Report of Waste Discharge

Submitted by

The County of Orange, Orange County Flood Control District and Cities of Aliso Viejo, Dana Point, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, Rancho Santa Margarita, San Clemente, and San Juan Capistrano

May 20, 2014

Report of Waste Discharge

Prepared for the California Regional Water Quality Control Board

May 20, 2014

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Mary Anne Skorpanich, Deputy Director
OC Public Works

2014 County of Orange Report of Waste Discharge for the San Diego Region

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Executive Summary

The Orange County Stormwater Program (the Program) is a cooperative municipal regulatory compliance initiative focused on the management of urban and stormwater runoff for the protection and enhancement of Orange County's creeks, rivers, streams, and coastal waters. The primary objective of the Program is to fulfill the commitment of the County of Orange, the Orange County Flood Control District and the cities of Orange County (collectively, the "Permittees"), to develop and implement a program that satisfies the requirements of area-wide Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permits.

The purpose of this document is to comply with the requirement for submittal of a "Report of Waste Discharge" (ROWD). This report discusses the Permittees' Fourth Term MS4 Permit compliance activities and accomplishments over the period June, 2009 to June, 2013. It identifies all of the activities, research and pilot studies the Permittees propose to undertake during the next permit term based upon a consideration of the effectiveness of the Program and need for additional pollutant control initiatives. The report requests coverage under a Fifth Term Permit that is specific to south Orange County.

The Permittees also consider a series of performance metrics to further enable the effectiveness of the Program's elements to be evaluated. This assessment of program effectiveness, comprising consideration of both the state of the aquatic environment and program performance metrics, is the basis for identifying the specific program activities and pilot studies the Permittees propose to undertake during the next permit term. These activities, which are identified as recommendations for program continuation, program enhancements, or program modifications, together with the Fifth Term MS4 Permit compliance milestones, are noted in each section of the report and are summarized in Section 7.0. The deliberate emphasis on program enhancement, rather than policy and programmatic change, is emblematic of a mature municipal stormwater program that is protective of water quality and is achieving meaningful environmental outcomes.

State of the Environment – Key Findings

This report includes an analysis of the state of water quality in Orange County and explores trends for four primary water quality issues on which the Permittees intend to focus during the Fifth Term. Key findings and trends are discussed for bacteria, total dissolved solids, nutrients and toxicity.

Bacteria

- The County's beaches support concentrated recreational activities for both residents and visitors and are important contributors to the local and regional economy.
- Concern about swimming safety is consistently high and epidemiology studies in dry weather show that some illness (for example, gastroenteritis) is associated with full immersion swimming in contaminated water.
- Contamination is very low during dry weather and has dropped steadily over time; beach report card grades are consistently high.

- Sources of contamination have been reduced through targeted actions; remaining issues during dry weather are localized and may have natural components.
- Contamination is more widespread during wet weather; wet weather flows are larger and qualitatively different.
- Health risks associated with wet weather flows are uncertain, but ongoing research and development focuses on improved monitoring tools and wet weather epidemiology studies.
- Progress on managing dry weather contamination demonstrates the efficacy of targeted BMPs appropriate to specific situations that may include natural sources (e.g., birds).

Dissolved Solids

- Persistent and widespread exceedances of total dissolved solids occur in channels and at discharge outfalls.
- Dissolved solids are a challenging to address because a large portion of these elevated levels derive from natural sources in regional groundwater.
- Understanding local geology is key to understanding sources of dissolved solids and the pathways they travel in the watershed.
- While the flood control system provides one pathway for dissolved solids in groundwater to reach the surface, other natural pathways (such as artesian springs) exist and there is evidence of historically elevated dissolved solids levels in surface water in the region.

Nutrients

- Nutrient levels in South Orange County streams and channels are frequently above commonly used thresholds that suggest increased likelihood of nutrient impacts. In contrast, there are much less frequent occurrences of impacts, such as macroalgal overgrowth, due to excessive nutrient levels.
- Nutrient issues are not limited to the urban portion of the County; regional monitoring data show nutrient enrichment and impacts such as increased macroalgal cover and/or lower dissolved oxygen in streams and estuaries in undeveloped regions.
- The major point sources of nutrients have been controlled. Therefore, nonpoint and diffuse sources such as leaching from upland soils and intrusions from shallow groundwater are increasingly important.
- Nutrients can be readily transported in and out of various reservoirs (e.g., sediments, groundwater) and undergo complex biological transformation and cycling. This makes traditional pollutant control strategies less effective for nutrients.

Improved management strategies may contribute to further progress, particularly in streams and channels, by accounting for site-specific conditions, promoting Low Impact Development, and accounting for broader regional sources.

Toxicity

- Toxicity in freshwater channels in all conditions (aquatic, sediment, wet and dry weather) occurs at low levels and is

sporadic, occurring at different locations at different times and varying unpredictably across test species.

- Aquatic toxicity in dry weather occurs in open (undeveloped) areas at levels equivalent to those in urban areas; suggesting that dry weather toxicity is not driven predominantly by urban pollutants.
- There are no apparent trends in toxicity over time.
- Metals, except for some instances of elevated copper, are at low levels and do not appear to contribute to aquatic toxicity in freshwater.
- The primary source of toxicity appears to be pesticides, with evidence that pyrethroids contribute to sediment toxicity.
- Use of organophosphate pesticides has declined virtually to zero but use of pyrethroid pesticides has increased and exceedances of thresholds for pyrethroid pesticides are high.
- Reported pesticide use in the County has declined from just over 2 million pounds a year in 1998 to just under 1 million pounds in 2011, due primarily to reduced use of indoor fumigants.
- There is a large data gap in our knowledge of retail pesticide sales and use.
- Pesticide use (which is regulated directly at the state and federal levels) presents a moving target for management because of the continued introduction of new products; the most effective management strategies are to continue to reduce dry weather runoff/flows and support education and outreach efforts to reduce pesticide use and runoff.

Controlling Pollutant Sources - Countywide/Jurisdictional Programs: Accomplishments

The management of sources of pollution from diffuse urban areas involves the strategic application of Best Management Practices (BMPs) to activities and drainage systems within the urban environment. The purpose of BMPs is to protect water quality by reducing pollutant loads and concentrations and by reducing discharges (volumetric flows and flow rates) causing stream channel erosion. Municipal efforts to prioritize, inspect and manage existing and new development, educate the public to encourage adoption of behaviors protective of water quality and to respond to illegal discharges or illicit connections are discussed in this section.

- The Model Municipal Activities Program ensures that BMPs are implemented and maintained at over 1,700 municipal facilities.
- The Model Integrated Pest Management Program ensures municipal conformance with an Integrated Pest Management Policy developed in partnership with University of California Cooperative Extension. Implementation of the policy is resulting in reductions in municipal fertilizer and pesticide use.
- Public awareness surveys conducted approximately every three years demonstrate increased levels of awareness regarding stormwater concerns and several positive behavior changes regarding car washing, use of landscape management products, and pet waste.

- The Program achieved over 155 million impressions through various forms of paid media, and over 5.5 million impressions at outreach events from 2008 to 2013.

- The Permittees initiated a strategic behavior-specific outreach program in 2012.

- Reductions in outdoor water use, retrofitting the residential environment to reduce outdoor water demand and elimination of runoff from irrigation are the foci of action-based outreach efforts initiated in 2013.

- The Permittees developed a significantly revised Model Water Quality Management Plan (WQMP) and Technical Guidance Document (TGD) to implement new requirements for the implementation of Low Impact Development (LID) BMPs.

- The Permittees implemented the new Model WQMP and TGD for all priority projects in north Orange County starting on August 17, 2011, and in south Orange County starting on December 20, 2013.

- During the permit term (through the FY2012-13 reporting period) 1,369 WQMPs for public and private projects were approved across all of Orange County for a total of 18,749 acres of development now that are now subject to Project WQMPs.

- South Orange County was mapped and a geodatabase was developed that includes conveyance systems, infiltration constraints, land use, and soil types. The County is using the geodatabase to evaluate channel susceptibility to hydromodification, and opportunities and constraints for infiltration and treatment BMP implementation at various scales.

- The Construction Program maintained an inventory of up to 12,060 construction sites, prioritized these sites regarding their threat to water quality, and inspected them at the frequency specified by the permit. Non-compliant sites were educated and required to implement BMPs as required.

- The Industrial/Commercial Program inventoried 14,000 sites and conducted inspections of these sites at frequencies specified by the permit.

- A new Mobile Business Pilot Model Program was developed and implemented.

- Residential sources of pollutants were addressed through the Model Residential Program, which included development of new outreach materials and continued outreach to Common Interest Areas and Homeowner's Associations.

- The Permittees continued to aggressively detect and eliminate Illicit Discharges and Illegal Connections (ID/IC) through discharge monitoring, source investigation, and enforcement.

- A spill reporting hotline (1-877-89-SPILL) provides a resource for public spill and water pollution reporting, and an iPhone reporting application was developed. All reports were responded to and resolved.

- The *Model Investigative Guidance for Orange County Illegal Discharges and Illicit Connections Program* was updated for the Non-stormwater Action Levels (NALs) based monitoring program by inclusion of a new *San Diego Region Dry Weather Numeric Action Level (NAL) Source Identification Guide*.

- Essential elements of the Countywide Area Spill Control Program were completed and implemented.

- The NALs monitoring program was fully implemented.

Controlling Pollutant Sources - Watershed Programs: Accomplishments

In addition to countywide and jurisdictional programs, the Permittees participated in water quality planning on the watershed scale. These efforts have led to multi-jurisdictional solutions to problems that cut across programs and jurisdictional boundaries. While the focus of watershed planning in south Orange County is on specific pollutants of concern associated with urban stormwater, particularly TMDLs, this management approach is also supportive of broader objectives such as watershed habitat restoration, consistent with the Practical Vision, and integrated water resource management.

- Extensive watershed mapping of hydromodification susceptibility, infiltration feasibility and regional BMP opportunity sites for the entire south Orange County area has been completed.

- Watershed Workplans for all six San Diego Region Watersheds were developed and implemented. These workplans describe the Watershed Permittees' collective watershed strategies to assess, prioritize and address water quality challenges within each watershed.

- Comprehensive Load Reduction Plans (CLRPs) were developed for Aliso Creek, San Juan Creek and San Clemente Coastal Streams Watersheds. These watershed CLRPs were developed to address bacteria pollutants and other watershed 303(d) listed constituents.

- Dana Point harbor was delisted for Indictor Bacteria and 17 shoreline stations were delisted for Enterococcus, Fecal Coliform and Total Coliform.

- Baby Beach TMDL dry weather load reductions have been achieved for total coliform and the 50% load reduction milestones for fecal coliform and Enterococcus have also been achieved. Wet weather data also supports the conclusion that TMDL load reductions have been achieved for total coliform and fecal coliform. Further reductions are needed for Enterococcus.

Plan Development

The Permittees have developed a strategic approach to stormwater management that is a cyclical process of measurement, analysis and program improvement.

- The Permittees have been implementing a strategic management approach that includes model programs specified in the permit and the DAMP, and watershed programs focused on specific water bodies and pollutants.

- The Program employs an iterative, adaptive management approach that includes monitoring, evaluation, program revision, BMP implementation adjustment/enhancement, and continued monitoring.

- The Program conducts annual and permit term (i.e. ROWD) using the guidance from CASQA approach.

- The ROWD recommends an evolution to a more holistic watershed management approach to support integrated water resource management and the optimization of watershed ecosystem services.

Program Management and Financing: Accomplishments

Program management includes maintaining a committee structure, participation in regional and statewide groups and tracking costs for compliance.

- The Program continued to operate with the County of Orange as the Principal Permittee during the permit term.

- The Program operated under a four-tier committee structure with participation at all levels by Permittee staff and management.

- An Implementation Agreement establishes responsibilities and provides a funding mechanism for cooperative activities. Funding has been sufficient to complete common program activities.

- The Program benefitted strongly from cooperation and representation among several regional and statewide groups including the California Stormwater Quality Association and the Southern California Coastal Water Research Project.

- Coordination with Orange County Transportation Authority (OCTA) on development of a Structural BMP Prioritization and Analysis Tool (SBPAT) to support disbursement of Measure M2 funding for water quality projects. SBPAT is a GIS-based decision support tool that is being used to identify and prioritize potential structural BMP retrofit projects throughout Orange County. To date Tier 1 funding of $8.6 million has been awarded to 85 projects and Tier 2 funding of $12.7 million has been awarded to 8 projects.

1.0 Introduction

The Story: Introduction

- Established in 1990, the Orange County Stormwater Program (the Program) is a cooperative regulatory partnership among the cities of Orange County, the County of Orange and the Orange County Flood Control District (collectively the Permittees) who operate an interconnected municipal storm drain system. Discharges of stormwater and urban runoff from this system are authorized by National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permits.

- The Program is focused on maintaining regulatory compliance of the Permittees with Clean Water Act mandates and mitigating the water quality impacts to streams, creeks and coastal waters that can arise from the imprint of urban development on the landscape.

- This Report of Waste Discharge (ROWD) constitutes the Permittees' application for a Fifth Term of NPDES Municipal Stormwater Permit that is specific to South Orange County and presents specific recommendations for the continuation and future development of the Program.

1.1 Overview

The Program is a cooperative regulatory partnership among the cities of Aliso Viejo, Dana Point, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, Rancho Santa Margarita, San Clemente, San Juan Capistrano, the County of Orange and the Orange County Flood Control District (collectively the Permittees - See **Attachment 1.1 - Primary Permittee Contacts**) who operate an interconnected municipal storm drain system which discharges stormwater and urban runoff pursuant to National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Permit (MS4 Permit). Clean Water Act Section 402(p) stipulates that MS4 permits must require the Permittees to:

- Effectively prohibit non-stormwater discharges to the storm drain system, and
- Implement controls to reduce the discharge of pollutants in stormwater to the Maximum Extent Practicable (MEP).

In anticipation of the expiration of the South Orange County MS4 Permit on December 16, 2014, this Report of Waste Discharge (ROWD):

- Describes the regulatory basis and environmental rationale for the Program and requests issuance of a Fifth Term Permit that is specific to south Orange County (see – "Introduction");
- Presents an assessment of the state of the environment for South Orange County with specific reference to swimming safety and aquatic ecosystem health and makes recommendations for the future allocation of monitoring resources (see – "State of the Environment");
- Evaluates jurisdictional pollutant control program effectiveness and makes recommendations for enhancing future program implementation (see – "Controlling Pollutant Sources: Jurisdictional Management Programs");
- Describes watershed-based planning in Orange County and makes recommendations for integrating Total Maximum Daily Load requirements into the Fifth Term Permit (see – "Controlling Pollutant Sources: Watershed Programs");
- Reviews the Program's jurisdictional and watershed planning processes and makes recommendations for a shift toward a "watershed management approach"

supportive of the restorative goals of the Clean Water Act (see – "Plan Development");
- Reviews the Program's management structure and describes current program financing including recommendations for future cost studies (see – "Program Management and Financing"); and
- Summarizes recommendations for the future direction of the Program with recommendations (see – "Summary and Conclusions").

In combination these discussions are intended to fulfill the requirements for the content of the Report of Waste Discharge (see R9-2009-0002 – Section K.2.b), which must include:

- Proposed changes to the Permittees' runoff management programs;
- Proposed changes to monitoring programs;
- Justification for proposed changes;
- Permittee and primary contact information; and
- Any other information for the reissuance of the Order.

1.2 Background

Urban Runoff and Water Quality

The Program is focused on mitigating the adverse impacts to creeks, streams, estuaries and coastal waters that can arise from the imprint of urban development on the landscape. Urbanization creates rooftops, driveways, roads and parking lots (Schueler and Holland, 2000) use the term *imperviousness* as the unifying theme for understanding the adverse hydrologic impacts of urbanization), which (1) increase the flow rate and volume of rainfall runoff (compared to pre-development conditions) and (2) provide a source of pollutants that are flushed or leached by rainfall runoff into surface water systems. These pollutants can include pathogens (disease causing bacteria, viruses and protozoan cysts from fecal sources), nutrients (bio-stimulatory substances such as nitrogen and phosphorus from fertilizers and organic wastes), sediments (sands and silts eroded from construction sites) and toxic organic and inorganic constituents (metals from automotive wear surfaces and pesticides applied to structures and landscapes).

> *There are four interrelated but separable effects of land-use changes on the hydrology of an area: changes in peak flow characteristics, changes in total runoff, changes in quality of water, and changes in the hydrologic amenities*
>
> Luna Leopold, 1968

For streams, creeks and coastal waters, urban runoff can result in:

- Water quality degradation from increased loadings of sediment, nutrients, metals, hydrocarbons, pesticides, and bacteria;
- Stream channel modification and habitat loss due to erosion or channel realignment for flood protection;
- Increased water temperatures resulting from solar energy absorption by urban surfaces and elimination of riparian shading; and
- Loss of groundwater recharge.

Water quality can be defined by both a set of concentrations, speciations, and physical partitions of organic and inorganic substances, and the composition and state of aquatic biota found in a waterbody (Meybeck and Helmer, 1992). Understanding these alternate definitions is highly significant to the ongoing development of the Program, the regulatory framework that impels it and the San Diego RWQCB's "Practical Vision (SDRWQCB 2013)."

Section 2.0 presents a comprehensive assessment of the "state of the environment" for South Orange County based on the results of long-term water quality monitoring and related special studies. However, from a regulatory compliance perspective the 303(d) has particular significance in setting the Program's specific pollutant priorities.

Regulatory History

The Program was initiated in 1990 as a cooperative local government response to a 1987 amendment to the federal Clean Water Act (CWA) that established National Pollutant Discharge System (NPDES) permit requirements for municipal operators of storm drain systems. This amendment was intended to specifically address the adverse water quality impacts of urban runoff. Permit application requirements were promulgated by US Environmental Protection Agency (EPA) in 1990 (40 CFR 122) and form the basis of the current program. There are two fundamental requirements:

- Effectively prohibit non-stormwater discharges to the storm drain system; and
- Implement controls to reduce the discharge of pollutants in stormwater to the Maximum Extent Practicable (MEP).

Orange County's first NPDES Permits were issued in 1990 with renewals in 1996, 2002 and 2009. The Permits require that surface water quality protection be a key consideration in local governments' oversight of construction and development, its regulation of industry and commerce, and in its construction, operation and maintenance of the public urban infrastructure.

There are separate NPDES Permits administered by the Santa Ana and San Diego Regional Water Quality Control Boards (RWQCBs). City and county jurisdictional boundaries rarely coincide with watershed boundaries and in Orange County five jurisdictions within the Program (County of Orange, Orange County Flood Control District and the cities of Lake Forest, Laguna Hills and Laguna Woods) are subject to both permits. For these jurisdictions, the designation provision in Water Code Section 13228 is an option for seeking a single set of permit requirements in instances, such as Orange County, where there is a trend of increasing divergence in permitting approaches between the Regional Boards. The adoption of the Fifth Term Permit will be an opportunity for the two of the split jurisdictions (Cities of Lake Forest and Laguna Hills) who have requested coverage under a single permit to have resolution of this issue.

> "*Maximum extent practicable (MEP) means to the maximum extent possible, taking into account equitable considerations of synergistic, additive, and competing factors, including but not limited to, gravity of the problem, fiscal feasibility, public health risks, societal concern, and social benefits.*"
>
> Elizabeth Miller Jennings, 1993

Management Approach

The management of water pollution arising from landscapes involves the strategic application of Best Management Practices (BMPs). The purpose of BMPs is to protect the beneficial uses of water resources principally through the reduction of pollutant loads and concentrations.

The Program's management approach is a process that involves:

1. Selecting and implementing BMPs to address site specific water quality problems based upon a consideration of

regulatory requirements and technical, institutional and economic feasibility;
2. Conducting comprehensive program effectiveness assessments to ensure that the BMPs are correctly implemented and to determine the effectiveness of BMPs in achieving water quality standards; and
3. Revising and/or enhancing BMPs if water quality standards are not being achieved.

This management approach is applied at two distinct scales: (1) activities conducted by the Permittees implementing jurisdictional programs based on the model programs in the Drainage Area Management Plan (DAMP); and (2) activities conducted by the Permittees and others participating in watershed programs addressing specific waterbody-pollutant combinations including the restorative goals of the Clean Water Act.

Drainage Area Management Plan

The **Drainage Area Management Plan (DAMP)** is the principal policy and program guidance document for the *Program*. The DAMP describes the agreements, structures and programs that:

- Identify urban impacts on receiving waters; produce environmental quality information to direct management activities, including prioritization of pollutants to support the development of specific controls to address these problems; and determine if aquatic resources are being protected;
- Improve existing municipal pollution prevention and removal best management practices (BMPs) to further reduce the amount of pollutants entering the storm drain system;
- Educate the public about the issues of urban stormwater and non-stormwater pollution and obtain their support in implementing pollution prevention BMPs;
- Ensure that all new development and significant redevelopment incorporates appropriate Site Design, Source Control, Treatment Control and LID BMPs to address specific water quality issues;
- Ensure that construction sites implement control practices that address control of construction related pollutants discharges including an effective combination of erosion and sediment controls and on-site hazardous materials and waste management;
- Ensure that existing development addresses discharges from industrial facilities, selected commercial businesses, residential development and common interest areas/homeowner associations.
- Detect and eliminate illegal discharges/illicit connections to the municipal storm drain system;
- Assess constituents of concern and manage urban runoff on a watershed basis with an emphasis on Total Maximum Daily Load (TMDL) obligations and the restorative goals of the Clean Water Act;
- Provide the framework for the program management activities and plan development, and
- Provide the legal authority for prohibiting unpermitted discharges into the storm drain system and for requiring

Best Management Practices

BMPs are defined as "schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants to receiving waters." The types of BMPs are source control, runoff treatment, and flow control.

BMPs in new development and significant redevelopment;

The model programs in the DAMP are implemented individually by each of the Permittees according to jurisdictional DAMP/Local Implementation Plans (LIPs). The ongoing development of the DAMP is informed by annual and five year (i.e. ROWD) program effectiveness assessments.

Orange County – Physical Landscape

Orange County comprises 790 square miles of land area, beginning on a coastal plain and rising to an elevation of over 5,000 feet in the Puente Hills and Santa Ana Mountains to the north and east. The northwestern part of the county lies on the coastal plain of the Los Angeles Basin, while the southeastern end rises into the foothills of the Santa Ana Mountains. The landscape of Orange County presents urbanized watersheds encompassing 34 cities and a total population of 3.1 million people.

Most of Orange County's population resides in one of two shallow coastal valleys either the Santa Ana Valley or the Saddleback Valley. The County has a history of large planned communities, the most notable being the City of Irvine, City of Mission Viejo, City of Aliso Viejo, Coto de Caza, Anaheim Hills, Tustin Ranch, Tustin Legacy, Ladera Ranch, Talega and City of Rancho Santa Margarita. Population growth has slowed as the County has become largely built out (**Figures 1.1 – 1.5**).

Before urbanization, Orange County was drained by ephemeral streams and agricultural drainage ditches which were dry most of the year and carried measurable flow primarily during short duration flash floods and longer duration general winter storms. As urbanization progressed, man-made agricultural drainage ditches were enlarged to flood control channels and the few natural streams such as Santa Ana River, San Diego Creek and San Juan Creek were constrained within levees to provide flood protection (**Figures 1.6 -1.10**). Ephemeral flows in some of the man-made and natural channels have been replaced with continuous low flows created from urban and agricultural irrigation and shallow groundwater.

South Orange County comprises five principal watersheds (Laguna Coastal Streams, Aliso Creek, Dana Point Coastal Streams, San Juan Creek and San Clemente Coastal Streams). In addition, small areas of largely undeveloped land in the City of San Clemente and unincorporated Orange County extend into the San Mateo Creek Watershed. These watersheds are hydrologically separate from North Orange County and physically, hydrologically and jurisdictionally isolated from the adjacent counties of Riverside and San Diego by mountain ranges and/or large swaths of federal land.

Across south Orange County, residential land uses, spread across characteristically modified topography, predominate. Beneath the urbanized landscapes, mostly clay-rich soils overlie marine sediments such as the Monterey and Capistrano Formations. Shallow groundwater from these formations is likely the major determinant of dry weather stream water chemistry and the cause of phosphorus, chloride, sulfates and total dissolved solids (TDS) being identified as the cause of water quality impairments.

Fifth Term Permit

The complexion of the south Orange County landscape is distinct both within Orange County and across the region. For the Program, this landscape presents a number of unique water quality challenges. For example, to enable the Program to effectively prohibit non-stormwater discharges, efforts to

abate dry weather discharges must be allowed to distinguish and prioritize between shallow groundwater influences and genuinely aberrant urban conditions.

In the absence of large areas of industrial and commercial enterprise and little residential redevelopment, addressing pollutant wash-off from impervious surfaces in predominantly residential landscapes requires an emphasis on public infrastructure solutions complemented with education and outreach. This approach ensures that both modifications to drainage infrastructure and public support for the Program will be sustained over the long term.

The history and nature of South Orange County's development also has implications for stormwater regulation and permitting if the broader ecological outcomes contemplated in the Practical Vision and recent imperatives for integrated water resource management are to be achieved. For example, the highly modified stream systems that have been reconstructed to protect historic floodplain development and high land values mean that opportunities for alternate channel configurations will need to be identified through a watershed analysis and cannot be assumed to be presented by every modified channel segment.

For reasons identified above and which are discussed in greater detail in the subsequent sections of this report, this ROWD constitutes the request by the Permittees for a Fifth Term Permit that is unique to South Orange County.

