A8. Benefits and Cost Analysis

Attachment 8 identifies the benefits and costs attributed to the first four projects proposed for implementation in the Santa Barbara County Region Proposition 84 (Prop 84) Integrated Regional Water Management (IRWM) Implementation Grant Application – Round 2 (Proposal).

This suite of projects can best be framed by the mutual challenges faced by both the state and the region. This Proposal aggressively meets these challenges that include persistent drought, a collapsing Bay-Delta ecosystem, need for equitable distribution of benefits among communities, aging infrastructure, poor water quality, and climate change.

The region takes aim at the challenge of drought and the need to reduce dependence on the Bay-Delta with a suite of groundwater recharge, water quality, and water recycling projects. Maintaining and increasing groundwater recharge is an important water supply option because disadvantaged communities in region rely primarily on groundwater as a drinking water supply. Furthermore, the region answers the challenge of improving water quality with advanced technology to treat water to a higher level that will improve groundwater quality and result in higher-quality recycled water. It answers the challenge of climate change with projects that reuse water, reduce energy consumption, and improve equipment efficiencies. It answers the challenge of outdated infrastructure with projects that update wastewater treatment facilities and recycled water treatment facilities.

Each of the first four projects included in this Proposal will generate economically significant benefits for the region and the state. The projects included in this Proposal will provide water supply reliability, water quality, and environmental benefits to the region and state by:

- Increasing quantity of recycled water supply
- Improving quality of groundwater, recycled water, and treated wastewater effluent applied to land by enhancing infrastructure reliability
- Increasing groundwater recharge
- Reducing carbon footprint
- Other benefits specific to each Project.

Table 8.0-1 presents a summarized table of the results from the benefits and cost analyses. The analyses show that the individual projects and the overall Proposal are good economic investments. With a total economic benefit of $34,601,638 and a total present value project cost of $12,317,654, the Proposal achieves a benefit-cost ratio (BCR) of 2.81.

TABLE 8.0-1
Summary of Benefit-Cost Analyses for Projects 1-4

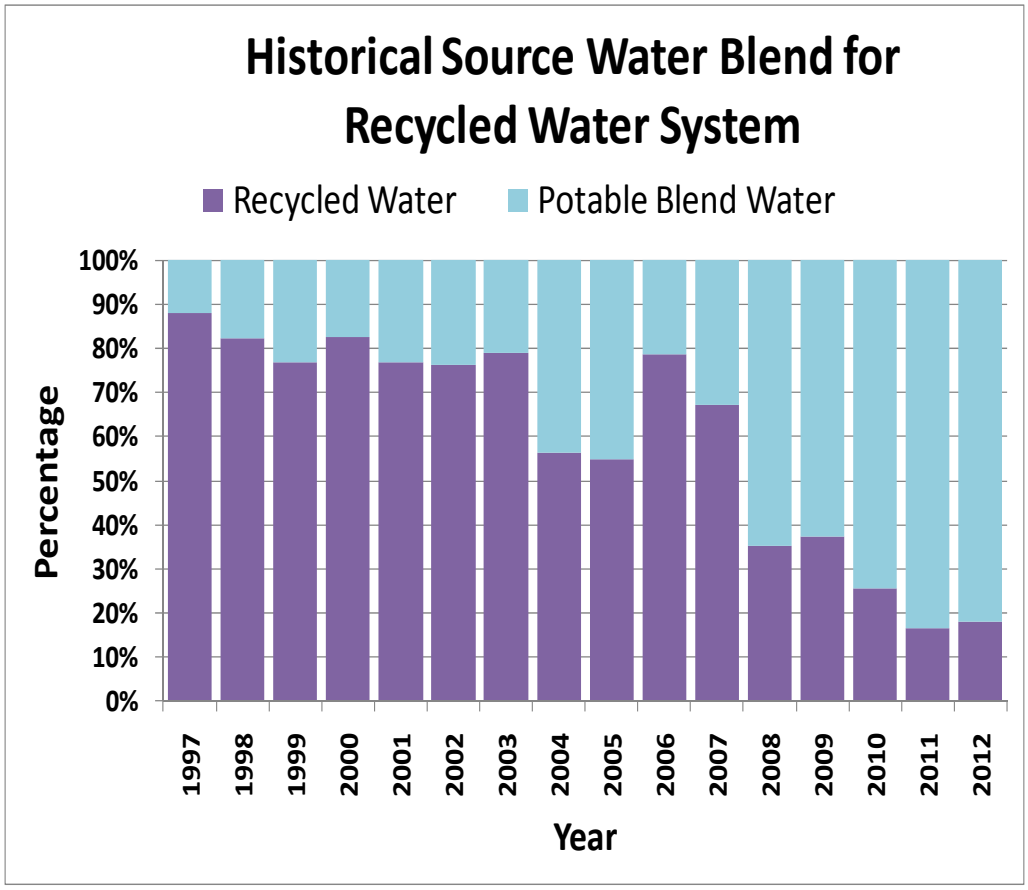
Total Present Value Project Benefits							
Project Name	Project Proponent	Total Present Value Project Costs	From Section D3 – Monetized	From Section D4 – Flood Damage Reduction	Total	Project NPV	Project BCR
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g) = (f) - (c)	h = (f) / (c)
Project 1: Recycled Water Enhancement Project	City of Santa Barbara	$8,011,181	$9,384,910	--	$9,384,910	$1,373,728	1.17
Project 2: Twitchell Reservoir Sediment Management and Groundwater Recharge Project	Santa Maria Valley Water Conservation District	$787,697	$11,459,183	--	$11,459,183	$10,671,486	14.55
Project 3: Recycled Water Expansion and Golf Course Retrofit Project	Laguna County Sanitation District	$2,928,031	$13,018,038	--	$13,018,038	$10,090,007	4.45
Project 4: Secondary Treatment Reliability Project	City of Guadalupe	$590,745	$739,507	--	$739,507	$148,763	1.25
		$12,317,654	$34,601,638	$0	$34,601,638	$22,283,984	2.81

Recycled Water Enhancement Project, City of Santa Barbara

Recycled water has been used in the City of Santa Barbara (City) to irrigate over 400 acres of landscaped areas (including schools, parks, the zoo, and golf courses), for toilet flushing in some public restrooms, and treatment plant processes. The City system is configured to treat as much as 1,400 acre-feet per year (AFY) of recycled water. Current connected recycled water demand is approximately 800 AFY (City of Santa Barbara, 2011). The present tertiary treatment system is failing, leaving the City unable to reliably deliver recycled water that meets Title 22 water quality standards for turbidity. As a consequence, the amount of potable water the City must blend with recycled water prior to customer delivery has increased dramatically since 2004 (Figure 8.1-1). Unless enhancements to the recycled water facility are made, recycled water treatment facilities will continue to be offline, and the City will lose a drought-proof source of water supply critical to its long-term supply plan (City of Santa Barbara 2011). The Project will install full microfiltration technology to replace the existing failed tertiary treatment system.

The Recycled Water Enhancement Project (Project) will rehabilitate the City's recycled water treatment facilities and allow it to increase the delivery of Title 22 recycled water throughout its existing recycled water distribution network. With the Project, blending with potable water will be reduced and delivery of recycled water is forecast to increase from 905 acre-feet (AF) in 2017 to 1,400 AF in 2035. Without the Project the City will have to replace these deliveries with a mix of groundwater and imported SWP water in normal and wet years. In dry or critically dry years options to replace the water are more limited and may include purchase of additional SWP water from willing sellers (if available) and/or reoperation of the City's desalination facility (City of Santa Barbara 2011).

FIGURE 8.1-1
Historical Source Water Blend for Recycled Water System (Source: City of Santa Barbara)



Project Costs

Project costs are comprised of initial capital costs associated with planning, permitting, and construction, as detailed in Attachment 4, and annual operational and maintenance costs that will be incurred during the operational life of the facility. The average operational life of the facility is estimated to be 25 years.[1] The Project is expected to go online in 2017.

All dollar amounts were converted to 2012 constant dollars prior to being used in the calculations presented in this section.

Initial Capital Costs

Initial capital costs are taken from Attachment 4. The expected timing of these costs is shown in Table 8.1-1. Approximately one million of the costs listed in the table are sunk costs associated with expenditure for non-salvageable planning and preliminary design

[1] Useful life of structures and major pipes is 30-35 years while useful life of pumps and other equipment is 15-20 years. An average of 25 years is used for the lifecycle cost analysis.

work in 2012. Sunk costs are excluded from the tally of Project economic costs, per PSP Exhibit D guidelines.

The recycled water distribution system is already in place. Provision of the recycled water does not require new capital investment in the distribution network. Therefore initial capital costs are solely comprised of the capital cost to rehabilitate the recycled water production facilities.

Initial capital costs are converted to 2012 present value using a 6% real discount rate. The present value equivalent cost is shown in the last column of the table. The sum of the present value equivalent initial capital costs is $6,163,532.

TABLE 8.1-1
Project Initial Capital Costs by Year

Year	Initial Cost from Attach. 4	Adjustment for Sunk Cost	Economic Cost	Present Value Coefficient	Present Value Equivalent
2012	$1,000,417	-$1,000,417	$0	1.000	$0
2013	$1,234,332		$1,234,332	0.943	$1,164,464
2014	$1,982,412		$1,982,412	0.890	$1,764,340
2015	$1,982,412		$1,982,412	0.840	$1,664,472
2016	$1,982,412		$1,982,412	0.792	$1,570,256
				Total Present Value Equivalent	$6,163,532

Operational and Maintenance Costs

The majority of operational costs for secondary treatment will be incurred with or without the Project and therefore are not represented here since they would simply net out of the Project costs and benefits. There is some secondary treatment cost for disinfection and de-chlorination prior to discharge to the ocean that will be avoided by the Project. Those costs are counted as an avoided cost benefit of the Project, as described in a later section. This section focuses on the incremental operations and maintenance (O&M) costs associated with production of Title 22 recycled water that will be incurred as a result of the Project. These costs are summarized in Table 8.1-2.

Maintenance costs are generally invariant to the level of recycled water production and include routine maintenance and replacement of facility equipment. Maintenance costs associated with the Project are estimated to average $100,000 per year based on recent experience with projects of similar technology and size. Operational costs associated with the production of Title 22 recycled water are primarily for energy and chemicals and are expected to average $71.40 per AF (CDM Smith 2013).

A 0.3% real escalation rate is applied to maintenance and operational costs over the operational life of the recycled water facilities. The real rate of cost escalation is based on the difference between O&M cost escalation forecasted in the City's draft rate study (Raftelis Financial Consultants Inc. 2013) and an expected long-term inflation rate of 2.5%. The long-term inflation rate is based on the current spread between 30-Year

Treasury Inflation Protected Securities (TIPS) and regular 30-year Treasuries. This is a somewhat more conservative forecast of long-term inflation (e.g., higher) than forecast by the Federal Reserve Bank of Philadelphia.[2]

The present value equivalent cost for O&M is shown in the last column of Table 8.1-2. The sum of the present value equivalent O&M costs is $1,847,651.

TABLE 8.1-2
Project O&M Costs by Year

Year	Operations	Maintenance	Economic Cost	Present Value Coefficient	Present Value Equivalent
2017	$64,643	$100,000	$164,643	0.747	$123,031
2018	$65,911	$100,300	$166,211	0.705	$117,172
2019	$67,187	$100,601	$167,788	0.665	$111,589
2020	$68,470	$100,903	$169,372	0.627	$106,266
2021	$69,759	$101,205	$170,965	0.592	$101,194
2022	$71,056	$101,509	$172,565	0.558	$96,360
2023	$72,360	$101,814	$174,174	0.527	$91,753
2024	$73,672	$102,119	$175,791	0.497	$87,363
2025	$74,990	$102,425	$177,415	0.469	$83,179
2026	$76,316	$102,733	$179,048	0.442	$79,193
2027	$77,649	$103,041	$180,689	0.417	$75,395
2028	$78,989	$103,350	$182,339	0.394	$71,777
2029	$80,336	$103,660	$183,996	0.371	$68,330
2030	$81,691	$103,971	$185,662	0.350	$65,046
2031	$86,406	$104,283	$190,689	0.331	$63,025
2032	$91,148	$104,596	$195,743	0.312	$61,034
2033	$95,917	$104,910	$200,827	0.294	$59,074
2034	$100,715	$105,224	$205,939	0.278	$57,149
2035	$105,540	$105,540	$211,080	0.262	$55,260
2036	$105,857	$105,857	$211,713	0.247	$52,289
2037	$106,174	$106,174	$212,348	0.233	$49,477
2038	$106,493	$106,493	$212,985	0.220	$46,816
2039	$106,812	$106,812	$213,624	0.207	$44,299
2040	$107,133	$107,133	$214,265	0.196	$41,917
2041	$107,454	$107,454	$214,908	0.185	$39,663
				Total Present Value Equivalent	$1,847,651

Project Total Economic Cost

The total economic cost of the Project is the sum of the present value cost for initial capital expenditure and operational and maintenance costs over the Project's 25-year useful life. Total economic cost is summarized in Table 8.1-3.

