Needs Assessment & Cost Estimate for the

Water Quality Enhancement Element

Quality of Life Funding Strategy

San Diego Region

April 2011

Prepared for:

Water Quality Working Group

Prepared by:

County of San Diego
Department of Public Works
Watershed Protection Program

With assistance from:

Weston Solutions, Inc.

Quality of Life Funding Strategy
San Diego Region

Final
Needs Assessment & Cost Estimate for the Water Quality Enhancement Element

Prepared for:
Water Quality Working Group

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LIST OF ACYRONMS & ABBREVIATIONS

§	section
B	billion
BMP	best management practice
County	County of San Diego
Framework	Water Quality Planning Framework
Funding Strategy	Quality of Life Funding Strategy
IRWM	Integrated Regional Water Management
IRWMPP	Integrated Regional Water Management Planning Process
JURMP	Jurisdictional Urban Runoff Management Program
M	million
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
Regional Board	Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
State Board	State Water Resources Control Board
SWG	Stakeholder Working Group
TMDL	total maximum daily load
WQO	water quality objective

ACKNOWLEDGEMENTS

The Water Quality Working Group acknowledges the many hours of dedication of the agency representatives, non-governmental organizations, and community members for their participation in the development of this report throughout 2009 and 2010 (Table 1). We specifically acknowledge the San Diego Association of Governments for their guidance and support of the consultant who provided facilitation of the monthly meetings, and the County of San Diego Department of Public Works, Watershed Protection Program for providing leadership and the technical consultant to the Water Quality Working Group.

Table 1

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Table 1

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EXECUTIVE SUMMARY

> *Healthy rivers, lakes, groundwater aquifers, lagoons, bays, and coastal estuaries are vital to preserving the high quality of life enjoyed in San Diego. Pristine beaches and clean, beautiful water are key focal points of the tourism industry and represent an important economic driver for the region. These waterbodies are also vital to maintaining public health, providing a local water supply, managing flood control, and preserving regional ecosystems. Funding regional projects and programs through the Water Quality Enhancement Element of the Quality of Life Funding Strategy will help preserve the San Diego experience for generations to come.* – Water Quality Working Group

This document presents the results of a regional water quality needs assessment and cost estimate, and outlines regional priorities for water quality programs and projects. This analysis is useful because, while the region has made significant progress towards achieving water quality goals over the past four decades, regulations are continuing to emerge, and it is important to address the public's concern about the needs and costs of achieving compliance.

Introduction

Early in 2009, the County of San Diego (County) Department of Public Works, Watershed Protection Program, accepted an invitation from the San Diego Association of Governments (SANDAG) to assist in developing an estimate of the funding needed for 'underfunded' water quality programs and projects. It was understood that this effort would support SANDAG's Quality of Life Funding Strategy (Funding Strategy).

The County convened a broad cross-section of stakeholders from throughout the region, and identified these participants as the Water Quality Working Group (WQWG). Their purpose was to provide input to the SANDAG Quality of Life Stakeholder Working Group (SWG) and assist in the development of a regional water quality needs assessment and priorities. The SWG in turn provided input to the Ad Hoc Steering Committee, made up of elected and appointed officials from SANDAG's Board of Directors, who ultimately advise the SANDAG Board on the Funding Strategy.

This report provides a summary of the assumptions used by the WQWG to guide their process, the approach used to establish the regional water quality goals and assess the needs to meet those goals, an estimate of the costs to achieve those goals, and their recommendations for regional priorities for water quality programs and projects.

Needs Assessment

First, the WQWG established a process to assess the remaining water quality needs in the region, which included the following:

- Define water quality goals.
- Define several approaches to achieve those goals in a pilot watershed.
- Estimate approach costs and extrapolate estimates from the pilot watershed to the region for development of a Rough-Order-Magnitude (ROM) cost estimate.

This document provides a description of the two approaches used to assess the water quality needs, as well as a discussion of the assumptions that were developed by the WQWG to support these approaches.

Cost Estimate

The analysis conducted showed that the cost per developed square mile of land to achieve water quality goals was estimated at $23.5 million (M). The total estimate of funding needed to achieve water quality goals was determined to be $24.6 billion (B) over 40 years. Based on current levels of funding, it is estimated that local government, non-government organizations, and other entities will spend approximately $6.1 B on water quality improvement activities over the next four decades. The estimated gap in water quality funding is therefore estimated at approximately $18.5 B over 40 years. The WQWG recognizes that these costs far exceed the Region's capacity to fund, but also recognize that this estimate is consistent with other regional cost estimates to achieve water quality goals developed by other regions throughout the state.

Regional Priorities

Recognizing that this large funding gap cannot be bridged with a single funding solution, this report also recommends water quality projects and programs prioritization. The Needs Assessment and Cost Estimate for the *Water Quality Enhancement Element of the Quality of Life Funding Strategy* (WQWG Report) includes preliminary recommendations regarding how to best use whatever amount of funding becomes available through the overall Funding Strategy with the intent of assuring that the largest return on investment is achieved. The WQWG determined that any funding strategy will benefit water quality provided it focuses on regional or watershed scale multi-purpose programs and projects, collaboration and efficiencies, leveraging of existing resources and selecting the most effective best management practices (BMPs) and water quality improvement projects possible. The WQWG also recognized that the Funding Strategy represents an opportunity for the region to move beyond single purpose water quality programs and projects and toward integrated solutions that enhance water quality while providing multiple community benefits (i.e., 'ancillary' benefits that augment and protect water supplies, restore habitat, and enhance community amenities).

Findings

Based on the results of their research and analysis, the WQWG made the following findings:

- **The current level of funding available for storm water quality programs in the San Diego region is inadequate to address existing and emerging water quality regulations.** Although the gap in needed funding is great and larger than any likely public appetite, the WQWG concluded significant progress can be made towards closing the gap with help from the Funding Strategy based on the analysis previously described.
- **Water quality is a regional issue, best addressed from a regional perspective.** Regional collaboration has increased in recent years, as local agencies recognize the benefit of pooling limited resources on joint programs (e.g., public outreach and storm water monitoring). Agencies envision that partnerships with other municipalities and non-government organizations will continue to grow. It is anticipated that the upcoming version of the Municipal Storm Water Permit and other water quality regulations will continue emphasis on a regional and watershed approach.

- **Large-scale, integrated, regional solutions provide a greater return on investment.** A benefit–cost analysis of these types of solutions was completed in 2006 for the *Greater Los Angeles Integrated Regional Water Management* (IRWM) *Plan* (Leadership Committee, 2006). That analysis found that regional-scale solutions (e.g., multi-purpose, long-term water quality solutions) generally had lower implementation costs per acre when compared with BMPs implemented at a smaller scale.
- **Non-compliance with regulatory requirements has potentially significant economic consequences.** Failure to achieve water quality goals can negatively impact the region's $8B tourism industry. Beach and bay closures that leave important tourist areas unusable—as well as associate a stigma of poor water quality—will immediately impact our economy and the specific quality of life we, as San Diegans, have come to expect. In addition, non-compliance will lead to potentially huge administrative fines, civil penalties, and criminal prosecution by regulators. Non-compliance can also lead to potentially expensive third-party lawsuits, while not alleviating the region from the actual costs of eventual compliance.

Summary

The results of the WQWG's efforts are presented in the following WQWG Report, as follows:

- Section 1 presents a brief description of the steps that led to the formation of the WQWG, a brief overview of the San Diego Region, and a description of the process that the WQWG defined for itself to develop the regional needs assessment and cost estimate.
- Section 2 presents the water quality goals on which the cost estimates are based and a description of how those goals were derived.
- Section 3 presents a description of the two approaches used to develop the cost estimates, including a description of the three types of BMPs used in the cost estimate and organized the "buckets" of similar BMPs, as well as the concept of the pilot watershed and the approach of extrapolating the results of the pilot watershed to a regional scale, and finally the assumptions on which the cost estimates are based.
- Section 4 presents the results of the cost estimate for the pilot watershed, results of the cost estimate when extrapolated to the region, and gap remaining between the funding needed and the existing funding currently being allocated for water quality programs.
- Section 5 includes recommendations for developing regional priorities and a ranking strategy for water quality projects and programs, discusses the value of leveraging local funding to attract additional outside funding, and presents the results of a funding options analysis that demonstrate some possible outcomes that could be achieved with various funding levels.
- Section 6 presents the conclusions of the WQWG and suggested next steps.

1.0 BACKGROUND

More and more, regions are being asked to leverage or match state and federal funds with local money or programs to help fill funding gaps. This is due to a lack of available resources at the national and state level to finance regional and local infrastructure needs. Because potential funding needs for local infrastructure are both great and varied, the San Diego Association of Governments (SANDAG) embarked on a regional dialogue to examine funding priorities and potential funding mechanisms for a Quality of Life Funding Strategy (Funding Strategy). The impetus for this discussion stemmed from both a commitment made by the SANDAG Board of Directors as part of the *TransNet* extension measure passed by the voters in November 2004, and key region-serving infrastructure areas lacking a sustainable, long-term funding source as identified in the Integrated Regional Infrastructure Strategy (IRIS), a component of the Regional Comprehensive Plan (RCP). Of the eight areas analyzed in the IRIS, habitat conservation, shoreline preservation, and water quality enhancement[a] were found to be lacking a dedicated and sustainable funding source.

In 2007, SANDAG created the Quality of Life Ad Hoc Steering Committee to begin a dialogue on regional funding priorities and mechanisms available to achieve those priorities. As a participant on the Quality of Life Ad Hoc Steering Committee, the County of San Diego (County) was asked to lead an effort to identify and address regional needs for the Water Quality Enhancement Element, one of the four areas under consideration for the Funding Strategy. The County initiated this effort by convening a group of stakeholders to provide input and direction on the formation of the Water Quality Enhancement Element. This stakeholder group, also referred to in this report as the Water Quality Working Group (WQWG), suggested that the Water Quality Enhancement Element could build upon other existing processes, such as the Integrated Regional Water Management Planning Process (IRWMPP). The IRWMPP focuses on securing long-term water supply by pursuing projects yielding multiple objectives, including water supply, water quality, and natural resource benefits. Building upon the IRWMPP, the WQWG defined guiding principles, identified overarching goals and objectives, and developed a Water Quality Planning Framework (Framework) to aid in estimating the regional water quality need.

1.1 San Diego Region

The San Diego region, presented on Figure 1-1, covers 4,086 miles^2. The western portion of the region consists of hills, mesas, and canyons that compose nine coastal watersheds draining to the Pacific Ocean. The eastern portion of the region drains to the Colorado River Basin Hydrologic Region (i.e., Region 7) and is made up of the Mountain Empire Subregion and Borrego Springs (Mills, 2009).

Major land uses across the San Diego region are classified as developed (i.e., urban or agricultural) or open space. Multiple waterbodies in each of the eleven coastal watersheds have been identified as either ‘impaired’ or ‘threatened’ by the San Diego Regional Water Quality Control Board (Regional Board). The particular causes of impairment vary with each waterbody but typically include one or more impairments, including indicator bacteria, metals (i.e., copper, lead, zinc, nickel, chromium, cadmium, manganese, and selenium), nutrients (e.g., nitrogen, phosphorus, and ammonia), and eutrophic conditions, pesticides, sediments and turbidity, and trash.

[a]Public transit was not included in the original IRIS analysis but was later added to the scope of the Quality of Life Funding Strategy by the SANDAG Board of Directors.

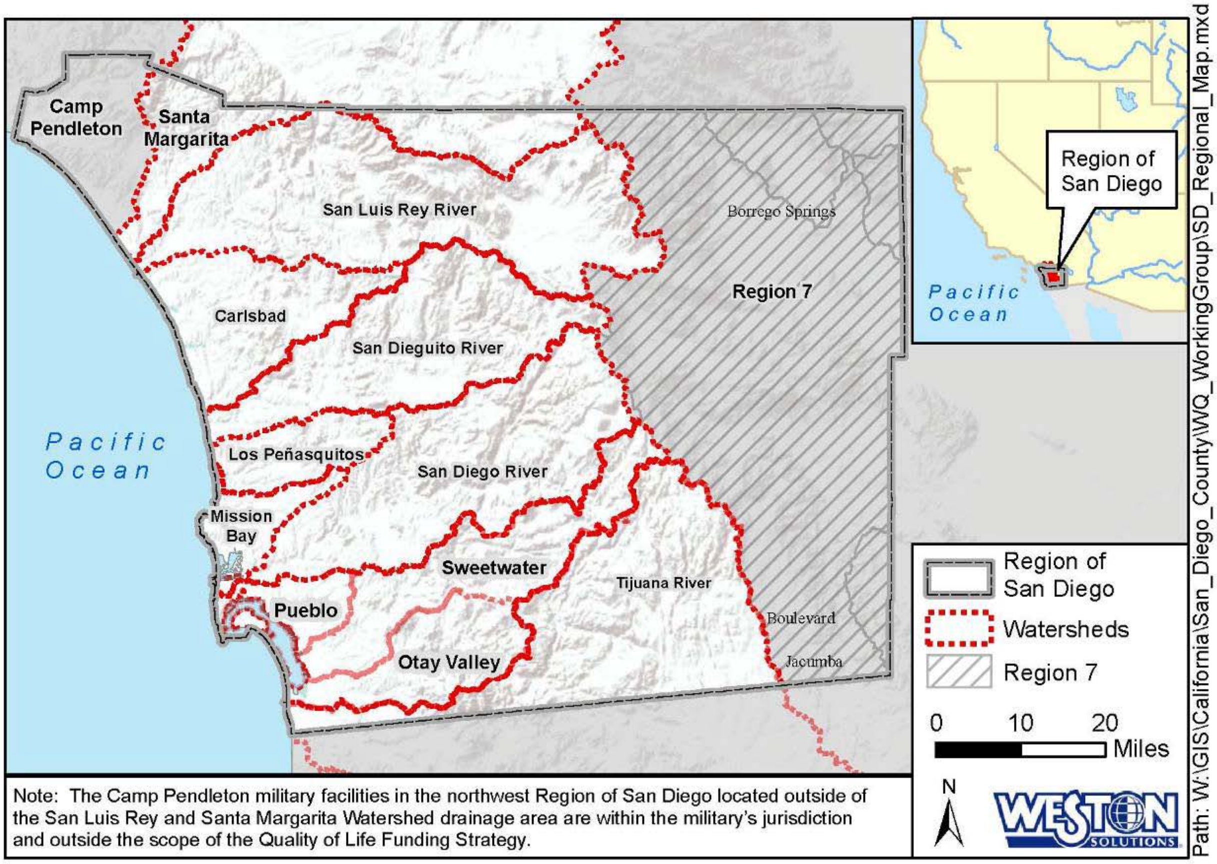

Figure 1-1 San Diego Region

Waterways in San Diego have been adapted, altered, and even rerouted to suit the needs of the region's ever-growing population. Beginning near the time of the earliest human habitation in San Diego, the pace of these changes and their impacts on our waterways has continued to accelerate.

Now, surrounded by extensive development and the daily activities of millions of residents, San Diego's waterways are being degraded by urban runoff, the aerial deposition of pollutants, and illegal dumping. The responsibility for addressing these impacts and for restoring water quality in our region falls to storm water managers in municipal agencies throughout the County.

Storm water quality management is an evolving field focused on reducing the impacts of urban runoff and other pollution on the quality of receiving waters. This work is required under the National Pollutant Discharge Elimination System (NPDES) Permit issued for San Diego Region 9. It is also required to prepare for rapidly increasing regulatory and legislative demands to dramatically improve water quality in San Diego.

Even with the dedicated funding, staff, and other resources committed by local agencies, San Diego continues to face water quality problems similar in scale to those that existed before the widespread implementation of storm water management programs.

Restoration of beneficial uses such as "fishable, swim-able, and drinkable" local waterbodies is the goal of state and federal standards. Reaching these outcomes and restoring the healthy eco-systems once supported in the region's waterways will require the implementation of carefully planned research and cost-effective best practices implemented on both a regional and watershed-wide scale. With this understanding, the WQWG worked to develop a strategic approach to the restoration of local waterbodies in the most cost-effective and beneficial manner possible.

1.2 Water Quality Working Group

In response to SANDAG's invitation to the County to develop a regional water quality needs assessment and cost estimate, a broad cross-section of stakeholders from throughout the San Diego region was convened and the WQWG was formed. The WQWG was formally established in 2009 to provide input on regional water quality to the Stakeholder Working Group (SWG). The SWG, in turn, is the advisory body to the Quality of Life Ad Hoc Steering Committee and SANDAG Board of Directors on the four elements proposed for the Funding Strategy (Figure 1-2).

Figure 1-2 Quality of Life Funding Strategy Advisory Structure

Upon its establishment, the WQWG defined its mission "to provide input on the development of a regional water quality needs assessment and cost estimate, and outline regional priorities for water quality programs and projects." The WQWG proposed a process to develop the regional needs assessment and cost estimate, which included the following:

- Develop a working definition of goals and objectives to evaluate existing water quality needs.
- Base regional costs on a conceptual 'pilot' watershed with a series of assumptions to 'scale-up' the costs across the region.
- Validate the proposed pilot approach and costs using cost estimates that have been performed throughout California over the past 15 years.

An overview of the proposed process for developing the needs assessment and cost estimate—and the implementation schedule conceptualized by the WQWG and used to develop this report—is presented on Figure 1-3.

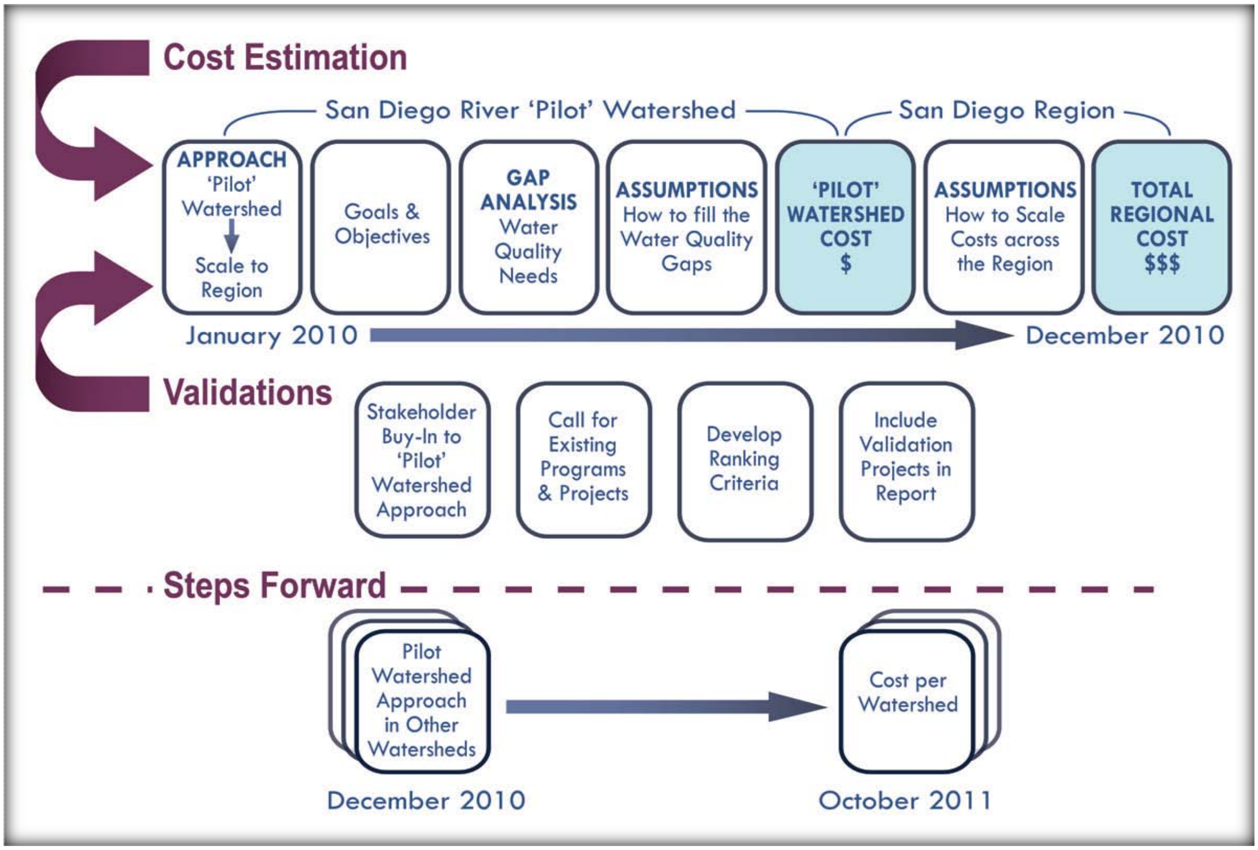

Figure 1-3 Process to Develop Water Quality Needs Assessment & Cost Estimate

In addition to this process, the WQWG developed the following principles and parameters that helped guide them through this process:

- The primary emphasis of the evaluation should be directed towards storm water quality programs, as these programs did not have any existing dedicated revenue streams.
- There is value in attempting to quantify the costs associated with achieving progress toward regional water quality goals because of an unwavering public interest in water quality both locally and nationally.
- It is important to quantify the magnitude of the solution, so decision-makers are informed regarding the scale and also understand the importance of prioritizing actions to assure the most cost-effective solutions are considered and implemented.
- Despite the distinct possibility that no public funding measure is likely to advance during these challenging economic times, the WQWG maintained it was still important to ask the question, 'What solutions should, would, or could be recommended if the funding were available to achieve water quality objectives (WQOs) in the region?'
- There is value in beginning the process of developing a comprehensive region-wide water quality management plan, because programs and projects that are part of comprehensive regional plans are much more likely to attract funding from multiple sources than stand-alone programs or projects.
- Assuming that costs would be significant, the WQWG understood that although they could rely upon other regional cost estimates developed throughout California over the past 15 years as the basis for the San Diego region, it would be important to develop recommendations for prioritizing funding as well as developing the cost estimate.

