



Attachment | **Proposition 1E Stormwater Flood Management**
9 | *City of San Marcos*
Economic Analysis – Water Quality and Other Expected Benefits

Attachment 9 consists of the following items:

- ✓ **Water Quality Background.** This attachment provides an overview of water quality issues in the region and within the City of San Marcos.
- ✓ **Water Quality and Other Expected Benefits.** The body of this attachment provides a description of the water quality and other benefits associated with implementation of the *San Marcos Creek Floodway Improvement Project*.

This attachment contains estimations of the water quality and other benefits, as well as the total costs associated with the *San Marcos Creek Floodway Improvement Project*. Section 1 provides a summary of local and regional water quality issues with respect to the San Diego IRWM Region, as well as with respect to the Project Area. Section 2 contains a narrative description of the expected costs that would be incurred to implement and operate the project over the project's lifetime (through 2060). Section 3 contains a narrative description of the expected water quality and other benefits of the *San Marcos Creek Floodway Improvement Project*, which are equivalent to the water quality and other benefits associated with this grant proposal. Where possible, each benefit was quantified and presented in physical or economic terms. In cases where quantitative analyses were not feasible, this attachment provides complimentary qualitative analyses. In addition, this attachment provides a description of economic factors that may affect or qualify the amount of economic benefits to be realized. This attachment also addresses uncertainties about the future that might affect the level of benefit received.

Regional Water Quality Background

Regional

The San Diego IRWM region lies entirely within the jurisdiction of the San Diego RWQCB, which regulates water quality and discharges to surface waters. Municipal stormwater runoff within the region is regulated through a single National Pollutant Elimination System (NPDES) MS4 Permit, which is issued by the San Diego RWQCB to 21 Copermitees (Order No. R9-2007-0001, NPDES CAS0108758) with the County of San Diego. The County of San Diego is designated as the Principal Copermitee.

The San Diego RWQCB has identified over 40 inland surface water bodies, located in ten of the region's eleven hydrologic units as not attaining applicable water quality objectives. Primary water quality constituents of concern for the region's surface waters include coliform bacteria, sediment, nutrients, salinity, metals, and toxic organic compounds. The RWQCB has completed TMDLs for several of these non-complying waters, and has initiated TMDLs for a number of additional impaired waters.

Local

The *San Marcos Creek Floodway Improvement Project* is located within the Upper San Marcos Creek Watershed, which is located within the Carlsbad Hydrologic Unit (San Diego RWQCB 1994). The headwaters of San Marcos Creek drain runoff from the Merriam Mountains and the San Marcos Mountains, which enter Twin Oaks Valley and flows south-southwesterly through the City of San Marcos and into Lake San Marcos (HDR 2007). The project area is located approximately 0.5 mile upstream from Lake San Marcos. San Marcos Creek eventually flows into the Batiquitos Lagoon and then another 2.5 miles before entering the Pacific Ocean. San Marcos Creek is the primary tributary to the 600-acre

Batiquitos coastal lagoon, which has been designated as an ecological reserve, and was previously impacted by excessive sedimentation prior to restoration efforts that took place in 1994 (HDR 2007).

Lake San Marcos is a small privately owned reservoir located within the San Marcos Creek watershed. The lake currently suffers algal blooms and has been placed on the San Diego RWQCB list of impaired water bodies (303(d) list) for nutrients, ammonia, and phosphorus. In addition, the primary tributary to Lake San Marcos, San Marcos Creek, is also listed for phosphorus, as well as DDE, which is a byproduct of dichlorodiphenyltrichloroethane (DDT), and sediment toxicity (Anderson 2010). Water quality in and around San Marcos is affected by chemical, physical, or biological changes to water as a result of flowing over, and through, developed areas soils or rock material. Issues of concern within the Carlsbad Hydrologic Unit include surface water quality degradation, beach closures, sedimentation, habitat degradation and loss, invasive species and eutrophication (HDR 2007).