Figure 1.1: Laguna Coastal Streams - Land Use

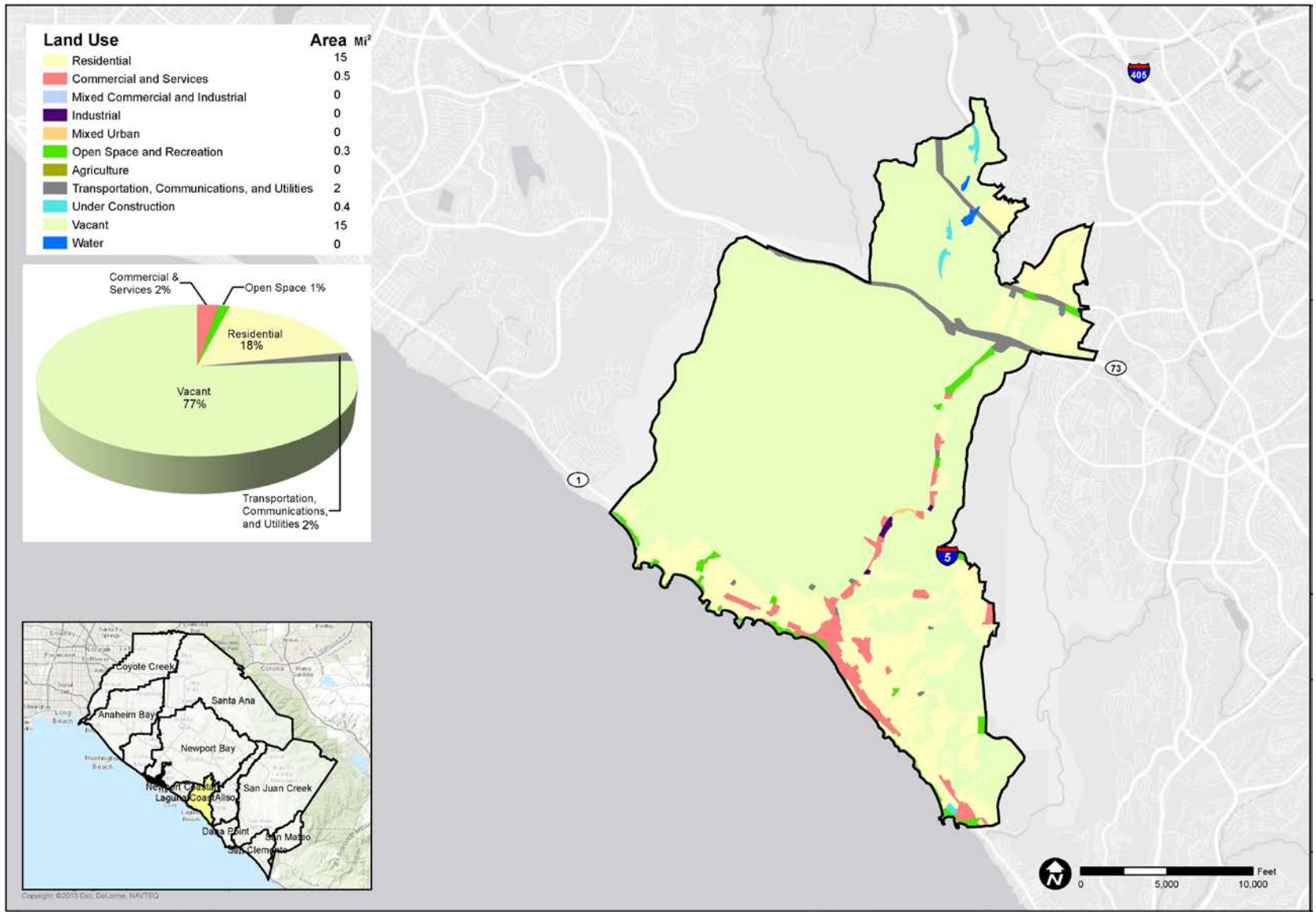


Figure 1.2: Dana Point Coastal Streams - Land Use

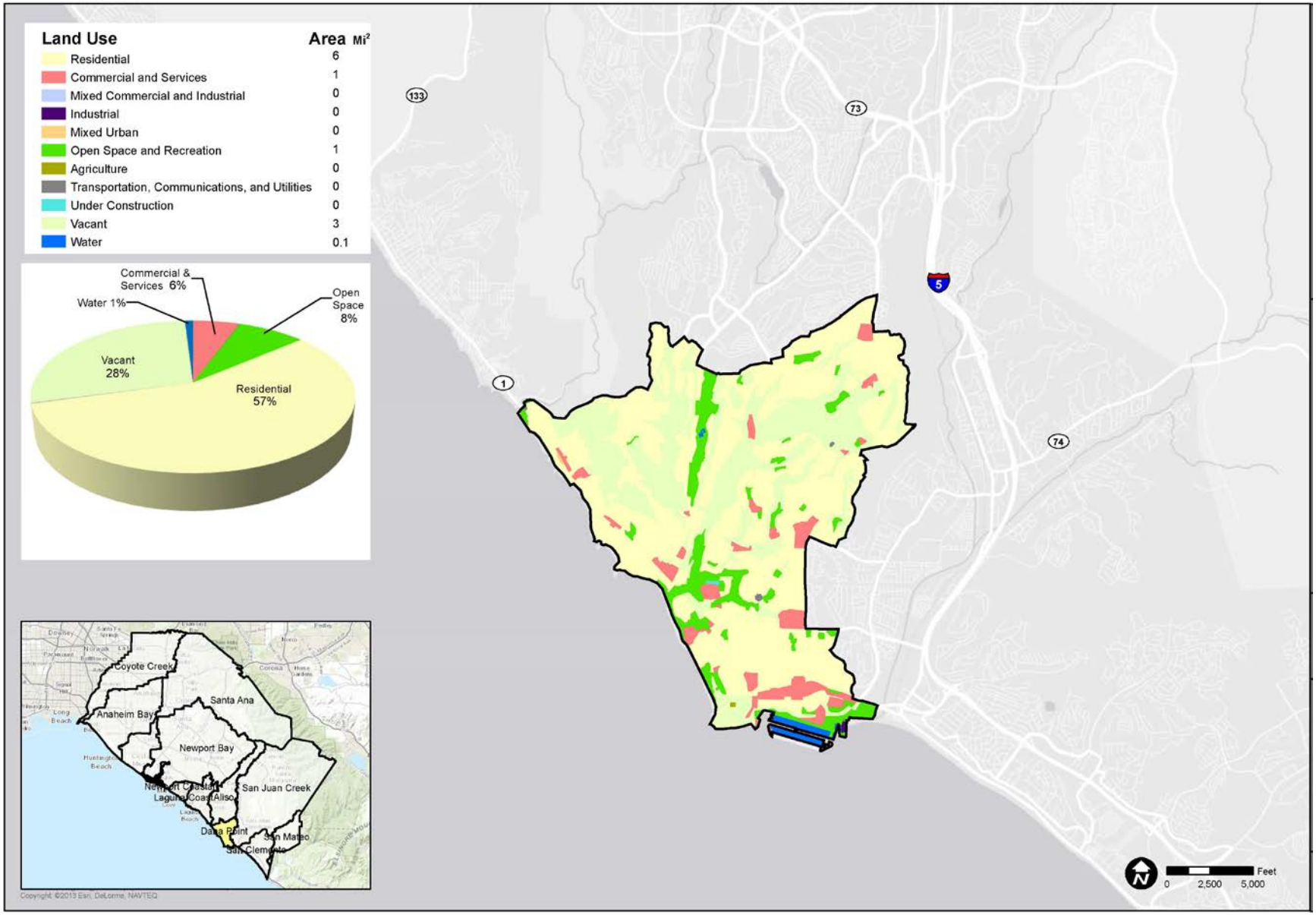


Figure 1.3: Aliso Creek - Land Use

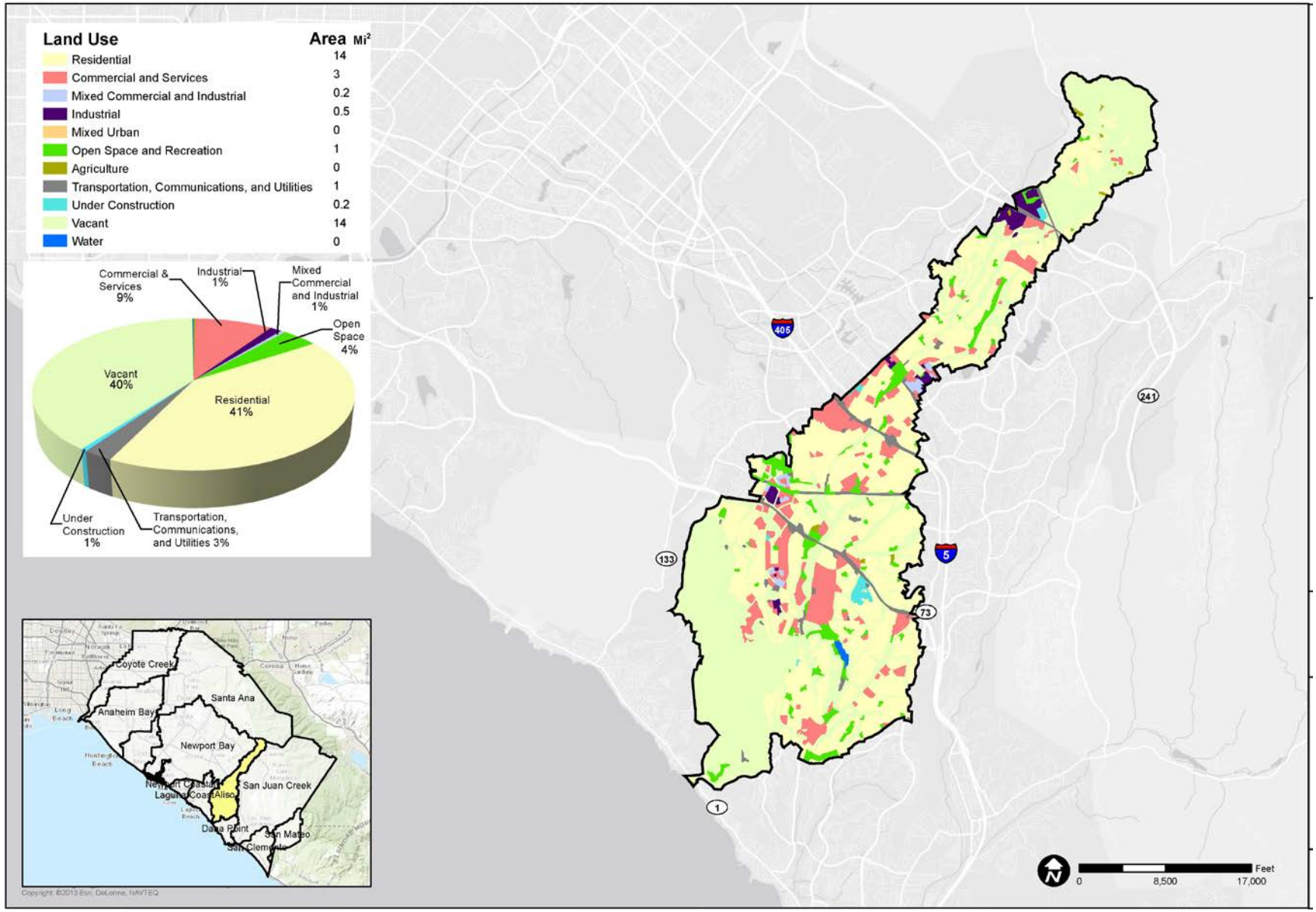


Figure 1.4: San Juan Creek – Land Use

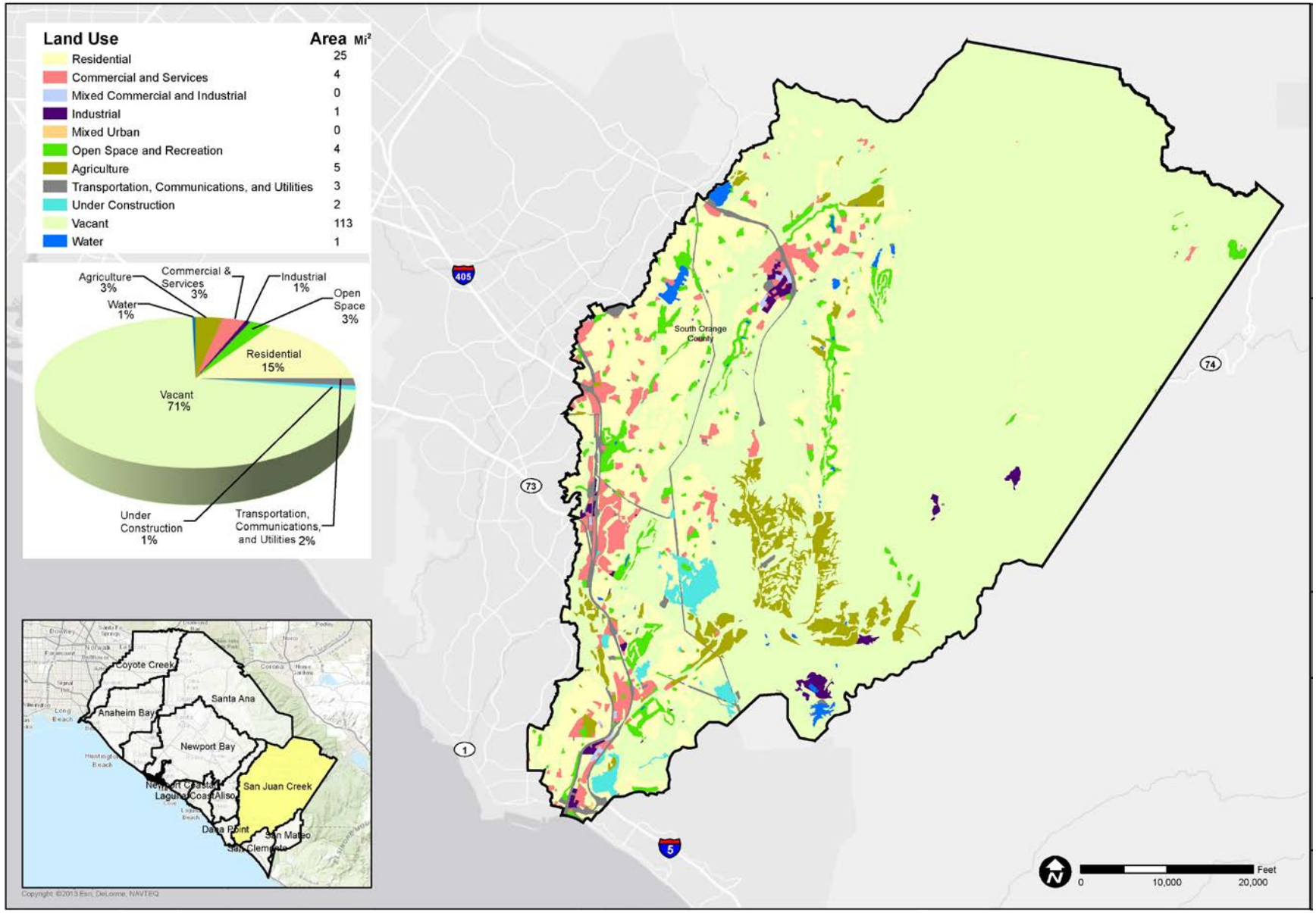


Figure 1.5: San Clemente Coastal Streams – Land Use

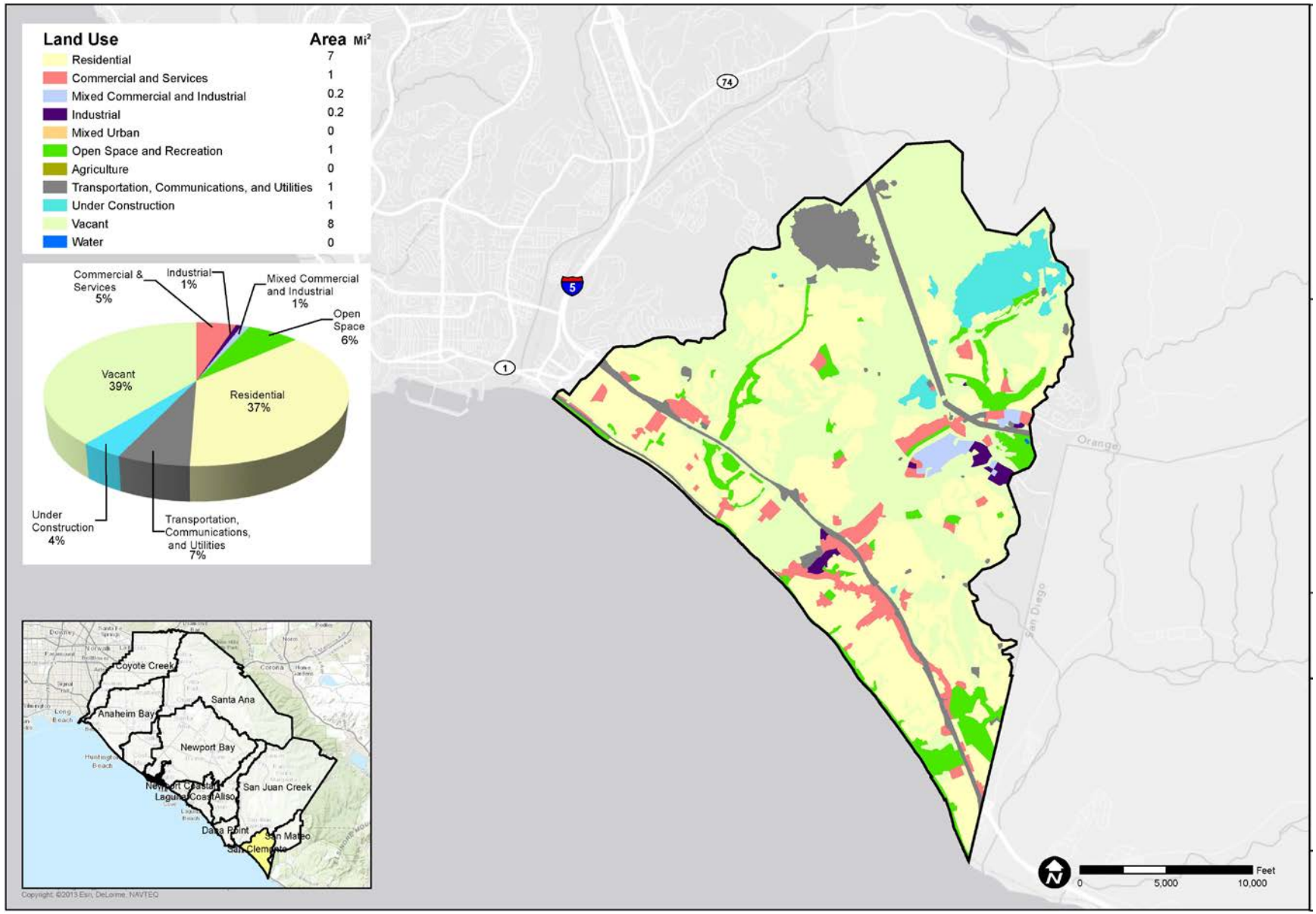


Figure 1.6: San Mateo Creek – Land Use

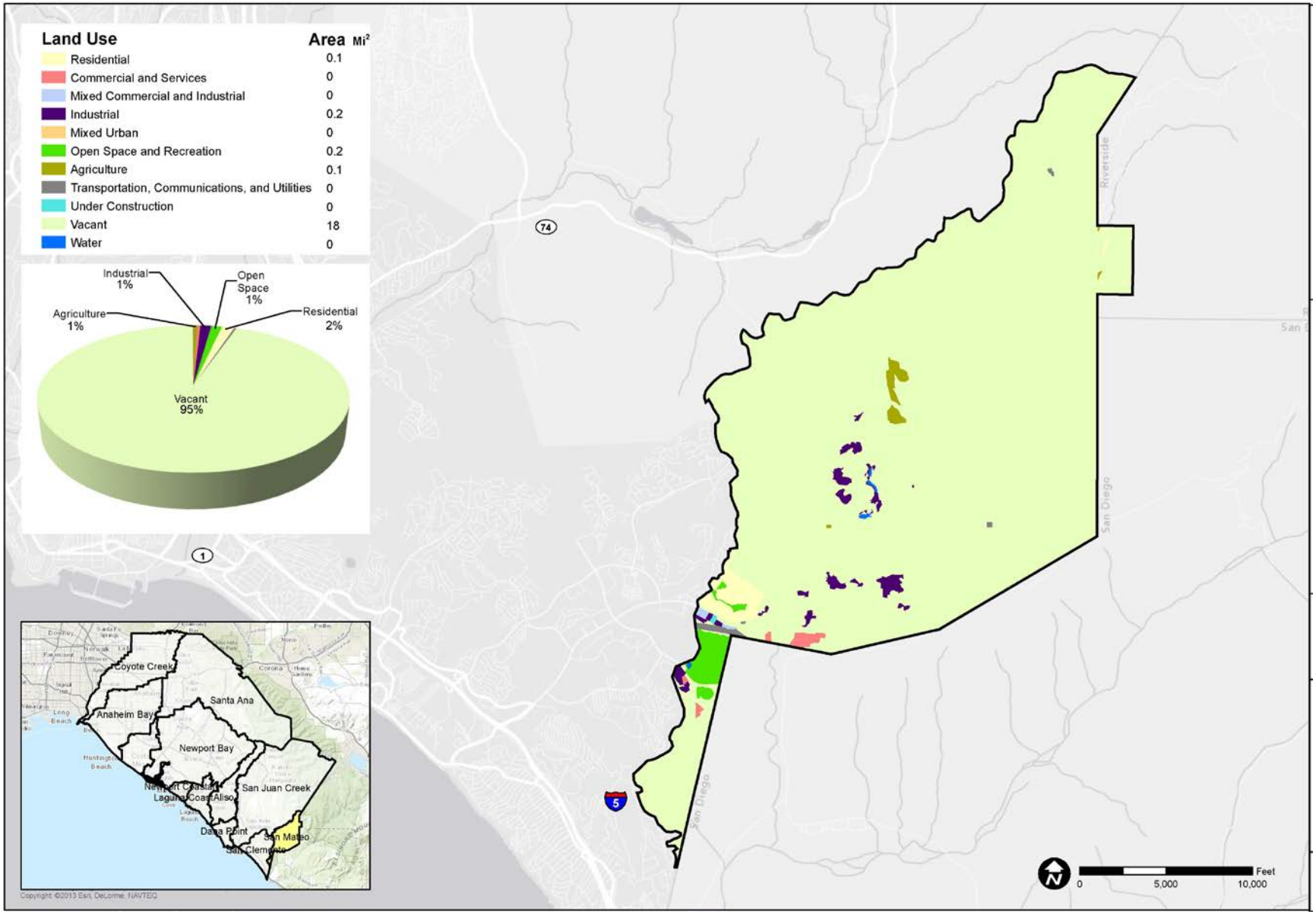


Figure 1.7: Laguna Coastal Streams – Main Stem Channel Type

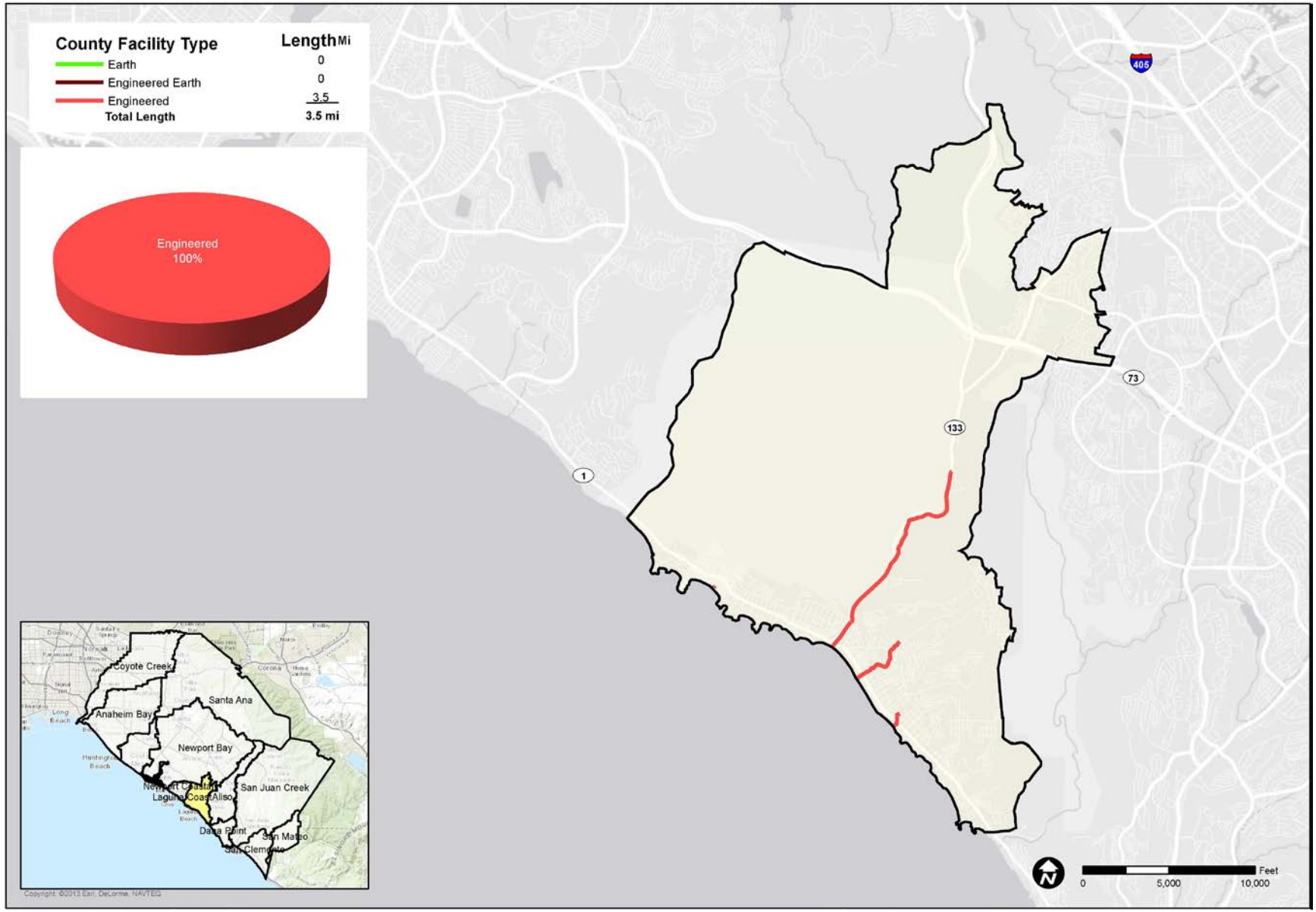


Figure 1.8: Dana Point Coastal Streams - Main Stem Channel Type

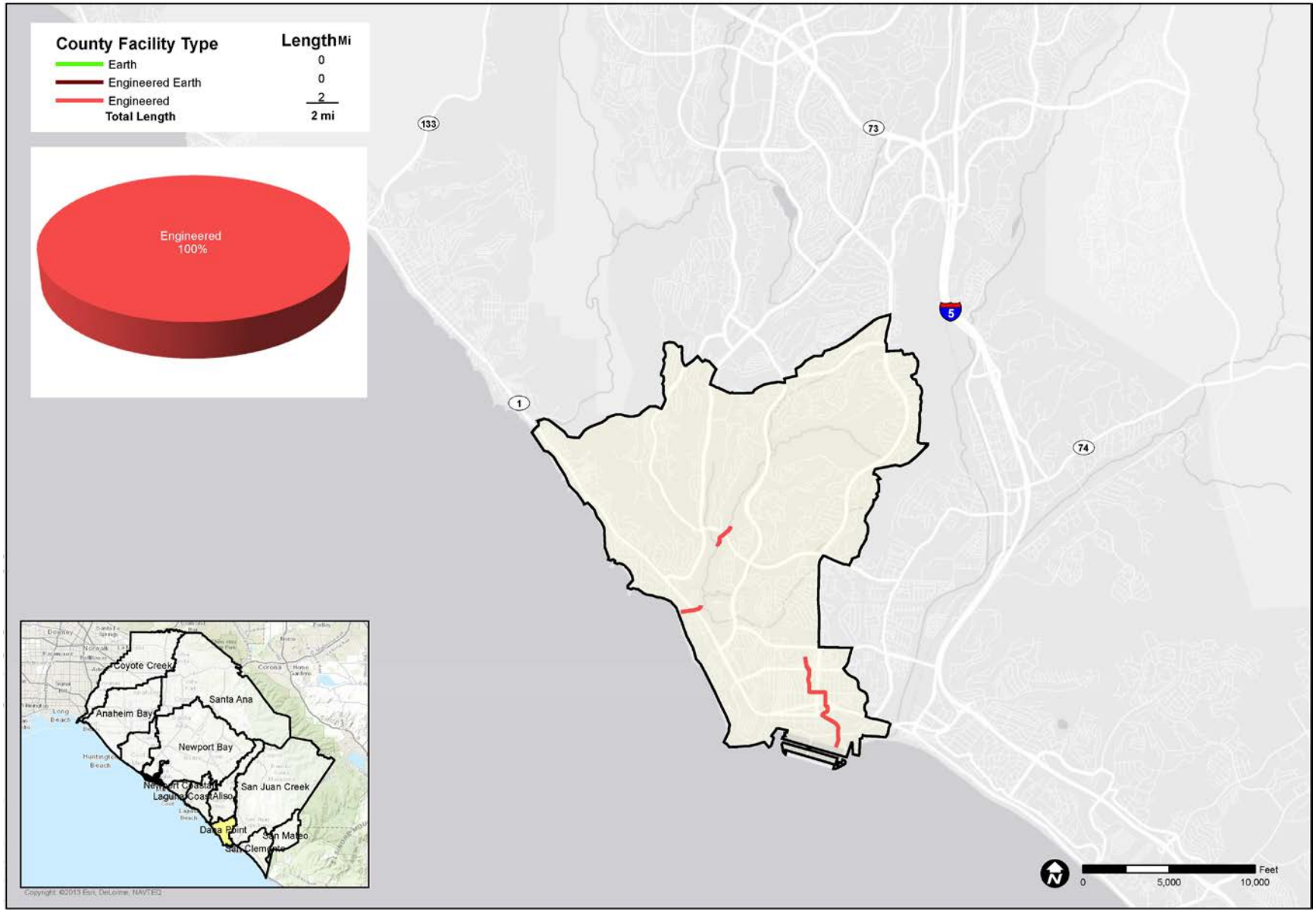


Figure 1.9: Aliso Creek - Main Stem Channel Type

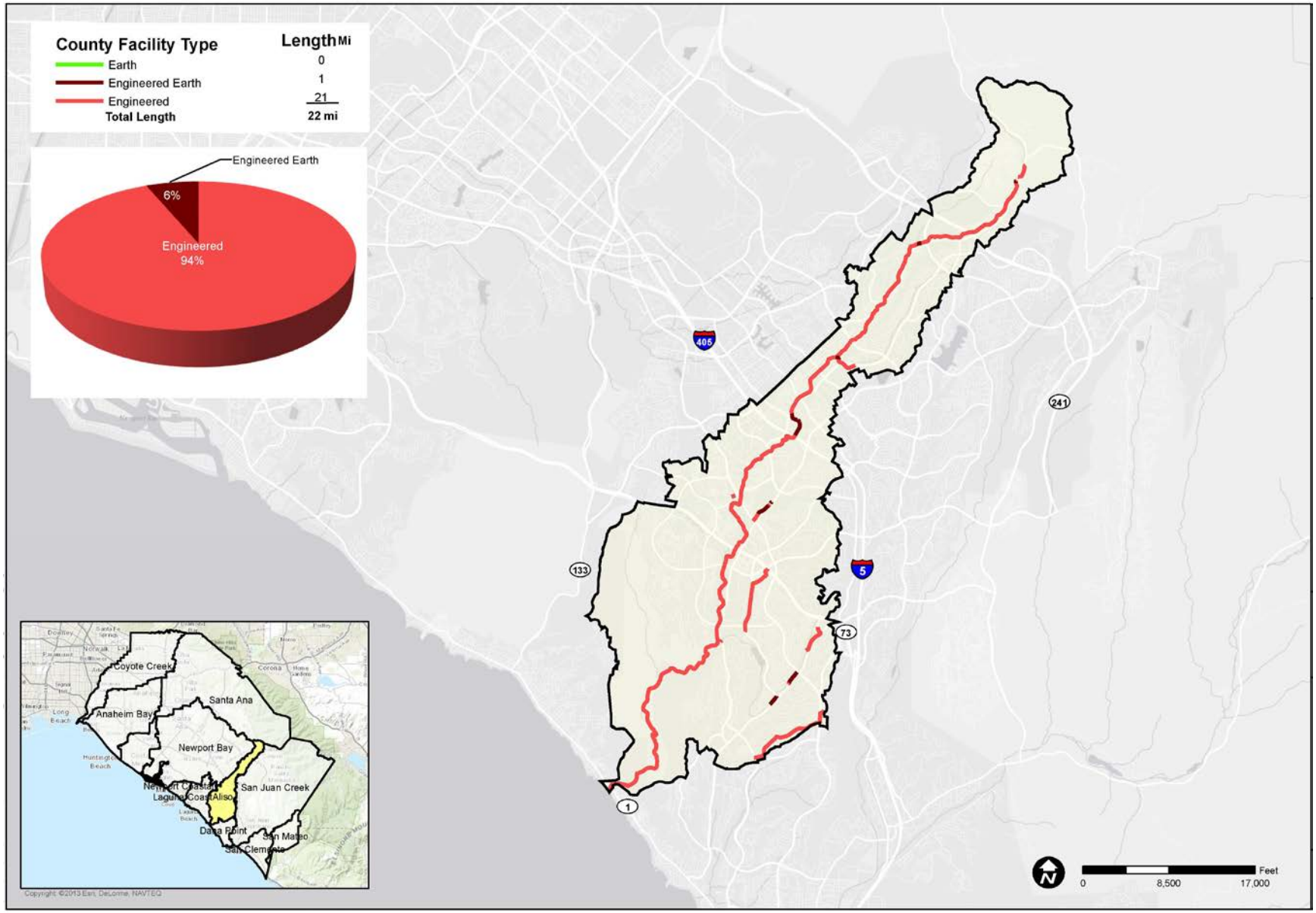


Figure 1.10: San Juan Creek – Main Stem Channel Type

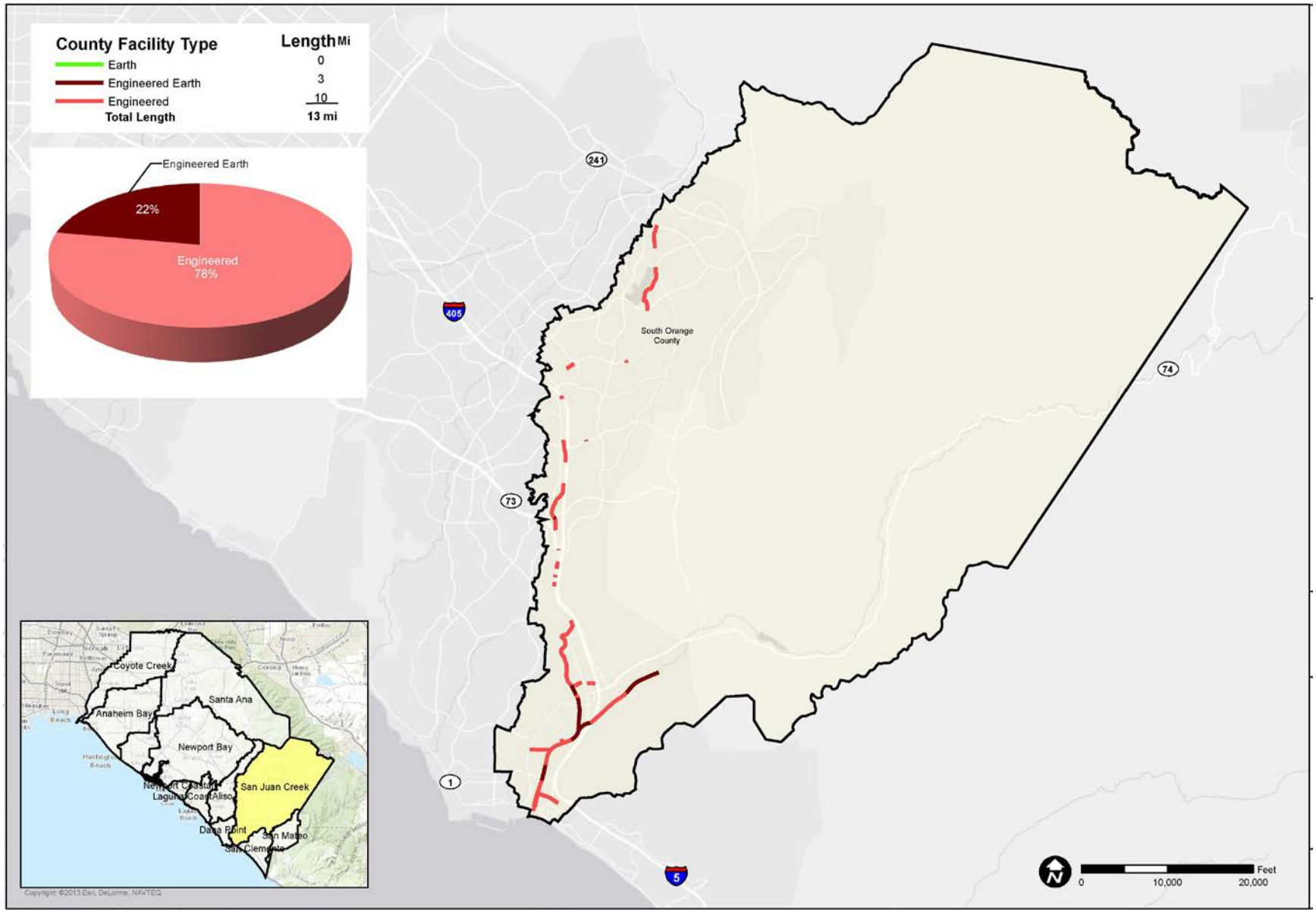
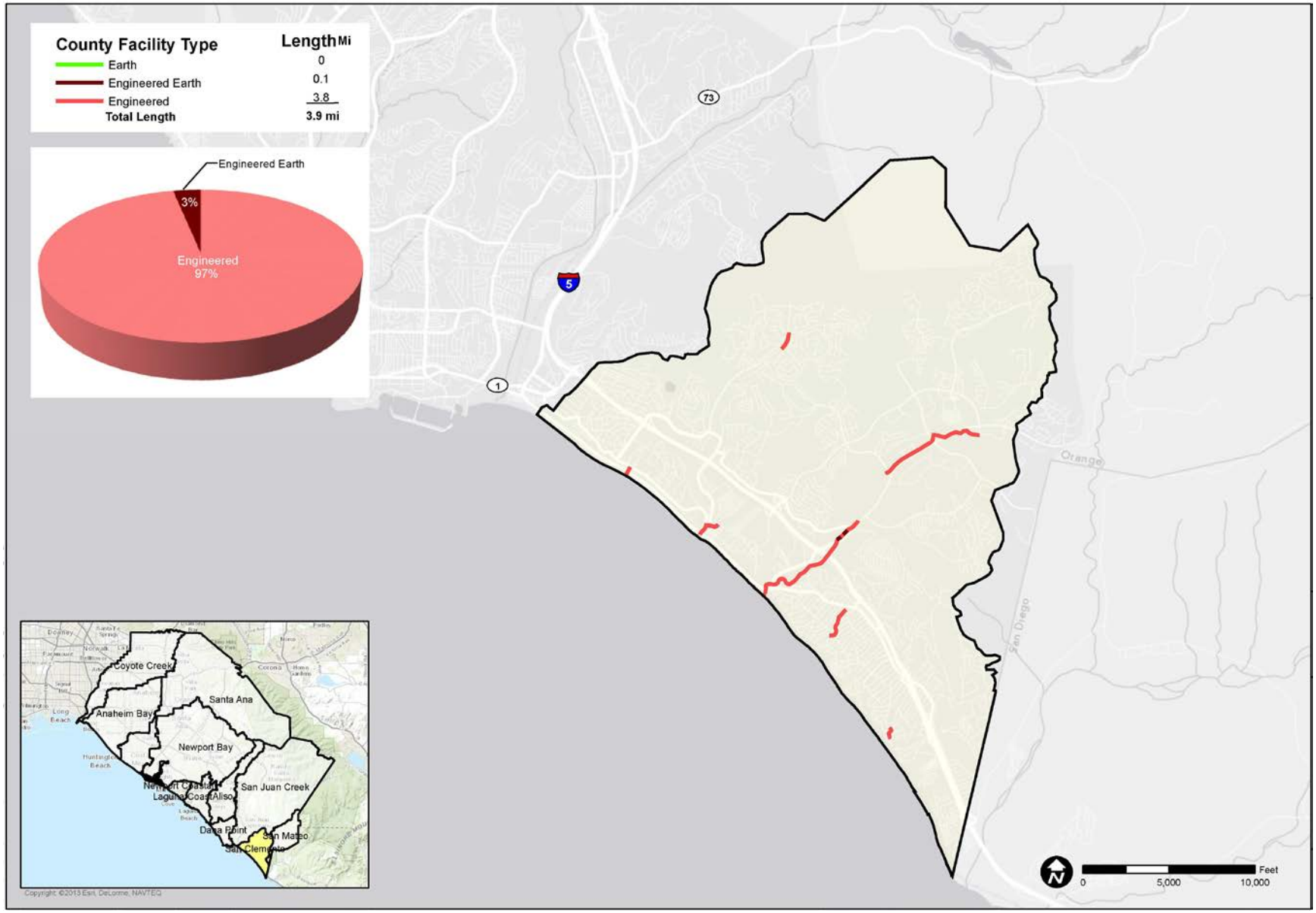


Figure 1.11: San Clemente Coastal Streams – Main Stem Channel Type



Orange County - Public Interest

A public that is informed and motivated to adopt practices protective of water quality can be a significant form of pollution source control. However, continually increasing public knowledge of and willingness to prevent water pollution at home and work is an ever-evolving process and significant challenge. In spite of this, public opinion surveys conducted in 2003, 2005, 2009 and 2012 indicate that Orange County residents have already become both more knowledgeable of environmental quality and are increasingly engaged in environmentally protective behaviors.