On behalf of the WQWG, the County held regular public meetings and invited agencies from across the San Diego region (i.e., agencies representing both Region 7 and Region 9)[b] to participate in the needs assessment and cost estimation process. Participation also included stakeholders representing environmental groups, non-government organizations, regulatory agencies, water districts, farming communities, developers, and the region at large. Public meetings were held monthly, generally on the third Tuesday of each month. Minutes and other reports from the monthly meetings are available on the Project Clean Water website (PCW, 2010).

A representative from Region 7, Borrego Water District staff, attended the fourth WQWG meeting, held on April 20, 2010. It was later determined that the Funding Strategy provides a funding opportunity to manage the unique water quality issues in the eastern drainage (i.e., flash floods and groundwater management), but the representative elected not to participate further in the process. At the time of publication, no other Region 7 agencies attended WQWG meetings, nor have these agencies provided input on the report. Therefore, this report focuses on projecting the cost and need for storm water and urban runoff management projects/programs in the Region 9 coastal watersheds draining to the Pacific Ocean. A cost estimate for Region 7 has also been provided of reference.

1.3 Existing Regional Water Management Planning Processes

As the WQWG considered their process for developing a regional needs assessment and cost estimate, they recognized that it would be beneficial to gather data on existing and proposed water quality programs and projects throughout the region. Because there were already local efforts underway to develop this information, the WQWG committed to leveraging, rather than duplicating, these efforts. Other plans and efforts include local Watershed Management Plans (WMPs), Watershed Urban Runoff Management Programs (WURMPs), other work completed by Regional Work Groups and Watershed Councils, and the Integrated Reginal Water Management Planning Process (IRWMPP). Existing watershed efforts were extremely useful in providing examples of programs and projects as a foundation for existing efforts to meet compliance in the region, including implementation and maintenance costs. The IRWMPP was useful because it recognizes the interconnectivity of water supplies and the environment, and it promotes programs and projects yielding multiple benefits. The IRWMPP also outlined a process for evaluating and prioritizing projects, which was reviewed and modified by the WQWG for future use as a potential ranking and selection strategy. A preliminary set of recommendations for water quality project prioritization was developed for the potential implementation of a SANDAG regional funding strategy and is provided in Section 5.0.

While there are existing regional planning processes and mechanisms to fund regional water quality programs, the WQWG concluded that these funding measures are insufficient to meet future local needs. There is a continual need for additional funding to support existing efforts (e.g., education and outreach programs, monitoring and data collection, and strategic planning efforts), operation and maintenance (O&M) of existing best management practices (BMPs), and funding of future non-structural and structural BMPs to achieve regional regulatory requirements. The Funding Strategy is the first step in creating a local funding mechanism to support program and project implementation.

[b]There are two branches of the California Regional Board with responsibility over San Diego, Region 9 (San Diego), and Region 7 (Colorado River).

2.0 REGIONAL WATER QUALITY GOALS

Storm water and urban runoff management is a regulatory requirement. Since the adoption of California's historic Porter Cologne Water Quality Act, the San Diego region has rapidly mobilized to bring regional waterbodies into compliance with the Clean Water Act. Although great efforts have been made over the last four decades, the WQWG recognizes that water quality is a timely, important issue and much more work is needed to reach water quality goals.

Clean water is also acknowledged as a community priority. Residents and visitors to San Diego value the region's beaches and recreational waters. Over the past few years, several public opinion polls have been conducted that identify important regional issues. In April 2009, a poll conducted by the Nature Conservancy demonstrated that water quality is an important issue to San Diegans (Nature Conservancy, 2009).

PUBLIC SURVEY
Priority Regional Issues

48%	Water Quality
16%	Public Transit
13%	Habitat Protection
23%	NONE of the Quality of Life Elements

Source: Nature Conservancy, 2009.

In spite of strong public support, regional water quality programs targeted at storm water and urban runoff management remain underfunded. Typically, agencies fund these programs using a variety of sources, primarily through the General Fund, but also by state and federal grants, fees, tariffs, bonds, and/or facility charges. Depending on the source, funding is either limited to specific programs and projects, or water quality programs are placed in direct competition with public services.[c] As a result, water quality programs are generally limited to NPDES Permit compliance activities (e.g., education, enforcement, monitoring, and two watershed activities per watershed each year). Therefore, although the majority of impacts caused by domestic and industrial wastewater discharges have been eliminated through the NPDES Permit and treatment projects, storm water and urban runoff continue to be a leading cause of waterbody impairment (Wright et al., 2006).

2.1 Water Quality Planning Framework

As a part of the WQWG's mission to assess the needs and estimate the costs of achieving regulatory requirements in the San Diego region, the WQWG initially agreed it needed to establish a working definition of 'water quality.' This process led to the development of the Water Quality Planning Framework (Framework). The purpose of the Framework was to establish guidelines to help the WQWG focus ongoing dialogue on regional water quality, and achieve its mission. The Framework was developed based on the Regional Board's *Water Quality Control Plan for the San Diego Basin* (Basin Plan) (Regional Board, 1994) and State Water Resources Control Board's (State Board's) *Water Quality Control Plan for Ocean Waters of California* (Ocean Plan) (State Board, 2001) and is intended to ensure this final product addressed the needs of the Funding Strategy. It outlines the guiding principles, long-term goals, objectives, evaluation criteria, and overall planning process used to develop this report. The Framework is a living document that was refined as the cost estimate took shape, and is provided in Attachment A.

The primary goal and objectives defined by the WQWG in the Framework are

[c]Fire and wildfire management, law enforcement, library services, land development planning, and engineering services are a few of the major public services that may be in direct competition with water quality programs.

highlighted below. As reflected in Objective 3, the WQWG recognizes that the Funding Strategy represents an opportunity for the region to move beyond single-purpose water quality programs and projects towards integrated solutions that enhance water quality and provide multiple benefits (i.e., 'ancillary' benefits that augment and protect water supplies, restore habitat, and enhance community amenities). By emphasizing local water quality, integrated solutions, and ancillary benefits, this report builds upon existing IRWM efforts in San Diego. Many of the programs and projects used to validate the cost estimates were obtained from the 162 projects submitted for funding through Proposition 50.

Water Quality Planning Framework

Element Goal

Protect and restore the beneficial uses of local waterbodies, watersheds, and aquifers from polluted runoff.

Water Quality Working Group Objectives

1. Support the implementation of watershed-based programs and projects that achieve cost-effective solutions for established WQO.
2. Support jurisdictional water quality programs and projects.
3. Support (cost-justified) projects with Ancillary Benefits that are complementary to and synergistic with other Elements of the Quality of Life Funding Strategy.

2.2 Defining the 'Gap' in Water Quality

The Clean Water Act is designed to protect and restore beneficial uses of local waterbodies. Beneficial uses are defined as the uses of water necessary for the survival or well being of man, plants and wildlife. These uses of water serve to promote the tangible and intangible economic, social and environmental goals of mankind (Basin Plan). Varying regulatory requirements have been established to preserve a range of beneficial uses (i.e., habitat protection, recreational swimming, and boating and navigation), and quality is evaluated by comparing monitoring data with the regulatory requirements defined in the Basin Plan and Ocean Plan (i.e., WQOs). While a quantitative assessment of each individual pollutant of concern or water quality indicator is beyond the scope of this study, it is useful to consider the following general discussion on the Clean Water Act. The purpose of this discussion is to demonstrate that a noteworthy gap remains between the existing and the desired quality of our region's waterbodies. The needs assessment began to identify the magnitude of the gap between the current state of regional water quality and desired water quality.

Section (§)303(d) of the Clean Water Act defines the requirements for identifying streams, rivers, lakes, lagoons, bays, and other waterbodies as 'impaired' or 'threatened' due to pollutant concentrations greater than pollutant-specific WQOs. These waterbodies are included on the §303(d) List and are eligible for regulatory enforcement. Historical monitoring data indicate that 157 waterbodies are impaired due to high pollutant concentrations and have therefore been included on the San Diego Regional

Water Quality Control Board's (Regional Board) 2008 §303(d) List (Regional Board, 2009). There are a total of 1,570 different combinations of waterbodies and pollutants on the 2008 State Board §303(d) List, which is noteworthy because each waterbody/pollutant combination may be subject to a separate enforcement action.[d] As illustrated in Figure 2-1, impaired waterbodies appear in the coastal watersheds of Region 9.[e] While the proximity of impaired waterbodies to the Pacific coastline gives the impression that water quality is a coastal, urban problem, watershed management recognizes that pollution from any development within a watershed contributes to impairment. The municipal separate storm sewer system (MS4) and smaller tributaries transport bacteria, nutrients, and sediments from upstream land uses to the Pacific Ocean, where monitoring activities identify poor water quality due to an accumulation of these pollutants. Potential sources of pollution from urban development, agriculture, and rural development are illustrated in . Given the broad geographic span and diversity of pollutant sources, an integrated, watershed-specific approach must be used to successfully enhance regional water quality. When the desired level of quality is proven, the Regional Board will remove a waterbody from the State Board §303(d) List. Therefore, as regional water quality improves, it is expected that monitoring data will identify fewer pollutants, and fewer waterbodies will be classified as 'impaired' or 'threatened' (i.e., the red presented on Figure 2-1will fade to blue).

Using the State Board §303(d) List as the criterion to evaluate water quality, the WQWG strives to ensure that the high quality of life enjoyed by residents and visitors to San Diego (e.g., recreational waters, fishing, boating, and native fauna and flora) are available both now and in the future. Since issuance of the first NPDES Permit for storm water in 1990, a great deal of data has been collected to advance this goal. By understanding the interaction between urban runoff, storm water runoff, and the environment, land use and development professionals are able to quantify and predict impacts of various levels of development on water resources, and therefore strategically design and implement solutions. Significant budget restrictions have generally limited water quality programs to regulatory compliance activities designed to protect existing quality (i.e., prevent degradation). Additional funding through project-specific grants and other small revenue sources have provided opportunity to innovate new solutions to enhance water quality based on watershed need, lessons learned and emerging technologies. Over the next 40 years, the region will continue to find more efficient and effective means to enhance water quality and advance towards the WQOs.

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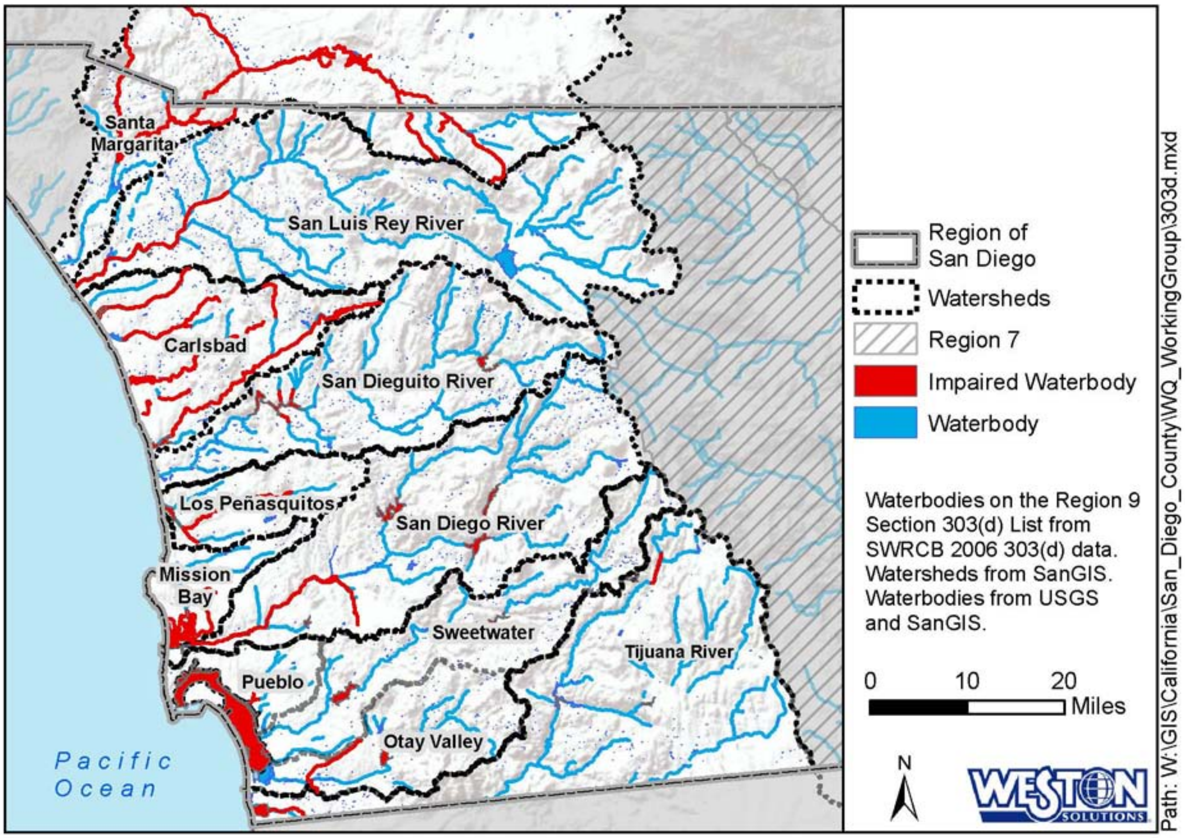
[d]If the impairment is not remedied, enforcement actions may range from a Notice of Violation to fines and other civil penalties. If no action is taken, the Regional Board or third-party groups may initiate a law suit based on environmental grounds, as happened in the La Jolla Cove (Coastal Law Group, 2010). The potential economic impact of non-compliance is discussed in greater detail in Section 0.
[e]GIS data are not available for the 2008 Regional Board §303(d) List or the 2010 State Board §303(d) List, but based on a comparison of the lists, the number of red versus unimpaired 'blue' waterbodies increase, especially in the San Luis Rey, San Dieguito, Sweetwater, and Tijuana watersheds (State Board, 2010).



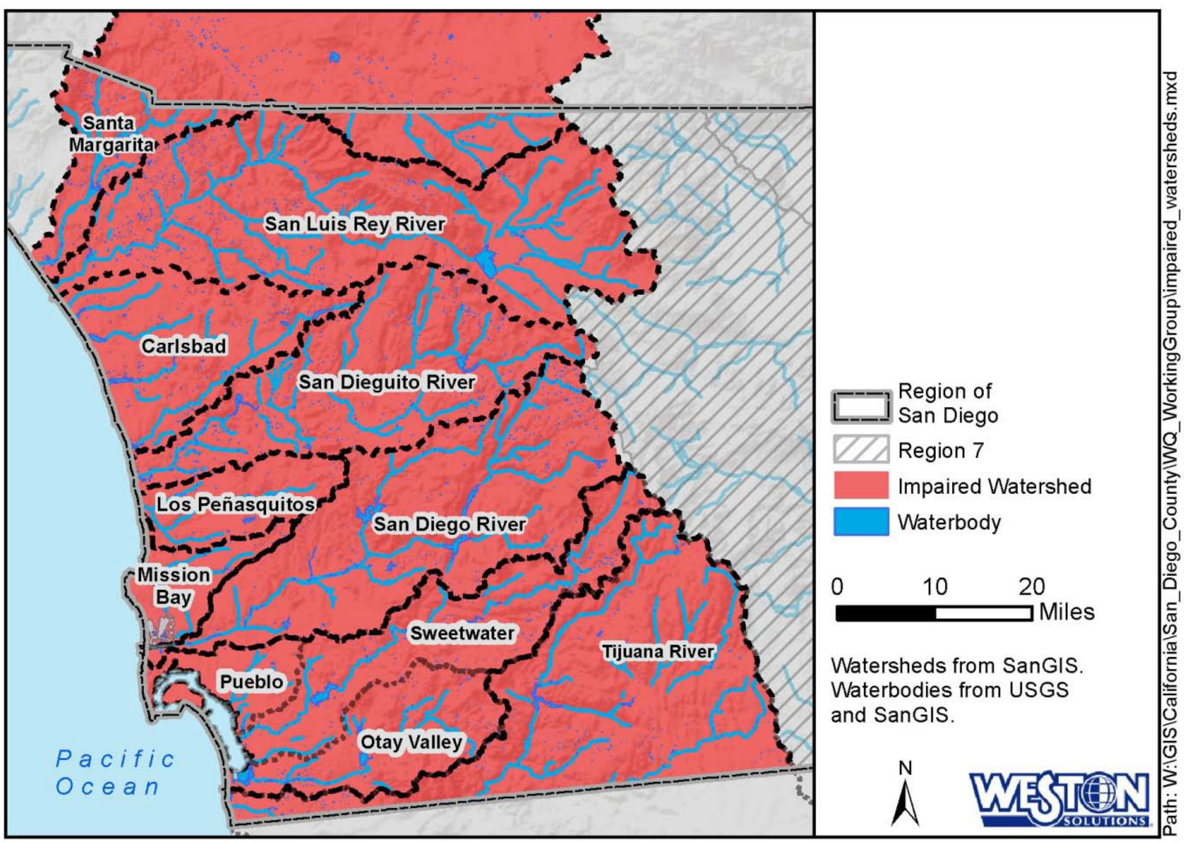


Figure 2-1 Impaired or Threatened Waterbodies & Watersheds in San Diego

Figure 2-2 Potential Sources of Pollutants across the San Diego Region

2.3 Targeted Pollutants

To identify the key water quality issues for each watershed and therefore tailor appropriate water quality solutions, a review of existing data and regulatory drivers was conducted for the San Diego region (Attachment B). The analysis identified bacteria, sediments, and dissolved minerals as three major and ubiquitous pollutants of concern across all watersheds. In addition, a large portion of the San Diego region recently received orders from the Regional Board, and a Total Maximum Daily Load (TMDL) was adopted for wet and dry weather bacteria concentrations in February of 2010. The bacteria TMDL provided a framework from which the validation process described in section 4.2, Pilot Watershed Cost Estimate Validation, was derived.

A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality objectives. According to the Clean Water Act, each state must develop TMDLs for all the waters on the 303(d) list. Ultimately, a TMDL is a plan that describes how water quality objectives will be met, and water quality brought back into compliance within a specified period of time, typically as little as 10 years. This short window, coupled with the significant concentration reductions necessary to achieve compliance (i.e., several orders of magnitude), identified bacteria the primary pollutant of concern.

Bacteria must be addressed using a combination of non-structural and structural solutions. Fortunately, the infiltration and treatment type BMPs necessary to address bacteria generally address other regional pollutants, as well. Selecting bacteria as the primary targeted pollutant ensures that the selected BMPs have adequate treatment capability to treat multiple pollutants of concern and therefore meet the WQOs and the WQWG objectives without creating redundancies.

3.0 PROCESS FOR DEVELOPING COST ESTIMATE

Attaining the water quality goals outlined in Section 2.0 will require significant regional investment in water quality management programs and infrastructure over the long term. This section describes the methodology used to estimate the costs of achieving these goals.

Attainment of beneficial uses in local waterbodies and aquifers is typically interpreted by comparing local watershed data to the WQOs established in the Basin Plan and Ocean Plan. As such, the cost estimation process described below is based on local water quality data and watershed criteria (e.g., acreage, land use, and channelized riverbed length) to project requirements to attain the WQOs.

Because water quality pollutants, sources of pollution, land uses, and BMPs within each watershed are comparable, it was determined that a detailed analysis for a smaller geographic area could be scaled to a regional level. By using a "pilot watershed" approach, methods to achieve water quality across the region could be estimated. The pilot watershed approach was also used to simplify the cost estimation process (Figure 3-1).

The WQWG chose the San Diego River Watershed as its representative watershed for this pilot approach for several reasons, including amount of available data collected and amount of developed land use within the watershed.