[2] http://www.phil.frb.org/research-and-data/real-time-center/survey-of-professional-forecasters/2013/survq113.cfm.

TABLE 8.1-3
Recycled Water Enhancement Project: Total Economic Cost

Cost Category	Present Value Equivalent
Initial Capital Costs (2012-2016)	$6,163,532
Operational & Maintenance Costs (2017-2041)	$1,847,651
Project Total Economic Cost	$8,011,183

Project Benefits

Project benefits are comprised of avoided costs of wastewater treatment and the supply value of the recycled water, as measured by the cost of alternative water supplies. Each of these Project benefits is described below.

All dollar amounts were converted to 2012 constant dollars prior to being used in the calculations presented in this section.

Avoided Costs of Wastewater Treatment

Prior to discharge to the ocean secondary treated effluent is disinfected and de-chlorinated. Water diverted by the Project for tertiary treatment will avoid this step in the treatment train. Costs for chemicals for disinfection and de-chlorination average $24.45 per AF.[3] As with other O&M costs, this cost is forecast to escalate at a real rate of 0.3%.

Avoided costs for wastewater treatment over the 25-year operational life of the Project are summarized in Table 8.1-4. The present value benefit of avoided wastewater treatment costs is $276,212.

TABLE 8.1-4
Recycled Water Enhancement Project: Avoided Wastewater Treatment Cost

Year	Recycled Water Production (AF)	Avoided Cost of Disinfection & De-chlorination ($/AF)	Economic Benefit	Present Value Coefficient	Present Value Equivalent
2017	905	$24.45	$22,126	0.747	$16,534
2018	920	$24.52	$22,560	0.705	$15,904
2019	935	$24.60	$22,997	0.665	$15,294
2020	950	$24.67	$23,436	0.627	$14,704
2021	965	$24.74	$23,877	0.592	$14,133
2022	980	$24.82	$24,321	0.558	$13,581
2023	995	$24.89	$24,768	0.527	$13,047
2024	1010	$24.97	$25,216	0.497	$12,532
2025	1025	$25.04	$25,668	0.469	$12,034
2026	1040	$25.12	$26,121	0.442	$11,554
2027	1055	$25.19	$26,578	0.417	$11,090
2028	1070	$25.27	$27,036	0.394	$10,643
2029	1085	$25.34	$27,498	0.371	$10,212

[3] This figure is based on City cost records for its WWTP operations.

TABLE 8.1-4
Recycled Water Enhancement Project: Avoided Wastewater Treatment Cost

Year	Recycled Water Production (AF)	Avoided Cost of Disinfection & De-chlorination ($/AF)	Economic Benefit	Present Value Coefficient	Present Value Equivalent
2030	1100	$25.42	$27,961	0.350	$9,796
2031	1160	$25.50	$29,575	0.331	$9,775
2032	1220	$25.57	$31,198	0.312	$9,728
2033	1280	$25.65	$32,831	0.294	$9,657
2034	1340	$25.73	$34,473	0.278	$9,566
2035	1400	$25.80	$36,124	0.262	$9,457
2036	1400	$25.88	$36,233	0.247	$8,949
2037	1400	$25.96	$36,341	0.233	$8,467
2038	1400	$26.04	$36,450	0.220	$8,012
2039	1400	$26.11	$36,560	0.207	$7,581
2040	1400	$26.19	$36,669	0.196	$7,174
2041	1400	$26.27	$36,779	0.185	$6,788
				Total Present Value Equivalent	$276,212

Economic Value of Recycled Water Supply

Recycled water supply is valued at the alternative cost of supply without the Project. It is assumed recycled water deliveries will displace the City's least economic supply (e.g. its supply with the highest marginal cost).

Marginal cost of supply varies with hydrology. In normal and wet years, the City's marginal source of supply is groundwater from its Ortega facility at $622/AF (Maddaus Water Management Inc. 2010).[4] In dry years, the City's marginal source of supply is supplemental water from the State Water Project at $714/AF (Maddaus Water Management Inc. 2010).[5] In critically dry years, the City's marginal source is less certain. The City's long-term supply plan outlines the supply strategy during extended drought periods and documents rehabilitation of its ocean desalination facility as a likely drought supply alternative in critically dry periods (City of Santa Barbara, 2011). The variable unit cost of production of $1,499/AF is used as the backstop cost of alternative supply in critically dry periods.

The weighted-average marginal supply cost shown in Table 8.1-5 is used to value project water supply. Weights are set to the frequency of hydrologic year type according to the Sacramento River Index. The Sacramento River index is used because it correlates closely with the percentage of SWP contract delivery. The weighted-average marginal supply cost is $750/AF.

[4] Supply C in Table 4 of Maddaus (2010).
[5] Supply E in Table 4 of Maddaus (2010).

TABLE 8.1-5
City of Santa Barbara Marginal Supply Cost

Year Type	Frequency	Marginal Source	Marginal Cost ($/AF)
Normal/Wet	67.9%	Groundwater	$622
Dry	19.6%	Supplemental SWP	$714
Critically Dry	12.5%	Desalination	$1,499
		Weighted-Average Cost	$750

A 1.0% real escalation rate is applied to the average marginal supply cost. The rate is based on the difference between the historical average rate of increase of 3.5% for SWP water delivered by the Central Coast Water Authority and the long-term expected inflation rate of 2.5% (Central Coast Water Authority 2012).

Water supply benefits over the 25-year operational life of the Project are summarized in Table 8.1-6. The present value equivalent benefit is $9,108,698.

TABLE 8.1-6
Recycled Water Enhancement Project: Water Supply Benefit

Year	Recycled Water Production (AF)	Water Supply Value ($/AF)	Economic Benefit	Present Value Coefficient	Present Value Equivalent
2017	905	$750	$678,608	0.747	$507,095
2018	920	$757	$696,754	0.705	$491,184
2019	935	$765	$715,195	0.665	$475,646
2020	950	$773	$733,936	0.627	$460,480
2021	965	$780	$752,979	0.592	$445,687
2022	980	$788	$772,330	0.558	$431,265
2023	995	$796	$791,993	0.527	$417,212
2024	1010	$804	$811,972	0.497	$403,525
2025	1025	$812	$832,272	0.469	$390,201
2026	1040	$820	$852,896	0.442	$377,237
2027	1055	$828	$873,849	0.417	$364,627
2028	1070	$837	$895,136	0.394	$352,367
2029	1085	$845	$916,762	0.371	$340,453
2030	1100	$853	$938,730	0.350	$328,878
2031	1160	$862	$999,833	0.331	$330,458
2032	1220	$871	$1,062,064	0.312	$331,157
2033	1280	$879	$1,125,440	0.294	$331,054
2034	1340	$888	$1,189,976	0.278	$330,225
2035	1400	$897	$1,255,692	0.262	$328,737
2036	1400	$906	$1,268,249	0.247	$313,230
2037	1400	$915	$1,280,931	0.233	$298,455
2038	1400	$924	$1,293,740	0.220	$284,377
2039	1400	$933	$1,306,678	0.207	$270,963
2040	1400	$943	$1,319,744	0.196	$258,182
2041	1400	$952	$1,332,942	0.185	$246,003
				Total Present Value Equivalent	$9,108,698

Project Total Economic Benefit

The total economic benefit of the Project is the sum of the present value benefit of water supply and avoided wastewater treatment cost over the Project's 25-year useful life. Total economic benefit is summarized in Table 8.1-7.

TABLE 8.1-7
Recycled Water Enhancement Project: Total Economic Benefit

Benefit Category	Present Value Equivalent
Avoided Wastewater Treatment Cost	$276,212
Water Supply	$9,108,698
Project Total Economic Benefit	$9,384,910

Benefit-Cost Summary

Project benefits and costs are summarized in Table 8.1-8. The Project's net present value is $1,373,727. The Project's benefit-cost ratio is 1.17.

TABLE 8.1-8
Recycled Water Enhancement Project: Benefit-Cost Summary

Summary Value	Present Value Equivalent
Project Economic Benefits	
Avoided Wastewater Treatment Cost	$276,212
Water Supply	$9,108,698
Total Economic Benefit	$9,384,910
Project Economic Costs	
Initial Capital Costs	$6,163,532
Operational & Maintenance Costs	$1,847,651
Total Economic Cost	$8,011,183
Net Present Value	$1,373,727
Benefit-Cost Ratio	1.17

References

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PSP Exhibit D, Section D3 and D5 Tables

Table 15 – Annual Benefit (All benefits in 2012 dollars) Project: City of Santa Barbara Recycled Water Enhancement Project									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change Resulting	Unit $ Value [1]	Annual $ Value	Present Value	Discounted
2017	Water Supply	AF	0	905	905.0	$750	$678,608	0.747	$507,095
2018	Water Supply	AF	0	920	920.0	$757	$696,754	0.705	$491,184
2019	Water Supply	AF	0	935	935.0	$765	$715,195	0.665	$475,646
2020	Water Supply	AF	0	950	950.0	$773	$733,936	0.627	$460,480
2021	Water Supply	AF	0	965	965.0	$780	$752,979	0.592	$445,687
2022	Water Supply	AF	0	980	980.0	$788	$772,330	0.558	$431,265
2023	Water Supply	AF	0	995	995.0	$796	$791,993	0.527	$417,212
2024	Water Supply	AF	0	1010	1010.0	$804	$811,972	0.497	$403,525
2025	Water Supply	AF	0	1025	1025.0	$812	$832,272	0.469	$390,201
2026	Water Supply	AF	0	1040	1040.0	$820	$852,896	0.442	$377,237
2027	Water Supply	AF	0	1055	1055.0	$828	$873,849	0.417	$364,627
2028	Water Supply	AF	0	1070	1070.0	$837	$895,136	0.394	$352,367
2029	Water Supply	AF	0	1085	1085.0	$845	$916,762	0.371	$340,453
2030	Water Supply	AF	0	1100	1100.0	$853	$938,730	0.350	$328,878
2031	Water Supply	AF	0	1160	1160.0	$862	$999,833	0.331	$330,458
2032	Water Supply	AF	0	1220	1220.0	$871	$1,062,064	0.312	$331,157
2033	Water Supply	AF	0	1280	1280.0	$879	$1,125,440	0.294	$331,054
2034	Water Supply	AF	0	1340	1340.0	$888	$1,189,976	0.278	$330,225
2035	Water Supply	AF	0	1400	1400.0	$897	$1,255,692	0.262	$328,737
2036	Water Supply	AF	0	1400	1400.0	$906	$1,268,249	0.247	$313,230
2037	Water Supply	AF	0	1400	1400.0	$915	$1,280,931	0.233	$298,455
2038	Water Supply	AF	0	1400	1400.0	$924	$1,293,740	0.220	$284,377
2039	Water Supply	AF	0	1400	1400.0	$933	$1,306,678	0.207	$270,963
2040	Water Supply	AF	0	1400	1400.0	$943	$1,319,744	0.196	$258,182
2041	Water Supply	AF	0	1400	1400.0	$952	$1,332,942	0.185	$246,003
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$9,108,698**
Comments: [1] Hydrologic-year weighted-average marginal supply cost. Marginal supply cost escalated at a real annual rate of 1%.									