The San Marcos Creek Specific Plan calls for many opportunities to use planned surface areas as low impact development site design/treatment control BMPs and reduce hydromodification effects. There are also opportunities to design and construct bio retention BMPs within the downtown San Marcos area, which meet the conceptual design of the Specific Plan. Analysis of potential BMPs and treatment systems demonstrate an expected decrease in pollutant loading when comparing the existing site conditions to the built-out Specific Plan for San Marcos. Therefore, this proposal would help to address significant water quality issues within San Marcos Creek, and ultimately Lake San Marcos (Ogawa 2010).

Water Quality and Other Expected Benefits

The following sections provide information about the water quality and other benefits associated with this grant proposal. The summary of total project costs is based on Table 10 in DWR's Stormwater Flood Management Grant Proposal Solicitation Package (DWR 2010), which is presented in Attachment 7 and Attachment 8.

The water quality and other benefits that are anticipated to result from implementation of the proposal are summarized below in Table 9-1, and the cost-benefit overview is summarized in Table 9-2. This project would generate monetized and qualitative water quality and other benefits. Detailed cost and benefit information associated with the project, including present value calculations, is provided in Table 9-3.

Table 9-1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Quality and Other Benefits		
Avoided Sediment and Water Quality Treatment Costs	Monetized	Local and Regional
Avoided City Maintenance Costs	Monetized	Local
Habitat/Creek Restoration	Qualitative	Local and Regional
Increased Recreation Opportunities	Qualitative	Local and Regional

Table 9-2: Benefit-Cost Analysis Overview

	Present Value (\$2009)
Costs – Total Capital and O&M	\$12,744,409
Monetizable Benefits	\$1,780,227
Avoided Sedimentation Costs	\$829,590
Reduced Maintenance Costs	\$950,637
Qualitative Benefits	<u>Qualitative Indicator*</u>
Habitat/Creek Restoration	+
Increased Recreation Opportunities	+

* Magnitude of effect on net benefits:

+/- (negligible or unknown); + (moderate positive); ++ (significant positive); - (moderate negative); -- (significant negative)

The “Without Project” Baseline

Existing conditions (without project) are those analyzed within the 2007 Environmental Impact Report conducted for the City of San Marcos on the San Marcos Creek Specific Plan (HDR 2007). This report demonstrated that the existing floodway and corresponding 100-year floodplain spanned throughout the downtown area of San Marcos, and would affect a multitude of residential and commercial developments. In addition, this report notes that there are substantial water quality issues within San Marcos Creek and Lake San Marcos, which were discussed above.

Benefits Analysis

This project would provide several water quality and other expected benefits. These benefits are described in detail below and are summarized in Table 9-3 (on the following page).

Avoided Sediment and Water Quality Treatment Costs

Current water quality conditions for San Marcos Creek and Lake San Marcos have rendered these water bodies impaired for nutrients, ammonia, phosphorous, DDE, and sediment toxicity. Creek restoration activities planned as part of the *San Marcos Creek Floodway Improvement Project* would improve San Marcos Creek by restoring native riparian vegetation within the channel to improve nutrient uptake and stabilize the channel and banks from erosion. Further, installation of a sediment control structure at Via Vera Cruz would induce sediment deposition on the upstream side and induce channel scour on the downstream side. The project seeks to manage the quality of stormwater runoff in San Marcos Creek by reducing the source of pollutants, encouraging development with a lower potential for pollutants, and reducing hydromodification effects. All on-site drainage from the Specific Plan area shall convey runoff through a desiltation system and/or filtering system prior to outlet into the San Marcos Creek and Lake San Marcos. Once established, the restoration of native riparian vegetation within the floodplain and implementation of other BMPs, will contribute to the uptake and removal of pollutants. Because riparian vegetation intercepts surface runoff, it has been shown to be effective in controlling nonpoint source pollution by removing nutrients, especially nitrogen, and sediment (USDA 1998).

A 2007 report that was completed for a lake similar to Lake San Marcos (Canyon Lake in Santa Anita), demonstrated that sedimentation was contributing to nutrient and pathogen contamination within the lake (Anderson et al 2007). This study analyzed various alternatives to for in-lake treatment to improve water quality in Canyon Lake. Specifically, this study analyzed the use of aeration, hypolimnetic oxygenation, and alum application (Anderson et al 2007). In addition, this study analyzed sediment dredge activities to remove existing sedimentation and associated water quality constituents.

