long-Term Solution	+
I. Improve Water Supply Reliability	++
J. Avoid Fertilizer Application	+
K. Improve Water Quality	+

* 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 net benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis

Narrative Description of Qualitative Benefits

E-Provide Social Recreation or Access Benefits

By switching to non-potable water, the seven golf courses served by the program would no longer be subject to watering restrictions during times of drought. This is because non-potable water consists of recycled water and Canal water, which are not considered to be highly impacted by climatic variations (drought). Thus, golf courses served by this program could continue to irrigate landscape/turf areas regardless of drought conditions (thus remaining green during dry periods). This would improve the aesthetics and enjoyment of the courses and, in extreme cases, may avoid closures that would otherwise be necessary to prevent further turf damage.

In addition, with the program, the golf courses would receive non-potable water at 85% of the cost they currently pay to pump groundwater.[2] This would result in cost savings for the golf courses, allowing them to spend additional funds on golf course improvements and maintenance. This would increase the enjoyment of the golf course for visitors, may attract additional golfers, and may also help to ensure that the golf courses can continue to operate by lowering costs associated with irrigation.

[2] Coachella Valley Water District (CVWD). 2011. *Coachella Valley Water District 2010 Urban Water Management Plan Final Report.* Page 4-29, Section 4.5.3, Recycled Water Customer Incentives.

F-Help Avoid, Reduce or Resolve Various Public Water Resources Conflicts

By providing 8,050 AFY of non-potable water, which includes 2,152 AFY of recycled water, this program helps to meet requirements set forth in the Recycled Water Policy to increase use of recycled wastewater by at least 1 million AFY by 2020 and by at least 2 million AFY by 2030.[3] Because the program would facilitate implementation of activities to help meet mandates and goals of a statewide statute, it would help to resolve potential public water resources conflicts related to urban water demands and recycled water use.

G-Reduce Demand for Net Diversions from the Delta

By reducing the need to import additional water into the Coachella Valley for groundwater recharge, the *Non-Potable Water Use Expansion Program* would reduce dependence on imported water from the State Water Project (SWP), which is exchanged with MSWD for Colorado River water. Reducing the need for additional SWP water would potentially augment in-stream flows in the Sacramento-San Joaquin Bay-Delta (Delta) or could offset other diversions that may otherwise reduce flows.

The Delta is considered to be in a state of crisis. Fish populations, including salmon and Delta-smelt, have declined dramatically in recent years. The levee system is aging, and vulnerability of the Delta to flooding, sea level rise, or a major earthquake has contributed to concerns about possible levee collapse. In addition, water quality problems continue, and there is little consensus on how to manage water resources through storage.[4] Reducing future additional demands and subsequent diversions of water from the Delta would help to address some of the aforementioned issues by making the Delta water available for other interests and needs. In addition, due to the current vulnerability of the Delta, reducing future demands on this water resource would directly benefit the Region by reducing reliability issues that could occur if a catastrophic event such as a levee collapse or an earthquake were to substantially damage Delta-related infrastructure.

H-Provide a Long-Term Solution

By increasing use of locally-available resources rather than increasing imported water demands for groundwater recharge, this program helps provide a long-term solution to the Region's groundwater overdraft. SWP supplies vary annually due to weather and runoff variations, and are also impacted by regulatory limitations on exports from the Delta. Under current conditions, the SWP can only provide about 60% of CVWD's Table A contract allocation.[5] In the absence of state and federal actions in the Delta to increase SWP supplies, it is anticipated that CVWD's long-term SWP reliability (deliveries) could decrease to 50% of current allocations.[6]

Local groundwater is also limited in the Coachella Valley, which is apparent due to storage (capacity) loss that the basin has experienced. Bulletin 108 (1964) and Bulletin 118 (2003) are the most recent DWR bulletins that characterize the condition of the Coachella Valley aquifer. In Bulletin 108, DWR noted that the amount of usable supply in the overdrafted aquifer was decreasing, while Bulletin 118 stated that overdraft remains a "primary challenge" in the aquifer. In their *2010 Urban Water Management Plan*, CVWD provides estimates for the change in storage in the aquifer, noting that in 2009, loss of storage in the groundwater basin was estimated to be 74,812 AFY.[7]

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[3] State Water Resources Control Board (SWRCB). 2009. *Recycled Water Policy.* Available: http://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy

[4] Delta Stewardship Council. 2010. *The Delta.* Available: http://deltacouncil.ca.gov/delta

[5] Coachella Valley Water District (CVWD). 2011. C*oachella Valley Water District 2010 Urban Water Management Plan Final Report*. Page 4-33, Section 4.6.2.2 Additional SWP Exchange Water.

[6] Coachella Valley Water District (CVWD). 2011. C*oachella Valley Water District 2010 Urban Water Management Plan Final Report*. Page 5-5, Section 5.2.3 State Water Project.

[7] Coachella Valley Water District (CVWD). 2011. C*oachella Valley Water District 2010 Urban Water Management Plan Final Report*. Page 4-10, Section 4.2.1.3 Overdraft.

Reduced reliability of SWP supplies and overdraft conditions in the groundwater basin highlight the need for additional (reliable) sources of water to meet current and future demands under all hydrologic conditions. The *Non-Potable Water Use Expansion Program* would provide infrastructure for the distribution and use of two sources of supply that are currently underutilized – recycled water and Canal water. Increasing the distribution and use of these non-potable sources is considered a long-term solution to issues associated with SWP reliability and groundwater overdraft, and is a long-term means to sustainably meet regional water demands.

I-Improve Water Supply Reliability

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The *Non-Potable Water Use Expansion Program* would help address reliability issues for the Region by facilitating the additional distribution and use of a drought-resistant and underutilized source of local supply (non-potable water). This would reduce reliance on local groundwater, offsetting the need for SWP exchange water for groundwater recharge purposes.

Although interest in water supply reliability is increasing due to increasing water demands and concerns over climate-related events, only a few studies have directly attempted to quantify its value. 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 $100 to more than $500 per household per year for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).[8]

The challenge in applying these values to determine a value of increased reliability as a result of the *Non-Potable Water Use Expansion Program* 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 *Non-Potable Water Use Expansion Program* only enhances overall reliability and does not guarantee 100% reliability. Thus, if applied directly to the number of households within the CVWD service area, the dollar values from the studies would overstate the reliability value provided by the program.

A 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 program. To adjust for the partial improvement in reliability from the *Non-Potable Water Use Expansion Program*, it is assumed that household willingness to pay for improved reliability is directly proportional to the amount of non-potable water that would be provided by the program as a percentage of the total non-potable water demand. This represents the percentage of total supply that has been improved in terms of overall reliability.

For example, the program would provide 8,050 AFY of non-potable water at full implementation (by 2017). In 2020, total non-potable water demand within the CVWD service area will be about 319,400

[8] Carson, R.T.; Mitchell, R.C. *Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area*; SWC Exhibit Number 54;

The Metropolitan Water District of Southern California, Los Angeles, 1987.

CUWA. *The Value of Water Supply Reliability: Results of a Contingent Valuation Survey of Residential Customers*, California Urban Water Agencies, Sacramento, CA. [Online] 1994, http://www.cuwa.org/library/TheValueofWaterSupplyReliabilityAug94.pdf (accessed October 1, 2009).

Griffin, R.C.; Mjelde, J.W. Valuing Water Supply Reliability. *American Journal of Agricultural Economics* 2000, *82*, 414–426

Raucher, R., J. Clements, and others. 2013. *The Value of Water Supply Reliability in the Residential Sector.* WateReuse Research Foundation. Project WRF-08-09.

Wolff, G. 2007. Calculating constant-reliability water supply unit costs. *Water Policy*. International Water Association, London, UK

AFY.[9] Thus, about 2.5% of total non-potable water demand would be met by non-potable water provisions provided by the program. To obtain a lower bound estimate for the value of improved reliability associated with this water, it is assumed that households within the CVWD service area are willing to pay about $2.50 per year for improved reliability of supplies ($100 multiplied by 2.5%). Applying this willingness to pay per household dollar value to the approximately 99,700 households within the service area in 2020[10] would result in $$249,250 of annual benefits.

Due to the uncertainty involved in applying quantified economic numbers to the water supply reliability benefits that the Region would accrue as a result of the *Non-Potable Water Use Expansion Program*, this benefit estimate has been provided here to give an idea of the potential magnitude of this benefit, but has not been economically monetized within the overall cost-benefit ratio for this program.

J-Avoid Fertilizer Application

Fertilizing compounds commonly present in recycled water (e.g., nitrogen, phosphorus, potassium) are typically not found in potable water at levels of significance. Thus, the use of recycled water for irrigation could reduce fertilizer costs for the golf courses serviced by the MVP portion of the program (i.e., The Lake Country Club, Desert Horizons, and Indian Springs).

The exact offset of fertilizer use from using recycled water is difficult to predict due to daily and seasonal nutrient variations in the recycled water, and because the recycled water provided by the MVP will be blended with Canal water that does not have the same level of nutrients. In addition, the water supplied via the MVP could have a higher or lower concentration of recycled water, depending on the time of year. Thus, this benefit is not monetized or included as part of the overall benefit-cost ratio.

K-Improve Water Quality

The 2010 *Coachella Valley Water Management Plan Update* indicates that groundwater pumping in some areas can cause water quality issues associated with constituents such as nitrates, as pumping may cause nitrates to leach into higher quality groundwater due to pressure changes in the basin.[11] Without the project, the golf courses will continue to contribute to overdraft problems in the basin through 2034, when enough infiltration capacity is brought online to be able to fully offset the full 8,050 AFY of groundwater pumping with imported water. This will result in further water quality degradation in the aquifer.

Beginning in 2034, the overall balance of the groundwater basin will be restored on an annual basis, with or without the program, as groundwater recharge would either occur due to importation of additional SWP exchange water or via the source substitution with non-potable water. While the *Non-Potable Water Use Expansion Program* would not change the overall water balance of the basin, it would abate localized groundwater pumping and therefore, could prevent pumping activities from causing nitrate-contaminated water from coming into contact with the basin's high-quality deep aquifer.

Currently, there is no available information regarding local groundwater in the program area and how water pressure in this area may impact water quality. As such, benefits that would accrue to water quality have not been physically or economically quantified.

[9] Coachella Valley Water District (CVWD). 2011. C*oachella Valley Water District 2010 Urban Water Management Plan Final Report*. Page 3-14, Table 3-17 Projected Non-Potable Water Demand.

[10] Coachella Valley Water District (CVWD). 2011. C*oachella Valley Water District 2010 Urban Water Management Plan Final Report*. Page 2-8, Table 2-4, Current and Projected Population. Estimate calculated based on the projected 2020 population documented in CVWD's 2010 UWMP. Population was divided by 3.15 persons per household (based on Census data for Riverside County) to obtain household estimate.

[11] Coachella Valley Water District (CVWD) 2010. *Coachella Valley Water Management Plan 2010 Update.* Page 5-13, Section 5.1.3.5 Nitrate.

Monetized Benefit Analysis

Several monetized benefits are expected to accrue over the expected 60-year life of the program, including:

- Avoided costs of purchasing additional imported water
- Avoided costs associated with construction of groundwater replenishment wells
- Reduced social costs associated with CO_2 emissions

A-Avoid Costs of Imported Water Purchases

The *Non-Potable Water Use Expansion Program* would provide an alternative source of non-potable water supply to seven golf courses that currently depend on local groundwater for irrigation purposes. By facilitating the distribution and use of non-potable water, this program would offset the purchase of imported water that would be required to recharge the Coachella Valley Groundwater Basin. SWP exchange water is CVWD's most expensive source of imported water (i.e., the marginal source) and will therefore be the source of imported water that is offset by this project.

As discussed in the subsequent section, without this project, CVWD will need to construct five groundwater injection wells in order to accommodate infiltration of 8,050 AFY of water into the groundwater aquifer to offset the golf course extractions from the basin. These wells will be built over a 20-year period (with one well being constructed every 5 years). Each well would provide about 1,610 AFY of infiltration capacity. Thus, the first well, which will be constructed in 2014 will allow for 1,610 AFY of groundwater recharge beginning in 2016. When the second well is completed in 2019, total infiltration capacity will amount to 3,220 AFY (beginning in 2020). This will continue through 2034, when the fifth well is completed. Together, the wells would provide a cumulative infiltration capacity of 8,050 AFY, which would offset the full amount of water used by the golf courses.

To calculate the avoided costs of imported water over time, the amount of imported water avoided each year was multiplied by the projected cost of imported water in that year. In 2013, the cost of SWP exchange water from MWD amounted to $915.93 (2012 USD) per AF of water delivered to CVWD. This rate includes a base water cost of $308.85 and a conveyance cost of $607.08 (Appendix 8-1 provides details).

Given the construction schedule for the infiltration wells, the program would avoid a total of 425,040 AF of SWP exchange water over its expected 60-year project life. Based on the rate assumptions described above and applying a discount rate of 6% (per DWR's PSP Guidelines), total present value benefits associated with the avoided purchase of this water amount to $104,011,739 over the 60-year program life.

Table 8-4: Imported Water Offsets and Costs by Year
Non-Potable Water Use Expansion Program

Year	Amount of Imported Water Offset	Discounted Price of Imported Water	Total Economic Benefit Resulting from Program
2016	1,610	$1,015.51	$1,634,971
2017	1,610	$1,051.05	$1,692,191
2018	1,610	$1,087.84	$1,751,422
2019	1,610	$1,125.91	$1,812,715
2020	3,220	$1,165.32	$3,752,330
2021	3,220	$1,182.80	$3,808,616
2022	3,220	$1,200.54	$3,865,739
2023	3,220	$1,218.55	$3,923,731
2024	3,220	$1,236.83	$3,982,593
2025	4,830	$1,255.38	$6,063,485
2026	4,830	$1,274.21	$6,154,434
2027	4,830	$1,293.32	$6,246,736
2028	4,830	$1,312.72	$6,340,438
2029	4,830	$1,332.41	$6,435,540
2030	6,440	$1,352.40	$8,709,456
2031	6,440	$1,372.69	$8,840,124
2032	6,440	$1,393.28	$8,972,723
2033	6,440	$1,414.18	$9,107,319
2034	6,440	$1,435.39	$9,243,912
2035-2077	8,050	$2,025.86	$675,228,605

**Please note that the discounted imported water price provided for 2035-2077 is an average of the imported water cost, and the cost-benefit analysis took into consideration the annual discounted price of imported water. The value presented in this table is for illustrative purposes only.*

B-Avoid Groundwater Pumping

By offsetting the use of local groundwater at the seven golf courses participating in this program, the *Non-Potable Water Use Expansion Program* would result in avoided costs associated with groundwater pumping. With the project, the golf courses will obtain non-potable water from CVWD and will therefore, cease local groundwater pumping. Information from CVWD demonstrates that average groundwater pumping costs currently amount to $53.08 per acre-foot[12] This value is estimated based upon pumping costs provided to CVWD by Southern California Edison, and are an average of pumping costs for 19 golf courses within the CVWD service area (refer to Attachment 7).

It is assumed that recycled water would be phased in according to project construction, and therefore, 2,311 AF would be provided in 2016, 7,281 would be provided in 2017, and 8,050 AF would be provided from 2018 through 2077. It is assumed that groundwater pumping would cease in a similar fashion. Table 8-5 provides an overview of the phasing assumptions and associated groundwater pumping offsets for the project.

Over the 60-year program life, total present value benefits associated with avoided groundwater pumping costs would amount to $5,546,288.

[12] Coachella Valley Water District (CVWD). 2012. *Non-Potable Water Agreement Charges and Details.*

Table 8-5: Groundwater Pumping Offsets by Year
Non-Potable Water Use Expansion Program

Year	Amount of Non-Potable Water Produced and Use (AFY)	Amount of Groundwater Pumping Offset (AFY)	Pumping Costs ($/AFY)	Total Economic Benefit Resulting from Program (Undiscounted)
2016	2,311	2,311	$53.08	$122,668
2017	7,281	7,281	$53.08	$386,475
2018-2077	483,000	483,000	$53.08	$25,637,640
TOTAL	492,592 (2016-2077)	492,592 (2016-2077)	$53.08	$26,146,783
**Please note that the discounted imported water price provided for 2017-2066 is an average of the imported water cost for that timeframe. The cost-benefit analysis took into consideration the annual discounted price of imported water, and the value provided in this table is for illustrative purposes only.*				

C-Avoid with Groundwater Replenishment

To accommodate the increased groundwater recharge that would be necessary if the program were not implemented, CVWD would need to construct additional groundwater injection wells to manage local groundwater overdraft that may occur within the area covered by the golf courses. The *Coachella Valley Water Management Plan Update* notes that the groundwater basin can be recharged by injection through either dedicated recharge wells or aquifer storage and recovery (ASR) wells which can be used for both recharge and groundwater production.[13] Injection has the benefit of placing replenishment water at the same location where pumping has occurred, which means that groundwater injection could be employed to address areas of acute overdraft that are experiencing localized land subsidence.

As described below, localized groundwater replenishment would require two types of costs: capital costs and O&M costs. Capital costs are those that would be required to construct necessary groundwater recharge facilities (injection wells). O&M costs are those that would be necessary to fund groundwater replenishment conducted by CVWD. CVWD recuperates costs associated with groundwater replenishment via leverage of a replenishment assessment charge (RAC) that is assessed per basin.

Capital Costs

In 2012, the Indio Water Authority (a CVRWMG agency and partner in the *Non-Potable Water Use Expansion Program*) investigated the costs associated with constructing an injection well as part of the planned Aquifer Storage and Recovery (ASR) program at Posse Park and Municipal Golf Course. The cost of one injection well at that site was estimated to be $1,239,930, assuming an injection rate of 1,000 gallons per minute (gpm).[14] The aforementioned cost does not include design and engineering costs associated with installing an injection well, and therefore represents a very conservative estimate for overall implementation of localized groundwater injection facilities.

Replenishment of 8,050 AFY would require an injection rate of 5,000 gpm, assuming that groundwater is being pumped on a continuous basis. As such, if the *Non-Potable Water Use Expansion Program* were not implemented, CVWD would need to install five (5) injection wells of a capacity of 1,000 gpm (or 1,610 AFY) each in order to provide for onsite local groundwater replenishment of the same magnitude provided by the program. Assuming the same capital cost of $1,239,930 per well, the total cost of

[13] CVWD. 2010. *Coachella Valley Water Management Plan Update*. Section 6.2.2 East Valley Recharge Facilities, page 6-35.

[14] Daniel B. Stephens & Associates, Inc. 2012. *IWA Aquifer Storage and Recovery Program, Preliminary Hydrogeologic Scope Cost Assessment.* Page 5, Table 2: Preliminary Cost Estimate for Drilling Subcontractor Costs, Injection Well Installation.

constructing five wells would amount to $6,199,650. It is assumed that construction of the wells would take one years each, and they would be constructed every five years beginning in 2014. The wells would all be brought online by 2034, at which point there would be cumulative capacity to recharge 8,050 AFY to the basin. Note that this timeline is much greater than the timeline of implementation for the *Non-Potable Water Use Expansion Program*. The proposed program is a more cost effective and reliable way to reduce groundwater overdraft and associated land subsidence in the near-term. Table 8-6 provides a brief overview of the cost and AFY assumptions for capital costs associated with groundwater replenishment.

Table 8-6: Average Capital Costs – Replenishment (Injection Wells)
Non-Potable Water Use Expansion Program

Year	Groundwater Replenishment (AFY)	Annual Capital Costs ($)*
2014	1,610	1,239,930
2019	1,610	1,239,930
2024	1,610	1,239,930
2029	1,610	1,239,930
2034	1,610	1,239,930
Total	8,050	$6,199,650
**Please note that these costs have not been discounted, and the values provided in this table is for illustrative purposes only.*		

Operations and Maintenance Costs (Replenishment Assessment Charge)

In 2012, CVWD's Replenishment Assessment Charge (RAC) for groundwater users in the Upper Whitewater River Subbasin (Upper) was $110.26 per AF for any water user pumping more than 25 AFY.[15] For groundwater users in the Lower Whitewater River Subbasin (Lower), RAC charges amounted to $38.00 per AF.[16] Based on the location of the seven golf courses – two are located within the Upper Whitewater River Subbasin and five are located within the Lower Whitewater River Subbasin – the weighted average 2012 RAC would be $66.50 per AF. Thus, average annual O&M costs of the replenishment wells would amount to $535,325 each year ($66.50 multiplied by 8,050 AFY).The methods used to calculate the aforementioned benefits are outlined in Table 8-7.

Table 8-7: Average Replenishment Assessment Charges
Non-Potable Water Use Expansion Program

Golf Course Name	Location	RAC ($/AF)	Annual Usage (AFY)	Annual RAC Charge ($/Year)
Desert Horizons	Upper	$110.26	867	$95,595
Lakes Country Club	Upper	$110.26	2,308	$254,480
Indian Springs	Lower	$38.00	975	$37,050
La Quinta Country Club	Lower	$38.00	975	$37,050
La Quinta Resort Mountain Course	Lower	$38.00	975	$37,050
LA Quinta Resort Dunes Course	Lower	$38.00	975	$37,050
Indian Palms	Lower	$38.00	975	$37,050
Total Across all Seven Golf Courses			**8,050**	**$535,325**
Average 2012 RAC ($/AF)				**$66.50**
Average Avoided Costs ($/year)				**$535,325**

[15] Coachella Valley Water District (CVWD). 2012. *Replenishment Assessment Charge: Upper Valley.* Available: http://www.cvwd.org/news/rac.php?area=uv

[16] Coachella Valley Water District (CVWD). 2012. *Replenishment Assessment Charge: Lower Valley.* Available: http://www.cvwd.org/news/rac.php?area=lv

Assuming that the O&M costs associated with groundwater replenishment (RAC) would phase in according to how groundwater replenishment would phase in, the total average avoided RAC ($535,325 per year) would not start accruing until 2035 when all five injection would be installed. As such, the RAC charges would phase in such that one-fifth (1/5) of the total RAC ($107,065) would be avoided from 2015-2019, 2/5 of the total RAC ($214,130) would be avoided from 2020-2024, 3/5 of the total RAC ($321,195) would be avoided from 2025-2029, 4/5 of the total RAC ($428,260) would be avoided from 2030-2034. Table 8-8 provides an overview of the phasing of avoided O&M costs associated with groundwater replenishment.

Table 8-8: Groundwater Pumping Offsets by Year
Non-Potable Water Use Expansion Program

Year	Total Average Avoided RAC ($/Year)	Percent of Groundwater Replenishment Wells Installed	Avoided RAC Costs ($)	Total Economic Benefit Resulting from Program (Undiscounted)*
2015-2019	$535,325	20% (1/5)	$107,065	$535,325
2020-2024	$535,325	40% (2/5)	$214,130	$1,070,650
2025-2029	$535,325	60% (3/5)	$321,195	$1,605,975
2030-2034	$535,325	80% (4/5)	$428,260	$2,141,300
2035-2077	$535,325	100% (5/5)	$535,325	$23,018,975
TOTAL				**$28,372,225**
**Please note that these costs have not been discounted, and the values provided in this table is for illustrative purposes only.*				

Based on the estimated capital and O&M costs described above, the total present value benefit associated with avoided costs of groundwater replenishment would amount to $7,966,326 over the 60-year program life.

D. Reduce Social Costs Associated With CO_2 Emissions

The *Non-Potable Water Use Expansion Program* would provide non-potable water to seven golf courses within the Coachella Valley. The provision and use of non-potable water would offset the use of local groundwater by these golf courses, as well as the conveyance of additional SWP exchange water for groundwater recharge purposes. As a result, this program would avoid energy requirements associated with groundwater pumping, as well as the energy requirements associated with transporting SWP exchange water to the Region. This in turn would result in avoided carbon dioxide (CO_2) emissions (a greenhouse gas (GHG)) associated with the without-project water sources (groundwater pumping and additional SWP exchange water).

For this analysis, it is assumed that energy requirements associated with delivering and using Colorado River water (including Canal water) are 2.0 MWh/AF, energy requirements associated with delivering and using both recycled water and local groundwater are 0.8 MWh/AF. [17] As described in Attachment 7, this project will provide 2,152 AFY of recycled water, which would be blended with 1,998 AFY of Canal water, through the MVP. An additional 3,900 AFY of Canal water will be supplied directly from the Coachella Canal. From 2015 through 2034, the project will also avoid increasing levels of imported SWP

[17] As described in Attachment 7, energy use estimates for alternative water supply sources are based on estimates provided in CEC 2005, Navigant 2006, and Equinox 2010. The estimates used for this analysis are as follows: Imported Colorado River Water 2.0 MWh/AF (used for both water supplied via CRA and Coachella Canal), groundwater pumping 0.80 MWh/AF; recycled water treatment and distribution 0.80 MWh/AF.

exchange water associated with groundwater recharge. Beginning in 2034 (following completion of the fifth injection well under the "without project" scenario), the program will result in a net energy savings of 9,030 MWh per year. Cumulative energy savings will amount to 407,940 MWh over the 60-year life of the program.

Table 8-9: Energy and Emissions Savings Estimates
Non-Potable Water Use Expansion Program

Year	Program Components	Amount Supplied (AFY) a.	Energy Requirements (MWh/yr) b.	Imported Energy Offsets* (MWh/yr) c.	Groundwater Pumping Offsets** (MWh/yr) d.	Cumulative Energy Savings (MWh/yr) c.+d. – b.	Cumulative CO_2 Savings (MT/yr)
2016	Recycled Water	230	184	460	184	460	163
	Canal Water	2,081	4,162	4,162	1,665	1,665	589
						Subtotal	**752**
2017	Recycled Water	1,758	1,406	3,516	1,406	3,516	1,245
	Canal Water	5,523	11,046	11,046	4,418	4,418	1,564
						Subtotal	**2,809**
2018-2077	Recycled Water	2,158	1,726	4,316	1,726	4,316	1,528
	Canal Water	5,892	11,784	11,784	4,714	4,714	1,669
Subtotal per Year (2018-2077)							**3,196**
Program Total (60-year lifetime)							**188,957**

** Imported Energy Offsets were calculated based on an assumption of 2.0 MWh/AF*
*** Groundwater Pumping Offsets were calculated based on an assumption of 0.8 MWh/AF*

To calculate avoided CO_2 emissions associated with the program, the amount of energy that would be saved due to implementation of the program was multiplied by the average carbon emissions rate associated with energy production in California (0.354 megatons of CO_2 per megawatt-hour of energy (MT/MWh)). By avoiding 8,050 AFY of groundwater pumping and imported SWP exchange water, the program would result in a net reduction in CO_2 emissions of 3,196 MT per year beginning in 2018. Given the schedule for program construction and related project phasing, total net CO_2 emissions reductions amount to 188,957 MT over the 60-year program life (2016-2077).

To monetize this benefit, the dollar value assigned to GHG emissions, measured in carbon dioxide equivalent (CO2e), was applied. The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present.[18] In February 2010, the U.S. Government's Interagency Working Group on Social Cost of Carbon issued guidance on recommend values for the social cost of carbon for use in regulatory benefit-cost analysis. The recommended mean estimate of the social cost of

[18] Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK. pp. 7–22.

reducing one metric ton of CO_2 in 2012 is $22.53/MT (updated from 2010 values using CPI), with a range of values from$4.95 to $68.33 per MT.[19]

For this analysis, the average value of $22.53/MT for 2012 was used when calculating social benefits and costs, which produces conservative estimates for the benefits and costs associated with GHG emissions. The United Kingdom has established an official estimate of the social cost of carbon for use in many of its program evaluations and models the growth rate of the cost at 2.4% per year in real terms. To determine total costs over the program period, the real social cost of carbon was escalated by 2.4% per year, which is above the general rate of inflation. The social cost of carbon would increase in future years because CO_2 would produce larger incremental damages as physical and economic systems become more stressed in responding to greater climate change.

Over the 60-year program life, total present value benefits associated with avoided social costs of carbon amount to $1,574,441.

Summary of Monetized Benefits

Tables 8-10 and 8-11 summarize the annual benefits from the program. Annual benefits include: avoided costs of purchasing imported water for groundwater replenishment, avoided groundwater pumping costs, and reduced social costs associated with CO_2 emissions. Annual benefits that are associated with avoided projects (constructing and operating five groundwater injection wells) are included in Table 8-11.

Table 8-10: Annual Benefits (PSP Table 15)

Non-Potable Water Use Expansion Program

Annual Project Benefits (2012 Dollars)									
(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)**
2016	Imported water supply	AF	1,610	0	1,610	$1,015.51	$1,634,971	0.792	$1,295,050
	Groundwater pumping	AF	2,311	0	2,311	$53.08	$122,668	0.792	$97,164
	Social costs of CO_2 emissions	MT	1,795	1,539	752	$24.77	$18,629	0.792	$14,756
2017	Imported water supply	AF	1,610	0	1,610	$1,051.05	$1,692,191	0.747	$1,264,503
	Groundwater pumping	AF	7,281	0	7,281	$53.08	$386,475	0.747	$288,797
	Social costs of CO_2 emissions	MT	3,202	4,409	2,809	$25.37	$71,255	0.747	$53,246
2018	Imported water supply	AF	1,610	0	1,610	$1,087.84	$1,751,422	0.705	$1,234,684
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.705	$301,225
	Social costs of CO_2 emissions	MT	3,420	4,783	3,196	$25.98	$83,017	0.705	$58,524

[19] Interagency Working Group. 2010. *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon,* United States Government. February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf.