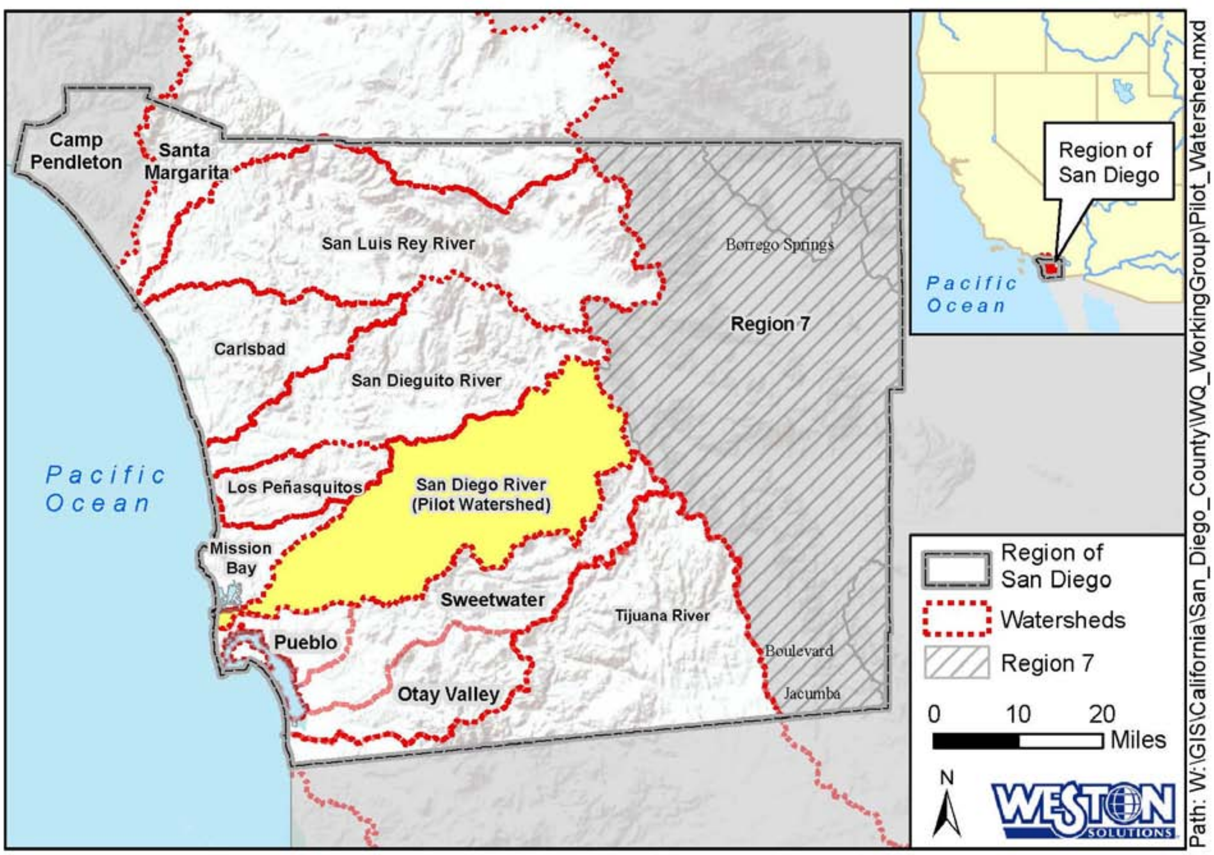


Figure 3-1 Regional Cost Estimates Scaled Based on Assumptions Used for the San Diego River Pilot Watershed

An iterative process was used to estimate regional costs (Figure 3-2). Initial cost assumptions were based on a unit price list established in a separate report by the City of San Diego for existing and proposed BMPs (both non-structural and structural)and used to create a preliminary cost estimate for the pilot watershed (City of San Diego, 2009). These assumptions were validated using actual storm water program costs and project costs from BMPs throughout the region and state. Stakeholders compiled information regarding actual implementation costs, operation and maintenance (O&M) costs, and tributary drainage areas for completed and planned water quality enhancement projects in Southern California.

After the initial assumptions and BMP costs were refined, the pilot watershed cost estimate was scaled across the San Diego region. (Subection 3.2, Scaling Process, provides a detailed discussion of scaling process and watershed classes.) First, the pilot watershed results were scaled to three representative watershed- classes (i.e., Pueblo Watershed, San Luis Rey Watershed, and Tijuana Watershed, further described in Subsection 3.3) selected based on land use. The scaling process involved adjusting the quantity of the different types of BMPs to address watershed-specific land uses, pollutants of concern, stream length, and total acreage.

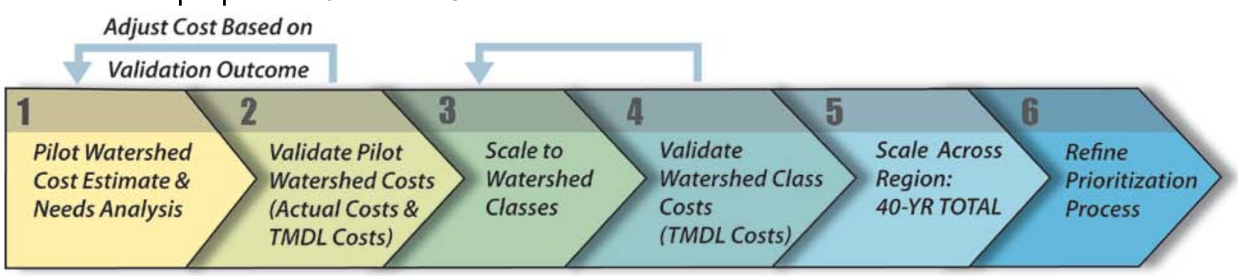


Figure 3-2 Iterative Process to Develop the Regional Cost Estimate

The order-of-magnitude cost for each of these four watershed 'classes' (i.e., San Diego River Class, Pueblo Class, San Luis Rey Class, and Tijuana Class) was validated by comparing the costs to TMDL implementation planning reports and cost estimates completed for watersheds in Southern California over the past decade. If the cost did not align with historic TMDL cost estimates, this first scaling calculation was refined. Once the watershed class cost estimates were finalized, the second scaling calculation was completed. A normalized cost value was determined for each watershed class (i.e., millions (M) of dollars per developed square mile). This normalized cost was extrapolated to the remaining watersheds in the region based on the land-use-specific watershed classes and total acreage in the watershed.

The following subsections detail the two approaches used to produce the preliminary cost estimate for the pilot watershed.

3.1 Cost Estimate Approaches

Two types of cost estimates were evaluated in the pilot watershed process, a Full Structural Approach that emphasized structural treatment projects and an Integrated Approach that emphasized non-structural programs, restoration projects, and a reduced structural program. The most cost-effective alternative was then scaled region-wide.

3.1.1 Full Structural Approach

The Full Structural Approach assumed an infrastructure-intensive strategy for attaining beneficial uses. It assumed that necessary pollutant load reductions will occur through the treatment of storm water and urban runoff. The BMP selection method under this approach addressed runoff from 100% of the developed areas in the pilot watershed, an area measuring 89,633 acres. Monitoring, education, enforcement, and other non-structural source control activities were assumed to be limited to basic regulatory requirements and were not assumed to result in any demonstrable water quality enhancement. Permit-required source control programs, such as street sweeping and storm drain infrastructure cleaning, were assumed to maintain existing water quality (i.e., prevent degradation). Therefore, using a conservative assumption, these activities were not credited with a load reduction benefit, whereas enhanced programs were credited with load reductions based upon the results of pilot studies.

3.1.2 Integrated Approach

Since the implementation cost of a Full Structural Approach is likely to be higher than any reasonable funding source, an alternative 'integrated' approach was used to estimate costs. Through the Integrated Approach, non-structural BMP programs were assumed to be effective in enhancing water quality. It was assumed that these types of aggressive programs could result in pollutant reductions of up to 40%.[f] Moreover, it assumed that alternative approaches to runoff management, such as pollutant source identification, delisting evaluations, and research to ban toxic products (i.e., synthetic pyrethroids and copper found in brake pads) could reduce regional pollutant loads by an additional 15% (USACE and USEPA, 2006). The Integrated Approach assumes that structural BMPs would only be required to address the remaining 45% of pollution (Table 3-1). This assumption represents the key difference between the two cost estimation approaches. The Full Structural Approach emphasizes structural BMPs. In contrast, the Integrated Approach enhances non-structural BMPs and reduces the need for structural, restoration, and treatment BMPs.

The Integrated Approach allows watershed stakeholders to implement BMPs strategically. Water quality assessments and BMP efficiency/effectiveness evaluations have been incorporated into the short-term and long-term watershed planning process. This enables stakeholders to properly evaluate the problem, develop targeted solutions in the form of structural retrofits or programs, and then if subsequent evaluations identify additional need, aggressive treatment and restoration projects may be designed and implemented. Based on emerging new technologies, innovative solutions, or changes in water quality regulations, new programs and projects may be planned, implemented, assessed, modified, and then re-implemented, iteratively. The 'best' programs and projects can be implemented for each watershed over the 40-year implementation period.

3.2 Cost Estimation Assumptions

A series of fundamental assumptions regarding sources of pollutants, evaluating progress towards the WQOs, and BMP implementation costs were necessary for the WQWG to develop a regional cost estimate. The key assumptions are defined in Table 3-2. Additional assumptions and processes used to develop the cost calculators for the pilot watershed are described in Attachment C.

[f] The *Chollas Creek Dissolved Metals TMDL Implementation Plan* (Weston, 2009) determined that the effectiveness of individual non-structural source control and runoff reduction measures could achieve 30–70% pollutant reductions. Pollutant reduction values were based on published data presented in the BMP Database (USACE and USEPA, 2006), other technical publications, and best professional judgment. It was assumed that integrated programs (e.g., proposed in Bucket No. 1 of the Integrated Approach) would achieve greater pollutant reductions.

Table 3-1 Land-Area Treatment Assumptions Applied to Each Bucket

Bucket	Full Structural Approach	Integrated Approach	
Bucket No. 1	0% WQO	55% WQO	
Bucket No. 2	65% WQO	45% WQO	65% WQO
Bucket No. 3	35% WQO		35% WQO
TOTAL	**100% WQO**	**100% WQO**	

Table 3-2 Assumptions Underlying the 40-Year Regional Cost Estimate

Category	Assumption	Justification
Drainage Area	San Diego Region – emphasis on the coastal Region 9 watersheds	The Funding Strategy will provide funding opportunities for agencies within the San Diego region (i.e., both Region 7 and Region 9). Due to minimal participation from San Diego agencies in Region 7, a representative watershed class could not be developed for the mountain/desert areas. Based on best professional judgment, this report assumed that the San Luis Rey Class best represents this area.
Source of Pollution*	Developed land uses (i.e., existing urban and agricultural land uses)	Impacts to watersheds from urbanization are primarily attributed to impervious cover and development. Different suites of BMPs are needed to address urban and agricultural land uses, therefore developed land uses were separated into these two broad categories. It is assumed that by treating the developed land area, there will be a direct pollutant reduction. Open spaces (i.e., open space / parks and recreation, vacant/undeveloped land, and water) that represent natural background are assumed not to contribute to pollution. It was also assumed that existing regulations for new development and significant redevelopment will address pollutants generated by future development. But, this assumption would not preclude new development projects from applying for funds through the Funding Strategy.
Primary Targeted Pollutant	Indicator bacteria	A preliminary analysis indicated that BMPs with close to 100% pollutant reduction efficiency are needed to achieve the bacteria WQOs in the pilot watershed, whereas other pollutants (e.g., sediments, pesticides, metals, minerals) require BMPs with 65–80% removal efficiencies. Priority was given to BMPs addressing bacteria and other pollutants.
Agency Size	Small, medium, or large	Costs for programs and certain non-structural BMPs were scaled according to the size of each agency. Agency size was determined using a combination of jurisdictional area (i.e., square miles), population per square mile, and fiscal year (FY) 2008/2009 budgets dedicated to water quality enhancement and storm water. Generally, small agencies had dedicated storm water budgets of less than \$1M and jurisdiction of 10 miles^2 or less. Large agencies had budgets greater than or equal to \$30M and jurisdiction of more than 300 miles^2. Agencies falling between these classifications were considered medium sized.
Cost Period	40 years	Project costs included an annual maintenance cost over 40 years. Assumed costs were validated using actual project data from San Diego and Southern California.

*Source: SANGIS, 2009.

3.3 Scaling Process

For purposes of estimating costs, the WQWG established the assumption that only urban and agricultural land uses contribute to pollution in storm water and urban runoff. Based on this assumption, land use data for each watershed were evaluated by comparing the developed land area and the ratio of agricultural to urban land uses. This analysis identified four classes, each made up of watersheds with similar land uses, water quality issues, and BMP needs. Watershed classes developed for the regional cost estimate are summarized in Table 3-3 and presented on Figure 3-3.

The San Diego River Pilot Watershed and two other watersheds within the San Diego Class represent mixed urban development and open spaces. The Pueblo Class represents the nearly built-out urbanized land uses, and the San Luis Rey Class represents rural agriculture land uses. The large percentage of open space and rural agricultural land uses found in Region 7 fit most closely with the San Luis Rey Class. The Tijuana Watershed did not match any of these descriptions and therefore underwent separate analysis.

Once the final suite of BMPs was completed for the pilot watershed cost calculator, BMPs were scaled for the three remaining watershed classes based on the dominant land uses (i.e., a higher urban to undeveloped land use ratio would translate to a greater number of BMPs suited for urban environments). The final costs for each class were extrapolated to the remaining watershed within each class based on the amount of developed area within each watershed.

Table 3-3 Watershed Classes & Dominant Land Uses

Class	Land Use	Implication	Watershed
San Diego	**32% Developed:** ▪ *31% Urban* ▪ *2% Agriculture*	Opportunities for a full range of BMPs.	San Diego River Otay Valley Sweetwater
Pueblo	**90% Developed:** ▪ *90% Urban* ▪ *0% Agriculture*	Limited space for structural BMPs.	Pueblo Mission Bay Carlsbad Los Peñasquitos
San Luis Rey	**37% Developed:** ▪ *14% Agriculture* ▪ *23% Urban*	Additional need for erosion control and agricultural BMPs.	San Luis Rey San Dieguito River Santa Margarita
	3.4% Developed: ▪ *2.4% Agriculture* ▪ *1.0% Urban*	Need for flood control and groundwater management.	Region 7
Tijuana	**15% Developed:** ▪ *13% Urban* ▪ *3% Agriculture*	Opportunities for a full range of BMPs. *(trash management)*	Tijuana River

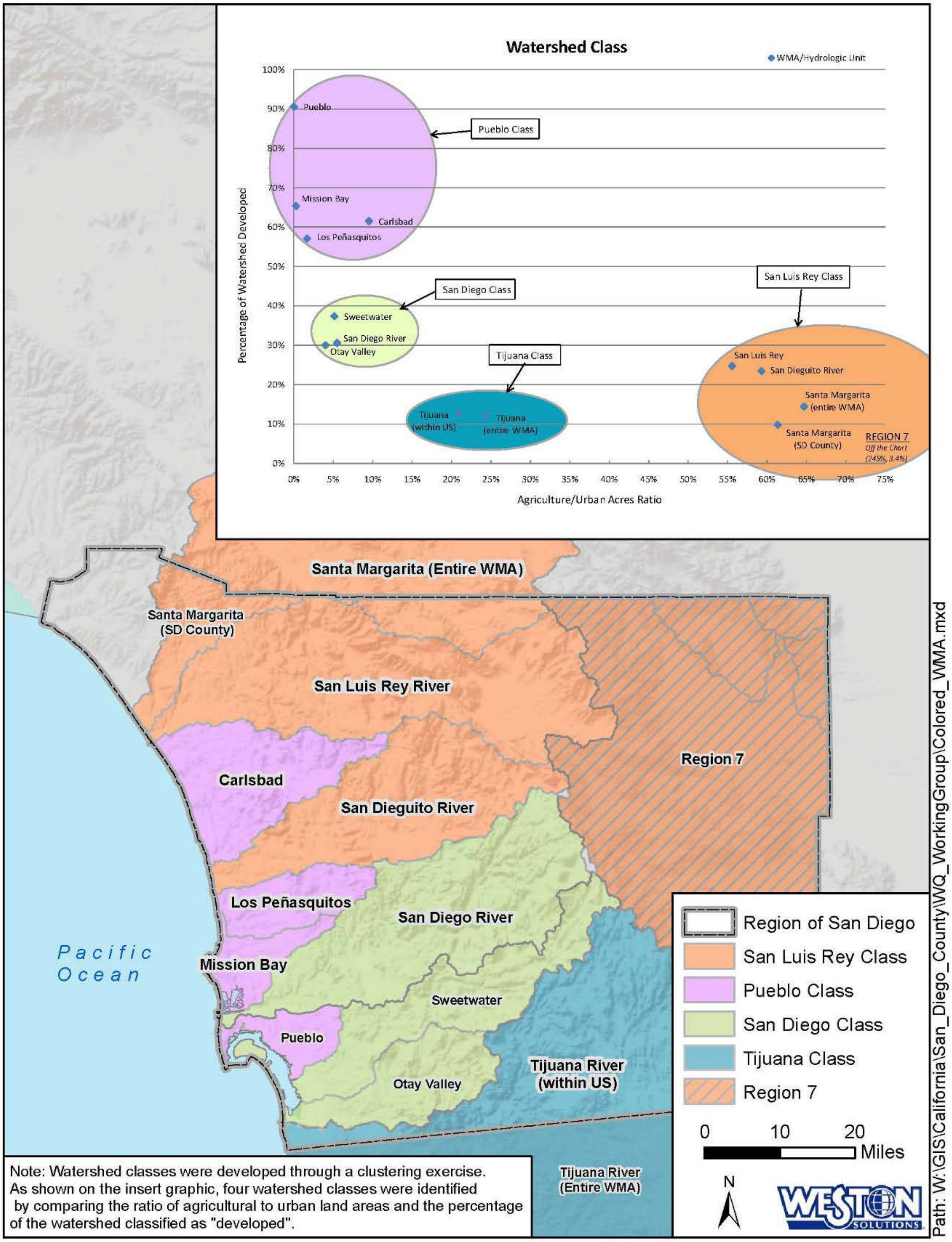


Figure 3-3 Watershed Classes Used to Scaling Implementation Costs across San Diego

3.4 Best Management Practices Classification Strategy

To provide a consistent frame of reference for selecting projects used to develop the pilot watershed cost estimates and the subsequent scaled cost estimates, BMPs were classified into three general types, or 'buckets.' The buckets were used to develop a strategy for effective, efficient, long-term BMP implementation and were assumed to function together through the tiering process depicted in Figure 3-4.

First, the non-structural BMPs representing Bucket No. 1 study, control, and prevent pollutants from entering the urban runoff and storm water, thus improving water quality and reducing the need for structural, restoration, and treatment BMPs. Similarly, Bucket No. 2 programs and projects would independently enhance water quality and integrate with larger Bucket No. 3 treatment and restoration projects.

Together, the three buckets would provide a suite of BMPs that would effectively enhance runoff and receiving water quality. The strategy was adopted from a local TMDL Implementation Plan, and is intended to provide flexibility for BMP selection, and the opportunity for adaptive management practices to be implemented with a hierarchical approach.

The bucket BMP classification strategy also served as a key organizational tool for the cost estimate 'calculators.' Separate cost-calculators were developed for each of the three buckets and were used to evaluate watershed needs, address targeted land uses and pollutants, and compare cost estimates. First, by developing a "quantity value" which indicated the number of BMPs that would be implement in a watershed over a 40-year period. And second, by developing a "BMP type" calculation representing the amount of land that would be treated by a specific type of BMP. The cost calculators were used for both the Full Structural and Integrated Approaches, and developed in this manner so the two approaches could be compared side-by-side.

Figure 3-4 Bucket Strategy for Classifying Best Management Practices

Bucket No. 1 – Permit Required & Non-Structural Best Management Practices

Bucket No. 1 includes NPDES-Permit-required education, monitoring, and enforcement programs and annual watershed activities. In addition to regulatory compliance, Bucket No. 1 would also provide funding for progressive non-structural BMPs, such as enhanced education programs, legislative controls, targeted enforcement, and special studies. Special studies would consist of monitoring and research activities used to fill gaps in watershed knowledge, pursue TMDL re-openers and State Board §303(d) delisting, and provide research to ban toxic products (e.g., Brake Pad Partnership supporting Senate Bill 346). Bucket 1 BMPs provide for special studies to best identify where BMPs should be placed, as well as keeping pollutants from entering the environment in the first place, reducing the need for treatment and restoration.

Bucket No. 2 – Structural Best Management Practices

Bucket 2 consists of low-cost to medium-cost BMPs providing a physical intervention to achieve an improvement in water quality or runoff volume. These BMPs include runoff reduction systems (e.g., low-flow irrigation systems and rain barrels), catch basin inserts, aggressive street sweeping, detention basins, erosion controls, agricultural BMPs, and low-impact development (LID) projects. Bucket 2 BMPs would be implemented iteratively, after analysis from Bucket 1 was completed and would serve to reduce runoff, and treat constituents of concern on a smaller scale.

Bucket No. 3 – Restoration & Treatment Best Management Practices

Bucket No. 3 consists of more costly, infrastructure or labor-intensive structural BMPs, focusing on the treatment and restoration of watersheds. These activities can include integrated stream habitat restoration, treatment devices (e.g., ultraviolet treatment), receiving water diversions, and sustainable approaches (e.g., large-scale multi-pollutant treatment trains, natural treatment systems, and sustainable canyons / open space projects).

Each of the cost estimate approaches – the Full Structural and the Integrated Approaches – used the buckets classification strategy to select example BMPs and determine representative costs associated with each type of approach further detailed in Section 4.0.

Example Projects

This section presents a few examples of programs and projects that fall within the scope of Water Quality Enhancement Element. These one-page descriptions summarize the implementation cost associated with targeting priority pollutants and achieving ancillary benefits to water quality.

River Clean-Up Campaign

The San Diego River Park Foundation River Clean-Up Campaign Clean Team and Green Team lead volunteers in bi-monthly greening and clean-up efforts along San Diego River.

Volunteers remove trash and debris from the river and restore habitat, which helps improve water quality (Figure 3-5). The River Clean-Up Campaign engages communities around San Diego River by providing an entry point for stewardship and service. As part of the program, educational resources for reducing storm water pollution and litter are on hand and available for participants to take home after each event.