Preservation of the environment out of concern for future generations is the number one environmental concern reported by respondents in the most recent opinion survey. A notable eighty-eight percent of respondents reported being concerned about preserving the environment for their children. As a powerful motivator, the connection to future generations can help communicate *why* a particular issue is important and supplement *how* the individual can personally help prevent pollution. Perhaps not surprisingly, parents of children who brought home water quality information were also substantially more likely to perform a greater number of "stormwater safe" behaviors. Of the seven behaviors measured, parents of informed students were more than three times as likely to perform all seven behaviors (22 percent compared to only seven percent).

Orange County residents are clearly concerned about the environment and can be motivated to adopt practices that protect water quality. The Permittees intend to respond to this interest by supplementing continued investment in mass-media education campaigns with targeted outreach that zeroes in on key pollutants and addresses behaviors that most regularly contribute to that source of pollution. This supplemental approach will use Community Based Social Marketing (CBSM) to encourage target audiences to adopt specific BMPs; the process of CBSM is explained further in **Section 3.3.4**. This two pronged approach provides the Permittees the ability to foster long-term engagement while continuing to provide mass media communication that reaches the entire Orange County population.

1.3 Approach to Preparing Report of Waste Discharge

The ROWD assesses the current Program and identifies revisions to the management program in response to the information learned. Indeed, it is a basic requirement of the Permits' receiving water limitations provisions that the Program continue to adapt and evolve when urban runoff is determined to be causing or contributing to impairments of beneficial uses.

The development of the DAMP is informed by two discrete, yet related water quality planning processes: "countywide/jurisdictional," and "watershed-based" water quality management (see – "Plan Development"). Each process incorporates findings from annual assessments focused on determining whether desired programmatic outcomes are being achieved. Specifically:

- Are program elements being implemented effectively?
- Are environmental improvements being realized?

In this ROWD, the assessment of the Program has produced three types of "Recommendations":

1. **Program Continuation** – Requires no changes in implementation approach, policy or permitting
2. **Program Enhancements** – Requires shift in implementation approach
3. **Program Modifications** – Requires adjustments in policy and permitting

The "Recommendations" are presented throughout the ROWD and are summarized in "Recommendations for Fifth Term Permit."

1.4 References

San Diego Regional Water Quality Control Board (SDRWQCB). *San Diego Regional Water Board Practical Vision: Healthy Waters, Healthy People.* 2000. http://www.swrcb.ca.gov/sandiego/water_issues/Practical_Vision/docs/PV.pdf

Thomas R. Schuler and Heather K. Holland. *The Practice of Watershed Protection: Techniques for protecting our nation's streams, lakes, rivers and estuaries* (Maryland: Center for Watershed Protection, 2000).

2.0 State of the Environment

2.1 Overview

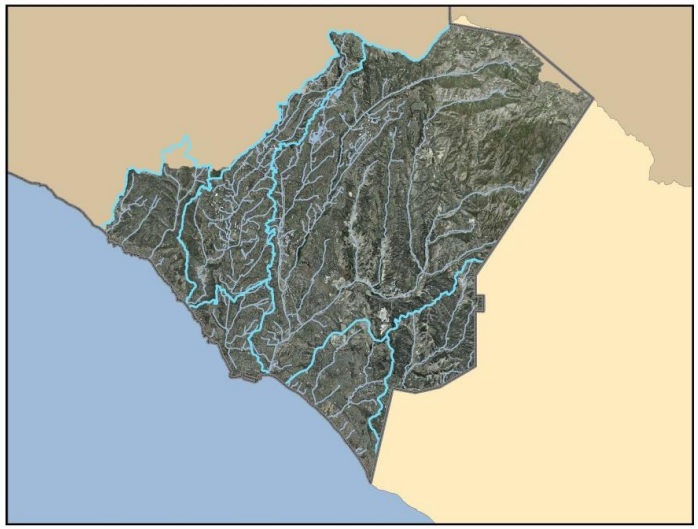
The Program's monitoring, assessment, and environmental research efforts are intended to track progress toward solving existing issues, identify emerging issues that could become issues in the future, and support research and development that improves our understanding of key processes and advances the efficiency and effectiveness of monitoring methods.

Monitoring is most often seen as a response to regulatory requirements, which it is, but it also provides information that guides the use of important resources and answers a set of fundamental questions of keen interest to both managers and the public. The State Water Resources Control Board has articulated the following four questions (based on the intent of the federal Clean Water Act) that provide a broad context for water quality monitoring in the state:

- Is our water safe to drink?
- Is it safe to swim in our waters?
- Is it safe to eat fish and shellfish from our waters?
- Are our aquatic ecosystems healthy?

This current assessment of the state of the environment for south Orange County (**Figure 2.1.1**) summarizes the results of long-term monitoring and related special studies that address the second and fourth of these questions (related to swimming safety and aquatic ecosystem health). These two issues are directly related to stormwater management priorities. The safety of drinking water is addressed by other agencies and programs that produce independent reports on drinking water quality. The safety of consuming local fish and shellfish is directly managed by the California Office of Environmental Health Hazard Assessment (OEHHA), supported by data and assessments conducted by the California Surface Water Ambient Monitoring Program (SWAMP) and others (the Beaches and Creeks TMDL for bacteria did not address the shellfish recreational use standard). In addition, the State Water Resources Control Board is in the process of conducting a statewide assessment of the potential contribution of contaminated sediments in enclosed bays and estuaries to the levels of contaminants in seafood tissue as well as shell beneficial use (SWRCB 2011).

Figure 2.1.1: The portion of South Orange County that is under the jurisdiction of the San Diego Regional Water Quality Control Board and is the focus of this Report. *Blue lines represent watershed boundaries.*



This Report therefore focuses on the two core management questions that are within the Stormwater Program's area of responsibility and that are not currently being assessed by other agencies. For each major question (e.g., Is it safe to swim in our waters?), monitoring and assessment should, over time, answer the following assessment questions:

- Is there a problem?
- If so, what is its magnitude and extent?
- What are the sources of the problem?
- Are conditions getting better or worse?
- Are management actions working as intended?

Monitoring, assessment, and research efforts should be tightly focused on one or more of these questions and be managed to ensure that resources are reallocated when questions are answered and new ones arise (**Figure 2.1.2**). Monitoring, assessment, and research should therefore be managed as a portfolio of resources invested in creating the information needed to meet the Program's goals, with the allocation of resources adjusted as needed. Assessment and research are included as a package with monitoring for two reasons. First, the information produced by ongoing monitoring programs is most useful when it is carefully analyzed, evaluated in the context of other related information, and applied to the basic questions motivating monitoring (i.e., assessed). Second, not all questions can be answered by routine monitoring and targeted special studies (i.e., research) are often needed to fill critical data gaps, develop more effective monitoring tools, and/or lay the groundwork for new management approaches. This approach follows the guidance contained in the Regional Board's recently adopted *Framework for Monitoring and Assessment (RWQCB 2012),* which emphasizes the importance of a sequential, question-driven approach supported by appropriate monitoring and assessment efforts that are adapted over time as knowledge improves and priorities shift.

Figure 2.1.2: Monitoring, assessment, and research provide the data and information required to answer the five key assessment questions. *Attention should shift among questions as information improves and priorities change, and the mix of monitoring, assessment, and research activities should be adjusted to correspond.*

The Program has identified three themes that help structure the assessment of the status and trends of environmental conditions in south Orange County and the accompanying recommendations for restructuring current monitoring programs:

- Theme 1: Focus on priority areas and constituents rather than trying to monitor all constituents, potential issues, and locations.

- Theme 2: Increase the integration of data from a wider range of sources in order to leverage the value and impact of the Program's efforts to address the five assessment questions.
- Theme 3: Continue evolving from a strictly discharge-specific approach to a risk prioritization approach that can highlight problem areas and support more flexible monitoring designs that include data driven adaptive triggers.

These three Report themes inform the following the section of progress toward meeting management goals for the four critical areas of concern (bacteria, dissolved solids, nutrients and toxicity). In these areas, there is a substantial amount of data available to support conclusions about progress, highlight remaining problem areas, and reexamine current monitoring designs to improve efficiency and effectiveness.

This Report begins with an evaluation of available data from the past ten years of monitoring in the region's water bodies in order to identify constituents whose concentrations and impacts have been successfully reduced, as well as those that remain of concern. This initial prioritization is then expanded and examined in greater detail in subsequent sections of this Report.

Subsequent sections examine these constituents in greater depth, the progress made and factors that contribute to continuing issues. Each section ends with recommendations for improving monitoring's effectiveness. A final section evaluates the study designs for the Dry Weather and the Coastal Ambient monitoring efforts, to assess whether their goals could be better met with different approaches.

2.2 Prioritization

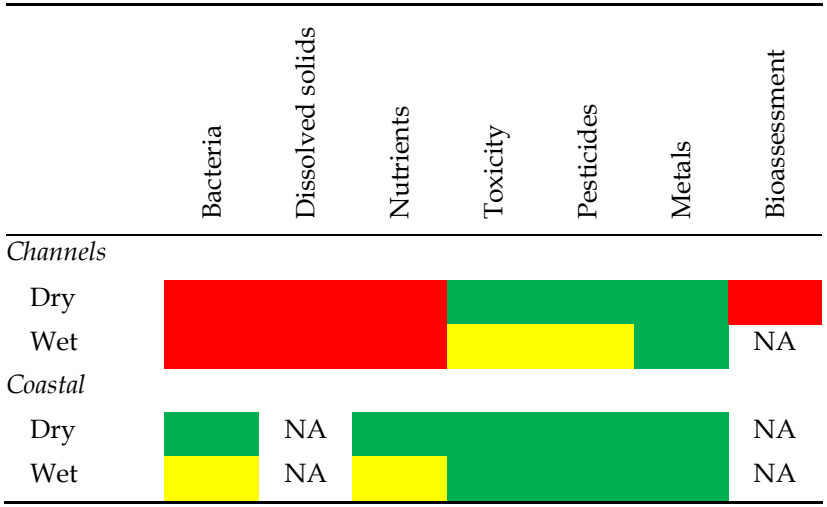
The Story: Prioritization

- Prioritization is a valuable tool for the Program to use its resources wisely to focus on the most important issues.
- Initial prioritization is based on the overall frequency and magnitude of exceedances of compliance standards and other measures of problem severity.
- In inland channels, bacteria, dissolved solids, and nutrients are persistent issues over time, particularly in wet weather.
- For coastal discharges, there are no persistent issues in wet weather, while bacteria and nutrients are issues in dry weather.
- Some elevated toxicity is present in inland channels during wet weather, but overall toxicity is not different from that described for background conditions by the Stormwater Monitoring Coalition (SMC).
- There are no persistent issues in the coastal surfzone due to discharges, other than localized bacteria contamination at a handful of problem beaches and localized and moderate nutrient exceedances in wet weather.

The Program has measured a broad suite of contaminants and other measures of condition (i.e., toxicity, bioassessment) and the accumulated data from many years of monitoring provides a valuable opportunity to compare the severity of impacts and adjust their relative priority. In order to provide a consistent basis of comparison across indicators (with the exceptions of toxicity and bioassessment), an overall index of the extent to which indicators meet regulatory standards is used.

The index, developed by the Canadian Council of Ministers of the Environment (CCME) was used in the Report of Waste Discharge (ROWD) for the northern portion of the County and such frequency-based indices are widely used in water quality assessment (e.g., by the Central Coast Regional Water Quality Control Board and the Ventura Countywide Stormwater Quality Management Program). It provides a measure, scored from 0 – 100, of the frequency and magnitude of exceedances that can be tracked over time, with lower scores representing worse conditions and higher scores better conditions. This index which is a more effective means of communicating water quality results accounts for the number of indicators within each category (e.g., bacteria, metals) that exceed standards in each year, the percentage of individual samples that exceed standards, and the average magnitude of any such exceedances (CCME 2001).

Table 2.2.1: Overall summary of results of prioritization analysis. *Red represents persistent and widespread exceedances of regulatory thresholds, yellow occasional exceedances, and green few if any exceedances. Measures of exceedance used in this analysis accounted for both the frequency and the magnitude of exceedance. Note: Bacteria, dissolved solids, and nutrients may be problem constituents in channels, and bioassessment scores in urban areas are generally low.*



2.2.1 Inland Channels

For inland channels, bacteria, dissolved solids, and nutrients are persistent issues over time. Toxicity is somewhat higher in wet than in dry weather, but is not substantially above background conditions described in SMC studies. Biological condition (i.e., bioassessment) is generally poor and is in the lower 50% of the distribution compared to other urban areas in southern California. The following figures present results of the prioritization analysis for these core constituents, beginning with **Figure 2.2.1**'s overall summary ranking of constituents based on monitoring data from receiving waters in inland channels.

Figure 2.2.2 presents a slightly different perspective with data collected from stormwater discharge points into inland channels prior to mixing with receiving water. No constituents in wet weather exceeded Stormwater Action Levels (SALs) (**Figure 2.2.2a**) which are higher than the Water Quality Objectives (WQO) that apply to dry weather discharges (**Figure 2.2.2b**) and receiving waters in channels (**Figure 2.2.1**). Nutrients and bacteria are persistent issues for dry weather discharges.

While toxicity is present in urban channels (**Table 2.2.2**), it is not higher, overall, in dry weather than the toxicity documented in the open (undeveloped) landuse by the SMC's regional monitoring program. Wet weather toxicity in the County's channels is higher in wet than in dryweather, and is somewhat higher in wet weather for *Americamysis bahia* than seen in the northern portion of the County, patterns discussed further in the subsequent section on toxicity.

Figure 2.2.1: Overall exceedance index for core monitoring constituents in inland channels, summarized over the 2003 – 2013 monitoring period. *The bar charts rank constituents based on their respective CCME exceedance indices in both dry and wet weather, with higher values indicating fewer and smaller exceedances. Note: pesticides and metals had considerably lower exceedance rates and magnitudes of exceedance than bacteria, dissolved solids, and nutrients.*

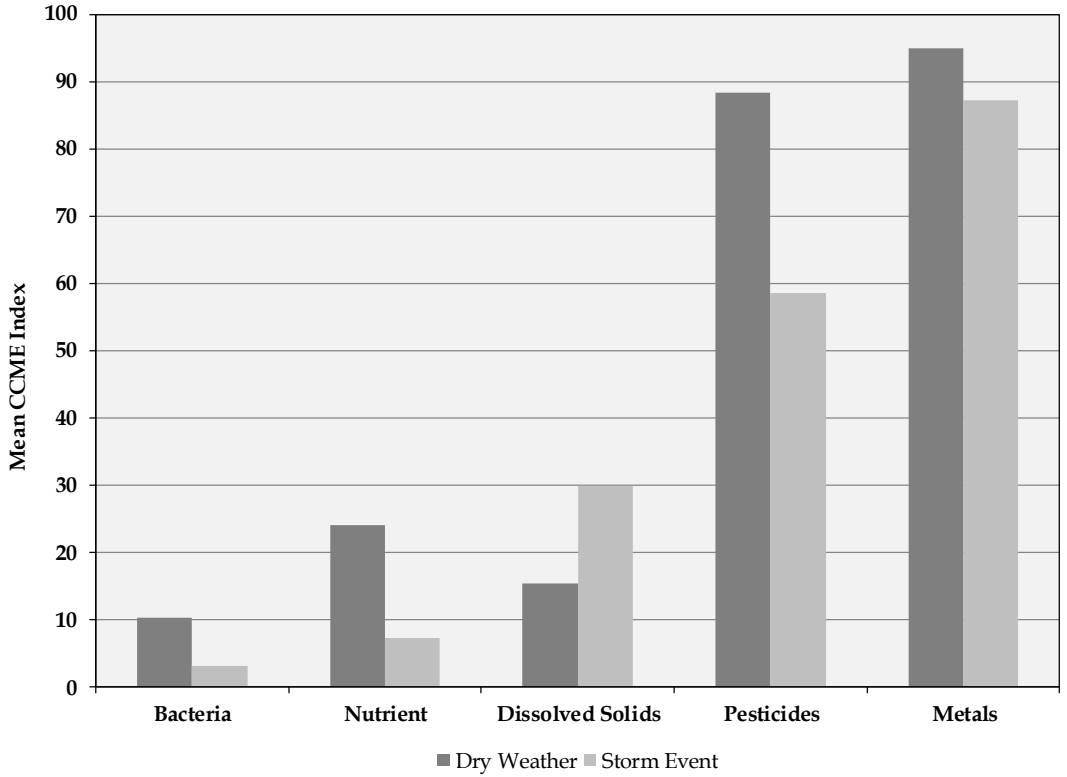
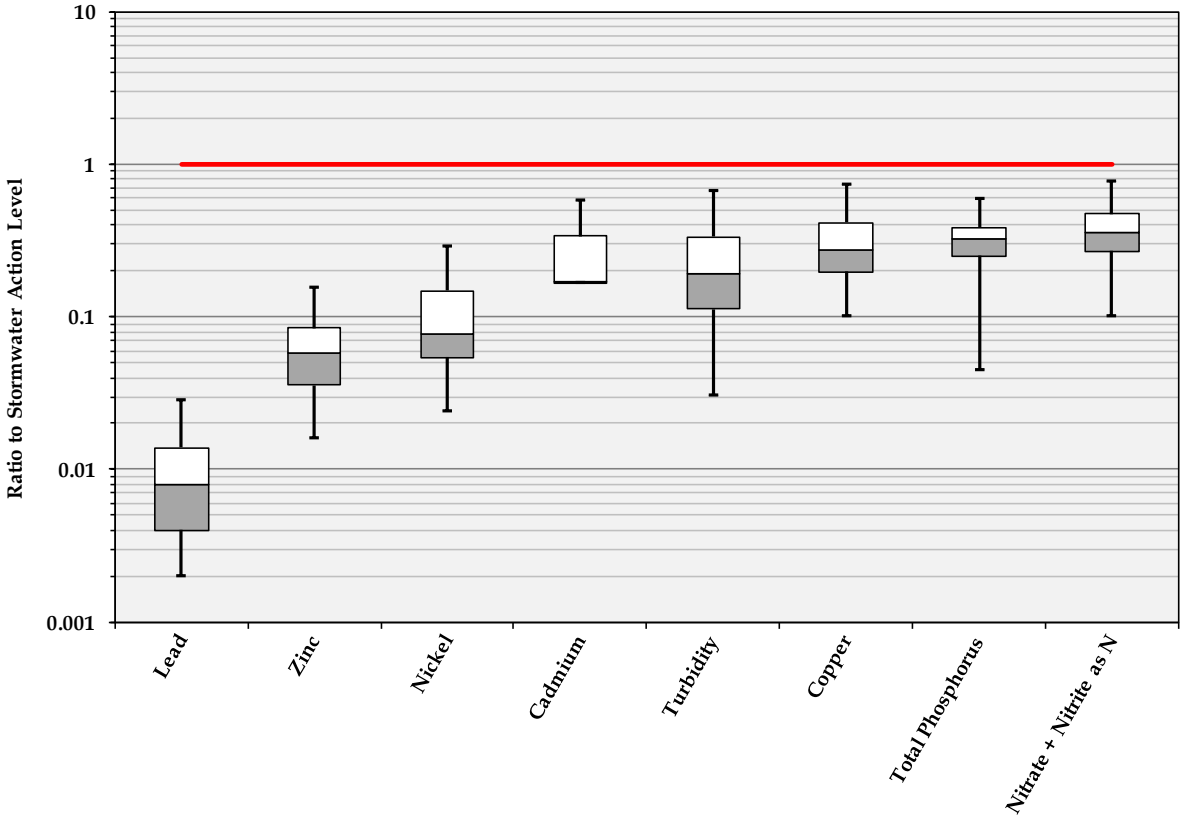


Figure 2.2.2: Comparison of individual constituent concentrations with a) stormwater action levels (SALs) for wet weather and b) water quality objectives (WQOs) for dry weather. *In the box and whiskers plot, the horizontal bar represents the median, with the upper and lower edge of the box the 75th and 25th percentiles of the distribution, respectively, and the whiskers the maximum and minimum values. Note: All constituents are below SALs in wet weather and only nutrients and bacteria are above NALs in dry weather.*

a)



b)

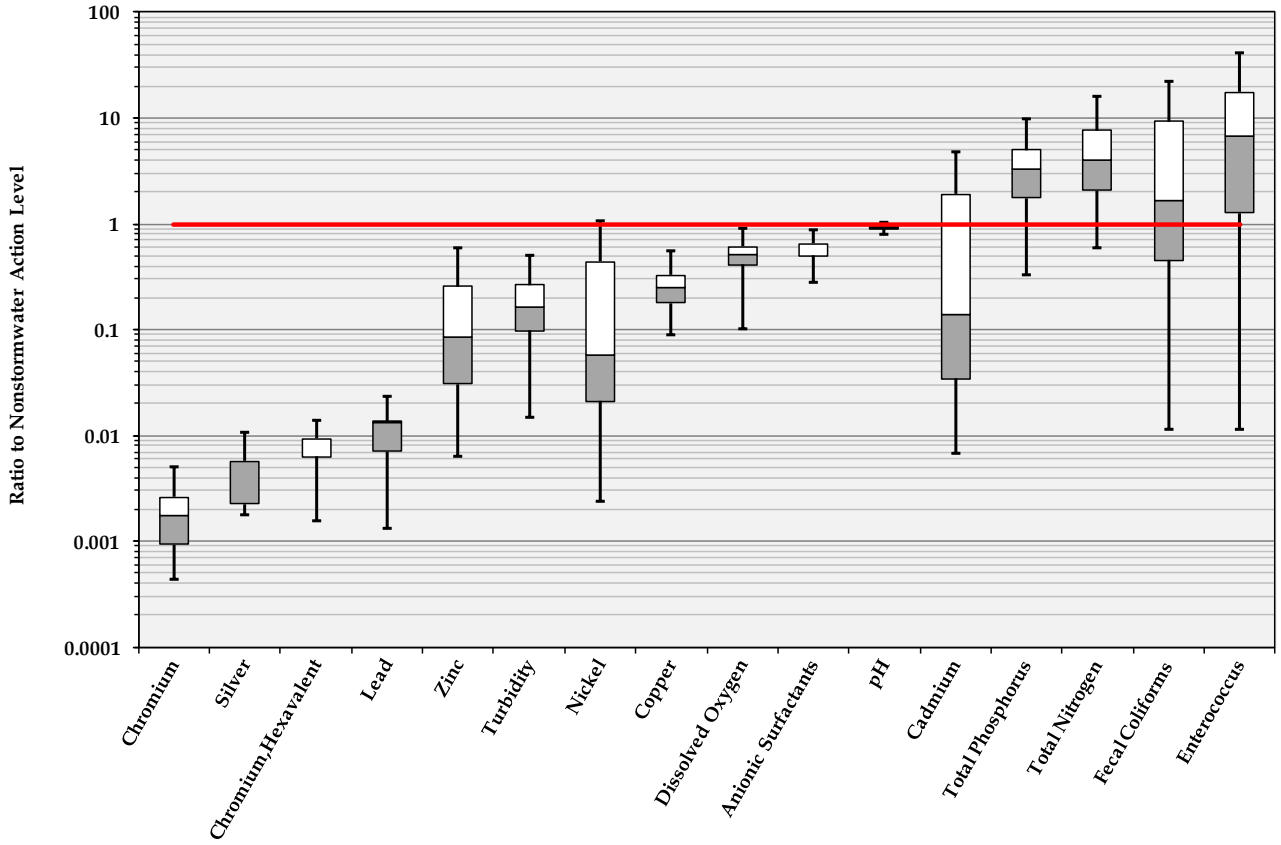

Ratio to Nonstormwater Action Level
100
10
1
0.1
0.01
0.001
0.0001
Chromium
Silver
Chromium,Hexavalent
Lead
Zinc
Turbidity
Nickel
Copper
Dissolved Oxygen
Anionic Surfactants
pH
Cadmium
Total Phosphorus
Total Nitrogen
Fecal Coliforms
Enterococcus

Table 2.2.2: Summary of the Program's toxicity testing in South Orange County from 2003 – 2012, an effort that includes 2548 tests on multiple species from a range of times, locations, and conditions. *Note: Toxicity levels are generally low except for one organism in wet weather that is susceptible to pesticides.*

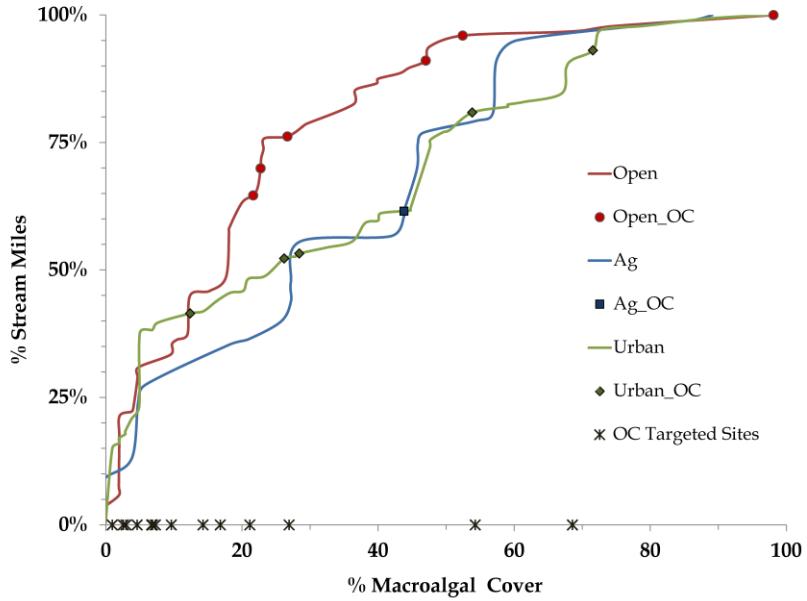
Test Species	Dry Weather			Wet Weather			Sediment		
	n	Toxic	Nontoxic	n	Toxic	Nontoxic	n	Toxic	Nontoxic
Americamysis bahia	391	34%	66%	573	45%	55%			
Strongylocentrotus purpuratus	179	5%	95%	293	24%	76%			
Ceriodaphnia dubia	569	20%	80%	51	12%	88%			
Pimephales promelas	64	9%	91%	1	0%	100%			
Hyalella azteca	224	11%	89%	17	53%	47%	9	0%	100%
Overall	1593	18%	82%	946	36%	64%	9	0%	100%

Biological condition, as measured by macroinvertebrate bioassessment results, is uniformly poor at targeted monitoring sites in South Orange County channels (**Figure 2.2.3**). Studies conducted as part of the State Water Resources Control Board's effort to develop a statewide Biological Integrity policy indicate that alterations to physical habitat are a major cause of degraded biological conditions. The somewhat elevated toxicity in wet weather (**Table 2.2.3**) might be another contributing factor. Because the Biological Integrity policy, with its new scoring protocol, is still under development, and its technical background studies have not been completed and released, the Program will defer a more detailed consideration of biological condition for now. At that point, however, a causal assessment, using the approach recommended by the State Water Board, would be appropriate and informative.

Table 2.2.3: Summary of aquatic toxicity results from the past five years of Stormwater Monitoring Coalition (SMC) samples from random sites across the southern California region. *Sites were located in both open (i.e., undeveloped) and urban landuse types. The large majority of stream miles were nontoxic for acute toxicity (i.e., survival), with an equivalent amount of sporadic background toxicity, in both open and urban landuses. The majority of stream miles were toxic for chronic toxicity (i.e., reproduction) in the open landuse, a strikingly different pattern than seen in the urban landuse. Note: Toxicity patterns in open undeveloped areas are not substantially from those in urban areas.*

	% Stream Miles	
Ceriodaphnia Survival	**Open**	**Urban**
Toxic	2.1	2.4
Nontoxic	97.9	97.6
Ceriodaphnia Reproduction		
Toxic	63.0	37.4
Nontoxic	37.0	62.6

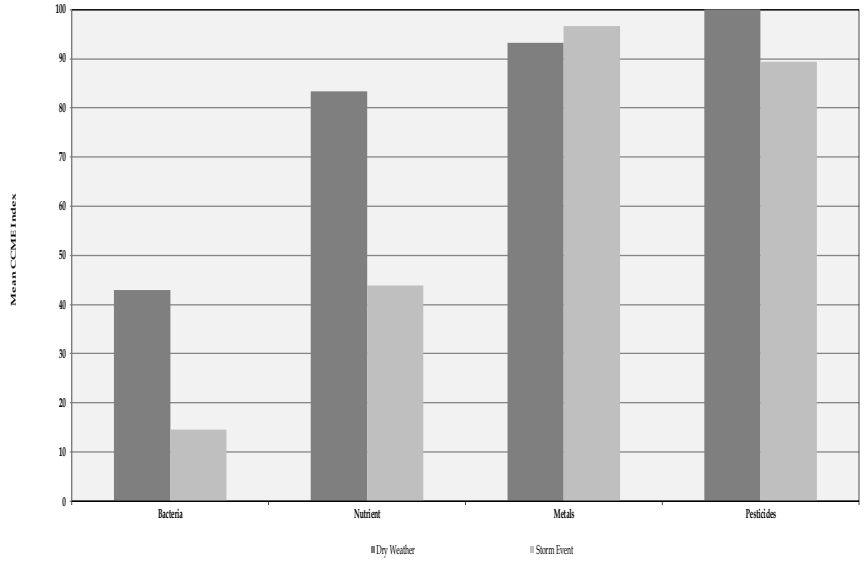
Figure 2.2.3: Cumulative frequency distribution of SMC bioassessment monitoring results across southern California in three distinct landuses. *The random sites within Orange County sampled as part of the SMC program are indicated on the curves for urban and open landuses. Targeted channel sites are shown along the X axis and Index of Biotic Integrity (IBI) scores for these sites, with one exception, fall in the lower 50% of the distribution compared to all urban landuse sites sampled as part of the SMC regional study. Note: Bioassessment IBI scores in urban areas are in the lower half of scores for urban areas in southern California.*



2.2.2 Coastal Surfzone

For the coastal surfzone, nutrients and bacteria are mild to moderate issues in wet weather, with most bacteria issues due to a small number of persistent problem beaches (**Figure 2.2.4**). Elevated nutrient concentrations in wet weather are a concern because they may contribute to regional eutrophication in coastal estuaries and to harmful algal blooms along the coast.

