Implementation Strategies

Summary - Providing Opportunities for Achieving Water Quality Benefits and Watershed Enhancement and Restoration

The Implementation Plan strategies that have been developed to address the anticipated requirements of Ballona Creek Bacteria TMDL that will include within a single TMDL the summer dry weather, winter dry weather, and winter wet weather conditions for indicator bacteria. The Implementation Plan particularly focuses on an integrated approach and describes a systematic strategy for progressively improving compliance with Ballona Creek Bacteria TMDL objectives while simultaneously providing opportunities for achieving broader water quality benefits and goals for the watershed enhancement and enhancement. The Preferred Strategy for reducing exceedances relies on a combination of measures designed to decrease migration and transport of bacteria and other pollutants by reducing the amount of dry weather and wet weather runoff while at the same time pursuing opportunities for beneficial reuse of runoff. However, an Alternative Strategy that focuses on "end-of-pipe" treatment solutions is also considered as a basis for comparison.

This Implementation Strategy has been developed through a collaborative, stakeholder-based process, initiated by the City of Los Angeles in the summer of 2004 with the creation of "Cleaner Rivers through Effective Stakeholder TMDLs" (CREST). The specific activities conducted in support of the Ballona Creek Bacteria TMDL are described in the following sections.

The Preferred Strategy incorporates elements from a wide range of activities and projects including: institutional flow source control (primarily dry weather); extensive structural/physical flow source control; limited diversion to sewer system (dry weather only); partial dry weather treat and discharge/return (possible use of the North Outfall Treatment Facility (NOTF)); limited wet weather treat and discharge/return (possible use of NOTF); bacteria source control; and in-stream solutions (primarily dry weather). Full implementation of this diverse range of activities and projects will require an extended time frame, and may require an overall investment of close to $400 million in the watershed and over $10 million/yr in a wide range of implementation and operational costs. At the same time, many of the activities and projects identified will provide value and benefits that support the implementation of other TMDLs in the watershed attainment of other TMDLs and water quality efforts.

The Water Resource

Ballona Creek watershed is dominated by urban development, with only 17% open space located predominantly in the northern and upper-most portions of the watershed. The remaining 83% of the Ballona Creek watershed is dominated by a combination of residential land use (high-density and low density) covering nearly 60%, and commercial land use covering nearly 16% of the total watershed area. This high degree of urbanization influences both the hydrology of the watershed and the pollutant loading to Ballona Creek. A map of the Ballona Creek Watershed is shown in Figure 1.

Urbanization leads to changes in the hydrologic response to rain events by both creating a more rapid runoff response and by increasing the total amount of runoff. The increased runoff is caused by decreased infiltration of rainwater within the watershed due to increased area of imperviousness. Urbanization in Ballona Creek has resulted in larger amounts of wet weather flood flows that have led to flood control measures such as construction of underground storm drain systems and concrete lined flood control channels for Ballona Creek and its primary tributaries. The sources of dry weather flows are the combination of nuisance flows (excess irrigation, car washing) and permitted National Pollution Discharge Elimination System (NPDES) discharges (e.g. cooling water, permitted industrial discharges). The persistence of dry weather flows from tributaries and within Ballona Creek results from these increased urban sources but is also partly the result of the concrete lined flood control channels preventing distributed, watershed-wide, infiltration.

Residential and commercial land uses result in the highest concentrations of bacterial indicators, based on Los Angeles County data collected from a number of mass emission sites between 1994 and 2000, including Ballona Creek. A highly urbanized environment can lead to increased bacterial loading from numerous sources such as pet waste, leaking sewer lines, illegal discharges, and homeless encampments.

General Regulatory Background

This TMDL and Implementation Plan are in response to the 303(d) current listing (2004) of the Ballona Creek Estuary as an impaired water body with respect to Coliform bacteria. The listing is based on the fact that sampling indicates that water quality in the estuary has exceeded the water quality objectives established for unrestricted water contact recreational use (REC-1). Although not specifically named in the 303(d) list, water quality in Ballona Creek Reaches 2 (Limited Contact Water Recreation) and 1 (Non-Contact Water Recreation), and Sepulveda Channel (Limited Contact Water Recreation) also can exceed the water quality objectives established for those beneficial uses.

Figure 1

The regulatory mechanisms used to implement the TMDL will include the Los Angeles County Municipal Storm Water NPDES Permit, the State of California Department of Transportation (Caltrans) Storm Water Permit, minor NPDES permits, general NPDES permits, general industrial storm water permits, and general construction storm water permits. Each NPDES permit that allows discharges into Ballona Creek or Estuary will be reopened or amended at re-issuance, in accordance with applicable laws, to address implementation and monitoring of this TMDL and to be consistent with the Waste Load Allocations (WLAs) of this TMDL.

Each permittee or group of permittees along with other responsible agencies[1] within a sub watershed may decide how to achieve the necessary reductions in exceedance days at each compliance point by employing one or more of the implementation strategies discussed below or any other viable strategy. The Porter Cologne Water Quality Control Act prohibits the California Regional Water Quality Control Board-Los Angeles Region (Regional Board) from prescribing the method of achieving compliance with water quality standards, and likewise TMDLs. The Stakeholder Process described in the following section has identified some potential implementation strategies; however, there is no requirement to follow the particular strategies proposed herein as long as the maximum allowable exceedance days are not exceeded.

There is a strong interest on the part of watershed stakeholders to focus on solutions to reducing bacterial loading in Ballona Creek and improving compliance with bacteria-related water quality objectives that emphasize watershed-based strategies to reduce both wet and dry weather flows, and bacterial source control. Many of these strategies are similar to implementation approaches that may be considered for meeting other Total Maximum Daily Loads (TMDLs) within the Ballona Creek Watershed including the Ballona Creek Metals TMDL and the Ballona Creek Estuary Toxics TMDL.

CREST Stakeholder Process

The overall stakeholder involvement process assisting with the development of the Ballona Creek Bacteria TMDL was initiated by the City of Los Angeles, in the spring of 2005 with the creation of "Cleaner Rivers through Effective Stakeholder TMDLs" (CREST). Stakeholders include representatives from cities, the County of Los Angeles, regulatory agencies, and environmental groups with interests in the watershed. The purpose of CREST is to provide a collaborative process for TMDL development. CREST's mission is to "restore and preserve beneficial uses of our rivers and creeks using a collaborative partnership to develop TMDLs and water quality attainment strategies with active and informed involvement by the community and stakeholders and by facilitating effective, innovative, practical, financially feasible, and integrated solutions."

[1] For the purposes of the TMDL, "responsible jurisdictions and responsible agencies" includes a local or state agency that (1) is responsible for discharges into the Ballona Creek watershed, or (2) is a permittee or a co-permittee on a municipal storm water permit.

CREST has organized a Steering Committee that meets every other month and a Technical Committee that meets monthly. The City of Los Angeles has contracted with a consultant team to facilitate both the Steering and Technical Committee meetings and to provide technical support and work products. CREST is chaired by the City, Regional Board and US Environmental Protection Agency – Region 9 (USEPA) who promote involvement of potential stakeholders in CREST with the participation open to all stakeholders.

The CREST Technical Committee and Steering Committees began discussing potential involvement in the Ballona Creek Bacteria TMDL process in the spring of 2005 through briefings from Regional Board staff and discussions at Committee Meetings. It was subsequently determined CREST would become actively involved in assisting the Regional Board in the development of the Implementation Strategies and Monitoring sections of the TMDL (also described under the CREST process as the "Water Quality Attainment Strategy" portion of the TDML). Stakeholders participated in several sessions to identify a range of potential implementation options, and proposed numerous, options which could be implemented as building blocks, that could be incorporated into one or more implementation alternatives designed to meet TMDL compliance. These options are summarized in a matrix (Table 1).

In order to evaluate the potential benefits as well as the challenges associated with the numerous individual options identified, the options were grouped into two major categories: 1) strategies to reduce or eliminate flow to the Creek; and 2) strategies to reduce bacteria in discharges and/or creek flow. Strategies that would reduce or eliminate flow to the Creek were further subdivided to identify options that involved: programmatic or institutional (non-structural) flow source control measures, such as irrigation control/oversight and public educational outreach campaigns; 2) structural or physical flow source control measures, such as watershed-based solutions involving reduction of impervious areas, onsite storage and reuse, and/or onsite percolation/recharge; and 3) diversion of flow from the Creek and/or tributaries for treatment and possible reuse. Strategies to reduce bacteria in discharges and/or Creek flow were subdivided into options that involved: 1) treatment and return of flow in the Creek and/or its tributaries; 2) bacterial source control; and 3) in-stream solutions, such as "day lighting" sections of the tributaries that are now culverted, or restoration of reaches of currently lined Creek or channels to more natural conditions.

In addition to the specific groups of options discussed above, the stakeholders also expressed the importance of considering combinations of options, multi-phased or adaptive management approaches, and pilot programs during the development of a comprehensive implementation alternative.

Table 1 - Ballona Creek Bacteria TMDL Implementation Options

Objective		Implementation Option Group	Specific Implementation Option	Considerations
Reduce or Eliminate Flow to Creek	FLOW SOURCE CONTROL (Institutional)	Flow Source Control	Irrigation Control/ Oversight Canvass water purveyors for use distribution data Institutional Educational Programs Fix leaking Water Supply/Infrastructure	Remote Controlled Irrigation Systems - CIMIS linkage Review IRP to understand irrigation water use by area Control the flow to control bacteria Staff to fix broken sprinklers (cheaper then persuading owners) Wet weather - limitted to minimal help with implementation due to size of flows
	FLOW SOURCE CONTROL (Structural/Physical)	Watershed Management Perspective Structural/Physical BMPs	Reduce % Impervious On-site Storage and Re-use On-site Percolation/ Groundwater Recharge Promote use of "grey" water systems Wet Weather - Promote use of Cisterns at invidual properties	Develop design standards for residents Identify large flow non-receiving water opportunities Local infiltration basin at catch basin near parks and schools Identify school yards near large drains Look at landuse layer to determine open space/park/school areas for possible BMP siting Identify a "Control" stormdrain or small catchment to pilot project
	DIVERSION	Treatment Plants	Dry weather - Low-flow Diversions to POTWs (for treatment and reuse). Wet Weather - Diversions to POTWs not pratical or limited to very small flows due to minimal excess wet weather capacity Dedicated Urban Run-Off Plant (for treatment and Re-use/discharge)	Placement of treatment important to consider An additional treatment plant at bottom of watershed is double-duty (LA River Experience - high percentage of treated effluent during dry weather) Depending on site, could serve as dilution for smaller drains Possible treatment placement option - bottom of Compton (before estuary) Wet Weather - very limited except for very small flows due to limited reuse potential
Reduce bacteria in discharges and/or creek flow	TREAT & RETURN	Treat and Discharge or Return	Dry weather - temparily divert and disinfect (Use UV or O3). Wet weather, temporarily divert, store, partial solids reduction and disinfect (Use UV or O3).	Disinfection only or treat other pollutants?
	SOURCE CONTROL (BACTERIAL)	Bacterial source control (residential/open space vs. commercial)		Implementation timeline too long? "Focused" san surveys to identify hot spots - target regular water in gutters Limits on sanitary surveys - ephemeral sources Use SCCWRP study as a starting point for identifying hot spots
			"Reverse" Sanitary Survey	Identify problem sources before they get into the stormdrain system TMDL compliance for doing watershed inspections Task City/County field staff with investigating water in gutters
			Control high load sources	Target flow or bacteria concentration hot-spots? Hot spots hard to identify; variability for both bacteria and flows Limits are so low; therefore important to control both flow high bacteria sources Identify low flow high concentration sources and high flow low concentration sources
			Understand High-Load Sources	Natural bacteria sources (including wildlife and biofilms)
			Identify Landuses that are Contributing Dry-weather Bacteria	Same high contributing land uses as during wet weather (as identified by SCCWRP)?
			Identify a Control Drainage Watershed	Use to run pilot studies
	IN-STREAM SOLUTIONS	Stream Restoration	Daylight to Prevent Growth/Re-growth; restore streams to natural condition	Treat water before daylighting? Reverse policies to culvert open channels Mapping of all natural and open drains; Identify land uses to "daylight" conduits Is there data to support whether daylighting will attenuate bacteria concentrations enough? Natural creek can attenuate other pollutants as well Wet weather - of limited potential except possibly at very low flows
Other Options or Combination of Options		Multi-phase Approach	Simple, short-term solutions at outset, then gather more info for specific correction of hot-spot problems	Cities need some commitment that good faith efforts satisfy some demands for some time.
		Pilot Project	Single Catchment Area with Mix of Landuses	Review SMB Restoration Study and SCCWRP studies - divide BC into sub-watersheds to site pilot project