Twenty-three events occurred during FY 2009–2010. The San Diego River Park Foundation Clean Team and Green Team organize events annually.

Figure 3-5 Alvarado Clean Up Project Before (left) and After (right) Clean Up

BUCKET NO. 1 – EDUCATION & BUCKET NO. 2 – CLEAN-UP

Cost	$100K per year
Stakeholder	San Diego River Park Foundation
Watershed/Location	San Diego River
Targeted Pollutants	Trash & debris

Forester Creek Restoration Project

The Forester Creek Restoration Project removed 400 ft of existing concrete channel along Forester Creek, a tributary to the San Diego River, and widened the channel to accommodate the 100-year flood event flows. Trash and invasive species were removed to provide water quality enhancement, flood control, and habitat restoration (Figure 3-6). A trash collector was installed at the beginning of the restored and unlined section of Forester Creek (i.e., the jurisdictional boundary between the City of Santee and City of El Cajon) to remove refuse before it entered the creek. The banks of creek were planted with coastal sage scrub and southern willow scrub. These native plants have attracted a variety of bird life, including gnat-catchers, terns, and cliff swallows. In addition to water quality enhancement and channel restoration, the project benefited the community through the construction of pedestrian and bicycle paths, and a small linear park with picnic tables and native plants and trees (e.g., sycamores, coastal live oaks, and toyans). A baseline water-quality survey of the project has been conducted. The baseline data indicated low levels of dissolved oxygen and high levels of phosphorus and fecal coliforms from sewage, homeless encampments, and wildlife. This project was designed to address these water quality issues. As native plants oxygenate the water and slower flows decrease turbidity, pollutants (e.g., hydrocarbons, metals, nutrients, and fecal coliforms) should be removed from the water through natural biological treatment in the wetland. Trash should be removed via the trash collector. Water quality and various biological indicators will be closely monitored for five years following project completion. This project won the 2002 Association of Environmental Professionals awards for Outstanding Environmental Solution and 2003 Outstanding Environmental Analysis Report.

Figure 3-6 Forester Creek before Restoration (left) and after Restoration (right)

BUCKET NO. 3 – RESTORATION

Cost	$36M total ($10M creek restoration)
Stakeholder	City of Santee
Watershed	San Diego River
Location	El Monte Valley (540 acres of drainage; 1.2 miles of creek)
Targeted Pollutants	Bacteria, dissolved oxygen, nutrients, & trash

Cottonwood Creek Park Project

Cottonwood Creek Park was built on an empty parcel of land in downtown Encinitas. Cottonwood Creek was formerly located in a 96-inch pipe underneath the property. In an effort to improve the water quality, the City of Encinitas resurfaced the creek and built an 8-acre passive recreation park. The creek emerges from underneath Encinitas Boulevard and first flows into a sedimentation pond. This pond allows for impurities in the water to settle into the mud. Once the water leaves the pond, it flows 650 ft over boulders through willows, cottonwoods, sycamores, and other native Californian rushes. This process aerates and treats the water. Water quality has been screened at Moonlight Beach, which the creek flows into, since 2002, and a distinctive improvement was shown after the park had been completed in 2004 and water started flowing through the resurfaced creek. The park provides a facility for community recreation, including playing fields, walking path, and picnic areas (Figure 3-7).

Figure 3-7 Cottonwood Creek Park Project

BUCKET NO. 2 – SEDIMENTATION BASIN & BUCKET NO. 3 – RESTORATION

Cost	$6.4M
Stakeholder	City of Encinitas
Watershed	Carlsbad
Location	Encinitas
Targeted Pollutants	Bacteria & sediments

Memorial Park Infiltration Basin

In 2010, a storage and infiltration basin is being installed beneath the grassy area of Memorial Park. Runoff from the parking on the west side of Memorial Park will be diverted from the existing storm drain system to the new infiltration basin (Figure 3-8). Before entering the basin, the runoff will pass through a hydrodynamic separator that removes pollutants that settle out or float. Runoff will then enter the basin where it will infiltrate the underlying soils. Runoff in excess of the five-year storm event levels (i.e., the BMP design storm) will bypass the BMP via an overflow pipe and return to the normal storm drain system.

This project was designed to target pollutants subject to TMDLs in the Chollas Creek Subwatershed. Baseline water quality monitoring was conducted at the project site during the 2007–2008 Monitoring Season. This wet weather and dry weather will be used to evaluate the load reduction achieved by this infiltration basin design.

Figure 3-8 Schematics & Construction Photos for the Memorial Park Infiltration Basin

BUCKET NO. 2 – MEDIUM INFILTRATION BASIN

Cost	$800K
Stakeholder	City of San Diego
Watershed	Pueblo
Location	Memorial Park (1.4 acres of drainage)
Targeted Pollutants	Bacteria; pesticides; and dissolved copper, lead & zinc

4.0 COST ESTIMATE RESULTS

The following subsections present the results of the cost estimate developed for the San Diego River Pilot Watershed as well as the scaled-up cost estimate for the San Diego Region.

4.1 Pilot Watershed Cost Estimate Results

The San Diego River Watershed, shown on Figure 4-1, was selected as the pilot watershed for several reasons. The land use within the watershed includes both urbanized and open space areas (i.e., 2% agricultural, 30% urbanized, and 68% open space land uses), and the geology includes coastal valleys, upland mesas, and mountains. The San Diego River Watershed also has a significant body of water quality and biological quality data. In addition to agency monitoring efforts, the San Diego River Watershed has been subject to special studies and data collection activities completed by third-party organizations, such as the Southern California Coastal Watershed Research Project (SCCWRP), San Diego River Foundation, San Diego Coastkeeper, and university researchers. Finally, the San Diego River Watershed was selected as the pilot watershed to leverage existing Special Drainage Area (SDA) reports, IRWM projects, and other watershed-level planning efforts.

The cost estimate for the pilot watershed was used as a representative estimate for the San Diego Class. The final costs for each BMP bucket were calculated for the pilot watershed and normalized by the total watershed and developed area (i.e., $M/developed mile^2). Using the normalized cost and watershed-specific developed area, costs were extrapolated to the Otay Valley Watershed and Sweetwater Watershed, and the additional watersheds within the San Diego Class.

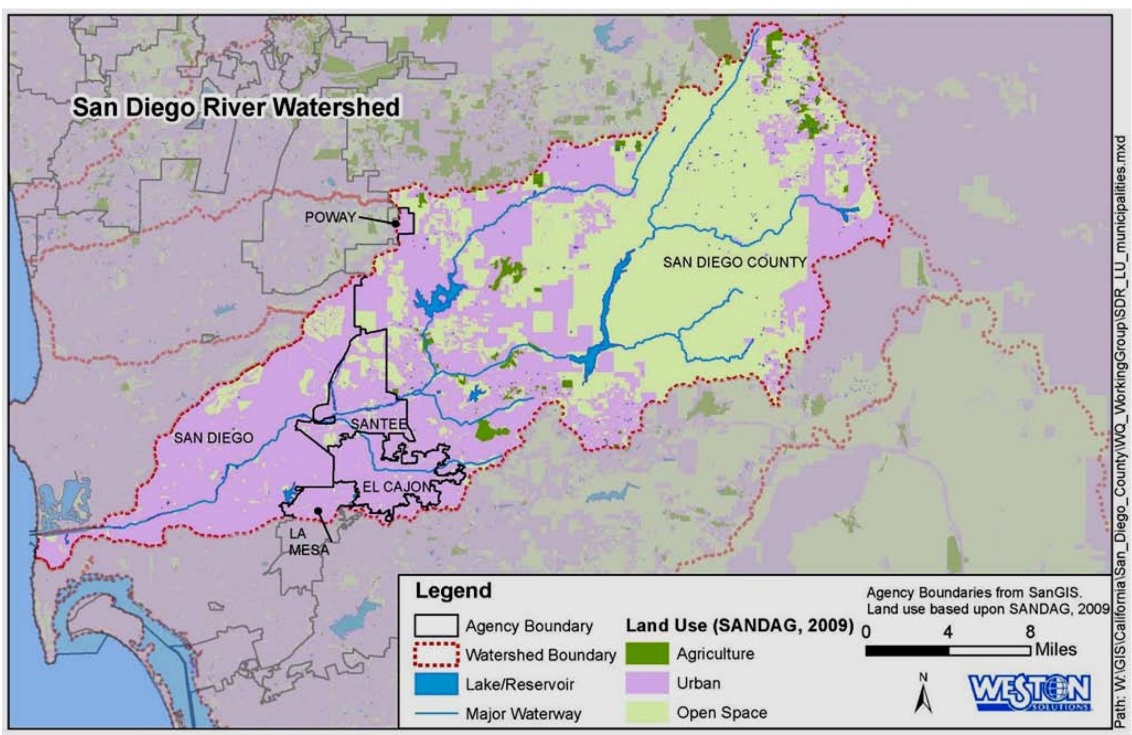


Figure 4-1 San Diego River Watershed

Cost estimates for the Full Structural Approach and Integrated Approach were developed for the pilot watershed. Both approaches were assumed to enhance water quality to achieve 100% of the WQOs. The summary of the assumptions and processes used to create the cost calculators for each of the three buckets are described below. The detailed cost calculators and final results, broken down into programs and projects for each bucket, are provided in Attachment C.

Bucket No. 1 – Permit-Required & Non-Structural Best Management Practices Cost Calculator

The Bucket No. 1 cost calculator data was derived from existing budget data provided by the 21 San Diego Copermittees (i.e., also referred to as agencies) in the 2008–2009 Jurisdictional Urban Runoff Management Program (JURMP) reports. These fiscal budgets were analyzed to determine the range of agency budgets for water quality enhancement and storm water programs. The JURMP data were also analyzed to determine typical annual budgets for permitting, program administration, education, enforcement, monitoring, capital improvement projects, and other activities. These agency-specific costs were grouped into cost ranges for small, medium, and large agencies based on population density, land area, and annual budget. The agencies with jurisdiction over developed land within the San Diego River Pilot Watershed (i.e., the County, City of San Diego, City of La Mesa, City of El Cajon, and City of Santee) were assigned an agency size classification. It was assumed that agencies would each contribute the typical program budget for the assigned agency size.

To simplify calculations and provide easier comparison between calculators, Bucket No. 1 was broken into three categories of non-structural BMP categories, including permit compliance BMPs, enhanced BMPs, and studies. The same permit compliance effort was applied to the Full Structural Approach and Integrated Approach calculators. The one-year implementation cost for the permit compliance BMPs was applied over 40 years using simple compound interest (i=3%). Based on the conservative assumption that compliance activities maintain the existing level of water quality (i.e., prevent water quality degradation), these BMPs were not credited with a load reduction. Since the Full Structural Approach only includes permit-compliance BMPs in Bucket No. 1, this assumption means that 100% of the load was addressed by Bucket No. 2 and Bucket No. 3. In contrast, the Integrated Approach enhanced Bucket No. 1 with BMPs and studies beyond the scope of standard permit compliance. It was assumed that these enhancements would provide treatment for approximately 55% of the total load, and the remaining load would be addressed by Bucket No. 2 and Bucket No. 3.[7] The one-year cost was applied over 40 years using simple compound interest (i=4.5%), where an interest rate equal to 1.5 times standard inflation was used to conservatively account for the additional staff and resources likely associated with an enhanced program. Unlike the permit compliance or enhanced BMPs to be implemented every year, it was assumed that the studies identified in Bucket No. 1 would only be implemented for a portion of the 40-year period. The 40-year implementation cost for studies was calculated by multiplying the one-year study cost by the number years of implementation. Attachment C provides details regarding the present worth calculations used to translate Bucket No. 1 cost estimates to 2010 dollars.

[7]Based on SANGIS data, the Integrated Approach assumed that 40,335 acres (i.e., 63 miles^2 or 45% of the developed area) would be treated by Bucket No. 2 and Bucket No. 3.

Bucket No. 2 – Structural Best Management Practices Cost Calculator

The Bucket No. 2 cost calculator is a compilation of BMPs typical for the region. BMPs in the calculator were color coded by type, including source control, runoff reduction, agriculture, erosion control, LID, and treatment. The calculator presents BMP data in terms of tributary area treated, unit cost, number of BMPs to be implemented over the 40-year implementation period, and final total cost. The unit cost includes the cost of implementing the BMPs, a 40-year O&M fee, and any anticipated land acquisition costs. Unit costs and typical drainage areas were validated using the example projects provided by the WQWG. The quantities of the various BMPs in Bucket No. 2 were increased until to the total area treated roughly matched 65% of the total developed area to be treated.8 To account for the 40 years of O&M incorporated into the cost, the total dollar amount was translated to 2010 dollars using a uniform series net present worth calculation (i=3%).

Bucket No. 3 – Restoration & Treatment Cost Calculator

The costs for the regional restoration and treatment BMPs associated with Bucket No. 3 were developed similar to the process used for Bucket No. 2. The quantities of the various BMPs in Bucket No. 3 were increased until to the total area treated equaled the 35% of the remaining pollutant load and developed area to be treated. The key difference between the Bucket No. 2 and Bucket No. 3 processes for the Full Structural Approach and Integrated Approach was the restoration component of the calculator. Restoration was excluded from the Full Structural Approach calculator, but included in the Integrated Approach calculator. Given the large open space areas in the San Diego River Watershed, the goal was to restore approximately 20% of the watershed through a combination of wetland and channel restoration projects. Channels are typically restored based on linear feet of riverbed. The typical drainage area of 0.16 acre/linear ft restored was determined based on example projects provided by the WQWG. A geographic information system (GIS) analysis was completed to determine the total length of the San Diego River and its major tributaries, and the length that has been channelized. In order account for flood control needs, it was assumed that 10% of this total length could be restored. A comparable area of the watershed was marked for restoration. More information may be found in Attachment C.

Cost estimate results for the San Diego River Pilot Watershed are presented in Table 4-1. The pilot watershed results indicate that approximately $2.5 B will be saved by implementing the Integrated Approach. If this amount was proportioned across the San Diego region based on the developed area in each watershed, using the Integrated Approach in place of the Full Structural Approach translates to approximately $19.2 B, or 45%, saved over 40 years. The Integrated Approach represents a cost-savings alternative that will achieve WQWG goal and objectives. The spectrum of estimated water quality implementation costs for Southern California is presented on Figure 4-2. Validations of these cost estimates for the Pilot Watershed were developed using two separate methods and are presented in Attachment D.

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[8]Similar to the Bucket No. 1 assumption for permit-compliance BMPs, standard street sweeping, and storm drain infrastructure cleaning programs required by the NPDES Permit were not credited with a load reduction.

Table 4-1 Cost Estimate Results for the San Diego River Pilot Watershed

Approach	Bucket	Cost (2010)	$/Total Area ($M/miles^2)	$/Developed Area ($M/miles^2)
Full Structural Approach	Bucket No. 1 *(only permit-required programs)*	$0.19B	0.4	1.3
	Bucket No. 2 *(aggressive structural program)*	$4.22B	9.7	30.1
	Bucket No. 3 *(aggressive treatment program)*	$1.16B	2.7	8.3
	40-YEAR TOTAL	**$5.57B**	**12.8**	**39.7**
Integrated Approach	Bucket No. 1 *(permit-required programs, enhanced non-structural programs, and special studies)*	$0.85B	2.0	6.1
	Bucket No. 2 *(reduced structural solutions program)*	$1.84B	4.3	13.2
	Bucket No. 3 *(reduced treatment program, with restoration projects)*	$0.47B	1.1	3.4
	40-YEAR TOTAL	**$3.16B**	**7.4**	**22.7**

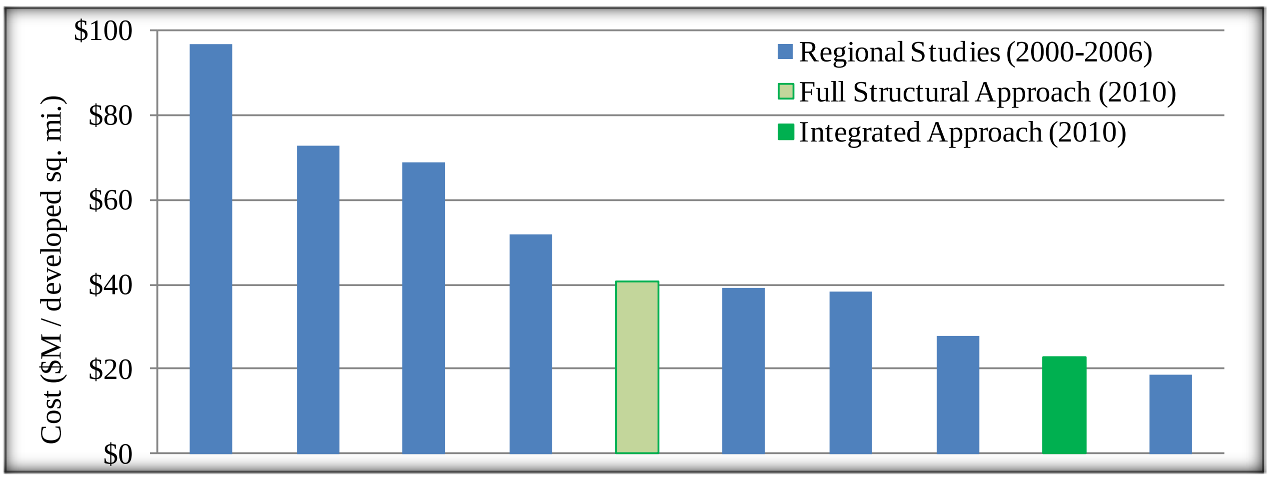

Figure 4-2 Cost Results for the Pilot Watershed Compared with Recent Regional Studies

4.2 Pilot Watershed Cost Estimate Validation

The results for the pilot watershed were validated using an approach based on recent water quality regulations, called the "TMDL Approach," and are presented below and described in detail in Attachment D. The TMDL Approach validated watershed costs by comparing the normalized cost result (i.e., $M/developed mile^2) for each watershed with regional estimates from across Southern California. As shown in Table 4-2, the typical cost of TMDL compliance across Southern California was estimated at $20–100M/mile^2 of developed area. The spectrum of estimated water quality implementation costs for Southern California was presented previously on Figure 4-2. As represented by the light green bar, the result for the Full Structural Approach fell in the middle of this typical range of costs, whereas the Integrated Approach result, represented by the dark green bar, fell at the low end of the cost spectrum. The 2010 pilot watershed results were also compared with analyses completed for the Chollas Creek Subwatershed in 2006. By implementing the Integrated Approach in place of the Full Structural Approach, the Chollas Creek estimate achieved a cost savings of approximately 40% (Weston, 2006). This is comparable to the 45% cost savings for the pilot watershed. These validation results indicate that the methodology used for this cost estimate are reasonable and typical of other needs assessments across Southern California.

Table 4-2 Cost Validations Using the Total Maximum Daily Load Approach

Cost Estimate – Year[a]	Developed Area (miles^2)	Low Range Cost ($M/developed miles^2)	High Range Cost ($M/developed miles^2)
1. Caltrans – 2000	1.3E (-2)	$96.6	–
2. Chollas Creek Full Structural Approach – 2006	20.4	$63.9	$69.0
3. Chollas Creek Integrated Approach[b] – 2006	20.4	$38.3	$44.7
4. Sun Valley – 2004	4.4	$39.1	$72.8
5. Santa Monica – 2006	8.1	$27.9	–
6. Los Angeles – 2006[c]	1,585[b]	$18.5	$51.9
Pilot Watershed – 2010	**140.1**	**22.7**	**39.7**

[a]The cost estimate implementation period used is shorter than the 40-year timeframe used in this report. Cost estimate values have been adjusted to 2010 dollars using annual compounding and an annual interest rate of i=3.0%, for standard inflation.
[b]The Integrated Approach resulted in an approximate 40% reduction in cost over the 20-year life cycle (Weston, 2006).
[c]The developed area addressed by the Los Angeles Integrated Regional WMP is not provided in the report. The jurisdictional/watershed boundaries for the participating agencies are unknown. Based on a GIS analysis using land use data from the Southern California Association of Governments (SCAG), the region is approximately 77% developed.
Sources: 1) Caltrans, 2000; 2) Weston, 2006; 3) Weston, 2006; 4) LADPW, 2004; 5) Brown & Caldwell, 2006; 6) Leadership Committee, 2006.

4.3 Regional Cost Estimate Results

The cost calculators developed for the pilot watershed were modified for the three remaining watershed classes based on land use and water quality data. The scaling methods used were defined as follows:

- **Pueblo Watershed** – Calculators were scaled to include fewer agricultural BMPs, infiltration-type BMPs, and BMPs requiring extensive land acquisition. The number of programs and projects targeted at urban area and with a relatively small footprint were increased. Source control structural BMPs (e.g., aggressive street sweeping and catchment cleaning) were increased by a factor of two. Given the relatively small drainage area and limited opportunities for restoration without impacting development, restoration projects were reduced by half.
- **San Luis Rey Watershed** – Calculators were scaled to include more agricultural BMPs, specifically cisterns and runoff reduction systems, and detention basins. Given the large open spaces and limited trash problems, source control structural BMPs and restoration opportunities were

generally reduced. In Bucket No. 3, emphasis was placed on dry weather flow diversion projects to manage irrigation flows and discharges.