Canyon Lake is 200 acres in size, and Lake San Marcos is 80 acres. Therefore, costs anticipated for Canyon Lake were scaled down by a factor of 0.4 (80/200) to estimate similar costs to address sediment and associated water quality issues within Lake San Marcos. For purposes of this comparison, the estimates for hypolimnetic oxygenation were analyzed as the most suitable treatment method for Lake San Marcos. This analysis assumed that the capital costs would be incurred as a lump sum in 2014, and that annual operations and maintenance costs would occur every year after that, until 2060. Table 9-3 provides a summary of avoided treatment costs and Table 9-4 provides further detail (first set of benefits).

Table 9-3: Avoided Sediment and Water Quality Treatment Costs

Potential Water Quality Improvements	Canyon Lake Costs	Scaled Lake San Marcos Costs	Years	Total Cost (Lake San Marcos)
Sediment Dredging	\$1,500,000	\$600,000	One Time	\$600,000
Capital Costs – Hypolimnetic Oxygenation	\$500,000	\$200,000	One Time	\$200,000
Operations and Maintenance Costs – Hypolimnetic Oxygenation	\$50,000	\$20,000	46	\$920,000
Total Costs				\$1,720,000
Total Costs after Discounting (2009 dollars)				\$829,590

Notes: For further information regarding how these numbers were calculated, please refer to Table 9-3.

Table 9-4: Water Quality and Other Expected Benefits

Table 19 - Water Quality and Other Expected Benefits (All benefits in 2009 dollars)													
(a) Year	<i>(b) Type of Benefit: Avoided Sediment and Water Quality Treatment Costs</i>				<i>(b) Type of Benefit: Avoided City Maintenance Costs</i>						<i>Discounting Calculations for Economic Benefits</i>		
	<i>(c) Measure of Benefit [Unit]: Annual Costs</i>				<i>(c) Measure of Benefit [Unit]: Annual Costs</i>						(h) Total Annual Benefits (\$)	(i) Discount Value	(j) Discounted Benefits [h x i]
	(d) Without Project	(e) With Project	(f) Change Resulting from Project	(g) Unit \$ Value	(h) Annual \$ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project	(g) Unit \$ Value	(h) Annual \$ Value [f x g]			
2009	-81955	-81955	0		\$0	0.0	0.0	0.0	--	0.0	\$0	1.000	\$0
2010	-81955	-81955	0		\$0	0.0	0.0	0.0	--	0.0	\$0	1.000	\$0
2011	-81955	-81955	0		\$0	0.0	0.0	0.0	--	0.0	\$0	0.943	\$0
2012	-81955	-81955	0		\$0	0.0	0.0	0.0	--	0.0	\$0	0.890	\$0
2013	-81955	-81955	0		\$0	0.0	0.0	0.0	--	0.0	\$0	0.840	\$0
2014	-81955	-81955	0		\$0	0.0	0.0	0.0	--	0.0	\$0	0.792	\$0
2015	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$800,000	0.747	\$597,600
2016	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.705	\$71,878
2017	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.665	\$67,800
2018	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.627	\$63,926
2019	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.592	\$60,357
2020	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.558	\$56,891
2021	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.527	\$53,730
2022	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.497	\$50,672
2023	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.469	\$47,817
2024	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.442	\$45,064
2025	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.417	\$42,515
2026	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.390	\$39,762
2027	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.371	\$37,825
2028	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.350	\$35,684
2029	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.331	\$33,747
2030	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.312	\$31,810
2031	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.294	\$29,975
2032	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.278	\$28,343
2033	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.262	\$26,712
2034	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.247	\$25,183

Table 19 - Water Quality and Other Expected Benefits
(All benefits in 2009 dollars)