Annual Project Benefits (2012 Dollars)									
(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)**
2019	Imported water supply	AF	1,610	0	1,610	$1,125.91	$1,812,715	0.665	$1,205,559
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.665	$284,175
	Social costs of CO_2 emissions	MT	3,420	4,783	3,196	$26.60	$85,010	0.665	$56,536
2020	Imported water supply	AF	3,220	0	3,220	$1,165.32	$3,752,330	0.627	$2,354,259
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.627	$268,090
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$27.24	$87,050	0.627	$54,616
2021	Imported water supply	AF	3,220	0	3,220	$1,182.80	$3,808,616	0.592	$2,254,314
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.592	$252,915
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$27.89	$89,139	0.592	$52,761
2022	Imported water supply	AF	3,220	0	3,220	$1,200.54	$3,865,739	0.558	$2,158,608
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.558	$238,599
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$28.56	$91,278	0.558	$50,969
2023	Imported water supply	AF	3,220	0	3,220	$1,218.55	$3,923,731	0.527	$2,066,973
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.527	$225,093
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$29.25	$93,469	0.527	$49,238
2024	Imported water supply	AF	3,220	0	3,220	$1,236.83	$3,982,593	0.497	$1,979,227
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.497	$212,352
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$29.95	$95,712	0.497	$47,566
2025	Imported water supply	AF	4,830	0	4,830	$1,255.38	$6,063,485	0.469	$2,842,799
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.469	$200,332
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$30.67	$98,009	0.469	$45,951
2026	Imported water supply	AF	4,830	0	4,830	$1,274.21	$6,154,434	0.442	$2,722,112
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.442	$188,993

Annual Project Benefits (2012 Dollars)									
(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)
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$31.40	$100,362	0.442	$44,390
2027	Imported water supply	AF	4,830	0	4,830	$1,293.32	$6,246,736	0.417	$2,606,545
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.417	$178,295
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$32.16	$102,770	0.417	$42,882
2028	Imported water supply	AF	4,830	0	4,830	$1,312.72	$6,340,438	0.394	$2,495,890
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.394	$168,203
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$32.93	$105,237	0.394	$41,426
2029	Imported water supply	AF	4,830	0	4,830	$1,332.41	$6,435,540	0.371	$2,389,931
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.371	$158,682
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$33.72	$107,762	0.371	$40,019
2030	Imported water supply	AF	6,440	0	6,440	$1,352.40	$8,709,456	0.350	$3,051,304
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.350	$149,700
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$34.53	$110,349	0.350	$38,660
2031	Imported water supply	AF	6,440	0	6,440	$1,372.69	$8,840,124	0.331	$2,921,776
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.331	$141,226
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$35.36	$112,997	0.331	$37,347
2032	Imported water supply	AF	6,440	0	6,440	$1,393.28	$8,972,723	0.312	$2,797,738
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.312	$133,232
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$36.20	$115,709	0.312	$36,079
2033	Imported water supply	AF	6,440	0	6,440	$1,414.18	$9,107,319	0.294	$2,678,967
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.294	$125,691
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$37.07	$118,486	0.294	$34,853
2034	Imported water supply	AF	6,440	0	6,440	$1,435.39	$9,243,912	0.278	$2,565,233

Annual Project Benefits (2012 Dollars)									
(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)**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.278	$118,576
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$37.96	$121,330	0.278	$33,670
2035-2077	Imported water supply	AF	8,050	0	8,050	$1,456.92	$11,728,206	Variable	$61,126,271
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	Variable	$1,814,949
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$38.87	$124,242	Variable	$740,952
Total Present Value of Discounted Benefits for Avoided Imported Water Purchase Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table									**$104,011,739**
Total Present Value of Discounted Benefits for Avoided Groundwater Pumping Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table									**$5,546,288**
Total Present Value of Discounted Benefits for Social Costs of CO_2 Emissions Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table									**$1,574,441**
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$111,132,468**

Table 8-11: Annual Avoided Costs (PSP Table 16)

Non-Potable Water Use Expansion Program

Annual Costs of Avoided Projects (2012 Dollars)						
	Costs				**Discounting Calculations**	
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**
Year	**Construction and Operation of Five Groundwater Replenishment Wells**					
	Avoided Capital Costs	**Avoided Replacement Costs**	**Avoided Operations and Maintenance Costs**	**Total Costs Avoided for Individual Alternatives (b) + (C) + (d)**	**Discount Factor**	**Discounted Costs (e) x (f)**
2014	$1,239,930		$0	$1,239,930	0.890	$1,103,533
2015			$107,065	$107,065	0.840	$89,894
2016			$107,065	$107,065	0.792	$84,806
2017			$107,065	$107,065	0.747	$80,005
2018			$107,065	$107,065	0.705	$75,477
2019	$1,239,930		$107,065	$1,346,995	0.665	$895,829
2020			$214,130	$214,130	0.627	$134,348
2021			$214,130	$214,130	0.592	$126,743

Annual Costs of Avoided Projects (2012 Dollars)						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Construction and Operation of Five Groundwater Replenishment Wells					
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Costs Avoided for Individual Alternatives (b) + (C) + (d)	Discount Factor	Discounted Costs (e) x (f)
2022			$214,130	$214,130	0.558	$119,569
2023			$214,130	$214,130	0.527	$112,801
2024	$1,239,930		$214,130	$1,454,060	0.497	$722,623
2025			$321,195	$321,195	0.469	$150,589
2026			$321,195	$321,195	0.442	$142,065
2027			$321,195	$321,195	0.417	$134,023
2028			$321,195	$321,195	0.394	$126,437
2029	$1,239,930		$321,195	$1,561,125	0.371	$579,746
2030			$428,260	$428,260	0.350	$150,038
2031			$428,260	$428,260	0.331	$141,546
2032			$428,260	$428,260	0.312	$133,533
2033			$428,260	$428,260	0.294	$125,975
2034	$1,239,930		$428,260	$1,668,190	0.278	$462,931
2035			$535,325	$535,325	0.262	$140,147
2036			$535,325	$535,325	0.247	$132,214
2037			$535,325	$535,325	0.233	$124,730
2038			$535,325	$535,325	0.220	$117,670
2039			$535,325	$535,325	0.207	$111,009
2040			$535,325	$535,325	0.196	$104,726
2041			$535,325	$535,325	0.185	$98,798
2042			$535,325	$535,325	0.174	$93,206
2043			$535,325	$535,325	0.164	$87,930
2044			$535,325	$535,325	0.155	$82,953
2045			$535,325	$535,325	0.146	$78,257
2046			$535,325	$535,325	0.138	$73,827
2047			$535,325	$535,325	0.130	$69,649
2048			$535,325	$535,325	0.123	$65,706
2049			$535,325	$535,325	0.116	$61,987
2050			$535,325	$535,325	0.109	$58,478
2051			$535,325	$535,325	0.103	$55,168
2052			$535,325	$535,325	0.097	$52,045
2053			$535,325	$535,325	0.092	$49,099

Annual Costs of Avoided Projects (2012 Dollars)						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Construction and Operation of Five Groundwater Replenishment Wells					
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Costs Avoided for Individual Alternatives (b) + (C) + (d)	Discount Factor	Discounted Costs (e) x (f)
2054			$535,325	$535,325	0.087	$46,320
2055			$535,325	$535,325	0.082	$43,698
2056			$535,325	$535,325	0.077	$41,225
2057			$535,325	$535,325	0.073	$38,891
2058			$535,325	$535,325	0.069	$36,690
2059			$535,325	$535,325	0.065	$34,613
2060			$535,325	$535,325	0.061	$32,654
2061			$535,325	$535,325	0.058	$30,806
2062			$535,325	$535,325	0.054	$29,062
2063			$535,325	$535,325	0.051	$27,417
2064			$535,325	$535,325	0.048	$25,865
2065			$535,325	$535,325	0.046	$24,401
2066			$535,325	$535,325	0.043	$23,020
2067			$535,325	$535,325	0.041	$21,717
2068			$535,325	$535,325	0.038	$20,488
2069			$535,325	$535,325	0.036	$19,328
2070			$535,325	$535,325	0.034	$18,234
2071			$535,325	$535,325	0.032	$17,202
2072			$535,325	$535,325	0.030	$16,228
2073			$535,325	$535,325	0.029	$15,309
2074			$535,325	$535,325	0.027	$14,443
2075			$535,325	$535,325	0.025	$13,625
2076			$535,325	$535,325	0.024	$12,854
2077			$535,325	$535,325	0.023	$12,127
Total Present Value of Discounted Costs (Sum of column (g))						**$7,966,326**
(%) Avoided Cost Claimed by Project						**100%**
Total Present Value Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$7,966,326**

Project Benefits and Costs Summary

Project Economic Costs

Capital costs for the program total $3,080,478 (undiscounted). Construction and implementation costs (including construction administration and contingency costs) account for $2,715,478 (about 88%) of total capital costs. Program administration, planning, design, environmental documentation and compliance, and mitigation costs account for the remainder of the capital budget.

O&M costs associated with the program would total about $27,155 per year and are based on an assumption of 1% of the capital costs. Because avoided groundwater pumping costs and avoided imported water purchases are claimed as a benefit in this analysis, the O&M costs associated with the program include the cost of purchasing and distributing 5,898 AFY of Canal water, as well as the cost of treating and distributing 2,152 AFY of recycled water via the MVP. This allows for a direct comparison of the program to the "without project" baseline (as described in Attachment 7).

In total, the present value capital and O&M costs associated with the project amount to $14,813,557 over the 60-year project life. Table 8-12 summarizes the economic project costs for the project.

Table 8-12: Annual Project Costs (PSP Table 19)

Non-Potable Water Use Expansion Program

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$0.00	1.000	$0.00
2013	$154,024.00							$154,024.00	0.943	$145,305.66
2014	$462,072.00							$462,072.00	0.890	$411,242.44
2015	$924,143.00							$924,143.00	0.840	$775,928.28
2016	$1,232,191.00			$171,860.36				$1,404,051.36	0.792	$1,112,140.18
2017	$308,048.00			$832,817.16				$1,140,865.16	0.747	$852,520.82
2018				$981,271.80				$981,271.80	0.705	$691,757.90
2019				$981,271.80				$981,271.80	0.665	$652,601.79
2020				$981,271.80				$981,271.80	0.627	$615,662.07
2021				$981,271.80				$981,271.80	0.592	$580,813.27
2022				$981,271.80				$981,271.80	0.558	$547,937.05
2023				$981,271.80				$981,271.80	0.527	$516,921.74
2024				$981,271.80				$981,271.80	0.497	$487,662.02
2025				$981,271.80				$981,271.80	0.469	$460,058.51
2026				$981,271.80				$981,271.80	0.442	$434,017.46
2027				$981,271.80				$981,271.80	0.417	$409,450.44
2028				$981,271.80				$981,271.80	0.394	$386,274.00
2029				$981,271.80				$981,271.80	0.371	$364,409.43
2030				$981,271.80				$981,271.80	0.350	$343,782.48
2031				$981,271.80				$981,271.80	0.331	$324,323.10

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2032				$981,271.80				$981,271.80	0.312	$305,965.19
2033				$981,271.80				$981,271.80	0.294	$288,646.40
2034				$981,271.80				$981,271.80	0.278	$272,307.93
2035				$981,271.80				$981,271.80	0.262	$256,894.27
2036				$981,271.80				$981,271.80	0.247	$242,353.08
2037				$981,271.80				$981,271.80	0.233	$228,634.99
2038				$981,271.80				$981,271.80	0.220	$215,693.38
2039				$981,271.80				$981,271.80	0.207	$203,484.32
2040				$981,271.80				$981,271.80	0.196	$191,966.34
2041				$981,271.80				$981,271.80	0.185	$181,100.32
2042				$981,271.80				$981,271.80	0.174	$170,849.36
2043				$981,271.80				$981,271.80	0.164	$161,178.64
2044				$981,271.80				$981,271.80	0.155	$152,055.32
2045				$981,271.80				$981,271.80	0.146	$143,448.42
2046				$981,271.80				$981,271.80	0.138	$135,328.70
2047				$981,271.80				$981,271.80	0.130	$127,668.58
2048				$981,271.80				$981,271.80	0.123	$120,442.06
2049				$981,271.80				$981,271.80	0.116	$113,624.58
2050				$981,271.80				$981,271.80	0.109	$107,193.00
2051				$981,271.80				$981,271.80	0.103	$101,125.47
2052				$981,271.80				$981,271.80	1.000	$981,271.80
2053				$981,271.80				$981,271.80	1.000	$981,271.80

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2054				$981,271.80				$981,271.80	1.000	$981,271.80
2055				$981,271.80				$981,271.80	1.000	$981,271.80
2056				$981,271.80				$981,271.80	1.000	$981,271.80
2057				$981,271.80				$981,271.80	1.000	$981,271.80
2058				$981,271.80				$981,271.80	1.000	$981,271.80
2059				$981,271.80				$981,271.80	1.000	$981,271.80
2060				$981,271.80				$981,271.80	1.000	$981,271.80
2061				$981,271.80				$981,271.80	1.000	$981,271.80
2062				$981,271.80				$981,271.80	0.097	$95,401.39
2063				$981,271.80				$981,271.80	0.092	$90,001.31
2064				$981,271.80				$981,271.80	0.087	$84,906.90
2065				$981,271.80				$981,271.80	0.082	$80,100.85
2066				$981,271.80				$981,271.80	0.077	$75,566.84
2067				$981,271.80				$981,271.80	0.073	$71,289.47
2068				$981,271.80				$981,271.80	0.069	$67,254.22
2069				$981,271.80				$981,271.80	0.065	$63,447.37
2070				$981,271.80				$981,271.80	0.061	$59,856.01
2071				$981,271.80				$981,271.80	0.058	$56,467.94
2072				$981,271.80				$981,271.80	0.054	$53,271.64
2073				$981,271.80				$981,271.80	0.051	$50,256.26
2074				$981,271.80				$981,271.80	0.048	$47,411.57
2075				$981,271.80				$981,271.80	0.046	$44,727.89

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2076				$809,411.45				$809,411.45	0.043	$34,805.88
2077				$148,454.64				$148,454.64	0.041	$6,022.42
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$24,626,275**

Benefits and Costs Summary

As shown in the Tables 8.-10 and 8-11 above, the total present value benefits associated with the *Non-Potable Water Use Expansion Program* amount to $119,098,794 over the expected 60-year life. The total present value cost of the program (including capital and O&M costs) is $24,626,275. The *Non-Potable Water Use Expansion Program* would therefore result in a total cost benefit ratio of approximately 5:1.

Omissions, Biases, and Uncertainties

The monetized benefits of the program include: avoided costs of purchasing imported water for groundwater replenishment, avoided groundwater pumping costs, avoided costs associated with construction and operation of new groundwater injection wells, reduced social costs associated with CO_2 emissions, and avoided fertilizer costs.

In addition to monetized benefits and costs, the program would also result in the following physically quantifiable and non-monetized benefits:

- Social recreation/access benefits due to golf courses connected to the MVP being able to irrigate during times of drought and for a lower per acre-foot cost. Social/recreation access benefits associated with reduced water costs for golf courses may include increased spending on golf course improvements, avoided golf course rate increases, or potentially avoided golf closures.
- Help avoid, reduce, or resolve various public water resources conflicts by helping to meet state mandates associated with water recycling.
- Improve groundwater quality by reducing localized groundwater pumping that could result in contamination of the high-quality lower aquifer with contaminants.
- Reduce demand for net diversions from the Delta
- Provide a long-term solution in place of a short-term one due to the use of more sustainable water supply sources.
- Improve water supply reliability by offsetting the use of unsustainable groundwater (which is currently in a state of overdraft), as well as the use of unreliable imported water.

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 cost of obtaining Table A water exchanges to replenish the groundwater basin in the without project baseline, and the social cost of carbon emissions. These issues are listed in Table 8-13.

Table 8-13: Omissions, Biases, and Uncertainties
Non-Potable Water Use Expansion Program

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided purchase of imported water for groundwater recharge	-	This analysis assumes that without the project, 8,050 AFY of SWP Exchange Water would be available each year for groundwater recharge. Due to the uncertainty of SWP supplies, the full amount of this water may not be available in each year. Insufficient groundwater recharge would then impose a range of short- and long-term costs.
Avoided purchase of imported water for groundwater recharge	U	The calculation of avoided imported water costs assumes that MWD water rates would increase annually (in real terms) by 3.5% through 2020. Beyond 2020, a 1.5% real increase in water rates is assumed. These projections are based on existing and planned MWD financial commitments and recent increases in MWD rates. It is uncertain whether actual future rate increases would be above or below these assumed rate increases.
Avoided construction of new injection wells	+	The cost estimate for the construction of additional injection wells does not include hydrologic analysis, design, planning, and engineering costs that would be incurred if the wells were constructed. This could significantly increase the unit cost of each well.
Reduced social costs of carbon	U	The social cost of carbon used in this analysis represents the mid-point of values presented in the literature. The true social cost of carbon may be higher or lower than the estimate used here.

*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 2: Coachella Valley Salt & Nutrient Management Program

Introduction

This attachment presents the economic analysis for the *Coachella Valley Salt & Nutrient Management Program*. A project abstract and project benefit summary table are followed by the following sections as outlined in the PSP: Non-Monetized Benefits Analysis (Section D2), Monetized Benefit Analysis (Section D3), and Project Benefits and Costs Summary (Section D5).

Abstract

The *Coachella Valley Salt & Nutrient Management Program* will implement the analytical and planning tasks needed to develop a SNMP for the Coachella Valley Groundwater Basin that is compliant with the State's Recycled Water Policy. Key tasks to be undertaken by the CVRWMG include:

1. Establish a collaborative process of Valley stakeholders interested in groundwater management, which will entail setting up working groups, conducting technical review meetings and conference calls, conducting stakeholder workshops, and program management.
2. *Characterize the groundwater basins*, including identifying the groundwater basins to be evaluated, collecting and reviewing existing groundwater data, documenting beneficial uses, characterizing groundwater quality and occurrences, identifying constituents of concern, and establishing baseline conditions.
3. *Identify salt/nutrient loading and trends* by first identifying salt/nutrient sources, and then quantifying salt/nutrient source loads and developing a plan for data gaps.
4. *Identify water management goals and potential strategies*, which would entail developing a list of potential management strategies, evaluating the feasibility of those potential management strategies, and then conducting an assimilative capacity analysis.
5. *Conduct anti-degradation process*, which includes assessing load reduction and water quality improvements, and identifying preferred management strategies.
6. *Finalize the SNMP*, which includes developing an implementation plan, identifying metrics and developing a monitoring plan, developing data management, reporting, and audit processes, determining CEQA/NEPA compliance needs, and producing the SNMP document.

Successful completion of the SNMP is necessary to ensure compliance with the Recycled Water Policy. Compliance with this policy is necessary for continued Colorado River RWQCB approval of recycled water permits in the Basin. Therefore, developing the SNMP will enable continued use and expansion of the Valley's water recycling efforts, which are an important component of the Region's groundwater management strategy.

Development of the Coachella Valley SNMP would be a collaborative process driven by stakeholders that have already been identified during Phase I activities. This program allows the Region's water and wastewater agencies to better manage salts and nutrients in the groundwater basin to preserve the high quality groundwater supply used for potable purposes.

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-14. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7. As shown in the table, this project will yield monetizable present value (PV) benefits that greatly exceed the PV costs, and will also provide important additional benefits that could not be reliably quantified and/or monetized.

Please note that the numbering associated with each benefit has been completed in accordance with the numbering presented in Attachment 7. Therefore, benefits described below may not be presented in numeric order.

Table 8-14: Benefit-Cost Analysis Overview
Coachella Valley Salt & Nutrient Management Program

	Present Value
Costs – Total Capital and O&M	**$707,985**
Monetizable Benefits	
A-Maintain use of recycled water and avoid additional imports	$50,373,746
B-Reduce social costs associated with CO_2 emissions	$825,204
J-Avoided cost of drilling new municipal wells	$825,362
Total Monetizable Benefits	**$52,024,312**
Physically Quantified Benefit or Cost	**Project Life Total**
C-Prevent stranded assets	$45-90 million
Qualitative Benefit or Cost	**Qualitative Indicator***
D-Provide social recreation or access benefits	++
E-Help avoid, reduce or resolve various public water resources conflicts	+
K-Promote social health and safety	+
L-Improve groundwater quality	++
F-Improve the overall, long-term management of California groundwater resources	+
G-Reduce demand for net diversions for the regions from the Delta	+
H-Provide a long-term solution in place of a short-term one	+
I-Improve water supply reliability	+

* 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 net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis

Narrative Description of Qualitative Benefits

D-Provide Social Recreation or Access Benefits

The golf course industry is an important part of the local and regional economy. The hotel and entertainment industry is the second largest employer in the region. This category is made up of hotels, resorts, Indian gaming, golf courses and other entertainment venues.[20] Recycled water is essential for the golf industry. Recycled water rates are set by CVWD at 15% below the documented cost of groundwater extraction for the golf courses as a financial incentive for using recycled water.[21] The current price DWA's customers pay for recycled water is one half the potable water rate ($0.645/100 CF).[22] Without

[20] Coachella Valley Economic Partnership (CVEP). 2011. *Compete and Prosper: Coachella Valley 2011 Economic Report.* Page 74, Appendix – Employment and Payroll Details. Available: http://cvep.com/LiteratureRetrieve.aspx?ID=107804

[21] Coachella Valley Water District (CVWD). 2011b. *Coachella Valley Water District 2010 Urban Water Management Plan Final Report.* Page 4-29, Section 4.5.3, Recycled Water Customer Incentives.

[22] Katie Ruark, Public Information Officer, Desert Water Agency, email dated February 13, 2013.

the source of recycled water, golf courses would likely revert to private groundwater pumping with the associated increases in energy needed for pumping and increased overdraft of the aquifer system.

E-Help Avoid, Reduce or Resolve Various Public Water Resources Conflicts

This program would ensure compliance with the State of California's Recycled Water Policy, which requires that SNMPs be developed to manage salts, nutrients, and other significant chemical compounds on a watershed- or basin-wide basis. The SNMPs are intended to help streamline permitting of new recycled water projects while ensuring compliance with water quality objectives and protection of beneficial uses. For each groundwater basin, a SNMP is to be provided to the Regional Water Quality Control Board (RWQCB) no later than May 2014. An extension of up to 2 years may be granted by the RWQCB if the region demonstrates substantial progress by the May 2014 deadline.

Stakeholder involvement is a key component of the SNMP. Stakeholders will include those whose activities and operations may impact salt and nutrient loading in the Basin, including water purveyors, wastewater and agricultural interests, private well owners, environmental groups, regulatory staff, and the general public. Stakeholder involvement will increase awareness and collaboration among these parties in addressing the Region's water quality and water supply issues.

K-Promote Social Health and Safety

The purpose of the SNMP provision of the Recycled Water Policy is to cumulatively manage salts and nutrients across groundwater basins. The 2010 *Coachella Valley Water Management Plan Update* reports data on nutrients and TDS that shows that the total load of these constituents is increasing in the Region.[23]Without the project, the Region would not undertake a regional planning process to address salt and nutrient loading in groundwater and, therefore, water quality degradation would likely continue unchecked.

L-Improve Groundwater Quality

The purpose of the SNMP provision of the Recycled Water Policy is to cumulatively manage salts and nutrients across groundwater basins. Information on nutrients and TDS shows that the total load of these constituents is increasing in the Region.[24] Without the project, the Region would not undertake a regional planning process to address salts and nutrients in groundwater and, therefore, salt and nutrient loading would likely continue to occur. Without this program, additional water would be needed to balance inflow and outflow in the groundwater basin. This would most likely come from the Colorado River which has higher TDS (625-975 mg/L[25]) than recycled water (450-500 mg/L[26]). Therefore, without exportation of salts, an increase in usage of Colorado River water for recharge would potentially continue salt loading into the basin.

F- Improve the Overall, Long-Term Management of California Groundwater Resources

The SNMPs are intended to help streamline permitting of new recycled water projects while ensuring compliance with water quality objectives and protecting beneficial uses. The plan will identify and rank overall management goals and strategies to be achieved within the groundwater basin or sub-basin/management areas. Desired goals may focus on source load reduction, treatment, providing other forms of water quality protection, or increased recycled water use.

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[23]Coachella Valley Water District (CVWD). 2010a. *Coachella Valley Water Management Plan Update.* Page5-5, Section 5.1.2.1 Impacts of Colorado River Water Recharge.

[24]Coachella Valley Water District (CVWD). 2010a. *Coachella Valley Water Management Plan Update.* Page5-5, Section 5.1.2.1 Impacts of Colorado River Water Recharge.

[25]Coachella Valley Water District (CVWD). 2012b. *Coachella Canal at Avenue 52 East – Water Quality Data.*

[26]Coachella Valley Water District (CVWD). 2010b. *Coachella Valley 2010 WMP Update Draft Subsequent Program EIR.* Page 6-58, Section 6.4.4.6, Impact of Recycled Water Use.

G-Reduce Demand for Net Diversions for the Regions from the Bay-Delta

This program is required for the continued use of recycled water for golf and other irrigation, thus reducing the need for groundwater extraction. This in turn reduces aquifer drawdown and thus lessens the amount of purchased/exchanged water that is needed for groundwater recharge. CVWD and DWA have contracts for imported water supplies from the State Water Project (SWP), which is managed by the California DWR. Because there is no direct delivery of SWP water to the Coachella Valley, CVWD's and DWA's SWP water is exchanged with MWD for Colorado River water delivered at turnouts from Metropolitan's Colorado River Aqueduct. Transfers or leases from north of or within the Bay-Delta could potentially affect Bay-Delta water quantity or quality. The SNMP, however, will enable continued recycled water use and reduce the demand for additional imported water, which would ultimately be delivered from the Bay-Delta via a SWP water exchange.

H- Provide a Long-Term Solution in Place of a Short-Term One

The SNMP is intended to be long-term planning document to manage salts, nutrients, and other significant chemical compounds on a watershed- or basin-wide basis. A collaborative process will be executed for establishing goals and objectives, gathering input on technical analysis tasks, and developing implementation and basin management measures. This collaborative process will help to ensure that long-term solutions are identified and implemented to manage salts, nutrients, and other relevant water quality constituents in the Region's most important water-related asset, the Coachella Valley Groundwater Basin.

I- Improve Water Supply Reliability

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The *Coachella Valley Salt & Nutrient Management Program* would help address reliability issues for the Region by offsetting the use of imported water through compliance with the Recycled Water Policy.

Although interest in water supply reliability is increasing due to increasing water demands and concerns over climate-related events, only a few studies have directly attempted to quantify its value. 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 $100 to more than $500 per household per year for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).[27]

The challenge in applying these values to determine a value for increased reliability as a result of the *Coachella Valley Salt & Nutrient Management Program* 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 *Coachella Valley Salt & Nutrient Management Program* only enhances overall reliability and does not guarantee 100% reliability. Thus, if applied directly to the number of households within the Region, the dollar values from the studies would overstate the reliability value provided by the program.

[27] Carson, R.T.; Mitchell, R.C. *Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area*; SWC Exhibit Number 54;

The Metropolitan Water District of Southern California, Los Angeles, 1987.

CUWA. *The Value of Water Supply Reliability: Results of a Contingent Valuation Survey of Residential Customers*, California Urban Water Agencies, Sacramento, CA. [Online] 1994, http://www.cuwa.org/library/TheValueofWaterSupplyReliabilityAug94.pdf (accessed October 1, 2009).

Griffin, R.C.; Mjelde, J.W. Valuing Water Supply Reliability. *American Journal of Agricultural Economics* 2000, *82*, 414–426

Raucher, R., J. Clements, and others. 2013. *The Value of Water Supply Reliability in the Residential Sector.* WateReuse Research Foundation. Project WRF-08-09.

Wolff, G. 2007. Calculating constant-reliability water supply unit costs. *Water Policy*. International Water Association, London, UK

A 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 program. To adjust for the partial improvement in reliability from the *Coachella Valley Salt & Nutrient Management Program*, it is assumed that household willingness to pay for improved reliability is directly proportional to the amount of recycled water that will offset imported water, as a percentage of the total water supply. This represents the percentage of total supply that has been improved in terms of overall reliability.

Due to the uncertainty involved in applying quantified economic numbers to the water supply reliability benefits that the Region would accrue as a result of the *Coachella Valley Salt & Nutrient Management Program*, this benefit estimate has been provided here to give an idea of the potential magnitude of this benefit, but has not been quantified or economically monetized within the overall cost-benefit ratio for this program.

Quantified Benefits

C-Prevent Stranded Assets

CVWD has invested $42 million in the Mid-Valley Pipeline (MVP) to date, and this recycled water pipeline asset would be stranded (i.e., would not be used) if water recycling was discontinued for any extended period of time. Additionally, the 2012 CVWD Comprehensive Annual Financial Report demonstrates that CVWD's total sanitation assets were valued at $451 million in 2012.[28] Verbal estimations from CVWD indicate that recycled water facilities are estimated to be 10 to 20 % of the Valley's total sanitation assets.[29] Estimates from DWA indicate that they have invested approximately $26 million (unadjusted for depreciation) in their tertiary treatment facilities and associated distribution system.[30]

As such, it is estimated that assets (recycled water facilities) that would be stranded if recycled water could not be used in the Region, are valued between $75and $125 million. Please note that the aforementioned figure represents a minimum value of stranded assets.

Monetized Benefit Analysis

Several monetized benefits are expected to accrue over the expected five-year life of the project. The five year lifetime is based on the mandated need to update the plan every five years. These monetized benefits include: 1) maintaining the ability to use recycled water and 2) avoiding the cost for drilling at least one new municipal well to replace wells otherwise likely to become nitrate-impacted.

A-Maintain Use of Recycled Water and Avoid Additional Imports

The State of California's Recycled Water Policy requires that Salt and Nutrient Management Plans (SNMPs) be developed to manage salts, nutrients, and other significant chemical compounds on a watershed- or basin-wide basis. The SNMPs are intended to help streamline permitting of new recycled water projects while ensuring compliance with water quality objectives and protection of beneficial uses. For each groundwater basin, a SNMP is to be provided to the Regional Water Quality Control Board (RWQCB) no later than May 2014. An extension of up to 2 years may be granted by the RWQCB if the region demonstrates substantial progress by the May 2014 deadline.

Without the project, the Region would not be in compliance with the state's Recycled Water Policy, and therefore would not be able to continue distribution and use of recycled water as projected. The Region current uses 14,268 AFY (in 2010) and is expected to increase recycled water use to 44,280 AFY in 2035.

[28] Coachella Valley Water District (CVWD). 2012a. *Coachella Valley Water District Comprehensive Annual Financial Report – for the Fiscal Year Ended June 30, 2012.* Page 14, Statement of Net Assets.

[29] Patti Reyes, CVWD Director of Planning and Special Programs, email dated February 15, 2013

[30] Katie Ruark, Public Information Officer, Desert Water Agency, email dated February 13, 2013.