Implementation Goals, Objectives and Performance Measures

As the Regional Board has been developing TMDLs for a number of water bodies and pollutants in the area, it has recognized two general approaches to implementing TMDLs. The first is an integrated water resources approach that takes a holistic view of regional water resources management. The objectives of this approach are to integrate planning for future wastewater, storm water, recycled water, and potable water needs and systems; focus on beneficial re-use of storm water, including groundwater infiltration, at multiple points throughout a watershed; and address multiple pollutants. The Regional Board recognizes that an integrated water resources approach not only provides water quality benefits, but also that responsible agencies implementing the TMDL can serve a variety of public purposes by adopting an integrated water resources approach. Such an integrated approach allows for the incorporation and enhancement of other public goals such as water supply, recycling and storage, environmental justice, parks, greenways and open space, and active and passive recreational and environmental education opportunities. The alternative to an integrated approach is a plan focused primarily on a single pollutant and on pollutant reduction through treatment and discharge that does not take into consideration these other watershed and integrated resource management goals.

The proposed Implementation Plan employs an iterative, adaptive management process by providing a framework to assist the responsible agencies with the identification and implementation of an integrated program of effective and practical solutions for progressively achieving compliance.

An important component of the stakeholder process in the development of an implementation plan for the Ballona Creek Bacteria TMDL was the development of a comprehensive set of criteria, consistent with CREST's stated mission, by which potential implementation strategies could be evaluated. An initial request from a member of the stakeholder group to look at the effectiveness versus cost of the various options was expanded to compare the performance of various potential options against a range of evaluation criteria. Recurring themes from stakeholder technical and steering committee meetings were incorporated into a preliminary list of objectives for implementation of the Ballona Creek Bacteria TMDL. These draft objectives were then reviewed and refined by the stakeholder group. The final objectives are provided in Table 2.

The groups of implementation options, as outlined in Table 1, were then compared to these objectives to evaluate which options were best able to meet a range of objectives and should therefore be considered for incorporation into a comprehensive, watershed-wide implementation alternative for which a cost estimate would be developed.

Table 2
CREST Ballona Creek Bacteria TMDL Implementation Objectives and Performance Measures

Objective	Potential Performance Measure
1 Protect Public Health and Safety	
1.1 Protect for Recreation Use (where designated)	Pathogen count reduction (e.g., E.coli or fecal coliform)
1.2 Protect from Safety Hazards	Safety hazard protection (e.g., flood hazards) -Not Applicable to Dry Weather
2 Protect the Environment	
2.1 Improve/Restore Habitat in Natural Surface Waters	Miles of river habitat revitalized; number/diversity of aquatic species; miles of riparian habitat; acres of riparian wetlands
2.2 Provide for Water Supply Benefits from Runoff Management	Amount of dry and wet runoff used for irrigation or groundwater recharge
3 Protect Quality of Life	
3.1 Provide Open Space/Enhance Land	Acres of increased open space.
4 Improve Compliance Certainty	
4.1 Certainty to Meet Target Levels	Proven technology (high certainty) to emerging technology (low certainty)
5 Enhance Cost Efficiency	
5.1 Provide Lower Cost Solutions	Life cycle costs, expressed as average household monthly cost
6 Provide Adaptable Solutions	
6.1 Effective Under Wet Weather Flow Conditions	
6.2 Effective for Other TMDLs (metals, toxics)	
6.3 Ability to Implement Phased Approach	
6.4 Applicable over Entire Watershed	
7 Improve Implementation Timeline	
7.1 Improve Implementation Timeline	Years to implement

The ability of each option to meet a particular objective was ranked, qualitatively, in comparison to other proposed options (high, medium, or low). Performance rankings were based on collaborative assessment by technical committee and considerations identified during stakeholder discussions. This ranking process was conducted for the purposes of promoting stakeholder discussion about the viability of the various potential options. The results of the ranking evaluations based on substantial input from the Stakeholders are presented in a series of bar charts [Appendix X]. The results of these individual comparisons of performance against individual objectives were then summed to examine the ability of a potential implementation option to meet the entire range of CREST objectives, under either the dry weather or wet weather scenario (Figure 2a and 2b).