Figure 2.2.4: Overall exceedance index for core monitoring constituents in the coastal surfzone, summarized over the 2003 – 2013 monitoring period. *Note: Constituents measured at coastal discharge points rarely exceed standards, except occasionally for bacteria and nutrients in wet weather.*

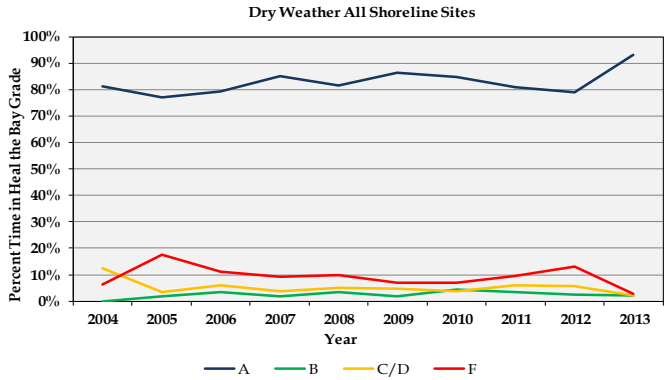


While **Figure 2.2.4** suggests that bacteria contamination is a moderate problem, particularly in wet weather, two other datasets present a different perspective. The data in **Figure 2.2.4** are drawn from the Program's monitoring at large coastal discharges, all of which are more likely to have elevated bacteria levels and thus represent a worst case estimate. In contrast, Heal the Bay beach report grades for a much larger set of South Orange County swimming beaches (**Figure 2.2.5**) show that the large majority of grades are in the A condition, even in wet weather and a more detailed examination of individual beaches (**Figure 2.2.6**) shows that bacteria shows continued improvement at some beaches over the past five years. However, **Figure 2.2.6** does not reflect recent dramatic improvements at these beaches because it summarizes data over the entire 2005 – 2013 period (see **Section 2.3** which reflects on the recent changes and provides a perspective of trends over time). The issues that do exist are localized to a few persistent problem beaches. For example, Heal the Bay has recently removed both Poche and Doheny beaches from its Beach Bummer list of the top 10 problem beaches in southern California. Thus, the data summarized for **Figure 2.2.4** do not provide the entire context for evaluating bacterial contamination at coastal beaches.

Figure 2.2.4 shows that nutrients may be a moderate issue in wet weather. However, unlike bacteria which cause relatively localized issues because they die off in seawater, nutrients can be a more regional concern due to their potential to contribute to plankton blooms and eutrophication both in local estuaries and the larger coastal ocean. A fuller assessment of potential nutrient impacts will depend on the developing state policy on Nutrient Numeric Endpoints (NNE) for coastal estuaries and Bight Program assessments of nutrients' potential contribution to plankton blooms in the coastal ocean.

Figure 2.2.5: Percentage of the time that swimming beaches are in each Heal the Bay report card category, averaged across all monitored beaches. *During dry weather beaches are in the A grade between 80 and 90% of the time. During wet weather the percentage of A grades drops, but has remained at about 80% for the past two years.*

a)



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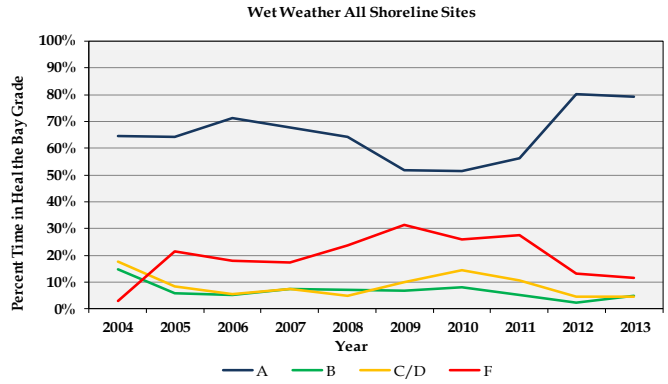
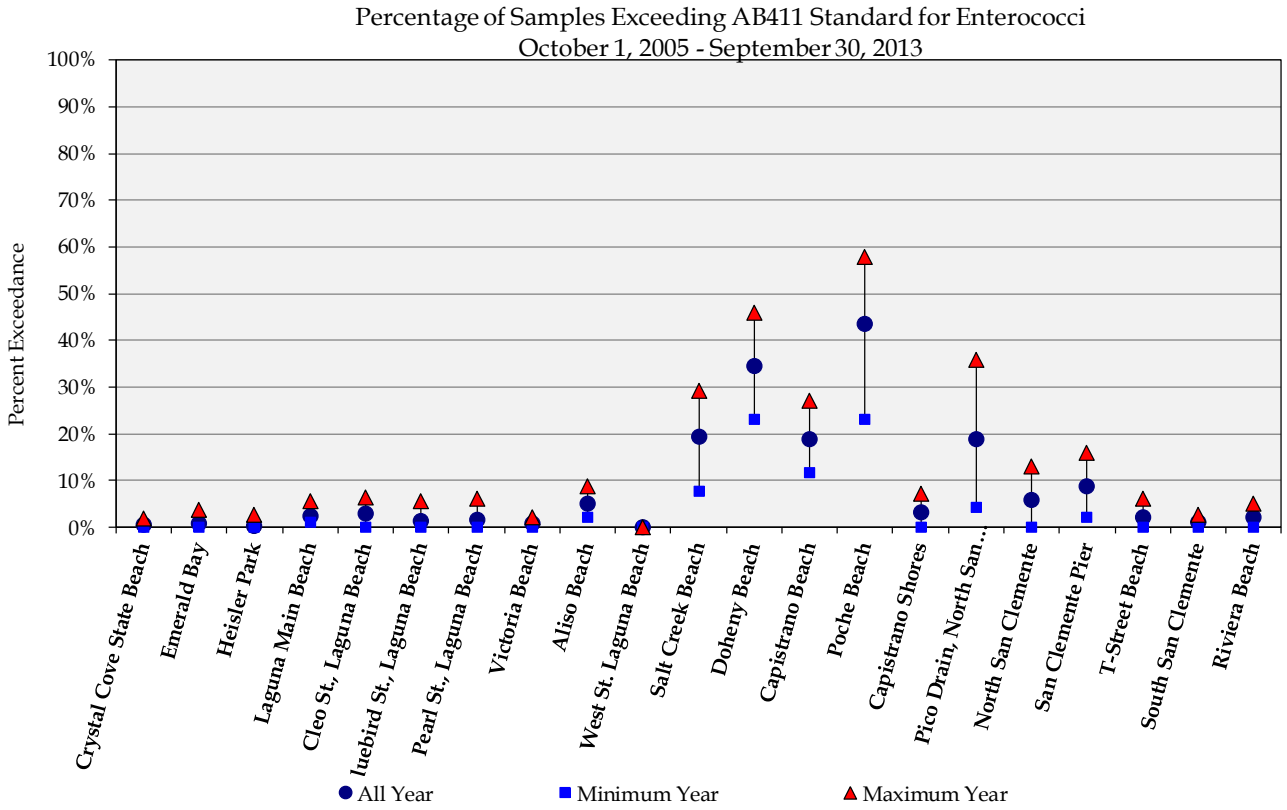


Figure 2.2.6: The overall percent exceedance of the AB411 *Enterococcus* standard over the time period 2005 - 2013. *Poche and Doheny, and to a lesser extent Pico, are the only persistent problem beaches and this summary figure overstates the problem because it does not clearly reflect significant recent improvements. This figure focuses on Enterococcus because it is the only one of the three AB411 indicators with any meaningful level of exceedance. Note: Exceedances of the Enterococcus standard occur at only a few problem beaches, which have improved dramatically in recent years.*



2.3 Bacteria

The Story: Bacteria

- The County's beaches support concentrated recreational activities for both residents and visitors and are important contributors to the local and regional economy.
- Concern about swimming safety is consistently high and epidemiology studies in dry weather show that some illness (for example, gastroenteritis) is associated with full immersion swimming in contaminated water.
- Contamination is very low during dry weather and has dropped steadily over time; beach report card grades are consistently high.
- Sources of contamination have been reduced through targeted actions; remaining issues during dry weather are localized and may have natural components.
- Contamination is more widespread during wet weather; wet weather flows are larger and qualitatively different.
- Health risks associated with wet weather flows are uncertain, but ongoing research and development focuses on improved monitoring tools and wet weather epidemiology studies.
- Progress on managing dry weather contamination demonstrates the efficacy of targeted BMPs appropriate to specific situations that may include natural sources (e.g., birds).

2.3.1 A Valued Resource

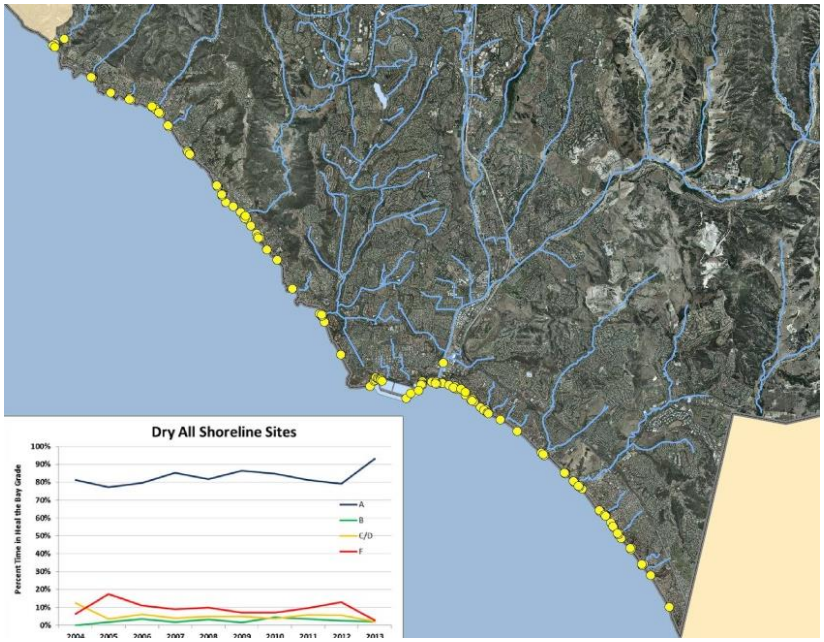
South Orange County's beaches (**Figure 2.3.1**) have been used for recreation at least as far back as the early 20th Century, and the local population as well as visitors from outside the region have enjoyed the opportunities they provide for sightseeing, picnicking, sunbathing, swimming, and surfing. The acceleration of urbanization and population growth in the last century increased beach usage at the same time as growing environmental awareness intensified concerns about contamination and its potential health impacts. The nexus of these two trends was illustrated dramatically in 1999 when persistent closures of Huntington State Beach due to contamination resulted in substantial economic impacts, anxiety about potential health effects, and concerted efforts to find and control the sources of contamination. While this event occurred in the north County, it affected perceptions among managers and the public throughout southern California. With over 100 million visits annually to southern California's beaches (nearly 40 million of which occur in Orange County) (Dwight et al. 2007) that contribute billions of dollars to the regional economy, the stakes related to contamination and public health are higher than ever.

The intensity of recreational use at beaches has stimulated a large amount of research, monitoring, and regulation at the federal, state, and local levels. These efforts have identified bacterial, protozoan, and viral pathogens that could be present when contaminated runoff and untreated sewage are released into the ocean (HCA 2012). Epidemiology studies in Santa Monica Bay (1995 & 2007/08) and at Doheny Beach (Colford et al. 2012) documented higher illness rates (e.g., gastroenteritis) among swimmers, especially near flowing stormdrains.

Figure 2.3.1: The beach is a popular recreational destination across the region.

These illnesses are not life threatening. However, the past history of beach contamination due to untreated sewage discharges (prior to passage of the federal Clean Water Act), along with current concerns about sewage spills and untreated storm-drain discharges, has led to constant vigilance and one of the preeminent beach water quality monitoring and improvement programs in the state (**Figure 2.3.2**). A unified monitoring program that improves coordination among monitoring efforts conducted by the Program and the water treatment agencies has been approved by the Regional Water Board and will be implemented shortly.

Figure 2.3.2: A Coordinated beach monitoring program conducted by the County Health Care Agency, the Program, and wastewater treatment agencies regularly monitors a large number of swimming sites. *Heal the Bay prepares weekly beach report card grades (inset figure and expanded* ***Figure*** **2.2.5***) that are made available on their website (www.healthebay.org).*



2.3.2 Progress during Dry Weather

Beach use and body contact recreation occur predominantly during the summer and in dry weather, although there is some use, mainly by surfers, during wet weather in the winter storm season. As a result, most regulation and monitoring focuses on dry weather conditions, using three bacterial indicators that indicate the presence of fecal pollution. These indicators are only indirect indicators of illness risk and not themselves pathogens, or disease agents. Thus, they do not provide a direct measure of potential health risk. However, they have been correlated with illness rates in dry weather when sewage contamination is present. They are more easily sampled and analyzed than the larger number of pathogens themselves. Long-term monitoring based on these indicators shows that exceedances of regulatory standards are also low and have been dropping over time and that the percentage of Heal the Bay report card grades of A has been at or above 80% in dry weather since 2004 (**Figure 2.3.2**).

This improvement in conditions during dry weather has been mirrored by a decrease over the past several years in beach closures due to contamination, as measured by Beach Mile Days (**Figure 2.3.3**). This metric is calculated by multiplying the length in days of each closure by the length (in miles) of beach affected and is a more accurate measure of the impact on beach users than the simple number of closures.

The improvement over time in these several measures of beach condition has resulted from a better understanding of contamination sources and targeted efforts to address the most severe of these sources. These efforts (**Figure 2.3.4**) initially focused on wastewater treatment plant improvements and treatment upgrades and have more recently expanded to include a wide range of localized BMPs (**Figure 2.3.5**) that have dramatically reduced the level of contamination at beaches and in the streams that discharges to the coastline. For example, the percent of *Enterococcus* exceedances at Salt Creek in Dana Point and the Pico stormdrain in San Clemente have dropped from 23 to 10% and from 22 to 4%, respectively, since 2005.

Figure 2.3.3: The total number of Beach Mile Days (the product of the length of beach posted times the length of beach posted) posted due to exceedances of standards during the April 1 – October 31 summer swimming season. *Beach Mile Days have declined substantially since 2000 and reached an all-time low in 2013. Adapted from HCA (2012).*

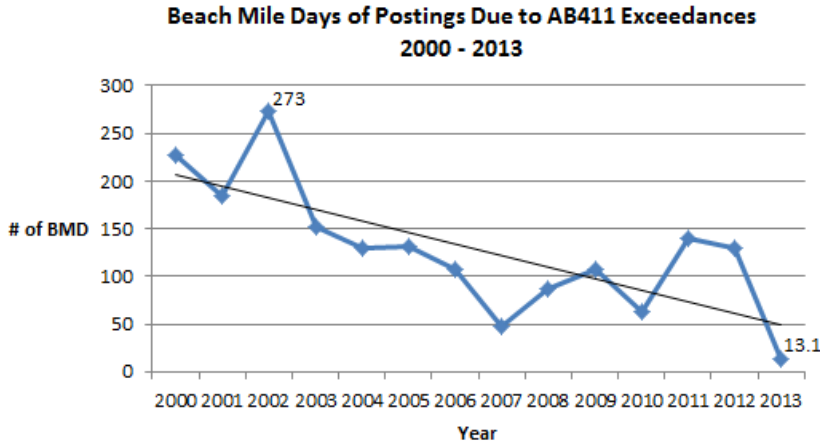


Figure 2.3.4: Timeline of significant actions in several categories that have contributed significantly to improved beach water quality.

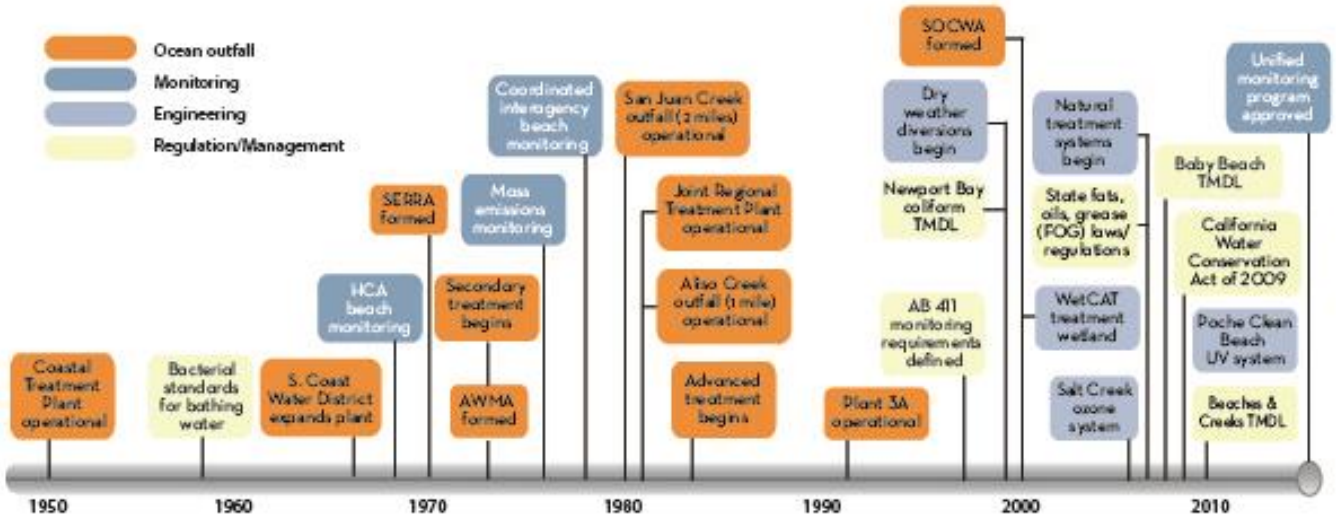
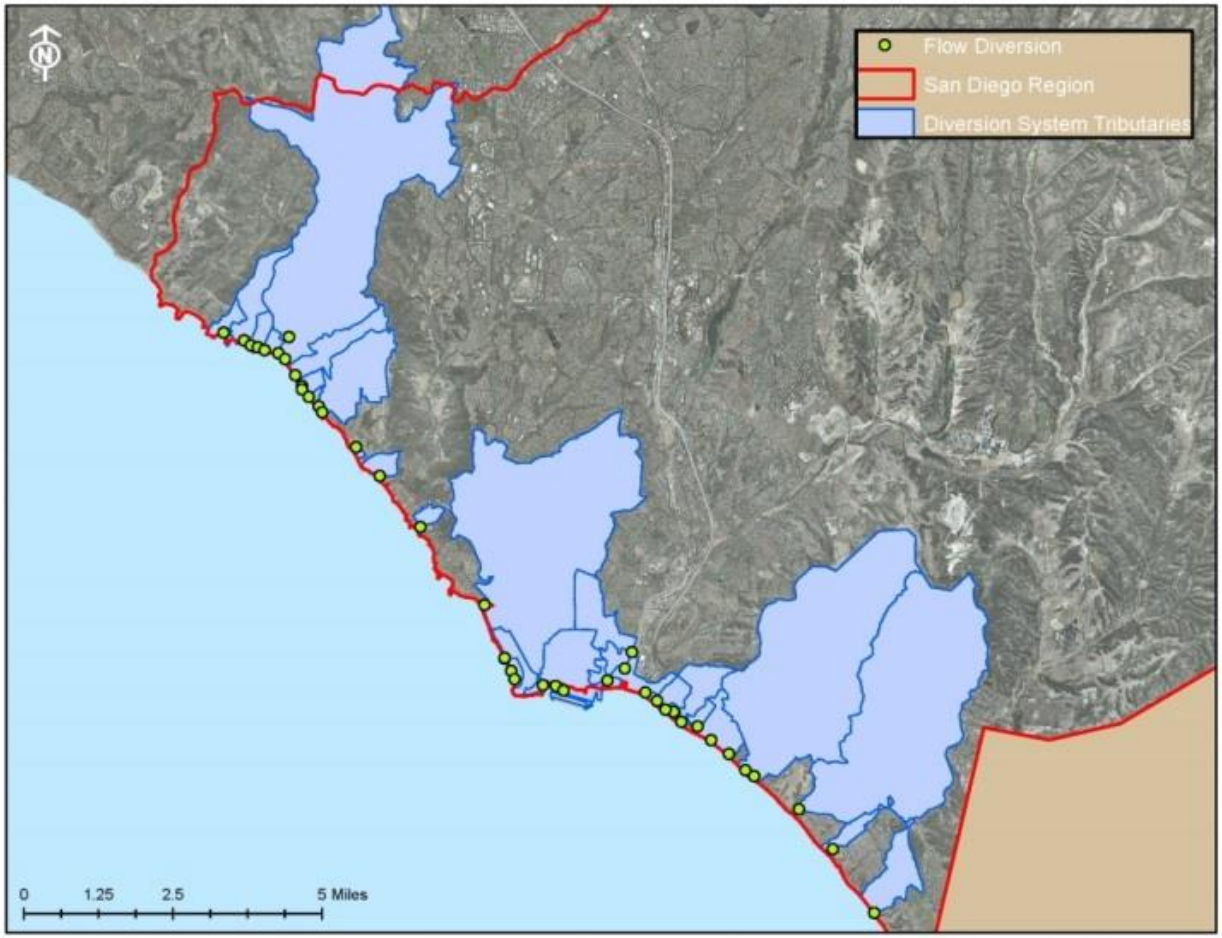


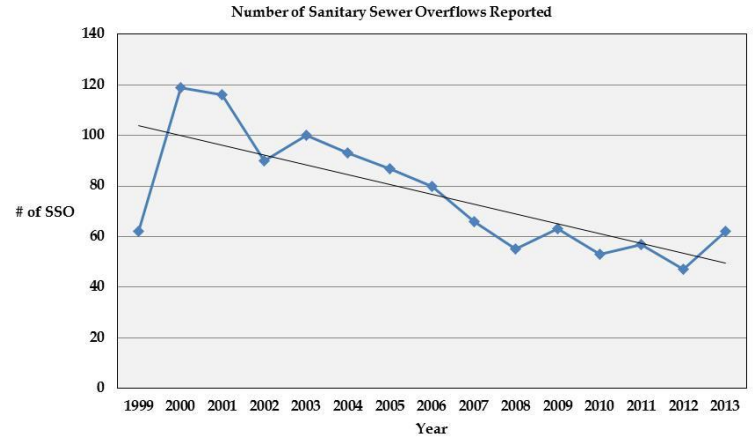
Figure 2.3.5: Coastal flow diversions that reroute dry weather flow to treatment plants that affect flow and/or bacterial loads.



Beginning around 2000, County agencies and individual cities began improving their spill response and prevention capability, supported by a number of state laws and policies targeted at the discharge of FOG (fats, oils and grease, which can clog sewer lines), with the result that the numbers of spills and beach closures due to spills have declined dramatically (**Figure 2.3.6**).

Attention also focused on urban runoff from rivers, creeks, and stormdrains, which can contain high levels of bacterial indicators. A notable regional example is the long-term effort to document and reduce levels of bacterial contamination in Aliso Creek which has been ongoing since the lat 1990s.

a)



b)

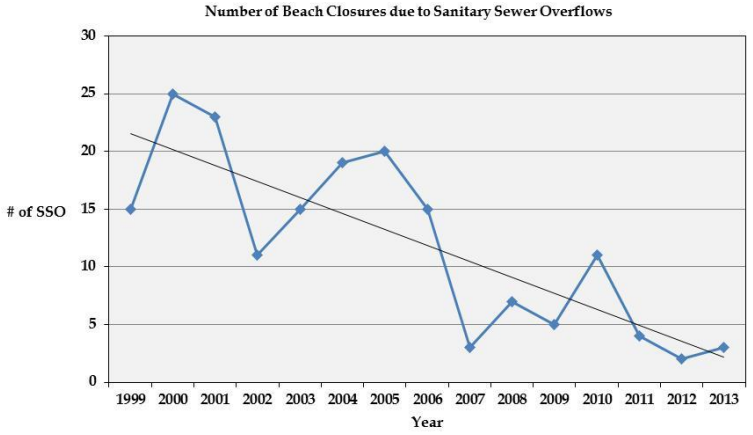


Figure 2.3.6: Two key metrics track the decreasing impact of sewage spills on beach condition in South Orange County over time. a) The number of reported sewage spills from 1999 through 2013. *The number of spills peaked in 2000 and has declined steadily since then (regression significant at p = 0 .001), reflecting increased attention to the causes of spills (primarily line blockages);* **b) the number of beach closures from 1999 through 2011 resulting from sewage spills.** *After peaking in 2000, the number of closures has declined steadily (regression significant at p <0.001), reflecting the reduction in the number of sewage spills and in the percentage of spills reaching the beach. Peaks in 2005 and 2010 are due to an unusual number of larger spills over 1000 gallons. Adapted from HCA (2012).*

2.3.3 Problem Beaches and Creeks

In response to persistent bacterial contamination issues at a number of creeks and beaches in the San Diego region, the San Diego Regional Water Board in 2007 adopted a Total Maximum Daily Loads for Indicator Bacteria, Project I - Beaches and Creeks in the San Diego Region, commonly referred to as the Beaches and Creeks TMDL. In the southern portion of the County, the primary focus of the TMDL was on a handful of persistent problem beaches (**Figure 2.2.6**). The TMDL was preceded by other individual actions, such as the Aliso Creek Directive issued by the Regional Water Board in 2001, also in response to elevated bacteria concentrations in the Aliso Creek watershed. These regulatory actions, combined with increased public and management attention to bacterial contamination (e.g., reduced sewage spills (**Figure 2.3.6**), have resulted in significant improvements to beach water quality. For example, both Poche and Doheny Beaches were recently removed from Heal the Bay's Beach Bummer list of the ten worst beaches in the region.

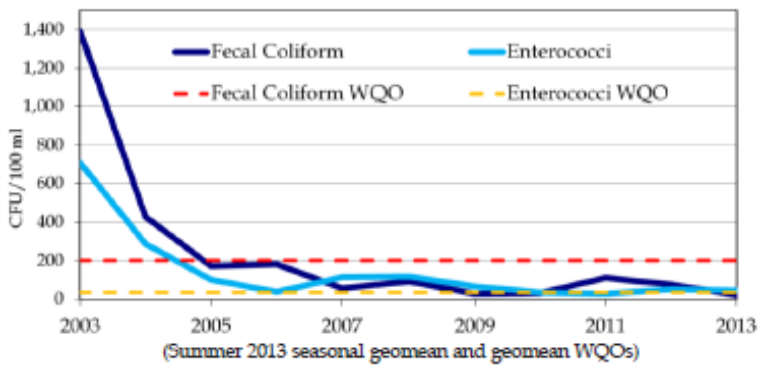
While actions to reduce bacterial inputs and improve water quality span the region (**Figure 2.3.5**), Aliso Creek and Poche and Doheny Beaches provide representative examples of the diversity of monitoring, assessment, prevention, and treatment efforts that combine to produce improvements over the past several years.

In addition to water conservation efforts that include the entire urbanized portion of the Aliso Creek watershed, four specific types of Best Management Practices (BMPs) have been implemented, including:

- **Treatment systems** such as sand filters, cartridge media filters, disinfection (ozone or Ultraviolet (UV) light, and dry weather diversions that send stormdrain flow to the sanitary sewer for treatment
- **Wetlands/channel restoration** that enhances a stream's natural capacity to absorb pollutant loads and restores riparian habitat
- **Landscape retrofits** such as weather-based irrigation controllers, edgescaping that replaces irrigated lawn area along the edge of a sidewalk, street curb, driveway, etc. with lower impact landscaping and permeable ground covering, and other irrigation improvements to improve water efficiency and reduce runoff
- **Catch basin retrofits** such as debris gates and in line baskets or filters that reduce the potential for bacterial growth by keeping trash out of catch basins

These actions have had noticeable effects, reducing fecal coliform levels below the regulatory standard at a key monitoring station in the lower watershed and reducing *Enterococcus* levels to near the standard (**Figure 2.3.7**).

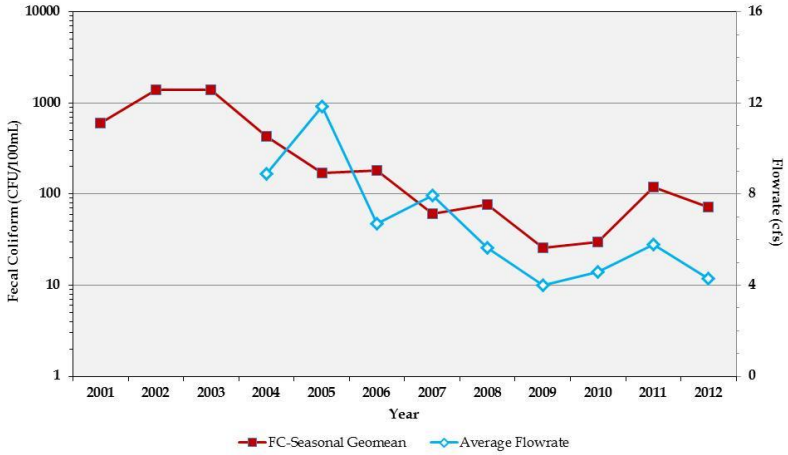
Figure 2.3.7: Fecal indicator bacteria concentrations at Aliso Creek monitoring site CTPJ01 have significantly declined and now meet recreational water quality objectives (WQOs) for fecal coliform.



Bacterial indicator levels in the Aliso Creek watershed have declined over the past several years in concert with a decline in the average flowrate from urban discharges to the creek (**Figure 2.3.8**). While correlation of course does not necessarily equal causality, in this instance there is a strong case that the reduced flow of water contaminated with urban pollutants (including bacteria) has contributed to the reduced levels seen in the creek monitoring program.

The story of success at Poche and Doheny Beaches is equally dramatice but involves a different set of studies and BMPs. In concert with the epidemiology study at Doheny Beach in 2008-08, a source identification pilot project (or SIPP) identified leaking sanitary sewer infrastructure as a source of human fecal markers seen in the surfzone. Targeted repair efforts essentially removed this source. A parallel program at Poche Beach, the Poche Clean Beach Project, used state grant funds to construct a filtration and UV treatment system that reduced input of bacterial contamination from the the channel discharging to the beach.

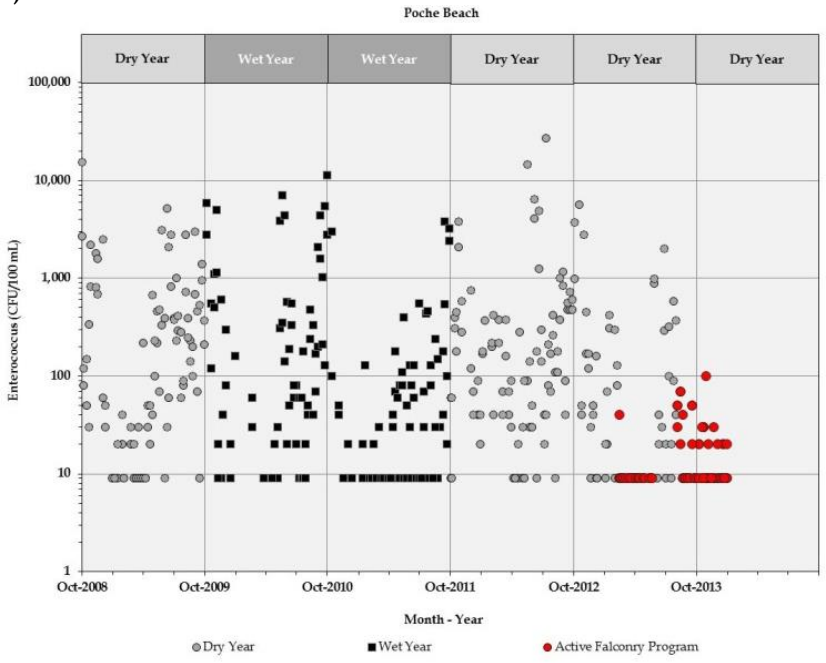
Figure 2.3.8: The fecal coliform seasonal geomean in the Aliso Creek watershed plotted in comparison to the average dry weather flow rate in the creek. *Note: Fecal coliforms have declined in concert with reductions in flow of urban runoff to Aliso Creek.*



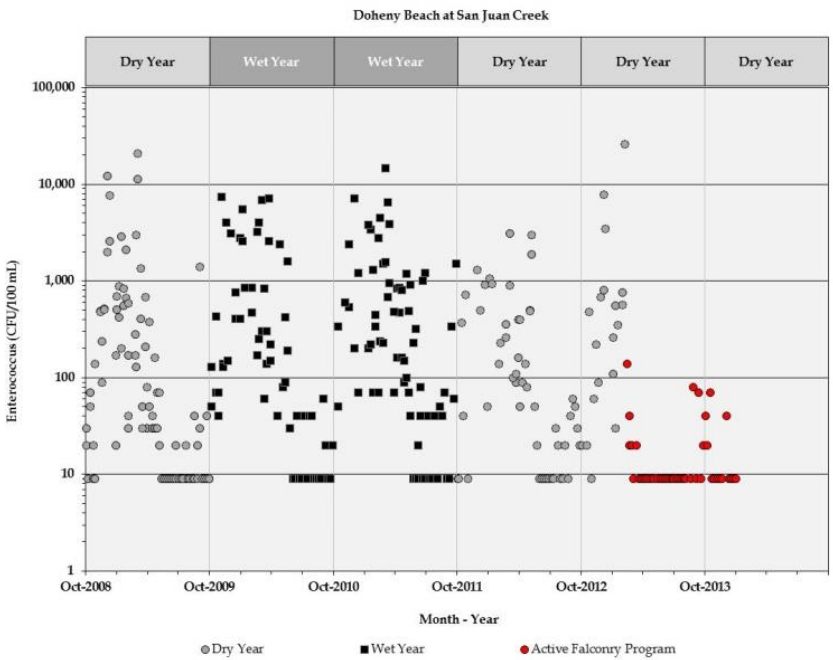
Additional studies identified another source of human fecal makers, this one airborne. Projects that involved genetic characerization as well as behavioral studies of seagulls found that seagulls feeding at the Prima Deshecha landfill in the upper watershed constituted a separate pathway for contamination. Better landfill maintenance, combined with falconry programs at both the landfill and the beach significantly reduce this source of contaminant input (**Figure 2.3.9**). Thus, the combination of modern genetics methods and the ancient practice of falconry provided an effective solution at Poche and Doheny Beaches.