- **Tijuana Watershed** – Calculators were scaled for a suite of BMPs relatively similar to the pilot watershed. Given the known trash problems, the number of clean-up projects was doubled. The number of Bucket No. 2 detention basins and infiltration basins was increased.

The scaling methods used to translate the pilot watershed cost to the remaining three watershed classes affected the normalized cost results (i.e., $M/developed mile^2).

Table 4-3 presents the cost results for each of the four watershed classes, extrapolated costs for the watersheds within each class, and total 40 year cost in 2010 dollars. As previously described in Section 3.0, the total 40-year regional cost was calculated by extrapolating the normalized watershed costs for each watershed class to the remaining watersheds within the class. For example, in the San Diego Class, the normalized cost for the pilot watershed was extrapolated to the Otay Valley Watershed based on the developed area (i.e., multiplying $22.6 by 48.0 miles^2 equals $1,086 M). The implementation cost for seven watersheds and Region 7 were extrapolated using this method. The resulting water quality cost estimate for the San Diego region is $24.6 B (2010 dollars).

Table 4-3 Final 40-Year Regional Cost Estimate for San Diego (2010 dollars)

Class	Watershed	Developed Area (miles^2)	$M / Watershed Mile^2	$M / Developed Mile^2	Total Cost (2010 $M)
San Diego	**San Diego River**	**140.1**	**$7.31**	**$22.63**	**$3,169**
	Otay Valley	48.0	–	–	*$1,086*
	Sweetwater	89.9	–	–	*$2,035*
Pueblo	**Pueblo**	**53.0**	**$30.66**	**$33.85**	**$1,794**
	Mission Bay	44.3	–	–	*$1,499*
	Carlsbad	142.5	–	–	*$4,822*
	Los Peñasquitos	54.8	–	–	*$1,855*
San Luis Rey	**San Luis Rey**	**209.3**	**$6.07**	**$16.26**	**$3,404**
	San Dieguito River	133.0	–	–	*$2,163*
	Santa Margarita	31.3	–	–	*$508*
	Region 7	42.7	–	–	*$695*
Tijuana	**Tijuana River**	**71.3**	**$3.29**	**$21.59**	**$1,539**
Total 40-Year Cost of Water Quality Program for San Diego					**$24.6B**

4.4 Regional Cost Estimate Validation

Similar to the pilot watershed, the results for the San Diego region (each of the three remaining watershed classes were also validated using the TMDL Approach (Attachment D). The TMDL Approach validated watershed costs by comparing the normalized cost result (i.e., $M/developed mile²) for each watershed with regional estimates from across Southern California. As shown on Figure 4-3, the Integrated Approach cost estimate results fell in the lower end of the typical spectrum, and three of four watershed classes were within the expected range of $20–100 M/developed mile². The San Luis Rey Watershed result was within $2.4 M/developed mile² of the lowest cost estimate completed for the greater Los Angeles area. This lower cost is likely due to the large proportion of agricultural lands and associated BMPs needed to treat agricultural runoff. The effect of the densely urbanized areas of the Pueblo Class caused the regional normalized cost of $30.7 M/developed mile² to be higher than the pilot watershed and Tijuana Watershed results. These results were considered reasonable and representative for Southern California.

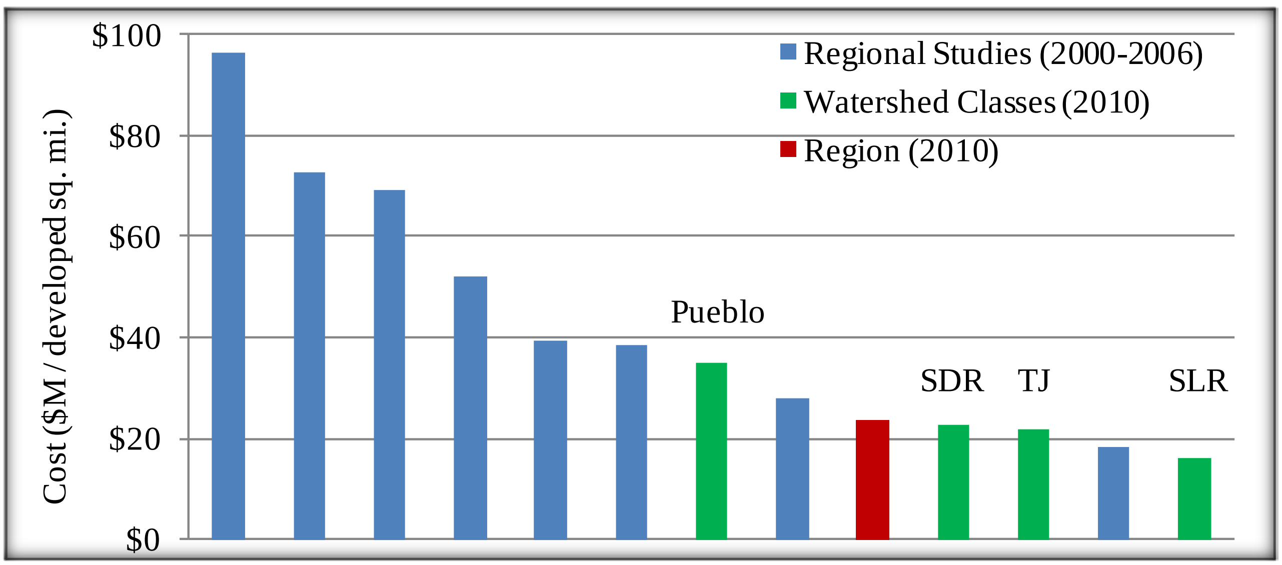

Figure 4-3 Cost Results for the Four Watershed Classes Compared with Recent Regional Studies

4.5 Defining the 'Gap' in Existing Funding

Current expenditure on regional water quality programs was quantified using available budgetary data. Agency budgets were based on the robust dataset presented in the 2008–2009 JURMP reports.[9] Budgetary information for regional stakeholder groups was limited to information provided by stakeholders and publically reported information.[10] The following analysis shows that regional water quality programs targeted at storm water and urban runoff management are underfunded.

As previously stated regional agencies fund water quality programs using a variety of sources (e.g., General Funds, fees, tariffs, grants, bonds, and facility charges), but typically, budgets are supported by the General Fund. The annual budgetary approval process for the use of General Funds places the long-term goal of clean water in direct competition with public services such as fire protection and law enforcement. As a result, agencies' budgets are generally constrained to short-term regulatory compliance activities. The 2008–2009 budgets typically consist of program administration, regional shared expenditures and special studies, outreach, enforcement, monitoring, activities required by the NPDES Permit such as street sweeping and MS4 catchment cleaning. An annual budget may also fund clean-up events, temporary erosion control BMPs (e.g., sand bags), capital improvement projects, and/or small pilot BMP studies. While the 2008–2009 budgets were predominantly non-structural, it is anticipated that future budgets will incorporate a more balanced mix of programs, non-structural, structural, treatment, and restoration BMPs. The cumulative 2008–2009 budget for the 21 regional agencies totaled approximately $112 M. To quantify the existing gap between available effort and projected need, the cumulative budget for 2008–2009 was projected over 40 years given standard inflation (i=3.0%) and converted to a net present worth in 2010 dollars using a uniform series calculation. If the existing water quality programs continue to be budgeted at the current level of permit compliance, the 21 agencies are projected to spend $4.9 B (2010 dollars).

Regional stakeholder groups fund water quality programs using a combination of grants, membership dues, donations, endowments/trusts, consultation fees, volunteers, and other investments. Budgetary information was collected for regional land trust conservancies, local environmental groups, and agricultural monitoring groups.

Budgets for land trust conservancies were generally larger than the other stakeholder groups to account for land acquisition.[11] The same process used for the 2008–2009 JURMP budgets was used to project the annual stakeholder budgets over 40 years. These water quality programs represent an additional $1.2 B in spending on regional programs and projects (including acquisitions). Cumulative regional spending on current water quality programs equals $6.1 B. A summary of current spending in San Diego on regional water quality, assuming effort is maintained at the current level, is presented in Table 4-4.

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[9] JURMP summarizes the programs and strategies used by each agency to reduce the discharge of pollutants from the MS4 and receiving waters to the maximum extent practicable. JURMP status reports, including annual budgetary information, are submitted to the Regional Board each year.

[10] Budgetary information was submitted to the WQWG from the San Diego River Park Foundation and a regional agricultural monitoring group. Budgetary information for land trust conservancies was based on publically available information reported by the Back Country Land Trust, Fallbrook Land Conservancy, San Elijo Conservancy, and the San Diego River Park Foundation.

[11] Larger environmental organizations (e.g., San Diego River Park Foundation) are involved in land acquisition and restoration. Currently in 2010, these types of projects are typically still in the planning phase of implementation, and are not typical of the annual budget of local environmental groups.

Table 4-4 40-Year Projection of Current Spending on Water Quality Programs

Agency Size (number of agencies)	Total Cost (2010)
Small agencies (8)	$0.3B
Medium agencies (11)	$1.7B
Large agencies (2)	$2.9B
Sub-Total	**$4.9B**
Other Regional Stakeholder Groups	Total Cost (2010)
Agriculture monitoring groups	$29M
Environmental groups	$154M
Land trust conservancies	$1,006M
Sub-Total	**$1.2B**
40-Year Total for San Diego Region	**$6.1B**

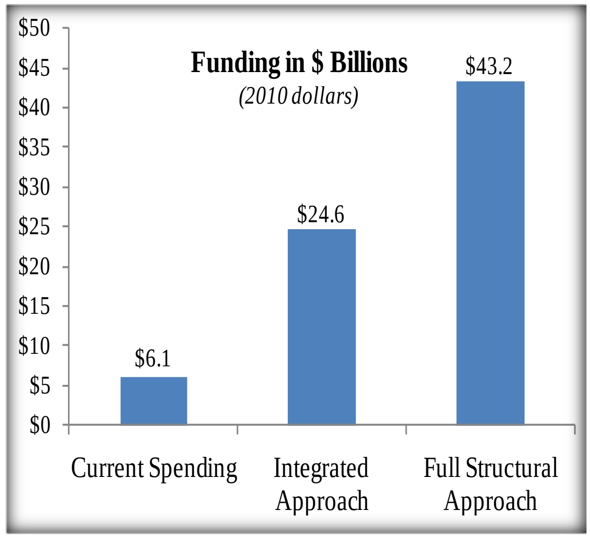


Figure 4-4 Gap between Current Funding and Projected Funding Need (2010 dollars)

The funding gaps between current spending and the two types of unconstrained funding needs are presented in Figure 4-4. The gap between the Full Structural Approach unconstrained cost estimate and existing spending is $37.1 B. By selecting the Integrated Approach as the preferred strategy for planning and implementing BMPs to meet the regulatory requirements for water quality, the WQWG reduced the gap in funding to $18.5 B, half of the original funding gap. Despite using this innovative strategy, existing spending still needs to be quadrupled to achieve the WQOs. As described earlier in this document, the projected funding need is comparable to other regional cost estimates, and due to budgetary constraints (i.e., tradeoffs in fundamental services), it is also unlikely for agencies to successfully close the gap on an individual basis. As an underfunded program, water quality has a significant need for new revenue streams such as the Funding Strategy.

5.0 RECOMMENDED REGIONAL PRIORITIES

It is generally understood that the Funding Strategy will only provide a percentage of the funds required to achieve the water quality needs identified in this report. The WQWG has developed a proposed prioritization process to evaluate programs and projects used for cost validation. The proposed process consists of the following (Table 5-1):

- **Qualifying Criterion** – Each project would be evaluated to ensure that the program or project falls within the scope of the Water Quality Enhancement Element (i.e., addresses the water quality issue or water resource impaired by urban runoff and/or storm water runoff).
- **Screening Criterion** – Next, each project would be screened for funding eligibility under the Funding Strategy using the four criteria developed by SANDAG.
- **Ranking Criterion** – If programs and projects passed these first two criteria, they would undergo ranking and prioritization. Although program and projects would not be penalized for being single purpose, additional points would be given for demonstrable ancillary benefits and/or integration with other regional activities.

Table 5-1 Proposed Prioritization Process

1. Qualifying Criterion (WQWG objectives in Framework)	2. Screening Criterion (SANDAG criterion)	3. Ranking Criterion (integrated ranking system)
WQWG Objective 1 Watershed-based programs and projects that achieve cost-effective solutions for established WQOs. **WQWG Objective 2** Jurisdictional water quality programs and projects (i.e., typical Bucket No. 1 activities including monitoring, education, enforcement, and source control).	Has a clearly demonstrable nexus to regional quality of life – Economy, Equity, & Environment. Moves the region towards sustainable growth and long-term solutions rather than presenting short-term fixes. Addresses underfunded or underfunded need. Benefits are quantifiable, measurable, and/or transparent.	**WQWG Objective 3** Additional points are given for programs with ancillary benefits (i.e., in addition to water quality, provides additional water supply, habitat restoration, or enhanced community amenities). Additional ranking criteria include the following: ▪ Addresses underlying causes affecting quality of life. ▪ High cost/benefit ratio. ▪ Benefits a larger number of communities in the region. ▪ Is equitable in its benefits and impacts and addresses social justice concerns. ▪ Leverages other funding. ▪ Addresses a previously deferred program need or activity. ▪ Anticipates evolving regulatory trends. ▪ Benefits are important to those who are being asked to help fund. ▪ Significant O&M costs. ▪ Significant or costly regional consequences if not funded. ▪ Credibility and accountability.

The WQWG used this draft prioritization process to evaluate multiple programs and projects used for the cost validation in the pilot watershed. Types of programs that ranked well using this method included the following:

- Agency programs for compliance.
- Agency programs for ongoing O&M.
- Pilot programs and projects.
- IRWMP projects, and/or programs and projects with ancillary benefits, especially for habitat restoration, transit improvement, and public/environmental health, etc.

One challenge encountered by the WQWG was equitably apportioning funds to non-structural, structural, restoration and treatment programs and projects. As described in the buckets strategy, enhancing water quality to achieve the WQOs will require integrated BMP selection and implementation (i.e., a combination of the three buckets rather than discrete implementation of BMPs in a single bucket). A benefit of the bucket classification system is that programs and projects are separated into three types of dissimilar BMPs. Therefore, one recommended solution to this challenge would be to prescribe a minimum portion of Quality of Life funding to each bucket and then apply the prioritization process to the proposals for each bucket. This solution ensures that dissimilar programs and projects are not placed in direct competition, but that each program and project undergoes the same rigorous prioritization process. The actual implementation of this process is still undergoing evaluation by the WQWG. It is anticipated that this effort will continue into the following 12 months, and will require approval by the SANDAG Board of Directors.

The WQWG acknowledges that the prioritization and ranking of projects within the Water Quality Enhancement Element is likely to be discussed at length by SANDAG as part of a larger discussion regarding the prioritization and ranking of projects within the overall Funding Strategy. The WQWG offers the recommendations in this section of the report for SANDAG's consideration based on their experience within the water quality arena.

5.1 Leveraging Opportunities

At present, agencies and regional stakeholders are able to leverage funding through grants, regional funds, and strategic partnerships. Table 5-2 presents types of leveraging opportunities available to agencies and regional stakeholders.

There are opportunities to leverage funding when resources are made available. For example, the City of Santee was able to leverage $3.0 M of funding for the Forester Creek Restoration Project into $36.0 M through partnerships with the Federal Highway Administration and the County, regional funding by *TransNet* and the Regional Board, and a state water bond (i.e., Proposition 13). As a result of the Used Oil Block Grant Program, which grants applicants up to $5,000 each year (provided a 50% match in funding by the applicant) agencies are able to provide San Diego residents with free used oil disposal. Land conservancy trusts and environmental groups are able to obtain property valued at hundreds of thousands or millions of dollars through donation, endowments, and grants. For example, the Grant Family donated 17 acres of raw land to the San Diego River Park Foundation. The river-front property in Mission Valley, a former sand mining site zoned for a commercial hotel, will now become the San Diego River Discovery Center at Grant Park (Figure 5-1).

By demonstrating fiscal commitment to water quality enhancement through a dedicated Quality of Life revenue stream, new funding opportunities can be leveraged within the region.

Table 5-2 Opportunities for Leveraging Funding as a Result of a Dedicated Regional Funding Stream for Water Quality Enhancement

Federal	State	Local
Clean Water Act United States Environmental Protection Agency (USEPA) 319H Grant Program **Federal Water Resource Development Act** **Airport and Airway Improvement Act** Airport Improvement Program Grants **Federal Farm Bill** Environmental Quality Incentives Program (EQIP) Agricultural Water Enhancement Program (AWEP)	**State Water Bonds** Proposition 84 (2006) Proposition 50 (2002) Proposition 13 (2000) **Disaster Preparedness & Flood Prevention Bonds** Proposition 1E (2006) **State Transportation Improvement Program** **Cleanup and Abatement Account** **Used Oil Block Grant Program** **California Coastal Conservancy**	***TransNet*** **Waste Management Fee** **Project Partnerships** **Philanthropy** San Diego Foundation ILACSD Endowments Donations

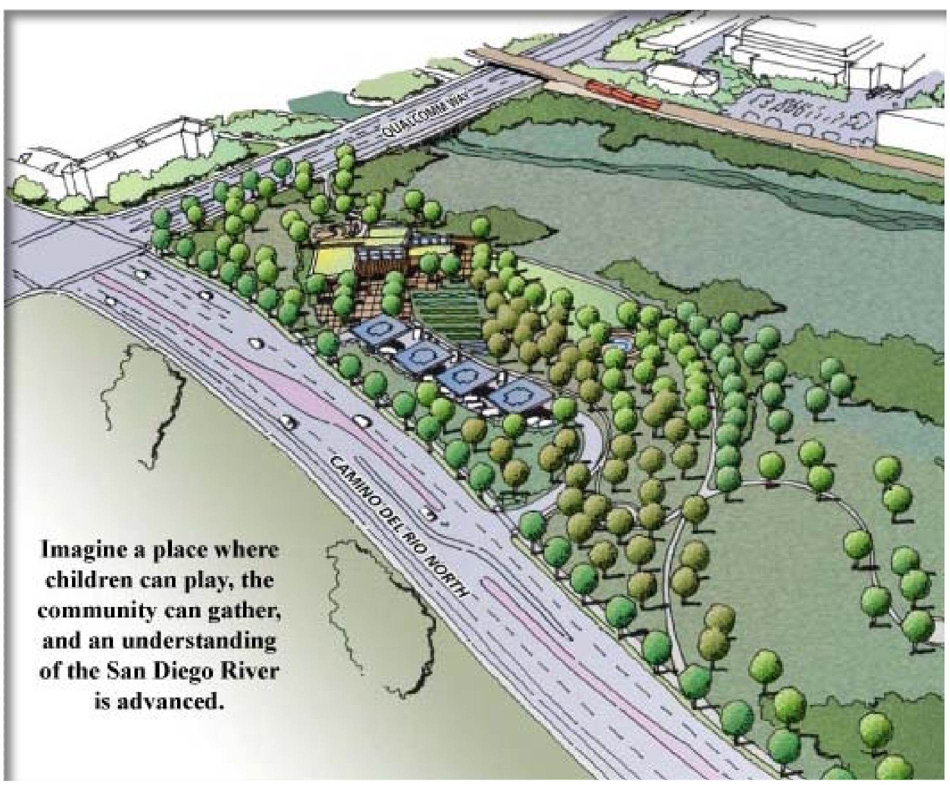


Figure 5-1 San Diego River Discovery Center Possible by Leveraging New Resources

5.2 Funding Options Analysis

During the Water Quality Enhancement Element update meeting to the SWG on October 20, 2010, the WQWG was directed to complete a series of analyses quantifying what could be done to enhance regional water quality with, and without, Quality of Life funding. While developing this needs assessment and cost estimate, the WQWG began developing criteria to evaluate programs and projects and to prioritize funding across the region, as previously outlined. One of the key questions considered by the group was how to equitably apportion limited funds. Three separate funding options were developed to help answer this question, and the method for analyzing these options is presented below.

Three funding option analyses were completed based on a total regional budget of up to $16.1 B over 40 years. The $16.1 B regional budget consists of $6.1 B in current funding, $5.0 B in Quality of Life funding, and up to $5.0 B in additional funding leveraged through grants and other sources. The three funding option analyses include the following:

- **Option No. 1** – Zero Quality of Life Funding.
- **Option No. 2** – $5.0 B in Quality of Life Funding with Proportionate Spending.
- **Option No. 3** – $5.0 B in Quality of Life Funding with Prioritized BMP Implementation.

Potential BMP combinations for these three funding options were modeled using the San Diego River Pilot Watershed Integrated Approach cost calculators (Attachment C). In addition to this quantitative analysis, it was assumed that regional and regulatory efficiencies would provide additional water quality benefit and help reduce the gap in existing funding. These efficiencies are more qualitative than quantitative. Regional efficiencies would be achieved by substituting agency programs for regional programs and projects (e.g., regional Think Blue education and outreach program, collaborative watershed monitoring programs, etc.). A cost-savings will be achieved through reduced redundancy and increased efficiency. Water quality will also be enhanced through regulatory change such as true source control measures (e.g., Registration of Pesticides, Brake Pad Partnership, styrofoam and once-use plastic bag bans), engaging the Region Board through the delisting process, integrated land use planning/zoning/development, and other regulatory/legislative efficiencies. A cost-savings will be achieved through a reduced need for treatment. These five opportunities to enhance water quality and close the gap in existing funding are summarized in Table 5-3.