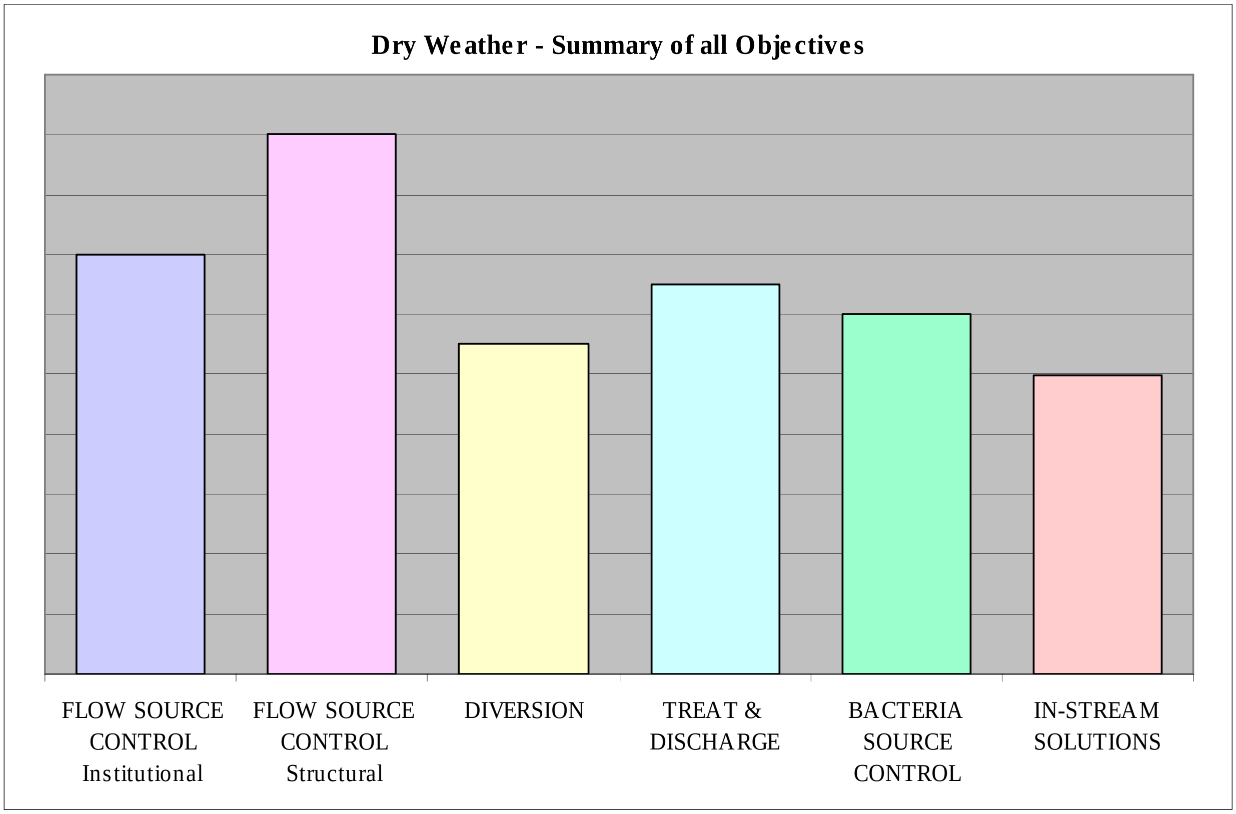


Figure 2a
Ballona Creek Bacteria TMDL – Dry Weather Summary Chart

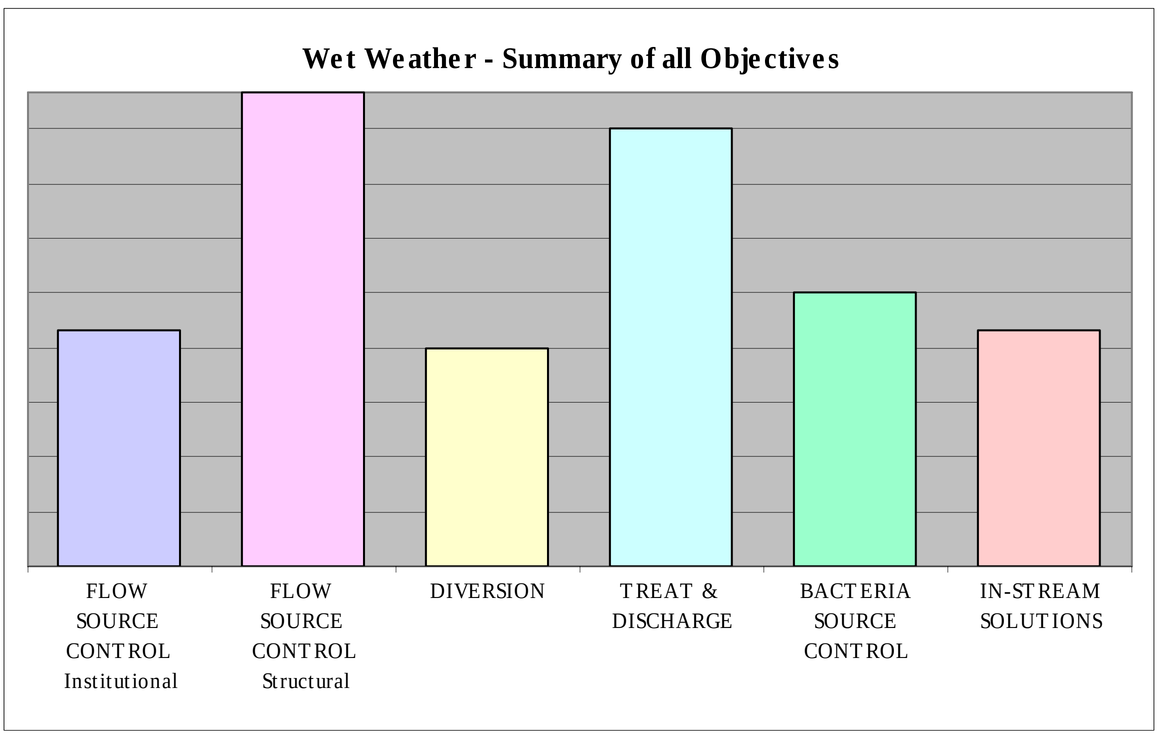


Figure 2b
Ballona Creek Bacteria TMDL – Wet Weather Summary Chart

Options involving flow source control (both institutional and dispersed, watershed-wide structural solutions) and the treatment and return of tributary and/or Creek flows ranked highest when evaluated cumulatively against the range of implementation objectives, as shown above in the summary bar charts (Figures 2a and 2b). Stakeholders expressed a preference for implementing an alternative that incorporates the ability to meet a range of long-term goals for the watershed, consistent with planning strategies outlined in the City of Los Angeles' Integrated Resource Plan (IRP). Based on these summary results, and on additional stakeholder input and discussion, the following specific iterative and adaptive approach was considered as the primary focus for developing an implementation cost estimates. In addition, , limited cost estimates were also developed for a more conventional capture, treat and discharge approach to meeting the TMDL requirements.

Implementation Strategies of Other Ballona Creek TMDLs and Other Current Watershed Planning Efforts and Activities

A integrated water resources approach to improving water quality for Ballona Creek has been outlined by the City of Los Angeles' Integrated Plan for the Wastewater Program (IPWP). In particular, Phase 2 of the IPWP resulted in the Integrated Resource Plan (IRP) that is a City-wide strategy developed to increase the amount of wet weather urban runoff that can be captured and beneficially used in Los Angeles. Increased capture and beneficial use of wet weather runoff alone may not be sufficient to achieve waste load allocations. Therefore, the implementation strategies proposed below, while emphasizing watershed based flow and bacterial source control, also include additional measures to increase the probability that TMDL requirements can be met.

Several TMDLs have been, or are in the process of being implemented for Ballona Creek. This includes the Trash TMDL, effective date August 2, 2002, a Metals TMDL, and a Toxics TMDL both adopted by the Regional Board in July of 2005 and expected to be approved in the near future by the State Water Resources Control Board and the USEPA Region 9. The Trash TMDL calls for a combination of institutional controls and capture systems to meet TMDL requirements. A secondary benefit of trash removal systems will be the capture and removal of sediment and associated pollutants. The metals TMDL calls for structural and non-structural watershed-wide Best Management Practices (BMP) implementation, together with diversion and treatment strategy for high volume wet weather flows.

Implementation of these other TMDLs will also assist with meeting the goals of the Bacteria TMDL. As an implementation plan for the Bacteria TMDL is finalized, the implementation plans for the other TMDLs (Metals and Toxics) should be reviewed to ensure consistency of approach and coordination.

The City of Los Angeles's Integrated Resources Plan alternatives, currently undergoing detailed environmental analyses, all include components for the significant beneficial reuse of urban runoff with multiple benefits including helping to meet both reuse and TMDL requirements. The comprehensive Ballona Creek Watershed Management Plan, completed in September 2004, recommends implementing a wide range of projects and activities that will enhance water resources (both quantity and quality), land and planning goals and objectives for the watershed. The water quality objectives recognize the need to improve water quality and implement the TMDLs. An initial list of potential projects that have water quality benefits, including meeting the Bacteria TMDL is identified in the Management Plan. These projects and activities generally address one or more of the implementation option groups noted in Table 1 including:

- Institutional flow source control
- Structural/physical flow source control
- Partial dry weather treat and discharge/return
- Bacteria source control
- In-stream solutions

The Ballona Creek Watershed Task Force is continuing forward with planning and implementation of a number of the projects identified in the Management Plan and is seeking grant funding under Proposition 50 and Proposition O. The Watershed Plan also identifies a number of ongoing or proposed community-based monitoring activities that can be integrated with a monitoring program for the TMDL as discussed under the Monitoring Program Section.

Another effort underway is the Ballona Creek BMP Prioritization Project. In 2003, the Santa Monica Bay Restoration Commission initiated a Ballona Creek BMP Project Work Group, to implement a BMP prioritization project for the Ballona Creek Watershed and monitor effectiveness of BMPs in treating 303(d) listed pollutants. In later phases, this work group is developing a planning and implementation strategy that can be used by municipalities to successfully plan, design, implement, and monitor structural retrofit BMPs for storm water quality management. The outcome of this study will assist the stakeholders in identifying and prioritizing watershed projects and BMPs for implementation relative to their effectiveness in meeting the TMDL requirements.

A third activity that has been started and may provide assistance in more specifically quantifying potential pollutant reduction (including bacteria) for a variety of implementation measures throughout the watershed is the development and application of Watershed Models for BMP simulations in Ballona Creek that has been initiated by the Southern California Coastal Water Research Project (SCCWRP). The models have the potential for providing a more rigorous analysis and prediction of the pollutant reduction that could be realized through extensive implementation of a wide range of non-structural and structural measures such as those included in the Preferred Strategy. Initial model development and calibration and some preliminary predictive runs have been conducted for a limited number of BMPs approaches/assumptions and several indicator constituents including bacteria. The models could be further developed and applied as part of the implementation phase of the TMDL to help guide decisions.

Potential Implementation Strategies for Ballona Creek Bacteria TMDL

Two strategies for achieving compliance with the TMDL were developed by the stakeholders. The "Preferred Strategy" provides an integrated resources approach to the TMDL implementation and meets a range of other long term watershed planning goals. An "Alternative Strategy" was also developed that relies more heavily on the capture, treatment and return of stormwater. This strategy was developed to compare the preferred strategy against an alternative strategy based on more conventional engineering and construction with potentially lower risk but much greater investment in infrastructure and much less opportunity to achieve multiple objectives. Both the preferred and alternative strategies are further described below.

Preferred Strategy – Emphasize Watershed-based and Integrated Solutions for Progressively Achieving Compliance

The preferred strategy is an integrated water resources approach. This approach takes a holistic view of regional water resources by integrating planning focused on beneficial re-uses of stormwater and other multiple purpose goals. For comparative purposes, an alternative strategy that primarily focuses only Bacteria TMDL compliance through a capture, treat and return approach is also summarized.

This strategy incorporates the following options:

- Institutional flow source control (primarily dry weather)
- Structural/physical flow source control
- Partial diversion to sewer system (dry weather only)
- Partial dry weather treat and discharge/return (possible use of the North Outfall Treatment Facility (NOTF))
- Limited wet weather treat and discharge/return (possible use of NOTF)
- Bacteria source control
- In-stream solutions (primarily dry weather)

Description of Preferred Strategy

Below is the general description of the Preferred Strategy:

- Implement aggressive institutional source control strategies to reduce dry weather runoff flows and bacteria densities (in dry and wet weather runoff) throughout the watershed.

- Implement extensive structural flow source control (i.e. onsite capture for infiltration, use, treatment) options throughout the watershed. Reuse portion of captured water where possible.

- Implement projects identified under Ballona Creek Watershed Management Plan, Prop. 50 projects and other related projects.

- Divert cumulative dry weather flows in Creek at the North Outfall Treatment Facility (NOTF) less source control reductions (7-8 cubic feet per second (cfs) on average; plan for maximum 15-23 cfs, which is high-end of dry weather flows); treat 100% of flow at a minimum to meet REC-1 water quality objectives (WQOs); return 3-4 cfs to Creek and reuse up to approximately 4 cfs of treated water in accordance with the IRP reclaimed water plan. Provide additional treatment equivalent to Title 22 requirements for unrestricted irrigation for reuse water.

- Divert 100% of the remaining dry weather flows from Sepulveda and West L.A. sub-watersheds (approximately 2 cfs average, 4 cfs max) to the sewer system at multiple locations within Ballona Creek or tributaries.

- Divert 100% of the remaining dry weather flows from the Centinela sub-watershed (approximately 4 cfs average, 8 cfs max) to the sewer system or a constructed wetlands facility if feasible.

- Divert, treat and return to Creek as much additional wet weather flow as possible at the NOTF without adding significant additional storage.

- Provide in stream treatment through Creek restoration and/or storm drain daylighting where feasible (dry weather only)

Assumptions Associated with Preferred Strategy

- Institutional and structural flow source control measures can achieve 25% reduction in dry weather flows reaching Ballona Creek.

- Existing average dry weather flows diverted at NOTF of approximately 7 cfs or 69% of average Ballona Creek dry weather flows at Sawtelle after watershed-based source control measures reduce flows by 25% (75% of 14 cfs or 10.5 cfs).

- North Outfall Treatment Facility will be available for this purpose.

- Treatment at NOTF will be for bacteria (treatment costs for other constituents (i.e. metals, toxics) will not be considered here). Treatment methods to be considered are: ultraviolet (UV) disinfection, or chlorination-dechlorination. Treatment for discharge to be below REC-1 standards (possibly accomplished with limited filtration). Treatment for reuse to include direct filtration and disinfection.

- Available Hyperion Treatment Plant (HTP) dry weather capacity on average of up to 15 cfs (9.7 mgd) with peak capacity of twice that much.

- Assume one diversion location for each of the lower sub-watersheds (West Los Angeles and Windsow Hills)

- Assumes sewer system tie-ins/junctions with sufficient capacity exist in locations near the Creek.

- Assumes sufficient land area at a location on the south side of Ballona Creek can be obtained/allocated for use as a treatment wetlands

- Includes wet weather on-site and subwatershed capture, infiltration, use and /or bacteria reduction treatment controls

- Projects and opportunities identified in Ballona Creek Watershed Management Plan, Prop 50 grant application and other sources represent good starting opportunities

Uncertainties Associated with the Preferred Strategy

- Degree to which institutional and structural source control measures will reduce dry weather flow.

- How much of the flow downstream from North Outfall Treatment Facility can cost-effectively be pumped back up to the facility? Sepulveda Channel, located 1.5 miles downstream of NOTF, accounts for about 1cfs or 30% of the remaining 3.3 cfs contributed to Ballona Creek below the NOTF after assumed 25% reduction through source control measures. Therefore, the maximum amount of flow below treatment facility that could be collected and returned for treatment is 2.3 cfs, and likely less.