Table 16 – Annual Costs of Avoided Projects (All avoided costs in 2012 dollars) Project: City of Santa Barbara Recycled Water Enhancement Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(f)	(g)	(h)
Year	Alternative (Avoided Project Name): Secondary Treatment Disinfection and Avoided Project Description: Avoided cost of disinfection and dechlorination prior to ocean discharge.				Present Value Coefficient	Discounted Costs (e) x (f) [2]
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs [1]	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2017			$22,126	$22,126	0.747	**$16,534**
2018			$22,560	$22,560	0.705	**$15,904**
2019			$22,997	$22,997	0.665	**$15,294**
2020			$23,436	$23,436	0.627	**$14,704**
2021			$23,877	$23,877	0.592	**$14,133**
2022			$24,321	$24,321	0.558	**$13,581**
2023			$24,768	$24,768	0.527	**$13,047**
2024			$25,216	$25,216	0.497	**$12,532**
2025			$25,668	$25,668	0.469	**$12,034**
2026			$26,121	$26,121	0.442	**$11,554**
2027			$26,578	$26,578	0.417	**$11,090**
2028			$27,036	$27,036	0.394	**$10,643**
2029			$27,498	$27,498	0.371	**$10,212**
2030			$27,961	$27,961	0.350	**$9,796**
2031			$29,575	$29,575	0.331	**$9,775**
2032			$31,198	$31,198	0.312	**$9,728**
2033			$32,831	$32,831	0.294	**$9,657**
2034			$34,473	$34,473	0.278	**$9,566**
2035			$36,124	$36,124	0.262	**$9,457**
2036			$36,233	$36,233	0.247	**$8,949**
2037			$36,341	$36,341	0.233	**$8,467**
2038			$36,450	$36,450	0.220	**$8,012**
2039			$36,560	$36,560	0.207	**$7,581**
2040			$36,669	$36,669	0.196	**$7,174**
2041			$36,779	$36,779	0.185	**$6,788**
Total Present Value of Discounted Costs (Sum of Column (g))						**$276,211**
(%) 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)						**$276,211**
Comments: [1] Avoided cost of secondary treated wastewater routed for tertiary treatment that would otherwise have been disinfected and dechlorinated prior to ocean discharge. [2] Difference in total present value of discounted costs in this table and Table A.8-4 due to rounding.						

Table 19 – Annual Costs of Project
(All costs in 2012 Dollars)
Project: City of Santa Barbara Recycled Water Enhancement Project

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost [1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operations	Maintenance	Replacement	Other	Total Costs (a) +...+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i) [3]
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$1,000,417	-$1,000,417						$0	1.000	**$0**
2013	$1,234,332							$1,234,332	0.943	**$1,164,464**
2014	$1,982,412							$1,982,412	0.890	**$1,764,340**
2015	$1,982,412							$1,982,412	0.840	**$1,664,472**
2016	$1,982,412							$1,982,412	0.792	**$1,570,256**
2017				$64,643	$100,000			$164,643	0.747	**$123,031**
2018				$65,911	$100,300			$166,211	0.705	**$117,172**
2019				$67,187	$100,601			$167,788	0.665	**$111,589**
2020				$68,470	$100,903			$169,372	0.627	**$106,266**
2021				$69,759	$101,205			$170,965	0.592	**$101,194**
2022				$71,056	$101,509			$172,565	0.558	**$96,360**
2023				$72,360	$101,814			$174,174	0.527	**$91,753**
2024				$73,672	$102,119			$175,791	0.497	**$87,363**
2025				$74,990	$102,425			$177,415	0.469	**$83,179**
2026				$76,316	$102,733			$179,048	0.442	**$79,193**
2027				$77,649	$103,041			$180,689	0.417	**$75,395**
2028				$78,989	$103,350			$182,339	0.394	**$71,777**
2029				$80,336	$103,660			$183,996	0.371	**$68,330**
2030				$81,691	$103,971			$185,662	0.350	**$65,046**
2031				$86,406	$104,283			$190,689	0.331	**$63,025**
2032				$91,148	$104,596			$195,743	0.312	**$61,034**
2033				$95,917	$104,910			$200,827	0.294	**$59,074**
2034				$100,715	$105,224			$205,939	0.278	**$57,149**
2035				$105,540	$105,540			$211,080	0.262	**$55,260**
2036				$105,857	$105,857			$211,713	0.247	**$52,289**
2037				$106,174	$106,174			$212,348	0.233	**$49,477**
2038				$106,493	$106,493			$212,985	0.220	**$46,816**
2039				$106,812	$106,812			$213,624	0.207	**$44,299**
2040				$107,133	$107,133			$214,265	0.196	**$41,917**
2041				$107,454	$107,454			$214,908	0.185	**$39,663**
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										**$8,011,181**

Comments: [1] Prior expenditures for project planning and engineering have no salvage value and thus are treated as sunk costs. [2] O&M costs escalated at real rate of 0.3%. [3] Difference in total present value of discounted costs in this table and Table A.8-3 due to rounding.

Table 20 – Proposal Benefits and Costs Summary

Proposal: Recycled Water Enhancement Project

Agency: City of Santa Barbara

Project	Project Proponent	Total Present Value Project Costs	Total Present Value Project Benefits			From Section D1 – Cost-Effectiveness Analysis, Cost Savings	From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D3 – Monetized	From Section D4 – Flood Damage Reduction	Total		
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)	(h)
City of Santa Barbara Recycled Water Enhancement Project	City of Santa Barbara	$8,011,181	$9,384,910		$9,384,910		

Project 2: Twitchell Reservoir Sedimentation Management and - Groundwater Recharge Project, Santa Maria Valley Water Conservation District

The Twitchell Reservoir Sedimentation Management and Groundwater Recharge Project (Project 2 or Project) will remove a large amount of sediment that has accumulated around the Twitchell Reservoir (Reservoir) outlet structure and threatens the intake and outlet works. During normal spring reservoir operations, water is slowly discharged from the Reservoir via the outlet works into the Cuyama River, flowing into the Santa Maria River, which serves as the main recharge source for the adjudicated Santa Maria Groundwater Basin (Basin). Discharge from the Reservoir provides, on average, 32,000 acre-feet (AF) of recharge annually to the Basin (Santa Maria Valley Water Conservation District v. City of Santa Maria, et. al., Stipulation, 2005).[1] If sedimentation in the downstream rivers occurs, recharge operations will be reduced. Sediment deposited in the tunnel, stilling basin, and upper reach of the Cuyama River must be removed. Cleanup can cost up to $1.5 million and require 4 to 8 months to complete, during which time water stored behind the Reservoir is lost to evaporation. The amount of recharge lost as a result of the downstream sedimentation is uncertain but upwards of 32,000 AF.[2]

Reservoir operators estimate a very high probability of a downstream blockage occurring in the next several years without the Project. Sediment was discharged into the outlet structure in 2010 and caused 80-90% of the 16-foot diameter tunnel to be blocked with sediment. Cleanup cost $1.25 million and took 6 months to complete.[3] Sediment has again built up around the outlet structure of the Reservoir and can discharge into the outlet works, intake pipe, and tunnel. A single large storm event could be sufficient to trigger a discharge of the sediment. While the Project will not completely eliminate the risk of future sediment discharges of the outlet structure, it is expected to lower the annual risk to about 5% over the next 20 years.[4]

Project Costs

Project costs are comprised of the initial capital costs associated with planning, permitting, and carrying out the outlet structure sediment removal operation, as detailed in Attachment 3. Once sediment removal is completed, the Project does not entail operations and maintenance (O&M) costs beyond those associated with normal reservoir operations. Sediment removal is expected to provide up to 20 years of protection before it would need to be repeated, though, as discussed above, some risk of

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[1] Santa Maria Valley Water Conservation District v. City of Santa Maria, e al., Stipulation, CV 770214, page 12.

[2] Personal Communication, Steve Kahn, City of Santa Maria, 03/12/2013.

[3] Ibid.

[4] Ibid.

sediment discharge and blockage following sediment removal will remain.[5] Sediment removal is expected to be completed by the end of 2013.

All dollar amounts were converted to 2012 constant dollars prior to being used in the calculations presented in this section.

Initial Capital Costs

Initial capital costs are taken from Attachment 4. The expected timing of these costs is shown in Table 8.2-1. None of the initial capital costs from Attachment 4 are sunk. Initial capital costs are converted to 2012 present value using a 6% real discount rate. The present value equivalent cost is shown in the last column of the table. The present value equivalent of initial capital costs is $787,697.

TABLE 8.2-1
Project Initial Capital Costs by Year

Year	Initial Cost from Attach. 4	Adjustment for Sunk Cost	Economic Cost	Present Value Coefficient	Present Value Equivalent
2013	$835,310		$835,310	0.943	**$787,697**
				Total Present Value Equivalent	**$787,697**

Project Total Economic Cost

Because the Project only entails the initial capital costs and does not entail any incremental O&M costs once sediment removal is completed, the total economic cost of the Project is equal to the present value cost for initial capital expenditure. The total economic cost, shown in Table 8.2-2, is $787,697.

TABLE 8.2-2
Total Economic Cost: Twitchell Reservoir Sedimentation Management Project

Cost Category	Present Value Equivalent
Initial Capital Costs (2013)	$787,697
Operational & Maintenance Costs[1]	NA
Project Total Economic Cost	**$787,697**

[1]Once sediment removal is completed, the Project does not entail O&M costs beyond those associated with normal reservoir operations. Sediment removal is expected to provide up to 20 years of protection before it would need to be repeated.

Project Benefits

The economic benefits of this Project are evaluated using a methodology similar to how one would evaluate a flood protection project. The expected present value damages from sediment flows are calculated without and with the Project. The economic benefit is the difference between these two estimates.

[5] The expected costs of blockage with and without sediment removal are presented in the Project Benefits section of this attachment.

Tunnel Sedimentation Impact Cost Assumptions

A sediment deposition in the outlet works could result in three distinct costs, as follows:

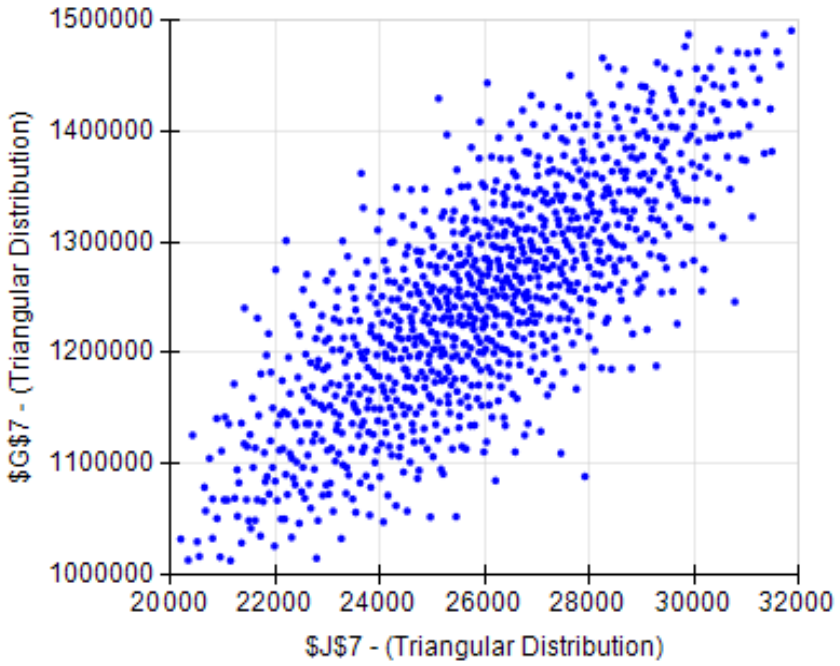
- Sediment will need to be removed from the outlet structure, stilling basin, and river reach below the Twitchell Dam. Other remediation also may be required. Cost for cleanup is uncertain but based on costs of cleanup following the 2010 blockage is expected to range between $1.0 and $1.5 million.
- Following sediment deposition and subsequent cleanup, remaining sediment will be dredged from around the outlet structure to lower the risk of further blockages in the near term. The cost of the dredging operation is assumed to be similar to the cost of the proposed Project, about $910,160 (in undiscounted 2012 dollars).
- Recharge operations for the Basin will be disrupted. The degree of disruption is uncertain but based on expected repair times for sediment cleanup and dredging following a blockage, reservoir operators expect the loss of recharge water to range between 20,000 AF and 32,000 AF.[6]

In the damages analysis, the uncertainties of cleanup cost and loss of recharge are modeled with triangular probability distributions.[7] Cost of cleanup is assumed to have a minimum cost of $1.0 million, a maximum cost of $1.5 million, and a mean cost of $1.25 million. Similarly, the minimum amount of recharge loss is set to 20,000 AF, the maximum amount is set to 32,000 AF, and the expected amount is set to 26,000 AF. It is not assumed the two distributions are independent. Rather, it is assumed that higher cleanup costs correlate with longer periods of disruption to reservoir operations and therefore greater loss of recharge. Similarly, lower cleanup costs are assumed to correlate with shorter periods of disruption and hence lesser loss of recharge. For this analysis, the correlation between the two distributions is set to 0.75. Figure 8.2-1 shows a scatter plot of the assumed relationship between the two uncertain variables. The scatter plot shows that while it is possible to have a large loss of recharge and a low cost of cleanup and vice versa, these outcomes are not very likely.

[6] See footnote 1.

[7] The triangular distribution is a common choice of distribution when there is limited information about an uncertain variable that is expected to range between two limits and there is knowledge of the most likely outcome. Its name derives from the shape of its probability density function, which is triangular. It is similar to a normal distribution, but gives much more weight to outcomes at the tail ends of the distribution than the normal distribution does.