Figure 2.3.9: The presence of an active falconry program to deter seagulls is associated with significant declines in bacterial contamination levels at both Poche (a) and Doheny (b) beaches. *Note: Falconry programs help reduce contaminant inputs from seagulls.*

a)



b)



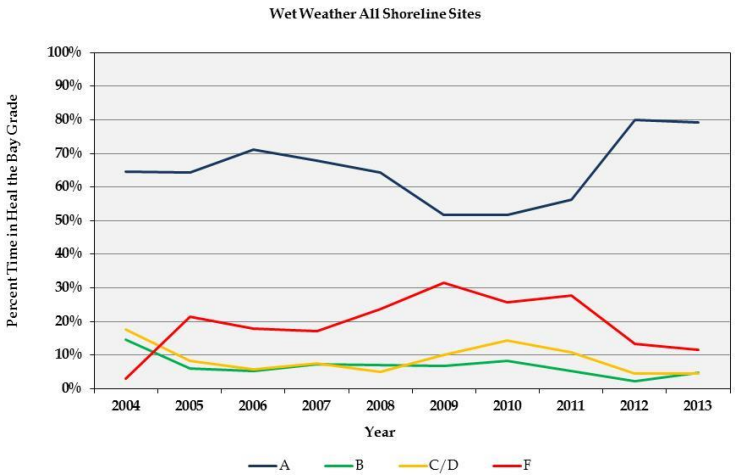
Ongoing efforts by cities and their stormwater programs to improve water conservation and reduce nuisance runoff have begun to ameliorate this problem. While concentrations of indicator bacteria in channels in both wet and dry weather combined continue to be elevated, the diversion of dry weather stormdrain and stream flows to treatment plants and other actions (**Figure 2.3.5**) has significantly reduced the volume of contaminated flows to beaches. Such efforts, along with the targeted identification and removal of specific problem sources, have also helped the County and watershed permittees make substantial progress toward improving conditions at the few problem beaches in the region. As a result of the effectiveness of these complementary actions, Orange County's beaches meet regulatory standards for the large majority of the time in dry weather and the health risks of swimming during dry weather conditions are very low, well understood, and well managed.

2.3.4 Continued Challenges in Wet Weather

In contrast to the progress achieved in maintaining clean beaches during dry weather conditions, significant challenges remain during wet weather. Channel flows during and immediately after wet weather storms are substantially higher than during dry weather (**Figure 2.3.11a vs. 2.3.11b**) which makes it infeasible to apply the management practices (e.g., diversion to treatment plants) that have been so successful in dry weather. In addition, these flows reach the beach more frequently (**Figure 2.3.10c**), which means that their loads of bacteria and other pathogens are delivered directly to the coastal ocean, with the result that beach grades worsen and exceedances of standards increase during wet weather (**Figure 2.3.11**). Nevertheless, the annual percentage of A grades for wet weather on the Heal the Bay report card has reached 70% in recent years (**Figure 2.3.11**). As a result of these characteristics of wet weather flow, the Orange County Health Care Agency issues routine health advisories recommending that the public stay out of the ocean during and for 72 hours after storms in order to avoid contact with potentially contaminated discharge. Despite this, there is significant recreational use during storms (**Figure 2.3.10d**), primarily by surfers taking advantage of the larger surf that often accompanies winter storms.

Figure 2.3.10: Photographs showing examples of the changes in flows during dry and wet weather and the subsequent changes in ocean water quality. *a) Dry weather flows are much smaller than b) wet weather flows; c) wet weather flows from stormdrains and channels typically reach the ocean in wet weather, in contrast to dry weather flows which rarely reach the ocean; d) surfers often take advantage of the large waves caused by winter storms, despite the increased exposure to contamination this may involve.*

Figure 2.3.11: The percentage of poor Heal the Bay report card grades at swimming beaches is much higher in wet weather than in dry weather (see insert in Figure 2.10), although the annual percentage of A grades has increased gradually in recent years to 80% and the percentage of F grades has dropped to 10% in the most recent monitoring year (2013). *Note: Heal the Bay beach grades in wet weather have improved recently and are mostly A.*



In addition to the higher flows in wet weather, there are two other aspects of this issue that complicate efforts to reduce wet weather contamination and its resultant potential health risks:

- Bacterial contamination in wet weather flows stems from a much wider range of sources than in dry weather
- Limitations in existing monitoring tools make it difficult to know when there is actually human fecal contamination and a resultant health problem

Rainfall and the resulting runoff from land surfaces mobilizes indicator bacteria from a wide range of sources, including humans and animals, soils, vegetation debris, and persistent bacterial films in gutters and stormdrains. These loads stem from sources in both urban and open areas, as documented in a number of studies that have correlated bacterial loading with rainfall and measured loading from both urban and natural landscapes. Controlling this large range of sources and the very large volumes of wet weather flow would present a daunting engineering problem. For example, the long-term (1986 – 2013) mean monthly flow of San Juan Creek in January, February, and March is approximately 6175, 9201, and 5095 acre feet, respectively. Because treating these runoff volumes is infeasible, approaches such as Low Impact Development (which reduces runoff) and amendments to the Basin Plan that include changing bacteria objectives, delisting of some concrete channels, and suspending objectives in highly modified flood control channels during periods of high flow may be called for.

Because of the different nature of wet weather flows and the indirect nature of monitoring indicators, it is impossible to draw firm conclusions about health risk in wet weather. Wet weather flows may actually include a large proportion of true pathogens or they may simply be mobilizing non-pathogenic indicator bacteria from multiple sources across the landscape and diluting a stable pool of human fecal pathogens. Epidemiological studies in dry weather, including in Santa Monica Bay in 1995 and 2007 - 08, and at Doheny Beach (Colford et al. (2012) have established a relationship between levels of indicator bacteria and health risk, as well as documenting that full immersion swimming closer to flowing stormdrains increases risk. In contrast, there are no epidemiological studies in wet weather that can help resolve the fundamental uncertainties that have so far precluded significant management actions.

New studies planned and underway should, over the next few years, provide significant insight into the nature and magnitude of health risks in wet weather as well as more powerful and targeted monitoring tools to support improved regulation and decision making.

2.3.5 Monitoring Methods

Current indicators do not measure pathogens directly and do not separate human vs. animal and other sources. This is problematic, especially in wet weather when higher flows mobilize indicator bacteria from a multitude of sources distributed widely across the landscape. The current bacterial indicators are present in soils, leaf litter, other forms of rotting biomass, biofilms in gutters and stormdrains, as well as in both domesticated animals and wildlife, and often recover and grow in the environment even after disinfection. In contrast, the pathogens responsible for human illness (about 90% of which are viruses) all derive from human fecal contamination. These shortcomings of traditional indicators make it difficult to reliably separate human from nonhuman sources, estimate health risk, and accurately track the sources of actual pathogens.

Recent research has led to new tools that resolve some of these handicaps, although further development remains to be done over the next few years. Ongoing research falls into three categories:

- Development of genetic markers that more reliably identify the presence of human fecal material
- Monitoring methods that directly measure the presence and abundance of pathogens, particularly viruses
- Wet weather epidemiology studies that will improve estimates of health risk from exposure to ocean waters during wet weather conditions

We now have the technology to reliably determine if there is a human fecal component to bacterial contamination, using the HF183 genetic marker from a *Bacteriodes* species that is present in large quantities in humans but not in other species. This marker is not itself a pathogen but does enable relatively accurate estimates of the percentage of time human fecal material is present. At present, it is most useful as a means of confirming / eliminating the presence of human sources, a key first step in microbial source tracking studies. However, it is not yet a suitable basis for revised regulatory standards because its persistence in the environment and its behavior compared to that of actual pathogens is poorly understood. A component of Bight '13 aims to improve our understanding of HF183's utility by measuring it, along with traditional indicators, in a number of coastal drainages across southern California in both wet and dry weather.

New monitoring methods that utilize digital polymerase chain reaction (dPCR) technology enable quantification of pathogenic viruses at very low detection limits. Researchers can now test for the presence of adenoviruses, noroviruses, and rotaviruses in environmental samples, although substantial further development is needed before these methods are available for routine application. Rotaviruses are related predominantly to gastrointestinal illness and some adenoviruses affect a broader range of membranes, including those in the nose and bronchia. Some noroviruses cause intense but shortlived (24 – 48 hour) illnesses that are not life threatening but are extremely unpleasant. With funding from the state of CA, the Southern California Coastal Water

Research Project is working with the Monterey Bay Aquarium Research Institute (MBARI) and researchers at Arizona State University to develop mobile digital PCR equipment that could enable new approaches to beach water quality monitoring, such as in situ sensors that provide a stream of real-time data. There are technical complications related to sample processing but once these are resolved, the digital PCR methods could provide the basis for updated standards.

The third area of research is the investigation of health effects associated with swimming and surfing in the ocean during wet weather conditions. SCCWRP is cooperating with the City and County of San Diego and USEPA this winter on a pilot wet weather epidemiology study that will follow a large sample of surfers to estimate the relationship between illness rates and the levels in ocean water of a number of indicator bacteria and pathogens. Plans are in place for a full epidemiology study at more locations during the winter of 2014/15. The results of these studies, in combination with quantitative risk assessment methods, could show that health risk is either lower or higher than the assumptions built into current regulations. In either case, the epidemiology studies, in combination with new monitoring methods, will provide the basis for improved regulations and more informed management decisions.

2.3.6 Recommendations

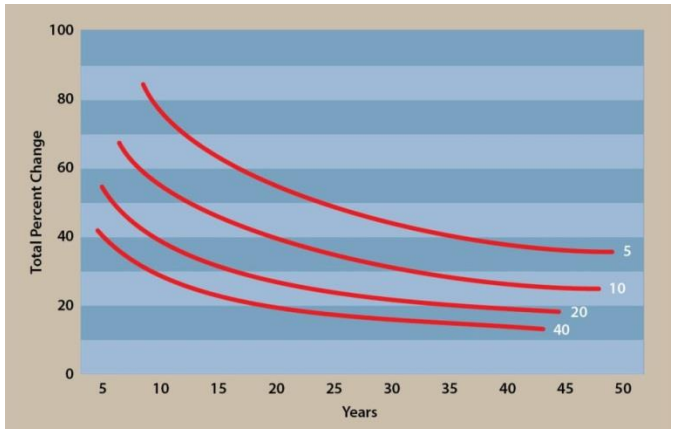
Past progress in identifying and controlling sources of contamination, the availability of a long time series of monitoring data, and the development of new monitoring and assessment tools provide the basis for this review of existing bacteria monitoring programs with the goal of improving their utility and efficiency. The following recommendations stem from a data-driven, risk prioritization approach that views monitoring, assessment, research, and management actions as a portfolio of related actions.

- Continue targeted data analyses of monitoring data to prioritize problem areas. Conduct additional source tracking studies as needed, using new monitoring methods based on genetic markers to identify potential sources of these issues such as infiltration into the MS4 from sewage lines. This effort should build on results of the Bight '13 Microbiology Study.
- Continue identifying opportunities to reduce and prevent flows in dry weather, where monitoring and source tracking data suggest the presence of human fecal contamination.
- Conduct statistical power analysis and optimization studies to improve existing monitoring program designs to improve efficiency and take advantage of available information about patterns and trends of contamination. **Figure 2.3.12** illustrates how statistical power analysis can provide information that can reduce and/or better target monitoring resources.
- Shift resources from routine monitoring to targeted source tracking and adaptive response, using new tools such as genetic markers of human fecal contamination as these become available.
- Continue supporting regional and collaborative research into better monitoring and source tracking tools.
- Improve understanding of health risk related to high wet weather flows, for example, through the Bight '13 Microbiology Study; follow results of the pilot wet weather epidemiology study planned for San Diego and consider

supporting the larger, follow-on study planned for 2014/2015.

- Conduct pilot mass balance studies to determine their utility for improving the prioritization of management actions.

Figure 2.3.12: Example analysis run with pesticide data to demonstrate statistical power analysis for a trend monitoring program. *The number of years of data required to detect varying amounts of change with different numbers of samples per year (5, 10, 20, 40) next to respective curves). This figure illustrates that increased sampling intensity often produces diminishing returns and that such analyses can inform tradeoffs among different types of sampling effort and the amount of change managers with to detect and/or the amount of time they can wait to detect a change. The figure also shows that the inherent variability in a system may make it impossible to detect small amounts of change with even large amounts of sampling effort.*



2.4 Dissolved Solids

The Story: Dissolved Solids

- Persistent and widespread exceedances of total dissolved solids occur in channels and at discharge outfalls.
- Dissolved solids are a challenging to address because a large portion of these elevated levels derive from natural sources in regional groundwater.
- Understanding local geology is key to understanding sources of dissolved solids and the pathways they travel in the watershed.
- While the flood control system provides one pathway for dissolved solids in groundwater to reach the surface, other natural pathways (such as artesian springs) exist and there is evidence of historically elevated dissolved solids levels in surface water in the region.

2.4.1 Natural Geology is Key

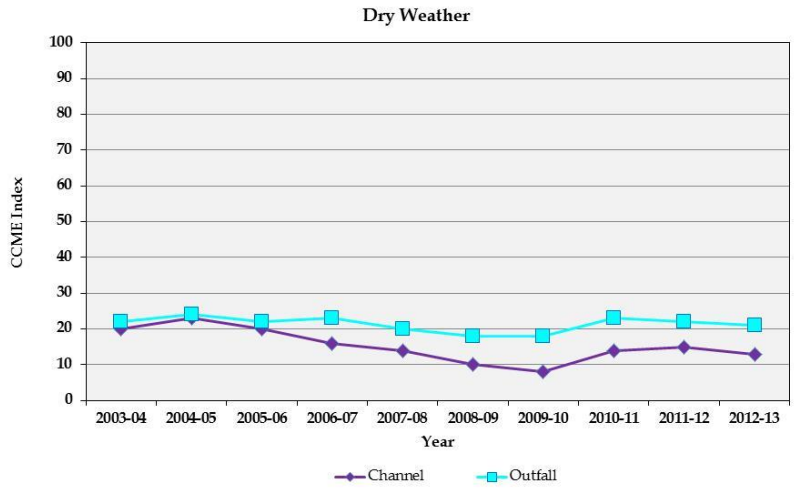
Dissolved solids refers to the amount of salt in water and can be a difficult water quality problem to address when concentrations are elevated. They can be toxic to fish and plants and require expensive processing in water reclamation systems to make the water drinkable or usable for irrigation. Dissolved solids, as general description of the amount of salt in water, consists of several other constituents including chloride, sulfate, nitrate, phosphate, calcium, magnesium, sodium, potassium, and sometimes a few trace metals such as cadmium, nickel, selenium, and zinc.

Total dissolved solids (TDS) consistently exceed the Basin Plan Objective (**Figure 2.4.1**) and these levels create the potential for detrimental impacts on the aquatic ecosystem; for example, TDS has been suspected as a causal factor in poor benthic macroinvertebrate community condition.

The key issue in deciding whether elevated dissolved solids represent a water quality problem, and thus a priority for management, depends directly on the source of these solids and the appropriate benchmark for comparison (**Figure 2.4.2**). Many creeks in South Orange County have elevated levels of dissolved solids that do not appear to be related to the urban sources. For example, the dissolved solids from common urban potable sources such as imported water from the Colorado River or northern California, or locally generated drinking water from deep groundwater supplies or from recycled water, are often at levels much lower than those measured in South Orange County creeks. Similarly, the shallow groundwater tables that provide most of the water to these streams are often much higher in dissolved solids than water from urban sources.

Figure 2.4.1: An overall exceedance index of the extent to which total dissolved solids meet regulatory standards in both a) wet and b) wet conditions is low (which means poor conditions) and has remained fairly steady since 2004.

a)



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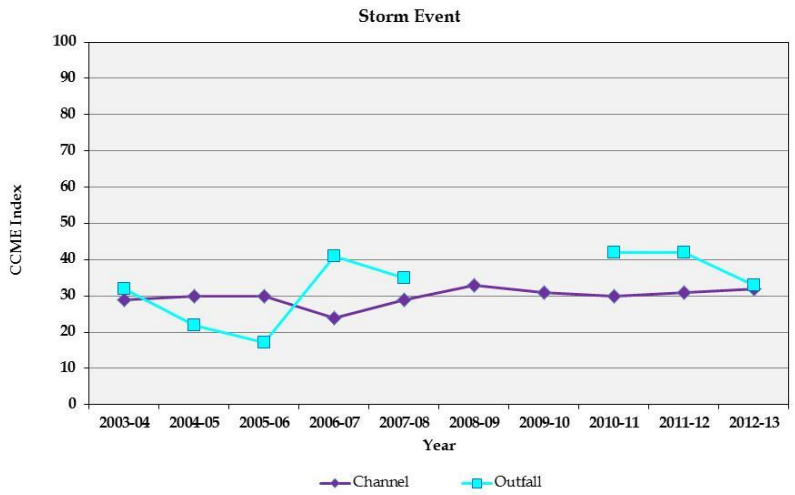


Local geology is the primary reason South Orange County creeks have dissolved solids higher than those in common urban sources of water. The coastal areas of South Orange County have salt-rich native soils, commonly referred to as marine sedimentary geology, with the result that creeks have elevated dissolved solids. Further, the creeks with elevated dissolved solids are not limited only to water bodies within urbanized areas. Natural reference creeks in coastal areas with this type of unique geology and little to no urban influence have levels of dissolved solids substantially above those in urban water sources (**Figure 2.4.2a**).

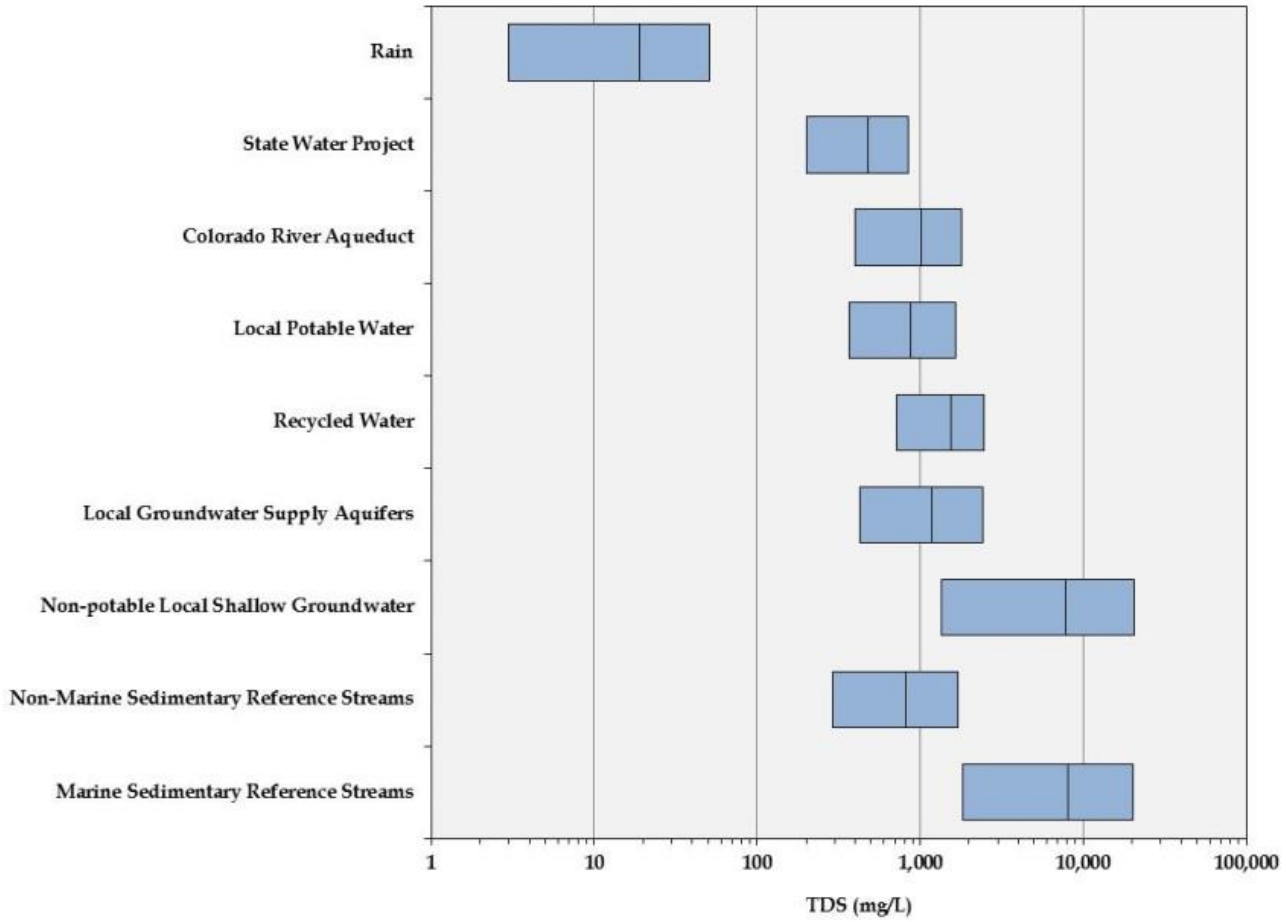
In contrast, the parts of South Orange County with geology more closely related to bedrock (i.e., igneous geology) and those soils found in the upland higher elevations closer to the Santa Ana mountains are much less related to marine sediments and thus have lower levels of dissolved solids (**Figure 2.4.2b**).

The Program has conducted several special studies to improve understanding of the relationships between natural and urban sources of dissolved solids in creeks. Studies in Oso Creek, which has elevated dissolved solids levels showed that dissolved solids concentrations in this Creek were comparable to those in three reference streams (**Figure 2.4.3a**), although loads of dissolved solids to Oso Creek were higher than those in natural streams (**Figure 2.4.3b**).

The Program has also conducted collaborative studies with researchers in the Geochemistry Group at University of Southern California's Department of Earth Sciences, using specialized testing of stable isotopes of hydrogen and oxygen. Physiographic conditions under which rain falls in the Sierra Nevada or Colorado River watersheds are very different from those in the County's low elevation coastal watersheds. These differences impart unique isotopic signatures that can help to uniquely identify the contribution from various sources. This study compared the isotopic signatures of groundwater emerging from weeps and springs in the urbanized areas of South Orange County to those from a range of potential sources including rain, natural groundwater, and urban sources (e.g., potable or recycled water). The stable isotopic signature for shallow groundwater from weeps and springs in urban areas is more similar to that of local rain water and natural reference streams and much less similar to the imported water that is the primary source of potable water in south Orange County.

Figure 2.4.2: Means and ranges of dissolved solids concentration in a) various water sources including rainwater, local potable, Colorado River potable, recycled, groundwater, and b) streams. *Data from these sources provide context as to which water source(s) most closely resemble surface waters with elevated dissolved solids.*

a)



b)

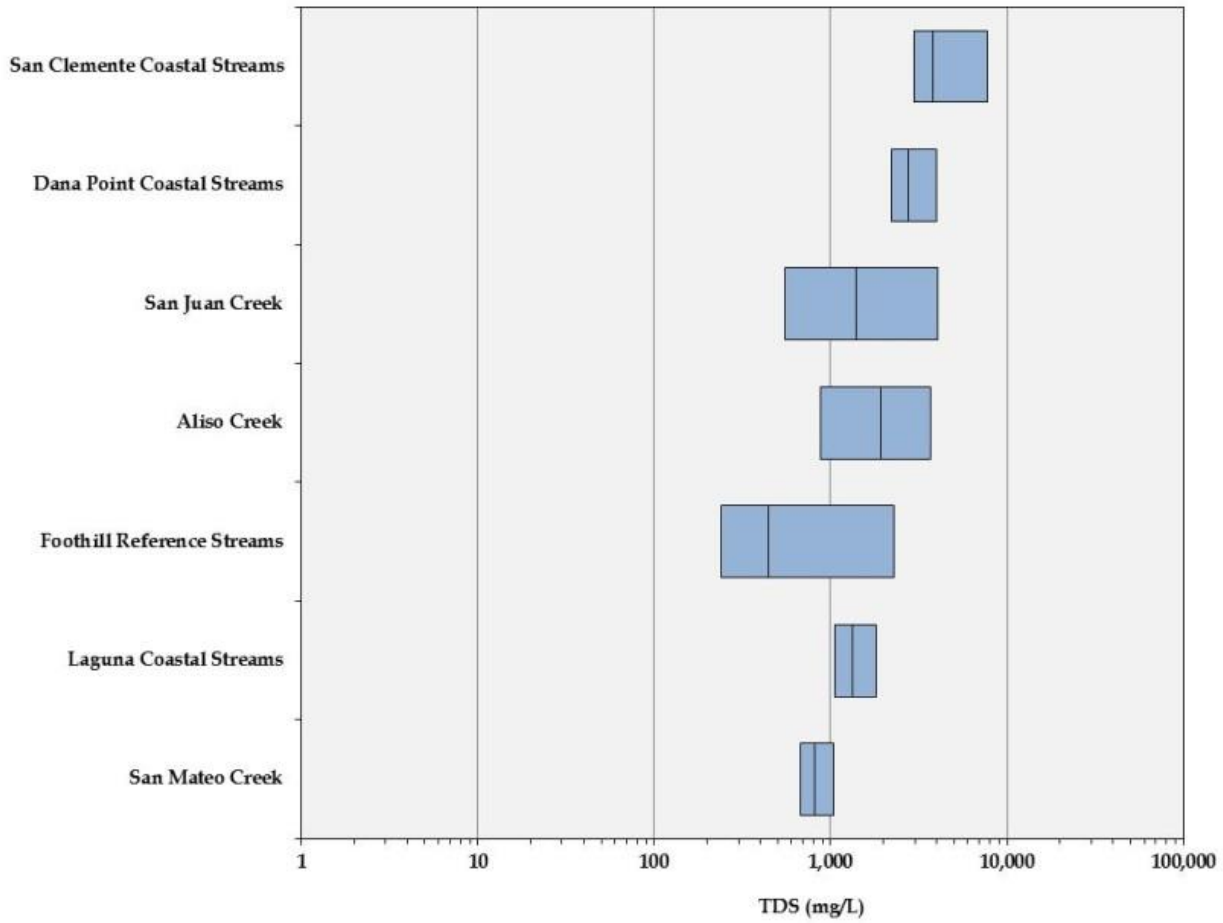
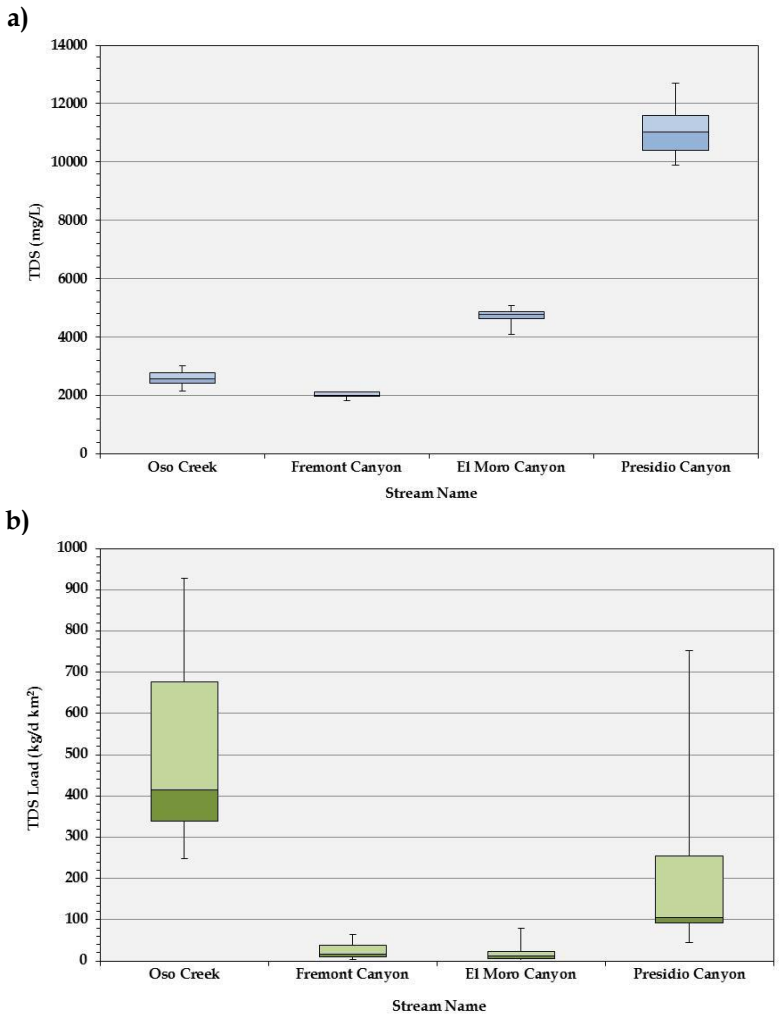
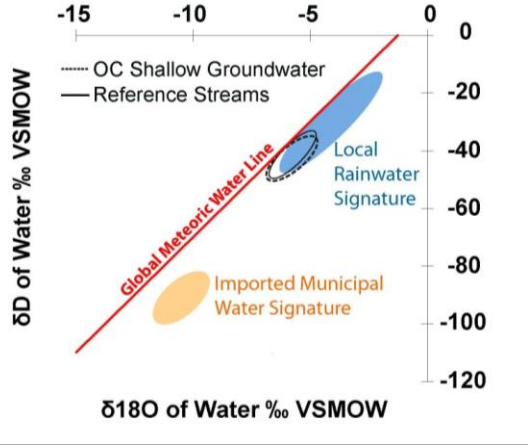

San Clemente Coastal Streams
Dana Point Coastal Streams
San Juan Creek
Aliso Creek
Foothill Reference Streams
Laguna Coastal Streams
San Mateo Creek
1
10
100
1,000
10,000
100,000
TDS (mg/L)

Figure 2.4.3: Ranges of dissolved solid concentrations (a) and loads (b) in Oso Creek in comparison to three reference streams of similar geology.



This study also compared shallow groundwater to the global meteoric water line, which describes the mean relationship between hydrogen and oxygen isotopes in water which has not been exposed to evaporation (**Figure 2.4.4**). The shallow groundwater in urban areas reflects conditions more similar to rainwater and reference streams than to an imported source of water.

Figure 2.4.4: Hydrogen and oxygen stable isotope compositions of shallow groundwater in urban creeks across south Orange County in comparison to rain, water from reference streams in undeveloped watersheds, and imported municipal water from Colorado River and the Sierra Nevada mountains.



These three pieces of information have important implications for the Program's efforts to identify sources of dry weather flow, understand the underlying natural conditions in streams in the urbanized portions of South Orange County, and to then determine whether elevated dissolved solids in a particular watershed are an important management priority for the future.

2.4.2 Recommendations

- Conduct a mass balance study, even if at a crude level, to determine the extent to which the MS4 contributes to dissolved solid levels in the creeks
- Prepare a summary report on historic and contemporary conditions of dissolved solids across south Orange County
- Invest effort into understanding whether dissolved solids are important stressor on macroinvertebrate communities in the creeks to evaluate the environmental significance of elevated dissolved solid concentrations
- Continue evaluating changes in dissolved solids at key locations such as Oso Creek in concert with water conservation efforts to track changes in dissolved solids over time.