- Locations in the watershed to target for structural source control. The obvious needs are for Sepulveda watershed, Centinela watershed, because these two contribute on average 1.3 cfs and 4.8 cfs respectively to Ballona Creek and Estuary, and cannot easily be routed for treatment to North Outfall Treatment Facility. Reduction in flow from these watersheds will directly result in lower costs for diversion to sewer system.

- Very limited data on amount of dry weather flow from West L.A. and Westwood Village watersheds.

- Exceedances at 90 percentile rainfall year may be greater than allowable under TMDL, but still significantly reduced for many years and under 17 days for some years.

Implications for Monitoring and Compliance

- Will need flexibility in timing and location of compliance monitoring within Reach 1 and will need flexibility in compliance upper portion of Reach 2 above NOTF facility. Assumption is that aggressive source control (flow and/or bacteria) measures will reduce FC to below the 2,000/4,000 MPN standard without diversions in this reach (note minimal sampling data available for FC for Reach 1). Compliance and monitoring point in Reach 2 should be downstream of point where NOTF would return disinfected flow to Creek. This will result in ensuring treated water returned to Ballona Creek at NOTF meets water quality standards prior to entering the estuary. Compliance and monitoring within the estuary, below Centinela Creek, will ensure that water quality standards are being met by the system as a whole. Also, compliance monitoring for tributary storm drain channels (e.g. Centinela, Sepulveda) would need to be at/near lower end of channels or in Ballona Creek/Estuary to allow these to be used as conveyance to points of diversion for treatment or to sewer system.

- Consider locations for diversion with regard to compliance points.

- Considerations regarding possible bacteria sources in a constructed wetland.

Alternative Strategy – Divert Dry Weather Flow and Intercept, Treat, Temporarily Store, Disinfect and Discharge Wet Weather Runoff

In addition to the Preferred Strategy described above, CREST also developed an Alternative Strategy for achieving compliance with the Ballona Creek Bacteria TMDL that relies more heavily on the capture, treatment and return of stormwater to the Creek. The alternative to the Preferred Strategy was developed for two reasons. First, stakeholders wanted to explore the range of potential implementation strategies in order compare the cost-effectiveness and the relative benefits of the two end-member implementation scenarios. Second, the Alternative Strategy was developed to address the possibility of a short implementation timeline for compliance with the TMDL. The dispersed, watershed-based solutions that are the primary focus of the Preferred Alternative will likely require longer implementation timelines and adaptive management approaches, whereas the Alternative Strategy provides a greater degree of certainty with regard to meeting WQOs in a relatively short timeline.

The Alternative Strategy incorporates the following elements:

- Institutional flow source control (primarily dry weather)

- Structural/physical flow source control

- Full diversion to sewer system (dry weather only)

- Bacteria source control

- Capture, store, treat and discharge or return

Description of the Alterative Strategy

Below is the general description of the Alternative Strategy:

- Implement aggressive institutional source control strategies to reduce dry weather flows and bacteria throughout the watershed.
- Implement structural flow source control (i.e. onsite capture for infiltration, use) options throughout the watershed, where feasible.
- Divert cumulative dry weather flows in Creek at North Outfall Treatment Facility less source control reductions (7-8 cfs on average; plan for max 15-23 cfs, which is high-end of dry weather flows) to the sewer system at the sewer junction structure near the North Outfall Treatment Facility.
- Divert 100% of the remaining dry weather flows from Sepulveda, West L.A. and Centinela sub-watersheds to the sewer system at multiple locations within Ballona Creek or tributaries
- Temporarily divert, capture, treat and discharge BC flow at three new treatment facilities located downstream with sufficient capacity to capture the runoff from approximately 0.45 in of rainfall across all subwatersheds. This estimated was originally developed as a theoretical target storm event to approximately represent the 17 day storm event in, 90th percentile year for beaches TMDL WLA). While not a regulatory standard, this provides an order-of-magnitude runoff target for facility sizing. This includes treatment facilities to serve the Upper Watershed (Proposed Treatment Plant 1), West L.A. and Westwood Village Watersheds (Proposed Treatment Plant 2), and Centinela Creek (Proposed Treatment Plant 3).

Assumptions Associated with the Alternative Strategy

- Institutional and structural flow source control measures can achieve 25% reduction in dry weather flows reaching Ballona Creek.
- HTP dry weather capacity on average of 7-8 cfs with peak capacity of twice that much.
- Assume one diversion location for each of the lower sub-watersheds.
- Assumes sewer system tie-ins/junctions with sufficient capacity exist in locations proximal to the Creek.
- HTP dry weather capacity on average of 15 cfs (including Centinela Creek) with peak capacity of twice that much
- Logical capture points would be: 1) North Outfall Treatment Facility; and 2) at two other major storm drain discharge points (one north of channel for Sepulveda and West LA watersheds, one south of channel from Centinela Creek watershed).
- Assumes sufficient capture volume constructed at strategic locations

- Use maximum wet weather storm event volumes for 0.45 inch rainfall event.

Uncertainties Associated with the Alternative Strategy

- Degree to which institutional and structural source control measures will reduce flow and bacteria.

- Locations in the watershed to target for structural source control. The obvious needs are for Sepulveda watershed, Centinela watershed, because these two contribute on average approximately 2 cfs and 4.8 cfs respectively to Ballona Creek and the Estuary, and cannot easily be routed for treatment to North Outfall Treatment Facility. Reduction in flow from these watersheds will directly result in lower costs for diversion to sewer system.

- Specific locations for diversion points for dry weather flow.

- Extent to which upper reaches and unnamed tributaries would have to meet bacteria objectives

Implications for Monitoring and Compliance

- May need flexibility in compliance within Reach 1 and will need flexibility in compliance in upper portion of Reach 2 above NOTF facility. Assumption is that aggressive source control (flow and/or bacteria) measures will reduce FC to below the 2,000/4,000 MPN standard without diversions in this reach (note minimal sampling data available for FC for Reach 1) but significant uncertainty under wet weather flow conditions. Compliance and monitoring point in Reach 2 preferred downstream of point where NOTF would return disinfected flow to Creek. This will result in ensuring treated water returned to Ballona Creek at NOTF meets water quality standards prior to entering the estuary. Compliance and monitoring within the estuary, below Centinela Creek, will ensure that water quality standards are being met by the system as a whole. Also, compliance monitoring for tributary storm drain channels (e.g. Centinela, Sepulveda) would need to be at/near lower end of channels or in Ballona Creek/Estuary to allow these to be used as conveyance to points of diversion for treatment or to sewer system.

- Consider locations for diversion with regard to compliance points.

Implementation Schedule

The proposed implementation schedule consists of a phased approach as discussed below and outlined in Table 3. This TMDL provides an implementation schedule allowing the responsible jurisdictions and agencies time to implement the preferred watershed-based and integrated strategy as well conduct targeted special studies identified in the following section.

To be consistent with the schedule outlined in the SMB Beaches Bacteria TMDL, the proposed Ballona Creek Bacteria TMDL schedule allows at least three years from the effective date of the Ballona Creek TMDL to meet summer dry-weather WQOs in the estuary.

The stakeholders recognize that fully meeting the dry weather TMDL targets in the Ballona Creek Watershed including the estuary will likely be more difficult than in the SMBB watersheds. Relatively short deadlines could result in driving dry weather solutions toward more sewer system diversions which are not the focus of the preferred strategy.

Because the Ballona Creek Bacteria TMDL will not be adopted until 2006 (close to four years after the effective date of the SMBB Bacteria TMDL), the implementation timeline must necessarily be contingent upon the effective date for this TMDL. Other interim compliance targets for wet weather and winter dry weather in the estuary and the final compliance targets for all named reaches and tributaries would also follow the relative timeline described in the SMBB Bacteria TMDL, as shown in Table 3.

For the inland reaches and the named tributaries (Sepulveda and Centinela), initial interim compliance targets are proposed to occur at 10 years after the effective date of this TMDL. This is a longer schedule than generally provided for in the Santa Monica Bay Beaches Bacteria TMDL. However, it is warranted due to the dispersed nature of the sources and the foreseeable implementation measures. This 10-year planning horizon is the anticipated timeline required to conduct several tasks, the combination of which will be necessary for this reach to meet compliance. These activities include: focused source identification and institution of control measures; initial implementation of dispersed structural source control projects; additional investigation regarding in-stream solutions and potential implementation of in-stream solutions where appropriate; and, potential re-outfitting of the North Outfall Treatment Facility for diversion of dry weather flows in Reach 2 for reuse and treatment/discharge of disinfected flow. Further, the incorporation of longer implementation timelines in the inland reaches recognizes the longer timelines associated with implementing the watershed-based approach outlined in the Preferred Strategy. This schedule allows the responsible agencies to conduct pilot-scale or phased implementations of programmatic and structural source control BMPs in focused areas of the watershed to determine the most cost effective combination of BMPs for widespread implementation.

The SMB Beaches TMDL is scheduled to be reviewed in 2007 to: re-evaluate the allowable winter dry-weather and wet-weather exceedance days based on additional data from bacterial indicator densities in the wave wash; to re-evaluate the reference system selected to set allowable exceedance levels; and to re-evaluate the reference year used in the calculation of allowable exceedance days. It is proposed that the BC Bacteria TMDL be scheduled for re-consideration four years from the effective date of adoption to review the findings of any special studies. This re-evaluation will include any revisions based on changes to the Santa Monica Bay Beaches Bacteria TMDL. Revising the TMDL will not create a conflict in the interim, since the Santa Monica Bay Beaches Bacteria TMDL does not require compliance during winter dry-weather or wet-weather until six and ten years, respectively, from the effective date of the TMDL. Therefore, the allowable exceedance days for winter dry-weather and wet-weather can be revised as necessary before the compliance deadline.