This benefit was calculated by determining the value of the current 14,268 AFY of recycled water that would be lost in 2016 if this project was not started. The year 2016 represents a conservative time frame, which assumes that from the time of violation it would take up to two years for current recycled water permits to be revoked. The amount of recycled water would not be available until a SNMP was ultimately completed, which we assume would occur five years after the current with project SNMP is expected to be completed. This five-year project lifetime was estimated, since state requirements call for the SNMP to be updated every five years. While this project would support the increase in the amount of recycled water, with a projected increase to 44,280 AFY by 2035, data is not currently available on when these increases will occur. Therefore the conservative current value of 14,268 AFY was applied for all fivey ears of the expected benefit for this project.

In order to account for the loss of recycled water, additional water would need to be imported from outside the basin and would most likely come from the Colorado River. The Valley already uses its full Colorado River water allocation, so additional recharge water would need to be acquired from other external sources. This would be done by acquiring rights to SWP water held by other entities, and exchanging these purchased rights with MWD for locally available Colorado River water. The cost per AF of these SWP acquisitions exchanged for Colorado River water has been estimated to be $928.50 in 2012 (see Appendix 8-1 for a detailed description of avoided imported water costs).

B-Reduce Social Costs Associated with CO_2 Emissions

Without this project, golf courses and other irrigation-related recycled water customers would shift to private groundwater wells or use potable municipally-supplied water. Recycled water is currently used as a means of managing the Region's groundwater overdraft, as recycled water use directly offsets both groundwater pumping from private wells and groundwater pumping associated with potable municipal water supplies. Additional groundwater pumping that would be required to replace recycled water would also require the Region to import additional water supplies to the Region. Cumulatively, these actions would increase net emissions, because they would directly increase pumping and associated energy requirements, and would also require energy associated with transporting additional imported water supplies to the Region. This project would also avoid the importation of additional SWP exchange water for groundwater recharge purposes. As a result, this program would avoid energy requirements associated with groundwater pumping, as well as the energy requirements associated with transporting SWP exchange water to the Region. This in turn would result in avoided carbon dioxide (CO_2) emissions (a greenhouse gas (GHG)) associated with the without-project water sources (groundwater pumping and additional SWP water).

For this analysis, it is assumed that energy requirements associated with delivering and using Colorado River water (the source of SWP exchange water) are 2.0 mega-watt hours per acre-foot (MWh/AF), energy requirements associated with delivering and using both recycled water and local groundwater are 0.8 MWh/AF.[31] The following table provides an overview of the cumulative energy and carbon dioxide savings that would result from the program.

[31] As described in Attachment 7, energy use estimates for alternative water supply sources are based on estimates provided in CEC 2005, Navigant 2006, and Equinox 2010. The estimates used for this analysis are as follows: Imported Colorado River Water 2.0 MWh/AF (used for both water supplied via CRA and Coachella Canal), groundwater pumping 0.80 MWh/AF; recycled water treatment and distribution 0.80 MWh/AF.

Table 8-15: Energy and Emissions Savings Estimates
Coachella Valley Salt & Nutrient Management Program

Program Components	Amount Supplied (AFY) a.	Energy Requirements* (MWh/year) b.	Imported Energy Offsets** (MWh/year) c.	Groundwater Pumping Offsets*** (MWh/year) d.	Cumulative Energy Savings (MWh/year) c.+d. – b.	Cumulative CO_2 Savings (MT/year)
Recycled Water Produced and Used	14,628	11,702	29,256	11,702	29,256	10,356
Program Total (per year)						**10,356**
Program Total (5-year lifetime)						**51,780**

**Energy requirements were calculated based on an assumption of 0.8 MWh/AF for pumping associated with use of reclaimed water*

*** Imported Energy Offsets were calculated based on an assumption of 2.0 MWh/AF for importation of Colorado River Water*

**** Groundwater Pumping Offsets were calculated based on an assumption of 0.8 MWh/AF for well pumping that would occur without this project.*

To calculate avoided CO_2 emissions associated with the program, the amount of energy that would be saved due to implementation of the program (29,256 MWh per year) was multiplied by the average carbon emissions rate associated with energy production in California (0.354 megatons of CO_2 per megawatt-hour of energy (MT/MWh)). By avoiding 14,628 AFY of groundwater pumping and imported SWP exchange water, the program would result in a net reduction in CO_2 emissions of 10,356 MT per year.

To monetize this benefit, the dollar value assigned to GHG emissions, measured in carbon dioxide equivalent (CO2e), was applied. The social cost of carbon is estimated as the aggregate net economic value of damages from climate change across the globe, and is expressed in terms of future net benefits and costs that are discounted to the present.[32] In February 2010, the U.S. Government's Interagency Working Group on Social Cost of Carbon issued guidance on recommend values for the social cost of carbon for use in regulatory benefit-cost analysis. The recommended mean estimate of the social cost of reducing one metric ton of CO_2 in 2012 is $22.53/MT (updated from 2010 values using CPI), with a range of values from$4.95 to $68.33 per MT.[33]

For this analysis, the average value of $22.53/MT for 2012 was used when calculating social benefits and costs, which produces conservative estimates for the benefits and costs associated with GHG emissions. The United Kingdom has established an official estimate of the social cost of carbon for use in many of its program evaluations and models the growth rate of the cost at 2.4% per year in real terms. To determine total costs over the program period, the real social cost of carbon was escalated by 2.4% per year, which is above the general rate of inflation. The social cost of carbon would increase in future years because CO_2 would produce larger incremental damages as physical and economic systems become more stressed in responding to greater climate change.

[32] Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK. pp. 7–22.

[33] Interagency Working Group. 2010. *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon,* United States Government. February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf.

Over the 5-year program life, total present value benefits associated with avoided social costs of carbon amount to $825,204.

J-Avoid Cost of Drilling New Municipal Wells

Data collected in the region has shown that nitrate levels are increasing in some areas. Since 2007, CVWD has inactivated four wells due to increasing nitrate levels (CVWD, 2011). A number of other wells are being monitored on a monthly basis, with some approaching triggers for removing them from service. Without this SNMP and the implementation of strategies to reduce nutrient levels, additional wells may need to be taken out of service.

Information from the CVRWMG agencies demonstrates that wellhead treatment for nitrates requires advanced water treatment that is prohibitively expensive on an individual well-by-well basis. [34] As such, when wells become contaminated (generally with nitrates), the agencies will tend to drill a new well in non-contaminated areas rather than invest in additional treatment at the contaminated site. Four wells are or particular concern and without this project may need to be replaced in the next 20 years. Therefore, over the assumed five year course of this project, it is estimated that one new well would need to be drilled.

According to estimates provided by DWA, the cost of drilling a new potable water well at Plant 41 was estimated to be $1,042,000.[35] The aforementioned numerical estimate was provided by DWA and represents the actual cost associated with construction potable water well Plant 41 in DWA's service area.

Table 8-16 summarizes the annual benefits from the project, and Table 8-17 summarizes the annual avoided costs from the project.

[34] Coachella Valley Water District (CVWD). 2010a. *Coachella Valley Water Management Plan Update.* Page 8-12 and 8-13, Section 8.1.4.3 Nitrate Remediation/Treatment.

[35] Katie Ruark, Public Information Officer, Desert Water Agency, email dated February 13, 2013.

Table 8-16: Annual Project Benefits (PSP Table 15

Coachella Valley Salt & Nutrient Management Program

Annual Project Benefits (2012 Dollars)									
(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)**	**Disco-unt Factor***	**Discounted Benefits (h) x (i)**
2016 - 2020	Maintain Use of Recycled Water and Avoid Additional Imports	AFY	0 AFY	14,268 AFY	14,268 AFY	$974/AF	$13,897,032	0.792	**$11,008,457**
2016 - 2020	Reduce Net Generation of GHGs	MT/Year	14,499 MT/Year	4,143 MT/Year	-10,356 MT/Year	$22.53/ MT	$233,321	0.792	**$184,812**
Total Present Value of Discounted Benefits for Maintaining Recycled Water Use Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$50,373,746**
Total Present Value of Discounted Benefits for Maintaining Recycled Water Use Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$825,204**
TOTAL Present Value of All Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$51,198,950**
***Note:** Discount factors provided in the table above are those for the year 2016. Discount rates from 2017-2020 have been applied to calculate the total present value of discounted benefits in accordance with DWR discount rates.*									

Table 8-17: Annual Costs of Avoided Projects (PSP Table 16)

Coachella Valley Salt & Nutrient Management Program

Annual Costs of Avoided Projects (2012 Dollars)						
	Costs				**Discounting Calculations**	
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**
Year	**Avoid Cost of Drilling New Municipal Wells**					
	Avoided Capital Costs	**Avoided Replace-ment Costs**	**Avoided Operations and Maintenance Costs**	**Total Costs Avoided for Individual Alternatives (b) + (C) + (d)**	**Discount Factor**	**Discounted Costs (e) x (f)**
2016	$1,042,000			$1,042,000	0.792	$825,362
Total Present Value of Discounted Costs (Sum of column (g))						**$825,362**
(%) Avoided Cost Claimed by Project						**100**
Total Present Value Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$825,362**

Project Benefits and Costs Summary

Project Economic Costs

Table 8-18 summarizes the schedule of expenditures for the Coachella Valley Salt & Nutrient Management Program and Table 8-19 summarizes the economic project costs for the project. Costs are for labor associated with managing and developing the SNMP. The labor is spread over a four year period, with the majority of work being accomplished in 2013, 2014, and 2015.

It is important to note that this project is Phase II of a two-phase effort. Phase 1 had a total cost of $107,625 and was completed in 2013.Phase I costs are included in the total present value costs associated with this project. Phase II, or this project, is what is needed to be in compliance with the Recycled Water Policy. The SNMP would also require periodic updating. This is estimated to be every five years because the Recycled Water Policy requires that a Blue Ribbon Panel update their Constituents of Emerging Concern [CEC] Report every 5 years. Further, it is realistic to assume that the SNMP will require regular updating similar to other water planning efforts such as Urban Water Management Plans, which are updated every five years. The effort (scope) and potential costs associated with updating the SNMP are unknown at this time, as it is unknown what would be required to complete a SNMP update. Further, no costs are included in this analysis for updating the plan, as each 5-year renewal increment is not currently required for compliance with the Recycled Water Policy, and therefore should be considered independently.

Table 8-18: Total Project Cost Schedule
Coachella Valley Salt & Nutrient Management Program

Year	Phase I	Phase II (Work included in Grant Work Plan)
2012	$90,000	$0
2013	$17,625	$128,733
2014	$0	$379,422
2015	$0	$169,385
Total	**$107,625**	**$677,540**

Table 8-19: Project Annual Costs (PSP Table 19)

Coachella Valley Salt & Nutrient Management Program

Project Annual Costs (2012 Dollars)										
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012							$90,000	$90,000	1.000	$90,000
2013	$128,733						$17,625	$146,358	0.943	$138,016
2014	$379,422							$379,422	0.890	$337,686
2015	$169,385							$169,385	0.840	$142,283
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$707,985**

Benefits and Costs Summary

The estimated present value of the benefits of this projects are $52,024,312, which are comprised of: the value of maintaining the use of recycled water ($50,373,746 present value benefit), the value of reducing net generation of greenhouse gases ($825,204 present value benefit), and the avoided costs associated with not needed to drill an additional well during the project period ($825,362 present value cost). The present value cost of this project is $707,985. Therefore, the benefit to cost ratio for this project is 73:1.

Omissions, Uncertainties, and Biases

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 benefit associated with maintaining the ability to use recycled water and avoid additional water imports. These issues are listed in Table 8-20.

Table 8-20: Omissions, Biases, and Uncertainties

Coachella Valley Salt & Nutrient Management Program

Benefit or Cost Category	Likely Impact on Net Benefits*	Omissions, Biases, and Uncertainties
Maintain Use of Recycled Water and Avoid Additional Imports	+	Does not account for any increase in recycled water volume for 2011 until end of without project impact
Maintain Use of Recycled Water and Avoid Additional Imports	U	Since the SNMP has not yet been developed, we do not know the specific outcomes for S&N management and their potential impacts on recycled water volumes
Maintain Use of Recycled Water and Avoid Additional Imports	U	Operations and maintenance savings from not operating the recycled water plant. May balance with new O+M needs associated with water imports.
Reduced social costs of carbon	U	The social cost of carbon used in this analysis represents the mid-point of values presented in the literature. The true social cost of carbon may be higher or lower than the estimate used here.

*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 3: Groundwater Quality Protection Program – Subarea D2

Introduction

This attachment presents the economic analysis for the Groundwater Quality Protection Program–Subarea D2 Project. A project abstract and project benefit summary table are followed by the following sections as outlined in the PSP: Non-Monetized Benefits Analysis (Section D2), Monetized Benefit Analysis (Section D3), and Project Benefits and Costs Summary (Section D5).

Project Abstract

The City of Desert Hot Springs is classified as an economically disadvantaged community (DAC), located within the Mission Springs Water District (MSWD) service area, which is located within the Colorado River Basin. This community overlays the Desert Hot Springs groundwater aquifer, a hot-water groundwater basin containing hot mineral water with temperatures exceeding 100 degrees Fahrenheit. This water serves as the economic basis of the City of Desert Hot Springs, because it draws visitors to the City's numerous spa resorts and hotels.

The Colorado River Basin Regional Water Quality Control Board's (RWQCB) *Water Quality Control Plan for the Colorado River Basin* (Basin Plan) notes septic system impacts to groundwater as a critical regional issue and specifically states that septic systems within the Colorado River Basin have the potential to negatively impact groundwater.[36] In addition, the RWQCB recommends a specific septic tank density that should be implemented to reduce groundwater quality impacts. Portions of the City of Desert Hot Springs have septic tank densities that are 2.3 to 2.8 times higher than the density recommended by the RWQCB. As such, the high density of the septic systems potentially threatens the water quality of the local groundwater supply, and therefore the local economy, which is highly dependent on hot mineral water to support the spa and hotel industry.

As a response to local issues associated with high-density septic systems, Assessment District 12 was approved by voters in 2004, providing approximately $28 million of matching funds that expires in 2014. This money was used to fund engineering design of a wastewater collection system that will abate approximately 6,000 on-site septic systems. Design of 10 sub-areas that make up the Assessment District is complete, and funds are now needed for construction. Environmental compliance documentation was completed in 1998 and re-certified in 2007.

The project area, Subarea D2, consists of 582 parcels and 382 existing on-site septic systems that will be converted to sewers by connecting to the existing MSWD sewer system. Wastewater collected by the MSWD sewer system would be sent to the existing Horton Wastewater Treatment Plant (WWTP), where it would be beneficially reused via percolation. Project construction includes installing 18,555 linear feet of 8-inch vitrified clay pipe (VCP) sewer, 15,281 lineal feet of 4-inch VCP sewer laterals, 70 manholes, and all appurtenances. Final design work for Subarea D2 was completed in 2010, and construction is currently ready to bid.

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-21. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7.

[36] Colorado River RWQCB. 2006. *Water Quality Control Plan for the Colorado River Basin (Region 7).* Includes Amendments through June 2006. Section III: Regional Board Issues, A: Septic System Impacts to Groundwater Basins, page 5-2. Section II. Point Source Controls, H: Septic Systems, page 4-5.

Please note that the numbering associated with each benefit has been completed in accordance with the numbering presented in Attachment 7; therefore benefits described below may not be presented in numeric order.

Table 8-21: Benefit-Cost Analysis Overview

Groundwater Quality Protection Program – Subarea D2

	Present Value
Costs – Total Capital and O&M	**$3,715,196**
Monetizable Benefits	
A. Avoid Cost of Imported Water for Recharge	$1,779,515
D. Avoid Loss of Hotel Revenue and Transient Occupancy Tax	$5,466,164
E. Avoid O&M Costs to Septic Tank Owners	$2,222,099
Total Monetizable Benefits	**$9,467,779**
Qualitative Benefit or Cost	**Qualitative Indicator***
B. Reduce Demand for Net Diversions from the Bay-Delta C. Improve Water Supply Reliability	+ +
F. Avoid Groundwater Treatment	++
G. Provide Social Recreation Benefits	++
H. Promote Social Health and Safety	+
I. Avoid Losses in Spa Economy	++
J. Benefit Wildlife or Habitat Through Recharge	U
K. Improve Groundwater Quality and Protect Beneficial Uses	+
L. Improve the Overall, Long-Term Management of California Groundwater Resources	+
M. Provide a Long-Term Solution	++

* 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 net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis

Narrative Description of Qualitative Benefits

B-Reduce Demand for Net Diversions from the Bay-Delta

The *Groundwater Quality Protection Program – Subarea D2* involves septic-to-sewer conversions that will allow for beneficial reuse (direct and indirect groundwater recharge) of wastewater flows that would otherwise be lost to the Desert Hot Springs subbasin. This additional recharge would amount to 158 AFY beginning in 2018, and would offset the need to import additional water for groundwater recharge purposes. CVWD and DWA have contracts for imported water supplies from the SWP, which is exchanged with MWD for Colorado River water delivered at turnouts from MWD's Colorado River Aqueduct. Because the Region already receives its entire imported water entitlements (as they are available) and also purchases additional SWP Table A water from other agencies[37], any additional imported water needed to balance groundwater extraction would be purchased and transferred from the

[37] Coachella Valley Water District (CVWD). 2011. *Coachella Valley Water District 2010 Urban Water Management Plan Final Report.* Page 4-19, Section 4.2.3.2 Other SWP Transfers.

SWP. Transfers or leases from north of or within the Bay-Delta could potentially affect Bay-Delta water quantity or quality.

By reducing the need to import additional water for groundwater recharge, the project would directly offset demands for additional State Water Project (SWP) water to balance basin extraction. Therefore, this project would offset net diversions from the Bay-Delta and help preserve this vital resource.

C- Improve Water Supply Reliability

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The project will help address reliability issues by offsetting the need for additional future use of imported water for groundwater recharge. The reliability of imported water is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought and earthquakes, to environmental regulations and water rights determinations.

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies indicate that residential and industrial customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay $100 to more than $500 per household per year for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).[38]

The challenge in applying these values is to determine a value of increased reliability as a result of this project and 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 this project only enhances overall reliability and does not guarantee 100% reliability. Thus, if applied directly to the number of households within the MSWD service area, the dollar values from the studies would overstate the reliability value provided by the project.

A 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. To adjust for the partial improvement in reliability from this project, it is assumed that household willingness to pay for improved reliability is directly proportional to the amount of recycled water that will offset imported water, as a percentage of the total potable water supply. This represents the percentage of total supply that has been improved in terms of overall reliability (i.e., by offsetting imported water demand with local sources).

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.

[38] Carson, R.T.; Mitchell, R.C. *Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area*; SWC Exhibit Number 54; The Metropolitan Water District of Southern California, Los Angeles, 1987.

CUWA. *The Value of Water Supply Reliability: Results of a Contingent Valuation Survey of Residential Customers*, California Urban Water Agencies, Sacramento, CA. [Online] 1994, http://www.cuwa.org/library/TheValueofWaterSupplyReliabilityAug94.pdf (accessed October 1, 2009).

Griffin, R.C.; Mjelde, J.W. Valuing Water Supply Reliability. *American Journal of Agricultural Economics* 2000, *82*, 414–426

Howe, C.W.; Smith, M.G. The Value of Water Supply Reliability in Urban Water Systems. *Journal of Environmental Economics and Management* 1994, *26*, 19–30.

Raucher, R., J. Clements, and others. 2013. *The Value of Water Supply Reliability in the Residential Sector.* WateReuse Research Foundation. Project WRF-08-09.

Wolff, G. 2007. Calculating constant-reliability water supply unit costs. *Water Policy*. International Water Association, London, UKGriffen and Mjelde, 2000, Raucher et al., 2013

F-Avoid Groundwater Treatment

By eliminating wastewater from entering the groundwater aquifer within the project area, the *Groundwater Quality Protection Program – Subarea D2* project would potentially reduce or eliminate the need to conduct groundwater treatment to remove nitrate, pathogens, and other constituents. The primary purpose of this project is to remove a source of contaminates (wastewater) from coming into contact with groundwater in the Desert Hot Springs aquifer. If the project were not implemented, it is possible that groundwater users such as local hotels and spas would install onsite treatment devices to remove contaminants such as nitrates, pathogens, and other constituents from the water. Although not economically monetized, such treatment activities would likely be expensive, potentially prohibitively expensive to the residents and business owners within Desert Hot Springs, an economically disadvantaged community.

An independent consultant has calculated the potential costs required to remove nitrates from wells within the Desert Hot Springs aquifer. Initial capital costs of $857,000 would be needed to install wellhead treatment equipment on two hypothetical wells with a combined capacity of 3,500 gallons per minute.

At this time it is not know what type of treatment would be required, because the specific type of contaminants present in the groundwater are not known. Further, it is not known what the treatment capacity would need to be since this value is dependent upon the impacted well in question, which is hypothetical at this time. Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables. However, an approximate treatment cost for nitrates is provided here to give an idea of the potential magnitude of this benefit.

G-Provide Social Recreation Benefits

The Desert Hot Springs subbasin, which underlies Subarea D2, contains natural mineral hot springs. The community of Desert Hot Springs contains an estimated 24 businesses that are marketed as a spa and other services associated with the natural mineral hot springs. If the Desert Hot Springs subbasin and the associated hot springs were to become contaminated from leaking or failing septic tanks in Subarea D2, the tourism-related business of the Desert Hot Springs community would be substantially impacted. The conversion of Subarea D2 to a municipal sewer system reduces the probability of contamination and associated loss of tourism and recreation. Direct monetized benefits associated with hotel revenue and transient occupancy tax revenue associated with tourism are provided in the preceding section. However, the mineral hot springs that would be protected by this project also provide other social benefits such as therapeutic recreation benefits that have not been monetized, because they are qualitative in nature.

H-Promote Social Health and Safety

If the Desert Hot Springs groundwater aquifer were contaminated with nitrates, pathogens, or other constituents from leaking or failing septic systems, those constituents could impact the public health of spa users that would come into direct contact with contaminated water.

I-Avoid Losses in Spa Economy

As shown in Figure 3-2 in Attachment 3, the City of Desert Hot Springs is a DAC whose households earn less on average than the Statewide median household income of $48,706. The City of Desert Hot Springs Financial Statements for FY 2011 also show that faced a $5.9 million deficit in 2011.[39] Because the city of Desert Hot Springs is a DAC, loss of revenue to this economy would be particularly burdensome and could cause catastrophic social and economic impacts. The project would help to avoid these impacts by protecting hotel revenues and transient occupancy tax revenue.

[39] City of Desert Hot Springs. 2012. *City of Desert Hot Springs Financial Statements, Year Ending June 30, 2011.* Page 4, "Change in Net Assets"

J-Benefit Wildlife or Habitat Through Recharge

A RWQCB staff report on the Salton Sea Transboundary Watershed shows that the Coachella Valley IRWM Region is located within the Salton Sea Transboundary Area, meaning that Subarea D2 is hydrologically connected to the Salton Sea.[40] This staff report also discusses water quality issues such as nutrient impairment and eutrophication within the Salton Sea, which are from constituents such as nitrates often found in septic effluent.[41] Without the project, water quality constituents from leaking or failing septic tanks in Subarea D2 would continue to infiltrate into the Desert Hot Springs groundwater aquifer, and could eventually enter the Salton Sea.

Groundwater extraction in the Region also has the potential to impact the continued viability of mesquite hummocks, which provide important habitat for locally-important species that include the Coachella Valley fringe-toed lizard, Palm Springs pocket mouse, and Coachella Valley round-tailed ground squirrel.[42] These mesquite hummocks often occur along fault zones where groundwater is forced to the surface, such as the mesquite hummocks along the Banning Fault in the Willow Hole Conservation Area. The vegetation structure of the mesquite traps sand that has been transported by wind from sand deposited or exposed by flood events in Mission Creek and Morongo Wash floodplains on the south side of the Banning Fault forming dunes and hummocks along the fault line. The mesquite associated with sand dunes enhances conditions that provide habitat for the aforementioned species.[43] The *Supplemental EIR/EIS for the Coachella Valley Multiple Species Habitat Conservation Plans/Natural Community Conservation Plan* acknowledges that potential threats to the mesquite hummocks natural community in the Region include competition for subsurface water from non-native tamarisk and the drawdown of the groundwater table within the Mission Creek subbasin.

As described above, MSWD currently percolates treated effluent into the Mission Creek subbasin. Though this does not reduce the demand for pumped groundwater (as would distribution of recycled water), it does provide recharge that benefits basin as a whole and lessens the impact of pumping.[44] The proposed project would contribute wastewater flows to the HWWTP which would in turn either recycle it for beneficial reuse (planned to begin in 2020)[45] or continue to percolate it at the plant. These activities will contribute to the long-term health of the mesquite hummocks and other groundwater-dependant habitats within the Coachella Valley.

K-Improve Groundwater Quality and Protect Beneficial Uses

Effluent from septic tanks is known to contain relatively high concentrations of nitrite, nitrate, and nitrogen as ammonia, which can leach into the local groundwater, thereby causing increased nitrate concentrations in groundwater. Further, leaking or failing septic tanks could potentially leach raw sewage into the local groundwater, which would pose further water quality issues associated with fecal matter contamination and associated pathogens. By removing this potential source of nitrate, the project will help improve water quality within the Desert Hot Springs and Mission Creek groundwater aquifers.

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[40] Regional Water Quality Control Board (RWQCB). 2000. *California Environmental Protection Agency Regional Water Quality Control Board Colorado River Basin Region – Staff Report: Water Quality Issues in the Salton Sea Transboundary Watershed.*

[41] Regional Water Quality Control Board (RWQCB). 2000. *California Environmental Protection Agency Regional Water Quality Control Board Colorado River Basin Region – Staff Report: Water Quality Issues in the Salton Sea Transboundary Watershed.*

[42] Coachella Valley Association of Governments. 2007. *Supplemental Environmental Impact Report/Supplemental Environmental Impact Statement for a Major Amendment to the Coachella Valley Multiple Species Habitat Conservation Plans/Natural Community Conservation Plan*. Page 4.2-10.

[43] Coachella Valley Association of Governments. 2007. *Supplemental Environmental Impact Report/Supplemental Environmental Impact Statement for a Major Amendment to the Coachella Valley Multiple Species Habitat Conservation Plans/Natural Community Conservation Plan*. Page 4.2-10.

[44] MSWD. 2011. *2010 Urban Water Management Plan.* Section 2.2.4 Recycled Water, page 2-19.

[45] MSWD. 2011. *2010 Urban Water Management Plan.* Section 2.2.4 Recycled Water, page 2-19.

Further, due to the project's location within the Salton Sea Transboundary Watershed, groundwater within the Desert Hot Springs groundwater aquifer is hydrologically connected to the Salton Sea, meaning that constituents from septic tanks could eventually enter the Salton Sea. The Salton Sea is already challenged with water quality issues such as nutrient impairment and eutrophication, which result in low dissolved oxygen, high ammonia levels, and foul odors.[46] Further inputs of nitrates into the sea could exacerbate these issues.

L-Improve the Overall, Long-Term Management of California's Groundwater Resources

The *Groundwater Quality Protection Project – Subarea D2* involves septic-to-sewer conversions that will increase the amount of treated wastewater that can be used for groundwater recharge and for recycled water when the HWWTP upgrades to tertiary treatment in the future.[47] Recharge from the HWWTP will supplement supplies in the Mission Creek groundwater aquifer that serves as the primary source of water for users within the MSWD service area. Further, future recycled water provided by the HWWTP will be used by irrigation customers to offset groundwater pumping, and will therefore also benefit water users within the MSWD service area and Valley-wide.

These benefits will help to manage California's groundwater resources (Mission Creek groundwater aquifer is Basin 7-21.02 as designated by DWR Bulletin 118[48]) on a long-term basis as they will help recharge the local groundwater basin or provide for source substitution due to recycled water provisions from HWWTP that would be used to offset localized groundwater pumping from the Mission Creek groundwater aquifer.

M-Provide a Long-Term Solution

The *Groundwater Quality Protection Project – Subarea D2* involves septic-to-sewer conversions that will provide sustainable long-term management of local wastewater (in lieu of septic systems) and increases beneficial reuse of wastewater flows, thereby reducing dependence on imported water necessary for recharging the groundwater basin. As such, this project provides a long-term solution to local wastewater management in the Desert Hot Springs community and will provide infrastructure that will help the Region to manage its groundwater resources on a long-term basis.

Monetized Benefit Analysis

Several monetized benefits are expected to accrue over the expected 60-year life of the project. Those include the avoided purchase of imported water, avoided loss of hotel revenue and transient occupancy tax, avoided O&M costs to septic tank owners, and avoided wellhead treatment.

A-Avoid Cost of Imported Water for Recharge

The MSWD groundwater protection program involves septic-to-sewer conversions that will increase wastewater flows to the HWWTP. The 2010 *Urban Water Management Plan* shows that wastewater produced at the HWWTP is currently placed in percolation ponds that are located over the Mission Creek groundwater aquifer.[49] Therefore, flows are currently used for recharge and are beneficially reused, as MSWD primarily uses water from the Mission Creek aquifer.[50] Without the project, wastewater flows

[46] Regional Water Quality Control Board (RWQCB). 2000. *California Environmental Protection Agency Regional Water Quality Control Board Colorado River Basin Region – Staff Report: Water Quality Issues in the Salton Sea Transboundary Watershed.*

[47] MSWD. 2011. *2010 Urban Water Management Plan.* Section 2.2.4 Recycled Water, page 2-19.

[48] California Department of Water Resources. 2013. *Basins and Subbasins of the Colorado River Hydrologic Region*. Available: http://www.water.ca.gov/groundwater/bulletin118/colorado_river.cfm

[49] Mission Springs Water District (MSWD). 2011. *2010 Urban Water Management Plan.* Section 2.2.4 Recycled Water, page 2-19.

[50] Mission Springs Water District (MSWD). 2011. *2010 Urban Water Management Plan.* Page 2-1, Section 2.1.1 Groundwater.

from Subarea D2 would infiltrate into the non-potable Desert Hot Springs groundwater aquifer, which is not used as a water supply source. Therefore, the water would not be beneficially reused.