2.5 Nutrients

The Story: Nutrients

- Nutrient levels in South Orange County streams and channels are frequently above commonly used thresholds that suggest increased likelihood of nutrient impacts. In contrast, there are much less frequent occurrences of impacts, such as macroalgal overgrowth, due to excessive nutrient levels.
- Nutrient issues are not limited to the urban portion of the County; regional monitoring data show nutrient enrichment and impacts such as increased macroalgal cover and/or lower dissolved oxygen in streams and estuaries in undeveloped regions.
- The major point sources of nutrients have been controlled. Therefore, nonpoint and diffuse sources such as leaching from upland soils and intrusions from shallow groundwater are increasingly important.
- Nutrients can be readily transported in and out of various reservoirs (e.g., sediments, groundwater) and undergo complex biological transformation and cycling. This makes traditional pollutant control strategies less effective for nutrients.
- Improved management strategies may contribute to further progress, particularly in streams and channels, by accounting for site-specific conditions, promoting Low Impact Development, and accounting for broader regional sources.

2.5.1 A Complex Regional Problem

Elevated levels of nutrients have become an increasing national and regional concern in recent years because of their impacts on lakes, streams and estuaries. Nutrient enrichment leads to the overgrowth of algae in streams, (**Figure 2.5.1**) and estuaries (**Figure 2.5.2**) that can reduce dissolved oxygen, sometimes to the point of causing mortality to fish and other aquatic organisms. Dense algal mats can also cause aesthetic (visual and odor) impacts and impair beneficial uses such as boating and swimming. There is also concern that nutrient runoff has contributed to the observed increased incidence and severity of harmful algal blooms (HABs) in California and their toxic effects in the coastal ocean (**Figure 2.5.3**). For example, the Bight '08 Program found that anthropogenic nutrient inputs are co-located with algal bloom hotspots at subregional and seasonal / daily scales and onging regional studies are further investigating this potential connection. Finally, nutrients are involved in geochemical processes that can amplify ocean acidification impacts in estuaries.

Unlike most other pollutants, nutrients are involved in complex biological transformation and cycling processes (**Figure 2.5.4**) and storage in a variety of reservoirs. This complicates nutrient assessment and management in two important ways. First, nutrient impacts can persist even after inputs have been reduced or ended because nutrients stored in sediments, groundwater, and plants can move in and out of these reservoirs on a range of time scales. For example, studies conducted by the Southern California Coastal Water Research Project and others have shown that nutrients cycle in and out of the sediments in bays and estuaries on a seasonal basis and (Fenn et al. 2010) showed that large portions of several vegetation types in California (e.g., chaparral, oak woodlands,

coastal sage scrub, annual grassland) exceed the "critical load" for nitrogen deposition. Excess loading of nitrogen from aerial deposition can cause shifts in the plant community by, for example, changing conditions to favor invasive grasses and other nutrient sensitive species. Where loadings exceed the amount that can be assimilated by plants, rainfall can more easily wash excess nutrients out of soils and into streams.

Figure 2.5.1: Nutrient enrichment causes overgrowth of algae in streams, particularly in warmer, low flow conditions. a) algal mats in a slow moving stream. *Urban and natural watershed areas can supply excessive nutrients, so algal overgrowth and its secondary impacts (e.g., low dissolved oxygen) occur in both urban channels (b) and streams in undeveloped open space (c).*

a)

b)

c)

Figure 2.5.2: Almost all estuarine segments in the Southern California Bight show some degradation on at least one of the three response indicators of eutrophication: macroalgal cover, phytoplankton, and dissolved oxygen concentration. *Adapted from Bight '08 program data.*

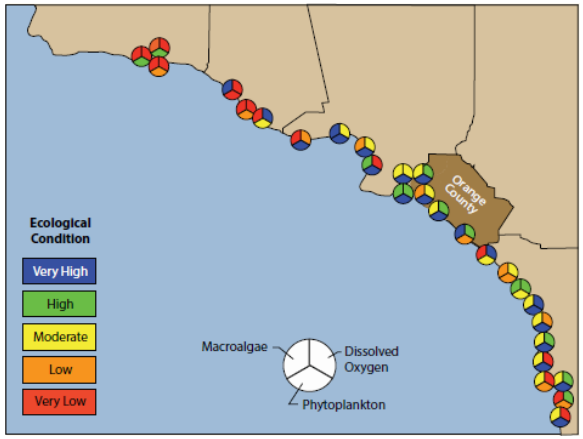
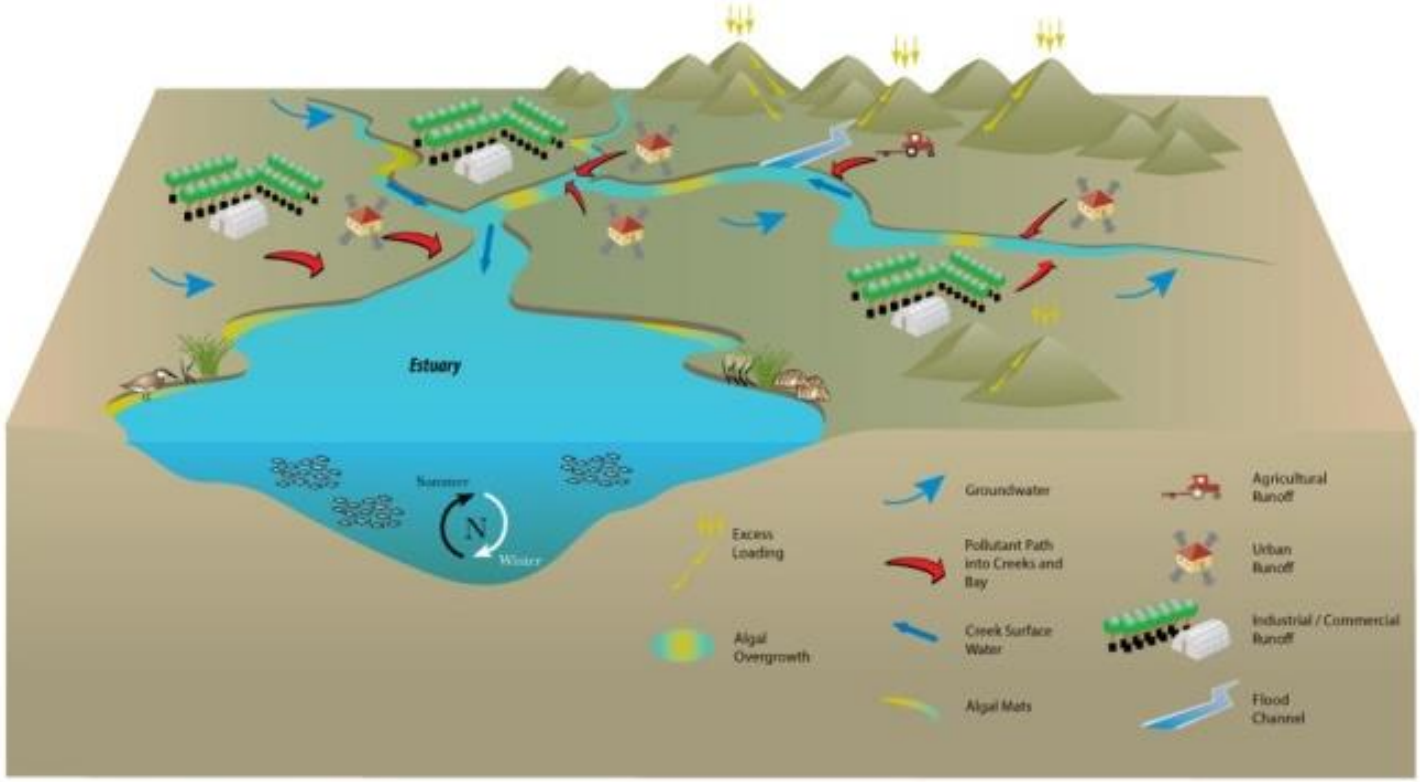


Figure 2.5.3: Bloom of the alga *Lingulodinium polyhedrum* in the coastal ocean off southern California. *This alga can be toxic to marine organisms.*

Figure 2.5.4: A graphical conceptual model of nutrient dynamics in a generalized estuarine system. *Nutrients derive from multiple sources, both natural and anthropogenic, spread across the watershed. Atmospheric deposition can exceed the carrying capacity of upland soils, leading to nutrient loading to streams during storm events. Nutrient loadings are higher in wet weather and they can be stored in and move through sediments, groundwater, and riparian and aquatic plants on different timescales. Because of these reservoirs, nutrients can require a lengthy period to move through the system and their impacts can continue long after inputs have been shut off. Note: Nutrients enter coastal systems through a variety of sources and pathways.*



The second way in which nutrients differ from most other pollutants is that complex bio- and geochemical dynamics can cause very different effects at different locations or times in response to the same nutrient concentration or load. As a result, there is no consistent functional relationship between the exceedance of a single, numeric regulatory standard for nitrogen or phosphorus and the presence or severity of impacts from nutrient overenrichment.

2.5.2 Nutrient Patterns in South Orange County

The Program collects three types of data that help document the extent, severity, and changes over time in nutrient issues:

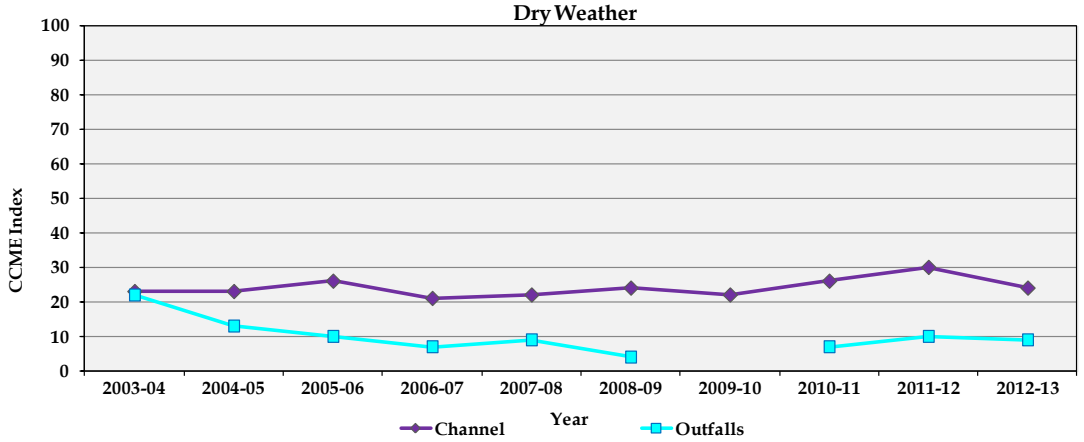
- Concentrations of nutrients and comparison of these data to commonly used thresholds(1 mg/l for total Nitrogen; 0.1 mg/L for total Phosphorus) that indicate likelihood of impacts
- The percent cover of algae, a measure of nutrient impacts on biological conditions in waterbodies
- Mass loads of nutrients at key mass emission stations

Figure 2.5.5a and **2.5.5b** shows that nutrients (total nitrogen and total phosphorus) commonly exceed thresholds in channels and that a frequency-based water quality index widely used in a number of monitoring and assessment programs has improved only slightly since 2000. While conditions are slightly better in dry weather in most years, the index values are consistently low (i.e., poor condition) in all years in both dry and wet weather.
However, this is not strictly an urban problem (see **Figures 2.5.1c and 2.5.6**). The Stormwater Monitoring Coalition (SMC) has for the past five years collected data from sites across southern California in urban, agricultural, and open (undeveloped) natural areas. The locations of SMC sites are selected randomly each year so that they can provide a statistically valid picture of regional conditions, which forms a valuable context for interpreting data from north County. **Figure 2.5.6** shows that targeted monitoring sites in South Orange County channels clustered in the lower end of the distribution (less than about 30% macroalgal cover) for the urban landuse. In other words, about half of the stream miles in southern California in the urban land use had a greater degree of macroalgal cover than did sites in channels in South Orange County. **Figure 2.5.6** also shows about half of the stream miles in southern California in the open (undeveloped) landuse had up to 20% macroalgal cover. Thus, while macroalgal cover is greater in the urban landuse, this problem also occurs in undeveloped streams in the region.

Figure 2.5.5 shows that elevated nutrient levels are pervasive in south County channels but **Figure 2.5.6** documents that the primary nutrient impact monitored in these channels, percent macroalgal cover, is at the lower end of the cumulative frequency distribution for the urban landuse in the region. Thus, nuisance algal growth is not always evident in streams when nutrients are above thresholds, which reflects the lack of a one-to-one correspondence between nutrient levels and impacts such as macroalgal cover and dissolved oxygen. Recognition of this issue is at the heart of the State Water Resources Control Board's attempt to develop a new approach to setting nutrient thresholds (see **Section 2.5.4** *New Management Approaches* below).

Figure 2.5.5: An overall index of the extent to which nutrients (total nitrogen and total phosphorus) meet thresholds in channels and outfalls, in both dry (a) and wet (b) weather is low (which means poor conditions) and has remained low over the monitoring period. *The index integrates the number of indicators and the percentage of samples higher than thresholds in each year, and the average magnitude of such excursions (CCME 2001). It provides a score, scaled from 0 - 100, that can readily be tracked over time. Note: Nutrients regularly exceed standards in channels in both wet and dry weather.*

a)



b)

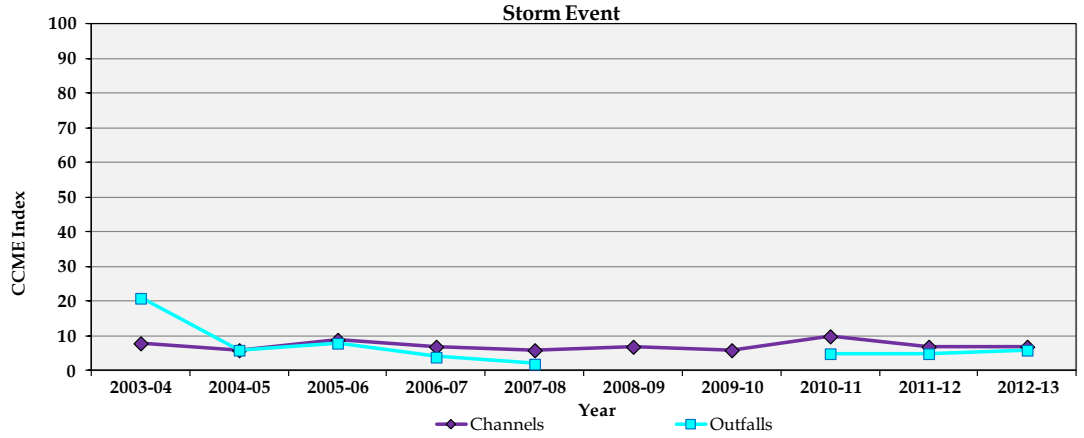
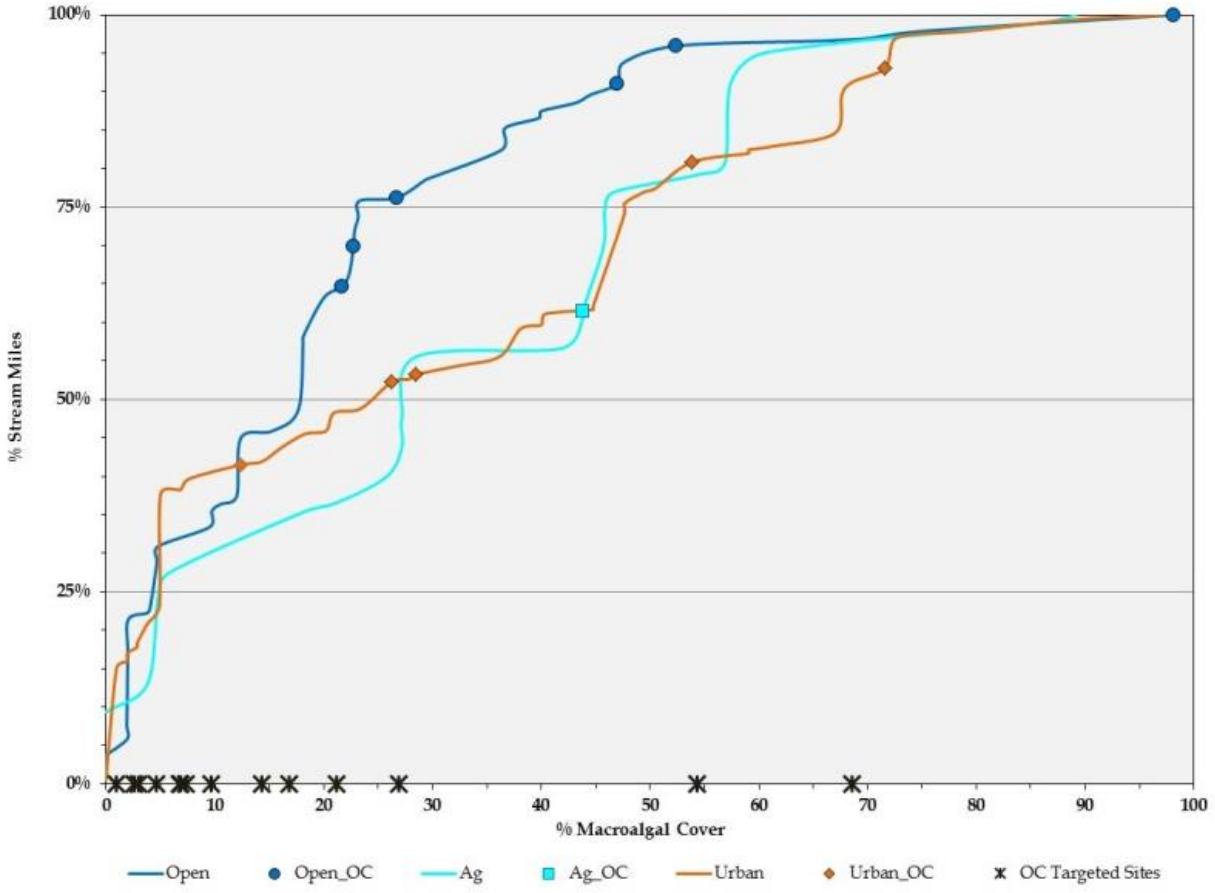


Figure 2.5.6: The cumulative frequency distribution function of macroalgal cover in the three landuse types sampled by the Stormwater Monitoring Coalition's (SMC) regional program. *Fifty percent of the stream miles in the open landuse had about 20% or less macroalgal cover, while about 50% of the stream miles in the urban landuse had about 30% or less macroalgal cover. The majority of the County's targeted sites (situated along the X axis) had less than 30% macroalgal cover.*



2.5.3 Nutrient Sources

As with many pollutants, the focus on sources of nutrient inputs has gradually shifted from distinct point sources to more widespread and diffuse sources as point sources have been identified, targeted for management action, and removed or reduced. Natural areas such as chaparral, oak woodlands, coastal sage scrub, and annual grassland can also be important sources of nutrient loading, particularly in wet weather. These areas have accumulated excess nutrients from aerial deposition (e.g., nitrogen oxides in smog) which can leach from soils during rain events. **Figure 2.5.7** shows that concentrations of nutrients in wet weather runoff from undeveloped open space are similar to those in runoff from urban sites. As a result, a narrow focus on urban sources of nutrients will miss an important category of inputs.

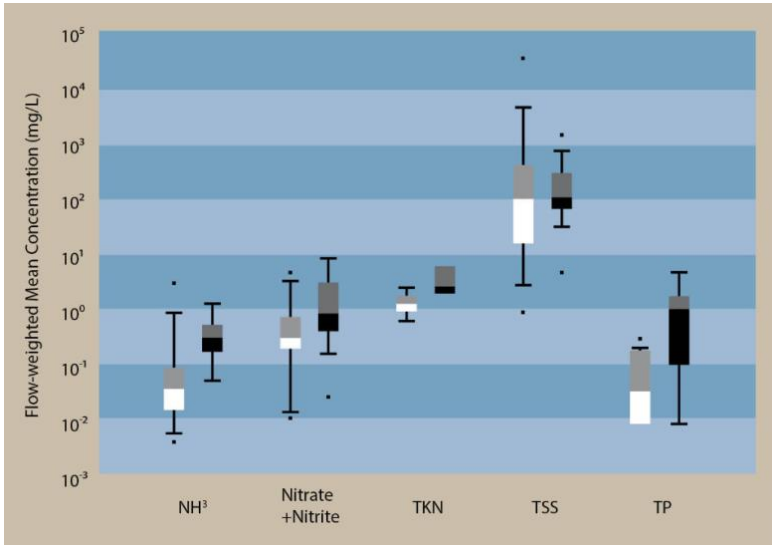
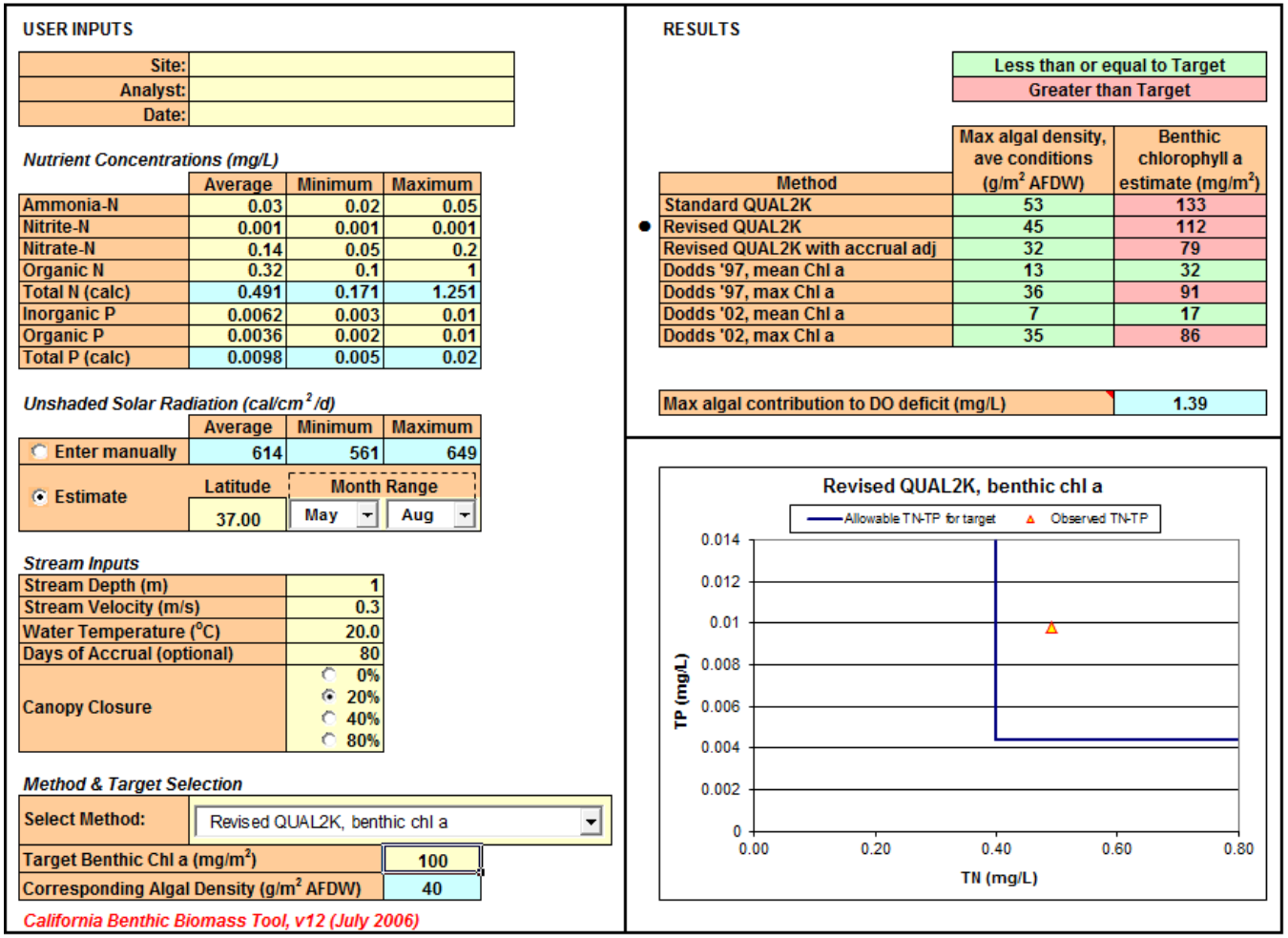


Figure 2.5.7: Wet weather flow-weighted mean concentrations of several forms of nutrients at urban (shaded boxes) and undeveloped open space (clear boxes) sites, as measured in the SCCWRP Natural Loadings Study. *These data document that natural areas are sources of nutrients at concentrations that are similar in some cases to those in runoff from urban sites. Boxes indicate the 25th and 75th percentiles and error bars indicate the 10th and 89th percentiles. From Stein and Yoon (2007).*

2.5.4 New Management Approaches

Improved knowledge about the lack of a tight correlation between nutrient levels and nutrient impacts, and about the importance of diffuse sources in open areas and in groundwater, has prompted the development of new management approaches at both the statewide and regional / local levels that more accurately measure and address the risk of impairment. For example, the State Water Resources Control Board's Nutrient Numeric Endpoint (NNE) project is developing methods (**Figure 2.5.8**) to derive a maximum allowable nutrient concentration in a particular stream reach, reservoir, or estuary based on local factors such as temperature, irradiance, and flow. The NNE's goal is to ensure that the key ecological indicators of macroalgae and dissolved oxygen remain within acceptable bounds.

Figure 2.5.8: The main user interface for the current version of the freshwater Nutrient Numeric Endpoint (NNE) biomass estimation spreadsheet tool. *In this figure, data fields are loaded with example data for illustrative purposes.*



USER INPUTS

Site:	
Analyst:	
Date:	

Nutrient Concentrations (mg/L)

	Average	Minimum	Maximum
Ammonia-N	0.03	0.02	0.05
Nitrite-N	0.001	0.001	0.001
Nitrate-N	0.14	0.05	0.2
Organic N	0.32	0.1	1
Total N (calc)	0.491	0.171	1.251
Inorganic P	0.0062	0.003	0.01
Organic P	0.0036	0.002	0.01
Total P (calc)	0.0098	0.005	0.02

Unshaded Solar Radiation (cal/cm^2/d)

	Average	Minimum	Maximum
Enter manually	614	561	649
Estimate	Latitude: 37.00	Month Range: May – Aug	

Stream Inputs

Stream Depth (m)	1
Stream Velocity (m/s)	0.3
Water Temperature (°C)	20.0
Days of Accrual (optional)	80
Canopy Closure	0% / 20% / 40% / 80%

Method & Target Selection

Select Method:	Revised QUAL2K, benthic chl a
Target Benthic Chl a (mg/m^2)	100
Corresponding Algal Density (g/m^2 AFDW)	40

California Benthic Biomass Tool, v12 (July 2006)

RESULTS

Less than or equal to Target
Greater than Target

Method	Max algal density, ave conditions (g/m^2 AFDW)	Benthic chlorophyll a estimate (mg/m^2)
Standard QUAL2K	53	133
Revised QUAL2K	45	112
Revised QUAL2K with accrual adj	32	79
Dodds '97, mean Chl a	13	32
Dodds '97, max Chl a	36	91
Dodds '02, mean Chl a	7	17
Dodds '02, max Chl a	35	86

Max algal contribution to DO deficit (mg/L)	1.39

2.5.5 Recommendations

Past progress in identifying and controlling sources of contamination, the availability of a long time series of monitoring data, and the development of new monitoring and assessment tools provide the basis for this review of existing nutrient programs with the goal of improving their utility and efficiency. The following recommendations stem from a data-driven, risk prioritization approach that views monitoring, assessment, research, and management actions as a portfolio of related actions.

- Conduct an assessment of sources and practices that input to the MS4, to assess the significance of each to downstream issues.
- Continue identifying opportunities to reduce and prevent flows in dry weather.
- Pilot a regional mass balance nutrient model, even if elementary, to help prioritize monitoring and management attention; the Newport Bay watershed and SCCWRP coastal ocean nutrient mass balance models provide useful examples.
- Use available time series of data to streamline monitoring to improve its statistical and economic efficiency. Sampling effort could be reduced by identifying stations that essentially mimic each other and/or by reducing the spatial and/or temporal intensity of sampling. Monitoring could shift to a sentinel program with a lower frequency of monitoring intended to ensure conditions do not worsen.

2.6 Toxicity

The Story: Toxicity

- Toxicity in freshwater channels in all conditions (aquatic, sediment, wet and dry weather) occurs at low levels and is sporadic, occurring at different locations at different times and varying unpredictably across test species.
- Aquatic toxicity in dry weather occurs in open (undeveloped) areas at levels equivalent to those in urban areas; suggesting that dry weather toxicity is not driven predominantly by urban pollutants.
- There are no apparent trends in toxicity over time.
- Metals, except for some instances of elevated copper, are at low levels and do not appear to contribute to aquatic toxicity in freshwater.
- The primary source of toxicity appears to be pesticides, with evidence that pyrethroids contribute to sediment toxicity.
- Use of organophosphate pesticides has declined virtually to zero but use of pyrethroid pesticides has increased and exceedances of thresholds for pyrethroid pesticides are high.
- Reported pesticide use in the County has declined from just over 2 million pounds a year in 1998 to just under 1 million pounds in 2011, due primarily to reduced use of indoor fumigants.
- There is a large data gap in our knowledge of retail pesticide sales and use.
- Pesticide use (which is regulated directly at the state and federal levels) presents a moving target for management because of the continued introduction of new products; the most effective management strategies are to continue to reduce dry weather runoff/flows and support education and outreach efforts to reduce pesticide use and runoff.

2.6.1 Low but Puzzling Patterns in Toxicity

Since the publication of Rachel Carson's Silent Spring in 1962, concerns about the potentially destructive impacts of chemicals released into the environment have expanded, supported by an increasingly sophisticated understanding of their impacts and modes of action. Environmental monitoring now provides a range of tools, including sensitive sampling for specific chemicals at very low levels and toxicity tests (**Figure 2.6.1**) that integrate the effects on organisms of multiple chemicals in ambient water and sediments. These tools can indicate the potential for toxic effects before they become major events and provide the means for tracking and managing the distribution and impacts of anthropogenic chemicals.

Figure 2.6.1: The water flea *Ceriodaphnia* which is commonly used as a laboratory test organism in both acute and chronic aquatic toxicity tests

The Program's monitoring efforts to assess aquatic ecosystem health include a range of toxicity tests (**Table 2.2.2**) including aquatic tests in both dry and wet weather as well as toxicity tests on sediment collected from streams and channels. These tests use a variety of test organisms sensitive to different types of chemicals include and assess both acute (i.e., survival / death) and chronic (i.e., reproduction / growth) endpoints to document a range of potential toxic effects. **Table 2.2.2** summarizes the results of 2548 separate toxicity tests performed since 2003. The overall level of toxicity is low but is highest in wet weather. Winter storms wash accumulated contaminants off land surfaces and the first flush of storms is known to have higher levels of contamination. In addition, some contaminants, particularly synthetic pyrethroids, which are an increasingly common pesticide, bind to sediments where, depending on their solubility, they may be a primary cause of aquatic and/or sediment toxicity in urban streams (Holmes et al. 2008). However, the occurrence of toxicity is highly variable, shifting from site to site at different sampling times; a careful examination of the Program's data shows no consistent spatial patterns or trends over time. The relatively low level of toxicity, combined with the fact it appears sporadically, makes it difficult to control.

Table 2.2.2 (Repeated): Summary of the Program's toxicity testing in South Orange County since from 2003 - 2012, an effort that includes 2548 tests on multiple species from a range of times, locations, and conditions. *Note: Toxicity levels are generally low except for one organism in wet weather that is susceptible to pesticides.*

Test Species	Dry Weather		
	n	Toxic	Nontoxic
Americamysis bahia	391	34%	66%
Strongylocentrotus purpuratus	179	5%	95%
Ceriodaphnia dubia	569	20%	80%
Pimephales promelas	64	9%	91%
Hyalella azteca	224	11%	89%
Overall	1593	18%	82%

The Program also has the benefit of comparing data from its sites in South Orange County to a collection of sites from across southern California sampled by the regional Stormwater Monitoring Coalition (SMC). The locations of SMC sites are selected randomly each year so that they can provide a statistically valid picture of regional background conditions, which forms a valuable context for interpreting data from South Orange County.

A summary of the past five years of SMC aquatic toxicity testing data (**Table 2.2.3**, repeated below for convenience) shows puzzling patterns. Acute toxicity (i.e., mortality) occurs in only a small fraction of stream miles in both open and urban landuses. In contrast, chronic toxicity (i.e., reduced reproduction) is more prevalent in the open landuse than the urban landuse. There is chronic toxicity present in the urban landuse, but in a much smaller portion of stream miles than in undeveloped open space. These results suggest that there are sources of toxicity that are more widely spread throughout the region and may not necessarily be directly associated with urban runoff. Speculation has focused on aerial deposition of airborne contaminants or natural factors such as high conductivity or turbidity. For example, a special study conducted by the Program in the Oso Creek watershed found that high levels of dissolved solids (see **Section 2.4** on dissolved solids, above), which can be toxic to aquatic species, derived from natural geologic formations and had increased in recent decades as development patterns caused the

groundwater table to rise. However, no regionwide followup studies on the SMC's findings have to date been planned or conducted.