Table 3
Potential Ballona Creek Bacteria TMDL Implementation Schedule

Time after BC Bacteria TMDL Effective Date	Implementation Activity/Compliance Target		
	Estuary (Mouth)	**Reach 2 and Sepulveda Channel**	**Reach 1**
1 year	Responsible jurisdictions and agencies submit a comprehensive monitoring plan.		
3 years	1. Responsible jurisdictions and agencies provide a draft report to the Regional Board outlining how each intends to cooperatively achieve compliance with the TMDL. The report shall include implementation methods, an implementation schedule, and proposed milestones. Specifically, the plan must include 1) a comprehensive description of all steps to be taken to meet the 3-year summer dry weather compliance schedule for the estuary and 2) the specific milestones associated with the 3-Year and 6-Year intervals for the inland reaches and the named tributaries. 2. If the responsible jurisdiction or agency is requesting an extension of the summer dry-weather compliance schedule, the plan must include a description of all local ordinances necessary to implement the detailed workplan and assurances that such ordinances have been adopted before the request for an extension is granted. 3. If a responsible jurisdiction or agency is requesting a longer schedule to the wet-weather compliance schedule based on an integrated approach, the plan must include a description of the integrated water resources (IRP) approach is required. Compliance with the wet-weather allocations shall be as soon as possible but under no circumstances shall it exceed XX years for non-integrated approaches or extend xx years for an integrated approach.		
42 months	4. Responsible jurisdictions and agencies submit a final implementation report to the Regional Board.		
1-3 Years	• Conduct special studies with the potential to change the TMDL. Results to be reported by the end of Year 3.		
4 Years	• No exceedances due to summer dry weather flows*	• Achieve interim implementation milestones to be described by each responsible jurisdiction in the detailed implementation plan.	• Achieve interim implementation milestones to be described by each responsible jurisdiction in the detailed implementation plan.
4 Years	• Reconsider TMDL based on revisions to SMBBB TMDL and results of special studies.		
6 Years	• Achieve 10% reduction from the total wet weather exceedance-day reduction* • Achieve compliance with allowable number of exceedance days - 4 winter dry weather days (under daily sampling) or 1 winter dry weather day (under weekly sampling) for Ballona Creek mouth (bottom of estuary)	• Achieve interim implementation milestones to be described by each responsible jurisdiction in the detailed implementation plan.	• Achieve interim implementation milestones to be described by each responsible jurisdiction in the detailed implementation plan.

Table 3 (Continued)
Potential Ballona Creek Bacteria TMDL Implementation Schedule

Time after BC Bacteria TMDL Effective Date	Implementation Activity/Compliance Target		
	Estuary (Mouth)	Reach 2 and Sepulveda Channel	Reach 1
10 Years	• Achieve 25% reduction from the total wet weather exceedance-day reduction*	• No exceedances due to summer or winter dry weather flow • Achieve 15% reduction from total wet weather exceedance-day reduction	• Achieve 15% reduction from total wet weather exceedance-day reduction
15 Years	• Achieve 50% reduction from the total wet weather exceedance-day reduction*	• Achieve 40% reduction from total wet weather exceedance-day reduction	• Achieve 40% reduction from total wet weather exceedance-day reduction
18+ Years	Achieve compliance with Water Quality Objectives (WQOs)		

* Relative timeline determined by Santa Monica Bay Beaches Bacteria TMDL, shifted to begin upon the effective date for Ballona Creek Bacteria TMDL.

It should be noted that 18 years may really not be enough time for full compliance under all hydrologic conditions for inland reaches since the Ballona Creek watershed is larger and more complex and longer time frames may be warranted.

Cost Estimates for Implementation Strategies

Two implementation cost estimates were developed. The first is for the "Preferred Strategy" which takes a holistic view of regional water resources by integrating TMDL compliance with planning focused on beneficial re-uses of stormwater and other multiple purpose goals. While this is the preferred strategy based on the summary of all the objectives, it is also more challenging to predict implementation costs as it relies to a much greater degree on distributed, watershed-wide multi-objective solutions, the majority of which will require partnerships with private landowners, residents and businesses, and other public landowners (e.g. school districts) that are not directly responsible for TMDL compliance. Therefore, the cost estimate attempts to account for a range of economic factors and requires a number of assumptions regarding the extent and cost of implementing many of the measures. The alternative, "single-purpose" strategy of capture, treat and return is based primarily on larger, less distributed regional or subregional structural approaches that focus principally on end-of-pipe bacteria reduction. The cost estimates for this approach are less detailed and also require a number of assumptions.

The following sections describe how the costs were derived for the various components of both strategies. Following the description, a summary of the costs for each strategy is presented.

Components of Preferred Strategy that have been included in the cost are:

- Aggressively implementing a suite of source control strategies and institutional solutions to reduce dry weather flow (including smart irrigation) and reduce bacteria from both dry and wet weather flows

- Installing cisterns at schools and government facilities to treat wet weather flows.

- Installing neighborhood recharge facilities in open spaces to treat dry and wet weather flows.

- Installing Infiltration Sand Filters to treat dry and wet weather flows.

- Retrofitting the NOTF to treat (disinfect) and discharge (return) dry weather flow and further treat up to 4 cfs of dry weather flow for indirect reuse; and treat additional wet weather flow not otherwise diverted or captured with watershed based solutions

- Diverting any remaining dry weather flows from downstream watersheds to treatment plants.

- No costs are directly included for stream restoration/Creek daylighting as this concept has not been developed sufficiently to assign costs, but this would be a concept that would be further explored

The components of the Alternative Strategy include:

- Aggressively implementing a suite of source control strategies and institutional solutions to reduce dry weather flow (including smart irrigation) and reduce bacteria from both dry and wet weather flows

- Diverting all dry weather flows to the wastewater system for treatment at the Hyperion Treatment Plant.

- Constructing a new treatment plant to temporarily store, disinfect and discharge flows from the Upper Watershed (Proposed Treatment Plant 1).

- Constructing a new treatment plant built at point downstream of flow coming from West L.A. and Westwood Village Watersheds to temporarily store, disinfect and discharge flows (Proposed Treatment Plant 2)

- Constructing a new treatment plant built at point downstream of flow coming from Windsow Hills Watershed (Centinela Creek) to temporarily store, disinfect and discharge flows (Proposed Treatment Plant 3

In reviewing these cost estimates, it should be noted that there are multiple additional benefits associated with the implementation of the dry and wet weather solutions under the Preferred Strategy. Many of the BMPs (both source and treatment control approaches) would also have the ability to reduce the amount of other contaminants in the runoff, which could assist in meeting the requirements of other Ballona Creek existing and emerging TMDLs, such as the Metals, Toxics and Trash TMDLs (e.g.. the infiltration trenches with a gross solids removal system would remove metals and trash from the runoff as well).

Institutional Flow and Bacteria Source Control Costs

Institutional source controls are measures that seek to reduce either the total flow or the amount of bacteria entering Ballona Creek and are assumed to be applicable and appropriate for implementation under either strategy. As these source controls are on a institutional level, the actual volume or concentration of bacteria that will be reduced cannot be accurately or precisely quantified. In the future, when these types of programs are implemented, a quantifiable correlation will likely be able to be made but it is not available at this time. For the purposes of this TMDL, it has been assumed that dry weather flows could be reduced by at least 25% through these measures.

A number of similar source control measures were already identified in the Ballona Creek Metals TMDL, with costs based on the entire Los Angeles Region, which has an area of 3,100 square miles. As the Ballona Creek Watershed is 128 square miles, the control measure costs were scaled down proportionally. The following represent the approximate values for Ballona Creek Watershed for these source control measures:

- Enforcement of litter ordinances - $0.4 million per year
- Public education - $0.2 million per year
- Improved street cleaning - $0.3 million per year
- Increased Storm Drain Cleaning - $1.1 million per year

In addition to these source controls identified in the Metals TMDL, an estimated $1 million per year was added for additional for bacteria source control measures specifically such as finding and eliminating hot spots, sewer overflows and other sources of elevated bacteria that may affect either dry or wet weather flows. Together this equals a total estimated annual cost of $3 million per year much of which can be shared with other TMDL (metals and toxics) implementation requirements.

Summary:

- Capital costs – NA
- Operation and Maintenance Costs - $3 million (M)/yr

"Smart Irrigation" refers to the use of irrigation controllers to monitor irrigation, based on actual weather data and soil moisture content using evapotranspiration (ET) controllers. In addition to reducing the amount of water use, the units would also reduce or eliminate over-watering, a significant contributor to dry weather runoff.

The City of Los Angeles IRP looked at studies being done in both the City of Los Angeles and by the Irvine Ranch Water District (IRWD). Based on the findings described in the

IRP, effectiveness rates of installing the devices at various land uses were determined as well as the costs for implementing these devices.

In the IRP, it was assumed that ET controllers could be installed at 70 percent of land uses throughout the City. Using the land use data presented in Table 4, if ET controllers were installed at 70% of the residential and commercial facilities in the Ballona Creek Watershed, dry weather runoff from the watershed could be reduced by approximately 3 mgd.

Table 4
Land use in Ballona Creek Watershed

Land Use	Area (acres)
High Density Residential	45,600
Low Density Residential	2,950
Mixed Urban	100
Commercial	12,950
Industrial	4,200
Open Space	14,000
Other	2,200
Total	82,000

Source: Ballona Creek Metals TMDL Land use data.

Table 5 presents the estimated runoff reduction from employing Smart Irrigation. As shown in the table, the runoff rate (as determined by the IRP) was multiplied by 70 percent of the total area for residential and commercial properties. This runoff amount was multiplied by the effectiveness rate of ET controllers in reducing this runoff amount for each land use shown. Finally, the calculation shows that runoff could be reduced by 3 million gallons per day (mgd) by implementing Smart Irrigation.

Assuming ET controllers were installed in 70% of all properties, total area of about 43,000 acres would be targeted for controllers. While there would be a wide range of densities and lot sizes for both single and multi-family residential properties, for cost estimating purposes an average of one controller per acre was assumed, with a particular emphasis on larger properties. Therefore the cost estimated is based on installing up to 43,000 units. At a cost of $175 per device (which includes installation), the total capital cost would be $7.5 million.

Table 5
Flow Reduction Through Implementation of Smart Irrigation

	High Density Res.	Low Density Res.	Commercial	Total
Area (acres)	45,600	2,950	12,950	61,500
70% of area implementing S.I. (acres)	31,920	2,065	9065	43,050
Runoff Coefficient (gpd/ac) [1]	230	230	230	NA
Total Runoff (mgd):	7.3	0.5	2.1	10
% Effectiveness of Smart Irrigation (%)[2]	30%	71%	20%	NA
Total Runoff Reduction (mgd)[3]	2.2	0.3	0.4	3.0

Notes:
[1] The Runoff coefficient is for the Ballona Creek Watershed as determined in the IRP.
[2] The% effective is the effectiveness of the Smart Irrigation device at reducing the amount of runoff for a given land use and is based on IRP Smart Irrigation analysis, which was based on Irvine Ranch Water District pilot project data.
[3] Total Runoff Reduction is the total runoff multiplied by the % effectiveness of the devices.

For an ET controller to operate, it must receive a satellite signal that controls the amount of irrigation that occurs. The monthly cost for this is $4 per device. With up to 43,000 devices installed, the annual operation and maintenance cost would be about $2 million per year.

Since these devices will reduce the amount of potable water demand that each residence or commercial facility uses for irrigation, these users will have a significant savings in potable water purchasing costs. As such, the capital and/or operation and maintenance costs could be borne by the individual user rather than the municipalities of the Ballona Creek Watershed.

It should be noted that this approach could over-estimate the reduction of runoff since the number of real estate properties with underground irrigation systems and automatic controllers is unknown. In addition, future implementation would depend on available funding, customer acceptance, reliability, and commercial availability of Smart Irrigation controllers. More detailed studies would be needed to determine the full benefits of a smart irrigation program.