FIGURE 8.2-1
Scatter plot showing assumed correlation between cleanup cost following an impact and loss of groundwater recharge. Groundwater recharge loss is measured on the horizontal axis. Cleanup cost is measured on the vertical axis.



Estimated Value of Groundwater Recharge

The Santa Maria Groundwater Basin was adjudicated in 2008 and is subject to a Stipulation Agreement allocating the basin's component sources of groundwater to various parties to the settlement (Santa Maria Valley Water Conservation District v. City of Santa Maria, et al., Judgement After Trial, 2008). As part of the Stipulation Agreement, Nipomo Community Services District (NCSD) was ordered to enter into a supplemental water purchase agreement of not less than 2,500 AFY to alleviate overdraft pressure on part of the Basin. NCSD entered into a long-term water purchase agreement with City of Santa Maria in 2011. The base price of water stipulated in the agreement is $1,063.37/AF. Under the terms of the agreement, the City of Santa Maria will provide water to NCSD from its water supply sources, including its perfected rights to groundwater from the Basin. NCSD is free to remarket the supplemental water to other parties within the Nipomo Mesa Management Area of the Basin. This agreement provides a reasonable assessment of the current fair market value of groundwater from the Basin measured at the point of delivery stipulated in the agreement (the NCSD interconnection with City of Santa Maria).

The in situ value of the groundwater can be approximated as the difference between this market price and the cost to extract, treat, and deliver the water to the NCSD interconnection. The extraction cost varies with changes in groundwater depth, but

currently averages $50/AF.[8] The delivery cost is stated in the purchase agreement to be $208.85/AF and is subject to annual increases (or decreases) equal to 50% of the Consumer Price Index - Energy Services - Los Angeles-Riverside-Orange County. The unit cost to operate the City of Santa Maria's blending and disinfection facility is unknown. For this analysis, it is assumed to average $100/AF, which is representative of the variable cost of treatment for M&I water. The total cost to extract, treat, and deliver the water to the NCSD interconnection is therefore estimated to be about $359/AF. The in situ value of Santa Maria groundwater is taken to be the difference between the purchase price of $1,063.37 and the delivery cost of $359/AF, about $704/AF. It is noted that the current rate charged by City of Santa Maria for water drawn from wells subject to its jurisdiction is $745/AF. The estimated in situ value is consistent with this rate level. A value of $704/AF is therefore used to value groundwater recharge losses for the without- and with-project conditions.

Without Project Damages Calculation

Without the Project, the sediment around the outlet structure will not be removed and the risk of impacts will remain very high. The probabilities of impacts without the Project assigned by reservoir operators over the next several years are shown in Table 8.2-3.

TABLE 8.2-3
Without Project Risk of Tunnel Impacts by Year

Year	Probability of Flow Impacts[1]
2014	0.70
2015	0.75
2016	0.80
2017 and thereafter	0.85

[1]*Probabilities shown in this table are the estimated probabilities of the event occurring given that it has not already occurred. Unconditional probabilities of an impact event by year are shown in Figure 8.2-5.*

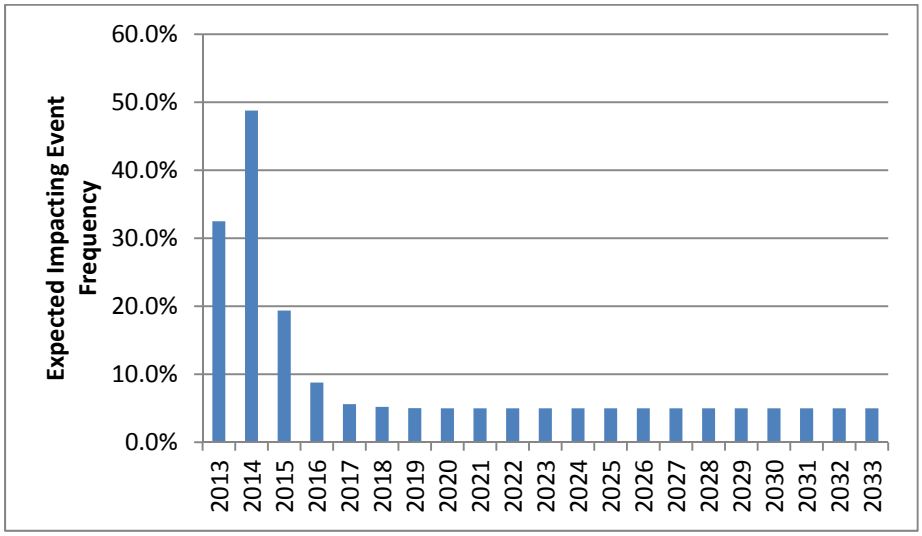
Given the existing buildup of sediment, there is also a significant risk of impacts between now and the end of the year (2013). For this analysis, it was assumed the risk of sediment flow impacts at the start of 2013 was 65% (based on linear interpolation of the probabilities in Figure 8.2-4) and the risk between now (March 2013) and the end of the year is 32.5%.[9] Once an impact occurs, it is assumed that remaining sediment around the outlet structure will be dredged. As discussed previously, the annual risk of blockage following removal of the sediment around the outlet structure is expected to fall to 5%.

[8] Personal communication, Marty Wilder, County of Santa Barbara Public Works, 3/4/2013.

[9] The logic for this value is as follows. The months of greatest risk for impacts are Jan-Apr and Nov-Dec and approximately half of the high risk months have passed without a notable impact. It is worth noting that January and February 2013 were the driest months on record and March is also likely to set a record for low rainfall. Thus, it is not surprising in hindsight that a notable impact or even complete blockage has not yet occurred.

Given these probability estimates and dynamics, the expected frequency of an impact for each year in the analysis period is shown in Figure 8.2-2.[10]

FIGURE 8.2-2
Without Project Expected Frequencies of Tunnel Sedimentation Impacting Events by Year



Expected damages over the analysis period for the without project condition are summarized in Table 8.2-4. The mean number of impacts without the Project is 1.953 and the expected loss of recharge water is 50,772 AF. The expected present value costs of cleanup and sediment removal are $1,742,450 and $1,267,507, respectively. The expected present value cost of the recharge loss is $25,515,063.

Total expected damage without the Project is the sum of the cleanup cost, sediment removal cost, and the value of lost groundwater recharge. These costs total to $28,526,020.

TABLE 8.2-4
Without-Project Expected Damages

Outcomes Over 2013-2032	Expected Value[1]
Number of Impacting Events	1.953
Groundwater Recharge Loss (AF)	50,772
Present Value Cleanup Cost	$1,742,450
Present Value Sediment Removal Cost	$1,268,507
Present Value Cost of Recharge Loss[2]	$25,515,063
Total Expected Damages Without Project[3]	**$28,526,020**

[1]Expected values were calculated from a 10,000 draw Monte Carlo simulation using Frontline System's Risk Solver Platform version 12. For present value calculations, future costs are discounted back to 2012 using a 6% real discount rate.
[2]Value of recharge loss is based on an in situ value of groundwater in the Santa Maria Groundwater Basin of $704/AF
[3]Total expected damages are the sum of cleanup cost, sediment removal cost, and value of recharge loss.

[10] Frequencies shown in Figure 8.2-5 were calculated from a 10,000 draw Monte Carlo simulation using Frontline System's Risk Solver Platform version 12.

With Project Damages Calculation

With the Project, the sediment around the outlet structure will be removed in 2013 and the annual risk of subsequent blockage over the analysis period will be reduced to 5%. This is the key difference between the without- and with-Project conditions. This difference is illustrated in Figure 8.2-3, which compares the expected frequencies of impacts with and without the Project.[11]

Expected damages over the analysis period for the with-project condition are summarized in Table 8.2-5. The mean number of impacts with the Project is 1.325 and the expected loss of recharge water is 34,458 AF. The expected present value costs of cleanup and sediment removal are $1,058,373 and $492,428, respectively.[12] The expected present value cost of the recharge loss is $15,516,036.

Total expected damage with the Project is the sum of the cleanup cost, sediment removal cost, and the value of lost groundwater recharge. These costs total to $17,066,837.

TABLE 8.2-5
With-Project Expected Damages

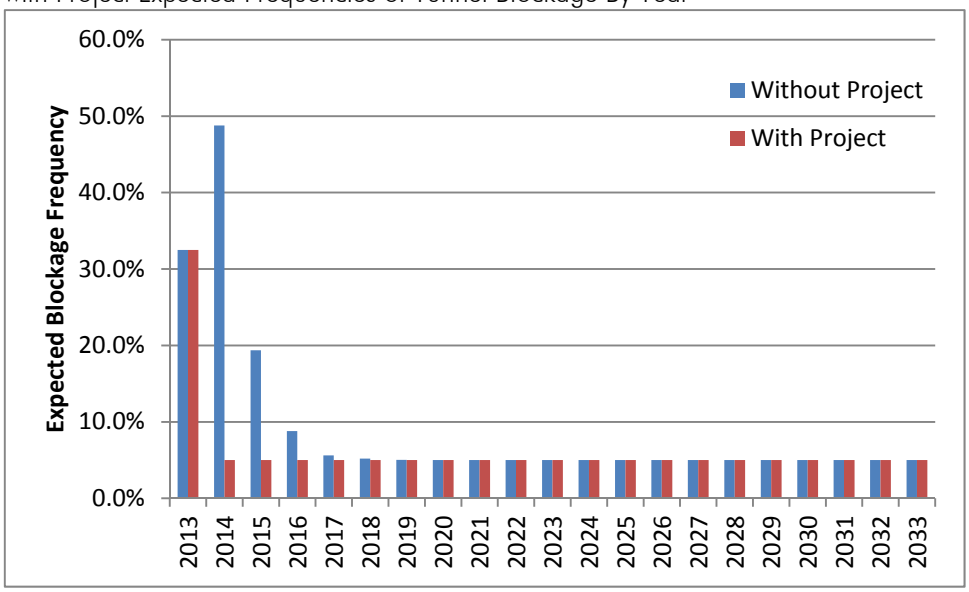
Outcomes Over 2013-2032	Expected Value[1]
Number of Tunnel Sedimentation Impacting Events	1.325
Groundwater Recharge Loss (AF)	34,458
Present Value Cleanup Cost	$1,058,373
Present Value Sediment Removal Cost	$492,428
Present Value Cost of Recharge Loss[2]	$15,516,036
Total Expected Damages With Project[3]	**$17,066,837**

[1]Expected values were calculated from a 10,000 draw Monte Carlo simulation using Frontline System's Risk Solver Platform version 12. For present value calculations, future costs are discounted back to 2012 using a 6% real discount rate.
[2]Value of recharge loss is based on an in situ value of groundwater in the Santa Maria Groundwater Basin of $704/AF
[3]Total expected damages are the sum of cleanup cost, sediment removal cost, and value of recharge loss.

[11] The risk of blockage in 2013 with the project is probably lower than represented in the analysis since most of the sediment will be removed before the high risk months of November and December. As a consequence, the analysis likely overstates damages for the with-project condition.

[12] The large reduction in expected sediment removal cost relative to the without-project condition is partly due to the fact that the cost of sediment removal in 2013 is zero when calculating damages for the with-project condition. This is true even though the risk of a blockage in 2013 is positive because the cost for sediment removal in 2013 is already counted as an economic cost of the project. To include it again in the calculation of with-project damages would double count the cost.

FIGURE 8.2-3
Without and with Project Expected Frequencies of Tunnel Blockage By Year



Project Total Economic Benefit

The total economic benefit of the Project is equal to the difference in expected damages for the without- and with-project conditions. Project economic benefit is summarized in Table 8.2-6. The total economic benefit of the Project is $11,459,183.

TABLE 8.2-6
Total Economic Benefit: Twitchell Reservoir Sedimentation Management Project

	Expected Value[1]		Difference
Outcomes Over 2013-2032	Without Project	With Project	(Economic Benefit)
Number of Tunnel Blocking Events	1.953	1.325	0.628
Groundwater Recharge Loss (AF)	50,772	34,458	16,314
Present Value Cleanup Cost	$1,742,450	$1,058,373	$684,077
Present Value Sediment Removal Cost	$1,268,507	$492,428	$776,079
Present Value Cost of Recharge Loss[2]	$25,515,063	$15,516,036	$9,999,027
Total Expected Damages[3]	**$28,526,020**	**$17,066,837**	**$11,459,183**

[1]Expected values were calculated from a 10,000 draw Monte Carlo simulation using Frontline System's Risk Solver Platform version 12. For present value calculations, future costs are discounted back to 2012 using a 6% real discount rate.
[2]Value of recharge loss is based on an in situ value of groundwater in the Santa Maria Groundwater Basin of $704/AF
[3]Total expected damages are the sum of cleanup cost, sediment removal cost, and value of recharge loss.