In addition to the generally low toxicity found in inland channels, the Program's toxicity testing in the surfzone up- and downcoast of stormwater discharge points has found virtually no toxicity in the nearshore marine environment.

Table 2.2.3: Summary of aquatic toxicity results from the past five years of Stormwater Monitoring Coalition (SMC) samples from random sites across the southern California region. *Sites were located in both open (i.e., undeveloped) and urban landuse types. The large majority of stream miles were nontoxic for acute toxicity (i.e., survival) in both landuse categories, with an equivalent amount of sporadic background toxicity in both open and urban landuses. The majority of stream miles were toxic for chronic toxicity (i.e., reproduction) in the open landuse, a strikingly different pattern than seen in the urban landuse.*

	% Stream Miles	
	Open	**Urban**
Ceriodaphnia Survival		
Toxic	2.1	2.4
Nontoxic	97.9	97.6
Ceriodaphnia Reproduction		
Toxic	63.0	37.4
Nontoxic	37.0	62.6

2.6.2 Metals not a Source of Toxicity

Toxicity is a useful indicator of ecological impacts but toxicity test results by themselves do not identify the specific pollutants or other stressors responsible for toxicity. Instead they can indicate the general category of pollutants, such as metals or organic pesticides, contributing to toxicity. The Program therefore combines three complementary lines of evidence to attempt to isolate the cause(s) of toxicity:

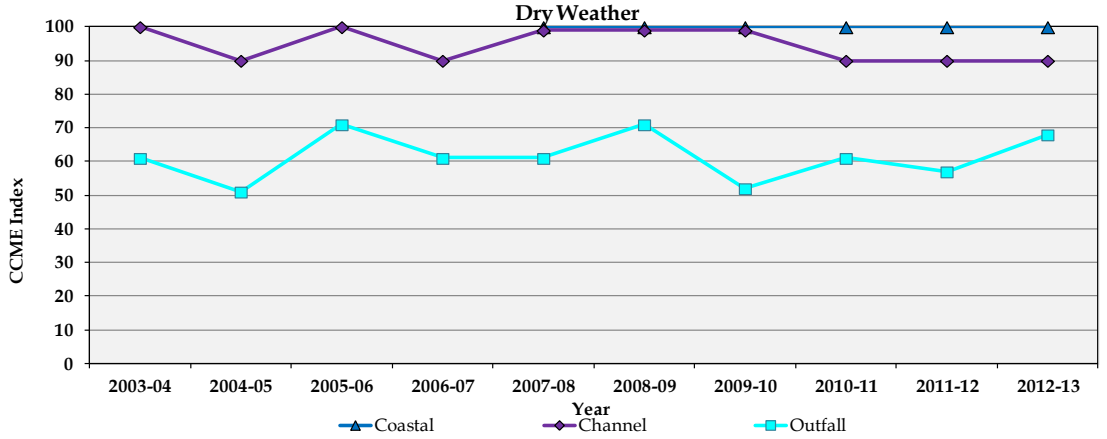
- Correlation between toxicity test results and chemical concentrations in the waters and sediments collected for toxicity tests
- Comparison of these chemical concentrations to regulatory standards in the California Toxics Rule (CTR) which are based on laboratory studies of test organisms' sensitivity to specific chemicals
- More detailed analyses of ambient water and sediments, called Toxicity Investigation Evaluations (TIEs), that sequentially remove classes of chemicals to determine whether toxicity drops in concert

Unfortunately, these studies have not succeeded in clearly identifying the sources of toxicity in the County's streams and channels. The sporadic nature of the toxicity signal makes it difficult to follow up on, correlations are inconsistent, and TIE methods have technical limitations that make their results less specific than desired. However, these methods have succeeded in ruling out metals as a source of toxicity and suggesting that the observed persistent toxicity patterns in the test species evaluated in urban streams and channels is due to organic compounds, likely pesticides.

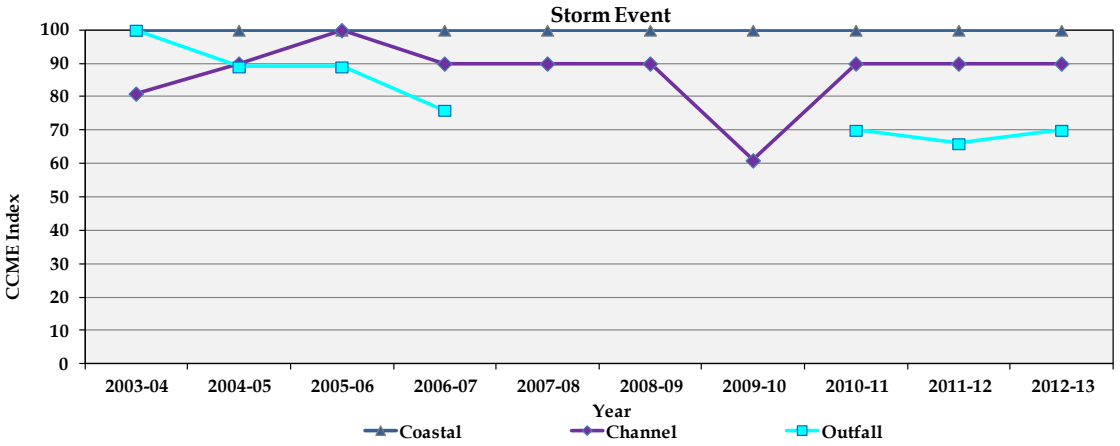
Exceedances of CTR standards for metals are consistently low in both dry and wet weather (**Figure 2.6.2**) and there is no apparent trend over time. While copper and cadmium account for the large majority of these limited exceedances, neither metal is correlated with the occurrence of toxicity in streams and channels and has not been identified as a cause of freshwater toxicity in TIEs. This conclusion matches findings from the SMC's regional program (see **Table 2.2.3**), a regional

Figure 2.6.2: An overall index of the extent to which metals meet regulatory standards in channels and embayments is high (meaning few exceedances) and has remained steady since 2003, in all samples for both dry (a) and wet (b) weather. *This index accounts for the number of metals that exceed standards in each year, the percentage of individual samples that exceed standards, and the average magnitude of any such exceedances (CCME 2001). It provides a score, scaled from 0 - 100, that can readily be tracked over time.*

a)



b)



study of loadings from natural areas (**Figure 2.6.3**), as well as from watershed monitoring programs in the San Gabriel River and Los Angeles River watersheds.

While copper is a concern in harbors, the 2002 TMDL for Toxic Pollutants in San Diego Creek and Newport Bay estimated that antifouling paint on boat hulls represents nearly 90% of the loading of copper to the Bay. In addition, a Bight '08 study of discharges to Areas of Special Biological Significance (ASBS) (Schiff et al. 2011) found no significant differences between post storm metals concentration at ASBS discharge sites and at reference drainages. There was some evidence for a slight increase in copper at ASBS discharge sites but this may be due to particular coastal sources such as harbors and coastal developments with copper architectural features.

2.6.3 A Localized Source of Copper

A history of persistent exceedances of regulatory thresholds for copper in the Irvine Cove community triggered a detailed, two-year special study to identify and prioritize sources of copper for future source control efforts. This cooperative effort between the County and the City of Laguna Beach included additional sampling of stormwater runoff at multiple locations along with field reconnaissance to identify potential sources of copper. This information helped focus targeted sampling at specific potential sources to rule them in or out and characterize their contribution to copper levels in runoff. The study showed that copper was concentrated in runoff from Irvine Cove below the Pacific Coast Highway, a spatial pattern that ruled out brake pad dust as a major source. Further reconnaissance focused attention on residential architectural copper uses such as roofs, rain gutters, and flashing (**Figure 2.6.4**). Sampling during a storm event of runoff from homes with and without architectural copper features showed that the average level of copper in runoff from homes with copper features was nearly ten times higher than copper in runoff from homes without copper, and nearly six times the regulatory action level. Maximum levels of copper were more than 1000 times higher. This information is useful in ruling out other sources and highlights the difficulty of controlling all sources of contaminants from urbanized watersheds.

Figure 2.6.3: Wet weather flow-weighted mean concentrations of metals at urban (shaded boxes) and undeveloped open space (clear boxes) sites, as measured in the regional study of runoff characteristics from natural drainages. *These data document that natural areas are sources of metals, although concentrations in runoff from natural drainages are somewhat lower than those at urban sites. Boxes indicate the 25th and 75th percentiles and error bars indicate the 10th and 89th percentiles. Dots represent extreme values.*

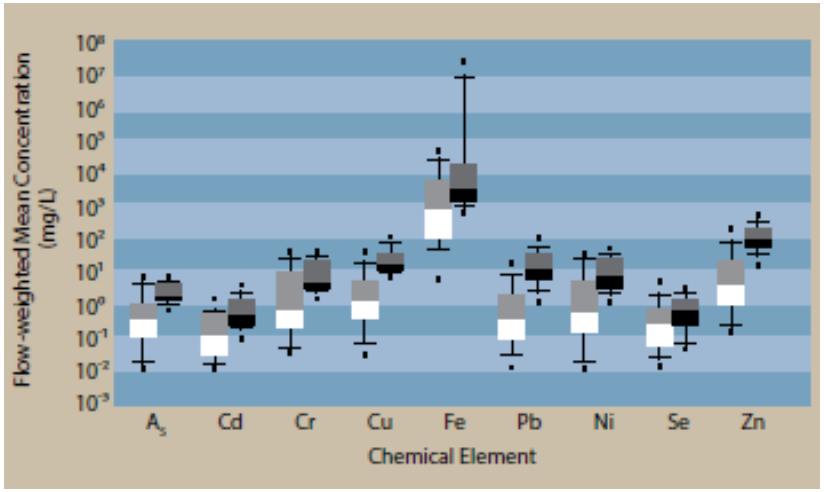


Figure 2.6.4: Aerial photograph of a portion of the Irvine Cove drainage area identifying various types of structural architectural copper uses.

2.6.4 Trends in Pesticide Use

While pesticides have been implicated as a cause of both aquatic and sediment toxicity, it has been extremely difficult to confirm their role largely because of technical challenges associated with TIEs. There are hundreds of pesticides in current use, neither certified laboratory methods nor toxic thresholds exist for many of these, and legacy pesticides such as DDT are still present in the environment. In addition, the population of pesticides in use changes continually over time in response to new regulatory requirements and increasing knowledge of their targets' physiology (**Figure 2.6.5**). Organochlorine pesticides (e.g., DDT, chlordane) were banned and replaced by organophosphate pesticides (e.g., diazinon and chlorpyrifos), whose use was tightly restricted and were in turn replaced by the synthetic pyrethroids (e.g., permethrin). Most recently, policies have tightened the use of pyrethroids, opening a door for increased use of fipronil. Newer pesticides are often toxic at much lower levels than older pesticides (e.g., pyrethroids exhibit toxic effects at the parts per trillion level), requiring the development of increasingly sensitive methods with lower detection limits. In addition, new pesticides often change the nature of toxicity and the types of organisms affected. This illustrates a core problem in pesticide monitoring, assessment, and management – the ever-changing cast of characters that pose a constant challenge to monitoring methods and the understanding of toxic processes.

Figure 2.6.5 shows that the use of organophosphate pesticides (chlorpyrifos and diazinon) has declined substantially since the early 1990s, even before their use in residential applications was banned in 2001 and 2004, respectively. Available data from the Program's monitoring efforts shows that, as a result, the exceedance index for organophosphate pesticides has increased (i.e., improved conditions) significantly in dry weather and to a lesser degree in wet weather (**Figure 2.6.6**). The slower rate of improvement in wet weather suggests that there may be reservoirs of these pesticides still present. Because agricultural uses must be reported and the reported use of these pesticides has declined to virtually zero (**Figure 2.6.5**), it is unlikely that still-permitted uses of these two pesticides are the source of the remaining wet weather exceedances. In contrast, the exceedance index for pyrethroid pesticides in wet weather is quite low (i.e., poor conditions), reflecting their increased use.

Figure 2.6.5: Trends in the use of the two most widely used organophosphate pesticides, diazinon and chlorpyrifos, and permethrin, the most widely used of the newer synthetic pyrethroids. *The organophosphates have virtually disappeared from the County after their residential use was banned by the USEPA, in 2001 for chlorpyrifos and 2004 for diazinon. Trends for all three pesticides are significant at the p <0.001 level.*

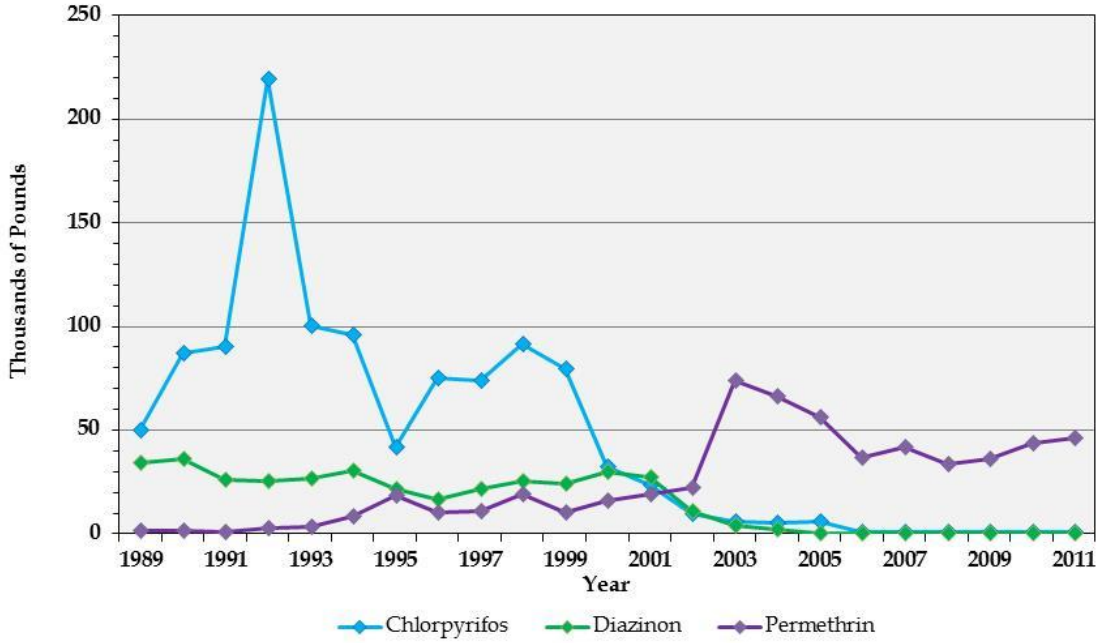
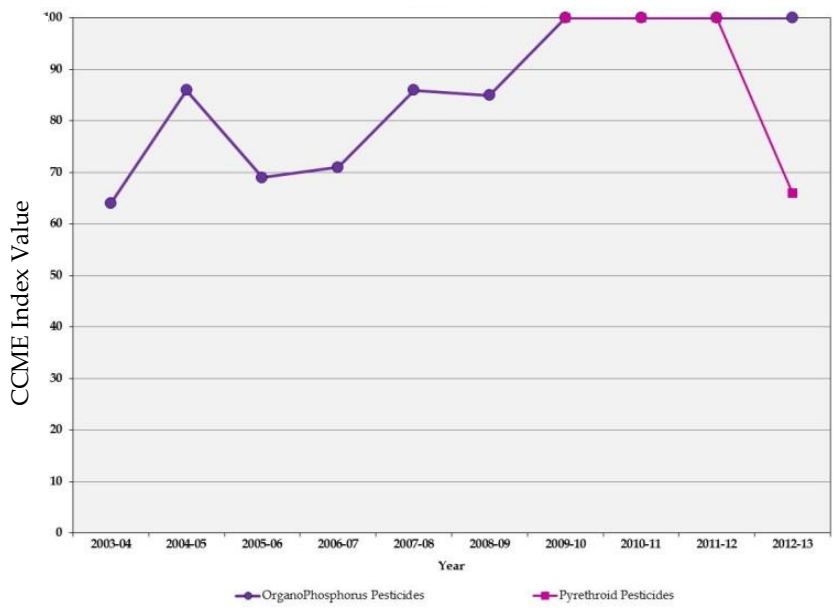
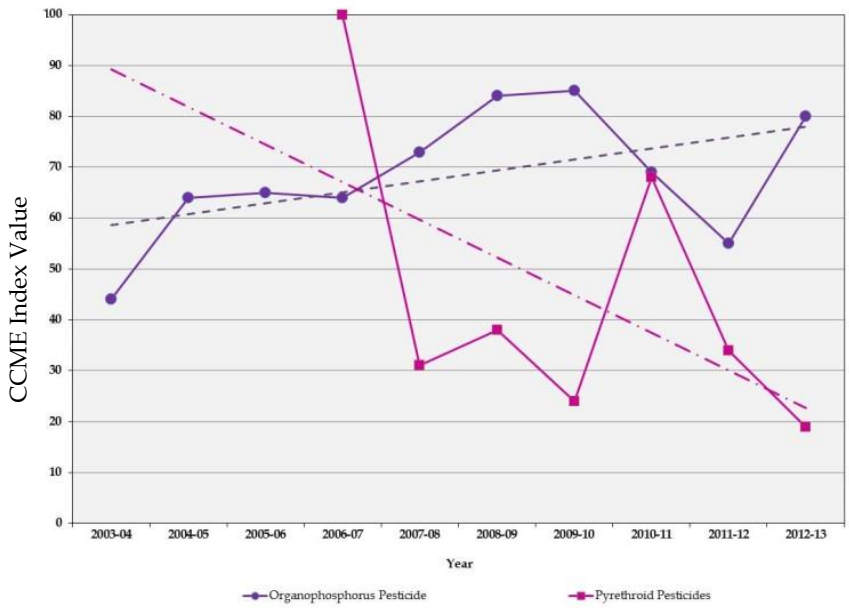


Figure 2.6.6: Trends over time in the exceedance index for a) organophosphate pesticides in dry weather and b) both organophosphate and pyrethroid pesticides in wet weather. *Higher values of the index indicate better conditions. Organophosphate pesticides reach an index value of 100 (no exceedances) in dry weather (a) and remain there, a trend significant at the p <0.001 level; pyrethroid exceedances appear in 2010 and increase quickly. While there are remaining exceedances for organophosphate pesticides in wet weather (b), the overall relationship between trends in the two types of pesticides reflects that in dry weather.*

a)



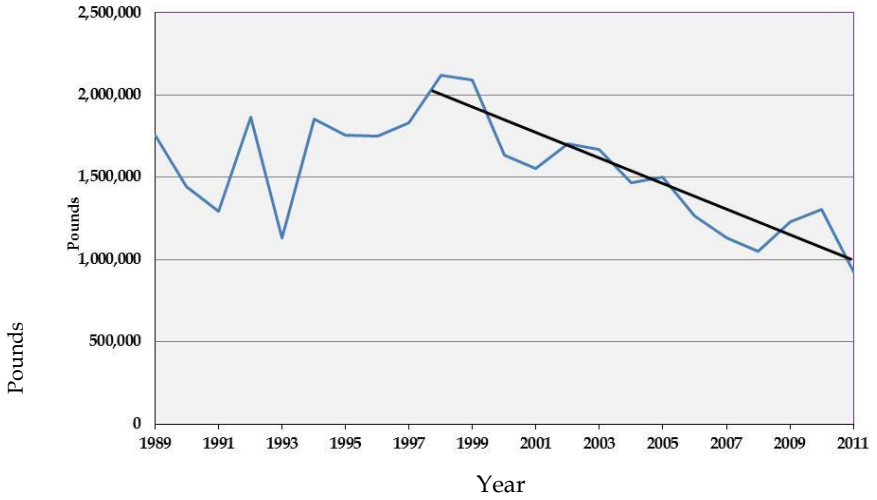
b)



Despite the challenges of assessing pesticides' impacts in waterbodies, we do know that total reported pesticide use in Orange County has declined dramatically since 1998 (**Figure 2.6.7**). Inspection of detailed annual reports on the California Department of Pesticide Regulation's (CDPR) website shows this is due to declines in the use of glyphosate (i.e., Roundup) and a set of indoor fumigants used, for example, in termite treatment of homes and other structures. Glyphosate is an herbicide that is applied in the environment and there are some concerns about its potential water quality impacts. Indoor fumigants, in contrast, are not applied outdoors, degrade relatively quickly, and vent to the atmosphere. Because it has extended over nearly 15 years, this decline is likely due to a combination of causes, including changes in the real estate market (fumigation is required as a condition of sale), growing concern about health effects of toxic compounds, the greater use of spot applications of pesticides, and the increased availability of alternative non-pesticide treatments for indoor and structural pests.

The CDPR data show that large declines in pesticide use are possible, and provide promise that continued education and improved policy can contribute to environmental improvement. However, the chemicals that contributed most to the decline shown in **Figure 2.6.7** are not those (e.g., pyrethroids, fipronil) most often implicated in environmental toxicity. Further examination of the CDPR database would be needed to determine whether the aggregate amount of reported environmentally toxic pesticide applications has also declined in recent years. More importantly, there is a large and significant data gap related to retail purchases at hardware, gardening, and home improvement stores. Sales at these outlets are not reported to the CDPR and methods to reliably capture these data have not yet been developed.

Figure 2.6.7: Total reported pesticide use in Orange County, drawn from the California Department of Pesticide Regulation's website (www.cdpr. ca.gov). *The amount applied annually has declined by over 50% since 1998 (regression significant at p <0.001). Note: Overall pesticide use appears to be declining.*



Continued efforts to expand the scope of pesticide sales / use reporting and to improve education on proper application and the use of effective alternatives (e.g., botanical oils) could reduce the loading of pesticides to the County's water bodies. For example, CDPR has developed new regulations for pyrethroid application that should substantially reduce pyrethroids in urban runoff. Such efforts will be amplified by the continuing focus on water conservation to reduce dry weather runoff (e.g., through Low Impact Development practices) and on reducing overuse to minimize or prevent toxicity in wet weather runoff, which are the two delivery

pathways for moving pesticides from the landscape to water bodies.

2.6.5 Recommendations

Past progress in identifying and controlling sources of contamination, the availability of a long time series of monitoring data, and the development of new monitoring and assessment tools provide the basis for this review of existing toxicity monitoring programs with the goal of improving their utility and efficiency. The following recommendations stem from a data-driven, risk prioritization approach that views monitoring, assessment, research, and management actions as a portfolio of related actions.

- Reassess management concerns and priorities about metals impacts in freshwater channels, bays and estuaries, and the nearshore coastal zone.
- To the extent that metals, particularly copper, remain a concern because of potential impacts in bays and harbors, recognize that inputs from antifouling paint, which are not an urban runoff issue, are likely a more important source than watershed input.
- Improve information on the use of pesticides in the County, particularly by the largest applicators
- Work with other interested parties to fill the data gap related to retail sales of pesticides.
- Examine the CDPR database to develop a more thorough picture of trends in reported pesticide use.
- Use this information to expand and focus cooperate outreach efforts about proper pesticide application and the use of alternatives such as botanical oils that are effective, but nonlethal, insect deterrents.
- Use available data to streamline monitoring and improve its statistical and economic efficiency. Consider reducing the current focus on metals monitoring and targeting pesticide monitoring on less expensive representative constituents or surrogates. Consider reducing the frequency of sampling for sediment associated constituents to the Bight Program's sampling frequency.
- Given the overall low level of observed toxicity, consider increasing the use of adaptive responses (e.g., TIEs and other types of causal assessment) in place of intensive routine monitoring.
- Continue taking advantage of opportunities to reduce dry weather runoff to channels.
- Continue the productive relationship the University of California's South Coast Research and Extension Center and take advantage of opportunities for its Director to communicate the stormwater management perspective to CDPR.

2.7 Reconsideration of Monitoring Program Elements

The Story: Revisiting Program Designs

- The designs of two program elements deserve reconsideration because of increased knowledge, improved monitoring and assessment tools, and shifting management priorities.
- Such reconsideration and adaptation is fully in the spirit of the Regional Board's recently adopted Framework for Monitoring and Assessment.
- The Coastal Ambient Program has served its purpose and documented that coastal stormwater discharges are not causing any meaningful exceedances or impacts in the very nearshore coastal zone.
- The Bight Program's regional assessment of the effects of stormwater discharges on protected areas at larger spatial scales is a more effective approach to answering questions about the potential impacts of stormwater discharges.
- Efforts to reduce dry weather flow, in part through water conservation and reclamation efforts have produced substantial declines in the amount of dry weather stormwater discharge.
- These reductions have resulted in concomitant reductions in the loads of a range of problematic constituents and represent an effective means of controlling pollution from urban runoff.

2.7.1 Coastal Ambient Monitoring has Served Its Purpose

The potential impacts of coastal stormwater discharges on the marine ecosystem have long been a concern because of the pollutants they carry to the ocean. Impacts could occur at the point of initial discharge where they are most concentrated and/or at larger distances as discharge plumes mix into the coastal ocean.

The Program's Coastal Ambient monitoring effort samples directly in front of and at a short distance up- and downcoast of key discharge points. It is designed to determine whether stormwater pollutants are reaching the surfzone in concentrations that exceed water quality objectives and are causing measurable toxicity. However, the prioritization analysis shows that this is not the case, with only minor exceedances and virtually no toxicity detected. The length of time this monitoring has continued and its consistent results in both wet and dry years suggests these findings are robust and reliable.

While the Coastal Ambient monitoring has confirmed that nearfield effects in the immediate vicinity of coastal discharges are not occurring, questions about the possibility of farfield effects, particularly on protected areas (ASBSs and MPAs), have not yet been resolved. This requires a more substantial effort and is being addressed by a Bight Program study that integrated several types of information on a regional scale. The Bight study included three main parts:

- A pollution index of the likely intensity of stormwater pollution at specific protected areas
- A fishing pressure index of the effects of commercial and recreational fishing on key species

- A new assessment tool for measuring the condition of biological communities on rocky reefs

The pollution index was based on a plume dispersion model (**Figure 2.7.1**) (Rogowski et al. 2014) that estimated the probability that stormwater discharge plumes would overlap with specific protected areas. This was combined with a measure of pollutant loads to develop an estimated index of pollution intensity. The regional assessment will then compare the relative effects of fishing pressure (**Figure 2.7.2**) and pollution on the status of biological communities.

Figure 2.7.1: Illustration of the use of coastal discharge flow and coastal current data to produce probability exposure maps for a series of discharges and nearby protected areas in southern California. *The figure is organized by rows for (A) Newport Bay, and (B) Santa Ana River. Additionally, each column represents a different temporal model run including (a) annual, (b) the February 22, 2008 storm event, and (c) the December 15, 2008 storm event. Local ASBS are also displayed in all figures and defined in column (b). The X-axis is longitude and the Y-axis latitude. Colors represent probability of plume exposure as indicated at the bottom of the the figure. These probability exposure maps are then combined with estimates of pollutant loads for each discharge to derive a pollutant index for each protected area. From Figure 3, Rogowski et al. (2014).*

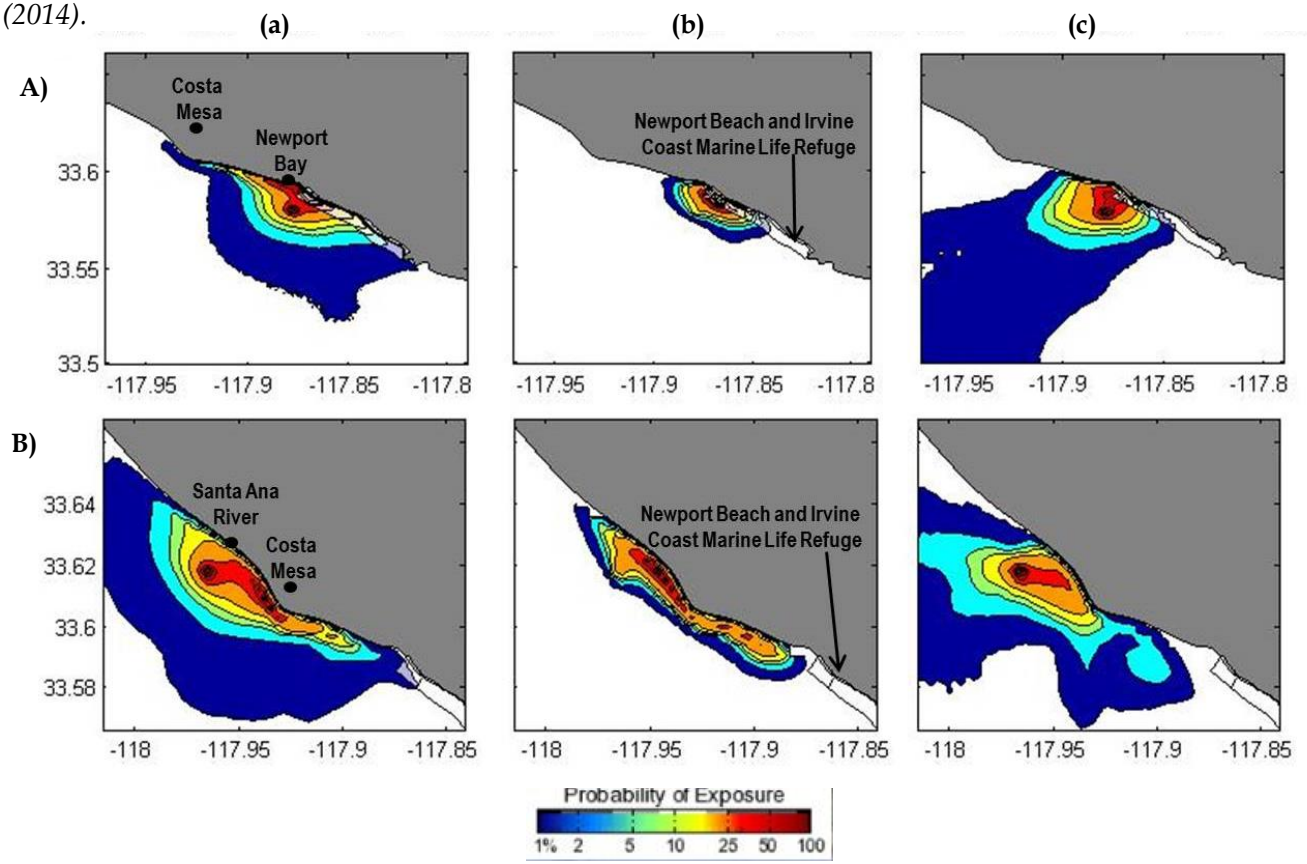
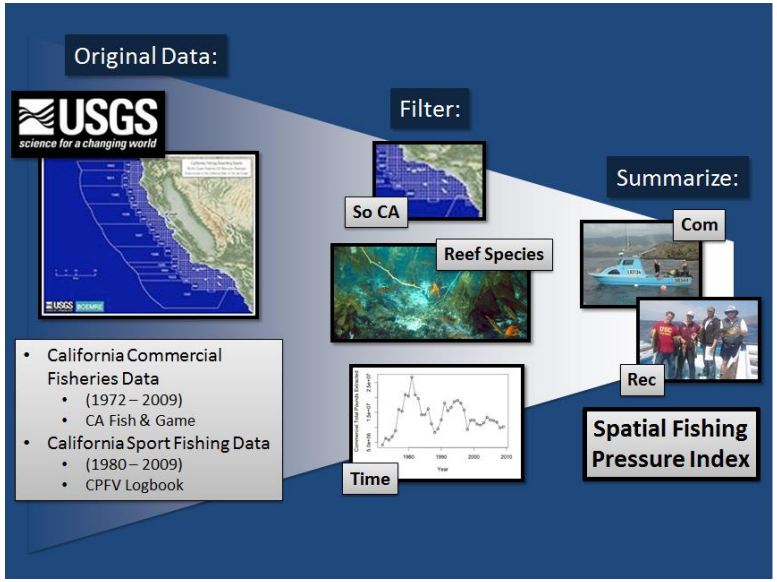


Figure 2.7.2: Schematic of the data integration and synthesis steps involved in producing an index of fishing pressure on protected areas in southern California. *From Update on Fishing Pressure Index presentation by SCCWRP, Ocean Science Trust, and Occidental College Vantuna Research Group, March 2, 2014.*

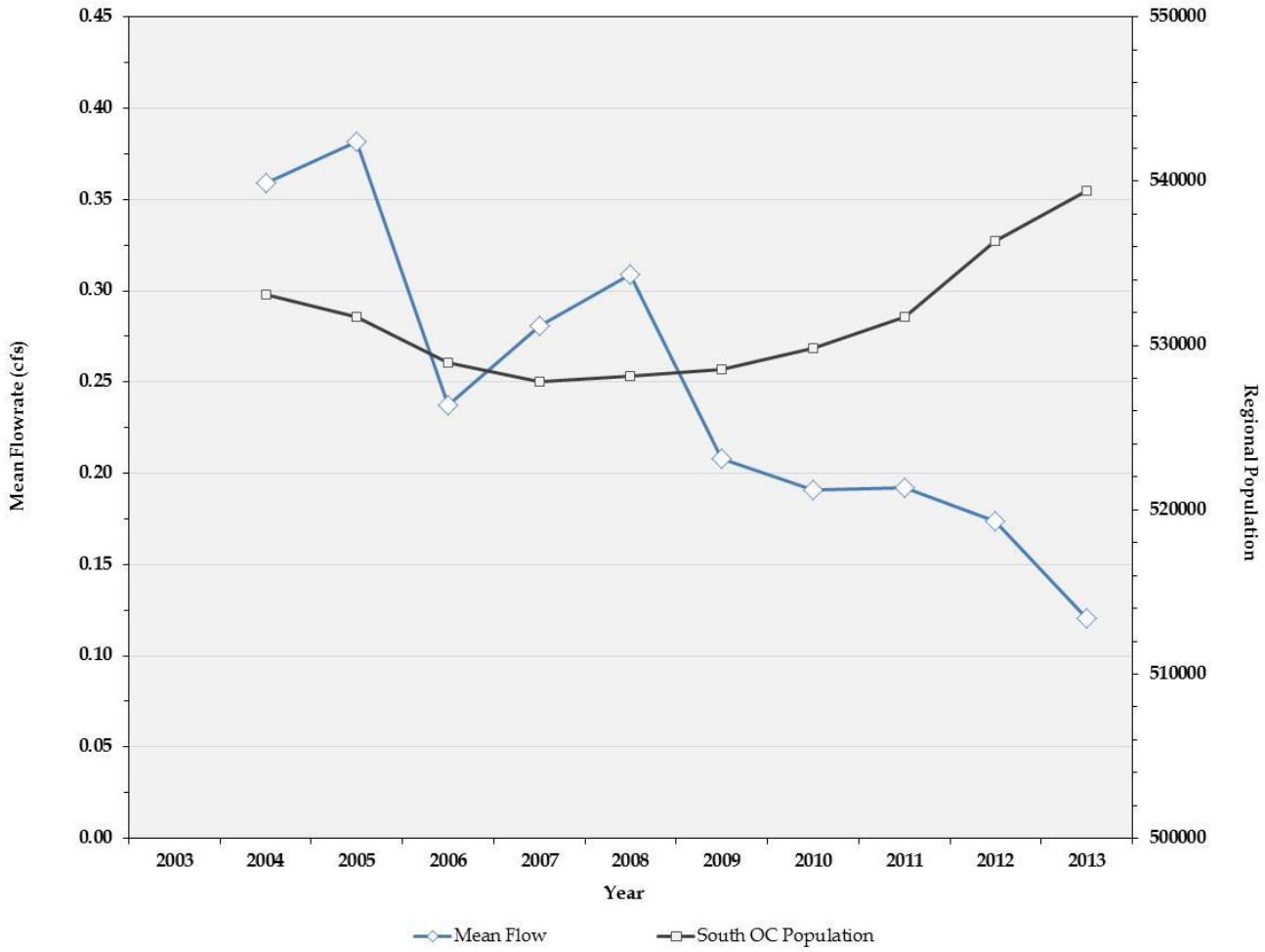


The integrated regional approach includes a more much more powerful and relevant set of questions and methods to address the potential impacts of coastal stormwater discharges on marine ecosystems. The Program's future efforts to assess the potential impacts of coastal discharges should therefore focus on contributing to this regional effort rather than continuing to monitor at extremely local scales in the vicinity of each discharge point.