Summary:

- Capital costs – $7.5M
- Operation and Maintenance Costs - $2 M/yr

Structural Flow Source Control Costs

Cistern Costs

For developing a cost estimate for the cisterns component, it is assumed that cisterns will be installed only at schools and government facilities, since these typed of controls are more easily implemented on these land uses, as opposed to at private homes, commercial, etc. Programs to encourage and assist in providing cisterns for private residential development (single or multifamily) would be encouraged but specific costs are not included in this estimate.

For schools and government facilities, it was assumed that a similar percentage of city-wide implementation as was used in the IRP would apply to Ballona Creek. As shown in the IRP, which used Southern California Association of Governments (SCAG) land use data, schools and government facilities cover 3% of the total area of the City of Los Angeles. Using the same percentage for the Ballona Creek Watershed which is 82,000 acres, the resulting area for schools and government facilities in the Ballona Creek Watershed is 2,500 acres.

Additionally, the IRP estimated the number of cisterns required to treat a target volume of 80 MG was 10,000. As shown in Table 6, these values were used to determine the proportional amount that Ballona Creek Watershed would require.

Table 6
Ballona Creek Watershed vs. City of Los Angeles

Land use	LA IRP	Ballona Creek Watershed
Total Area (acres)	295,000	82,000
Area of Schools/Gov. Facilities (acres)	9,200	2,500
Runoff Target Volume [1]	80	14
Number of 10,000 Gallon Cisterns Required [2,3]	10,000	2,260

Note:
1. Runoff coefficient = 0.47 (per Watershed Protection Division Pollutant Load Model
2 Cisterns are assumed to be 10,000 gallons, as determined by the IRP. In the IRP, 50 years of rainfall data was analyzed to estimate what size cistern would be required to manage all of the flow from these land uses. Though actual size would be determined on a site by site basis, for the purposes of cost estimation an average size of 10,000 gallons is assumed.
3 The number of cisterns needed for Ballona Creek Watershed (BCW) at schools and government facilities was determined on a percentage basis using the average of the % by area and % by flow volume. (BCW has 18% of the flow from schools/government that the entire City of LA has, and 28% of the area. The average is 23% which is used here).

Based on the data shown in Table 5, up to 2,260 cisterns could be installed in the Ballona Creek Watershed to manage the flow from all schools and government facilities. With a unit cost of $1/gallon as estimated in the City of Los Angeles IRP, for the 10,000 gallon cisterns the total cost would be: $1/gallon * 10,000 gallons/cistern * 2,260 cisterns = $22.6 million.

Operation and maintenance costs for cisterns are based on the amount of water pumped. In order to estimate these costs, the volume of water, size of pump, and energy costs were assumed. In the cistern analysis done for the IRP (referred to in Note 2 of Table 3), 50 years of rainfall data was analyzed to estimate the size of cisterns that would be required to managed the flows for these land uses for these rainfall amounts. In addition to determining that the 10,000 gallon cistern would, on average be the appropriate size, it was determined that approximately 70,000 gallons per year of runoff would be used by each cistern. Additional assumptions include:

- 3 horsepower pump
- Flow rate of 10 gallons per minute
- Unit energy cost of $0.10 per kilowatt-hour

Using the standard equation of W=Power*Volume/Flow, which for these assumptions is:

W = (3hp) * (.745kW/hp) * (70,000gal/yr/cistern) / ((10gal/min) * (60min/hr)) = 261 kW-hr/cistern/yr

For 2,260 cisterns and the energy cost of $0.10 per kilowatt-hour, the total operation and maintenance cost for electrical power is $0.06 M/yr. A total O&M cost of $0.2 per mgd was assumed to allow for other operation, maintenance and replacement costs.

Summary:

- Capital costs – $22.6M
- Operation and Maintenance Costs - $0.2 M/yr

Neighborhood Recharge Costs

The concept of "neighborhood recharge" is based on developing local, on-site or subwatershed-based projects in parks, public land, vacant property, and other open spaces within the Ballona Creek Watershed. As shown in Table 3 above, the area of open space in Ballona Creek Watershed is estimated at 14,000 acres. Approximately half of this area, or about 6,500 acres is in the hills, which are assumed to be unsuitable for any form of infiltration projects. For the remainder of the watershed, substantial portions of the remaining 7,500 acres would include areas where soils are poor for infiltration, where land use is not compatible or otherwise committed to other uses, or areas are unsuitable for other reasons. Therefore, it was assumed that up to 5 percent of the remaining 7,500 acres of open space might be suitable for neighborhood recharge. This results in the potential to develop up to 375 acres of land for some form of neighborhood recharge.

It was also assumed that in the areas where neighborhood recharge would be installed, a relatively moderate infiltration rate of 0.5 ft/day could be achieved since the soils in much of the coastal area are much less suitable for significant (per Los Angeles County DPW Hydrology Manual). Using this infiltration rate and the 375 acres of land, an estimated 61 mgd could be managed by implementation of neighborhood recharge projects.

For the IRP, a unit cost of $0.65 M/ac was assumed based on data developed under the Sun Valley Project. Therefore, the total estimated capital cost for full implementation of this concept would be approximately $244 million.

For operation and maintenance costs, information from the Sun Valley project was used to develop an average operation and maintenance cost for similar local/neighborhood recharge facilities of approximately $3,000/ac/yr. This would result in approximately

$1.1 M/yr in operation and maintenance costs for 375 acres of neighborhood recharge facilities.

Summary:

- Capital Costs - $244 M
- Operation and Maintenance Costs - $1.1 M/yr

Sand Filters and Infiltration Trenches Costs

An additional implementation method that was included was implementation of sand filters or infiltration trenches in local watersheds, similar to the analysis conducted for the Ballona Creek Metals TMDL. Sand filters are specifically designed to treat urban runoff in high density areas, and are proposed as part of the Ballona Creek Metals TMDL. In the Metals TMDL, these BMPs were selected in part due to the fact that they can also remove bacteria. USEPA reports that sand filters have a 76 percent removal rate for fecal coliform (USEPA, 1999c). These BMPs have the additional positive impact of addressing the effects of development and increased impervious surfaces in the watershed, and both approaches can be designed to capture and treat at least 0.5 to 1 inch of runoff. Additional flow exceeding the design capacity would be allowed to bypass the device and enter the storm drain untreated. The device could also manage the entire dry weather flow.

Sand filters must be used in conjunction with a pretreatment device such as a biostrip or gross solids removal device to remove sediment and trash in order to increase their efficiency and service life. As stated above, these devices would then have the combined effect of achieving compliance with the Metals TMDL and the Trash TMDL as well as the Bacteria TMDL. The cost analysis was done for the Trash and Metals TMDLs, as shown below, and accounts for the gross solids removal systems, including structural vortex separation systems and end of pipe nets, as well as the costs associated with installing sand filters.

The Metals TMDL assumed that sand filters would treat 20 percent of the urbanized portion of the watershed. Costs were estimated by using data provided by USEPA (USEPA, 1999a and 1999c) in 1997 dollars, and the Federal Highway Administration (FHWA, 2003) in 1996 dollars for infiltration trenches and 1994 dollars for sand filters. Where costs were reported as ranges, the highest range was assumed. These costs were then compared to Caltrans costs determined in their BMP Retrofit Pilot Program (Caltrans, 2004) that were reported in 1999 dollars. Refer to Appendix A of the Ballona Creek Metals TMDL for the cost analysis and sizing constraints.

Since the 0.45-inch storm event, rather than the 0.5 inch storm, was used to develop this analysis, an adjustment was made to determine 20% of this flow. As was determined by the EPA/Tetra Tech flow model, the total flow from the 0.45 inch storm for this area is 544 MG per event. Therefore, 20 percent of this flow is 109 MG per event, which is what would be managed with sand filters.

For this TMDL, the cost data provided in the Metals TMDL and estimating the runoff from the 0.5 inch storm event that these costs were based on, a unit cost for the sand filter was determined. Taking the 109 MG/event that the sand filter would manage, the total capital and O&M costs were calculated as shown in table 7.

Table 7
Capital and Operation and Maintenance Costs for Sand Filters

Sand Filters	From Metals TMDL (0.5 in rainfall)					For 20% of flow from 0.45 inch storm event	
	Capital Costs ($M)[1]	O&M Costs ($M/yr)[1]	Flow Managed (MG/event)[2]	Unit Capital Cost per MG ($M/MG)[2]	Unit O&M Cost per MG ($M/MG/yr)[2]	Total Capital Costs ($M)[3]	Total O&M Costs ($M/yr)[3]
	88.00	4.00	120.93	0.73	0.03	$79	$3.60

Note:
[1] Source: Ballona Creek Metals TMDL - for columns 2,3,4. All other columns calculated based on this data and flow from 0.45-inch storm
event. These costs are the average of USEPA and FHWA Estimates that were presented in the Metals TMDL. FHWA did not report O&M data, so O&M data shown in from USEPA only. Only Delaware sand filters are presented as they are used from smaller drainage areas (approx 1 acre) as opposed to 50 plus acres.
[2] Flow managed in this column is based on Metals assumptions listed and IRP values. Unit costs calculated based on this flow and the total costs in columns 2 and 3.
[3] Total capital and O&M costs based on, which is 47 MG/event.

Summary:

- Capital Costs - $79 M
- Operation and Maintenance Costs - $3.6 M/yr

Dry Weather Diversion Costs

This component involves diverting any remaining dry weather runoff that has reached the storm drain system to the wastewater collection system for treatment at the Hyperion Treatment Plant (HTP). The Cities of Los Angeles and Santa Monica have already initiated diversion programs on most of the storm drains discharging to the Santa Monica Bay Beaches. Based on the actual costs associated with these diversions, a unit cost per mgd of diversion capacity was estimated to be approximately $1.2 million. Adding on 30 percent to account for non-construction costs including project management, design, construction management, startup, etc, the unit capital cost of $1.6 million per mgd was assumed.

For the two strategies discussed, different amounts of dry weather runoff would require diversion. For the Preferred Strategy, only dry weather flows downstream of the North Outfall Treatment Facility that would not be managed by source controls or other watershed-based BMPs would be diverted. This is estimated to be a peak flow total of about 7.8 mgd, which results in a capital cost of approximately $12 million. For the Alternative Strategy, all of the dry weather runoff that is not already reduced through source controls would be diverted, an estimated peak flow of 19.7 mgd, which would result in a capital cost of $31 million.

Operation and maintenance costs are also taken from the constructed dry weather low flow diversions as presented in the IRP, using a unit operation and maintenance cost of about $34,000/mgd/yr. Using an average of 4 mgd of diverted flow for the Preferred Strategy, the total operation and maintenance cost estimate is $0.13 M/yr. For the Alternative Strategy, with an average flow of approximately 19.7 mgd diverted, the total operation and maintenance cost would be $0.32 M/yr.