This project will connect 582 parcels and 382 septic systems to MSWD wastewater collection system. Information from the engineering and design work completed to date for the project shows that the total wastewater flows from Subarea D2 are 0.141 million gallons per day (mgd) or 158 acre-feet per year (AFY).[51] Applying MSWD's assumption that 10% would be losses in the treatment system, Subarea D2 will provide 142.2 AFY in future recycled water supply.

As described above, MSWD currently percolates treated effluent into the Mission Creek subbasin. Though this does not reduce the demand for pumped groundwater (as would distribution of recycled water), it does provide recharge that benefits basin as a whole and lessens the impact of pumping.[52] Without this project, additional water may need to be imported from outside the basin to balance extraction. Regional water purveyors already use their full Colorado River water allocations for groundwater recharge, so additional groundwater recharge water would need to be acquired from other external sources. [53] This would be done by acquiring rights from to State Water Project (SWP) water held by other entities, and exchanging these purchased rights with MWD for locally-available Colorado River water. The cost per acre-foot of these SWP acquisitions exchanged for Colorado River water has been estimated to be $928.50 in 2012 (see Appendix 8-1).

As demonstrated in Table 8-24, it is anticipated that avoided imported water benefits would begin accruing in 2018, with 25% of the properties connected each year for the first four years. As such, in 2018 approximately 25% of the total imported water costs will be offset by project-related groundwater recharge (35.55 AFY), and this value will increase to the total project flow value (142.2 AFY) by 2021 and extend through the 60-year project lifetime (through 2078). As indicated within Appendix 8-1, the offset imported water costs will increase annually based on a variety of factors.

D-Avoided Loss of Hotel Revenue and Transient Occupancy Tax

The Desert Hot Springs subbasin, over which Subarea D2 lies, contains natural mineral hot springs. The Desert Hot Springs community contains an estimated 24 businesses that are marketed for spa and other services associated with the natural mineral hot springs. If the Desert Hot Springs subbasin and the associated mineral hot springs were to become contaminated by contaminants from septic discharges, the tourism-related business of the Desert Hot Springs community would be substantially impacted.

The hotel industry in Desert Hot Springs for fiscal year (FY) 2011 brought in $9,066,667 in revenue to the region. The calculation for estimated lost revenue is based on the Transit Occupancy Tax (TOT) and sales tax revenues for the *City of Desert Hot Springs Annual Financial Report* from 2011. This report shows that hotel revenue in Desert Hot Springs included $1,088,000 for TOT revenue in 2011 from a 12% hotel tax, which represents tax collected on hotel revenue of $9,066,667 (12% of $9,066,667 = $1,088,000).[54] A 1% loss of this income would be $90,667/year. In addition to this loss in hotel revenue there also would be a loss in the TOT, which was 12% of the hotel revenue in 2011. For FY 2011, the TOT received from the hotel industry in Desert Hot Springs was $1,088,000, and 1% of this amount is $10,880.[55] Therefore, given the assumed probability and extent of impact, the expected benefit received by preventing contamination of the Desert Hot Springs subbasin would be $101,547 per year. This calculation assumes that it will take businesses five years to recover annual hotel and TOT revenues.

[51] Mission Springs Water District (MSWD). 2013. *Groundwater Protection Program Sewer Exhibit.*

[52] MSWD. 2011. *2010 Urban Water Management Plan.* Section 2.2.4 Recycled Water, page 2-19.

[53] Coachella Valley Water District (CVWD). 2010a. *Coachella Valley Water Management Plan Update.* Page 4-15, Section 4.3, State Water Project.

[54] City of Desert Hot Springs. 2011. *Financial Statements Year Ended June 30, 2011.* Page 4, Statement of Activities, Transient Occupancy Taxes.

[55] City of Desert Hot Springs. 2011. *Financial Statements Year Ended June 30, 2011.* Page 4, Statement of Activities, Transient Occupancy Taxes.

For purposes of assessing the benefits of this project, it was assumed that there is 2% risk in any given year that 50% of the businesses would be impacted by septic-related contamination and forced to close without this project, starting in 2018 after project construction and spanning over the 60 year lifetime of this project. This is equivalent to 24 businesses being impacted over the course of this project, or 0.24 businesses per year. This would equivalent to a 1% loss in the mineral hot springs-related tourism industry revenue per year (0.24/24 X 100).

Once contaminated, it is assumed that each individual business would suffer a five- year reduction in business. This five-year period would be needed to provide time to explore and implement alternatives such as on-site treatment and then rebuild consumer confidence in the water quality and the local mineral hot springs spa industry. Therefore, the total risk of loss without this project would be 5% annually (5 years X 1% loss per year). However, taking a conservative approach and assuming that since the risk of contamination is first monetized starting in 2018, then the losses start at one percentage and increase by 1% per year until the 5 % maximum is reached (1% in 2018, 2%in 2019, etc.).

This calculation conservatively assumes no treatment costs, which may significantly increase the avoided costs of this project. Further, this analysis is conservative in that contamination at one resort in the Region may have a spillover effect to other resorts, and may take more than five years to restore consumer confidence. The calculations also do not account for any increases in the amount of business, or price increases, which would increase the overall value of spa-related services put at risk without the project. Calculations considered in this analysis are provided in the following table.

Table 8-22: Summary of Avoided Hotel Revenue and TOT Losses (Undiscounted)
Groundwater Quality Protection Program – Subarea D2

Year	Annual Hotel Revenue (Avoided) a.	Annual TOT Revenue (Avoided) b.	Contamination Risk (Percent) c.	Total Annual Losses Avoided (a.+b.) x c.
2018	$90,667	$10,880	1	$101,547
2019	$90,667	$10,880	2	$203,094
2020	$90,667	$10,880	3	$304,641
2021	$90,667	$10,880	4	$406,188
2022-2078	$90,667	$10,880	5	$507,735

E-Avoid O&M Costs to Septic Tank Owners

By replacing septic systems with sewer connections, the *Groundwater Quality Protection Program – Subarea D2* project would eliminate costs to septic tank owners associated with operations, maintenance, and replacement costs of septic tanks. Of the 6,000 septic tanks in AD-12, this project would replace 382 septic tanks associated with 582 parcels. It is assumed that approximately 25% of the individual septic systems would be replaced with municipal service connections each year from 2018 - 2021.

MSWD estimates that septic system replacement costs average $10,000 over a 25-year period, or approximately $400 per year.[56] This project would replace 382 septic tanks, therefore resulting in an annualized avoided cost of $152,800 per year ($400 x 382). It is assumed that approximately 25% of Subarea D2 customers would connect each year from 2018 – 2021, therefore staggering this avoided cost through those first four years. This is reflected as an avoided replacement cost in Table 8-25.

MSWD also estimates that for 382 septic systems, the annualized O&M costs are estimated to be $500 for pumping every three to five years, indicating an average maintenance cost of $125 per year per septic

[56] Personal communication from John Soulliere, Admin Officer/Public Relations, Mission Springs Water District

tank.[57] Therefore the net benefit would be $525/year per septic tank avoided ($400 per year + $125 per year).

This project assumes that 25% (95.5) of septic systems will be connected per year to this project between 2018-2021, so net avoided cost benefits begin in 2018 and increase on an annual basis from 2018-2021.

Table 8-23: Summary of Avoided Costs to Septic Tank Owners
Groundwater Quality Protection Program – Subarea D2

Year	Number of Septic Systems Replaced	Septic System Replacement Costs (Avoided)	O&M Costs (Avoided)	Total Avoided Costs*
2018	95.5	$38,200	$11,938	$50,138
2019	191	$76,400	$23,875	$100,275
2020	286.5	$114,600	$35,813	$150,413
2021-2078	382	$152,800	$47,750	$200,550
**The avoided costs presented in this table are undiscounted for illustrative purposes only*				

Table 8-24: Annual Project Benefits (PSP Table 15)
Groundwater Quality Protection Program– Subarea D2

Annual Project Benefits (2012 Dollars)									
(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)
2018	Avoid Cost of Imported Water for Recharge	AFY	0 AFY	35.6 AFY	35.6 AFY	$999.31	$35,575	.705	$25,079
2018	Avoid Loss of Hotel Revenue and TOT	$/year	$0	$101,547	$101,547	1	$101,547	.705	$71,587
2019	Avoid Cost of Imported Water for Recharge	AFY	0 AFY	71.1 AFY	71.1 AFY	$1,012.59	$71,995	.665	$47,881
2019	Avoid Loss of Hotel Revenue and TOT	$/year	$0	$203,094	$203,094	1	$203,094	.665	$135,069
2020	Avoid Cost of Imported Water for Recharge	AFY	0 AFY	106.7 AFY	106.7 AFY	$1,026.35	$109,511	.627	$68,709
2020	Avoid Loss of Hotel Revenue and TOT	$/year	$0	$304,641	$304,641	1	$304,641	.627	$191,136

[57] Personal communication from John Soulliere, Admin Officer/Public Relations, Mission Springs Water District

Annual Project Benefits (2012 Dollars)									
(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)**
2021-2078	Avoid Cost of Imported Water for Recharge	AFY	0 AFY	142.2 AFY	142.2 AFY	$1,032.45	Variable	Variable	$1,637,846
2021	Avoid Loss of Hotel Revenue and TOT	$/year	$0	$406,188	$406,188	1	$406,188	.592	$240,422
2022-2078	Avoid Loss of Hotel Revenue and TOT	$/year	$0	$507,735/yr	$507,735/yr	57 years	$28,940,895	Variable	$4,827,951
Total Present Value of Discounted Benefits from Avoided Cost of Imported Water Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$1,779,515**
Total Present Value of Discounted Benefits from Avoided Loss of Hotel Revenue and TOT Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$5,466,164**
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$7,245,679**

Table 8-25: Annual Costs of Avoided Projects
Groundwater Quality Protection Program – Subarea D2

Annual Costs of Avoided Projects (2012 Dollars)						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Avoided Costs to Septic Tank Owners					
Year	**Avoided Capital Costs**	**Avoided Replacement Costs**	**Avoided Operations and Maintenance Costs**	**Total Costs Avoided for Individual Alternatives (b) + (c) + (d)**	**Discount Factor**	**Discounted Costs (e) x (f)**
2018	$0	$38,200	$11,938	$50,138	.705	$35,345
2019	$0	$76,400	$23,875	$100,275	.665	$66,689
2020	$0	$114,600	$35,813	$150,413	.627	$94,371
2021-2078	$0	$152,800	$47,750	$200,550	Variable	$2,025,695
Total Present Value of Discounted Costs (Sum of column (g))						**$2,222,099**
(%) Avoided Cost Claimed by Project						**100%**
Total Present Value Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$2,222,099**

Project Benefits and Costs Summary

Project Economic Costs

Table 8-27 summarizes the economic costs for the project. The project costs include project management, construction management, and all permitting and approval required for project implementation. The large majority of costs are associated with installation of the sewer collection system, installation of sewer piping, laterals, and manholes, including costs for street repair.

There will be an additional cost to decommission the existing septic tanks. MSWD estimates that the costs would range from $1,200 - $1,500 per septic tank, with a conservative total cost of $573,000 ($1,500 X 382 septic tanks). A loan process has been established that will offer 10-year no interest loans. Therefore the costs for decommission septic tanks will be spread over a 10 year period. Also since it is assumed that 25% of the septic tanks will be replaced per year, the total payback period will be over a 13 year period. Table 8-26 below provides a summary of the decommissioning costs for the project.

MSWD estimates that O&M costs associated with ongoing maintenance of the sewer mains and laterals will equate to approximately 1% of capital costs annually ($30,509 per year) for 50 years starting in 2018. This analysis assumes that household-borne sewer charges (which are approximately $31.23 per month[58]) reflect the added treatment cost at the HWWTP.

Table 8-26: Summary of Septic Decommissioning Costs
Groundwater Quality Protection Program– Subarea D2

Year	Total Number of Septic Tanks Replaced	Total Costs with a 10-Year Payback
2018	95.5	$14,325
2019	191	$28,650
2020	286.5	$42,975
2021	382	$57,300
2022		$57,300
2023		$57,300
2024		$57,300
2025		$57,300
2026		$57,300
2027		$57,300
2028		$42,975
2029		$28,650
2030		$14,325
Total	**382**	**$573,000**

[58] State Water Resources Control Board. 2012. *Division of Financial Assistance, Facility Plan Approval, CWSRF Program, Mission Springs Water District AD-12 Area F and M-1 Sewer Construction Project, CWSRF No. C-06-4250-310*. page 8.

Table 8-27: Project Annual Costs (PSP Table 19)
Groundwater Quality Protection Program– Subarea D2

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year			(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2013	$3,826							$3,826	0.943	$3,609
2014	$15,304							$15,304	0.890	$13,621
2015	$1,702,549							$1,702,549	0.840	$1,429,493
2016	$1,530,381							$1,530,381	0.792	$1,212,205
2017	$573,893							$573,893	0.747	$428,846
2018					$7,627		$14,325	$21,952	0.705	$15,475
2019					$15,255		$28,650	$43,905	0.665	$29,199
2020					$22,882		$42,975	$65,857	0.627	$41,319
2021					$30,509		$57,300	$87,809	0.592	$51,974
2022					$30,509		$57,300	$87,809	0.558	$49,032
2023					$30,509		$57,300	$87,809	0.527	$46,257
2024					$30,509		$57,300	$87,809	0.497	$43,638
2025					$30,509		$57,300	$87,809	0.469	$41,168
2026					$30,509		$57,300	$87,809	0.442	$38,838
2027					$30,509		$57,300	$87,809	0.417	$36,640
2028					$30,509		$57,300	$87,809	0.394	$28,927
2029					$30,509		$57,300	$87,809	0.371	$21,970
2030					$30,509		$14,325	$44,834	0.350	$15,707
2031-2078					$30,509			$30,509	Variable	$167,277
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$3,715,196**

Benefits and Costs Summary

The estimated present value benefits of this project are $9,467,779. Monetized benefits for the projects are associated with avoided costs of purchasing imported water for recharge, avoided loss of hotel revenue and transient occupancy tax, and avoided O&M costs to septic tank owners. The present value cost of this project is $3,715,196. Therefore the benefit to cost ratio for this project is approximately 3:1.

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 benefits of avoided cost of imported water and avoided loss of hotel revenue and transient occupancy tax. These issues are listed in Table 8-28.

Table 8-28: Omissions, Biases, and Uncertainties
Groundwater Quality Protection Program– Subarea D2

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided cost of imported water	U	The quantity of inflow and the cost of imported water offset can vary
Avoided loss of hotel revenue and transient occupancy tax	U	There was an assumption that approximately 50% of spas would be impacted if contamination occurred, and a 2% probability of this occurring each year, with impact confined to 5 years.
Avoided loss of hotel revenue and transient occupancy tax	U	Assumed that contamination would cause the facilities to close for 5 years and not just a reduction in business. It also does not account for the possible installation of water treatment (an avoided cost that is omitted). The calculations do not account for any increases in the amount of business or price increases that increase the value of the sector at risk.
Avoided costs to septic tank owners	U	This analysis assumed costs to septic tank owners based on estimates provided by MSWD, and assumes a certain timeframe for replacement and O&M. As these are generalized estimates, the actual benefits provided by the project could vary.

*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 4: San Antonio del Desierto DAC Sewer Extension Project

Introduction

This attachment presents the economic analysis for the *San Antonio del Desierto DAC Sewer Extension Project*. A project abstract and project benefit summary table are followed by the following sections as outlined in the PSP: Non-Monetized Benefits Analysis (Section D2), Monetized Benefit Analysis (Section D3), and Project Benefits and Costs Summary (Section D5).

Abstract

The San Antonio del Desierto (St. Anthony) Mobile Home Park is located along Highway 111, south of Avenue 66 and north of Avenue 68 in the Coachella Valley in an unincorporated portion of Riverside County known as Mecca. The mobile home park currently relies upon five (5) anaerobic wastewater treatment lagoons for wastewater treatment and disposal. The lagoons are in extremely close proximity (within 150 feet) to the mobile home park residents. Inadequate design of the lagoons, including lack of proper lining, location, and unstable dikes, urge the need to provide a sanitary and reliable wastewater disposal and treatment system for residents of the mobile home park. Inadequate design of the lagoons not only provides concerns relating to the health and safety of mobile home park residents, but also presents water quality concerns within and surrounding the project area. Due to the project's location within the eastern Coachella Valley, the project area is underlain by a shallow groundwater aquifer with a high water table. As such, inadequate lagoon conditions pose a potential threat to groundwater quality within the surrounding area as wastewater and associated contaminants from the lagoons could potentially contaminate the groundwater due to the lack of an adequate barrier lining the lagoons. Due to the proximity of the mobile home park to the Coachella Valley Water District's (CVWD's) sewer sanitary collection system, connecting to the CVWD municipal wastewater system is the best option for meeting project-related needs.

The project proposes the installation of a gravity sewer pipeline, lift station, and a sewer force main pipeline that would collect wastewater from the St. Anthony Mobile Home Park, which has an approximate population of 400 people. The project would provide sewer service to the residents and convey the wastewater to CVWD's Water Reclamation Plant No. 4 (WRP-4).

Summary Project Benefits and Costs

A summary of all benefits and costs of the project are provided in Table 8-29. Monetized benefits and non-monetized benefits are presented in this attachment, while physically quantified (but not monetized) benefits are described in Attachment 7. As shown in the table, this project will yield monetizable present value (PV) benefits that greatly exceed the PV costs, and will also provide important additional benefits that could not be reliably quantified and/or monetized.

Please note that the numbering associated with each benefit has been completed in accordance with the numbering presented in Attachment 7; therefore benefits described below may not be presented in numeric order.

Table 8-29: Benefit-Cost Analysis Overview
San Antonio del Desierto DAC Sewer Extension Project

	Present Value
Costs – Total Capital and O&M	**$ 1,676,119**
Monetizable Benefits	
A. Avoid Cost of Imported Water for Recharge	$ 541,365
I. Avoid Cost of Rehabilitating Existing Lagoons	$1,142,561
Total Monetizable Benefits	**$1,683,927**
Qualitative Benefits	**Qualitative Indicator***
B. Reduce Demand for Net Diversions from the Bay-Delta	+
C. Improve Water Supply Reliability	+
D. Promote Social Health And Safety	++
E. Other Social Benefits Associated with Displacing DACs	++
F. Benefit Wildlife or Habitat at Torres-Martinez Wetlands	+
G. Improve Groundwater Quality and Protect Beneficial Uses	+
H. Provide a Long-Term Solution for DACs	++

* 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 net benefits.
— = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Non-Monetized Benefits Analysis

Narrative Description of Qualitative Benefits

B-Reduce Demand for Net Diversions from the Bay-Delta

The *San Antonio del Desierto DAC Sewer Extension Project* involves sewer connections that will allow for beneficial reuse of wastewater flows, thereby reducing dependence on imported water necessary for recharging the groundwater basin. Beneficial reuse would after the WRP-4 is upgraded to tertiary treatment and is able to produce recycled water. It is anticipated that WRP-4 would produce approximately 1,760 acre-feet per year (AFY) of tertiary-treated recycled water, assuming that WRP-4 is upgraded to recycled water service beginning in 2015.[59] Additional recharge from the 38 AFY of wastewater flows from St Anthony's Mobile Home Park would begin in 2017 after construction of the sewer main and lift station are complete. CVWD and DWA have contracts for imported water supplies from the SWP, which is exchanged with MWD for Colorado River water delivered at turnouts from MWD's Colorado River Aqueduct. Because the Region already receives its entire imported water entitlements (as they are available) and also purchases additional SWP Table A water from other agencies[60], any additional imported water needed to balance groundwater extraction would be purchased and transferred from the SWP. Transfers or leases from north of or within the Bay-Delta could potentially affect Bay-Delta water quantity or quality.

[59] Coachella Valley Water District. 2011. *2010 Urban Water Management Plan.* Page 4-24 and Page 4-26, Section 4.5.1.5 WRP-4 and Table 4-13 Historical and Future Recycled Water Production.

[60] Coachella Valley Water District (CVWD). 2011. *Coachella Valley Water District 2010 Urban Water Management Plan Final Report.* Page 4-19, Section 4.2.3.2 Other SWP Transfers.

By reducing the need to import additional water for groundwater recharge, the project would directly offset demands for additional SWP water to balance basin extraction. Therefore, this project would offset net diversions from the Bay-Delta and help preserve this vital resource.

C-Improve Water Supply Reliability

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The project will help address reliability issues by offsetting the need for additional future use of imported water for groundwater recharge. The reliability of imported water is subject to a number of natural and human forces, ranging from increased population growth (and accompanying increased demands), to drought and earthquakes, to environmental regulations and water rights determinations.

The reliability of a water supply refers to its ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The *San Antonio del Desierto DAC Sewer Extension Project* would help address reliability issues for the Region by providing additional wastewater for purposes of beneficial reuse (recycled water).

Although interest in water supply reliability is increasing due to increasing water demands and concerns over climate-related events, only a few studies have directly attempted to quantify its value. 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 $100 to more than $500 per household per year for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).[61]

The challenge in applying these values to determine a value of increased reliability as a result of the *San Antonio del Desierto DAC Sewer Extension 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 *San Antonio del Desierto DAC Sewer Extension Project* only enhances overall reliability and does not guarantee 100% reliability. Thus, if applied directly to the number of households within the Region, the dollar values from the studies would overstate the reliability value provided by the program.

A 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 program. To adjust for the partial improvement in reliability from the *San Antonio del Desierto DAC Sewer Extension Project*, it is assumed that household willingness to pay for improved reliability is directly proportional to the amount of recycled water that will offset imported water, as a percentage of the total water supply. This represents the percentage of total supply that has been improved in terms of overall reliability.

Due to the uncertainty involved in applying quantified economic numbers to the water supply reliability benefits that the Region would accrue as a result of the *San Antonio del Desierto DAC Sewer Extension Project*, this benefit estimate has been provided here to give an idea of the potential magnitude of this

[61] Carson, R.T.; Mitchell, R.C. *Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area*; SWC Exhibit Number 54;

The Metropolitan Water District of Southern California, Los Angeles, 1987.

CUWA. *The Value of Water Supply Reliability: Results of a Contingent Valuation Survey of Residential Customers*, California Urban Water Agencies, Sacramento, CA. [Online] 1994, http://www.cuwa.org/library/TheValueofWaterSupplyReliabilityAug94.pdf (accessed October 1, 2009).

Griffin, R.C.; Mjelde, J.W. Valuing Water Supply Reliability. *American Journal of Agricultural Economics* 2000, *82*, 414–426

Raucher, R., J. Clements, and others. 2013. *The Value of Water Supply Reliability in the Residential Sector.* WateReuse Research Foundation. Project WRF-08-09.

Wolff, G. 2007. Calculating constant-reliability water supply unit costs. *Water Policy*. International Water Association, London, UK

benefit, but has not been quantified or economically monetized within the overall cost-benefit ratio for this program.

D-Promote Social Health and Safety

The current wastewater lagoons provide a health and safety threat to the residents of the mobile home park and the surrounding community of Mecca. Airborne contaminants and the potential for sewage overflow continue to present a risk to community members. A recent large storm event eroded banks of lagoons, furthering potential for overflow and contamination. By connecting the community to the CVWD municipal sewer, there would be reduced exposure and risk to the local community as wastewater flows would be captured in closed pipelines and conveyed to a water reclamation plant (WRP-4). Therefore, the project would directly remove this potential contaminant source from coming into contact with community members. Although this benefit has not been quantified or monetized, it is anticipated that this impact would be substantial as the proximity of the wastewater lagoons to St. Anthony Mobile Home Park residents and the poor physical condition of the lagoons pose a serious health risk to the community.

Photo of the existing wastewater lagoon in warm months when the water has evaporated and underlying sediment is exposed to the air.

The case is similar to one involving a mobile home park, referred to as Duroville, or Desert Mobile Home Park, near Thermal, California. The Duroville mobile home park previously received national attention associated with onsite conditions, including suffering from inadequate wastewater facilities and other health and safety issues. Recently, the residents of Duroville were moved to the Mountain View Estates, a newly-created mobile home park that was connected to a CVWD sewer line to ensure that wastewater services were in place to provide adequate infrastructure for residents.[62]

E-Have Other Social Benefits Associated with Displacing DACs

Without the project, the mobile home park would not meet permitting requirements established by the County of Riverside, and therefore may need to close down. The pending conditional use permit (CUP)

[62] Supervisor Benoit. 2013. *News Release: Duroville Replacement Housing Project to be Celebrated Jan. 5.* Available: http://www.rivco4.org/web/news/articles/news_0226.html

from the County of Riverside (CUP#03645) indicates that one of the conditions of approval for the CUP is the assumption that the mobile home park would connect to the CVWD wastewater system.[63]

If the mobile home park were to shut down, approximately 400 economically disadvantaged residents would be displaced. As there is currently a shortage of affordable housing for low-income residents in the area (the eastern Coachella Valley), the 400 displaced residents would not have readily available access to other housing options.[64] Obtaining a compliant CUP from the County of Riverside via the infrastructure improvements associated with this project could potentially help to catalyze the development of further infrastructure in the eastern Coachella Valley, which could help to create new opportunities for affordable housing in the vicinity. Therefore, the project would not just help to provide reliable housing to residents within the existing St. Anthony Mobile Home Park, but could also spur other infrastructure and development projects that could help meet affordable housing shortages throughout the eastern Coachella Valley.

Photo of the St. Anthony's mobile home park, directly adjacent to wastewater lagoons in foreground.

The CUP that has been filed and is being processed by the County of Riverside involves infrastructure development within the existing 100-unit St. Anthony Mobile Home Park, and would include expansion to a 136-unit mobile home park along with a 6,200 square-foot community center with a child care center, community park, and recreation facilities. Therefore, the project would not just provide housing support to local residents, but would also facilitate development of infrastructure and facilities within the park that would help to contribute to improving the quality of life of residents within the area.

Lastly, the residents of the St. Anthony Mobile Home Park and other similar developments within the eastern Coachella Valley are largely low-income migratory agricultural workers, which are vital to the local economy. The agricultural industry contributed nearly $4.3 billion to the Riverside County economy and created nearly 30,000 jobs in 2011.[65] Without suitable infrastructure and housing, agricultural

[63] County of Riverside Planning Department. 2011. *CZ07738/CUP03645 – PC Staff Report: May 25, 2011.* Page 3 of 4, Finding No. 5.

[64] Gross, Elena Blank. N.D. *Market Study: the Unincorporated Community of Mecca.* Page 19, Section IV Market Area Economy, Section E. Available Affordable Housing.

[65] Riverside County. 2011. *Agricultural Production Report* - 2011. Page 1, Agricultural Commissioner's Office Letter.

workers could potentially leave the area, which would potentially harm the local economy if there were not enough agricultural workers to support this large and labor-intensive industry.

F-Benefit Wildlife or Habitat at Torres-Martinez Wetlands

Due to the project's location in the eastern Coachella Valley, possible drainage from the lagoons may flow to the Salton Sea via the Coachella Valley Stormwater Channel (CVSC) or flow directly to the Salton Sea via local agricultural drainages. [66] The flows that enter the Salton Sea via the CVSC also come into contact with the Torres-Martinez wetlands, an 85-acre freshwater-salt water habitat complex near the mouth of the CVSC, which was constructed and is still operated by the Torres-Martinez Desert Cahuilla Indians. These wetlands remove nutrients and pollutants from drain water from the CVSC. [67]

The project would benefit both the Salton Sea and the Torres-Martinez wetlands by capturing wastewater flows from the St. Anthony's Mobile Home Park and diverting them to WRP-4 where they would be treated and reused as recycled water beginning in 2017, assuming that WRP-4 is upgraded to recycled water in 2015. Due to the hydrologic connectivity of the Region to the Salton Sea, it is likely that some of the recycled water applied as irrigation would still drain to the Salton Sea, although on a greatly reduced scale as compared to existing conditions. Further, as these flows would be treated to tertiary levels, the quality of these flows would be greatly improved as a result of the project.

The Salton Sea currently suffers for water quality issues such as nutrient impairment and eutrophication from constituents such as nitrates often found in wastewater effluent.[68] Therefore, without the project, water quality constituents from the sewage lagoons could flow, untreated, to the Salton Sea, where they could further exacerbate existing impairments such as eutrophication. In addition, any flows from the project that enter the CVSC could potentially contaminate the Torres-Martinez wetlands that are used to remove pollutants from drain water from the CVSC. The project would, therefore, provide benefits to wildlife and habitat within the Torres-Martinez wetlands and the Salton Sea by removing a potential source of nutrients and other contaminants that may negatively affect these wildlife areas.

G-Improve Groundwater Quality and Protect Beneficial Uses

The community of Mecca, and the majority of the eastern Coachella Valley is underlain by a shallow groundwater aquifer that has limited groundwater percolation due to silt and clay layers (an aquitard).[69] Due to the aquitard, surface water in this area percolates into the shallow groundwater aquifer and may eventually drain into the Salton Sea. Although there is no site-specific water quality data on the water quality of water from the wastewater lagoons, it is suspected that wastewater from the lagoons percolates to and potentially contaminates the underlying shallow groundwater aquifer. Further, as there has been observed erosion on the banks of the lagoons, it is possible that the wastewater also drains off the surface of these ponds, potentially contaminating agricultural drains in the area.

The project would, therefore, improve both the quality of the shallow groundwater aquifer and local agricultural drains by diverting wastewater flows to WRP-4 where they would receive additional treatment before being beneficially reused as recycled water, assuming that WRP-4 is upgraded to recycled water service beginning in 2015.

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[66] Coachella Valley Water District. 2010. *Coachella Valley WMP 2010 Update.* Page 4-5, Section 4.1 Local Groundwater, Section 4.1.1.2 Thermal Subarea.

[67] Coachella Valley Water District. 2010. *Coachella Valley WMP 2010 Update.* Page 8-12, Section 8.1.3 Environmental Enhancement and Mitigation Projects.

[68] Regional Water Quality Control Board (RWQCB). 2000. *California Environmental Protection Agency Regional Water Quality Control Board Colorado River Basin Region – Staff Report: Water Quality Issues in the Salton Sea Transboundary Watershed.*

[69] Coachella Valley Water District. 2010. *Coachella Valley WMP 2010 Update.* Page 4-3, Section 4.1 Local Groundwater, Section 4.1.1 Whitewater River Subbasin.