Benefit-Cost Summary

Project benefits and costs are summarized in Table 8.2-7. The Project's net present value is $10,671,486. The Project's benefit-cost ratio is 14.55. While most of the Project's net present value is associated with avoiding the loss of groundwater recharge, it is worth noting that even if the recharge had no economic value, which is emphatically not being

suggested here, Project benefits would exceed costs by over $670,000 and the Project's BCR would still exceed 1.8. Thus, on the grounds of avoiding future repair and sediment removal costs alone, the Project is a good economic investment. However, as shown by the economic analysis, its primary value is associated with avoiding the future loss of groundwater recharge for the Basin.

TABLE 8.2-7
Benefit-Cost Summary: Twitchell Reservoir Sedimentation Management Project

Summary Value	Present Value Equivalent
Project Economic Benefits	
Avoided Sediment Cleanup Cost	$684,077
Avoided Sediment Removal Cost	$776,079
Avoided Groundwater Recharge Loss	$9,999,027
Total Economic Benefit	$11,459,183
Project Economic Costs	
Initial Capital Costs	$787,697
Operational & Maintenance Costs	NA
Total Economic Cost	$787,697
Net Present Value	$10,671,486
Benefit-Cost Ratio	14.55

Project Benefits Not Quantified

In addition to the monetized project benefits described in the previous sections, the Project will provide flood protection, improved Basin water qualities, and habitat protection benefits. Data are not available to quantify the economic value of these benefits. They are described qualitatively here.

- *Flood Damage Reduction.* Sediment build-up in the Twitchell Reservoir reduces the storage volume of the Reservoir. During a storm event, an ordered release from the Reservoir has the potential to result in flooding and damage to land and structures downstream of the dam. The likelihood of this occurring depends on a number of factors including the level of storage in the Reservoir prior to the event, the amount of inflow into the Reservoir during the event, and the volume ordered to be released. While this risk is unknown, the more events that occur the greater the possibility a flood event will happen. Since the proposed Project is expected to reduce the mean number of events from 1.953 to 1.325 over the Project's lifecycle, the likelihood of a flood event with the Project is certainly lower than without it.

- *Water Quality.* Recharge of the Basin from Twitchell Reservoir helps to regulate the quality of surface and groundwater in the Basin by providing high quality natural water that is low in nitrates, total dissolved solids (TDS), and other contaminants of concern (Luhdorf and Scalmanini, Inc., 2012). The expected increase in basin recharge is about 16,000 AF with the Project compared to without it. The Project will

therefore provide more water quality benefits to the Basin from Twitchell Reservoir than the without project condition.

- *Habitat Protection.* Uncontrolled release of sediment from Twitchell Reservoir can degrade sensitive habitat downstream of the Reservoir. In 2009, sediment releases impacted wetlands downstream of the Reservoir that are breeding sites and critical habitat of the red-legged frog, a federally-listed threatened species. Uncontrolled sediment releases can also impact habitat of the Southwestern pond turtle and coast horned lizard, both of which are classified as California Species of Special Concern. By reducing the risk of uncontrolled sediment releases, the proposed Project will lower the likelihood of adverse impacts to these sensitive habitats and at-risk species.

References

Luhdorf and Scalmanini, Inc. 2012. *2011 Annual Report of Hydrogeologic Conditions, Water Requirements, Supplies, and Disposition: Santa Maria Valley Management Area.*

Santa Maria Valley Water Conservation District v. City of Santa Maria, e al., Stipulation, CV 770214 (Superior Court of the State of California, County of Santa Clara June 40, 2005).

Santa Maria Valley Water Conservation District v. City of Santa Maria, et al., Judgement After Trial, 1-97-CV-770214 (Superior Court of the State of California, County of Santa Clara January 25, 2008).

PSP Exhibit D, Section D2, D3 and D5 Tables

Table 18 – Present Value of Expected Annual Damage Reduction Benefits Project: Twitchell Reservoir Sedimentation Management Project			
	Expected Present Value Damages Without Project [1]		
(a)	Cleanup Cost Following Sediment Blockage		$1,742,450
(b)	Sediment Removal (Dredging)		$1,268,507
(c)	Value of Lost Groundwater Recharge		$25,515,063
(d)	Subtotal	(a)+(b)+(c)	**$28,526,020**
	Expected Present Value Damages With Project [1]		
(e)	Cleanup Cost Following Sediment Blockage		$1,058,373
(f)	Sediment Removal (Dredging)		$492,428
(g)	Value of Lost Groundwater Recharge		$15,516,036
(h)	Subtotal	(e)+(f)+(g)	**$17,066,837**
(i)	**Present Value of Future Benefits Transfer to Table 20, column (e).**	**(d)-(h)**	**$11,459,183**

[1] Expected present values were calculated from a 10,000 draw Monte Carlo simulation using Frontline System's Risk Solver Platform version 12. For present value calculations, future costs are discounted back to 2012 using a 6% real discount rate.

Table 19 – Annual Costs of Project

(All costs in 2012 Dollars)

Project: Twitchell Reservoir Sedimentation Management Project

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost	Annual Costs [1]						Discounting Calculations	
			Admin	Operations	Maintenance	Replacement	Other	Total Costs (a) +...+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$0	1.000	**$0**
2013	$835,310							$835,310	0.943	**$787,697**
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										**$787,697**

Comments: [1] Project does not entail any incremental O&M costs.

Table 20 – Proposal Benefits and Costs Summary

Proposal: Twitchell Reservoir Sedimentation Management Project

Agency: Santa Maria Valley Water Conservation District

Project	Project Proponent	Total Present Value Project Costs	Total Present Value Project Benefits			From Section D1 – Cost-Effectiveness Analysis, Cost Savings	From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D3 – Monetized [1]	From Section D4 – Flood Damage Reduction	Total		
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)	(h)
Twitchell Reservoir Sedimentation Management Project	SMVWCD	$787,697	$11,459,183		$11,459,183		

Table 12
Non-monetized Benefits Checklist

No.	Question	Enter "Yes", "No" or "Neg"
	Community/Social Benefits	
	Will the proposal	
1	Provide education or technology benefits?	No
2	Provide social recreation or access benefits?	No
3	Help avoid, reduce, or resolve various public water resources conflicts? Proposed project will increase the amount of groundwater recharge in the Santa Maria Groundwater Basin. The basin was adjudicated in 2005 and rights to groundwater in the basin have been extensively litigated over the past decade and a half. By increasing the amount of recharge to the basin, this project will help to reduce water scarcity in the region, which is the primary driver of the conflicts over the basin.	Yes
4	Promote social health and safety? Proposed project will reduce the risk of uncontrolled water releases from the Twitchell Reservoir spillway and downstream damage to property and structures. Proposed project will also help to reduce the concentration of nitrates, TDS, and other water quality contaminants of concern in regional groundwater and surface water supplies.	Yes
5	Have other social benefits?	No
	Environmental Stewardship Benefits:	
	Will the proposal	
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Uncontrolled release of sediment from Twitchell Reservoir can degrade sensitive habitat downstream of the reservoir. In 2009, sediment releases impacted wetlands downstream of the reservoir that are breeding sites and critical habitat of the red-legged frog, a federally-listed threatened species. Uncontrolled sediment releases can also impact habitat of the Southwestern pond turtle and coast horned lizard, both of which are classified as California Species of Special Concern. By reducing the risk of uncontrolled sediment releases, the proposed project will lower the likelihood of adverse impacts to these sensitive habitats and at-risk species.	Yes
7	Improve water quality in ways that were not quantified in Attachment 7? Recharge of the Basin from Twitchell Reservoir helps to regulate the quality of surface and groundwater in the Basin by providing high quality natural water that is low in nitrates, total dissolved solids (TDS), and other contaminants of concern (Luhdorf and Scalmanini, Inc., 2012). The expected increase in basin recharge is about 16,000 AF with the project compared to without it. The project will therefore provide more water quality benefits to the Basin from Twitchell Reservoir than the without project condition.	Yes

Table 12
Non-monetized Benefits Checklist

No.	Question	Enter "Yes", "No" or "Neg"
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
	Sustainability Benefits:	
	Will the proposal	
10	Improve the overall, long-term management of California groundwater resources? Proposed project will increase the amount of groundwater recharge in the Santa Maria Groundwater Basin. The basin was adjudicated in 2005 and rights to groundwater in the basin have been extensively litigated over the past decade and a half. By increasing the amount of recharge to the basin, this project will help to reduce water scarcity in the region, which is the primary driver of the conflicts over the basin.	Yes
11	Reduce demand for net diversions for the regions from the Delta? Proposed project will increase the amount of groundwater recharge in the Santa Maria Groundwater Basin, which will reduce the need for supplemental water supplies imported into the basin. The primary supplemental water source for the basin is surface water imported from the Coastal Branch of the State Water Project.	Yes
12	Provide a long-term solution in place of a short-term one? Proposed project will significantly reduce the annual risk of disruption to Twitchell Reservoir groundwater recharge operations over the 20-year lifecyle of the project. Without the project, there will be a high likelihood in each of the next several years that Twitchell Reservoir's outlet structure will become blocked, at which time the blockage will have to be removed and the sediment around the reservoir outlet structure dredged. The proposed project provides a long-term solution to this year-to-year risk.	Yes
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
14	Improve water supply reliability in ways not quantified in Attachment 7?	No
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)?	No

Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course, Laguna County Sanitation District

The Laguna County Sanitation District (District) currently uses spray irrigation on District-owned permanent pasture to discharge its recycled effluent. The District needs to expand its discharge capacity to accommodate forecasted increases in influent to its wastewater treatment plant (WWTP). Current discharge capacity is only 2.4 million gallons per day (mgd) while WWTP treatment capacity is 3.7 mgd. Projected development by the Orcutt Community Plan and other planned developments will eventually require treatment and discharge capacity of 4.5 to 5.0 mgd (CH2M HILL Inc. 2010). By constructing a pipeline and irrigation network to deliver 537 acre-feet (AFY) of recycled water to the Rancho Maria Golf Course for irrigation of its fairways, the proposed Project will increase District discharge capacity by approximately 0.5 mgd to 2.9 mgd.[1]

Without the Project, the District would need to implement an alternative project to increase WWTP discharge capacity. The District's Discharge Requirements and Master Recycling Permit allow for recycled water reuse involving irrigation of landscape and crop and pastureland on District-owned property, approved user sites as they become available, and other uses approved by the Regional Water Quality Control Board (RWQCB) (CH2M HILL Inc. 2009). The proposed Project falls into the second category—approved user sites as they become available. The next best alternative to the proposed Project is to expand the District's spray fields onto adjacent farmland (CH2M HILL Inc. 2008). This would require the purchase of 200 acres of prime farmland currently used for row crop production, is expected to cost more than double the proposed Project, may require use of eminent domain to implement, and would negatively impact the local economy by shifting prime farmland into less productive pasture.[2]

Both the proposed Project and the next best alternative would benefit the adjudicated Santa Maria Groundwater Basin (Basin) by reducing the amount of pumping from the Basin for irrigation. The proposed Project would do this by displacing groundwater pumping by the golf course for fairway irrigation while the next best alternative would do it by displacing groundwater pumping for row crop irrigation. Similarly, recycled water delivered to the golf course or an expanded spray field would result in similar levels of return flow to the groundwater basin (Luhdorf and Scalmanini, Inc., 2009).[3]

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[1] Influent to the District WWTP is treated to the disinfected tertiary level including salt reduction for groundwater basin water quality purposes. Therefore, expanding the use of recycled water from the District's WWTP only requires investment in transmission and distribution capacity.

[2] Another potential alternative is to use the recycled effluent to recharge the adjudicated Santa Maria Groundwater Basin that underlies the District's service area. This alternative was evaluated and deemed infeasible due to cost and jurisdictional issues (CH2M HILL Inc. 2008). Construction of the necessary infiltration basins alone was estimated to cost $24.4 million, about eight times more than the proposed Project.

[3] Roughly 80% of water applied to general landscape and pasture irrigation is lost to evapotranspiration and 20% returns to the groundwater basin (Ludorff and Scalmanini 2009, Chapter 4, page 25). Thus, the Project is expected to reduce annual groundwater

Thus, both alternatives would help to recharge the adjudicated groundwater basin, but the proposed Project would do so at considerably lower cost and without negatively impacting the local farm economy.

Project Costs

Project costs are comprised of initial capital costs associated with planning, permitting, and construction of the recycled water line and golf course distribution system, as detailed in Attachment 4, and annual operational and maintenance costs that will be incurred during the operational life of the facility. The operational life of the transmission and distribution lines is estimated to be 60 years (State Water Resources Control Board 1998). The Project is expected to go online in 2015.