Summary:

- Capital Costs - $12.1 M (Preferred Strategy); $31 M (Alternative Strategy)
- Operation and Maintenance Costs - $0.11 M/yr (Preferred Strategy); 0.32 M/yr (Alternative Strategy)

Treatment and Discharge/Reuse Costs

The following runoff capture and treatment facilities are included in the costs:

- Retrofit North Outfall Treatment Facility (NOTF) to treat dry and wet weather runoff, with reuse of up to 4 cfs of dry weather runoff (Preferred Strategy)
- Install New Urban Runoff Treatment Plant in Upper Watershed (Alternative Strategy)
- Install Urban Runoff Treatment Plant at West Los Angeles Subwatershed (Alternative Strategy
- Install Urban Runoff Treatment Plant at Windsow Hills Subwatershed (Alternative Strategy)

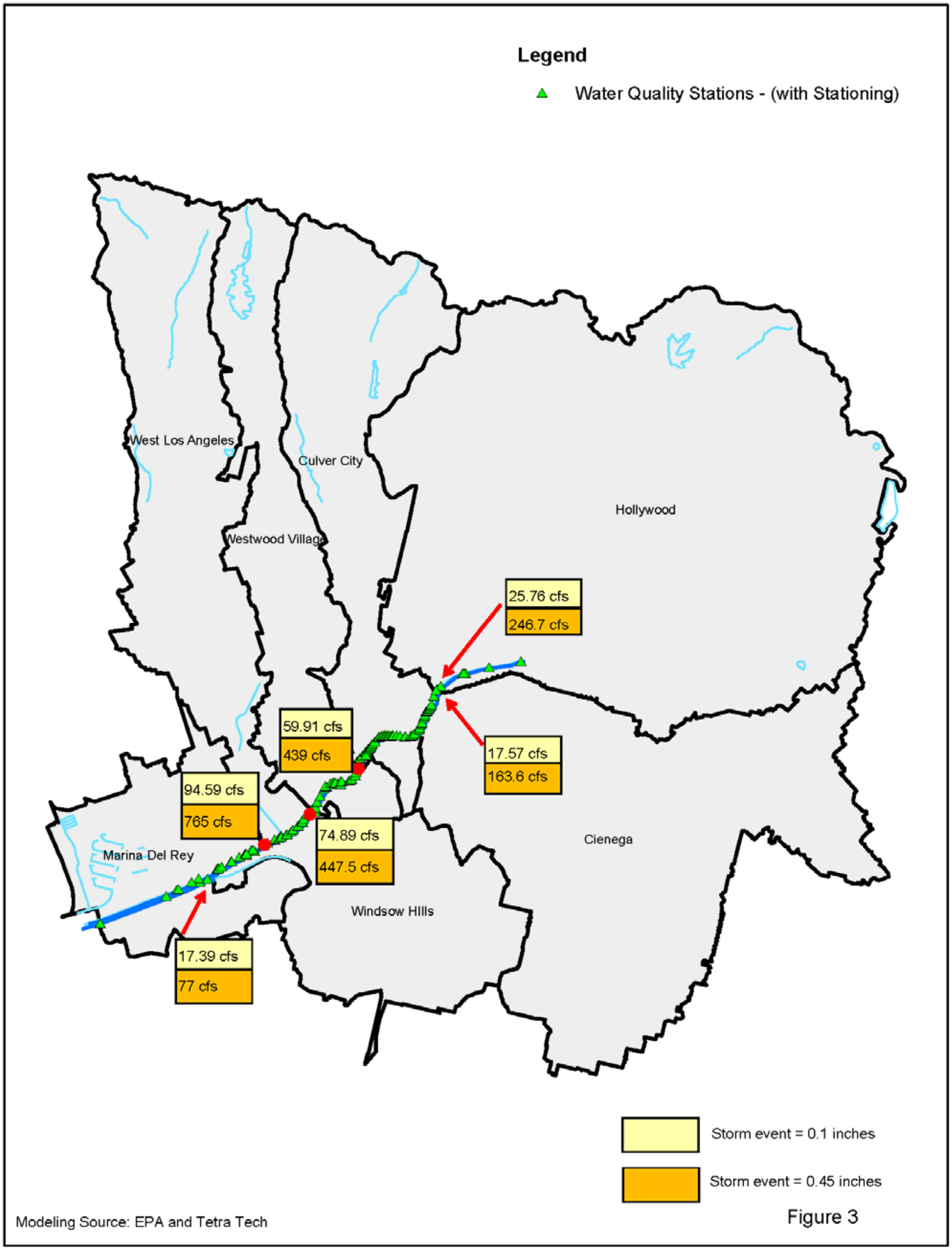
The following dry weather flow data represents the maximum dry weather flow rate:

- North of NOTF = 23 cfs = 15 mgd
- Sepulveda & West LA = 7 cfs = 5 mgd
- Centinela = 5 cfs = 3 mgd
- Total = 35 cfs = 23 mgd

The following wet weather flow information was determined based on an EPA/Tetra Tech flow modeling program to manage up to a 0.45 inch storm event. This data is also presented in Figure 3 below.

Subwatershed flows:

- Hollywood Subwatershed: 247 cfs
- Cienega: 164 cfs
- Windsow Hills: 77 cfs


Legend
Water Quality Stations - (with Stationing)
West Los Angeles
Culver City
Westwood Villag
Hollywood
Marina Del Rey
Cienega
Windsow HIlls
25.76 cfs
246.7 cfs
17.57 cfs
163.6 cfs
59.91 cfs
439 cfs
94.59 cfs
765 cfs
74.89 cfs
447.5 cfs
17.39 cfs
77 cfs
Storm event = 0.1 inches
Storm event = 0.45 inches
Modeling Source: EPA and Tetra Tech
Figure 3

Flows within Ballona Creek:

- Approx. at NOTF: 439 cfs
- At Westwood Village Subwatershed: 447 cfs
- At West LA Subwatershed: 765 cfs
- Runoff Volume from a single storm event: 471 MG = 1,445 AF

Retrofit NOTF to Treat Dry and Wet Weather Runoff, with Reuse of up to 4 cfs of Dry Weather Runoff

Part of the Preferred Strategy includes retrofitting the existing NOTF. A study was done for the City of Los Angeles Bureau of Engineering in 1995 entitled *Ballona Creek Treatment Facility Feasibility Study and Preliminary Design (Study).* This study estimated the costs associated with retrofitting the NOTF, which is currently not in use as a wet weather sewer overflow facility, to capture, store, treat, disinfect and discharge urban runoff. One of the alternatives analyzed included treating dry weather runoff and a fraction of wet weather runoff and reusing a portion of the dry weather runoff. Costs were presented for two different amounts of reuse, and the costs shown below represent an interpolation of the two to meet the reuse target of 4 cfs.

The feasibility study examined converting the existing NOTF, maximum capacity is of approximately 150 cfs (97 mgd) for solids reduction and disinfection sufficient to achieve REC-1 standards in the discharge and it has 1 MG of storage available without additional construction. Using a typical hydrograph presented in the *Study*, the 1 MG of storage could manage an additional 19 cfs (12 mgd). Therefore, the wet weather total flow that could be managed at the retrofitted NOTF is 109 mgd. Under the Preferred Strategy, if a full suite of non-structural and structural source control measures could ultimately be developed across the upper subwatersheds, the combination of source control measures and projects and making use of conversion of existing facilities at the NOTF it is possible to manage sufficient flow to meet the TMDL target for the upper watershed as well as provide a significant source of treated dry weather flow for reuse.

By updating study costs to current (2005) values, the capital costs for constructing diversion facilities into the plant, retrofitting the plant for treatment and discharge, and constructing additional facilities to provide water of sufficient quality for unrestricted non-potable reuse of up to 4 cfs (2.6 mgd) of dry weather runoff, is estimated to be approximately $9 million. Operation and maintenance costs are estimated to be approximately $0.9 million per year (adjusted for inflation). Neither the capital nor the operation and maintenance costs include any reuse distribution costs.

Summary:

- Capital Costs - $9 M
- Operation and Maintenance Costs - $0.9 M/yr

Construct Urban Runoff Treatment Plant in the Upper Watershed (Plant 1)

Under the Alternative Strategy, one new urban runoff treatment plant is assumed to be constructed, with sufficient storage and capacity to serve the upper watershed (approximately the same portion of the watershed as is tributary to the vicinity of the existing NOTF). The watershed flows at this point are approximately 440 cfs, as shown in Figure 3. In order to analyze the flows, hydrograph from the NOTF *Study* discussed above was used. This hydrograph, which is Figure 2-5 of that document is for a comparable flow (470 cfs at its peak[2]), and therefore this hydrograph was assumed to be comparable. This hydrograph shows that the average flow is approximately 250 cfs for a duration of 2 hours. Using this data, and assuming that 150 cfs (97mgd) would be treated instantaneously, the storage required to treat this entire 437 cfs (284 mgd) was calculated as follows:

- Storage required = (250cfs-150cfs) * 3600 sec/hr * 2 hrs * 7.48 gal/cf / 1M gal/MG = 5.4 MG

The unit cost of $4.7 M/mgd that was used in the IRP resulted in a total treatment plant cost (including land acquisition) of 97 mgd * $4.7 M/mgd = $456 M. The cost for building additional temporary storage was calculated based on the unit costs shown in the IRP of $1.30M/MG of storage capacity. For the 5.4 MG of storage, the total cost would be $7 million. In addition, a lump sum cost for collection and discharge pipelines was included at $50 million. The total capital cost is therefore estimated at $512 million.

Operation and maintenance costs were estimated based on the information presented in the *Study*. These costs included the following:

- Power: $0.20 million/yr
- Labor: $0.25 million/yr
- Chemicals: $0.01 million/yr
- General Maintenance: $0.07 million/yr

This results in a total unit cost of $0.53 million per year in operation and maintenance costs.

Summary:

- Capital Costs - $512 M
- Operation and Maintenance Costs - $0.53 M/yr

[2] Flow from hydrograph metered at Sawtelle Blvd., determined to be within 2% of flow at BCTF and negligible for the purposes of this study.

Construct Urban Runoff Treatment Plant at West Los Angeles Subwatershed

Construction of a new treatment plant built at a location north of Ballona Creek, downstream of flow coming from West LA and Westwood Village subwatersheds is for Alternative 2 only. At this point in Ballona Creek, the flow is 326 cfs. For developing cost estimates, it was assumed that a treatment plant constructed with a capacity of 100 cfs would be built. With this assumption, a proportionally scaled down version of the hydrograph as shown in the *City of LA BOE Ballona Creek Treatment Facility Feasibility Study and Preliminary Design* document was used to estimate the amount of storage needed. From this scaled down hydrograph, an average flow of 175 cfs, with a duration of 2 hours resulted in the following storage required to treat the entire 326 cfs (210 mgd) of flow in a 100 cfs (65 mgd) treatment plant:

- Storage required = (175cfs-100cfs) * 3600 sec/hr * 2 hrs * 7.48 gal/cf / 1M gal/MG = 4 MG

To determine the cost associated with constructing this plant, again unit cost estimates from the IRP were used. The unit cost of $4.7 M/mgd resulted in a total treatment plant cost (including land acquisition) of 65 mgd * $4.7 M/mgd = $304 M. The cost for building additional temporary storage was calculated based on the unit costs shown in the IRP of $1.30M/MG of storage capacity and a 4 MG tank is estimated at approximately $5.3 M. Additionally, collection pipelines and discharge pipelines were assumed to be a lump sum of $40 M. The total cost is then $349 M.