Table 5-3 Opportunities to Close the 'Gap' in Existing Funding

Opportunity	Assumed Amount	Definition
Current Funding	$6.1 B	Current agency and regional stakeholder budget.
Quality of Life Funding	$5.0 B	Quality of Life funding, included in Option No. 2 & Option No. 3.
Leveraged Funding	$5.0 B	Agencies and regional stakeholders leverage matching funds for programs and projects.
Regional Efficiencies	Qualitative	Regional cost savings through collaborative programs (i.e., monitoring, education, common legislation policies) and regional projects.
Regulatory Changes		Reduced need for BMPs due to true source control, pollutant delisting, green development standards, etc.

5.2.1 Option No. 1 – Zero Quality of Life Funding

Option No. 1 would exclude the Water Quality Enhancement Element from the Funding Strategy. Under this option, agencies and regional stakeholders would continue to fund programs and projects using existing, restricted funding mechanisms (e.g., General Funds, fees, tariffs, and grants). This analysis assumed that agencies would use current funding to implement 100% of the permit-compliance BMPs. Approximately 40% of the budget was applied to Bucket No. 1 BMPs, and the remaining suite of enhanced structural, restoration, and treatment type BMPs were given equal priority. Based on standard grant match requirements, it was assumed that agencies and stakeholders could leverage 25% matching funds for additional BMP implementation (i.e., $1.5 B region-wide, or $196.7 M for the San Diego River Pilot Watershed). If the SANDAG Board of Directors elects to not include the Water Quality Enhanced Element in the Funding Strategy, regional agencies and stakeholders within the San Diego River Pilot Watershed could address 40.5% of the watershed load.

5.2.2 Option No. 2 – Proportionate Analysis

The SWG directed the WQWG to provide an analysis of what could feasibly be done to enhance water quality with $5.0 B provided through the Funding Strategy, a dollar match to the current funding available to regional agencies. For the Option No. 2 analysis, 20% of the Quality of Life funds were reserved for permit-compliance BMPs and current funds available to agencies were used to cover the remaining budget. Funding was apportioned for BMP implementation similar to the Option No. 1 analysis. By demonstrating fiscal commitment to water quality enhancement through a dedicated Quality of Life revenue stream, it was assumed that regional agencies and stakeholders could leverage an addition $5.0 B (i.e., matching current agency budgets). If the SANDAG Board of Directors elects to not apportion $5.0 B to the Water Quality Enhanced Element, and to distribute funds proportionately to BMPs, regional agencies, and stakeholders within the San Diego River Pilot Watershed could address 69.1% of the watershed load.

5.2.3 Option No. 3 – Prioritized Best Management Practices Analysis (Preferred Option)

Selective implementation of BMPs will enable the region to adaptively implement programs and projects based on the changing environmental, social, and regulatory climate, and thus achieve the greatest potential water quality enhancement with limited resources. The output for the Option No. 3 analysis presents one potential suite of selectively implemented BMPs. It is anticipated that as technologies improve and the region discovers more efficient and effective BMPs, this type of result will be achieved. If the SANDAG Board of Directors elects to not apportion $5.0 B to the Water Quality Enhanced Element and to prioritize BMP implementation, regional agencies and stakeholders within the San Diego River Pilot Watershed could address 81.3% of the watershed load.

Figure 5-2 presents the portion of the water quality need (i.e., portion of the San Diego River Watershed area treated with BMPs) addressed by each funding options. Table 5-4 presents specific examples of some of the BMPs that can be implemented by agencies and regional stakeholders over the next 40 years.

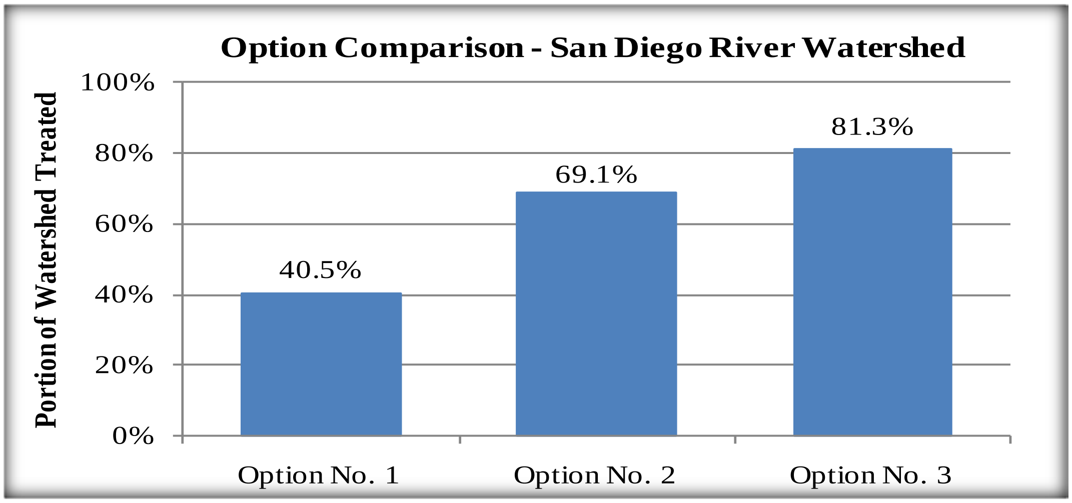
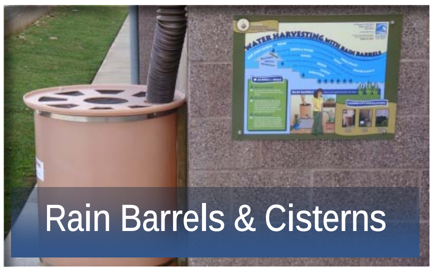
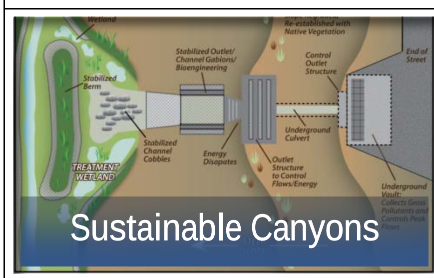


Figure 5-2 Water Quality Need Potentially Met by Each Funding Option

Table 5-4 Examples of Best Management Practices by Funding Option

BMPs Potentially Implemented	Option No. 1 57 miles² treated	Option No. 2 97 miles² treated	Option No. 3 114 miles² treated
	100% Permit Compliance BMPs		
	70% Studies & 59% Enhanced Non-Structural BMPs	85% Studies & 75% Enhanced Non-Structural BMPs	100% Special Studies & Enhanced Non-Structural BMPs
	1,300 systems	7,100 systems	3,080 systems
	260 acres treated	1,300 acres treated	1,100 acres treated
	100 Green Malls	460 Green Malls	400 Green Malls
	1 Canyon *(115-acre tributary drainage)*	5 Canyons *(127-acre tributary drainage each)*	5 Canyons *(130-acre tributary drainage each)*
	4,800-ft channel *(widened & restored)*	13,200-ft channel *(widened & restored)*	19,400-ft channel *(widened & restored)*

6.0 CONCLUSIONS & NEXT STEPS

6.1 Conclusions

The WQWG recommends that the SWG, the Quality of Life Ad Hoc Steering Committee, and ultimately the SANDAG Board of Directors include the Water Quality Enhancement Element in the Funding Strategy and pursue a funding distribution program similar to what has been developed under Option 3. The WQWG recommends a selective, regional BMP implementation strategy for the following reasons:

1. Currently, funding available for San Diego region storm water programs is inadequate to address existing and emerging water quality problems.

Although the gap in needed funding is great and larger than any likely public appetite, the WQWG concluded significant progress can be made towards closing the gap with help from the Funding Strategy based on the analysis previously described.

2. Water quality is a regional issue best addressed from a regional perspective.

Regional collaboration has increased in recent years, as local agencies recognize the benefit of pooling limited resources on joint programs (e.g., public outreach and storm water monitoring). The current trend of partnerships between agencies, municipalities and non-government organizations is expected to continually increase. It is anticipated that the upcoming version of the Municipal Storm Water Permit and other water quality regulations will continue emphasis on a regional and watershed approach. The Funding Strategy represents a great opportunity to efficiently and effectively pool resources for regional solutions and partnered projects.

The Funding Strategy also presents an opportunity to forego inefficient funding measures. The process of establishing a storm water utility fee is lengthy and requires considerable public education to obtain a successful vote (i.e., two-thirds majority of the public electorate). Incorporating water quality into a regional tax would reduce the probability of failure associated with presenting a fee on multiple ballots and provide regional efficiencies due to a centralized campaign across the San Diego region (City of Carlsbad, 2003). Local taxes also have a greater negative impact on local economies compared with a similar funding source implemented at the regional, state, or federal level (Ogden et al., 1995; City of Solana Beach, 2007).

3. Large-scale, integrated regional solutions provide a greater return on investment.

Large-scale, integrated regional solutions provide a greater return on investment by addressing larger drainage areas with a suite of solutions designed to minimize sources of pollution, attenuate and beneficially reuse runoff, and treat remaining flows. A benefit–cost analysis of these types of solutions was completed in 2006 for the *Greater Los Angeles IRWM Plan* (Leadership Committee, 2006). That analysis found that regional-scale solutions (e.g., multi-purpose, long-term water quality solutions) generally had lower implementation costs per acre when compared with BMPs implemented at a smaller scale. The cost calculators support this conclusion (Attachment C); Bucket No. 3 regional BMPs generally had lower implementation costs per acre treated compared to smaller BMPs from Bucket No. 2. While it is important to acknowledge that any future solution for addressing water quality in urban environments will likely include a full suite of solutions derived from each scenario, or bucket, it is valuable to understand that, where feasible, regional solutions will likely provide regional efficiencies and the largest return on investment.

4. Non-compliance with regulatory requirements has potentially significant economic consequences.

San Diego's Gross Regional Product (GRP) totals nearly $1.69 B. Failure to achieve water quality goals can negatively impact the region's $16 B tourism industry (Regional Chamber of Commerce, 2010), an industry ranked 3rd highest in the region. Beach and bay closures that leave important tourist areas unusable—as well as associate a stigma of poor water quality—will immediately impact our economy[12] and the specific quality of life we, as San Diegans, have come to expect (Figure 6-1). In addition, non-compliance will lead to potentially huge administrative fines, civil penalties, and criminal prosecution by regulators. Non-compliance can also lead to potentially expensive third-party lawsuits, while not alleviating the region from the actual costs of eventual compliance.[13]

Figure 6-1 Tourism is the Third Largest Industry in San Diego

[12] For example, the San Diego Convention Center supports 12,500 jobs county-wide and is projected to have an economic impact of $1.27B (Convention Center, 2010). Non-compliance with water quality regulatory requirements as a result of significantly underfunded programs under Option No. 1 will impact the tourism market.

[13]According to the California Water Code §13308, the Regional Board may issue penalties up to $10K for each day of violation (Legal Tips, 2007). Similarly, the USEPA may file a civil suit with penalties of up to $37.5K per day of violation (IECA, 2006). Not only would the region need to pay these fines, but would also be ordered to comply with the regulatory requirements. Lawsuits successfully filed against agencies would include both the awarded penalty and the plaintiffs' legal fees.

6.2 Next Steps

It is anticipated that the SANDAG Board of Directors will be evaluating the input received on the needs for each element in December 2010, and then refining the Funding Strategy throughout 2011. Based on SANDAG's current schedule, the WQWG intends to use 2011 to also refine its primary objectives to support SANDAG with the Water Quality Enhancement Element. Table 6-1 summarizes steps forward recommended by the WQWG. Ongoing efforts by the WQWG to ensure that these steps are accomplished include holding public meetings and subcommittee meetings, WQWG agency and stakeholder coordination, engaging stakeholders not currently represented on the WQWG, and planning activities.

Table 6-1 Steps Forward to Support Development of the Water Quality Enhancement Element

Steps Forward	Effort	Purpose
Step 1 Refine the 2010 regional cost estimate	The rough cost estimate developed during 2010 included scaled costs based on the detailed analysis completed for the pilot watershed. Steps to refine the regional cost estimate will include the following: ▪ Discussing the value of the pilot watershed exercise with stakeholders in each watershed. ▪ Completing similar detailed exercises in each of the other watersheds across the region in 2011.	▪ To refine the rough cost estimate developed during the compressed schedule used in 2010.
Step 2 Develop final ranking criteria for programs and projects	The WQWG Criteria Subcommittee developed a prioritization process used to evaluate programs and projects used for cost validation. Steps to finalize the ranking criteria used in the prioritization process will include the following: ▪ Refining the prioritization process and criteria developed by the WQWG subcommittee. ▪ Continue developing an equitable method to apportion funding across the region. ▪ Integrating the criterion with the bucket strategy. ▪ Presenting ranking process and criteria to SANDAG.	▪ To provide a consistent prioritization process that may be used to evaluate/rank programs and projects submitted for funding through the Quality of Life process. ▪ To support SANDAG in finalizing the Funding Strategy.
Step 3 Develop a comprehensive regional water quality plan	A comprehensive water quality plan will focus regional water quality management. It will provide a common strategy—developed and supported by regional agencies and stakeholders—that prioritizes pollutants of concern, pollutant sources, monitoring, structural BMPs, and integrated regional solutions. Similar to the IRWMPP, this plan will also provide a nexus for developing example programs and projects eligible for funding through Quality of Life, IRWMPP, and build on WURMPs and other planning processes.	▪ Support SANDAG in finalizing the Funding Strategy. ▪ Attract outside funding (e.g., state/federal grants). ▪ Achieve WQOs through a comprehensive regional strategy.

Recognizing the fundamental importance of water quality to the San Diego region along with conclusions and recommendations presented in this report, the SANDAG Board of Directors will be considering whether or not to include the Water Quality Enhancement Element in the Funding Strategy. The WQWG acknowledges that the recommended prioritization and ranking of projects within the Water Quality Enhancement Element, as well as the proposed steps forward in this section, will likely be included in a lengthy SANDAG discussion as part of a larger dialogue regarding all four Funding Strategy elements. The WQWG offers these report recommendations for SANDAG's consideration based upon the members experience in the water quality arena.

7.0 REFERENCES

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ATTACHMENT A

Planning Framework

Water Quality Working Group Planning Framework, Quality of Life Funding Strategy

The purpose of this planning framework is to identify water quality objectives that are appropriate to address in this funding strategy, and help provide a course of action for the working group to utilize during this process. Using the planning framework will help achieve the following outcomes: to define regional goals and objectives, develop a regional cost estimate for consideration by SANDAG, discuss alternative funding mechanisms, and rank and prioritize programs and projects associated with reaching regional water quality goals. The planning framework is intended to be a living document and subject to modification as the WQWG moves forward during the funding strategy process.

Background

In 2004, the SANDAG Board of Directors adopted the Regional Comprehensive Plan (RCP), a long term planning framework for the region. The Integrated Regional Infrastructure Strategy (IRIS) is a component of the RCP developed in response to the need to manage demand for infrastructure services as the region continues to grow. The IRIS provides a framework for better integrating long-range planning with short-term capital expenditures for key region-serving infrastructure areas. Of the eight areas of regional infrastructure analyzed and reported upon in the IRIS, three areas were found not to have a regional dedicated and sustainable funding source. Those three areas included habitat conservation, shoreline preservation and stormwater management. In addition to the RCP and IRIS, the *TransNet* Extension Ordinance passed in late 2004 included an obligation to “act on additional regional funding measures (a ballot measure and/or other secure funding commitments) to meet long-term requirements for implementing habitat conservation plans in the San Diego region.” The current deadline outlined in the *TransNet* Extension Ordinance for meeting this commitment is November 2012. To determine how best to meet these regional needs, SANDAG created the Quality of Life Ad Hoc Steering Committee in 2007 to begin a regional dialogue on funding priorities and mechanisms.

Since that time regional dialogue on the funding strategy has continued. Independent third-party polling and community mapping processes performed in 2009 revealed that water quality is not only an important regional issue, but nearly everyone asked has a different concept or understanding for what constitutes “water quality”. Beginning with the original framework created by the County for SANDAG, the following framework has been established by the WQWG. It is intended to be used as an aid in the development of regional goals and objectives, development of a regional cost estimate, ranking and prioritization criteria for projects and programs specifically to address water quality issues in the region, and to support the effort to report these findings to SANDAG Stakeholder Working Group (SWG) for the Water Quality Working Group.

Planning Framework

This framework includes Guiding Principles, a Program Mission and Long-term Goal and Specific Program Focus Objectives for this funding strategy. Furthermore, the framework identifies the types of programs and projects that may be developed or enhanced to achieve water quality, not only to meet jurisdictional requirements (regulatory compliance) but taking into consideration other objectives as well, including environmental, groundwater protection and other ancillary benefits.

The WQWG identified the following principles to help guide the development of this planning framework:

Guiding Principles:

- Focus on protecting water quality, but acknowledge that programs and projects may provide other benefits
- Focus on water quality programs and projects that lack an existing, dedicated, sustainable funding source.
- Focus on programs or projects that are regional in nature and/or are most effectively implemented at the regional or watershed basis, but acknowledge that local/jurisdicational programs and projects can contribute to regional solutions.
- Acknowledge that “Beneficial Uses” (i.e., as defined by the Federal Clean Water Act) are a useful construct for defining needs.
- Acknowledge that when considering programs/projects eligible for funding, it is appropriate to aim to achieve an equitable distribution throughout the region.

Water Quality Element Program Mission:

To enhance and preserve the region’s quality of life through the restoration and protection of the quality of our surface water and groundwater from polluted runoff.

Overall Long-Term Water Quality Element Goal:

Protection and restoration of beneficial uses of local water bodies, watersheds, and aquifers from polluted runoff.

Specific Program Focus Objectives:

Tier 1 Objectives - Surface Water Quality / Runoff Management

1. Support the implementation of watershed-based programs and projects that achieve cost effective solutions for established water quality objectives.

   - Protect coastal waters such as bays, beaches, and estuaries from polluted runoff
   - Protect reservoirs from polluted runoff
   - Protect aquifers from polluted runoff
   - Enhance biota and habitat through creek and wetlands restoration

2. Support jurisdictional water quality programs and projects such as monitoring, education, enforcement, and source control.

   - Expand regional monitoring efforts for a more efficient and comprehensive program.
   - Expand coordinated regional education and outreach program to create a more robust program
   - Support special source studies that identify the sources of pollution, impacts and the steps needed to address them.

Examples of potential program and projects may include:

- Purchase of land for water quality treatment
- Conversion of hardened channels to natural
- Removal of invasive species
- Trash capture
- Retrofit of existing development with Low Impact Development (LID)
- Design and build structural treatment control BMPs
- Reservoir watersheds protection and management

Tier 2 Objectives – Ancillary Benefits

The primary scope of water quality needs identified for the purposes of the Quality of Life Funding Strategy are aimed first and foremost at demonstrable and significant improvements to water quality. Other programs and/or projects that can augment water supply, restore habitat, amend or include community enhancements such as parks or trails that provide multiple benefits, in addition to water quality, are included in the Tier 2 Objectives, entitled Ancillary Benefits.

The WQWG recognizes that these Ancillary Benefits should be justified on a cost-benefit basis and would be appropriate as they are complementary to and synergistic with other Quality of Life elements. Three categories of ancillary benefits have been identified, including:

1. Habitat Restoration
2. Community Enhancement
3. Water Supply Augmentation

Examples of potential programs and projects for ancillary benefits include:

- Creation of natural areas and trails in association with water quality projects
- Purchase, preservation and protection of lands to protect watersheds.
- Purchase of land adjacent to existing flood control channels for the purpose of constructing/ retrofitting multipurpose solutions including
  - flood control,
  - stormwater retention/treatment facilities,
  - treatment wetlands,
  - parks, trails, bike paths, and
  - riparian habitat restoration.

- Repaving of parking lots with pervious pavements, creating / implementing rain gardens and other LID applications (LID)
- Rain barrels to facilitate stormwater / condensation capture.
- Support of pilot projects that use captured and treated stormwater to augment irrigation on a localized scale, in combination with utilization of gray water.

ATTACHMENT B

Pollutants

SAN DIEGO RIVER WATERSHED
High Frequency of Occurrence Ratings and Pollutant Trends

SAN DIEGO RIVER WATERSHED	Ambient	Wet Weather		
	2007-2008	2007-2008	2006-2007	2005-2006
Bacteria	♦♦♦ Enterococci	♦♦♦ Fecal coliform	♦♦♦ Total coliform Fecal coliform	♦♦♦ Total coliform Fecal coliform
Dissolved Minerals	♦♦♦ TDS	-	-	-
Sediments	-	♦♦♦ Turbidity	♦♦♦ Turbidity	♦♦♦ Turbidity
Metals	-	-	-	-
Pesticides	-	-	-	-
Gross Pollutants	-	-	-	-
TRENDS: Increasing	-	TSS Turbidity *	TSS Turbidity *	-
TRENDS: Decreasing	-	Diazinon Chlopyrifos Dissolved arsenic Dissolved copper Nitrate	Diazinon Chlopyrifos Dissolved arsenic Dissolved copper Nitrate	Diazinon Chlopyrifos

* Trend is above the water quality benchmark.