H-Provide a Long-Term Solution for DACs

The *San Antonio del Desierto DAC Sewer Extension Project* involves conversion of a mobile residential community to sewer service that will provide sustainable long-term management of local wastewater (in lieu of lagoons) and increases beneficial reuse of wastewater flows, thereby reducing dependence on imported water necessary for recharging the groundwater basin. As such, this project provides a long-term solution to local wastewater management in the disadvantaged Mecca community and will provide infrastructure that will help the Region to manage its groundwater resources on a long-term basis.

Monetized Benefit Analysis

Several monetized benefits are expected to accrue over the expected 60-year life of the project. Those include: avoided cost of imported water and avoided cost of rehabilitating the existing lagoons.

A-Avoid Cost of Imported Water for Recharge

The project would provide sewer service to and therefore collect wastewater from the St. Anthony Mobile Home Park. The wastewater would be transferred to the CVWD WRP-4, where it would be recycled beginning in 2015, assuming that WRP-4 is upgraded to recycled water service beginning in 2015.[70] Given that the project would be complete in 2017, it is assumed that all of the flows from the project would be treated to a tertiary level and recycled.

The *City of Coachella General Plan Update 2012* states that the wastewater generation factor for other local agencies within the Coachella Valley ranges from 250 gallons per day (gpd) per equivalent dwelling unit (EDU) to 300 gpd/EDU.[71] This project would connect 136 units at St. Anthony Mobile Home Park to the CVWD WRP-4. Assuming an average wastewater production of 250 gallons/day per unit, this would be 0.28 AFY per unit. Therefore, cumulatively, the project would result in 38 AFY (0.28 AFY x 136 units) of total recycled water production throughout the project lifetime (through 2077).

Currently, recycled water is used within the Region for irrigation purposes in accordance with Title 22 of the California Code of Regulations. This recycled water use is considered as source substitution as its use directly avoids groundwater pumping. As such, recycled water use offsets the need for the Region to import additional water to replenish the groundwater aquifer.

Therefore, the project would avoid the need to import additional water from outside the basin for groundwater recharge. The Region already uses its full Colorado River water allocation for groundwater recharge, so additional recharge water would need to be acquired from other external sources. This is done by acquiring rights to State Water Project (SWP) water held by other entities, and exchanging these purchased rights with MWD for locally-available Colorado River water.[72]

The cost per AF of these SWP acquisitions exchanged for Colorado River water has been estimated to be $986 in 2017 (see Appendix 8-1). Table 8-30 provides an overview of the monetized benefits associated with recycled water use (imported water offsets) that would occur as a result of the project.

I-Avoid Cost of Rehabilitating Existing Lagoons

As explained previously, the need for the project is primarily based on the need to successfully permit the St. Anthony Mobile Home Park via a CUP with the County of Riverside. Although the pending CUP states that it is assumed the mobile home park would connect to the CVWD municipal wastewater system, it is possible that the mobile home park could be permitted via other means. Specifically, it is

[70] Coachella Valley Water District. 2011. *2010 Urban Water Management Plan.* Page 4-24 and Page 4-26, Section 4.5.1.5 WRP-4 and Table 4-13 Historical and Future Recycled Water Production.

[71] City of Coachella. 2012. *City of Coachella General Plan Update Environmental Impact Report Existing Settings - Wastewater.* Page 2.14-1, Section 2.14 – Wastewater.

[72] Coachella Valley Water District (CVWD). 2010a. *Coachella Valley Water Management Plan Update.* Page 4-15, Section 4.3, State Water Project.

possible that the existing wastewater lagoons could be rehabilitated such that these lagoons are legally compliant with applicable regulations.

The existing lagoons are compromised in many aspects including inadequate lining, proximity to dwelling units, unstable dikes and potential for groundwater contamination due to a very high water table. One alternative to connecting to the CVWD sewer system involves rehabilitating the existing lagoons and re-applying for County authorization for continued service. Without a full assessment of the operating system, it is difficult to scope the rehabilitation needed. Thus, for the purpose of this study it is assumed that a new liner be installed with an anchoring system. The rehabilitation process involves four elements:

- ***Draining and evaporation***: The physical configuration of the lagoons provides roughly 28 million gallons (MG) of storage capacity. However, since they are rotated in and out of service all of the lagoons are never completely full. All of the lagoons could be placed into service to maximize the benefit of evaporation, which for this region averages 6 to 8 feet per year. Draining of each lagoon would involve drawing the water down to facilitate the installation of a small sump to allow the pump to be placed below the bottom of the lagoon and result in near complete dewatering.
- ***Solar drying of the sludge***: Because of the solids content in the water and the difficulty in removing all of the water, it is estimated that there will be approximately 3 inches of water left in the bottom of each lagoon after draining. After each lagoon is drained, the remaining volume is approximately 300,000 gallons and would be left in the lagoons to dry out to reduce the disposal costs at a landfill certified to accept the biosolids (sludge).
- ***Removal of the dried residual and disposal:*** The dried sludge would be scraped and hauled to a landfill. With an estimate of 85% solids, the dry weight of the sludge totals approximately 13 tons. It is anticipated that some of the native material will be removed during the scraping operation. Thus as much as 26 tons should be anticipated to be removed and disposed at a rate of approximately $50 per ton.
- ***Construction of new liner and anchoring system:*** A concrete ring and anchors would be installed, along with a high-density polyethylene (HDPE) liner (estimated $600,000), to prevent contamination of the underlying groundwater aquifer.

Estimated costs to rehabilitate the wastewater lagoons would total $1,212,683 and could be implemented in 2014. However, it should be noted that there are significant barriers to this alternative:

- the wastewater lagoons are outside of the St. Anthony's property boundaries;
- the owner of the lagoon property is allowing PUCDC time to connect to CVWD prior to decommissioning, but is not interested in selling the property so that they can continue use; and
- the approved CUP03645 mandates connection to CVWD.

Ongoing O&M costs for the rehabilitated lagoons are estimated to be $24,800 every five years for sludge pumping that is necessary for a properly-functioning lagoon.

Table 8-30: Annual Project Benefits (PSP Table 15)
San Antonio del Desierto DAC Sewer Extension Project

Annual Project Benefits (2012 Dollars)									
(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)**
2017	Avoided cost of imported water	AFY	0	38	38	$986	$37,486	0.747	$28,012
2018-2077	Avoided cost of imported water	AFY	0	38	38	Variable	Variable	Variable	$513,354
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$541,365**

Table 8-31: Annual Costs of Avoided Projects (PSP Table 16)
San Antonio del Desierto DAC Sewer Extension Project

Annual Costs of Avoided Projects (2012 Dollars)						
	Costs				**Discounting Calculations**	
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**
Year	**Avoided Rehabilitation and O&M of Existing Lagoons**					
	Avoided Capital Costs	**Avoided Replacement Costs**	**Avoided Operations and Maintenance Costs**	**Total Costs Avoided for Individual Alternatives (b) + (C) + (d)**	**Discount Factor**	**Discounted Costs (e) x (f)**
2014	$1,212,683			$1,212,683	0.890	$1,079,284
2015						$0
2016						$0
2017						$0
2018						$0
2019-2077			$24,800 every 5 years	$297,600	Variable	$63,278
Total Present Value of Discounted Costs (Sum of column (g))						**$1,142,561**
(%) Avoided Cost Claimed by Project						**100**
Total Present Value Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$1,142,561**

Project Benefits and Costs Summary

Project Economic Costs

Table 8-32 summarizes the economic project costs for the project. The costs are for design, connection fees, and construction of gravity and forced sewer mains, and a lift station. The total present value cost of this project will be $1,676,119. Ongoing O&M costs for the new sewer are estimated to be 1% of construction costs of $1,334,326 or $13,343 annually, beginning in 2017 and extending through the 60-year lifetime of the project. Per stated policy from CVWD, treatment costs required to pay for additional wastewater treatment are encompassed by wastewater users within monthly bills.

The costs for *San Antonio del Desierto DAC Sewer Extension Project* must necessarily include decommissioning the existing wastewater lagoons. The decommissioning process would begin after the PUCDC San Antonio del Desierto DAC Sewer Extension Project is completed and the development is connected to the CVWD sanitary sewer. Decommissioning the lagoons involves a process similar to the rehabilitation process described above, except the lagoons would be restored to a natural environment after removal of dried residual. After the lagoon is cleaned, the soil in the lagoon should be disturbed to break-up the natural clay lining. Tilling or discing the bottom and side walls will laterally displace and invert the soil and destroy the natural clay lining which will increase the permeability of the soil and allow it to drain naturally. Estimated costs to decommission the lagoons would total $132,608 and would occur in year 2017 once the project has been constructed.

The total project cost of $1,676,119 would include project costs associated with design, connection fees, and construction (included in Attachment 4), operations and maintenance fees ($13,343 per year) associated with operating and maintaining the sewer system, and the one-time cost of $132,608 to decommission the existing wastewater lagoons.

Table 8-32: Annual Project Costs (PSP Table 19)

San Antonio del Desierto DAC Sewer Extension Project

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year			**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2012										
2013	$8,592							$8,592	0.943	$8,106
2014	$60,145							$60,145	0.890	$53,529
2015	$790,480							$790,480	0.840	$663,702
2016	$859,218							$859,218	0.792	$680,581
2017					$13,343		$132,608	$132,608	0.747	$109,063
2018-2077					$13,343			$800,580	Variable	$161,138
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$1,676,119**

Benefits and Costs Summary

The estimated present value benefits of this project are $1,683,927. Monetized benefits for the projects are associated with avoided costs of purchasing imported water for recharge and avoided cost of rehabilitating the existing wastewater lagoons. The present value cost of this project is $1,676,119. Therefore the benefit to cost ratio for this project is 1:1.

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 benefits of avoided cost of imported water and avoided cost of rehabilitating the existing wastewater lagoons. These issues are listed in Table 8-33.

Table 8-33: Omissions, Biases, and Uncertainties
San Antonio del Desierto DAC Sewer Extension Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided Cost of Imported Water	U	The quantity of inflow and the cost of imported water offset can vary
Avoided Cost of Rehabilitating Existing Lagoons	U	The approximate value of rehabilitating the existing lagoons was based on a conceptual engineering estimate completed for this analysis. As such, the actual on-site costs associated with rehabilitating the existing lagoons could vary.

*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 5: Torres-Martinez Avenue 64 Water Supply Connection Project

Introduction

This attachment presents the economic analysis for the *Torres-Martinez Avenue 64 Water Supply Connection Project*. A project abstract and project benefit summary table are followed by the following sections as outlined in the PSP: Cost Effectiveness Analysis (Section D1) and Project Benefits and Costs Summary (Section D5).

Abstract

This project will include engineering and design work necessary to ultimately connect the Torres-Martinez Avenue 64 potable water system (PWS) to the CVWD municipal water system to meet the critical water supply needs of the Avenue 64 Subdivision, an economically disadvantaged tribal community (DAC). The overall *Torres-Martinez Avenue 64 Water Supply Connection Project* includes two total phases, the first phase of which includes pre-engineering (completed) and design and engineering (included in this scope of work), and the second phase will include future construction activities. This project (Phase I) will provide the engineering and design documentation necessary for the Torres-Martinez Desert Cahuilla Indians (DCI)to seek additional funding through the United States Department of Agriculture(USDA) for Phase II (construction). As such, this project meets the DAC eligible project type as described by DWR as, "a specific project that may lead to a construction project to address DAC needs, such as engineering designs and specifications…"[73]

The design and engineering work included in this project will provide the necessary planning work for CVWD to construct a 5,400-foot extension of its existing water distribution system and provide a master meter that would connect to the existing Avenue 64 Subdivision potable water system. From that point, the Torres-Martinez DCI would continue to own and maintain the existing onsite distribution system. The new CVWD water main would be connected at two points to the existing water distribution system located in the Torres-Martinez Avenue 64 Housing Subdivision (Avenue 64 Subdivision). The existing wells, pumping system, and storage tanks currently servicing the subdivision would be permanently disconnected from the system; however, they would not be dismantled, in the event thatthe Torres-Martinez DCI desired to convert them into a non-potableirrigation system in the future. CVWD would own the short water main extension and the master meter; the Torres-Martinez DCI would own and maintain the subsequent water main and the existing water main within the Avenue 64 Subdivision.

Phase I of the overall program includes a preliminary evaluation of water supply system of the Avenue 64 Subdivision via a Preliminary Engineering Report (PER)that was conducted by Indian Health Services (IHS) in 2012. The PER demonstrates that the current water system that serves the Torres-Martinez Avenue 64 Subdivision poses multiple health and safety hazards to the community and to the operators who run the system.[74] These hazards are extensively documented in the United States Environmental Protection Agency (EPA) Sanitary Survey Information[75], as well as in correspondence from EPA to the Torres Martinez DCI.[76] In the correspondence letter from EPA[77], EPA notified the Torres-Martinez DCI

[73]California Department of Water Resources (DWR). 2012. *IRWM Grant Program – Proposal Solicitation Package for Round 2, Implementation Grants.*Page 8, Section II.C.Eligible Project Types.

[74] Indian Health Service (IHS). 2012. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*

[75]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Appendix A.

[76]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Appendix F.

that the deficiencies in the water system and its management pose a critical risk to human health. In this letter, the Torres-Martinez DCIwas given 120 days to respond with concrete actions to address the many deficiencies in the system or face a formal enforcement action.

The project included herein (refer to Attachment 3) is a critical component of the concrete actions that the Torres-Martinez DCI is taking to resolve water system deficiencies within the Avenue 64 Subdivision. Torres-Martinez DCI is actively pursuing USDA funding for construction activities (Phase II), but does not have the financial or technical means to complete engineering and design work that are required prior to construction in order to be eligible for funding from USDA. As such, this project would meet the critical water supply needs of a tribal DAC by including work necessary to lead to a construction project that would permanently resolve water supply and associated public health issues within the Avenue 64 Subdivision by connecting the subdivision to the CVWD municipal water supply system.

Summary Project Benefits and Costs

A summary of all benefits and costs for the funding requested for this project are provided in Table 8-34. It is important to note that the net present value of costs provided is for the project described in Attachment 3 (final engineering and design only), as these are the activities included within this grant application. Future construction activities associated with Phase II are not included below.

Table 8-34: Benefit-Cost Analysis Overview
Torres-Martinez Avenue 64 Water Supply Connection Project

	Present Value
Costs – Total Capital and O&M	**$220,280**
Benefits– Total Qualitative Benefits	**Qualitative Indicator***
A. Increase in Drinking Water Health and Safety	++
B. Increase in Water Supply Reliability	++
C. Increase in Water Supply Adequacy	++
D. Provide a Long-Term Solution	++
E. Decrease in Hazardous Physical Conditions	++
F. Avoid Pump Station Rehabilitation and Deeper Drilling of Current Well	++
G. Avoid Additional Treatment Necessary to Address Water Quality Concerns	++
H. Avoid Ongoing O&M of Tribal Water System	++

* 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 net benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

Cost-Effectiveness Analysis

A cost-effectiveness analysis was completed for this project, because it meets the DWR threshold of having a total project cost of less than $300,000. However, because this project also serves critical water supply needs of a DAC, according to DWR the project could have a total budget of up to $1,000,000 and still meet the requirements of completing a cost-effectiveness analysis.[78] The sections below explain the

[77] Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Appendix F.

[78] California Department of Water Resources (DWR). 2012. *IRWM Grant Program – Proposal Solicitation Package for Round 2, Implementation Grants.* Page 44, Exhibit D, Section D1 – Cost-Effectiveness Analysis.

information necessary to complete Table 11 – Statement of Cost-Effectiveness as required by DWR. A summary of this information is presented below in Table 8-3.

Types of Benefits Provided

A. Increase in Drinking Water Health and Safety
B. Increase in Water Supply Reliability
C. Increase in Water Supply Adequacy
D. Improved Public Safety
E. Provide a Long-Term Solution vs. a Short-Term Solution
F. Avoid Pump Station Rehabilitation and Deeper Drilling of Current Well
G. Avoid Additional Treatment Necessary to Address Water Quality Concerns
H. Avoid Ongoing O&M of Tribal Water System

A-Increase in Drinking Water Health and Safety

The existing water system that serves the Avenue 64 Subdivision poses multiple health and safety hazards to the subdivision residents and to the operators who run the system. These health and safety risks are documented extensively in the USEPA Sanitary Survey Information[79]and correspondence from EPA[80] to the Torres Martinez DCI. In the latter; EPA notified the Torres-Martinez DCI that the deficiencies in the water system and its management pose a critical risk to human health.[81] In this letter, the Tribe was given 120 days to respond with concrete actions to address the many deficiencies in the system or face a formal enforcement action. Issues that need to be resolved include:

- Water outages several times per month. These outages pose water health and safety issues as they result in a temporary loss of water supply, and may potentially allow for contaminated water to enter the PWS.[82]
- Lack of chlorination for back-up water supply. If this back-up water supply is needed for more than one to two days, there would be no more chlorine residual in the PWS, and Avenue 64 Subdivision water users would receive water that has not been disinfected. Providing disinfected water is a violation of the EPA Groundwater Rule[83]and poses a significant health threat to water system users, because water that has not been disinfected is associated with higher rates of gastrointestinal disease, eye infections, and skin infections.[84]
- Chromium and perchlorate levels in the well. Torres-Martinez DCI has expressed concerns regarding perchlorate and chromium levels in the existing PWS, which may pose human health threats associated with ingestion of these constituents.

[79]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Appendix A.

[80]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Appendix F.

[81] United States Environmental Protection Agency (EPA). 2011. *Transmittal of January 27, 2011 Sanitary Survey Reports for Avenue 64 and Torres Martinez Clinic Water Systems (PWSs 0605116 and 0605130); Calling Special Attention to Operational Deficiencies which Place These Systems at Risk.*

[82]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Page 9, Section IV.A.1. Need for Project: Water Outages.

[83] United States Environmental Protection Agency (EPA). 2006. Page 65602. *Ground Water Rule (GWR).*Page Available: http://water.epa.gov/lawsregs/rulesregs/sdwa/gwr/index.cfm

[84]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Page 11, Section IV.A.1. Need for Project: Water Quality Potential Risks.

Allof the identified drinking water safety concerns associated with the existing Avenue 64 PWS would be resolved by connecting this system to the CVWD municipal water system, because the CVWD domestic drinking water supply is reliable and meets all applicable state and federal water quality standards.[85]

B-Increase in Water Supply Reliability

The Torres-Martinez DCI reports water outages several times per month, and there is no single cause for the water outages. Sometimes outages are related to power surges or loss of commercial power, and sometimes outages are due to failure of the existing onsite PWS (booster pumps or primary well pump). Water outages occur at random and inconvenient times, leaving the homes and other facilities within the Avenue 64 Subdivision with no access to water until service is restored, which may be a few hours.[86] These water supply unreliability issues associated with water outages would be resolved by connecting to the CVWD water system, which does not have similar water outage issues and includes an extensive backup system to prevent and avoid water outages from occurring.

C-Increase in Water Supply Adequacy

The back-up well does not currently have a production capacity to meet community demands without severely stressing the well pump. If the primary well were to run dry, collapse or become inoperable for more than a day or two, the backup well would not be able to meet demands and water shortages and/or water outages would result.[87]

This water supply inadequacy would be resolved by connecting to the CVWD water system, as CVWD has expressed their willingness to serve water to the Avenue 64 Subdivision and has substantial backup facilities to ensure water deliveries.[88]

D-Provision of Long-term Water Management Solution

Connecting to the CVWD water system will address not only the current infrastructure deficiencies, but will also address the ongoing O&M problems facing the Avenue 64 Subdivision. Connecting to the CVWD municipal water system provides a sustainable long-term solution to an economically disadvantaged tribal community.

E-Decrease in Hazardous Physical Conditions

There are numerous open electrical connections and junction boxes without lids throughout the pump house as well as extensive corrosion of many electrical components throughout the system. Each of these issues represents an electrical shock hazard for the water operator who frequently conducts operation and maintenance activities without an assistant. An electrical shock experienced by the operator while unaccompanied could result in hospitalization or could potentially be fatal.[89]

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[85] Coachella Valley Water District (CVWD). 2012b. *Coachella Valley Water District 2011-12 Annual Review.*Page 6, 2012 Domestic Water Quality Report.

[86]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Page 9, Section IV.A.1. Need for Project: Water Outages.

[87]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Page 9 and Page 10, Section IV.A.1. Need for Project: Insufficient Backup Water Source.

[88]Coachella Valley Water District.2012a. *Avenue 64 & Monroe Street – Domestic Water and Sewer Service.*

[89]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Page 10 and Page 11, Section IV.A.1. Need for Project: Safety and Security Risks.

In addition, the current system is inadequate for providing fire protection to the community. The connection to CVWD would assure adequate and reliable water for firefighting purposes, thereby providing a major public safety improvement.[90]

There are also substantial safety concerns regarding the patch on the hydropneumatic water tank, which is currently leaking and does not have a pressure relief value. This combination could result in an explosion in the large steel water tank, which could be lethal to anybody near, and would result in a massive and difficult to repair water system leak.[91]Additionally, the water storage tank is not secured to prevent public access to climb the tank or to open the roof hatch; creating a concern for a fall risk to unauthorized individuals as well as a potential health risk to all users if vandalism or other potential contamination that could occur in the tank.[92]

These safety concerns would be resolved by connecting to the CVWD water system as onsite operations and maintenance would no longer be necessary, and the CVWD is a secure and reliable supply that includes flows necessary to provide fire protection and security and testing necessary to prevent vandalism and contamination.

F-Avoid Pump Station Rehabilitation and Deeper Drilling of Current Well

One of the potential methods identified in the *Preliminary Engineering Report* to address concerns with the existing Avenue 64 PWS is to rebuild the existing infrastructure, including drilling a new (deeper) well, provide a suitable backup water supply (pump station), and make other necessary onsite infrastructure improvements.[93]Implementation of the project would avoid the need to complete the aforementioned onsite improvements, as the existing PWS would be abandoned and the Avenue 64 Subdivision would be connected to the existing CVWD municipal system. This would be considered a direct benefit associated with avoided construction and operational costs to replace the existing onsite PWS.

G-Avoid Additional Treatment Necessary to Address Water Quality Concerns

As mentioned above, one of the potential methods identified in the *Preliminary Engineering Report* to address concerns with the existing Avenue 64 PWS is to rebuild the existing infrastructure, including making infrastructure improvements to address potential water quality issues concerning the Torres-Martinez DCI (perchlorate and chromium).[94] The *Preliminary Engineering Report* indicates that such system improvements would be very costly and difficult to operate and maintain. As the project would connect the Avenue 64 Subdivision to the CVWD municipal water system, the project would provide CVWD domestic water supplies to the subdivision. Domestic water provided by CVWD meets all applicable state and federal drinking water standards, including those established for chromium, perchlorate, and other constituents of concern in the eastern Coachella Valley such as arsenic.[95] Therefore, the project would effectively avoid the need to construct and operate additional infrastructure

[90]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Page 10, Section IV.A.1. Need for Project: Inoperable Components.

[91]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Page 10 and Page 11, Section IV.A.1. Need for Project: Safety and Security Risks.

[92]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Page 10 and Page 11, Section IV.A.1. Need for Project: Safety and Security Risks.

[93]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Page 13, Section V. Alternatives Considered.

[94]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Page 13, Section V. Alternatives Considered.

[95] Coachella Valley Water District (CVWD). 2012b. *Coachella Valley Water District 2011-12 Annual Review.*Page 6, 2012 Domestic Water Quality Report.

needed to treat groundwater for applicable water quality concerns. This would be considered a direct benefit associated with avoided construction and operational costs to upgrade the existing onsite PWS for water treatment purposes.

H-Avoid Ongoing O&M of Tribal Water System

Due to funding and staffing issues, the Torres-Martinez DCI has few resources available to conduct O&M activities. The lack of resources available for operations and maintenance of the Avenue 64 PWS is a significant contributing factor to many of the issues described in the preceding sections.[96] In a 2011 letter from the USEPA to the Torres-Martinez DCI, the USEPA noted that, "there currently is no Torres Martinez Water Department, Water Board, or Public Works governing structure to oversee and ensure that the water systems remain reliable and safe."[97] The *Preliminary Engineering Report* further elaborated on this, noting that there is a lack of structure in many elements of the Torres-Martinez DCI's O&M activities, which would make an operations and maintenance of a functioning on-site PWS difficult even if the existing failing system were replaced with new facilities.[98]Therefore, connecting to the CVWD municipal water system as proposed in this project would provide the direct benefit of avoided operations and maintenance needs associated with an onsite PWS at the Avenue 64 Subdivision.

Alternative Methods to Achieve the Same Benefits

A Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians was prepared by Indian Health Service in June 2012.The information provided in this section is taken from this report (Report). The *Preliminary Engineering Report* states:

> "an attempt to rebuild the existing infrastructure would likely yield the lowest capital cost, however it would not address three primary concerns. First, there is no certainty that improving the existing infrastructure could provide a suitable back-up water supply. Presumably a new well would need to be drilled, which could have water quality or quantity issues. Second, improvements to existing infrastructure that would address the potential water quality issues concerning the Tribe (perchlorate and chromium) would be costly and difficult to operate and maintain. Finally, capital improvements of any kind would not address the many ongoing O&M issues, which the Tribe would have a hard time resolving without additional financial and manpower resources that would be difficult to obtain.
>
> For these reasons, options involving some rebuilding of the existing infrastructure are not considered. Connecting to the nearby Coachella Valley Water District (CVWD) not only addresses infrastructure deficiencies, but also the O&M problems facing the Tribe. Therefore, the options considered in the Report are based on connecting to the CVWD water system."[99]

The *Preliminary EngineeringReport* analyzed two options for resolving current issues and providing the Torres-Martinez DCI and the Avenue 64 Subdivision residentswith the following benefits:

A. Increase in Drinking Water Health and Safety

B. Increase in Water Supply Reliability

[96]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Page 11 and Page 12, Section IV.A.1. Need for Project: System O&M.

[97] United States Environmental Protection Agency (EPA). 2011. *Transmittal of January 27, 2011 Sanitary Survey Reports for Avenue 64 and Torres Martinez Clinic Water Systems (PWSs 0605116 and 0605130); Calling Special Attention to Operational Deficiencies which Place These Systems at Risk.*

[98]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.*Page 11 and Page 12, Section IV.A.1. Need for Project: System O&M.

[99]Indian Health Service (IHS). 2012a. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Page 13, Section V. Alternatives Considered.

C. Increase in Water Supply Adequacy
D. Provides a Long-Term Water Management Solution
E. Decrease in Hazardous Physical Conditions
F. Avoided Pump Station Rehabilitation and Deeper Drilling of Current Well
G. Avoided Additional Treatment Necessary to Address Water Quality Concerns
H. Avoided Ongoing O&M of Tribal Water System

The primary difference between Options 1 and 2 concerns design, ownership, and maintenance of the water main along Monroe Street. In Option 1, the proposed option, CVWD would own, build, maintain and ultimately replace a 12" DI water main and master meters. In Option 2, the Torres-Martinez DCI would own, maintain and ultimately be responsible for replacing the water main connection along Monroe Street. In Option 2 the water main would be 8"PVC (less expensive and the 12" DI is not required by the Torres-Martinez DCI).

Option 1 describes the proposed project. The total estimated costs are $1,610,000. O&M costs are $23,610 per year (or $58 per connection per month). Capital replacement costs of facilities owned by CVWD will be the water district's responsibility and are reflected in the water billing costs and are already included in the O&M calculation. CVWD is required to use ductile iron for the water main which increases both costs and life time for this option. Because this option includes having CVWD extend their system further, it allows for possible further expansions in other areas on the Torres-Martinez reservation.

Option 2 is similar to Option 1 with one significant difference, in Option 2 the Torres-Martinez DCI would own, maintain and eventually need to replace, when it exceeds its design life, almost a mile of new water main (in Option 1this mile is owned, maintained, and will eventually be replaced by CVWD). The cost of the project is estimated at $1,460,000. O&M costs are $25,610 annually (or $62 per connection per month). The need to budget for capital replacement of the infrastructure would increase monthly billing by about $70 dollars more per connection per month (for an increase in monthly fees of $62 plus $70, totaling $132). At the same time, this option would not allow for the further extension of the CVWD water system to areas where it would eventually serve other portions of the Torres-Martinez reservation. In addition, the ductile iron water main required by CVWD would have a longer design life.

Table 8-35: Comparison of Project Alternatives
Torres-Martinez Avenue 64 Water Supply Connection Project

	Increase in Drinking Water Safety	Increase in Water Supply Reliability	Increase in Adequacy of Water Supply	Decrease Safety Concerns	Capital Cost	O & M Cost	Replace-ment Cost	Contributes to Regionaliz-ation
Option 1*	X	X	X	X		X	X	X
Option 2	X	X	X	X	X			
* Option 1 is currently under consideration, and is the project included in Attachment 3								

Table 8-35 evaluates the advantages and disadvantages of both options. Both options provide significant benefits to the Torres-Martinez DCI, including: increases in drinking water safety, water supply reliability, water supply adequacy, and decreases in safety concerns. The option presented in this project is the recommended option (Option 1). Although this option is $150,000 more in initial capital costs, it is $2,000 less in annual O&M costs and almost $30,000 less per year when set-aside for capital replacement of Tribally-owned infrastructure is included. This option reduces the Tribe's O&M burden and contributes to the regionalization of the water system, which could serve other portions of the Torres-Martinez reservation in the future.

Both the Torres-Martinez DCI and CVWD selected Option 1 as their preferred option as it results in a better long-term solution for both entities.

Responses to questions posed in DWR's *Proposal Solicitation Package* for the cost-effectiveness analysis method are summarized in Table 8-36.