(a) Year	(b) Type of Benefit: Avoided Sediment and Water Quality Treatment Costs					(b) Type of Benefit: Avoided City Maintenance Costs					Discounting Calculations for Economic Benefits		
	(c) Measure of Benefit [Unit]: Annual Costs					(c) Measure of Benefit [Unit]: Annual Costs							
	(d) Without Project	(e) With Project	(f) Change Resulting from Project	(g) Unit \$ Value	(h) Annual \$ Value [f x g]	(d) Without Project	(e) With Project	(f) Change Resulting from Project	(g) Unit \$ Value	(h) Annual \$ Value [f x g]	(h) Total Annual Benefits (\$)	(i) Discount Value	(j) Discounted Benefits [h x i]
2035	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.233	\$23,756
2036	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.220	\$22,430
2037	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.207	\$21,105
2038	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.196	\$19,983
2039	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.185	\$18,862
2040	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.174	\$17,740
2041	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.164	\$16,721
2042	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.155	\$15,803
2043	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.146	\$14,885
2044	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.138	\$14,070
2045	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.130	\$13,254
2046	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.123	\$12,540
2047	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.116	\$11,827
2048	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.109	\$11,113
2049	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.103	\$10,501
2050	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.097	\$9,890
2051	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.092	\$9,380
2052	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.087	\$8,870
2053	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.082	\$8,360
2054	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.077	\$7,851
2055	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.073	\$7,443
2056	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.069	\$7,035
2057	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.065	\$6,627
2058	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.061	\$6,219
2059	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.058	\$5,913
2060	-81955	0	81955		\$81,955	-20,000	0.0	20,000	--	\$20,000	\$101,955	0.054	\$5,535
Total Present Value of Discounted Benefits over Project Life (Monetized Benefits):												\$1,780,227	

Avoided City Maintenance Costs

When flooding occurs in San Marcos Creek, which disturbs property and infrastructure within the City of San Marcos, the City is required to provide cleanup activities. Cleanup activities require public works personnel, contractors, and equipment to respond to the damage caused by flooding events associated with each seasonal storm.

A response crew would typically consist of a crew leader with three members, a drainage facility leader with three members, and support for street barricades and trees. Based on the estimated average loaded rates for public works personnel, a crew of three costs approximately \$11,520 per day. Contractors with specialized expertise in tree maintenance cost approximately \$1,320 per day. Equipment that would typically be deployed to respond to a seasonal flood event would include the following: debris pumping trucks, dump truck, crane truck, small front loader and backhoe, chipper, aerial truck, and a chipper trailer. Materials needed to respond to support the response crew include barricades to control the flow of traffic and ensure worker safety. Daily equipment and material costs associated with a seasonal flooding event are approximately \$3,551. Table 9-5 provides a summary of average cleanup response costs associated with flooding events.

Table 9-5: Approximate Daily Costs for Response to Seasonal Flooding

	Cost (per day)
Response Crew (Public Works personnel)	\$11,520
Contractors (tree maintenance)	\$1,320
Equipment and Materials	\$3,551
Total Daily Costs for Cleanup Response	\$16,391

Based on seasonal flooding experienced in the San Marcos Creek area, it is estimated that five days are spent annually to respond to the maintenance needs associated with keeping the drainage facilities operating properly, keeping the roadways clear and safe for public transit, and clearing debris that has the potential to cause damage. Therefore, the annual maintenance cost is estimated to include five days a year at \$16,391 per day, or \$81,955 annually.

The large majority of flooding-related cleanups described above are due to flooding within the 100-year flood zone (refer to Attachment 7 for more information). This proposal aims to confine those flood flows within the newly renovated San Marcos Creek channel, thereby eliminating flood damage outside of the flood channel. Therefore, it is assumed that with implementation of the *San Marcos Creek Floodway Improvement Project*, maintenance costs would be reduced by \$81,955 per year, beginning after project construction is completed (in 2015), and carrying out over the lifetime of the project (to 2060). Table 9-6 provides a summary of avoided City maintenance costs and Table 9-4 above provides further detail (second set of benefits).