The gap analysis conducted for the San Diego River "Pilot" Watershed identified the following three major pollutants of concern:

- Bacteria,
- Sediments, and
- Dissolved minerals.

SAN LUIS REY WATERSHED
High Frequency of Occurrence Ratings and Pollutant Trends

SAN LUIS REY WATERSHED	Ambient	Wet Weather		
	2007-2008	2007-2008	2006-2007	2005-2006
Dissolved Minerals	-	♦♦♦ TDS	♦♦♦ TDS	♦♦♦ TDS
Sediments	-	-	-	-
Metals	-	-	-	-
Pesticides	-	-	-	-
Gross Pollutants	-	-	-	-
TRENDS: Increasing	-	Nitrate ** Turbidity * Total coliform Fecal coliform * Enterococcus	Nitrate ** BOD Total coliform Fecal coliform * Enterococcus	Nitrate Dissolved phosphorus Total coliform Fecal coliform*
TRENDS: Decreasing	-	-	-	-

* Trend is above the water quality benchmark.
** Not likely to exceed wet weather benchmark during current permit cycle.

The gap analysis conducted for the San Luis Rey Watershed identified the following two major pollutants of concern:

- Bacteria, and
- Dissolved minerals.

TIJUANA RIVER WATERSHED
High Frequency of Occurrence Ratings and Pollutant Trends

TIJUANA WATERSHED	Ambient	Wet Weather		
	2007-2008	2007-2008	2006-2007	2005-2006
Bacteria	-	♦♦♦ Total coliform Fecal coliform Enterococci	♦♦♦ Total coliform Fecal coliform Enterococci	♦♦♦ Total coliform Fecal coliform Enterococci
Dissolved Minerals	-	-	-	-
Sediments	-	♦♦♦ TSS Turbidity	♦♦♦ TSS Turbidity	♦♦♦ TSS Turbidity
Metals	-	-	-	-
Pesticides	-	♦♦♦ Diazinon	♦♦♦ Diazinon	♦♦♦ Diazinon
Gross Pollutants	-	-	♦♦♦ Ammonia	-
TRENDS: Increasing	-	Nitrate TOC TSS * Turbidity * Total coliform Fecal coliform * Total arsenic Total lead * Total zinc * Toxicity *	Nitrate TOC TSS * Turbidity * Total coliform Fecal coliform * Total arsenic Total lead * Total zinc * Toxicity *	TSS Total coliform Enterococcus Toxicity *
TRENDS: Decreasing	-	TDS Diazinon * Dissolved arsenic Dissolved nickel Conductivity	TDS Diazinon * Dissolved arsenic Dissolved nickel Conductivity	Total phosphorus Diazinon * Dissolved nickel

* Trend is above the water quality benchmark.

The gap analysis conducted for the Tijuana River Watershed identified the following three major pollutants of concern:

- Bacteria,
- Sediments, and
- Pesticides.

Additional consideration should be given to the following:

- Metals, and
- Nutrients.

PUEBLO WATERSHED
High Frequency of Occurrence Ratings and Pollutant Trends

PUEBLO WATERSHED	Ambient	Wet Weather		
	2007-2008	2007-2008	2006-2007	2005-2006
Bacteria	-	♦♦♦ Total coliform Fecal coliform Enterococci	♦♦♦ Total coliform Fecal coliform Enterococci	♦♦♦ Total coliform Fecal coliform Enterococci
Dissolved Minerals	♦♦♦ TDS	-	-	-
Sediments	-	♦♦♦ TSS Turbidity	♦♦♦ Turbidity	♦♦♦ Turbidity
Metals	♦♦♦ Copper	-	♦♦♦ Copper Lead Zinc	♦♦♦ Copper Lead Zinc
Pesticides	-	-	-	-
Gross Pollutants	-	-	-	-
TRENDS: Increasing	-	Turbidity Total copper Toxicity	Turbidity * Nitrite Total copper Total zinc	Nitrate Total coliform Toxicity
TRENDS: Decreasing	-	TDS Diazinon Nitrate	TDS Diazinon MBAS Nitrate Toxicity *	Diazinon Total Lead

* Trend is above the water quality benchmark.

The gap analysis conducted for the Pueblo Watershed identified the following four major pollutants of concern:

- Bacteria,
- Dissolved Minerals,
- Sediments, and
- Metals.

Additional consideration should be given to the following:

- Nutrients.

ATTACHMENT C

Cost Estimate Assumptions

COST ESTIMATE ASSUMPTIONS

Introduction

The needs assessment and cost estimate developed for the Water Quality Enhancement Element of the Quality of Life Funding Strategy use a pilot watershed approach to simplify the assumptions and process. The San Diego River Watershed was selected as the “pilot” watershed for this exercise. Estimates completed for the San Diego River Pilot Watershed were scaled (i.e. different number and combinations of best management practices (BMPs) used to address targeted pollutants) for three land-use specific watershed classes. During the scaling process, it was determined that a set structure was needed to provide a consistent frame of reference for comparing and evaluating the BMP types used for each calculation. The cost “calculators” discussed in this Attachment, also provided in Attachment F, represent the final calculation structure developed.

This appendix describes the assumptions used to develop the cost calculators and needs assessment criteria for the San Diego River Pilot Watershed. This appendix also describes the assumptions to scale the pilot watershed calculator costs to address the land uses and water quality needs for each watershed class.

Targeted Pollutants

Based on the results of the gap analysis bacteria were selected as the priority targeted pollutant. Bacteria were selected because of:

- Its prevalence across the Region,
- The large disparity between the water quality objectives (WQOs) and current water quality, therefore requiring highly efficient (75% or greater efficiency) BMPs to reduce pollutant loads,
- An established total maximum daily load (TMDL) (i.e., a regulatory standard representing the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards), and
- Its limited methods of treatment (i.e. flow reduction or treatment type BMPs).

Preliminary analysis indicated that BMPs with high pollutant reduction efficiency (i.e. typically closer to 100% efficiency than 75% efficiency) are needed to reduce bacteria counts to below safe levels in the pilot watershed. Other pollutants (i.e. sediments, pesticides, metals, minerals) require 65–80% removal efficiencies. Priority was given to BMPs which address bacteria and other pollutants.

Sources of Pollutants

Impacts to watersheds from urbanization (i.e. developed areas of the watershed) are primarily attributed to impervious cover. Impervious cover limits the landscape’s natural ability to treat or infiltrate stormwater and urban runoff, and provides a mechanism for pollutants to travel efficiently from storm drains directly to creeks, rivers, lakes, reservoirs and ultimately the ocean. Studies reveal that degradation to the natural system begins with as little as 5% impervious cover in a watershed (Wright, et. al., 2006). Therefore the following assumptions were used for the needs assessment and cost estimate:

- By treating developed land area, there will be a direct pollutant reduction.
- Different suites of BMPs are needed to address urban and agricultural land uses. The total developed area was separated into these two broad categories. All land area and land use information was obtained from the 2009 version of the SanGIS GIS dataset.
- Open spaces (i.e. open space, land, water) represent natural background and was assumed not to contribute to pollution. Existing regulations for new development and significant redevelopment will address pollutants generated by future development. This assumption would not preclude new development projects from applying for funds through the Quality of Life Funding Strategy.

The tributary drainage area treated by each BMP was determined and input to the cost calculators. The "total tributary area (treated)" by each type of BMP was determined by multiplying the tributary drainage area and the quantity of BMPs to be implemented in the watershed over the 40-year program. When the sum of the "total tributary area (treated)" for all Bucket No. 2 and Bucket No. 3 BMPs was greater than or equal to the total area to be treated, it was assumed that the gap between the WQOs and actual water quality was achieved. The final quantities of each BMP were determined through an iterative process, wherein different combinations of BMPs were evaluated against the final developed area treated.

Cost Calculators and the Bucket Organizational Structure

As discussed in the *Needs Assessment and Cost Estimate for the Water Quality Enhancement Element Report*, BMPs were classified into the three buckets defined in Table C-1. The cost estimate and water treatment analysis completed for each watershed was structured into a three-part calculator. Separate calculators were developed for all three buckets. Developing three bucket-specific cost calculators simplified the analysis. This structure ensured that a balance of both Bucket No. 2 and Bucket NO. 3 was incorporated into the analysis (i.e., 65% treatment using Bucket No. 2 and 35% treatment using Bucket No. 3), and allowed calculations to be compared side-by-side (i.e. Full Structural Approach versus Integrated Approach, or pilot watershed versus a specific watershed class), as discussed below.

Table C-1. Three "Buckets" Used to Classify and Group Best Management Practices

Bucket	Definition	Types of BMPs
BUCKET No. 1 PERMIT REQUIRED & NON-STRUCTURAL BMPs	Nonstructural BMPs - including NPDES permit required activities and enhanced non-structural BMPs.	▪ Permit Required Activities (i.e. education, enforcement, monitoring, and annual watershed activities) ▪ Enhanced Nonstructural Activities – Enhanced Education/Outreach (i.e. community-based social marketing) – Enhanced Enforcement – Legislative Controls – Special Studies (i.e. developing lines of evidence to support adjusted WLAs during a TMDL re-opener and 303(d) de-listing, jurisdictional boundary monitoring, source identification studies, and studies designed to fill gaps in understanding). – Research to ban toxic products (i.e. Brake Pad Partnership supporting Senate Bill 346)

Table C-1. Three "Buckets" Used to Classify and Group Best Management Practices

Bucket	Definition	Types of BMPs
BUCKET No. 2 STRUCTURAL BMPS	Medium to low cost BMPs which provide a physical intervention to achieve an improvement in water quality or runoff volume.	▪ Street Sweeping/Catchment Cleaning ▪ Low Impact Development (LID) Retrofits ▪ Integrated "Green" Solutions (i.e. integrated Green Roof, Green Lot, Green Mall projects) ▪ Runoff Reduction BMPs ▪ Agriculture BMPs / Erosion Controls
BUCKET No. 3 RESTORATION & TREATMENT BMPS	Costly, infrastructure or labor intensive structural BMPs which provide treatment to large areas (typically regional projects).	▪ River, Stream & Habitat Restoration ▪ Treatment Trains – Ultraviolet treatment – Sand Filtration ▪ Sustainable Approaches – Diversions – Natural Treatment Systems – Large Scale Multi-Pollutant Treatment Trains – Sustainable Canyons/Open Space Projects

Major differences between calculators were illuminated by comparing the "quantity" and "BMPs by Type (% Total)" columns in each calculator. The "quantity" value indicates how many BMPs ought to be implemented within the watershed over the 40-year program. The "BMPs by Type (% Total)" identifies the how much area will be treated by a type of BMP. Given the different total developed acreages for each watershed, the percentage value was the preferred method of measure.

A comparison of the two cost estimates completed for the pilot watershed (Attachment F) illustrates that the Integrated Approach enhanced Bucket No. 1 by adding eight new nonstructural BMPs to the bottom of the calculator. Similarly, Bucket No. 3 was enhanced through two new restoration-type projects which did not appear on the Full Structural Approach Bucket No. 3 calculator. The different BMP priorities are highlighted by the "quantity" and "BMPs by Type (% Total)" values.

Best Management Practices Used in Cost Calculators

The natural soil type and low percolation rates observed across the Region generally limit the implementation of direct infiltration-type BMPs. Based on experiences with BMP planning and design across the Region, the BMPs identified in Table C-2 were selectively used in the cost calculators. The baseline cost of these BMPs was initially determined using basic designs and applying typical unit pricing sheets. These typical costs were compared to actual project and program costs/drainage areas provided by participants in the Water Quality Working Group (WQWG) as part of the validation process.

Table C-2. Best Management Practices Selected to Estimate Implementation Cost of the 40-year Regional Water Quality Enhancement Element

Type of BMP	Bucket	Used/ Not Used	Targeted Pollutants	Justification
Program Administration	Bucket 1	Used	General	Classified as a Standard / Permit Required Stormwater Program component (Stormwater Program).
Permit Fees	Bucket 1	Used	General	Stormwater Program
Education / Outreach	Bucket 1	Used	General	Stormwater Program

Table C-2. Best Management Practices Selected to Estimate Implementation Cost of the 40-year Regional Water Quality Enhancement Element

Type of BMP	Bucket	Used/ Not Used	Targeted Pollutants	Justification
Permit/Compliance Monitoring	Bucket 1	Used	General	Stormwater Program
Inspections / Enforcement	Bucket 1	Used	General	Stormwater Program
Code Modification/ Legislation	Bucket 1	Used	General	Enhanced Stormwater Program (Enhanced Program).
Master Planning (pre-TMDL)	Bucket 1	Used	General	Enhanced Program
Agriculture Education and BMP Cost Sharing Program	Bucket 1	Used	General	Enhanced Program
Targeted Outreach/CBSM	Bucket 1	Used	General	Enhanced Program
Special Studies	Bucket 1	Used	General	Enhanced Program
Targeted Enforcement	Bucket 1	Used	General	Enhanced Program
BMP Assessment Studies	Bucket 1	Used	General	Provided for long-term planning and local evaluation of projects/programs through an adaptive management approach.
Non-Structural Source Controls	Bucket 1	Used	General	Enhanced Program
Permit Compliance Street Sweeping and Catchment Cleaning	Bucket 1	Used	Trash, Debris, Metals, Sediments, Bacteria	Stormwater Program
Aggressive Street Sweeping	Bucket 1	Used	Trash, Debris, Metals, Bacteria	City of San Diego Targeted Aggressive Street Sweeping Study (2010) indicates that this type of program is effective at removing trash, debris, metals, and pesticides.
Aggressive Catchment Cleaning	Bucket 1	Used	Trash, Debris, Sediments, Bacteria	Enhanced Program
River / Creek / Beach Clean Ups	Bucket 1	Used	Trash, Debris, Bacteria	Stormwater Program Outreach and Partnering Opportunity. Direct Pollutant Removal.
Bioretention System	Bucket 2	Used	Bacteria, General	-
Pervious Concrete - Infiltration	Bucket 2	Used	Bacteria, General	Fewer projects identified relative to Pervious Concrete – Filtration.
Pervious Concrete - Filtration	Bucket 2	Used	Bacteria, General	-
Permeable AC - Filtration	Bucket 2	Used	Bacteria, General	
Rain Barrels - Filtration	Bucket 2	Used	Runoff, Bacteria, Metals	City of San Diego Rain Barrel and Downspout Disconnect Study (2010) indicates that this type may be an effective runoff management BMP.
Rain Barrels - Water Harvesting	Bucket 2	Used	Runoff, Bacteria	Enhanced Program Reuse opportunity

Table C-2. Best Management Practices Selected to Estimate Implementation Cost of the 40-year Regional Water Quality Enhancement Element

Type of BMP	Bucket	Used/ Not Used	Targeted Pollutants	Justification
Rain Barrels - Cisterns	Bucket 2	Used	Runoff, Sediment, Nutrients, Bacteria	Cisterns would be the BMP of choice for agricultural facilities to provide opportunities for irrigation water reuse. These systems would generally be larger than urban systems and require reduced settling time and treatment before reuse.
Large Harvesting Project (or similar)	Bucket 2	Used	Runoff, Bacteria	Enhanced Program Reuse opportunity
Annual Hydroseeding / Mulching	Bucket 2	Used	Runoff, Sediment, Nutrients, Bacteria	Combined agricultural and erosion control BMP
Low Flow Irrigation *(Drip line or similar)*	Bucket 2	Used	Runoff, Bacteria, Sediment	Combined agricultural and erosion control BMP
Silt Fence	Bucket 2	Used	Runoff, Sediments	Combined agricultural and erosion control BMP
Erosion / Agriculture Type 1: Integrated solutions	Bucket 2	Used	Runoff, Sediment, Nutrients, Bacteria	Combined agricultural and erosion control BMP
Erosion/Agriculture Type 2: Structural Controls	Bucket 2	Used	Runoff, Sediment, Nutrients, Bacteria	Combined agricultural and erosion control BMP
Green Roof	Bucket 2	Used	General	Low frequency of use. No more than one Green Roof project per year.
Green Lot	Bucket 2	Used	Bacteria, General	-
Green Mall	Bucket 2	Used	Bacteria, General	-
Medium Infiltration Basin	Bucket 2	Used	Bacteria, General	-
Extended Dry Pond	Bucket 2	Used	Bacteria, Sediment	-
Treatment Train	Bucket 2	Used	Bacteria, Trash, Debris, Metals, Pesticides, Oil/Grease	-
Integrated Community BMPs	Bucket 2	Used	Bacteria, General	-
Channel Restoration	Bucket 3	Used	General	-
Habitat / Wetlands Restoration	Bucket 3	Used	General	-
Dry Weather Creek Diversion	Bucket 3	Used	Runoff, Bacteria, General	-
Large Integrated Sustainable Canyon/	Bucket 3	Used	General	In highly urbanized areas, canyons represent an opportunity and space for restoration,

Table C-2. Best Management Practices Selected to Estimate Implementation Cost of the 40-year Regional Water Quality Enhancement Element

Type of BMP	Bucket	Used/ Not Used	Targeted Pollutants	Justification
Restoration Project				erosion control, and stormwater management on the surrounding mesas.
Large Scale Treatment Train	Bucket 3	Used	Bacteria, Trash, Debris, Metals, Pesticides, Oil/Grease	-
Infiltration Trench	Bucket 2	Not Used	-	Clay soils provide limited opportunity for infiltration projects. Pervious Concrete - Infiltration as the typical small type of infiltration BMP feasible for Region. Medium Infiltration Basin was also selected as the watershed-level preferred alternative. (Limited Application).
Infiltration Basin	Bucket 2	Not Used	-	Limited Application.
Vegetated Swale	Bucket 2	Not Used	-	Limited Application. Difficult placement in urbanized areas (Urban Areas).
Vegetated Stripe	Bucket 2	Not Used	-	Urban Areas. Limited Application.
Sand Filter	Bucket 2	Not Used	-	Limited Application.
Unit Pavers - Infiltration	Bucket 2	Not Used	-	Urban Areas. Limited Application.
Unit Pavers - Filtration	Bucket 2	Not Used	-	Urban Areas.
Crushed Aggregate	Bucket 2	Not Used	-	Limited Application.
Permeable AC - Infiltration	Bucket 2	Not Used	-	Limited Application.
Cobbles	Bucket 2	Not Used	-	Urban Areas. Limited Application (except as integrated into creek bed Restoration – this was considered a separate BMP).

Agency Size

Costs for Bucket No. 1 (programs and non-structural BMPs) and Bucket No. 2 source controls (street sweeping, catchment cleaning, and clean-up projects) were scaled according to the “size” of each agency in the Region. This approach recognizes that each watershed has a unique number and combination of agencies with different budget structures and limitations. The main objective of this sizing exercise was to avoid applying a single permit compliance and program cost to all watersheds equally.

Agency sizes used to scale program and non-structural BMP costs were obtained from the FY 2008/2009 JURMP reports and are presented in Table C-3. Agency size was determined using a combination of jurisdictional area in square miles, population per square mile, and FY 2008/2009 budgets dedicated to stormwater and water quality enhancement. Generally, small agencies had stormwater and water quality enhancement budgets of less than $1M and jurisdiction of 10 miles^2 or less. Large agencies had budgets greater than or equal to $30M and jurisdiction of more than 300 miles[2]. Agencies falling between these classifications were considered "medium" sized.

Table C-3. Agency Size Classifications

Agency	Agency Size	Area (Sq Mile) [a]	Persons/ Sq Mile [a]
County	Large	4,200	670
City of San Diego	Large	324	3,772
City of Chula Vista	Medium	48	3,551
City of Oceanside	Medium	40	3,967
City of Poway	Medium	39	1,225
City of Carlsbad	Medium	37	2,090
City of Escondido	Medium	36	3,681
City of San Marcos	Medium	23	2,314
City of Encinitas	Medium	19	3,036
City of Vista	Medium	18	4,810
Port of SD	Medium	-	-
Airport Authority	Medium	-	-
City of Santee	Medium	16	3,299
City of El Cajon	Medium	14	6,511
City of La Mesa	Small	9	5,912
City of Coronado [b]	Small	8	2,879
City of Imperial Beach	Small	7	6,321
National City	Small	7	7,342
City of Lemon Grove [b]	Small	4	6,473
City of Solana Beach [b]	Small	4	3,731
City of Del Mar [b]	Small	2	2,656

a) U.S. Census Bureau. Figures provided for 2000 (U.S. Census Bureau, 2010). No data was available for the Cities of Coronado, Lemon Grove, Solana Beach, or Del Mar.

b) Source: City Data, 2010.

Creek Restoration

The actual length of channelized or impacted riverbed across the Region is currently unknown. General assumptions had to be made in order to determine the potential length currently channelized, and the length which could feasibly be restored.

The SanGIS "Rivers" GIS dataset provided the blue line stream length data for each watershed across the Region. Storm drain channel data (i.e., dimensions, lengths, and type of channel bottom) was obtained from available agency GIS layers. Comparing the storm drain channel data with the Rivers data would have been the standard method of determining the proportion of channelized river. Generally, storm drain channel data available in SanGIS 2009 were limited.[1]

[1] The "Drainage Conveyance" GIS layer for the City of San Diego identifies channels, ditches and culverts among the storm drain conveyance features in the data set and includes information on material type. This represented the best available dataset.