All dollar amounts were converted to 2012 constant dollars prior to being used in the calculations presented in this section.

Initial Capital Costs

Initial capital costs are taken from Attachment 4. The expected timing of these costs is shown in Table 8.3-1. Costs for planning/design/engineering/environmental documentation shown in the Attachment 4 budget were incurred prior to 2013 and are treated as sunk costs. Initial capital costs are converted to 2012 present value using a 6% real discount rate. The present value equivalent cost is shown in the last column of the table. The sum of the present value equivalent initial capital costs is $2,625,967.

TABLE 8.3-1
Project Initial Capital Costs by Year

Year	Initial Cost from Attach. 4	Adjustment for Sunk Cost	Economic Cost	Present Value Coefficient	Present Value Equivalent
2013	$1,598,543	-$234,043	$1,369,000	0.943	$1,290,967
2014	$1,500,000		$1,500,000	0.890	$1,335,000
				Total Present Value Equivalent	$2,625,967

Operational and Maintenance Costs

The District treats all effluent to tertiary levels and reduces the salt levels on a portion of that flow to meet salinity requirements as a condition of its discharge permit. Hence, operations and maintenance (O&M) costs for treatment will be the same with or without the Project and therefore are not represented here since they would simply net out of the project costs and benefits. Similarly, O&M costs for the golf course are expected to be generally the same whether the golf course irrigates with recycled water or groundwater, and therefore these costs are also not represented in this section.[4] This section focuses on the incremental O&M costs associated delivering the recycled water

withdrawal by about 430 acre-feet (AF) on net. Over the 60-year Project life, the Project is therefore expected to reduce groundwater withdrawals by nearly 26,000 AF.

[4] Although the golf course will avoid the cost of pumping groundwater, this will be offset by cost charged to the golf course for the recycled water. Other O&M costs related to golf course irrigation are expected to be the same with or without the Project.

to the golf course. These costs are summarized in Table 8.3-2. Administration costs cover billing and other administrative functions associated with serving recycled water to the golf course. Operations costs are primarily related to energy costs for pumping. The annual replacement cost of $10,000 covers anticipated costs for periodic major repair or replacement of transmission line segments and is based on straight line depreciation of the initial pipeline costs.[5] The present value equivalent cost for O&M, shown in the last column of Table 8.3-2, is $302,064.

TABLE 8.3-2
Annual Project O&M Costs

Year	Admin	Operations	Maintenance	Replacement	Total OM&R	Present Value Coefficient	Present Value Equivalent
2015-2074	$1,000	$5,000	$2,500	$12,500	$21,000	14.384	$302,064

Project Total Economic Cost

The total economic cost of the Project is the sum of the present value cost for initial capital expenditure and O&M costs over the Project's 60-year useful life. The total economic cost, shown in Table 8.3-3, is $2,928,031.

TABLE 8.3-3
Total Economic Cost

Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course	
Cost Category	Present Value Equivalent
Initial Capital Costs (2013-2014)	$2,625,967
Operational & Maintenance Costs (2015-2074)	$302,064
Project Total Economic Cost	$2,928,031

Project Benefits

By implementing this Project, the District will realize three related benefits:

- It will avoid the financial cost to District ratepayers associated with extending its effluent spray fields into neighboring agricultural land.
- It will avoid the economic cost to the state associated with shifting prime farmland currently used for high-value row crop production into less productive pasture use.
- It will provide approximately 26,000 AF of recharge to the Basin, which is an adjudicated groundwater basin facing significant overdraft pressures.[6]

[5] Annual replacement cost = 0.75 x $1,000,000 (cost of pipeline)/60 = $12,500. Only 75% of initial pipeline cost is used to account for the fact that full replacement even after periods longer than 60 years is seldom needed.

[6] See footnote 3 for the basis for this estimate.

Avoided Cost of Extending District Effluent Spray Field

Extending the District's existing effluent spray field to offset the need for the proposed Project would require the district to purchase 200 acres of prime farmland adjacent to the District's existing spray field. Irrigated vegetable and strawberry acreage in the Santa Maria Valley currently sells for between $30,000 and $60,000 per acre and is in restricted supply (American Society of Farm Managers and Rural Appraisers 2011). Using the midpoint of the current price range, land acquisition alone is expected to cost $9,000,000.

Because prime farmland in the valley is in limited supply and there have been few willing sellers in recent years, it is possible that land acquisition would require use of eminent domain.[7, 8] Implementation of the proposed Project would avoid this possibility and the legal and administrative costs associated with it. Expected costs of eminent domain proceedings are more speculative and therefore excluded from the analysis. But it is nonetheless a potential non-quantified avoided cost of the Project.

In addition to costs for land acquisition, the District would have to install new spray irrigation distribution infrastructure on the land and make other improvements prior to planting the land to pasture. These one-time costs are expected to total about $100,000.[9]

Net operating cost for the District's existing 370-acre spray field average about $243 per acre.[10] Annual operating cost for an additional 200 acres, assuming a similar unit cost, would be about $48,600 per year.

Total avoided costs of extending the District's effluent spray field are summarized in Table 8.3-4. The present value equivalent of future avoided costs is $9,275,062.

TABLE 8.3-4
Avoided Cost of Extending the District Effluent Spray Field

Year	Initial Cost One-Time Costs	Annual O&M Costs	Avoided Economic Cost	Present Value Coefficient	Present Value Equivalent
2013	$9,000,000		$9,000,000	0.943	**$8,487,000**
2014	$100,000		$100,000	0.890	**$89,000**
2015-2074		$48,600	$48,600	14.384	**$699,062**
				Total Present Value Equivalent	$9,275,062

[7] Personal communication, Marty Wilder, County of Santa Barbara Public Works, March 6, 2013.

[8] See p. 69 of American Society of Farm Managers and Rural Appraisers (2011) for history of recent agricultural land transactions in the Santa Maria Valley.

[9] Personal communication, Marty Wilder, County of Santa Barbara Public Works, March 6, 2013.

[10] Historically, the District has received about $60,000 per year in rent and paid out about $200,000 per year for labor and incidentals for irrigation, resulting in a net cost of about $378 per acre. However, the District recently renegotiated with its tenant to take over the irrigation operation at a net cost to the district of about $243 per acre. The lower per acre cost is assumed for this analysis.

Economic Cost of Converting Prime Farmland to Pasture

Extending the District's existing effluent spray field to offset the need for the proposed Project would convert 200 acres of prime farmland used for row crop production to irrigated pasture. Row crop production generates significantly more economic value than irrigated pasture. Row crops grown in Santa Barbara County have an average output value of $6,573 per acre, whereas irrigated pasture has an average output value of just $120 per acre (County of Santa Barbara 2011).[11] In addition to the value of irrigated pasture, extending the District's spray field would also generate economic activity (primarily through hiring of labor) associated with operation of the spray field, which is estimated to cost about $243 per acre. The combined output value once the acre is converted is therefore about $363 per acre.[12] On balance, then, converting 200 acres of prime farmland from row crop production to irrigated pasture and spray field operation would reduce annual state economic output by $1.24 million.

The change in state gross domestic product (GDP) (or value added) associated with this reduction in output is approximately $0.73 million.[13] This reduction in state GDP can be decomposed into three components: (1) the direct component, which represents the change in value added generated on the converted acreage (e.g., the change in wages and profits from using the land for irrigated pasture instead of row crop production); (2) the indirect component, which represents the change in value added generated by firms and individuals supplying inputs for production on the land (e.g., the change in wages and profits of firms providing production inputs such as fertilizer or harvest labor); and (3) the induced component, which represents the change in value added generated by the spending of directly or indirectly generated wages and profits. This decomposition of the change in value added is summarized in Table 8.3-5.

[11] This is a conservative estimate of the difference in production value. Strawberry acreage, which is common in Santa Maria Valley, has an average output value of $56,600 per acre.

[12] Of course, the primary value produced by the acre is for disposal of effluent from the District WWTP. However, this value is realized under both the with- and without-project conditions and therefore nets out of the analysis.

[13] Changes in state GDP were calculated with the IMPLAN Input-Output Model and 2006 California State Data File and default regional purchase coefficients. Results are reported in 2012 constant dollars.

TABLE 8.3-5

Decomposition of Annual Change in State GDP (or Value Added) due to Conversion of 200 Acres of Prime Farmland from Row Crop Production to Irrigated Pasture and Spray Field Operation

Value Added Category[1]	With Project[2]	Without Project[3]	Difference
Direct	$502,151	$33,660	$468,491
Indirect	$103,701	$4,930	$98,771
Induced	$180,828	$19,381	$161,447
Total	**$786,680**	**$57,971**	**$728,709**

[1] Changes in state GDP were calculated with the IMPLAN Input-Output Model and 2006 California State Data File and default regional purchase coefficients. Results are reported in 2012 constant dollars.
[2]In the with-project condition, the acreage is used for row crop production.
[3]In the without-project condition, the acreage is used for irrigated pasture and spray field operation.

The direct component is already accounted for through the purchase price of the land. Thus, including it again here as an avoided cost would result in double counting. This component is therefore excluded. The remaining change in state GDP associated with the indirect and induced impacts represents an economic loss to the state that would be avoided by the proposed Project. The annual value of this loss in state GDP is $260,218. The present value equivalent of future annual losses over the life of the proposed Project, shown in Table 8.3-6, is $3,742,976.

TABLE 8.3-6

Avoided Cost of Prime Farmland Conversion

Indirect/Induced Value Added[1]					
Period	With Project	Without Project	Avoided Cost	Present Value Coefficient	Present Value Equivalent
2015-2074	$284,529	$24,311	$260,218	14.384	$3,742,976

[1] Changes in state GDP were calculated with the IMPLAN Input-Output Model and 2006 California State Data File and default regional purchase coefficients. Results are reported in 2012 constant dollars.

Economic Value of Groundwater Recharge

As discussed previously, both the proposed Project and the next best alternative, pasture irrigation, would benefit the adjudicated Basin by reducing the amount of pumping from the Basin for irrigation and providing similar amounts of groundwater recharge. For this reason, the groundwater recharge benefit is excluded from the economic analysis, since it would be the same for the with- and without-project conditions. Nonetheless, the magnitude of this benefit is non-trivial and should be kept in mind when evaluating the merits of the proposed Project. Moreover, the proposed Project will provide this benefit to the region at much lower cost to District ratepayers and without negatively impacting the local farm economy.

The proposed Project is expected to reduce net annual groundwater withdrawal from the Basin by 430 AF.[14] The Basin was adjudicated in 2008 and is subject to a Stipulation Agreement allocating the Basin's component sources of groundwater to various parties to the settlement.[15] As part of the Stipulation Agreement, Nipomo Community Services District (NCSD) was ordered to enter into a supplemental water purchase agreement of not less than 2,500 AFY to alleviate overdraft pressure on part of the Basin. NCSD entered into a long-term water purchase agreement with City of Santa Maria in 2011. The base price of water stipulated in the agreement is $1,063.37 per AF. Under the terms of the agreement, City of Santa Maria will provide water to NCSD from its water supply sources, including its perfected rights to groundwater from the Basin. NCSD is free to remarket the supplemental water to other parties within the Nipomo Mesa Management Area of the Basin. This agreement provides a reasonable assessment of the current fair market value of groundwater from the Basin measured at the point of delivery stipulated in the agreement (the NCSD interconnection with City of Santa Maria).

The in situ value of the groundwater can be approximated as the difference between this market price and the cost to extract, treat, and deliver the water to the NCSD interconnection. The extraction cost varies with changes in groundwater depth, but currently averages $50 per AF.[16] The delivery cost is stated in the purchase agreement to be $208.85 per AF and is subject to annual increases (or decreases) equal to 50% of the Consumer Price Index—Energy Services—Los Angeles-Riverside-Orange County. The unit cost to operate City of Santa Maria's blending and disinfection facility is unknown. For this analysis, it is assumed to average $100 per AF, which is representative of the variable cost of treatment for municipal and industrial (M&I) water. The total cost to extract, treat, and deliver the water to the NCSD interconnection is therefore estimated to be about $359 per AF. The in situ value of Santa Maria groundwater is taken to be the difference between the purchase price of $1,063.37 and the delivery cost of $359 per AF, about $704 per AF. It is noted that the current rate charged by City of Santa Maria for well water subject to its jurisdiction is $745 per AF. The estimated in situ value is consistent with this rate level.

Given an in situ value of $704 per AF, the annual groundwater recharge benefit is $302,720. The present value equivalent of future recharge over the useful life of the Project is therefore $4,354,325 – about 1.4 times to present value cost of the proposed Project. This is considered to be a lower-bound estimate since it does not account for the high likelihood that the in situ value of the groundwater resource will escalate in real terms over time.[17]

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[14] See footnote 3 for the basis for this estimate.