Table 9-6: Avoided City Maintenance Costs

	Annual Cost	Years	Total Cost
Avoided City Maintenance Costs Associated With Flooding Events	\$81,955	46	\$3,769,930
Total Avoided Maintenance Costs			\$3,739,930
Total Avoided Maintenance Costs after Discounting			\$950,637

Habitat/Creek Restoration

The *San Marcos Creek Floodway Improvement Project* proposes to restore natural riparian habitat and floodplain function within the project area. Habitat and water quality improvements that would result from the proposal would support both aquatic and terrestrial ecosystems. Specifically, the proposal would promote beneficial uses of water for warm water ecosystems, such as preservation or enhancement of aquatic habitats, vegetation, and fish or wildlife (including invertebrates). The proposal would also promote beneficial uses of water for terrestrial ecosystems, such as preservation and enhancement of terrestrial habitats, vegetation, wildlife, and wildlife water and food sources.

Analysis completed in 2007 demonstrates that restoration activities associated with San Marcos Creek would create 23.37 acres of habitat, and would enhance 12.99 acres of existing habitat (HDR 2007). These acreage values are those for the entire San Marcos Creek Specific Plan, and may extend outside of the benefits accrued by this specific project. Environmental compliance and mitigation efforts anticipated for this project will determine the exact acreage of habitat that will be restored or created as part of the *San Marcos Creek Floodway Improvement Project*. These benefits were not monetized.

Increased Recreation Opportunities

The proposed improvements that would be implemented as part of this proposal would help to improve water quality within San Marcos Creek and Lake San Marcos. Both of these water bodies are currently listed as having recreational beneficial uses according to the San Diego RWQCB Basin Plan (San Diego RWQCB 1994).

Current recreation opportunities exist within the project area; however these opportunities have been decreased due to flooding in and around San Marcos Creek (HDR 2007). In addition, the project would provide recreation opportunities through the provision of park space and a creekside multi-use trail. Analysis in 2007 demonstrated that the current total of local City-owned parkland was 188 acres, and that the General Plan would require 284 acres of local parkland. In sum, the City of San Marcos has an approximately parkland deficit of 196 acres (HDR 2007).

The proposal would provide additional open space with multiple benefits for residents in the project area. Additional recreation benefits that would be provided by the project are associated with non-contact water recreation activities such as picnicking, sunbathing, hiking, sightseeing, or aesthetic enjoyment. These benefits have not been quantified and/or monetized.

Distribution of Project Benefits and Identification of Beneficiaries

Table 9-8 below provides a summary of the beneficiaries anticipated to receive the various water quality and other benefits that will be provided by the *San Marcos Creek Floodway Improvement Project*. Benefits are anticipated to be realized on a local and regional basis.

Table 9-8: Project Beneficiaries Summary

Local	Regional	Statewide
Local residents	Regional residents	<i>Not applicable</i>

Project Benefits Timeline Description

This project would provide water quality and other benefits following project construction in 2014 and through the project’s 46-year lifetime (until 2060).

Potential Adverse Effects from the Project

Any potential short-term construction impacts associated with project construction will be mitigated through the environmental documentation and permitting processes. No long-term adverse effects are expected as a result of the proposed project.

Uncertainty of Benefits

Uncertainties relating to the water quality and other benefits of this project are summarized below in Table 9-9. Projected savings from operations and maintenance costs are based on current City of San Marcos estimates, and could vary. Similarly, monetized benefits associated with sediment reduction could vary from those calculated for Canyon Lake. All benefits that were not monetized could potentially have a positive impact on net benefits.

Table 9-9: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided Sedimentation Costs	+/-	The costs applied to this project were based on those for a similar but different water body. It is possible that due to specific conditions within Lake San Marcos, water quality abatement costs could vary from those presented in this attachment. However, due to the pervasive water quality impacts within Lake San Marcos, it is likely that these water quality benefits have been understated.
Reduced Maintenance Costs	+/-	The flood-related cleanup costs utilized for this proposal vary based on flood events and other local conditions. They may change over the 46-year lifetime of this project.
Habitat/Creek Restoration	+	These benefits were not monetized, so their exact benefits are not certain. It is highly likely that they would contribute positively to the benefits of this proposal.
Increased Recreation Opportunities	+	These benefits were not monetized, so their exact benefits are not certain. It is highly likely that they would contribute positively to the benefits of this proposal.

* Magnitude of effect on net benefits

+/- (negligible or unknown); + (moderate positive); ++ (significant positive); - (moderate negative); -- (significant negative)

References

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