Based on the pilot watershed approach used for this Regional cost estimation, a detailed analysis was conducted for the San Diego River Watershed and is detailed below. This analysis was then scaled to the three remaining Watershed Classes.

Using the SanGIS "Rivers" GIS dataset, there are 142.2 miles of blue line stream within the San Diego River Watershed identified as "major" tributaries. This estimate does not include the many tributaries and streams within the larger NHD hydrography dataset.[2] Features overlaying the San GIS Rivers file which were not labeled as natural or unknown material were selected to represent the portions of the river and creeks that have been channelized or altered. The lengths of these features found within the San Diego River, Murphy Canyon, and Alvarado Canyon rivers were estimated to be 9.40 miles, or 36.34% channelized. Based on aerial imagery, the percent modified was roughly calculated. The portion channelized was then determined as summarized in Table C-4.

Table C-4. Proportion of Modified River in the San Diego River Pilot Watershed

Agency	Total Length River (miles)	Total Length Modified River (miles)	Proportion Modified (%)	Method
City of San Diego	25.86	9.40	36.34%	Directly Calculated from SanGIS 2009 and "Rivers"
City of El Cajon	6.50	6.18	95%	Aerial Imagery and "Rivers"
County of San Diego	103.93	20.79	20%	Aerial Imagery and "Rivers"
City of Santee	5.90	0.29	5%	Aerial Imagery and "Rivers"
City of Poway	-	-	-	-
AVERAGE	-	-	**39.1%**	-

Based on aerial imagery, it was determined that 36% was an adequate representation of channelized stream/river length for each watershed.[3] Based on a general understanding that the majority of these channelized streams/rivers are located in highly urbanized areas where increasing channel widths and/or adding more natural channel is not possible, it was assumed that 10% of this final portion of stream could be restored.

Land Acquisition Assumptions

As shown in Table C-5, five types of BMPs were assumed to require the acquisition of land for implementation. Land acquisition was limited to the project footprint, and only for a portion of the total number of BMPs of the type implemented in the cost estimate. Due to detention-type layout of four of the projects, more BMPs were assumed to require land to be acquired (i.e. 80% to 90% of the BMPs). It was assumed that 50% the Large Scale Multi-Drainage Area treatment train projects would require land acquisition in order to provide adequate placement of treatment infrastructure. A summary of the land acquisition assumptions is provided in Table C-5.

[2] The creeks and rivers includes in this analysis include: San Diego River, Alvarado Canyon, Boulder, Broadway Channel, Cedar, Chocolate Canyon, Coleman, Daney Canyon, Dye Canyon, Forester Creek, King, Los Coches, Los Conejos, Murphy Canyon, San Vicinte, and Temescal.

[3] According to the Chollas Creek Dissolved Metals TMDL Implementation Plan, approximately 30% of the creek was channelized prior to November 28, 1975.

Table C-5. Structural Best Management Practices and Land Acquisition Assumptions

Structural BMP	Amount of Land to be Acquired	Portion of BMPs Assuming Land Acquisition
Bioretention System	Footprint~0.05 ac	80%
Medium Infiltration Basin	Footprint~0.02 ac/1 ac tributary	90%
Extended Dry Pond	Footprint~0.02 ac/1 ac tributary	90%
Habitat Restoration/Wetlands	Footprint~0.02 ac/1 ac tributary	90%
Large Scale Multi-Drainage Area/Multiple Neighborhood Treatment Train	Footprint ~0.5 ac/1 ac tributary	50%

The *Chollas Creek TMDL Source Loading Assessment, BMP Evaluation, and Recommended Monitoring Strategy Report* assumed land acquisition would cost $1.6 million/square mile (2006 dollars). Given the different land uses across the Region and changes in property values due to changes in the economy, a survey of property prices across the Region was conducted in June 2010 to determine actual property values. A survey of 90 listings for different property types and property areas was completed using the real estate for sale portion of the Signon San Diego website (www.signonsandiego.com/). All costs were normalized to dollars per acre of property. The average costs by location are summarized in Table C-6. The final land acquisition price used in the cost assumption was $2.6M per acre.

Table C-6. Average Real Estate Costs Across San Diego in Summer 2010

Area within the San Diego Region	Type of Property for Sale (Average $ per acre of property, by Location and Property Type)					
	Commercial (# properties)	Industrial (# properties)	Single Family (# properties)	Raw Land (# properties)	Multi Family (# properties)	Average
Carlsbad	$6,730,212 (1)		$4,202,875 (2)			$5,045,320 (3)
Chula Vista	$5,435,217 (1)	$3,630,000 (1)		$433,333 (1)	$2,939,357 (3)	$3,052,770 (6)
El Cajon	$1,025,362 (1)	$2,131,329 (1)	$4,977,514 (1)			$2,711,401 (3)
Escondido		$2,613,600 (1)		$72,408 (2)	$2,414,366 (3)	$1,666,919 (6)
Imperial Beach		$2,916,778 (1)			$4,277,085 (3)	$3,937,008 (4)
La Jolla		$8,521,438 (2)				$8,521,438 (2)
La Mesa		$5,700,714 (1)	$3,894,677 (2)			$4,496,690 (3)
National City	$3,370,714 (1)	$3,341,729 (3)	$1,399,541 (1)	$926,888 (4)	$1,230,174 (1)	$1,973,317 (10)
Oceanside			$2,225,522 (3)			$2,225,522 (3)
Poway		$2,125,000 (1)			$1,594,607 (1)	$1,859,804 (2)
"San Diego"	$3,761,619 (2)	$2,140,852 (5)	$4,083,797 (9)	$1,244,382 (12)	$2,580,587 (6)	$2,511,699 (34)
San Marcos				$312,444 (1)	$1,505,956 (2)	$1,108,119 (3)
Santee		$4,495,089				$4,495,089

Table C-6. Average Real Estate Costs Across San Diego in Summer 2010

Area within the San Diego Region	**Type of Property for Sale** *(Average $ per acre of property, by Location and Property Type)*					
	Commercial (# properties)	**Industrial (# properties)**	**Single Family (# properties)**	**Raw Land (# properties)**	**Multi Family (# properties)**	**Average**
		(1)				(1)
"Unincorporated Areas"	$374,375 (1)		$291,696 (1)	$4,452 (1)		$223,508 (3)
Vista	$984,211 (1)	$1,295,910 (1)		$44,750 (1)	$1,804,307 (3)	$1,289,632 (6)
Fallbrook					$3,056,513 (1)	$3,056,513 (1)
Grand Total	**$3,180,416 (8)**	**$3,482,264 (18)**	**$3,489,189 (19)**	**$889,997 (22)**	**$2,551,394 (23)**	**$2,585,341 (90)**

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ATTACHMENT D

Cost Estimate Validations

COST ESTIMATION VALIDATION

Estimated watershed costs were validated using costs generated for existing or planned programs and projects. The following two types of validations were used to ensure that the cost estimates developed for the San Diego region adequately represented real-world implementation needs.

Total Maximum Daily Load Approach

A TMDL represents the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Compliance with existing and future TMDLs is the likely driver for future water and storm water management. Therefore a TMDL-centric approach was developed to validate BMP implementation costs.

The TMDL approach was used to validate the order-of-magnitude costs developed for the region using the Full Structural and Integrated Approaches described in the *Needs Assessment and Cost Estimate for the Water Quality Enhancement Element Report*. This verification approach identified recent cost estimates completed as part of watershed-level TMDL compliance planning efforts across Southern California. Four estimates completed between 2004 and 2006 determined that TMDL compliance would cost between \$20–100M/mile^2 of developed watershed. If watershed costs for the region differed significantly from this range (i.e., order of magnitude difference), a hypothesis was presented as an explanation for the significantly different cost and/or a more detailed cost evaluation was completed.

Program Validation

Information provided by regional stakeholders regarding current and planned programs and projects was used to validate individual BMP costs used in the cost calculators. In addition to construction/implementation costs and maintenance costs, the data collected through this validation process were used to evaluate the type and mix of BMPs appropriate for the region, the typical drainage area addressed by the each BMP, and implementation constraints.

Programs and projects used for the cost of programs validation were evaluated against WQWG goals and objectives, SANDAG Element Criteria, and overall mission of the Funding Strategy. Additional criteria, specific to the Framework goals, were developed by a subcommittee of WQWG and were used to aid in example projects selection. Additional information regarding the criteria and evaluation process is provided in the following sections of this Appendix.

COST ESTIMATION VALIDATION RESULTS

The pilot watershed cost estimates were validated using the TMDL Approach and the BMP cost estimates were validated using the Program Validation Approach, described below.

Total Maximum Daily Load Approach Cost Validation

The TMDL Approach validated the order of magnitude costs generated by the cost calculator used for the pilot watershed. The TMDL Approach identified recent cost estimation efforts for TMDL compliance planning completed across Southern California. In 2000, the California Department of Transportation (Caltrans) completed the first large-scale BMP cost estimates for Southern California. According to the BMP Retrofit Pilot Program report, it would cost approximately $1.0M to implement BMPs at eight locations across Los Angeles County and subsequently treat approximately 33,700 meters^2 of urbanized area (Caltrans, 2000). The Caltrans estimate was used to validate the 2006 Los Angeles IRWMP. The Los Angeles IRWMP estimated TMDL compliance in a 2,058-mile^2 drainage area (approximately 77% developed area) to cost between $27–76B over a 20-year timeframe (Leadership Committee, 2006). The *Sun Valley Watershed Management Plan* cost estimate for 4.4 miles^2 of developed area would cost $150–279M and take 10–12 years to implement (LADPW, 2004). The *Santa Monica Watershed Management Plan* estimated costs of $209M over 8.1 miles^2 and 20-year timeframe (Brown & Caldwell, 2006). The *Chollas Creek TMDL Source Loading Assessment, BMP Evaluation, and Recommended Monitoring Strategy Report* estimated a Full Structural Program would cost from $1.2–1.4B over 13,027 developed acres and 10 years (Weston, 2006).[1] As shown in Table D-1, the typical cost of TMDL compliance across Southern California was estimated at $20–100M/mile^2 of developed area. The spectrum of estimated water quality implementation costs for Southern California is presented on Table D-1. The result for the Full Structural Approach fell in the middle of this typical range of costs, whereas the Integrated Approach result, represented by the dark green bar, fell at the low end of the cost spectrum. The 2010 pilot watershed results were also compared with analyses completed for the Chollas Creek Subwatershed in 2006. By implementing the Integrated Approach in place of the Full Structural Approach, the Chollas Creek estimate achieved a cost savings of approximately 40% (Weston, 2006). This is comparable to the 45% cost savings for the pilot watershed. These validation results indicate that the methodology used for this cost estimate are reasonable and typical of other needs assessments across Southern California.

[1] This cost estimate was completed for the City of San Diego's jurisdictional area only.

Table D-1. Cost Validations Using the Total Maximum Daily Load Approach

Cost Estimate – Year[a]	Developed Area (miles^2)	Low Range Cost ($M/developed miles^2)	High Range Cost ($M/developed miles^2)
1. Caltrans – 2000	1.3E (-2)	$96.6	–
2. Chollas Creek Full Structural Approach – 2006	20.4	$63.9	$69.0
3. Chollas Creek Integrated Approach[b] – 2006	20.4	$38.3	$44.7
4. Sun Valley – 2004	4.4	$39.1	$72.8
5. Santa Monica – 2006	8.1	$27.9	–
6. Los Angeles – 2006[c]	1,585[b]	$18.5	$51.9
Pilot Watershed – 2010	**140.1**	**22.7**	**39.7**

[a]The cost estimate implementation period used is shorter than the 40-year timeframe used in this report. Cost estimate values have been adjusted to 2010 dollars using annual compounding and an annual interest rate of i=3.0%, for standard inflation.
[b]The Integrated Approach resulted in an approximate 40% reduction in cost over the 20-year life cycle (Weston, 2006).
[c]The developed area addressed by the Los Angeles Integrated Regional WMP is not provided in the report. The jurisdictional/watershed boundaries for the participating agencies are unknown. Based on a GIS analysis using land use data from the Southern California Association of Governments (SCAG), the region is approximately 77% developed.
Sources: 1) Caltrans, 2000; 2) Weston, 2006; 3) Weston, 2006; 4) LADPW, 2004; 5) Brown & Caldwell, 2006; 6) Leadership Committee, 2006.

Program Validation Results

Stakeholders participating in WQWG provided actual project costs and implementation data (e.g., project type, drainage area, and O&M requirements), which was used to validate the original estimated watershed costs. Lessons learned from the planning and implementation processes were used to identify and confirm the types of BMPs appropriate for the region based on soil type, space constraints, and other design factors. Table D-2 summarizes the final costs used to formulate the final cost estimates used for the San Diego River Pilot Watershed and regional cost estimates.

Table D-2. Cost Validations for Best Management Practices

Bucket No. BMP Type	Project	Agency/ Stakeholder	Actual Project Cost	Drainage Area[a]	Assumed Cost[a]	San Diego River Cost[a]
Bucket No. 1 Agriculture Education & Source Control	Education Program targeting small-farm fertilizing and watering practices. Recommended BMPs would be subsidized	County of San Diego	$300K/ yr	Regional	Watershed-specific *(agricultural area, acres)*	$12.4K/yr
Bucket No. 1 Master Planning	Water quality treatment for the SDA-7 Storm Water Quality Master Plan	County of San Diego	$1.4M	4,565 acres	Small: $10K Medium: $100K Large: $500K	Small: $100K Medium: $500K Large: $1.5M
	JURMP 2008–2009 Regional Shared Costs and TMDL Investigations	City of Solana Beach	$10–47K	Small agency		
		Port of San Diego	$75K	Medium agency		
		City of Vista	$65–335K	Medium agency		
		City of Chula Vista	$165K	Medium agency		
Bucket No. 2 Clean Ups	Clean Team and Green Team	San Diego River Park Foundation	$100K/yr	Watershed	$100K/yr	Small: $15K/yr Medium:
	JURMP 2008–2009[b]	City of	$18K	Small		

Table D-2. Cost Validations for Best Management Practices

Bucket No. BMP Type	Project	Agency/ Stakeholder	Actual Project Cost	Drainage Area[a]	Assumed Cost[a]	San Diego River Cost[a]
	Budget for Annual Clean-Up Events	Coronado		agency		$75K/yr Large: $100K/yr
		City of Solana Beach	~$10K	Small agency		
		Port of San Diego	~$2.0K	Medium agency		
		City of Poway	$250K	Medium agency		
Bucket No. 2 Rain Barrels (filtration)	Rain Barrels / Down Spout Disconnect Pilot Study – Southcrest Park	City of San Diego	$22.7K/ yr	0.25 acre	$21K/40-yrs	$29K/ 40-yrs
	Rain Barrels / Down Spout Disconnect Pilot Study – South Bay Wastewater Treatment Plant	City of San Diego	$19.6K/ yr	0.07 acre		
Bucket No. 2 Rain Barrels (harvesting)	Rain Barrels / Down Spout Disconnect Pilot Study	City of San Diego	$3,600–4,500/ system	0.05 acre	$19K/40-yrs	$25K/ 40-yrs
Bucket No. 2 Green Roof	Unknown County Building – 4-inch design	City of San Diego / County of San Diego	$480,700	0.11 acre	$110K (0.07 acre)	$574K (0.10 acre)
	Unknown County Building – 8-inch design		$326,850	0.11 acre		
Bucket No. 2 Green Lot	Phase I Bioretention Planter – Environmental Service Facilities	City of San Diego	$284K	0.9 acre	–	$437K/ 40-yrs

Table D-2. Cost Validations for Best Management Practices

Bucket No. BMP Type	Project	Agency/ Stakeholder	Actual Project Cost	Drainage Area[a]	Assumed Cost[a]	San Diego River Cost[a]
Bucket No. 2 Green Mall	Complex Street	City of San Diego	$116K	0.59 acre	$186K/ 40-yrs (0.6 acre)	$415K/ 40-yrs (3.0 acres)
	San Ysidro Boulevard	City of San Diego	$200K	1.7 acres		
	Environmental Services Facility	City of San Diego	$893K	13.6 acres		
Bucket No. 2 Treatment Train	Mission Valley Library	City of San Diego	$181K	5.0 acres	$211K/ 40-yrs (5.0 acres)	$347K/ 40-yrs (3.5 acres)
	Phase II Bacteria Treatment Train – Environmental Service Facilities	City of San Diego	$488K	2.0 acres		
Bucket No. 2 Bioretention System	Environmental Service Facilities (small)	City of San Diego	$89K	1.0 acre	$101K/ 40-yrs (0.8 acre)	$229K/ 40-yrs (0.9 acre)
	Environmental Service Facilities (large)	City of San Diego	$284K	2.0 acres		
Bucket No. 2 Pervious Concrete (filtration)	Allied Gardens (full)	City of San Diego	$166K	0.6 acre	$158K/ 40-yrs (1.5 acres)	$355/ 40-yrs (1.0 acre)
	Allied Gardens (partial)	City of San Diego	$123K	0.3 acre		
	Green Alley Filtration BMPs for San Diego Bay Protection	City of San Diego	$566K	2.0 acres		
Bucket No. 2 Medium Infiltration Basin	Sefton Field Infiltration Basin *(amended soils project)*	City of San Diego	$170K	5.5 acres	$448,200[d] /40-yrs	$762,800[d]/ 40-yrs

Table D-2. Cost Validations for Best Management Practices

Bucket No. BMP Type	Project	Agency/ Stakeholder	Actual Project Cost	Drainage Area[a]	Assumed Cost[a]	San Diego River Cost[a]
	Memorial Park Infiltration Basin *(underground storage tank project)*	City of San Diego	$800K	1.4 acres	(5.5 acres)	(3.5 acres)
	Chollas Creek Infiltration Basin[d]	City of San Diego	$2.3M	22.9 acres	–	$1.1M/ 40-yrs (10 acres)
Bucket No. 2 Erosion/ Agriculture Type 2 – Structural	Erosion/Sediment Control BMPs for Famosa Slough and San Diego River Watershed Protection	City of San Diego	$120K ($1,000/ yr O&M)[e]	1.3 acres	$250,000/ 40-yrs (2.0 acres)	$158,600/ 40-yrs (1.5 acres)
	Vortex Separator	San Diego River Park Foundation	$35–120K/ system	1.0 acre or less		
Bucket No. 3 Creek/River Restoration	Forester Creek Restoration Project	City of Santee	$10.0M	1.2 creek miles	$1,500/ linear ft (0.16 acre)	$1,524/ linear ft (0.16 acre)
	Cottonwood Creek Park Project	City of Encinitas	$1.2M	650 linear ft		
	Ruxton Avenue Channel Project	County of San Diego	$790K	500 linear ft		
	Sustainable Canyons Program – Maple Street Canyon Upland Restoration	City of San Diego	$330K	300 linear ft		
Bucket No. 3	Forester Creek	City of	$36.0M	540 acres	$15,000	$17,016

Table D-2. Cost Validations for Best Management Practices

Bucket No. BMP Type	Project	Agency/ Stakeholder	Actual Project Cost	Drainage Area[a]	Assumed Cost[a]	San Diego River Cost[a]
Wetland Restoration	Restoration Project	Santee			(1.0 acre)	(1.0 acre)
	Cottonwood Creek Park Project	City of Encinitas	$6.4M	2,200 acres		
	Kimball and Bickmore Natural Treatment Project	City of Chino	$2.3M	1,487 acres		
	San Diego Zoo Safari Park Treatment Wetland Demonstration Project	County of San Diego	$600K	62.5 acres		
	Sustainable Canyons Program – Maple Street Canyon Natural Treatment Wetland	City of San Diego	$420K	96 acres		
Bucket No. 3 Dry Weather / Low Storm Flow Creek Diversion with Wetland / Basin	Water Quality Case Study – Santa Ana River	Orange County Water District	$160M	2,650 miles^2	$30M / 40-yrs (2,500 acres)	$10M / 40-yrs (2,500 acres)
	Cucamonga Creek Watershed Regional Water Quality Project	City of Chino	$19.7 M	76.7 miles^2		
	Westchester Storm Water BMP Design *(detention basin and infiltration system with pump systems)*	City of Los Angeles	$21.8 M	2,190 acres		
Bucket No. 3 Large Scale	Robb Field	City of San Diego	$9.5M	460 acres	$30.8M/	$19.3M/

Table D-2. Cost Validations for Best Management Practices

Bucket No. BMP Type	Project	Agency/ Stakeholder	Actual Project Cost	Drainage Area[a]	Assumed Cost[a]	San Diego River Cost[a]
Multi-Drainage Area Treatment Train	Bannock Avenue	City of San Diego	$3.6M	65 acres	40-yrs (460 acres)	40-yrs (300 acres)

[a]Agency size was determined using a combination of jurisdictional area (i.e., square miles), population per square mile, and FY 2008–2009 budget. Generally, small agencies had budgets of less than $1M and jurisdiction of 10 miles^2 or less. Large agencies had budgets greater than or equal to $30M and jurisdiction of more than 300 miles^2. Agencies falling between these classifications were considered medium sized.

[b]Source: Weston, 2007; Weston, 2008.

[c]Assumes additional land acquisition cost. Initial assumption of $3M per acre acquired was reduced to $2.6M per acre acquired based on regional land acquisition prices.

[d]Large underground infiltration basin with a small tributary drainage area. This cost was only applied to the highly urbanized watersheds (i.e., Pueblo Class) where project space is limited.

[e]Assumed value.