[15] *Santa Maria Valley Water Conservation District v. City of Santa Maria, et al.*, Case No. 1-97-CV-770214, Judgment After Trial, Filed January 25, 2008.

[16] Personal communication, Marty Wilder, County of Santa Barbara Public Works, March 4, 2013.

[17] Where groundwater is limited and subject to growing competition, economic theory predicts the in situ value (or rental rate) will increase with time.

Project Total Economic Benefit

The total economic benefit of the Project is comprised of two parts. The first is the avoided cost of acquiring, converting, and operating 200 acres of prime farmland for spray field operation, which is the only economically viable alternative to the proposed Project. The present value equivalent of this benefit is $9,275,062. The second is the avoided cost associated with converting 200 acres of prime farmland from high-value row crop production to irrigated pasture. The present value equivalent of this benefit is $3,742,976. The total economic benefit, shown in Table 8.3-7, is $13,018,038.

TABLE 8.3-7
Total Economic Benefit: Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course

Benefit Category	Present Value Equivalent
Avoided Spray Field Expansion Cost	$9,275,062
Avoided Cost of Converting Prime Farmland to Pasture	$3,742,976
Project Total Economic Benefit	$13,018,038

Benefit-Cost Summary

Project benefits and costs are summarized in Table 8.3-8. The Project's net present value is $10,090,007. The Project's benefit-cost ratio is 4.45.

TABLE 8.3-8
Benefit-Cost Summary: Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course

Summary Value	Present Value Equivalent
Project Economic Benefits	
Avoided Spray Field Expansion Cost	$9,275,062
Avoided Cost of Converting Prime Farmland to Pasture	$3,742,976
Total Economic Benefit	$13,018,038
Project Economic Costs	
Initial Capital Costs	$2,625,967
Operations & Maintenance Costs	$302,064
Total Economic Cost	$2,928,031
Net Present Value	$10,090,007
Benefit-Cost Ratio	4.45

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PSP Exhibit D, Section D3 and D5 Tables

Table 15 – Annual Benefit (All benefits in 2012 dollars) Project: Laguna County Sanitation District Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course									
(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)	Present Value Coefficient	Discounted Benefits (1) (h) x (i)
2015-2074	State GDP (or Value Added) [1]	$	$24,311	$284,529	$260,218	$1	$260,218	14.384	$3,742,976
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$3,742,976**

Comments: [1] Changes in state GDP were calculated with the IMPLAN Input-Output Model and 2006 California State Data File and default regional purchase coefficients. Results are reported in 2012 constant dollars. The values shown in columns (d) and (e) correspond to the indirect and induced impacts to state GDP from converting 200 acres of prime farmland in Santa Maria Valley from row crop production to irrigated pasture production. Direct impacts to state GDP are excluded from this table to avoid double counting, as explained in the text of Attachment 8.

Table 16 – Annual Costs of Avoided Projects (All avoided costs in 2012 dollars) Project: Laguna County Sanitation District Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(f)	(g)	(h)
Year	Alternative (Avoided Project Name): LCSD WWTP Spray Field Expansion Project Avoided Project Description: Expand existing spray field by 200 acres to increase LCSD WWTP discharge capacity by 0.5 MGD.				Present Value Coefficient	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs [4]	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2013	$9,000,000			$9,000,000	0.943	**$8,487,000**
2014	$100,000			$100,000	0.890	**$89,000**
2015-2074			$48,600	$48,600	14.384	**$699,062**
Total Present Value of Discounted Costs (Sum of Column (g))						**$9,275,062**
(%) 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)						**$9,275,062**
Comments:						

Table 19 – Annual Costs of Project

(All costs in 2012 Dollars)

Project: Laguna County Sanitation District Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost [1]	Annual Costs [1]						Discounting Calculations	
			Admin	Operations	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$0	1.000	**$0**
2013	$1,603,043	-$234,043						$1,369,000	0.943	**$1,290,967**
2014	$1,500,000							$1,500,000	0.890	**$1,335,000**
2015-2074			$1,000	$5,000	$2,500	$12,500		$21,000	14.384	**$302,064**
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										**$2,928,031**

Comments: [1] Costs for planning/design/engineering/environmental documentation shown in the Attachment 4 budget were incurred in 2010 and are treated as sunk costs of the project.

Table 20 – Proposal Benefits and Costs Summary

Proposal: Laguna County Sanitation District Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course

Agency: Laguna County Sanitation District

Project	Project Proponent	Total Present Value Project Costs	Total Present Value Project Benefits			From Section D1 – Cost-Effectiveness Analysis, Cost Savings	From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D3 – Monetized	From Section D4 – Flood Damage Reduction	Total		
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)	(h)
Recycled Water Pipeline Extension/Retrofit at Rancho Maria Golf Course	LCSD	$2,928,031	$13,018,038		$13,018,038		

Project 4: Secondary Treatment Reliability Project, City of Guadalupe

The Secondary Treatment Reliability Project (Project 4 or Project) will install a new grit removal system and influent pumps at the City of Guadalupe's (City's) wastewater treatment plant (WWTP). The new grit removal system will eliminate the accumulation of grit in the biological treatment system as well as eliminate the abrasion in the piping, pumps, and aeration system, thereby increasing their useful life and decreasing maintenance requirements. The new influent pumps will improve pumping efficiency and result in a reduction in electricity use of up to 90 kilowatt-hours (kWh) per day.

The Project directly ensures the reliability and efficiency of the WWTP. By removing grit from the treatment process, the volume for biological treatment is maintained without the need for expensive dredging. Replacement of the obsolete variable speed drive pumping system with new influent pumps improves reliability, electrical efficiency and reduces greenhouse gases (GHGs).

Moreover, the improvements to the WWTP and the production of consistently higher water quality are all steps toward the eventual upgrade of the WWTP to produce recycled water. Over the past 8 years, the City has pursued a path of upgrading the treatment process, improving water quality, and investigating the use of reclaimed water for the community. The City is currently preparing a recycled water feasibility study that will be an important planning document and tool to inform the City in the next steps toward recycled water use and distribution.

Project Costs

Project costs consist of initial capital costs associated with planning and construction of the WWTP upgrades, as detailed in Attachment 4, and annual operational and maintenance costs that will be incurred during the operational life of the facility. A 25-year average operational life for the plant upgrades is estimated.[1] The Project is expected to go online in 2016.

All dollar amounts were converted to 2012 constant dollars prior to being used in the calculations presented in this section.

Initial Capital Costs

Initial capital costs are taken from Attachment 4. The expected timing of these costs is shown in Table 8.4-1. None of the initial capital costs from Attachment 4 are sunk. Initial capital costs are converted to 2012 present value using a 6% real discount rate. The present value equivalent cost is shown in the last column of the table. The sum of the present value equivalent initial capital costs is $590,744.

[1] Per State Water Resources Control Board guidelines, the operational life for structures and equipment for grit chamber and influent pump station are 40 and 15 years, respectively. The average life is 27.5 years, which has been rounded down to 25 years for this analysis (State Water Resources Control Board, 1998).

TABLE 8.4-1
Project Initial Capital Costs by Year

Year	Initial Cost from Attach. 4	Adjustment for Sunk Cost	Economic Cost	Present Value Coefficient	Present Value Equivalent
2013	$46,567		$46,567	0.943	$43,912
2014	$218,863		$218,863	0.890	$194,788
2015	$419,100		$419,100	0.840	$352,044
				Total Present Value Equivalent	$590,744

Operational and Maintenance Costs

The Project is expected to substantially reduce overall operation and maintenance (O&M) costs at the WWTP (Dudek 2012). The basis for and magnitude of O&M cost savings are addressed in the Project Benefits section of this attachment, since they constitute an avoided cost benefit of the Project.

Project Total Economic Cost

The total economic cost of the Project is equal to the present value cost for initial capital expenditure. The total economic cost, shown in Table 8.4-2, is $590,744.

TABLE 8.4-2
Total Economic Cost: City of Guadalupe WWTP Grit Removal System and Influent Pump Improvement

Cost Category	Present Value Equivalent
Initial Capital Costs (2013-2015)	$590,744
Operational & Maintenance Costs (2015-2074)[1]	NA
Project Total Economic Cost	$590,744

[1]*Project will result in WWTP O&M cost savings, which are presented in the Project Benefits section of this attachment as an avoided cost benefit.*

Project Benefits

By implementing this Project, the City's WWTP will realize substantial O&M cost savings by:

- Reducing daily electricity consumption by up to 90 kWh/day.
- Avoiding the need to periodically dredge the biological system of grit. Without the Project, dredging is expected to be required every 8 years.
- Reducing abrasion in the piping, pumps, and aeration system and associated maintenance and repair costs.

In addition to lowering annual operating costs of the WWTP, the electricity savings will reduce GHG emissions associated with electricity generation. The economic value to the state of reduced GHG emissions is also estimated.

Avoided Electricity Purchases

The new influent pumps will initially reduce WWTP electricity requirements by 60 kWh/day based on current influent levels. This is forecast to increase in line with plant production to 90 kWh/day by 2020 (Dudek 2012). Electricity cost savings are valued at $0.202/kWh, the average cost of electricity in Southern California (U.S. Department of Labor 2013).

Total avoided costs of electricity purchases are summarized in Table 8.4-3. The present value equivalent of future avoided costs is $67,084.

TABLE 8.4-3
Avoided Cost of Electricity Purchases

Year	Avoided Electricity Requirement (kWh)	Unit Value ($/kWh)	Avoided Economic Cost	Present Value Coefficient	Present Value Equivalent
2016	21,900	$0.202	$4,424	0.792	$3,504
2017	24,638	$0.202	$4,977	0.747	$3,718
2018	27,375	$0.202	$5,530	0.705	$3,899
2019	30,113	$0.202	$6,083	0.665	$4,045
2020-2040	32,850	$0.202	$6,636	7.824	$51,918
				Total Present Value Equivalent	$67,084

Avoided Biolac Basin Dredging Cost

The City completed a plant upgrade in 2012 that converted a poorly performing pond system to an extended aeration, activated sludge system utilizing the Biolac® process. Because of the age of Guadalupe's collection system, the typical sandy soils in the service area, proximity to the beach, and the characteristic agricultural community, the WWTP's influent has a high grit load (estimated to be 4 to 5 cubic feet per MG). Without installation of a new grit removal system, it is estimated that dredging of the Biolac basin will need to be done on an 8-year cycle (Dudek 2012) to maintain the system's treatment capacity. Basin dredging is estimated to cost $350,000 (as of 2012) (Dudek 2012). This cost is expected to escalate at a real rate of 0.5% over the project's lifecycle.[2] Additionally, the WWTP will need to meet all discharge requirements while the Biolac pond is bypassed for dredging. Costs associated with reoperation of the WWTP during the dredging operation are estimated to total about $180,000 (as of 2012) (Dudek 2012). Reoperation costs are also expected to escalate at a real rate of 0.5%.

[2] The escalation rate is based on the difference between a forecasted nominal rate of increase in WWTP maintenance costs of 3% (Dudek 2012) and a long-term inflation rate of 2.5%. The long-term inflation rate is based on the current spread between 30-Year Treasury Inflation Protected Securities (TIPS) and regular 30-year Treasuries. This is a somewhat more conservative forecast of long-term inflation (e.g., higher) than forecast by the Federal Reserve Bank of Philadelphia (http://www.phil.frb.org/research-and-data/real-time-center/survey-of-professional-forecasters/2013/survq113.cfm).

Installation of the proposed grit removal system is expected to eliminate the need for cyclical dredging of the Biolac basin (Dudek 2012), thus avoiding those maintenance and reoperation costs entirely over the lifecycle of the project.

Expected cost savings are summarized in Table 8.4-4. The first dredging is expected to occur in 2020 (8 years following the installation of the system in 2012). Two additional dredging operations would be expected to occur within the 25-year Project lifecycle: one in 2028 and the other in 2036. A credit is shown in 2040, the last year of the Project lifecycle, to account for the 4 years after the end of the Project lifecycle until the next dredging is required.[3] The present value of expected cost savings over the 25-year lifecycle of the project due to avoided dredging and WWTP reoperation is $668,846.