Table 8-36: Statement of Cost-Effectiveness (PSP Table 11)
Torres-Martinez Avenue 64 Water Supply Connection Project

Statement of Cost-Effectiveness	
Types of Benefits Provided	A. Increase in Drinking Water Health and Safety B. Increase in Water Supply Reliability C. Increase in Water Supply Adequacy D. Provides a Long-Term Water Management Solution E. Decrease in Hazardous Physical Conditions F. Avoided Pump Station Rehabilitation and Deeper Drilling of Current Well G. Avoided Additional Treatment Necessary to Address Water Quality Concerns H. Avoided Ongoing Operations and Maintenance A.
Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?	Yes
If no, why?	N/A
If yes, list the methods (including the proposed project) and estimated costs	In 2012 Indian Health Service was retained by Torres-Martinez DCI to complete a Preliminary Engineering Report (PER) for the Avenue 64 Subdivision. The PER provides extensive details on the existing onsite potable water system, issues with the system, and potential solutions to address these issues. The ultimate conclusion of the PER is that there is a need to find an alternative water supply for the Avenue 64 Subdivision due to health and safety issues and operations and maintenance issues associated with the existing system. Ultimately, the PER concludes that the best option is for the subdivision to connect to a nearby municipal water system that is owned and operated by the Coachella Valley Water District.[100] Within the PER, IHS conducted an assessment on two potential options that could be implemented to meet the aforementioned goals. The cost estimations for those options are described below. **Option 1 (The Proposed Option):** The total estimated costs are $1,610,000. O&M costs are $23,610 annually ($58 per connection per month). Capital replacement costs of facilities owned by CVWD will be the water district's responsibility and are reflected in the water billing costs and are already included in the O&M calculation. **Option 2:** The cost of the project is estimated at $1,460,000. O&M costs are $25,610 annually (or $62 per connection per month). The need to budget for capital replacement of the infrastructure would increase monthly billing by about $70 dollars more per connection per month (for an increase in monthly fees of $62 plus $70).
If the proposed project is not the least cost alternative, why is it the preferred alternative?	Both options provide significant benefits to the residents of the Avenue 64 Subdivision and the Torres-Martinez DCI, including increases in drinking water safety, water supply reliability, water supply adequacy and decreases in operator and

[100] Indian Health Service (IHS). 2012. *Preliminary Engineering Report for the Torres-Martinez Desert Cahuilla Indians: CVWD Water Main Extension to Avenue 64 Housing Subdivision.* Page 13, Section V. Alternatives Considered.

Statement of Cost-Effectiveness	
Provide an explanation of an accomplishment of the proposed project that is different from the alternative project or methods.	public safety concerns. The option presented in this project is the recommended option. Although this option is $150,000 more in capital costs, it is $2,000 less in annual O&M costs and almost $30,000 less per year when set-aside for capital replacement of Tribally-owned infrastructure is included. This option reduces Torres-Martinez DCI's O & M burden and contributes to the regionalization of the water system which could serve other portions of the Torres-Martinez reservation in the future. Both the Tribe and CVWD selected Option 1 as their preferred option as it results in a better long-term solution for both entities.
Comments: See further discussion provided above.	

Project Benefits and Costs Summary

Project Economic Costs

Table 8-38 summarizes the economic costs for the *Torres-Martinez Avenue 64 Water Supply Connection Project*. The project has a present value cost of $220,280. This project provides funding for design and engineering that can be used to apply for construction funding (approximately $1.5 million) from USDA or USEPA. A *Preliminary Engineering Report* and associated technical studies have been already been completed by IHS ($23,827) and is included as part of the tribe's funding match in Phase I.

Additional construction costs that are anticipated in Phase II of the overall program are anticipated to be $1,514,324 (undiscounted), while operations and maintenance (O&M) costs are anticipated to be $13,854 (undiscounted) over 50 years. Note that these costs are not included in the total project cost because additional engineering design must be completed by CVWD to confirm and solidify them.

Benefits and Costs Summary

The *Torres-Martinez Avenue 64 Water Supply Connection Project* has a present value cost of $220,280. This project provides funding for design and engineering work that can be used to apply for construction funding (approximately $1.5 million) from USDA. A preliminary engineering Report has been already been completed by IHS ($23,827) and is included as part of the tribe's funding match in Phase I.

Although no benefits are quantifiable or monetizable for this project, the project has extensive non-monetized benefits including:

A. Increase in Drinking Water Health and Safety
B. Increase in Water Supply Reliability
C. Increase in Water Supply Adequacy
D. Improved Public Safety
E. Provide a Long-Term Solution vs. a Short-Term Solution
F. Avoided Pump Station Rehabilitation and Deeper Drilling of Current Well
G. Avoided Additional Treatment Necessary to Address Water Quality Concerns
H. Avoided Ongoing Operations and Maintenance

Table 8-38: Annual Project Costs (PSP Table 19)

Torres-Martinez Avenue 64 Water Supply Connection Project

Project Annual Costs (2012 Dollars)										
			Annual Costs						Discounting Calculations	
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year			(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$23,827							$23,827	1.000	$23,827
2013	$83,394							$83,394	0.943	$78,641
2014	$131,048							$131,048	0.899	$117,812
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$220,280**

Appendix 8-1:
Coachella Valley IRWM Avoided Imported Water Costs

Regional Water Supply Background

The Coachella Valley IRWM Region is chiefly the same boundary as the Whitewater River watershed boundary, also known as the Coachella Valley. The area is drained primarily by the Whitewater River that flows southward to the Salton Sea. The Coachella Valley is characterized by low precipitation and high summer daytime temperatures.

Water supply for the Coachella Valley is generally pumped from sub-basins of the Coachella Valley Groundwater Basin. Water is pumped from many wells around the region into each of the regional water purveyor's distribution systems. Each of the five water purveyors of the region – Coachella Valley Water District (CVWD), Coachella Water Authority (CWA), Desert Water Agency (DWA), Indio Water Authority (IWA), and Mission Springs Water District (MSWD) – operates its own water distribution system.

Groundwater is the largest source of water supply for the region. The Coachella Valley Groundwater Basin has an estimated storage capacity of 39 million acre-feet (AF) of water. Prior to 1949, groundwater levels steadily declined due to agricultural pumping. The Coachella branch of the All American Canal (Coachella Canal) was completed in 1949 and the first deliveries of Colorado River water to the Coachella Valley began in that year. As a result, groundwater pumping was significantly reduced from 1950 to the early 1980s, and water levels rose in the eastern Coachella Valley. However, since the 1980s, increased pumping has caused water levels in the eastern Coachella Valley to decline despite Colorado River imports. CVWD estimates the decrease in freshwater storage in the Coachella Valley Groundwater Basin for 1999 to be 137,000 AF, with a cumulative overdraft of nearly 4.8 million acre-feet between 1936 and 1999.[1] For the ten year period of 2000 to 2009, an average of 110,000 af was annually over-drafted from the Whitewater River Subbasin.[2]

Due to potentially significant consequences caused by groundwater overdraft, the region has developed imported water supplies to supplement and replenish groundwater supplies. CVWD and DWA obtain imported water supplies through two primary sources 1) State Water Project (SWP) supply via exchange with Metropolitan Water District of Southern California (MWD) for delivery through the Colorado River Aqueduct and 2) Colorado River supply via the Coachella Canal. These sources are used to recharge the Groundwater Basin and are used in lieu of groundwater for some irrigation demands. Currently, no infrastructure exists to deliver SWP water directly to the Coachella Valley. CVWD and DWA exchange their SWP entitlement, when available, with the Metropolitan Water District (MWD) for an equal amount of MWD's Colorado River water. CVWD and DWA currently have a combined entitlement of 194,000 ac-ft/year. See Table 8-1 which shows allotments for 2010 through 2012 which illustrates how entitlement allotment is achieved.

[1] CVWD. 2002. Coachella Valley Water Management Plan.
[2] CVWD. 2010. Coachella Valley Water Management Plan Update.

Table 8-1: Allotments (in AF for 2010-2012)

	Original SWP Table A	Tulare Lake Basin Transfer #1	Tulare Lake Basin Transfer #2	MWD Transfer	Berrenda Mesa Transfer	Total
CVWD	23,100	9,900	5,250	88,100	12,000	138,350
DWA	38,100		1,750	11,900	4,000	55,750
Total	61,200	9,900	7,000	100,000	16,000	194,100

SWP Contract Water Types

The SWP contracts define several classifications of water available for delivery to contractors under specific circumstances. All classifications are considered "project" water. Many contractors make frequent use of these additional water types to increase or decrease the amount available to them under Table A. CVWD and DWA aggressively pursue the purchase of additional water supplies as they come available.

Table A Water -Each contract's Table A is the amount in acre-feet that is used to determine the portion of available supply to be delivered to that contractor. Table A water is water delivered according to this apportionment methodology and is given first priority for delivery.

Article 21 Water - Article 21 of the contracts permits delivery of water excess to delivery of Table A and some other water types to those contractors requesting it. It is available under specific conditions. Article 21 water is apportioned to those contractors requesting it in the same proportion as their Table A and must be delivered in the same year as it is purchased. Individual contractors are responsible for coordinating the delivery of Article 21 water via their normal contracts.

Turnback Pool Water - Contractors may choose to offer their allocated Table A water excess to their needs to other contractors through two pools, A and B, in February and March. Contributing contractors receive a reduction in charges, and taking contractors pay extra.

Carryover Water – SWP contractors can carry over a portion of their allocated water approved for delivery in the current year for delivery during the next year. Contractors can carry over water with advanced notice when they submit their initial request for Table A water, or within the last three months of the delivery year, under Article 12E for various reasons, including local wet conditions and exchange and transfer arrangements. The carryover program was designed to encourage the most effective and beneficial use of water and to avoid obligating the contractors to use or lose the water by December 31 of each year. The water supply contracts state the criteria of carrying over Table A water from one year to the next. Normally, carryover water is water that has been exported during the year, has not been delivered to the contractor during that year, and has remained stored in the SWP share of San Luis Reservoir to be delivered during the following year. Storage for carryover water no longer becomes available to the contractors if it interferes with storage of SWP water for project needs.

Avoided Water Supply Costs

Water conservation anticipated as part of the program would reduce regional water demand, thereby reducing the Coachella Valley region's future dependence on imported water from the State Water Project (SWP). Reducing future dependence on imported water would potentially produce benefits associated with avoiding the costs of transporting, pumping, and recharging imported water into the groundwater basin.

In 1962 and 1963, respectively, DWA and CVWD entered into contracts with the State of California for 61,200 AFY of SWP water. To avoid the then-estimated $150 million cost of constructing an aqueduct to bring SWP water directly to the Valley, CVWD and DWA entered into an exchange agreement with

MWD to exchange SWP water for Colorado River water. The exchange agreement allows for delivery of Colorado River Water water to replenish groundwater in the Whitewater River Sub-basin of the Upper Coachella Valley Groundwater Basin.

By the 1980s, groundwater demand in the East Valley had again exceeded supplies, resulting in significant groundwater level decreases in some parts of the East Valley. Because groundwater recharge in the East Valley is complicated by relatively impervious clay layers in the Valley floor, CVWD began looking for sites sufficiently far away from the main clay layer to allow groundwater recharge.

CVWD, DWA, and MWD executed an Advance Delivery Agreement in 1983 (updated in 2003), which allows MWD to store up to 600,000 acre feet of water in the Whitewater River Sub-basin. MWD assigned 11,900 acre feet of its annual Table A allocation to DWA and 88,100 acre feet of its annual Table A allocation to CVWD for a total of 100,000 acre feet (Table A is an entitlement schedule set forth by the SWP on an annual basis). CVWD and DWA executed the Mission Creek Groundwater Replenishment Agreement in April 2003, which also allows for storage of advanced deliveries from MWD.

CVWD and DWA now operate four recharge areas in the Coachella Valley IRWM region:

- *Whitewater Spreading Area* recharges Colorado River water and captures stormwater, with historical peak recharge of 288,000 acre-feet in 1986,
- *Mission Creek Spreading Facility* recharges Colorado River water and has a recharge capacity of 30,000 to 40,000 AFY,
- *Thomas E. Levy Recharge Facility* recharges water obtained from the Coachella Canal and has a recharge capacity of approximately 30,000 to 40,000 AFY, and
- *Martinez Canyon Pilot Recharge Project* recharges Coachella Canal water and currently has capacity of about 2,000 AFY.

SWP supplies vary annually due to weather and runoff variations, as well as regulatory limitations on exports from the Delta. Under current conditions, the SWP can only provide about 60 percent of the Table A allocation indicated in CVWD's and DWA's contracts. In the absence of state and federal actions in the Bay Delta to increase SWP supplies, it is anticipated that long-term SWP reliability (deliveries) could decrease to 50 percent of the Table A allocations.[3]

Because current water supplies imported into the Valley are from purchased entitlements via the SWP, these costs were used to estimate the avoided costs of water supply purchases that would result from the proposed projects. These costs can vary and are currently estimated to be around $4,000 per AFY based on CVWD's 2010 Coachella Valley Water Management Plan (CVWMP) Update. With an estimated long-term reliability of only 50 percent, this means the actual unit cost of imported water supply is closer to $8,000 per AFY. When exchanged for MWD's Colorado River water, additional costs for conveying the water are also incurred and are estimated to be around $600 per AFY. The total discounted future value of avoided water supply costs are based on a unit value derived from the cost of importing, transporting, and recharging of imported water and was estimated at $1,166/AF (in 2009 dollars).

Unit Cost for Supplemental Water Supplies

The District can purchase and import water from either the SWP or the Colorado River which is subject to a one-time entitlement cost plus the cost to transport the water which varies from year to year. It is assumed that costs associated with recent purchases of SWP entitlements are, representative of permanent transfers of all types. The Consumer Price Index adjusted weighted average unit cost to purchase water

[3] CVWD. 2010. *Coachella Valley Water Management Plan Update – Draft Report*. Available at: http://www.cvwd.org/news/publicinfo/2010_12_02_CVWMP_Update_Draft.pdf

rights for imported water is $3,025 per acre-foot. Table 8-2 below lists recent District transfers of SWP Table A water entitlements. In addition to the one-time entitlement cost which could be amortized, there is also a delivery cost. The derivation of these costs is described below.

Table 8-2: SWP Entitlements of Table A Water ($2009)

From	To	Year	Amount (ac-ft/yr)	Cost ($/ac-ft)	CPI Factor	Adjusted Unit Cost	Total Adjusted Cost
Tulare Lake Basin Water Storage District	CVWD and DWA	May-07	7,000	$3,000	1.27%	$3,000	$21,266,700
Berrenda Mesa Water District	CVWD and DWA	Nov-07	16,000	$3,000	0.65%	$3,000	$48,312,000
Totals			23,000				$69,578,700
Weighted Average/Acre Foot = $3,025							
Source: CVWD, Patti Reyes, pers.comm.							

The costs shown above may not be representative of the current and future situations due to the State's water crisis. The opportunity to purchase water rights is limited and the rights available for purchase are at a much higher price than shown in the above table. Historically, the SWP can deliver only a portion of their entitlements; therefore, the reliability of the SWP is factored into the unit cost for imported sources. The current reliability of SWP ranges between 71% and 78%as reported in "The State Water Project Delivery Reliability Report, 2011" by the California Department of Water Resources.[4] This projected reliability factor takes into account recent water ligation, including the 2007 Wanger Decision, as well as potential variability in the hydrologic cycle associated with climate change. Therefore, the District must purchase 59% more entitlement than it expects to receive in order to ensure adequate supplemental supplies. Therefore, the actual unit cost to purchase rights for imported water is $4,810 per acre-foot ($3,025 x 1.59) in $2009. Updated using the national Consumer Price Index (CPI), this amounts to $5,148/AF in $2012.

The delivery costs are developed on a fiscal year basis and are developed through the consideration of the fixed costs, the variable costs, and the demand for water. The delivery costs change from year to year with FYs 2012 and 2013 presented below in Table 8-3.

Table 8-3: Delivery Costs for FY2012 and FY2013

Item	FY 2012	FY 2013
Total Variable Before Refunds	$11,513,388.26	$9,117,890.00
Total Fixed	$41,736,746.52	$28,860,287.77
Subtotal	$53,520,134.78	$37,978,177.77
Total Acre-feet	102,127	61,290
Cost per acre-foot	$521.41	$619.65
Source: CVWD, Patti Reyes, pers.comm. The water costs included in this table were estimated by CVWD finance staff based on fiscal year 2012 billing, and include all annual variable and fixed State Water Project O&M and Transportation costs.		

As shown above, the delivery costs amount to $619.65/AF for 2013. Adjusting this 2013 value into $2012, using the 2012 CPI, the delivery cost comes to $607.08/AF (in $2012), as shown in Table 8-4.

[4] California Department of Water Resources (DWR). 202. *The State Water Project: Final Delivery Reliability Report – 2011.* Available: http://baydeltaoffice.water.ca.gov/swpreliability/FINAL2011DRR_DWR_Review_File-clean-6-25-12.pdf

Table 8-4: CVWD and DWA Water Rates Effective January 1, 2013 ($2012)

	Entitlement ($/AF)	Delivery ($/AF)
Volumetric Charges	$5,148	$607.08

For the purpose of the economic analyses, the cost for an AF of entitlement needs to be converted to the equivalent cost per AF per year (AFY). To do this, the entitlement to a stream of AF over all future years needs to be converted into its present value equivalent, using the 6.0% rate of discount mandated by DWR in the *Proposition 84-Round 2 Proposal Solicitation Package*. Discounting one AF of water in each year, through an infinite number of future years at 6.0%, yields a present value equivalent of 16.667 AF (1/0.06 = 16.667). That is, a permanent entitlement to 1 AF per year is equivalent to 16.6667 AF today. Dividing the entitlement cost of $5,148 by 16.667 provides an effective cost of $308.85/AFY. Adding to this the $607.08 cost per AF of delivery, and a total cost is derived of $915.93 per AFY ($2012). This is the effective cost per AF delivered of "imported" water to Coachella Valley.

Real Price Escalation for Imported Water

Several proposed projects enhance local water supplies and, thus, reduce the region's reliance on waters imported from the Bay-Delta via the SWP. The avoided cost of imported SWP water is thus an important monetized benefit for projects that enhance local supplies.

An important aspect in monetizing the value of avoided imports entails predicting the future cost of imported SWP water. The economic analyses in these grant applications are developed in real terms (based on 2012 dollars), meaning that the future stream of benefits and costs typically are not adjusted for general inflation. This is because most outcomes are expected to see price changes that generally align with broader measures of inflation, such as the Consumer Price Index (CPI), which is measured and reported by the federal Bureau of Labor Statistics (ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt).

The price of imported SWP water is an important exception, because various factors have led to rate increases that have considerably outpaced general inflation over the past two decades (as detailed below). This trend of real price increases for imported water (i.e., above the projected CPI) is likely to continue in the future as well, because the same factors that have driven these prices upward will remain relevant for several years to come. These factors principally include limitations on overall supply, due to a variety of factors primarily linked to the declining health of the Bay-Delta system from which these waters are extracted.

The supply-constraining factors for the Bay-Delta include Court rulings and environmental regulations related to the severe adverse impacts that declining water levels and the associated alterations in water quality (e.g., salinity) have imposed on this important ecosystem. Fish populations have declined dramatically in recent decades (including threatened and endangered species such as salmon and the delta smelt, for which the Bay Delta provides critical habitat). The levee system is aging, and vulnerability of the Delta to flooding, sea level rise, or a major earthquake has contributed to concerns about possible levee collapse which could have devastating and far-reaching consequences. In addition, water quality problems continue, with impacts not only on fisheries and natural systems, but also on water treatment needs to meet drinking water standards for protecting human health and aesthetics.

These factors – and the associated investments the Metropolitan Water District of Southern California (MWD) and other water agencies have needed to make in infrastructure and potable water treatment – have resulted in dramatic increases in the cost of water that MWD wholesales or exchanges throughout southern California. Large investments in new infrastructure made over the past ten to twenty years include the Diamond Valley Lake and Inland Feeder. In the coming years, additional large-scale costs are likely to be incurred for the Delta Conveyance, which may cost around $20 billion in its current formulation, with MWD likely to bear a large portion (e.g., one-third to one-half) of the cost.

Tables 8-5 and 8-6 reveal the extent to which MWD water rates have increased over the past 10 to 20 years, relative to general inflation as reflected by the federal CPI. Table 8-5 shows the change in MWD "Tier 1 treated" supply rates, and Table 8-6 provides the same information for MWD's "Tier 2 treated" water rates.[5] In both instances, it is evident that over both the recent short-term (5-year period) and longer-term periods (10-year and 20-year), imported water costs have increased at rates well above inflation. For example, Tier 1 rates in the 2008 through 2012 period increased by over 56%, which is 8.5 times greater than the CPI over the same period. A very similar result is evident for Tier 2 rates. This indicates that the real rate of price increase (above general inflation) for MWD water has been between 9.4% and 10.2% over the past five years (as shown in the right-most column in Tables 8-5 and 8-6).

Over a longer timeframe, similar escalations are evident as well. Over the last decade, the 10-year average annual cost increase for MWD water has been from 4.8% to 5.2% per year above inflation, for Tier 2 and Tier 1, respectively. The 20-year price trend indicates a real annual increase in imported water costs of nearly 2% above inflation.

Table 8-5 MWD Tier 1 Treated Rates compared to CPI

		cumulative change			average annual change		
time interval	# years	Tier 1	CPI	ratio	Tier 1	CPI	Real Tier 1
2008 - 2012	5 years	56.3%	6.6%	8.5	11.8%	1.6%	10.2%
2003 - 2012	10 years	94.6%	24.8%	3.8	7.7%	2.5%	5.2%

Table 8-6: MWD Tier 2 Treated Rates compared to CPI

		cumulative change			average annual change		
time interval	# years	Tier 2	CPI	ratio	Tier 2	CPI	Real Tier 2
2008 - 2012	5 years	51.8%	6.6%	7.8	11.0%	1.6%	9.4%
2003 - 2012	10 years	88.1%	24.8%	3.6	7.3%	2.5%	4.8%
1993 - 2012	20 years	123.3%	58.9%	2.1	4.3%	2.5%	1.9%

Based on these data, it is appropriate for the economic analyses to reflect how imported water costs in Southern California are likely to continue to increase at rates considerable above general inflation. To reflect real prices of imported water in the future, we have adopted the following conservative assumptions:

1. For water imported between 2013 and 2020 (inclusive), we derive a real cost by escalating the prior year's cost by 3.5%. Thus, for example, the 2013 imported water cost (in 2012) is estimated as the 2012 cost multiplied by 1.035. This escalation of 3.5% above CPI is fairly conservative (i.e., low end), given the documented trends over the past 5 to 10 years (for which real increases have ranged from 4.8% to 10.2% per year).
2. For water imported in 2021 and years thereafter, we escalate at a rate of 1.5% per year to obtain real prices. This is also a conservative, given that observed 10 to 20 year escalation rates have been in the 1.9% to 5.2% range).

Another benchmark for considering these real price adjustments is provided by the long-term forecast for CPI for the upcoming 10-year period, 2013 through 2022. The Federal Reserve Bank of Philadelphia indicates an anticipated annual average CPI of 2.3% over the next ten years.[6]

[5] MWD rates derived from http://www.mwdh2o.com/mwdh2o/pages/finance/finance_03.html
[6] Survey of Professional Forecasters, http://www.phil.frb.org/research-and-data/real-time-center/survey-of-professional-forecasters/2013/survq113.cfm, accessed February 28, 2013

Combining the CPI forecast with the real escalation rates we propose above for MWD imports suggests an average nominal increase in imported water costs of only 5.8% per year through 2020 (2.3% + 3.5%), and 3.8% from 2021 onwards (2.3% + 1.5%). Both of these nominal price increases are well below the average nominal price increases observed for MWD over the relevant comparable time periods:

The MWD 5- and 10-year average nominal rate increase has ranged from 7.3% to 11.8% (as shown in Tables 1 and 2), compared to our use of 5.8% over the 6-year period 2015 – 2020; and The 10- and 20-year MWD history shows nominal increases of 4.3% to 7.7%, contrasted to our use of a 3.8% nominal increase starting in 2012, eight years in the future.

Future Projected Prices

For this study, changes in imported water costs pertinent for CVWD and DWA are based on the above estimated cost of $928.50 per AF for 2012. As described above, for future years, we escalate the real cost of imported water by 3.5% above general inflation through 2020, and 1.5% real for 2021 onwards. Table 8-6 assumes that both water rates and delivery costs increase faster than CPI.

Table 8-6: CVWD and DWA Projected Water Rates, 2012-2060 ($/AF, in real prices, $2012)

Year	Water Cost	Transportation Cost	Total Cost
2013	$ 308.85	$ 607.08	$ 915.93
2014	$ 319.66	$ 628.33	$ 947.99
2015	$ 330.85	$ 650.32	$ 981.17
2016	$ 342.43	$ 673.08	$ 1,015.51
2017	$ 354.41	$ 696.64	$ 1,051.05
2018	$ 366.82	$ 721.02	$ 1,087.84
2019	$ 379.66	$ 746.26	$ 1,125.91
2020	$ 392.94	$ 772.38	$ 1,165.32
2021	$ 398.84	$ 783.96	$ 1,182.80
2022	$ 404.82	$ 795.72	$ 1,200.54
2023	$ 410.89	$ 807.66	$ 1,218.55
2024	$ 417.06	$ 819.77	$ 1,236.83
2025	$ 423.31	$ 832.07	$ 1,255.38
2026	$ 429.66	$ 844.55	$ 1,274.21
2027	$ 436.11	$ 857.22	$ 1,293.32
2028	$ 442.65	$ 870.08	$ 1,312.72
2029	$ 449.29	$ 883.13	$ 1,332.41
2030	$ 456.03	$ 896.37	$ 1,352.40
2031	$ 462.87	$ 909.82	$ 1,372.69
2032	$ 469.81	$ 923.47	$ 1,393.28
2033	$ 476.86	$ 937.32	$ 1,414.18
2034	$ 484.01	$ 951.38	$ 1,435.39
2035	$ 491.27	$ 965.65	$ 1,456.92
2036	$ 498.64	$ 980.13	$ 1,478.77
2037	$ 506.12	$ 994.84	$ 1,500.95
2038	$ 513.71	$ 1,009.76	$ 1,523.47
2039	$ 521.42	$ 1,024.90	$ 1,546.32
2040	$ 529.24	$ 1,040.28	$ 1,569.52
2041	$ 537.18	$ 1,055.88	$ 1,593.06
2042	$ 545.23	$ 1,071.72	$ 1,616.95
2043	$ 553.41	$ 1,087.80	$ 1,641.21
2044	$ 561.71	$ 1,104.11	$ 1,665.83
2045	$ 570.14	$ 1,120.67	$ 1,690.81
2046	$ 578.69	$ 1,137.48	$ 1,716.18
2047	$ 587.37	$ 1,154.55	$ 1,741.92
2048	$ 596.18	$ 1,171.86	$ 1,768.05
2049	$ 605.13	$ 1,189.44	$ 1,794.57
2050	$ 614.20	$ 1,207.28	$ 1,821.49
2051	$ 623.42	$ 1,225.39	$ 1,848.81
2052	$ 632.77	$ 1,243.77	$ 1,876.54
2053	$ 642.26	$ 1,262.43	$ 1,904.69
2054	$ 651.89	$ 1,281.37	$ 1,933.26
2055	$ 661.67	$ 1,300.59	$ 1,962.26
2056	$ 671.60	$ 1,320.10	$ 1,991.69
2057	$ 681.67	$ 1,339.90	$ 2,021.57
2058	$ 691.89	$ 1,360.00	$ 2,051.89
2059	$ 702.27	$ 1,380.40	$ 2,082.67

Year	Water Cost	Transportation Cost	Total Cost
2060	$ 712.81	$ 1,401.10	$ 2,113.91
2061	$ 723.50	$ 1,422.12	$ 2,145.62
2062	$ 734.35	$ 1,443.45	$ 2,177.80
2063	$ 745.37	$ 1,465.10	$ 2,210.47
2064	$ 756.55	$ 1,487.08	$ 2,243.63
2065	$ 767.90	$ 1,509.39	$ 2,277.28
2066	$ 779.41	$ 1,532.03	$ 2,311.44
2067	$ 791.10	$ 1,555.01	$ 2,346.11
2068	$ 802.97	$ 1,578.33	$ 2,381.30
2069	$ 815.02	$ 1,602.01	$ 2,417.02
2070	$ 827.24	$ 1,626.04	$ 2,453.28
2071	$ 839.65	$ 1,650.43	$ 2,490.08
2072	$ 852.24	$ 1,675.18	$ 2,527.43

Conclusions

The fundamental source of the Coachella Valley's domestic water is the Coachella Valley Groundwater Basin. All water used for domestic water purposes is extracted from this basin through wells that are located throughout the Valley. Currently, the water extracted from the basin exceeds the natural recharge. In other words, the Coachella Valley Groundwater Basin is in a state of overdraft. Without imported water, the Coachella Valley Groundwater Basin would eventually be depleted and, in the interim, would impose significant costs as the groundwater levels decline and pumping costs and subsidence impacts increase. Further, new development within the Valley increases the demand on the existing water supply. These increased demands, as well as existing non-sustainable rates of groundwater extraction, have required CVWD and DWA to seek new additional water supply sources to keep pace with the Valley's growth. Each AF of water the region can save through conservation, or develop from local sources such as recycled or non-potable water, will offset the need for an AF of imported water to help recharge the local groundwater basin. Given the high cost of imported water, there is a high value that can be attributed to each local AF of groundwater saved or supplemented with local sources.