Using a similar approach to operation and maintenance costs, the unit cost per cfs would be: $0.53 M/yr divided by 150 cfs = $3,530 /yr. Adjusted for the 100 cfs treated at this site, the total operation and maintenance costs would be approximately $0.35 M/yr.

Summary:

- Capital Costs - $343 M
- Operation and Maintenance Costs - $0.35 M/yr

Construct Urban Runoff Treatment Plant at Windsow Hills Subwatershed

This treatment plant would be constructed at point south of Ballona Creek to intercept flow coming from Windsow Hills subarea (Centinela Creek). At this point in Ballona Creek, the estimated target flow is 77 cfs. It is assumed that a treatment plant designed to treat 25 cfs would be build, and with this assumption, a proportionally scaled down version of the aforementioned hydrograph as shown in the *Study*, with an average flow of 40 cfs and a with a duration of 2 hours, the resulting storage required to treat the entire 77 cfs (50 mgd) of flow in a 25 cfs (16 mgd) treatment plant would be:

- Storage required = (40cfs-25cfs) * 3600 sec/hr * 2 hrs * 7.48 gal/cf / 1M gal/MG = 0.8 MG

To determine the cost associated with building this plant, unit cost estimates from the IRP were used. The unit cost of $4.7 M/mgd resulted in a total treatment plant cost (including land acquisition) of 16 mgd * $4.7 M/mgd = $75 M. The cost for building additional temporary storage was calculated based on the unit costs shown in the IRP of , $1.3 M/MG, which for the 0.8 MG tank is $1.1 M. Additionally, collection pipelines and discharge pipelines were estimated to be a lump sum of $10.0 M. The total capital cost is then estimated at approximately $87 M.

Using a similar approach to O&M costs as previously presented, the unit cost per cfs would be: $0.53 M/yr divided by 150 cfs = $0.00353 M/yr. Adjusted for the 25 cfs treated here, the total operation and maintenance costs would be $0.09 M/yr.

Summary:

- Capital Costs - $82 M
- Operation and Maintenance Costs - $0.09 M/yr

In-stream Solutions

"In-Stream Solutions" represent a range of potential approaches which may include "daylighting" of segments of tributary reaches that are currently underground storm drain systems, and restoring natural habitat along an existing stream segment (tributary or main stem) in a reach that is currently fully lined, which is typical of nearly all of inland Ballona Creek and it's tributaries. Under this concept, the restoration or daylighting project concept would be undertaken to provide multiple benefits, one of which would be to optimize the ability of the restored reach to provide in-stream or off-stream bacteria reduction. This would be primarily targeted at reducing bacteria reduction in dry weather flow.

Summary

The following two tables identify the total cost estimates for the Preferred Strategy (Table 8) and the Alternative Strategy (Table 9).

Table 8
Preferred Strategy Summary Table

Option	Volume of Dry Weather Flow Managed (mgd)	Volume of Wet Weather Flow Managed (MG/event)	% of Dry Weather Flow	% of Wet Weather Flow from 0.45 inch storm[1]	Capital Cost ($M)	O&M Cost ($M/yr)
Non-Structural Source Controls[2]	3.0	NA	13%	NA	$8	$5.07
Cisterns	-	14	-	3%	$23	$0.06
Neighborhood Recharge	1.0	61	4%	11%	$244	$2.63
Sand Filter	4	109	17%	20%	$79	$3.60
BCTF retrofit	7	99	31%	18%	$9	$0.84
Divert Dry Weather Flow	8	NA	34%	NA	$12	$0.26

to Wastewater						
Totals:	**23**	**284**	**100%**	**52%**	**$374**	**$12.46**

[1] The % of total wet weather flow is based on the total wet weather flow from the 0.45-inch storm for Ballona Creek at West LA subwatershed point plus the flow from Windsow Hills (i.e. 765 cfs+77cfs=842dfs = 544 mgd).

[2] Non-structural source controls include institutional solutions and smart irrigation implementation.

Table 9
Alternative Strategy Summary Table

Component	**Flow Managed (mgd)**	**% of Flow[1,2]**	**Capital Costs ($M)**	**O&M Costs ($M/yr)**
Dry Weather				
Non-Structural Source Controls[3]	3.0	13%	$8	$5.07
Dry Weather Diversions	20	87%	$31	$0.66
Dry Weather Totals	*23*	*100%*	*$38*	*$5.73*
Wet Weather				
Proposed Treatment Plant 1	284	52%	$453	$0.53
Proposed Treatment Plant 2	211	39%	$343	$0.35
Proposed Treatment Plant 3	50	9%	$82	$0.09
Wet Weather Totals	*544*	*100%*	*$878*	*$0.98*
Total Cost (Dry & Wet Weather)			**$916**	**$6.71**

Notes:
1 The % of flow for dry weather is the percent of the total Dry Weather flow that is managed through diversions.
2 The % of total wet weather flow is based on the total wet weather flow from the 0.45-inch storm for Ballona Creek at West LA subwatershed point plus the flow from Windsow Hills (i.e. 765 cfs+77cfs=842dfs = 544 mgd).
3 Non-structural source controls include institutional solutions and smart irrigation implementation.

Monitoring Program

Monitoring Program Objectives

The monitoring program for the Ballona Creek bacteria TMDL has the following objectives:

(1) provide data and information to support the effectiveness of the implementation plan;

(2) determine whether the implementation strategy is effective in meeting the water quality objectives for the listed water bodies (compliance monitoring);

(3) provide information useful for possible future revisions to the TMDL plan.

Under the current regulatory framework, monitoring in Ballona Creek watershed for the purposes of determining compliance with this Bacteria TMDL shall be established in each of the 303(d) listed waterbodies in order to determine if water quality standards are being met. This includes Reaches 1 and 2 of Ballona Creek, the Ballona Creek Estuary, and Sepulveda Channel. It is also expected that responsible jurisdictions and agencies within the watershed may conduct additional monitoring and study efforts (special studies) designed to address specific questions that may either serve to help refine or revise the TMDL at future dates, or assist with TMDL implementation and adaptive management such as source characterization/identification and BMP effectiveness. Existing monitoring efforts are expected to continue in the near term (could be considered "pre-compliance monitoring" once the TMDL is adopted), to help support special studies as well support trends that can potentially be transitioned into compliance monitoring programs when future dates are determined under the adopted TMDL. The existing monitoring efforts are currently conducted by the City and County of Los Angeles. Once the TMDL is adopted, potential cost sharing may be considered for continued monitoring that supports the TDML.

Design of the compliance monitoring program requires careful consideration of the planned implementation strategies for the Ballona Creek Bacteria TMDL. The Ballona Creek Bacteria TMDL implementation strategy was developed by stakeholders in the watershed, including cities, regulatory representatives and representatives of environmental groups with an interest in the watershed. The preferred implementation alternative focuses on an integrated watershed-based program consisting of a variety of non-structural institutional and decentralized structural solutions to reduce flow to and bacteria concentrations within Ballona Creek, as opposed to heavily engineered structural "end-of-pipe" solutions such as large-scale diversion and treatment. Stakeholders favored the preferred alternative, which addresses a broad range of long -term planning goals for the watershed, in spite of the lower degree of certainty it offers with regard to reducing bacteria concentrations and the potentially longer timeline required for implementation. Accordingly, monitoring programs will need to be sufficiently flexible and adaptable in order to complement the preferred alternative implementation approach.

As noted above, wherever possible and appropriate, the TMDL monitoring program incorporates existing monitoring programs, and existing "baseline" databases of historical water quality and flow results in order to efficiently evaluate water quality conditions and trends. In addition, coordination with compliance monitoring conducted for other Ballona Creek TMDLs (e.g. metals and toxics) is encouraged.

Compliance Monitoring

A compliance monitoring program will be designed to determine compliance with water quality objectives at specific locations within the 303(d)-listed reaches. For Ballona Creek, it is anticipated that one location within each of the listed reaches (Reach 1, Reach 2, Estuary and Sepulveda Channel) will be monitored for TMDL compliance. Such monitoring would include either daily or systematic weekly sampling. Exact locations and methodology for sampling will be defined in a detailed monitoring plan to be submitted to the Regional Board for approval by responsible jurisdictions. Sampling in the impaired reaches for compliance determination during dry and wet weather conditions will begin in accordance with the Implementation Schedule shown in the previous section.

Indicator bacteria analyses for compliance monitoring of the impaired reaches will be conducted in accordance with the applicable water quality objectives as follows:

- Ballona Creek Estuary – E. coli, enterococcus, fecal coliform, total coliform
- Ballona Creek Reach 2 and Sepulveda Channel – E. coli, fecal coliform
- Ballona Creek Reach 1 – fecal coliform (or E. coli. with an approved translator)

It is possible that E. Coli can serve as the primary surrogate indicator in all reaches at the choice of the responsible agencies, and at a 1:1 E.coli to FC ratio, unless the responsible agencies provide an appropriate translator. In addition, to enhance understanding of bacteria sources in the watershed, responsible jurisdictions conducting compliance monitoring are encouraged to analyze collected water samples for indicator bacteria other than those defined in water quality objectives. For instance, analysis of enterococcus in Reach 2 could be used to quantify by difference the magnitude of loading from sources that originate in the downstream Estuary.

Relationship to Monitoring programs of other Ballona Creek TMDLs

Responsible jurisdictions are encouraged to use similar monitoring locations and timing in Ballona Creek and/or Ballona Creek Estuary where feasible to conduct compliance monitoring for both the Bacteria TMDL and the Metals and Toxics TMDLs.

Special Studies

As noted above, responsible jurisdictions and agencies may conduct special studies and monitoring for the purposes of providing information useful for possible future revisions or updates to the TMDL and/or to provide data and information to support the effectiveness, or adaptive management, of the implementation plan. Specific studies that may provide information for possible future TMDL revisions or updates include:

- Monitoring an inland reference watershed to quantify the loading of indicator bacteria from background/natural sources (in conjunction with and/or support of others e.g. the Southern California Coastal Water Research Project)
- Characterizing the hydrodynamics in the Estuary and the relationship of Ballona Creek water quality and tidally-influenced flows; potentially including a determination of the most appropriate monitoring location/depth, the effect of the estuarine environment on bacteria moving through the Estuary; and the relative effectiveness of diverting upstream dry weather flows.
- High frequency (e.g. hourly) monitoring to better understand the temporal variability of bacteria concentrations during both dry and wet weather
- Sampling of sediment to determine its role in bacteria water quality objective exceedances, particularly during wet weather
- Water quality modeling to better define the effectiveness of implementation strategies.