TABLE 8.4-4
Avoided Cost of Dredging and WWTP Reoperation

Year	Biolac Basin Dredging Cost	WWTP Reoperation Cost	Avoided Economic Cost	Present Value Coefficient	Present Value Equivalent
2020	$364,247	$187,327	$551,575	0.627	$345,838
2028	$379,075	$194,953	$574,028	0.394	$226,167
2036	$394,506	$202,889	$597,395	0.247	$147,557
2040[1]	($170,876)	($87,879)	($258,754)	0.196	($50,716)
				Total Present Value Equivalent	$668,846

[1]*A credit is provided in the last year of the project lifecycle to account for the salvage value of the dredging operation completed in 2036. The salvage value is calculated by assuming a straight-line depreciation of the dredging cost over the 8-year cycle and calculating the present value (in 2040) of the 4 years of depreciation falling outside the project's 25-year lifecycle.*

Avoided Maintenance and Replacement Cost

The proposed grit removal system is also expected to avoid additional costs associated with reduced reactor volume and loss of treatment efficiency, additional wear on pumps and damage to diffuser equipment, and the additional cost of routine O&M attention to the plant to handle nuisance grit in the Biolac basin, clarifiers, and sludge equipment (Dudek 2012). These avoided costs are expected to offset the added annual operating costs of maintaining the grit removal system (Dudek 2012). Because these offsetting costs would simply net out of the benefit-cost calculations, they are not represented in the analysis.

Avoided GHG Emissions

By requiring less electricity to operate the WWTP upgrades will reduce state GHG emissions. Estimated emission reduction is based on the non-baseload output emission rates for CO_2, CH_4, and N_2O reported for California by the U.S. Environmental

[3] The credit is calculated by assuming a straight-line depreciation of the dredging cost over the 8-year cycle and calculating the present value (in 2040) of the 4 years of depreciation falling outside the project's 25-year lifecycle.

Protection Agency's (EPA's) eGrid2007 database shown in Table 8.4-5 (U.S. Environmental Protection Agency n.d.).[4]

Table 8.4-5
GHG Emission Factors

GHG	Lbs/MWh[1]	CO_2 Equivalents[2]	Lbs/MWh
CO2	1,083.02	1.0	1,083.02
CH4	0.03924	25.0	0.981
N2O	0.00555	298.0	1.654
Total CO2 Equivalent			1,085.655

[1]*http://cfpub.epa.gov/egridweb/ghg.cfm*
[2]*www.climatechangeconnection.org/emissions/CO2_equivalents.htm*

California CO_2 equivalent emission reductions had an estimated value of $13/ton in 2009 (Shaw et al. 2009). This value is forecast to escalate at a real rate of 2.5% per year (Nordhaus 2008).[5] Therefore, emission reductions starting in 2016 are valued at $15/ton. This value is escalated by 2.5% thereafter.

Annual benefits of GHG emission reductions are summarized in Table 8.4-6. The present value equivalent of GHG reduction benefits is $3,580.

TABLE 8.4-6
GHG Emission Reduction Benefit

Year	Avoided Electricity Requirement (kWh)	Reduction in CO_2 Equivalents (Tons)	Unit Value ($/Ton)	Annual Economic Benefit	Present Value Coefficient	Present Value Equivalent
2016	21,900	11.9	$15	$184	0.792	$146
2017	24,638	13.4	$16	$212	0.747	$158
2018	27,375	14.9	$16	$241	0.705	$170
2019	30,113	16.3	$17	$272	0.665	$181
2020	32,850	17.8	$17	$304	0.627	$191
2021	32,850	17.8	$17	$312	0.592	$185
2022	32,850	17.8	$18	$320	0.558	$178
2023	32,850	17.8	$18	$328	0.527	$173
2024	32,850	17.8	$19	$336	0.497	$167
2025	32,850	17.8	$19	$344	0.469	$161
2026	32,850	17.8	$20	$353	0.442	$156
2027	32,850	17.8	$20	$362	0.417	$151
2028	32,850	17.8	$21	$371	0.394	$146

[4] Per EPA guidance, annual non-baseload output emission rates, rather than baseload rates, should be used to estimate GHG emissions reductions from reductions in electricity use.

[5] Shaw et al. 2009; Nordhaus 2008. .

TABLE 8.4-6
GHG Emission Reduction Benefit

Year	Avoided Electricity Requirement (kWh)	Reduction in CO_2 Equivalents (Tons)	Unit Value ($/Ton)	Annual Economic Benefit	Present Value Coefficient	Present Value Equivalent
2029	32,850	17.8	$21	$380	0.371	$141
2030	32,850	17.8	$22	$389	0.350	$136
2031	32,850	17.8	$22	$399	0.331	$132
2032	32,850	17.8	$23	$409	0.312	$128
2033	32,850	17.8	$24	$419	0.294	$123
2034	32,850	17.8	$24	$430	0.278	$119
2035	32,850	17.8	$25	$441	0.262	$115
2036	32,850	17.8	$25	$452	0.247	$112
2037	32,850	17.8	$26	$463	0.233	$108
2038	32,850	17.8	$27	$474	0.220	$104
2039	32,850	17.8	$27	$486	0.207	$101
2040	32,850	17.8	$28	$498	0.196	$98
Total	793,876	430				$3,580

Project Total Economic Benefit

The total economic benefit of the Project consists of the avoided costs for electricity, Biolac basin dredging, and WWTP reoperation during dredging, plus the value to the state of reduced GHG emissions. The total economic benefit, shown in Table 8.4-7, is $739,510.

TABLE 8.4-7
Total Economic Benefit: City of Guadalupe WWTP Grit Removal System and Influent Pump Improvement

Benefit Category	Present Value Equivalent
Avoided Electricity Purchases	$67,084
Avoided Biolac Basin Dredging Cost	$668,846
Avoided GHG Emissions	$3,580
Project Total Economic Benefit	$739,510

Benefit-Cost Summary

Project benefits and costs are summarized in Table 8.4-8. The Project's net present value is $148,766. The Project's benefit-cost ratio is 1.25.

TABLE 8.4-8
Benefit-Cost Summary: City of Guadalupe WWTP Grit Removal System and Influent Pump Improvement

Summary Value	Present Value Equivalent
Project Economic Benefits	
Avoided Electricity Costs	$67,084
Avoided Biolac Basin Dredging Cost	$668,846
Avoided GHG Emissions	$3,580
Total Economic Benefit	**$739,510**
Project Economic Costs	
Initial Capital Costs	$590,744
Operational & Maintenance Costs	NA
Total Economic Cost	**$590,744**
Net Present Value	$148,766
Benefit-Cost Ratio	1.25

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PSP Exhibit D, Section D3 and D5 Tables

Table 15 – Annual Benefit (All benefits in 2012 dollars) Project: City of Guadalupe Wastewater Treatment Plant Grit Removal System and Influent Pump Improvement									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change Resulting	Unit $ Value [1]	Annual $ Value [1]	Present Value	Discounted
2016	GHG Reduction	Tons CO2	0	11.9	11.9	$15	$184	0.792	$146
2017	GHG Reduction	Tons CO2	0	13.4	13.4	$16	$212	0.747	$158
2018	GHG Reduction	Tons CO2	0	14.9	14.9	$16	$241	0.705	$170
2019	GHG Reduction	Tons CO2	0	16.3	16.3	$17	$272	0.665	$181
2020	GHG Reduction	Tons CO2	0	17.8	17.8	$17	$304	0.627	$191
2021	GHG Reduction	Tons CO2	0	17.8	17.8	$17	$312	0.592	$185
2022	GHG Reduction	Tons CO2	0	17.8	17.8	$18	$320	0.558	$178
2023	GHG Reduction	Tons CO2	0	17.8	17.8	$18	$328	0.527	$173
2024	GHG Reduction	Tons CO2	0	17.8	17.8	$19	$336	0.497	$167
2025	GHG Reduction	Tons CO2	0	17.8	17.8	$19	$344	0.469	$161
2026	GHG Reduction	Tons CO2	0	17.8	17.8	$20	$353	0.442	$156
2027	GHG Reduction	Tons CO2	0	17.8	17.8	$20	$362	0.417	$151
2028	GHG Reduction	Tons CO2	0	17.8	17.8	$21	$371	0.394	$146
2029	GHG Reduction	Tons CO2	0	17.8	17.8	$21	$380	0.371	$141
2030	GHG Reduction	Tons CO2	0	17.8	17.8	$22	$389	0.350	$136
2031	GHG Reduction	Tons CO2	0	17.8	17.8	$22	$399	0.331	$132
2032	GHG Reduction	Tons CO2	0	17.8	17.8	$23	$409	0.312	$128
2033	GHG Reduction	Tons CO2	0	17.8	17.8	$24	$419	0.294	$123
2034	GHG Reduction	Tons CO2	0	17.8	17.8	$24	$430	0.278	$119
2035	GHG Reduction	Tons CO2	0	17.8	17.8	$25	$441	0.262	$115
2036	GHG Reduction	Tons CO2	0	17.8	17.8	$25	$452	0.247	$112
2037	GHG Reduction	Tons CO2	0	17.8	17.8	$26	$463	0.233	$108
2038	GHG Reduction	Tons CO2	0	17.8	17.8	$27	$474	0.220	$104
2039	GHG Reduction	Tons CO2	0	17.8	17.8	$27	$486	0.207	$101
2040	GHG Reduction	Tons CO2	0	17.8	17.8	$28	$498	0.196	$98
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$3,580**

Table 16 – Annual Costs of Avoided Projects (All avoided costs in 2012 dollars) Project: City of Guadalupe Wastewater Treatment Plant Grit Removal System and Influent Pump Improvement						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(f)	(g)	(h)
Year	Alternative (Avoided Project Name): Operate Existing Plant Without Upgrades Avoided Project Description: Annual cost of electricity and Biolac Pond dredging.					
	Avoided Capital Costs	Avoided Electricity Costs	Avoided Biolac Pond Dredging	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Present Value Coefficient	Discounted Avoided Costs
2016		$4,424	$0	$4,424	0.792	**$3,504**
2017		$4,977	$0	$4,977	0.747	**$3,718**
2018		$5,530	$0	$5,530	0.705	**$3,898**
2019		$6,083	$0	$6,083	0.665	**$4,045**
2020		$6,636	$551,575	$558,210	0.627	**$349,998**
2021		$6,636	$0	$6,636	0.592	**$3,928**
2022		$6,636	$0	$6,636	0.558	**$3,703**
2023		$6,636	$0	$6,636	0.527	**$3,497**
2024		$6,636	$0	$6,636	0.497	**$3,298**
2025		$6,636	$0	$6,636	0.469	**$3,112**
2026		$6,636	$0	$6,636	0.442	**$2,933**
2027		$6,636	$0	$6,636	0.417	**$2,767**
2028		$6,636	$574,028	$580,663	0.394	**$228,781**
2029		$6,636	$0	$6,636	0.371	**$2,462**
2030		$6,636	$0	$6,636	0.350	**$2,322**
2031		$6,636	$0	$6,636	0.331	**$2,196**
2032		$6,636	$0	$6,636	0.312	**$2,070**
2033		$6,636	$0	$6,636	0.294	**$1,951**
2034		$6,636	$0	$6,636	0.278	**$1,845**
2035		$6,636	$0	$6,636	0.262	**$1,739**
2036		$6,636	$597,395	$604,030	0.247	**$149,196**
2037		$6,636	$0	$6,636	0.233	**$1,546**
2038		$6,636	$0	$6,636	0.220	**$1,460**
2039		$6,636	$0	$6,636	0.207	**$1,374**
2040		$6,636	($258,754)	($252,119)	0.196	**($49,415)**
Total Present Value of Discounted Costs (Sum of Column (g))						**$735,927**
(%) 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)						**$735,927**

Table 19 – Annual Costs of Project

(All costs in 2012 Dollars)

Project: City of Guadalupe Wastewater Treatment Plant Grit Removal System and Influent Pump Improvement

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost	Annual Costs [1]						Discounting Calculations	
			Admin	Operations	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Present Value Coefficient	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$0	1.000	**$0**
2013	$46,567							$46,567	0.943	**$43,912**
2014	$218,863							$218,863	0.890	**$194,788**
2015	$419,100							$419,100	0.840	**$352,044**
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										**$590,745**

Comments: [1] Annual O&M of the grit removal system expected to be offset by avoided cost of grit-related maintenance, repair, and replacement if system not install (Dudek Memo). Therefore, O&M costs not shown in table since they would simply net out of the calculation of project net present value.

Table 20 – Proposal Benefits and Costs Summary

Proposal: City of Guadalupe Wastewater Treatment Plant Grit Removal System and Influent Pump Improvement

Agency: City of Guadalupe

Project	Project Proponent	Total Present Value Project Costs (1)	Total Present Value Project Benefits			From Section D1 – Cost-Effectiveness Analysis, Cost Savings	From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D3 – Monetized (2)	From Section D4 – Flood Damage Reduction (3)	Total		
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)	(h)
City of Guadalupe Wastewater Treatment Plant Grit Removal System and Influent Pump Improvement	City of Guadalupe	$590,745	$739,507		$739,507		