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit

Project: _____Non-Potable Water Use Expansion PRogram_____

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value [1]	(h) Annual $ Value [1] (f) x (g)	(i) Discount Factor [1]	(j) Discounted Benefits [1] (h) x (i)
2012									
2013									
2014									
2015									
2016	Imported water supply	AF	1,610	0	1,610	$1,015.51	$1,634,971	0.792	**$1,295,050**
	Groundwater pumping	AF	2,311	0	2,311	$53.08	$122,668	0.792	**$97,164**
	Social costs of CO_2 emissions	MT	1,795	1,539	752	$24.77	$18,629	0.792	**$14,756**
2017	Imported water supply	AF	1,610	0	1,610	$1,051.05	$1,692,191	0.747	**$1,264,503**
	Groundwater pumping	AF	7,281	0	7,281	$53.08	$386,475	0.747	**$288,797**
	Social costs of CO_2 emissions	MT	3,202	4,409	2,809	$25.37	$71,255	0.747	**$53,246**
2018	Imported water supply	AF	1,610	0	1,610	$1,087.84	$1,751,422	0.705	**$1,234,684**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.705	**$301,225**
	Social costs of CO_2 emissions	MT	3,420	4,783	3,196	$25.98	$83,017	0.705	**$58,524**
2019	Imported water supply	AF	1,610	0	1,610	$1,125.91	$1,812,715	0.665	**$1,205,559**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.665	**$284,175**
	Social costs of CO_2 emissions	MT	3,420	4,783	3,196	$26.60	$85,010	0.665	**$56,536**
2020	Imported water supply	AF	3,220	0	3,220	$1,165.32	$3,752,330	0.627	**$2,354,259**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.627	**$268,090**
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$27.24	$87,050	0.627	**$54,616**
2021	Imported water supply	AF	3,220	0	3,220	$1,182.80	$3,808,616	0.592	**$2,254,314**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.592	**$252,915**
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$27.89	$89,139	0.592	**$52,761**
2022	Imported water supply	AF	3,220	0	3,220	$1,200.54	$3,865,739	0.558	**$2,158,608**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.558	**$238,599**
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$28.56	$91,278	0.558	**$50,969**
2023	Imported water supply	AF	3,220	0	3,220	$1,218.55	$3,923,731	0.527	**$2,066,973**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.527	**$225,093**
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$29.25	$93,469	0.527	**$49,238**
2024	Imported water supply	AF	3,220	0	3,220	$1,236.83	$3,982,593	0.497	**$1,979,227**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.497	**$212,352**
	Social costs of CO_2 emissions	MT	4,560	4,783	3,196	$29.95	$95,712	0.497	**$47,566**
2025	Imported water supply	AF	4,830	0	4,830	$1,255.38	$6,063,485	0.469	**$2,842,799**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.469	**$200,332**
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$30.67	$98,009	0.469	**$45,951**
2026	Imported water supply	AF	4,830	0	4,830	$1,274.21	$6,154,434	0.442	**$2,722,112**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.442	**$188,993**

Appendix 8-2: Cost-Benefit Tables

	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$31.40	$100,362	0.442	**$44,390**
2027	Imported water supply	AF	4,830	0	4,830	$1,293.32	$6,246,736	0.417	**$2,606,545**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.417	**$178,295**
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$32.16	$102,770	0.417	**$42,882**
2028	Imported water supply	AF	4,830	0	4,830	$1,312.72	$6,340,438	0.394	**$2,495,890**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.394	**$168,203**
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$32.93	$105,237	0.394	**$41,426**
2029	Imported water supply	AF	4,830	0	4,830	$1,332.41	$6,435,540	0.371	**$2,389,931**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.371	**$158,682**
	Social costs of CO_2 emissions	MT	5,700	4,783	3,196	$33.72	$107,762	0.371	**$40,019**
2030	Imported water supply	AF	6,440	0	6,440	$1,352.40	$8,709,456	0.350	**$3,051,304**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.350	**$149,700**
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$34.53	$110,349	0.350	**$38,660**
2031	Imported water supply	AF	6,440	0	6,440	$1,372.69	$8,840,124	0.331	**$2,921,776**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.331	**$141,226**
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$35.36	$112,997	0.331	**$37,347**
2032	Imported water supply	AF	6,440	0	6,440	$1,393.28	$8,972,723	0.312	**$2,797,738**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.312	**$133,232**
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$36.20	$115,709	0.312	**$36,079**
2033	Imported water supply	AF	6,440	0	6,440	$1,414.18	$9,107,319	0.294	**$2,678,967**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.294	**$125,691**
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$37.07	$118,486	0.294	**$34,853**
2034	Imported water supply	AF	6,440	0	6,440	$1,435.39	$9,243,912	0.278	**$2,565,233**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.278	**$118,576**
	Social costs of CO_2 emissions	MT	6,840	4,783	3,196	$37.96	$121,330	0.278	**$33,670**
2035	Imported water supply	AF	8,050	0	8,050	$1,456.92	$11,728,206	0.262	**$3,070,412**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.262	**$111,864**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$38.87	$124,242	0.262	**$32,526**
2036	Imported water supply	AF	8,050	0	8,050	$1,478.77	$11,904,099	0.247	**$2,940,057**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.247	**$105,532**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$39.81	$127,223	0.247	**$31,421**
2037	Imported water supply	AF	8,050	0	8,050	$1,500.95	$12,082,648	0.233	**$2,815,240**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.233	**$99,559**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$40.76	$130,277	0.233	**$30,354**
2038	Imported water supply	AF	8,050	0	8,050	$1,523.47	$12,263,934	0.220	**$2,695,736**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.220	**$93,924**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$41.74	$133,403	0.220	**$29,323**
2039	Imported water supply	AF	8,050	0	8,050	$1,546.32	$12,447,876	0.207	**$2,581,291**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.207	**$88,607**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$42.74	$136,605	0.207	**$28,328**

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2040	Imported water supply	AF	8,050	0	8,050	$1,569.52	$12,634,636	0.196	**$2,471,716**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.196	**$83,592**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$43.77	$139,884	0.196	**$27,365**
2041	Imported water supply	AF	8,050	0	8,050	$1,593.06	$12,824,133	0.185	**$2,366,780**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.185	**$78,860**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$44.82	$143,241	0.185	**$26,436**
2042	Imported water supply	AF	8,050	0	8,050	$1,616.95	$13,016,448	0.174	**$2,266,295**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.174	**$74,396**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$45.89	$146,679	0.174	**$25,538**
2043	Imported water supply	AF	8,050	0	8,050	$1,641.21	$13,211,741	0.164	**$2,170,092**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.164	**$70,185**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$47.00	$150,199	0.164	**$24,671**
2044	Imported water supply	AF	8,050	0	8,050	$1,665.83	$13,409,932	0.155	**$2,077,968**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.155	**$66,212**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$48.12	$153,804	0.155	**$23,833**
2045	Imported water supply	AF	8,050	0	8,050	$1,690.81	$13,611,021	0.146	**$1,989,744**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.146	**$62,464**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$49.28	$157,495	0.146	**$23,024**
2046	Imported water supply	AF	8,050	0	8,050	$1,716.18	$13,815,249	0.138	**$1,905,282**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.138	**$58,929**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$50.46	$161,275	0.138	**$22,242**
2047	Imported water supply	AF	8,050	0	8,050	$1,741.92	$14,022,456	0.130	**$1,824,395**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.130	**$55,593**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$51.67	$165,145	0.130	**$21,486**
2048	Imported water supply	AF	8,050	0	8,050	$1,768.05	$14,232,803	0.123	**$1,746,945**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.123	**$52,446**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$52.91	$169,109	0.123	**$20,757**
2049	Imported water supply	AF	8,050	0	8,050	$1,794.57	$14,446,289	0.116	**$1,672,782**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.116	**$49,478**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$54.18	$173,167	0.116	**$20,052**
2050	Imported water supply	AF	8,050	0	8,050	$1,821.49	$14,662,995	0.109	**$1,601,769**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.109	**$46,677**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$55.48	$177,324	0.109	**$19,371**
2051	Imported water supply	AF	8,050	0	8,050	$1,848.81	$14,882,921	0.103	**$1,533,767**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.103	**$44,035**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$56.81	$181,579	0.103	**$18,713**
2052	Imported water supply	AF	8,050	0	8,050	$1,876.54	$15,106,147	0.097	**$1,468,653**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.097	**$41,542**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$58.18	$185,937	0.097	**$18,077**
2053	Imported water supply	AF	8,050	0	8,050	$1,904.69	$15,332,755	0.092	**$1,406,306**

	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.092	**$39,191**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$59.57	$190,400	0.092	**$17,463**
2054	Imported water supply	AF	8,050	0	8,050	$1,933.26	$15,562,743	0.087	**$1,346,604**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.087	**$36,973**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$61.00	$194,969	0.087	**$16,870**
2055	Imported water supply	AF	8,050	0	8,050	$1,962.26	$15,796,193	0.082	**$1,289,437**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.082	**$34,880**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$62.47	$199,649	0.082	**$16,297**
2056	Imported water supply	AF	8,050	0	8,050	$1,991.69	$16,033,105	0.077	**$1,234,695**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.077	**$32,906**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$63.97	$204,440	0.077	**$15,744**
2057	Imported water supply	AF	8,050	0	8,050	$2,021.57	$16,273,639	0.073	**$1,182,281**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.073	**$31,043**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$65.50	$209,347	0.073	**$15,209**
2058	Imported water supply	AF	8,050	0	8,050	$2,051.89	$16,517,715	0.069	**$1,132,088**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.069	**$29,286**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$67.07	$214,371	0.069	**$14,693**
2059	Imported water supply	AF	8,050	0	8,050	$2,082.67	$16,765,494	0.065	**$1,084,028**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.065	**$27,628**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$68.68	$219,516	0.065	**$14,194**
2060	Imported water supply	AF	8,050	0	8,050	$2,113.91	$17,016,976	0.061	**$1,038,008**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.061	**$26,064**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$70.33	$224,784	0.061	**$13,711**
2061	Imported water supply	AF	8,050	0	8,050	$2,145.62	$17,272,241	0.058	**$993,943**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.058	**$24,589**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$72.02	$230,179	0.058	**$13,246**
2062	Imported water supply	AF	8,050	0	8,050	$2,177.80	$17,531,290	0.054	**$951,745**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.054	**$23,197**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$73.75	$235,703	0.054	**$12,796**
2063	Imported water supply	AF	8,050	0	8,050	$2,210.47	$17,794,284	0.051	**$911,342**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.051	**$21,884**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$75.52	$241,360	0.051	**$12,361**
2064	Imported water supply	AF	8,050	0	8,050	$2,243.63	$18,061,222	0.048	**$872,654**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.048	**$20,645**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$77.33	$247,153	0.048	**$11,942**
2065	Imported water supply	AF	8,050	0	8,050	$2,277.28	$18,332,104	0.046	**$835,606**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.046	**$19,477**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$79.19	$253,085	0.046	**$11,536**
2066	Imported water supply	AF	8,050	0	8,050	$2,311.44	$18,607,092	0.043	**$800,132**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.043	**$18,374**

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	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$81.09	$259,159	0.043	**$11,144**
2067	Imported water supply	AF	8,050	0	8,050	$2,346.11	$18,886,186	0.041	**$766,164**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.041	**$17,334**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$83.03	$265,378	0.041	**$10,766**
2068	Imported water supply	AF	8,050	0	8,050	$2,381.30	$19,169,465	0.038	**$733,638**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.038	**$16,353**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$85.03	$271,747	0.038	**$10,400**
2069	Imported water supply	AF	8,050	0	8,050	$2,417.02	$19,457,011	0.036	**$702,493**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.036	**$15,427**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$87.07	$278,269	0.036	**$10,047**
2070	Imported water supply	AF	8,050	0	8,050	$2,453.28	$19,748,904	0.034	**$672,671**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.034	**$14,554**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$89.16	$284,948	0.034	**$9,706**
2071	Imported water supply	AF	8,050	0	8,050	$2,490.08	$20,045,144	0.032	**$644,115**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.032	**$13,730**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$91.30	$291,787	0.032	**$9,376**
2072	Imported water supply	AF	8,050	0	8,050	$2,527.43	$20,345,812	0.030	**$616,770**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.030	**$12,953**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$93.49	$298,790	0.030	**$9,058**
2073	Imported water supply	AF	8,050	0	8,050	$2,565.34	$20,650,987	0.029	**$590,586**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.029	**$12,220**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$95.73	$305,960	0.029	**$8,750**
2074	Imported water supply	AF	8,050	0	8,050	$2,603.82	$20,960,751	0.027	**$565,514**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.027	**$11,528**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$98.03	$313,304	0.027	**$8,453**
2075	Imported water supply	AF	8,050	0	8,050	$2,642.88	$21,275,184	0.025	**$541,507**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.025	**$10,876**
	Social costs of CO_2 emissions	MT	7,980	4,783	3,196	$100.38	$320,823	0.025	**$8,166**
2076	Imported water supply	AF	8,050	0	8,050	$2,682.52	$21,594,286	0.024	**$518,518**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.024	**$10,260**
	Social costs of CO_2 emissions	MT	7,980	2,796	3,196	$102.79	$328,523	0.024	**$7,888**
2077	Imported water supply	AF	8,050	0	8,050	$2,722.76	$21,918,218	0.023	**$496,505**
	Groundwater pumping	AF	8,050	0	8,050	$53.08	$427,294	0.023	**$9,679**
	Social costs of CO_2 emissions	MT	7,980	375	3,196	$105.26	$336,407	0.023	**$7,621**
								TOTAL	**$111,132,468**

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Table 16 – Annual Costs of Avoided Projects (All avoided costs should be in 2012 dollars) Project: _____Non-Potable Water Use Expansion Program_____						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): _____ Avoided Project Description:				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012					1.000	
2013					0.943	
2014	$1,239,930			$1,239,930	0.890	**$1,103,533**
2015			$107,065	$107,065	0.840	**$89,894**
2016			$107,065	$107,065	0.792	**$84,806**
2017			$107,065	$107,065	0.747	**$80,005**
2018			$107,065	$107,065	0.705	**$75,477**
2019	$1,239,930		$107,065	$1,346,995	0.665	**$895,829**
2020			$214,130	$214,130	0.627	**$134,348**
2021			$214,130	$214,130	0.592	**$126,743**
2022			$214,130	$214,130	0.558	**$119,569**
2023			$214,130	$214,130	0.527	**$112,801**
2024	$1,239,930		$214,130	$1,454,060	0.497	**$722,623**
2025			$321,195	$321,195	0.469	**$150,589**
2026			$321,195	$321,195	0.442	**$142,065**
2027			$321,195	$321,195	0.417	**$134,023**
2028			$321,195	$321,195	0.394	**$126,437**
2029	$1,239,930		$321,195	$1,561,125	0.371	**$579,746**
2030			$428,260	$428,260	0.350	**$150,038**
2031			$428,260	$428,260	0.331	**$141,546**
2032			$428,260	$428,260	0.312	**$133,533**
2033			$428,260	$428,260	0.294	**$125,975**
2034	$1,239,930		$428,260	$1,668,190	0.278	**$462,931**
2035			$535,325	$535,325	0.262	**$140,147**
2036			$535,325	$535,325	0.247	**$132,214**
2037			$535,325	$535,325	0.233	**$124,730**
2038			$535,325	$535,325	0.220	**$117,670**
2039			$535,325	$535,325	0.207	**$111,009**
2040			$535,325	$535,325	0.196	**$104,726**
2041			$535,325	$535,325	0.185	**$98,798**
2042			$535,325	$535,325	0.174	**$93,206**
2043			$535,325	$535,325	0.164	**$87,930**
2044			$535,325	$535,325	0.155	**$82,953**
2045			$535,325	$535,325	0.146	**$78,257**
2046			$535,325	$535,325	0.138	**$73,827**
2047			$535,325	$535,325	0.130	**$69,649**
2048			$535,325	$535,325	0.123	**$65,706**
2049			$535,325	$535,325	0.116	**$61,987**
2050			$535,325	$535,325	0.109	**$58,478**
2051			$535,325	$535,325	0.103	**$55,168**
2052			$535,325	$535,325	0.097	**$52,045**
2053			$535,325	$535,325	0.092	**$49,099**
2054			$535,325	$535,325	0.087	**$46,320**
2055			$535,325	$535,325	0.082	**$43,698**
2056			$535,325	$535,325	0.077	**$41,225**
2057			$535,325	$535,325	0.073	**$38,891**

Appendix 8-2: Cost-Benefit Tables

2058			$535,325	$535,325	0.069	**$36,690**
2059			$535,325	$535,325	0.065	**$34,613**
2060			$535,325	$535,325	0.061	**$32,654**
2061			$535,325	$535,325	0.058	**$30,806**
2062			$535,325	$535,325	0.054	**$29,062**
2063			$535,325	$535,325	0.051	**$27,417**
2064			$535,325	$535,325	0.048	**$25,865**
2065			$535,325	$535,325	0.046	**$24,401**
2066			$535,325	$535,325	0.043	**$23,020**
2067			$535,325	$535,325	0.041	**$21,717**
2068			$535,325	$535,325	0.038	**$20,488**
2069			$535,325	$535,325	0.036	**$19,328**
2070			$535,325	$535,325	0.034	**$18,234**
2071			$535,325	$535,325	0.032	**$17,202**
2072			$535,325	$535,325	0.030	**$16,228**
2073			$535,325	$535,325	0.029	**$15,309**
2074			$535,325	$535,325	0.027	**$14,443**
2075			$535,325	$535,325	0.025	**$13,625**
2076			$535,325	$535,325	0.024	**$12,854**
2077			$535,325	$535,325	0.023	**$12,127**
Total Present Value of Discounted Costs (Sum of Column (g))						**$ 7,966,326.31**
(%) 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)						**$ 7,966,326.31**

Appendix 8-2: Cost-Benefit Tables

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: _____Non-Potable Water Use Expansion Program_____

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$0.00	1.000	$0.00
2013	$154,024.00							$154,024.00	0.943	$145,305.66
2014	$462,072.00							$462,072.00	0.890	$411,242.44
2015	$924,143.00							$924,143.00	0.840	$775,928.28
2016	$1,232,191.00			$171,860.36				$1,404,051.36	0.792	$1,112,140.18
2017	$308,048.00			$832,817.16				$1,140,865.16	0.747	$852,520.82
2018				$981,271.80				$981,271.80	0.705	$691,757.90
2019				$981,271.80				$981,271.80	0.665	$652,601.79
2020				$981,271.80				$981,271.80	0.627	$615,662.07
2021				$981,271.80				$981,271.80	0.592	$580,813.27
2022				$981,271.80				$981,271.80	0.558	$547,937.05
2023				$981,271.80				$981,271.80	0.527	$516,921.74
2024				$981,271.80				$981,271.80	0.497	$487,662.02
2025				$981,271.80				$981,271.80	0.469	$460,058.51
2026				$981,271.80				$981,271.80	0.442	$434,017.46
2027				$981,271.80				$981,271.80	0.417	$409,450.44
2028				$981,271.80				$981,271.80	0.394	$386,274.00
2029				$981,271.80				$981,271.80	0.371	$364,409.43
2030				$981,271.80				$981,271.80	0.350	$343,782.48
2031				$981,271.80				$981,271.80	0.331	$324,323.10
2032				$981,271.80				$981,271.80	0.312	$305,965.19
2033				$981,271.80				$981,271.80	0.294	$288,646.40
2034				$981,271.80				$981,271.80	0.278	$272,307.93
2035				$981,271.80				$981,271.80	0.262	$256,894.27
2036				$981,271.80				$981,271.80	0.247	$242,353.08
2037				$981,271.80				$981,271.80	0.233	$228,634.99
2038				$981,271.80				$981,271.80	0.220	$215,693.38
2039				$981,271.80				$981,271.80	0.207	$203,484.32
2040				$981,271.80				$981,271.80	0.196	$191,966.34
2041				$981,271.80				$981,271.80	0.185	$181,100.32
2042				$981,271.80				$981,271.80	0.174	$170,849.36
2043				$981,271.80				$981,271.80	0.164	$161,178.64
2044				$981,271.80				$981,271.80	0.155	$152,055.32
2045				$981,271.80				$981,271.80	0.146	$143,448.42
2046				$981,271.80				$981,271.80	0.138	$135,328.70
2047				$981,271.80				$981,271.80	0.130	$127,668.58
2048				$981,271.80				$981,271.80	0.123	$120,442.06
2049				$981,271.80				$981,271.80	0.116	$113,624.58
2050				$981,271.80				$981,271.80	0.109	$107,193.00
2051				$981,271.80				$981,271.80	0.103	$101,125.47
2052				$981,271.80				$981,271.80	1.000	$981,271.80
2053				$981,271.80				$981,271.80	1.000	$981,271.80
2054				$981,271.80				$981,271.80	1.000	$981,271.80
2055				$981,271.80				$981,271.80	1.000	$981,271.80
2056				$981,271.80				$981,271.80	1.000	$981,271.80
2057				$981,271.80				$981,271.80	1.000	$981,271.80
2058				$981,271.80				$981,271.80	1.000	$981,271.80
2059				$981,271.80				$981,271.80	1.000	$981,271.80
2060				$981,271.80				$981,271.80	1.000	$981,271.80
2061				$981,271.80				$981,271.80	1.000	$981,271.80
2062				$981,271.80				$981,271.80	0.097	$95,401.39
2063				$981,271.80				$981,271.80	0.092	$90,001.31
2064				$981,271.80				$981,271.80	0.087	$84,906.90
2065				$981,271.80				$981,271.80	0.082	$80,100.85
2066				$981,271.80				$981,271.80	0.077	$75,566.84
2067				$981,271.80				$981,271.80	0.073	$71,289.47
2068				$981,271.80				$981,271.80	0.069	$67,254.22
2069				$981,271.80				$981,271.80	0.065	$63,447.37
2070				$981,271.80				$981,271.80	0.061	$59,856.01
2071				$981,271.80				$981,271.80	0.058	$56,467.94
2072				$981,271.80				$981,271.80	0.054	$53,271.64
2073				$981,271.80				$981,271.80	0.051	$50,256.26
2074				$981,271.80				$981,271.80	0.048	$47,411.57
2075				$981,271.80				$981,271.80	0.046	$44,727.89
2076				$809,411.45				$809,411.45	0.043	$34,805.88
2077				$148,454.64				$148,454.64	0.041	$6,022.42
column totals	$3,080,478.00	$0.00	$0.00	$58,876,308.00	$0.00	$0.00	$0.00	$61,956,786.00		$24,626,274.97
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$24,626,274.97**

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit (All benefits should be in 2012 dollars) Project: _____Coachella Valley Salt and Nutrient Management Program_____									
(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 [1]	Annual $ Value [1] (f) x (g)	Discount Factor [1]	Discounted Benefits [1] (h) x (i)
2014									
2015									
2016	Maintain ability to use recycled water	14268 AFY	0	14268 AFY	14268	$ 974	$ 13,897,923	0.792	**$ 11,008,457**
2017	Maintain ability to use recycled water	14268 AFY	0	14268 AFY	14268	$ 986	$ 14,074,910	0.747	**$ 10,517,591**
2018	Maintain ability to use recycled water	14268 AFY	0	14268 AFY	14268	$ 999	$ 14,258,091	0.705	**$ 10,051,392**
2019	Maintain ability to use recycled water	14268 AFY	0	14268 AFY	14268	$ 1,013	$ 14,447,683	0.665	**$ 9,608,535**
2020	Maintain ability to use recycled water	14268 AFY	0	14268 AFY	14268	$ 1,026	$ 14,643,911	0.627	**$ 9,187,771**
Last Year of Project Life								...	
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$ 50,373,746**

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit (All benefits should be in 2012 dollars) Project: _____Coachella Valley Salt and Nutrient Management Program_____									
(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 (1)	Annual $ Value (1) (f) x (g)	Discount Factor (1)	Discounted Benefits (1) (h) x (i)
2014									
2015									
2016	Avoid Energy Use	MT/Year	4143	14499	10356	$ 22.53	$ 233,321	0.792	**$ 184,812**
2017	Avoid Energy Use	MT/Year	4143	14499	10356	$ 22.53	$ 233,321	0.747	**$ 174,351**
2018	Avoid Energy Use	MT/Year	4143	14499	10356	$ 22.53	$ 233,321	0.705	**$ 164,482**
2019	Avoid Energy Use	MT/Year	4143	14499	10356	$ 22.53	$ 233,321	0.665	**$ 155,172**
2020	Avoid Energy Use	MT/Year	4143	14499	10356	$ 22.53	$ 233,321	0.627	**$ 146,388**
Last Year of Project								...	
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$ 825,204**

Appendix 8-2: Cost-Benefit Tables

Table 16 – Annual Costs of Avoided Projects (All avoided costs should be in 2012 dollars) Project: _____Coachella Valley Salt and Nutrient Management Program_____						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): _____ Avoided Project Description:				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012					1.000	
2013					0.943	
2014					0.899	
2015					0.839	
2016	$1,042,000				0.792	**$825,362**
2017					0.747	
2018					0.705	
2019					0.665	
2020					0.627	**$0**
2021					0.592	
2022					0.558	
2023					0.527	
2024					0.497	
					...	
Last Year of Project Life					...	
Total Present Value of Discounted Costs (Sum of Column (g))						**$0**
(%) Avoided Cost Claimed by Project						**100**
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$ 825,362**

Appendix 8-2: Cost-Benefit Tables

Table 19 – Annual Costs of Project (All costs should be in 2012 Dollars) Project: Coachella Valley Salt and Nutrient Management Program_____										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012							$90,000	$ 90,000	1.000	**$ 90,000**
2013	$ 128,733						$17,625	$ 146,358	0.943	**$ 138,016**
2014	$ 379,422							$ 379,422	0.890	**$ 337,686**
2015	$ 169,385							$ 169,385	0.840	**$ 142,283**
…									…	
2019									…	
Last Year of Project Life									…	
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										**$ 707,985**

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit
(All benefits should be in 2012 dollars)

Project 3: Groundwater Quality Protection Project – Subarea D2 - Benefit - : Increased groundwater recharge

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	a					$ 928.50		1.000	
2013	b					$ 939.31		0.943	
2014	c					$ 950.50		0.890	
2015	Increased	AFY				$ 962.08	$ -	0.840	**$ -**
2016	Increased	AFY				$ 974.06	$ -	0.792	**$ -**
2017	Increased	AFY				$ 986.47	$ -	0.747	**$ -**
2018	Increased	AFY		35.6	35.6	$ 999.31	$ 35,575	0.705	**$ 25,079**
2019	Increased	AFY		71.1	71.1	$ 1,012.59	$ 71,995	0.665	**$ 47,881**
2020	Increased	AFY		106.7	106.7	$ 1,026.35	$ 109,511	0.627	**$ 68,709**
2021	Increased	AFY		142.2	142.2	$ 1,032.45	$ 146,814	0.592	**$ 86,899**
2022	Increased	AFY		142.2	142.2	$ 1,038.64	$ 147,694	0.558	**$ 82,472**
2023	Increased	AFY		142.2	142.2	$ 1,044.92	$ 148,588	0.527	**$ 78,274**
2024	Increased	AFY		142.2	142.2	$ 1,051.30	$ 149,495	0.497	**$ 74,295**
2025	Increased	AFY		142.2	142.2	$ 1,057.78	$ 150,416	0.469	**$ 70,521**
2026	Increased	AFY		142.2	142.2	$ 1,064.35	$ 151,351	0.442	**$ 66,942**
2027	Increased	AFY		142.2	142.2	$ 1,071.02	$ 152,299	0.417	**$ 63,549**
2028	Increased	AFY		142.2	142.2	$ 1,077.79	$ 153,262	0.394	**$ 60,331**
2029	Increased	AFY		142.2	142.2	$ 1,084.66	$ 154,239	0.371	**$ 57,279**
2030	Increased	AFY		142.2	142.2	$ 1,091.64	$ 155,231	0.350	**$ 54,384**
2031	Increased	AFY		142.2	142.2	$ 1,098.72	$ 156,238	0.331	**$ 51,639**
2032	Increased	AFY		142.2	142.2	$ 1,105.90	$ 157,260	0.312	**$ 49,034**
2033	Increased	AFY		142.2	142.2	$ 1,113.20	$ 158,297	0.294	**$ 46,564**
2034	Increased	AFY		142.2	142.2	$ 1,120.60	$ 159,349	0.278	**$ 44,220**
2035	Increased	AFY		142.2	142.2	$ 1,128.11	$ 160,418	0.262	**$ 41,997**
2036	Increased	AFY		142.2	142.2	$ 1,135.74	$ 161,503	0.247	**$ 39,888**
2037	Increased	AFY		142.2	142.2	$ 1,143.48	$ 162,603	0.233	**$ 37,886**
2038	Increased	AFY		142.2	142.2	$ 1,151.34	$ 163,721	0.220	**$ 35,987**
2039	Increased	AFY		142.2	142.2	$ 1,159.32	$ 164,855	0.207	**$ 34,186**
2040	Increased	AFY		142.2	142.2	$ 1,167.41	$ 166,006	0.196	**$ 32,476**
2041	Increased	AFY		142.2	142.2	$ 1,175.63	$ 167,174	0.185	**$ 30,853**
2042	Increased	AFY		142.2	142.2	$ 1,183.97	$ 168,360	0.174	**$ 29,313**
2043	Increased	AFY		142.2	142.2	$ 1,192.43	$ 169,564	0.164	**$ 27,852**
2044	Increased	AFY		142.2	142.2	$ 1,201.02	$ 170,786	0.155	**$ 26,464**
2045	Increased	AFY		142.2	142.2	$ 1,209.74	$ 172,026	0.146	**$ 25,148**
2046	Increased	AFY		142.2	142.2	$ 1,218.60	$ 173,284	0.138	**$ 23,898**
2047	Increased	AFY		142.2	142.2	$ 1,227.58	$ 174,562	0.130	**$ 22,711**
2048	Increased	AFY		142.2	142.2	$ 1,236.70	$ 175,859	0.123	**$ 21,585**
2049	Increased	AFY		142.2	142.2	$ 1,245.95	$ 177,175	0.116	**$ 20,516**
2050	Increased	AFY		142.2	142.2	$ 1,255.35	$ 178,511	0.109	**$ 19,500**
2051	Increased	AFY		142.2	142.2	$ 1,264.88	$ 179,867	0.103	**$ 18,536**
2052	Increased	AFY		142.2	142.2	$ 1,274.56	$ 181,243	0.097	**$ 17,621**
2053	Increased	AFY		142.2	142.2	$ 1,284.39	$ 182,640	0.092	**$ 16,752**
2054	Increased	AFY		142.2	142.2	$ 1,294.36	$ 184,058	0.087	**$ 15,926**
2055	Increased	AFY		142.2	142.2	$ 1,304.48	$ 185,497	0.082	**$ 15,142**
2056	Increased	AFY		142.2	142.2	$ 1,314.75	$ 186,958	0.077	**$ 14,397**
2057	Increased	AFY		142.2	142.2	$ 1,325.18	$ 188,440	0.073	**$ 13,690**
2058	Increased	AFY		142.2	142.2	$ 1,335.76	$ 189,945	0.069	**$ 13,018**
2059	Increased	AFY		142.2	142.2	$ 1,346.50	$ 191,473	0.065	**$ 12,380**
2060	Increased	AFY		142.2	142.2	$ 1,357.40	$ 193,023	0.061	**$ 11,774**
2061	Increased	AFY		142.2	142.2	$ 1,368.47	$ 194,597	0.058	**$ 11,198**
2062	Increased	AFY		142.2	142.2	$ 1,379.70	$ 196,194	0.054	**$ 10,651**
2063	Increased	AFY		142.2	142.2	$ 1,391.10	$ 197,815	0.051	**$ 10,131**
2064	Increased	AFY		142.2	142.2	$ 1,402.68	$ 199,461	0.048	**$ 9,637**
2065	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.046	**$ 9,168**
2066	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.043	**$ 8,649**
2067	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.041	**$ 8,159**
2068	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.038	**$ 7,698**
2069	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.036	**$ 7,262**
2070	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.034	**$ 6,851**
2071	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.032	**$ 6,463**
2072	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.030	**$ 6,097**
2073	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.029	**$ 5,752**
2074	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.027	**$ 5,426**
2075	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.025	**$ 5,119**
2076	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.024	**$ 4,830**
2077	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.023	**$ 4,556**
2078	Increased	AFY		142.2	142.2	$ 1,414.42	$ 201,131	0.021	**$ 4,298**
...	..							...	
Last Year of Project Life								...	
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 1,779,515**

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit
(All benefits should be in 2012 dollars)

Project 3: Groundwater Quality Protection Project – Subarea D2 - Benefit - : Avoided Losst of Transient Occupancy Tax

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value [1]	(h) Annual $ Value [1] (f) x (g)	(i) Discount Factor [1]	(j) Discounted Benefits [1] (h) x (i)
2012								1.000	
2013								0.943	
2014								0.890	
2015							$ -	0.840	**$ -**
2016							$ -	0.792	**$ -**
2017							$ -	0.747	**$ -**
2018	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	1	$ 101,547.00	0.705	**$ 71,587**
2019	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	2	$ 203,094.00	0.665	**$ 135,069**
2020	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	3	$ 304,641.00	0.627	**$ 191,136**
2021	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	4	$ 406,188.00	0.592	**$ 240,422**
2022	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.558	**$ 283,517**
2023	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.527	**$ 267,468**
2024	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.497	**$ 252,329**
2025	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.469	**$ 238,046**
2026	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.442	**$ 224,572**
2027	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.417	**$ 211,860**
2028	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.394	**$ 199,868**
2029	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.371	**$ 188,555**
2030	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.350	**$ 177,882**
2031	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.331	**$ 167,813**
2032	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.312	**$ 158,314**
2033	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.294	**$ 149,353**
2034	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.278	**$ 140,899**
2035	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.262	**$ 132,924**
2036	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.247	**$ 125,400**
2037	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.233	**$ 118,302**
2038	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.220	**$ 111,605**
2039	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.207	**$ 105,288**
2040	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.196	**$ 99,328**
2041	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.185	**$ 93,706**
2042	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.174	**$ 88,402**
2043	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.164	**$ 83,398**
2044	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.155	**$ 78,677**
2045	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.146	**$ 74,224**
2046	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.138	**$ 70,023**
2047	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.130	**$ 66,059**
2048	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.123	**$ 62,320**
2049	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.116	**$ 58,792**
2050	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.109	**$ 55,464**
2051	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.103	**$ 52,325**
2052	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.097	**$ 49,363**
2053	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.092	**$ 46,569**
2054	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.087	**$ 43,933**
2055	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.082	**$ 41,446**
2056	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.077	**$ 39,100**
2057	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.073	**$ 36,887**
2058	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.069	**$ 34,799**
2059	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.065	**$ 32,829**
2060	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.061	**$ 30,971**
2061	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.058	**$ 29,218**
2062	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.054	**$ 27,564**
2063	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.051	**$ 26,004**
2064	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.048	**$ 24,532**
2065	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.046	**$ 23,143**
2066	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.043	**$ 21,833**
2067	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.041	**$ 20,598**
2068	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.038	**$ 19,432**
2069	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.036	**$ 18,332**
2070	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.034	**$ 17,294**
2071	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.032	**$ 16,315**
2072	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.030	**$ 15,392**
2073	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.029	**$ 14,520**
2074	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.027	**$ 13,699**
2075	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.025	**$ 12,923**
2076	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.024	**$ 12,192**
2077	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.023	**$ 11,502**
2078	Avoided loss of	$	$ 10,053,120	$ 10,154,667	$ 101,547	5	$ 507,735.00	0.021	**$ 10,851**
...	..							...	
Last Year of Project Life								...	
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 5,466,164**

Appendix 8-2: Cost-Benefit Tables

Table 16 – Annual Costs of Avoided Projects (All avoided costs should be in 2012 dollars)						
Project 3: Groundwater Quality Protection Project – Subarea D2						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Remain on Septic Systems Avoided Project Description: Coninued maintenance and periodic septic replacement				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs (net of annual sewer charge)	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012					1.000	
2013					0.943	
2014					0.890	
2015				$ -	0.840	**$0.00**
2016				$ -	0.792	**$0.00**
2017				$ -	0.747	**$0.00**
2018		$38,200	$11,938	$ 50,138	0.705	**$35,345**
2019		$76,400	$23,875	$ 100,275	0.665	**$66,689**
2020		$114,600	$35,813	$ 150,413	0.627	**$94,371**
2021		$152,800	$47,750	$ 200,550	0.592	**$118,705**
2022		$152,800	$47,750	$ 200,550	0.558	**$111,986**
2023		$152,800	$47,750	$ 200,550	0.527	**$105,647**
2024		$152,800	$47,750	$ 200,550	0.497	**$99,667**
2025		$152,800	$47,750	$ 200,550	0.469	**$94,026**
2026		$152,800	$47,750	$ 200,550	0.442	**$88,703**
2027		$152,800	$47,750	$ 200,550	0.417	**$83,683**
2028		$152,800	$47,750	$ 200,550	0.394	**$78,946**
2029		$152,800	$47,750	$ 200,550	0.371	**$74,477**
2030		$152,800	$47,750	$ 200,550	0.350	**$70,261**
2031		$152,800	$47,750	$ 200,550	0.331	**$66,284**
2032		$152,800	$47,750	$ 200,550	0.312	**$62,532**
2033		$152,800	$47,750	$ 200,550	0.294	**$58,993**
2034		$152,800	$47,750	$ 200,550	0.278	**$55,654**
2035		$152,800	$47,750	$ 200,550	0.262	**$52,503**
2036		$152,800	$47,750	$ 200,550	0.247	**$49,532**
2037		$152,800	$47,750	$ 200,550	0.233	**$46,728**
2038		$152,800	$47,750	$ 200,550	0.220	**$44,083**
2039		$152,800	$47,750	$ 200,550	0.207	**$41,588**
2040		$152,800	$47,750	$ 200,550	0.196	**$39,234**
2041		$152,800	$47,750	$ 200,550	0.185	**$37,013**
2042		$152,800	$47,750	$ 200,550	0.174	**$34,918**
2043		$152,800	$47,750	$ 200,550	0.164	**$32,941**
2044		$152,800	$47,750	$ 200,550	0.155	**$31,077**
2045		$152,800	$47,750	$ 200,550	0.146	**$29,318**
2046		$152,800	$47,750	$ 200,550	0.138	**$27,658**
2047		$152,800	$47,750	$ 200,550	0.130	**$26,093**
2048		$152,800	$47,750	$ 200,550	0.123	**$24,616**
2049		$152,800	$47,750	$ 200,550	0.116	**$23,222**
2050		$152,800	$47,750	$ 200,550	0.109	**$21,908**
2051		$152,800	$47,750	$ 200,550	0.103	**$20,668**
2052		$152,800	$47,750	$ 200,550	0.097	**$19,498**
2053		$152,800	$47,750	$ 200,550	0.092	**$18,394**
2054		$152,800	$47,750	$ 200,550	0.087	**$17,353**
2055		$152,800	$47,750	$ 200,550	0.082	**$16,371**
2056		$152,800	$47,750	$ 200,550	0.077	**$15,444**
2057		$152,800	$47,750	$ 200,550	0.073	**$14,570**
2058		$152,800	$47,750	$ 200,550	0.069	**$13,745**
2059		$152,800	$47,750	$ 200,550	0.065	**$12,967**
2060		$152,800	$47,750	$ 200,550	0.061	**$12,233**
2061		$152,800	$47,750	$ 200,550	0.058	**$11,541**
2062		$152,800	$47,750	$ 200,550	0.054	**$10,888**
2063		$152,800	$47,750	$ 200,550	0.051	**$10,271**
2064		$152,800	$47,750	$ 200,550	0.048	**$9,690**
2065		$152,800	$47,750	$ 200,550	0.046	**$9,141**
2066		$152,800	$47,750	$ 200,550	0.043	**$8,624**
2067		$152,800	$47,750	$ 200,550	0.041	**$8,136**
2068		$152,800	$47,750	$ 200,550	0.038	**$7,675**
2069		$152,800	$47,750	$ 200,550	0.036	**$7,241**
2070		$152,800	$47,750	$ 200,550	0.034	**$6,831**
2071		$152,800	$47,750	$ 200,550	0.032	**$6,444**
2072		$152,800	$47,750	$ 200,550	0.030	**$6,080**
2073		$152,800	$47,750	$ 200,550	0.029	**$5,735**
2074		$152,800	$47,750	$ 200,550	0.027	**$5,411**
2075		$152,800	$47,750	$ 200,550	0.025	**$5,104**
2076		$152,800	$47,750	$ 200,550	0.024	**$4,816**
2077		$152,800	$47,750	$ 200,550	0.023	**$4,543**
2078		$152,800	$47,750	$ 200,550	0.021	**$4,286**
Last Year of Project Life					...	
Total Present Value of Discounted Costs (Sum of Column (g))						**$2,222,099**
(%) Avoided Cost Claimed by Project						
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$ 2,222,099**

Appendix 8-2: Cost-Benefit Tables

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project 3: Groundwater Quality Protection Project – Subarea D2

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012									1.000	
2013	3,826							3,826	0.943	$ 3,609
2014	15,304							15,304	0.890	$ 13,621
2015	1,702,549							1,702,549	0.840	$ 1,429,493
2016	1,530,381							1,530,381	0.792	$ 1,212,205
2017	573,893							573,893	0.747	$ 428,846
2018					$7,627		$ 14,325	$ 21,952	0.705	$ 15,475
2019					$15,255		$ 28,650	$ 43,905	0.665	$ 29,199
2020					$22,882		$ 42,975	$ 65,857	0.627	$ 41,319
2021					$30,509		$ 57,300	$ 87,809	0.592	$ 51,974
2022					$30,509		$ 57,300	$ 87,809	0.558	$ 49,032
2023					$30,509		$ 57,300	$ 87,809	0.527	$ 46,257
2024					$30,509		$ 57,300	$ 87,809	0.497	$ 43,638
2025					$30,509		$ 57,300	$ 87,809	0.469	$ 41,168
2026					$30,509		$ 57,300	$ 87,809	0.442	$ 38,838
2027					$30,509		$ 57,300	$ 87,809	0.417	$ 36,640
2028					$30,509		$ 42,975	$ 73,484	0.394	$ 28,927
2029					$30,509		$ 28,650	$ 59,159	0.371	$ 21,970
2030					$30,509		$ 14,325	$ 44,834	0.350	$ 15,707
2031					$30,509			$ 30,509	0.331	$ 10,084
2032					$30,509			$ 30,509	0.312	$ 9,513
2033					$30,509			$ 30,509	0.294	$ 8,974
2034					$30,509			$ 30,509	0.278	$ 8,466
2035					$30,509			$ 30,509	0.262	$ 7,987
2036					$30,509			$ 30,509	0.247	$ 7,535
2037					$30,509			$ 30,509	0.233	$ 7,109
2038					$30,509			$ 30,509	0.220	$ 6,706
2039					$30,509			$ 30,509	0.207	$ 6,327
2040					$30,509			$ 30,509	0.196	$ 5,968
2041					$30,509			$ 30,509	0.185	$ 5,631
2042					$30,509			$ 30,509	0.174	$ 5,312
2043					$30,509			$ 30,509	0.164	$ 5,011
2044					$30,509			$ 30,509	0.155	$ 4,728
2045					$30,509			$ 30,509	0.146	$ 4,460
2046					$30,509			$ 30,509	0.138	$ 4,208
2047					$30,509			$ 30,509	0.130	$ 3,969
2048					$30,509			$ 30,509	0.123	$ 3,745
2049					$30,509			$ 30,509	0.116	$ 3,533
2050					$30,509			$ 30,509	0.109	$ 3,333
2051					$30,509			$ 30,509	0.103	$ 3,144
2052					$30,509			$ 30,509	0.097	$ 2,966
2053					$30,509			$ 30,509	0.092	$ 2,798
2054					$30,509			$ 30,509	0.087	$ 2,640
2055					$30,509			$ 30,509	0.082	$ 2,490
2056					$30,509			$ 30,509	0.077	$ 2,349
2057					$30,509			$ 30,509	0.073	$ 2,216
2058					$30,509			$ 30,509	0.069	$ 2,091
2059					$30,509			$ 30,509	0.065	$ 1,973
2060					$30,509			$ 30,509	0.061	$ 1,861
2061					$30,509			$ 30,509	0.058	$ 1,756
2062					$30,509			$ 30,509	0.054	$ 1,656
2063					$30,509			$ 30,509	0.051	$ 1,563
2064					$30,509			$ 30,509	0.048	$ 1,474
2065					$30,509			$ 30,509	0.046	$ 1,391
2066					$30,509			$ 30,509	0.043	$ 1,312
2067					$30,509			$ 30,509	0.041	$ 1,238
2068					$30,509			$ 30,509	0.038	$ 1,168
2069					$30,509			$ 30,509	0.036	$ 1,102
2070					$30,509			$ 30,509	0.034	$ 1,039
2071					$30,509			$ 30,509	0.032	$ 980
2072					$30,509			$ 30,509	0.030	$ 925
2073					$30,509			$ 30,509	0.029	$ 873
2074					$30,509			$ 30,509	0.027	$ 823
2075					$30,509			$ 30,509	0.025	$ 777
2076					$30,509			$ 30,509	0.024	$ 733
2077					$30,509			$ 30,509	0.023	$ 691
Last Year of Project Life - 2078					$30,509			$ 30,509	0.021	$ 652
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										$ 3,715,196

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit (All benefits should be in 2012 dollars) Project 4: San Antonio del Desierto DAC Sewer Extension 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 [1]	Annual $ Value [1] (f) x (g)	Discount Factor [1]	Discounted Benefits [1] (h) x (i)
2012	a					$ 929		1.000	
2013	b					$ 939		0.943	
2014	c					$ 950		0.890	
2015	Avoided cost					$ 962	$ -	0.840	**$ -**
2016	Avoided cost					$ 974	$ -	0.792	**$ -**
2017	Avoided cost	AFY	0	38	38	$ 986	$ 37,486	0.747	**$ 28,012**
2018	Avoided cost	AFY	0	38	38	$ 999	$ 37,974	0.705	**$ 26,770**
2019	Avoided cost	AFY	0	38	38	$ 1,013	$ 38,479	0.665	**$ 25,590**
2020	Avoided cost	AFY	0	38	38	$ 1,026	$ 39,001	0.627	**$ 24,470**
2021	Avoided cost	AFY	0	38	38	$ 1,032	$ 39,233	0.592	**$ 23,222**
2022	Avoided cost	AFY	0	38	38	$ 1,039	$ 39,468	0.558	**$ 22,039**
2023	Avoided cost	AFY	0	38	38	$ 1,045	$ 39,707	0.527	**$ 20,917**
2024	Avoided cost of imported	AFY	0	38	38	$ 1,051	$ 39,950	0.497	**$ 19,854**
2025	Avoided cost of imported	AFY	0	38	38	$ 1,058	$ 40,196	0.469	**$ 18,845**
2026	Avoided cost of imported	AFY	0	38	38	$ 1,064	$ 40,445	0.442	**$ 17,889**
2027	Avoided cost of imported water	AFY	0	38	38	$ 1,071	$ 40,699	0.417	**$ 16,982**
2028	Avoided cost of imported water	AFY	0	38	38	$ 1,078	$ 40,956	0.394	**$ 16,122**
2029	Avoided cost of imported water	AFY	0	38	38	$ 1,085	$ 41,217	0.371	**$ 15,307**
2030	Avoided cost of imported water	AFY	0	38	38	$ 1,092	$ 41,482	0.350	**$ 14,533**
2031	Avoided cost of imported water	AFY	0	38	38	$ 1,099	$ 41,751	0.331	**$ 13,799**
2032	Avoided cost of imported water	AFY	0	38	38	$ 1,106	$ 42,024	0.312	**$ 13,103**
2033	Avoided cost of imported water	AFY	0	38	38	$ 1,113	$ 42,302	0.294	**$ 12,443**
2034	Avoided cost of imported water	AFY	0	38	38	$ 1,121	$ 42,583	0.278	**$ 11,817**
2035	Avoided cost of imported water	AFY	0	38	38	$ 1,128	$ 42,868	0.262	**$ 11,223**
2036	Avoided cost of imported water	AFY	0	38	38	$ 1,136	$ 43,158	0.247	**$ 10,659**
2037	Avoided cost of imported water	AFY	0	38	38	$ 1,143	$ 43,452	0.233	**$ 10,124**
2038	Avoided cost of imported water	AFY	0	38	38	$ 1,151	$ 43,751	0.220	**$ 9,617**
2039	Avoided cost of imported water	AFY	0	38	38	$ 1,159	$ 44,054	0.207	**$ 9,135**
2040	Avoided cost of imported water	AFY	0	38	38	$ 1,167	$ 44,362	0.196	**$ 8,678**

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit (All benefits should be in 2012 dollars) Project 4: San Antonio del Desierto DAC Sewer Extension 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 [1]	Annual $ Value [1] (f) x (g)	Discount Factor [1]	Discounted Benefits [1] (h) x (i)
2041	Avoided cost of imported water	AFY	0	38	38	$ 1,176	$ 44,674	0.185	**$ 8,245**
2042	Avoided cost of imported water	AFY	0	38	38	$ 1,184	$ 44,991	0.174	**$ 7,833**
2043	Avoided cost of imported water	AFY	0	38	38	$ 1,192	$ 45,312	0.164	**$ 7,443**
2044	Avoided cost of imported water	AFY	0	38	38	$ 1,201	$ 45,639	0.155	**$ 7,072**
2045	Avoided cost of imported water	AFY	0	38	38	$ 1,210	$ 45,970	0.146	**$ 6,720**
2046	Avoided cost of imported water	AFY	0	38	38	$ 1,219	$ 46,307	0.138	**$ 6,386**
2047	Avoided cost of imported water	AFY	0	38	38	$ 1,228	$ 46,648	0.130	**$ 6,069**
2048	Avoided cost of imported water	AFY	0	38	38	$ 1,237	$ 46,995	0.123	**$ 5,768**
2049	Avoided cost of imported water	AFY	0	38	38	$ 1,246	$ 47,346	0.116	**$ 5,482**
2050	Avoided cost of imported water	AFY	0	38	38	$ 1,255	$ 47,703	0.109	**$ 5,211**
2051	Avoided cost of imported water	AFY	0	38	38	$ 1,265	$ 48,066	0.103	**$ 4,953**
2052	Avoided cost of imported water	AFY	0	38	38	$ 1,275	$ 48,433	0.097	**$ 4,709**
2053	Avoided cost of imported water	AFY	0	38	38	$ 1,284	$ 48,807	0.092	**$ 4,477**
2054	Avoided cost of imported water	AFY	0	38	38	$ 1,294	$ 49,186	0.087	**$ 4,256**
2055	Avoided cost of imported water	AFY	0	38	38	$ 1,304	$ 49,570	0.082	**$ 4,046**
2056	Avoided cost of imported water	AFY	0	38	38	$ 1,315	$ 49,961	0.077	**$ 3,847**
2057	Avoided cost of imported water	AFY	0	38	38	$ 1,325	$ 50,357	0.073	**$ 3,658**
2058	Avoided cost of imported water	AFY	0	38	38	$ 1,336	$ 50,759	0.069	**$ 3,479**
2059	Avoided cost of imported water	AFY	0	38	38	$ 1,347	$ 51,167	0.065	**$ 3,308**
2060	Avoided cost of imported water	AFY	0	38	38	$ 1,357	$ 51,581	0.061	**$ 3,146**
2061	Avoided cost of imported water	AFY	0	38	38	$ 1,368	$ 52,002	0.058	**$ 2,992**

Appendix 8-2: Cost-Benefit Tables

Table 15 – Annual Benefit (All benefits should be in 2012 dollars) Project 4: San Antonio del Desierto DAC Sewer Extension 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 [1]	Annual $ Value [1] (f) x (g)	Discount Factor [1]	Discounted Benefits [1] (h) x (i)
2062	Avoided cost of imported water	AFY	0	38	38	$ 1,380	$ 52,429	0.054	**$ 2,846**
2063	Avoided cost of imported water	AFY	0	38	38	$ 1,391	$ 52,862	0.051	**$ 2,707**
2064	Avoided cost of imported water	AFY	0	38	38	$ 1,403	$ 53,302	0.048	**$ 2,575**
2065	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.046	**$ 2,450**
2066	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.043	**$ 2,311**
2067	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.041	**$ 2,204**
2068	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.038	**$ 2,042**
2069	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.036	**$ 1,935**
2070	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.034	**$ 1,827**
2071	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.032	**$ 1,720**
2072	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.030	**$ 1,612**
2073	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.029	**$ 1,559**
2074	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.027	**$ 1,451**
2075	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.025	**$ 1,344**
2076	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.024	**$ 1,290**
2077	Avoided cost of imported water	AFY	0	38	38	$ 1,414	$ 53,748	0.023	**$ 1,236**
								Total Present Value of Discounted Benefits Based on Unit Value	**$ 541,365**

Appendix 8-2: Cost-Benefit Tables

Table 16 – Annual Costs of Avoided Projects (All avoided costs should be in 2012 dollars)						
Project 4: San Antonio del Desierto DAC Sewer Extension Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Rehabilitation of On-site Lagoon System Avoided Project Description:				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012					1.000	
2013					0.943	
2014	$1,212,683			$ 1,212,683	0.890	**$ 1,079,283.55**
2015					0.840	**$ -**
2016					0.792	**$ -**
2017					0.747	**$ -**
2018					0.705	**$ -**
2019			$24,800	$ 24,800	0.665	**$ 16,493.42**
2020				$ -	0.627	**$ -**
2021				$ -	0.592	**$ -**
2022				$ -	0.558	**$ -**
2023				$ -	0.527	**$ -**
2024			$24,800	$ 24,800	0.497	**$ 12,324.84**
2025				$ -	0.469	**$ -**
2026				$ -	0.442	**$ -**
2027				$ -	0.417	**$ -**
2028				$ -	0.394	**$ -**
2029			$24,800	$ 24,800	0.371	**$ 9,209.84**
2030				$ -	0.350	**$ -**
2031				$ -	0.331	**$ -**
2032				$ -	0.312	**$ -**
2033				$ -	0.294	**$ -**
2034			$24,800	$ 24,800	0.278	**$ 6,882.13**
2035				$ -	0.262	**$ -**
2036				$ -	0.247	**$ -**
2037				$ -	0.233	**$ -**
2038				$ -	0.220	**$ -**
2039			$24,800	$ 24,800	0.207	**$ 5,142.73**
2040				$ -	0.196	**$ -**
2041				$ -	0.185	**$ -**
2042				$ -	0.174	**$ -**
2043				$ -	0.164	**$ -**
2044			$24,800	$ 24,800	0.155	**$ 3,842.94**
2045				$ -	0.146	**$ -**
2046				$ -	0.138	**$ -**
2047				$ -	0.130	**$ -**
2048				$ -	0.123	**$ -**
2049			$24,800	$ 24,800	0.116	**$ 2,871.67**
2050				$ -	0.109	**$ -**
2051				$ -	0.103	**$ -**
2052				$ -	0.097	**$ -**
2053				$ -	0.092	**$ -**
2054			$24,800	$ 24,800	0.087	**$ 2,145.88**
2055				$ -	0.082	**$ -**
2056				$ -	0.077	**$ -**
2057				$ -	0.073	**$ -**

Appendix 8-2: Cost-Benefit Tables

2058				$ -	0.069	**$ -**	
2059			$24,800	$ 24,800	0.065	**$ 1,603.53**	
2060				$ -	0.061	**$ -**	
2061				$ -	0.058	**$ -**	
2062				$ -	0.054	**$ -**	
2063				$ -	0.051	**$ -**	
2064			$24,800	$ 24,800	0.048	**$ 1,198.25**	
2065				$ -	0.046	**$ -**	
2066				$ -	0.043	**$ -**	
2067				$ -	0.041	**$ -**	
2068				$ -	0.038	**$ -**	
2069			$24,800	$ 24,800	0.036	**$ 892.80**	
2070				$ -	0.034	**$ -**	
2071				$ -	0.032	**$ -**	
2072				$ -	0.030	**$ -**	
2073				$ -	0.029	**$ -**	
2074			$24,800	$ 24,800	0.027	**$ 669.60**	
2075				$ -	0.025	**$ -**	
2076					0.024	**$ -**	
2077					0.023	**$ -**	
Last Year of Project Life					...		
Total Present Value of Discounted Costs (Sum of Column (g))						**$ 1,142,561.17**	
(%) Avoided Cost Claimed by Project							
Total Present Value of Discounted Avoided Project Costs Claimed by Alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$ 1,142,561.17**	

Appendix 8-2: Cost-Benefit Tables

Table 19 – Annual Costs of Project (All costs should be in 2012 Dollars) Project 4: San Antonio del Desierto DAC Sewer Extension Project										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012									1.000	
2013	$ 8,592							$ 8,592	0.943	$ 8,106
2014	$ 60,145							$ 60,145	0.890	$ 53,529
2015	$ 790,480							$ 790,480	0.840	$ 663,702
2016	$ 859,218							$ 859,218	0.792	$ 680,581
2017					$13,343		$ 132,608	$ 145,951	0.747	$ 109,063
2018					$13,343			$ 13,343	0.705	$ 9,406
2019					$13,343			$ 13,343	0.665	$ 8,874
2020					$13,343			$ 13,343	0.627	$ 8,372
2021					$13,343			$ 13,343	0.592	$ 7,898
2022					$13,343			$ 13,343	0.558	$ 7,451
2023					$13,343			$ 13,343	0.527	$ 7,029
2024					$13,343			$ 13,343	0.497	$ 6,631
2025					$13,343			$ 13,343	0.469	$ 6,256
2026					$13,343			$ 13,343	0.442	$ 5,902
2027					$13,343			$ 13,343	0.417	$ 5,568
2028					$13,343			$ 13,343	0.394	$ 5,252
2029					$13,343			$ 13,343	0.371	$ 4,955
2030					$13,343			$ 13,343	0.350	$ 4,675
2031					$13,343			$ 13,343	0.331	$ 4,410
2032					$13,343			$ 13,343	0.312	$ 4,160
2033					$13,343			$ 13,343	0.294	$ 3,925
2034					$13,343			$ 13,343	0.278	$ 3,703
2035					$13,343			$ 13,343	0.262	$ 3,493
2036					$13,343			$ 13,343	0.247	$ 3,295
2037					$13,343			$ 13,343	0.233	$ 3,109
2038					$13,343			$ 13,343	0.220	$ 2,933
2039					$13,343			$ 13,343	0.207	$ 2,767
2040					$13,343			$ 13,343	0.196	$ 2,610
2041					$13,343			$ 13,343	0.185	$ 2,463
2042					$13,343			$ 13,343	0.174	$ 2,323
2043					$13,343			$ 13,343	0.164	$ 2,192
2044					$13,343			$ 13,343	0.155	$ 2,068
2045					$13,343			$ 13,343	0.146	$ 1,951
2046					$13,343			$ 13,343	0.138	$ 1,840
2047					$13,343			$ 13,343	0.130	$ 1,736
2048					$13,343			$ 13,343	0.123	$ 1,638
2049					$13,343			$ 13,343	0.116	$ 1,545
2050					$13,343			$ 13,343	0.109	$ 1,458
2051					$13,343			$ 13,343	0.103	$ 1,375
2052					$13,343			$ 13,343	0.097	$ 1,297
2053					$13,343			$ 13,343	0.092	$ 1,224
2054					$13,343			$ 13,343	0.087	$ 1,155
2055					$13,343			$ 13,343	0.082	$ 1,089
2056					$13,343			$ 13,343	0.077	$ 1,028
2057					$13,343			$ 13,343	0.073	$ 969
2058					$13,343			$ 13,343	0.069	$ 914
2059					$13,343			$ 13,343	0.065	$ 863
2060					$13,343			$ 13,343	0.061	$ 814
2061					$13,343			$ 13,343	0.058	$ 768
2062					$13,343			$ 13,343	0.054	$ 724
2063					$13,343			$ 13,343	0.051	$ 683
2064					$13,343			$ 13,343	0.048	$ 645
2065					$13,343			$ 13,343	0.046	$ 608
2066					$13,343			$ 13,343	0.043	$ 574
2067					$13,343			$ 13,343	0.041	$ 547
2068					$13,343			$ 13,343	0.038	$ 507
2069					$13,343			$ 13,343	0.036	$ 480
2070					$13,343			$ 13,343	0.034	$ 454
2071					$13,343			$ 13,343	0.032	$ 427
2072					$13,343			$ 13,343	0.030	$ 400
2073					$13,343			$ 13,343	0.029	$ 387

Appendix 8-2: Cost-Benefit Tables

2074					$13,343			$	13,343	0.027	$ 360
2075					$13,343			$	13,343	0.025	$ 334
2076					$13,343			$	13,343	0.024	$ 320
2077					$13,343			$	13,343	0.023	$ 307
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries											**$ 1,676,119**
Comments: 2017 cost for decommissioning the existing lagoons											