2.7.2 Runoff Reduction, a Powerful All-Around Tool

Evidence from a number of the Program's monitoring efforts documents the value of water conservation and reduced urban runoff (i.e., discharge flow into streams and channels) in reducing pollutant inputs and their impacts. Water conservation and related efforts to reduce urban runoff therefore represent a potentially powerful all-around tool for addressing impacts of urban runoff. While water conservation efforts motivated by state and local policies provide the underlying impetus, pollutant control could add another important rationale for pursuing such policies as part of a larger, coordinated strategy. The effectiveness of such programs is dramatically illustrated by the declining trend of dry weather discharge flow to channels and streams from urban outfall (**Figure 2.7.3**).

Figure 2.7.3: Discharge of dry weather flow to channels and creeks from urban outfalls has declined dramatically despite an increase in regional population. *The decline spans both wet and dry years and is therefore not simply a result of drought conditions.*



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3.0 Controlling Pollutant Sources: Jurisdictional Programs

3.1 Overview

The management of sources of pollution from diffuse urban areas involves the strategic application of Best Management Practices (BMPs) to activities and drainage systems within the urban environment. The purpose of BMPs is to protect water quality by reducing pollutant loads and concentrations and by reducing discharges (volumetric flows and flow rates) causing stream channel erosion.

The DAMP is the principal policy and program guidance document for the *Program*. At its core is a series of Model Programs that are individually implemented by the Permittees in accordance with DAMP/Local Implementation Plans (LIPs). These Model Programs are intended to enable the Permittees to:

- Improve existing municipal pollution prevention and removal BMPs to further reduce the amount of pollutants entering the storm drain system (**Model Municipal Activities and Model IPM Program**);
- Educate the public about the issues of urban stormwater and non-stormwater pollution and obtain their support in implementing pollution prevention BMPs (**Model Education and Outreach Program)**;
- Ensure that all new development and significant redevelopment incorporates appropriate Site Design, Source Control and Treatment Control BMPs to address specific water quality issues (**Model Land Development Program)**;
- Ensure that construction sites implement an effective combination of erosion and sediment controls and on-site hazardous materials and waste management (**Model Construction Program)**;
- Ensure that existing development addresses discharges from industrial facilities, selected commercial businesses, residential development and common interest areas/homeowner associations (**Model Existing Development**), and
- Detect and eliminate illegal discharges/illicit connections to the municipal storm drain system (**Model ID/IC Program)**.

3.2 Municipal Infrastructure and Integrated Pest Management

The Story: Municipal

- The Model Municipal Activities Program ensures that BMPs are implemented and maintained at over 1,700 municipal facilities.

- Municipal services, including trash and debris removal, solid waste collection, household hazardous waste disposal and street sweeping were established prior to the First Term MS4 Permits but are monitored and contribute to water quality protection.

- The Model Integrated Pest Management Program ensures municipal conformance with an Integrated Pest Management Policy developed in partnership with University of California Cooperative Extension. Implementation of the policy is resulting in reductions in municipal fertilizer and pesticide use.

3.2.1 Overview

The Permittees own and operate facilities and build and maintain much of the transportation, drainage and recreational infrastructure of the urban environment. To ensure that BMPs are incorporated into municipal areas and infrastructure maintenance programs, the Permittees have followed a systematic process of BMP evaluation of municipal areas, activities and drainage facilities since the First Term Permits. The Permittees also implement Integrated Pest Management (IPM) approaches at municipal sites to address sources of toxicity from municipal activities.

3.2.2 Municipal Activities Program Implementation and Assessment

The Model Municipal Activities Program has been implemented since 2002-03. It requires the Permittees to:

- Inventory municipal sites
- Prioritize municipal areas and maintenance activities based upon water quality threat
- Prepare BMP guidance
- Conduct inspections of municipal areas/facilities
- Implement Model Maintenance Procedures
- Conduct training
- Implement an IPM Policy
- Examine retrofit opportunities for municipal facilities

Site Inventories

Annually, the Permittees inspect over 1,700 municipal facilities comprising 27% high priority sites, 11% medium priority sites and 62% low priority sites.

BMP Guidance

The Permittees have produced BMP factsheets for the Model Municipal Program that are available at www.ocwatersheds.com. In addition to training, these BMP factsheets serve as the primary guidance for Permittee municipal maintenance procedures. The Permittees will complete a review of the municipal BMP factsheets in late 2014 or early 2015.

Training

Municipal training materials for "Municipal 101" were available for Permittee use as a "train the trainer" tool covering the minimum required BMPs discussed in the fact sheets. The focus of municipal training during the permit term was on development and implementation of jurisdictional IPM programs **(Table 3.2.1)**.

In the Fifth Term MS4 Permit, the Permittees will examine opportunities to enhance training formats with "flip the classroom" approaches that emphasize in-classroom discussion and hands-on application of concepts.

Table 3.2.1: Municipal Training

Date	Subject Matter/Title	Target Audience	Permittee Staff in Attendance
September 15, 2010	Integrated Pest Management (IPM) Training	Stormwater Program Managers	23
May 17, 2012	Implementing Integrated Pest Management Policy Within Local Jurisdictions: The Impacts of Pesticide Formulations and Exotic Pests	Municipal Training Instructors and Field Staff	52
May 15, 2013	Implementing Integrated Pest Management Policy Within Local Jurisdiction: The Who, What, Where and Why	Stormwater Program Managers and Field Staff	32

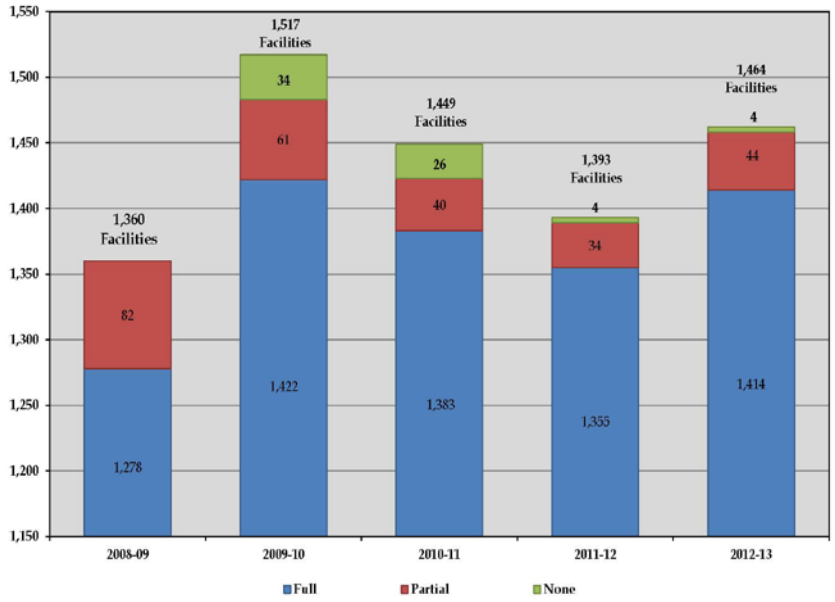
Inspection and BMP Implementation

Municipal Facilities

Inspectors implement the Model Municipal Program by ensuring implementation of the Model Maintenance Procedures. For each facility, inspectors categorize the degree of BMP implementation on site as "fully implemented," "partially implemented" or "not implemented."

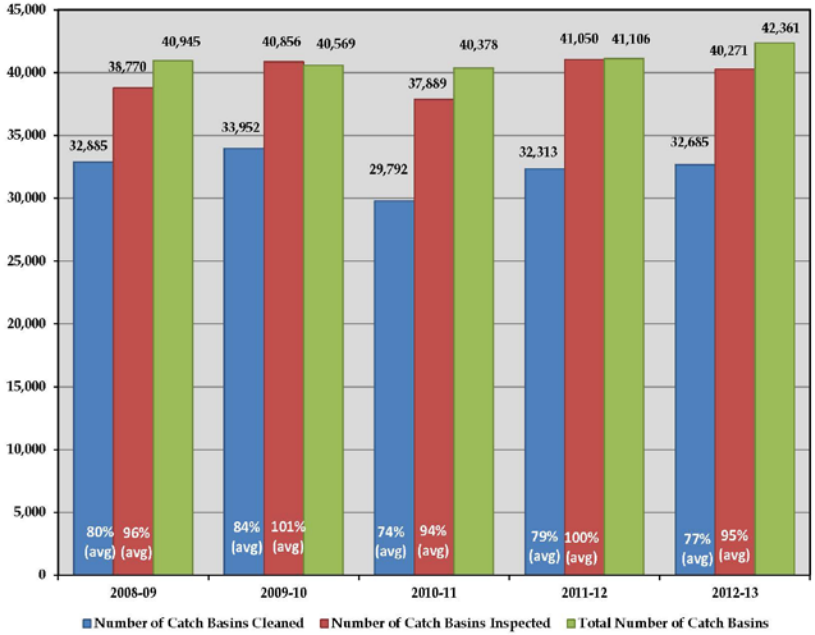
Since 2008, more than 90% of facilities have consistently implemented all required BMPs. In addition, the number of facilities with no BMP implementation has decreased since 2009 from 2.4% to 0.28% of facilities **(Figure 3.2.1)**.

Figure 3.2.1: Municipal Area Inspections and BMP Implementation from 2008-09 to 2012-13



Between 2008 and 2013, a majority of Permittees reported inspecting an average of more than 90% of catch basins on an annual basis and 100% of catch basins on a bi-annual basis **(Figure 3.2.2)**. The percentage of drainage facilities requiring cleaning as a result of inspections has remained approximately 80% **(Figure 3.2.2)**.

Figure 3.2.2: Catch Basin Inspections Performed from 2008-09 to 2012-13



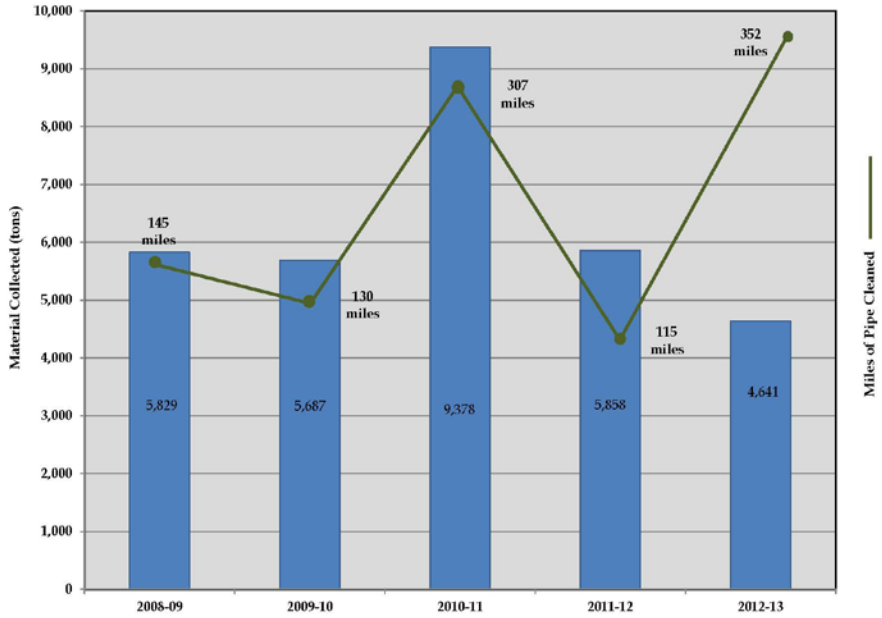
Municipal Services (Baseline BMPs)

Permittees collect data on a number of municipal activities that pre-date the adoption of MS4 permits for Orange County, but nonetheless contribute significantly to water quality protection. These "baseline BMPs" include storm drain cleaning, street sweeping, solid waste and household hazardous waste collection, used oil grant participation and trash and debris control.

Storm Drain Maintenance

The Permittees inspected and cleaned an average of 210 miles of storm drain and removed an average of 6,279 tons of material on an annual basis **(Figure 3.2.3)**.

Figure 3.2.3: Drainage Facility Maintenance and Material Removed from 2008-09 to 2012-13

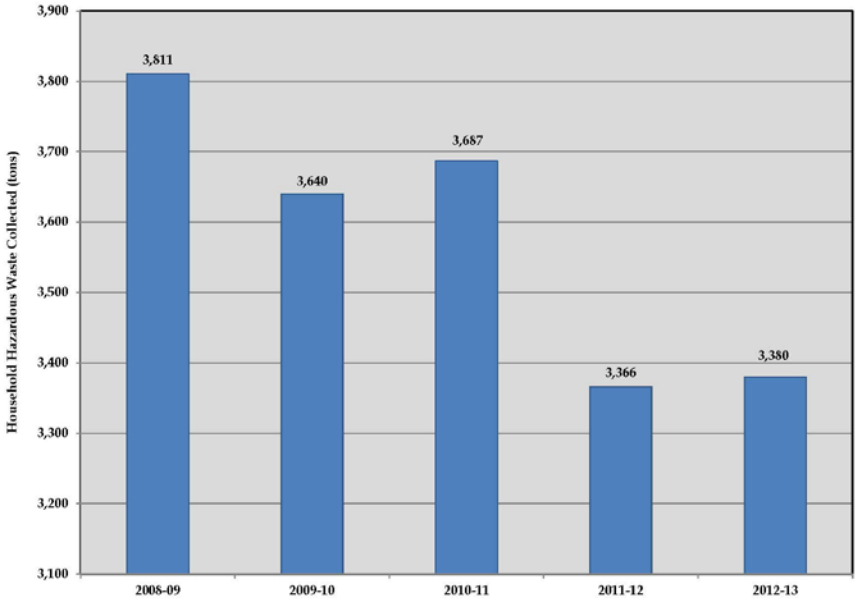


Household Hazardous Waste (HHW) Collection

OC Public Works finalized a memorandum of understanding

with OC Waste and Recycling on June 23, 2010 to ensure that household hazardous waste collection, transfer and disposal practices do not cause or contribute to water quality problems. The County, on behalf of the Permittees has collected an annual average of almost 3,600 tons of household hazardous waste since 2008 **(Figure 3.2.4).**

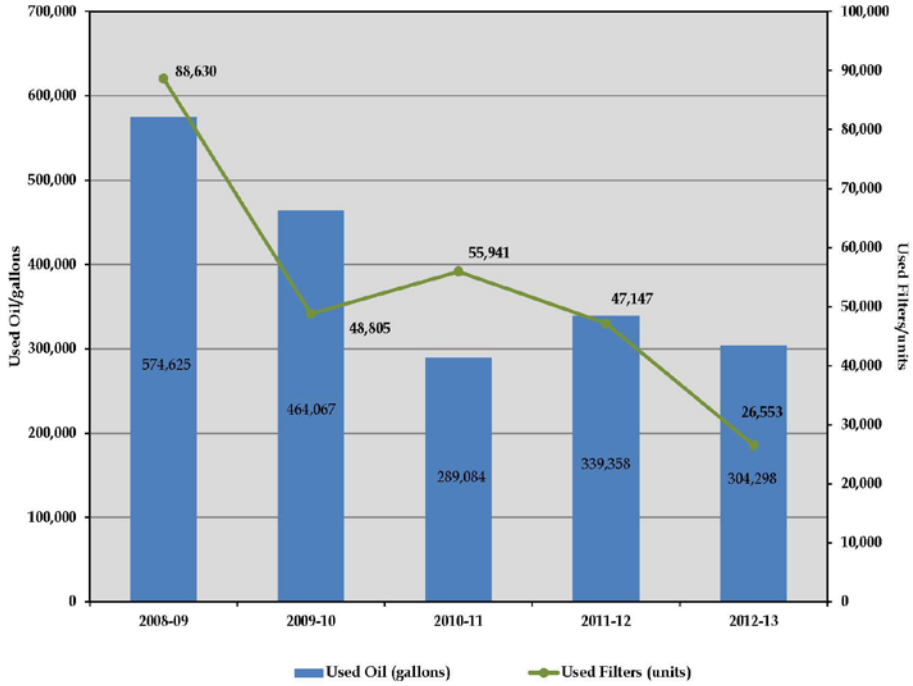
Figure 3.2.4: Tons of Household Hazardous Waste Collected from 2008-09 to 2012-13



Used Oil Grant Participation

Nearly all of the Permittees and the County's Health Care Agency participated in the Used Oil Grant program during the past five years. Through these programs, hundreds of thousands of gallons of used oil and tens of thousands of used oil filters have been collected and disposed of properly, preventing these contaminants from entering the environment **(Figure 3.2.5)**.

Figure 3.2.5: Used Oil and Filters Collected from 2008-09 to 2012-13



Trash & Debris Control

Trash can degrade surface water quality and negatively impact aquatic habitat. The Permittees utilize a combination of trash and debris controls to address this issue. Controls include structural BMPs such as debris booms, catch basin inserts and continuous deflection separation (CDS) units and source control BMPs such as public education and street sweeping. The Orange County Stormwater Program GIS Cloud layer includes locations of all trash and debris booms

(http://oc.giscloud.com/map/242085/orange-county-stormwater-program-san-diego-region).

The Permittees also engage the public in cleanup events throughout the year when requested and annually every September for Inner-Coastal & Watershed and Coastal Cleanup Day, resulting in the removal of thousands of pounds of trash and debris. The County also initiated a pilot Adopt A Channel program in 2012 whereby Disneyland Resort adopted a 2-mile segment of Anaheim Barber City Channel and a debris boom. Though the pilot adoption was within the Santa Ana Region, the County is in the process of expanding the program county-wide to promote community involvement in keeping trash out of local waterways and to supplement jurisdictional resources.

Additionally, ongoing efforts to characterize the flux of trash and debris through the County's urban watersheds may ultimately produce recommendations for enabling management and maintenance approaches to be more effectively prioritized. These efforts include the Newport Bay Trash Management Plan and South Orange County Trash and Litter Special Study described in Section 3.2.4 of the 2012-13 Unified Annual Report. Also, the Permittees collaborated on the Stormwater Monitoring Coalition's (SMC) Regional Bioassessment Study to incorporate trash and debris data from multiple sampling sites throughout southern California in 2012 and 2013. As a result of ongoing watershed and regional trash monitoring efforts, the Permittees would like to see the opportunity retained for jurisdictions to leverage the information arising from these studies to prioritize control efforts consistent with the MEP standard established by the statute.

Model Integrated Pest Management Program

Since pesticide-related water column toxicity is a priority issue of countywide concern, Integrated Pest Management (IPM) will continue to be a focus of the Program. A key component of an effective Integrated Pest Management (IPM) Program is an emphasis on maintaining plant health through proper fertilizer and pest management. Reducing unnecessary fertilizer and pesticide applications reduces the opportunity for these chemicals to inadvertently enter local waters through irrigation and rain events.

The Permittees formally adopted individual IPM Policies during the 2010-2011 reporting period based on an IPM Policy template developed with assistance from University of California Cooperative Extension (UCCE). The result has been the adoption of a set of basic IPM guidelines implemented by each public agency.

Fertilizer

Fertilizer usage is tracked and reported by total nitrogen, phosphorus and potassium applied per acre. Since 2010, the amount of all three nutrients applied per acre has decreased; nitrogen per acre decreased 49%, phosphorus per acre decreased 60% and potassium decreased by 55% **(Figure 3.2.6)**.

Figure 3.2.6: Fertilizer Applied per Acre 2008-09 to 2012-13

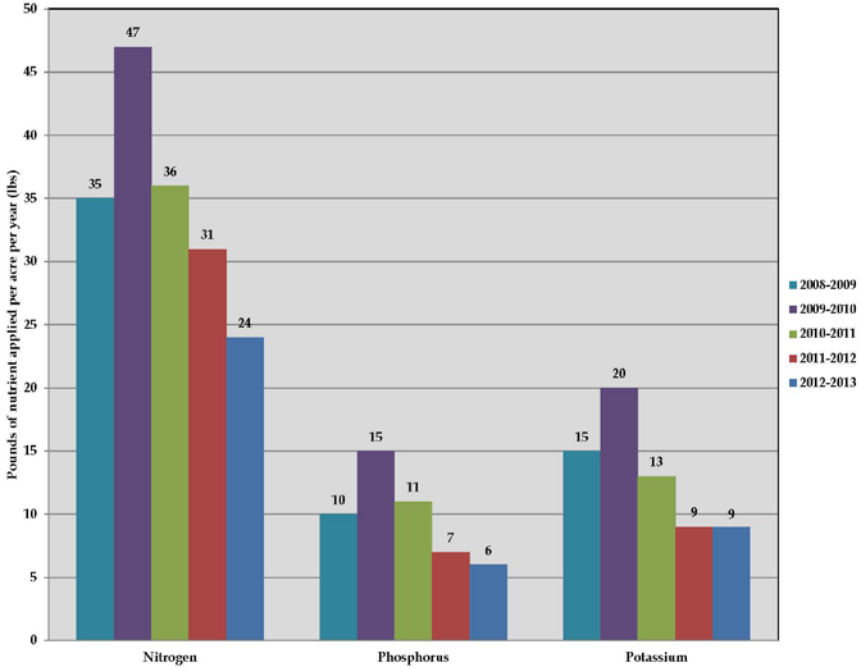
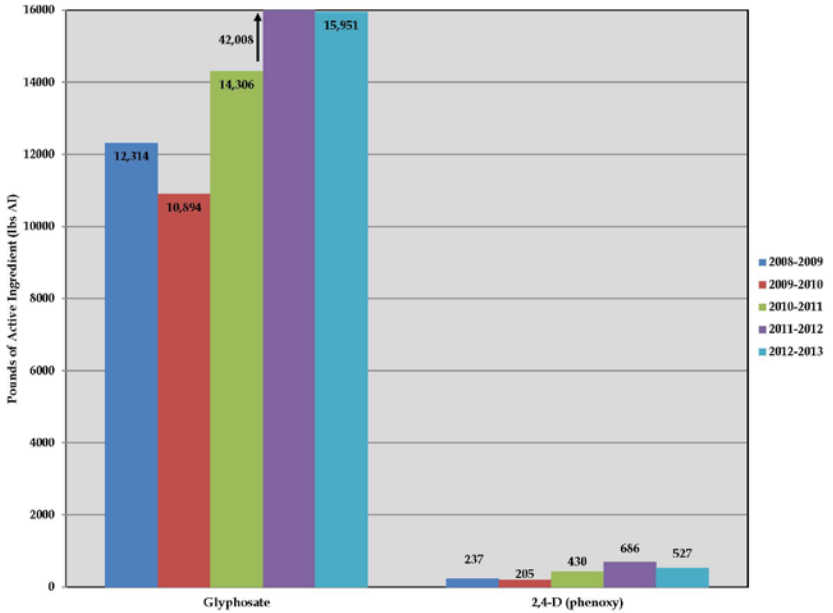


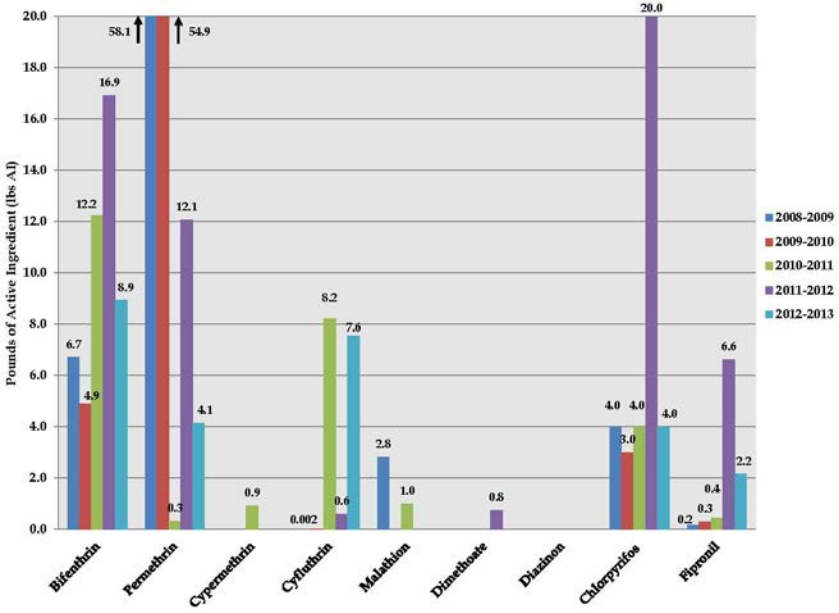
Figure 3.2.7: Active Ingredient Herbicide Applied 2008-09 to 2012-13



Pesticides

Permittees have utilized fewer pounds of insecticides on an annual basis since 2010, especially those recognized by research as having the greatest potential for causing aquatic toxicity. For the 2012-13 reporting year, Permittees reduced application of the herbicide glyphosate by 62% **(Figure 3.2.7)**. Additionally, Permittees reduced overall application of pyrethroid, organophosphate and phenylpyrazole pesticides by 47% collectively between 2012 and 2013 **(Figure 3.2.8)**.

Figure 3.2.8: Active Ingredient Pesticide Applied 2008-09 to 2012-13



3.2.3 Municipal Retrofit Opportunities & the Practical Vision for Sustainable Water Supply

Municipal Retrofitting

Municipal stormwater retrofits and specifically regional stormwater retrofits are potentially an important tool in the municipal stormwater tool box. Municipal stormwater retrofits provide an opportunity to implement BMPs to provide treatment for existing urban areas, assist with achieving TMDL compliance, serve as offset mitigation for land development and contribute toward integrated water resource management.

Through the Orange County BMP Retrofit Opportunities Study numerous potential stormwater BMP retrofit sites were identified in various municipal right-of-ways. Water quality models have also been developed for some of the watersheds in Orange County that can help identify the water quality benefits of the proposed BMP sites. The Permittees will continue to identify public land suitable for stormwater retrofitting and projects supportive of the "*Practical Vision – A Vision for Achieving a Sustainable Local Water Supply* (SDRWQCB 2013)."

OCTA Environmental Cleanup Grant Program

The Permittees have also implemented trash and debris controls and regional retrofit projects through the Orange County Transportation Authority (OCTA) Measure M Environmental Cleanup Program. The structure of the Environmental Cleanup Program, its management and coordination with the Permittees was discussed in Section C-3.2.6.1 of the 2012-13 Unified Annual Report**. Section 6.0** of this report summarizes the two-tier grant process which provides funding for BMPs, including catchbasin screens and regional multi-jurisdictional projects.

Green Infrastructure

Green infrastructure is also an important tool in the municipal stormwater tool box. Green infrastructure incorporates LID concepts to help achieve stormwater management goals of improving water quality and reducing volume of stormwater runoff while also meeting infrastructure needs of municipalities in a sustainable manner. Opportunities exist for implementation of green infrastructure either as a part of municipal capital improvement projects (CIP) or as part of Green Street retrofit projects. Evaluation of how green

infrastructure can be incorporated into CIP or as part of green street retrofit projects will be undertaken.

3.2.4 Recommendations

Based upon consideration of the water quality priorities of the Program (bacteria, nutrients and pesticide related toxicity) and the evaluation of program implementation, the recommendations are:

1. **Enhance municipal training** to address common issues encountered through municipal related complaints and to utilize innovative education formats to encourage effective discussion-based learning. The four most common issues that occur are: trash/debris, pathogen/bacteria, hydrocarbons and exempt discharges (County of Orange PNIR data, n=205 municipal related complaints, 2008-2012). Training will focus on in-classroom engagement of concepts learned prior to the training session and focus on reducing issues and pollutants of concern through specific actions (e.g. runoff reduction to reduce bacteria loading).

2. **Develop a municipal green infrastructure program** that could include evaluation of opportunities for pilot green street projects of different land use/density configurations and development of a green street guidance manual.

3. **Examine public land retrofit opportunities** for regional BMPs and propose a program to evaluate previously identified regional retrofit opportunities in jurisdictionally owned areas for use in TMDL compliance and LID and/or hydromodification management alternative compliance. This effort will involve the development of watershed models and evaluation of the previously identified potential BMP retrofit sites. Previous reviews (e.g. 2005 RBF retrofit study) will be integrated with current mapping.

4. **Develop and initiate the implementation of individualized IPM Guidelines for each Permittee** with the goal of demonstrating significant and consistent reductions in fertilizer and pesticide applications based on the mission and goals outlined in jurisdictional IPM Policies.

5. **Conduct pilot soil and/or leaf tissue analysis to guide fertilizer use** to ensure nitrogen is not applied at annual rates above those recommended by UCCE research. The Permittees would identify the most fertilizer-intensive area by type (e.g. sports fields) and select one site for analysis. The analysis would assist Permittees in fine-tuning nitrogen application based on the needs of plants at the highest use areas.

6. **Improve methods for documenting usage of fertilizer and active ingredient of pesticide on an annual basis** to allow for more reliable data on the acreage receiving fertilizer applications. In collaboration with the UCCE, a standardized reporting method would be developed, improving reporting accuracy on both the amount of nitrogen and pesticides applied by Permittees on an annual basis. The objective would be to minimize fertilizer applications where annual rates exceed those recommended by UC research (174 -261 lbs. N/acre) while more accurately capturing the acreage to which fertilizer is applied.

7. **Expand training to include peer-reviewed online training**

courses offered by University of California IPM (UC IPM) and UCCE to ensure the IPM and water quality message reaches as many field staff as possible. Possible options include the UC IPM Urban Pesticide Runoff and Mitigation online training series developed by UC academics across the state to provide a more suitable method to reach field staff unable to attend in-person training. The online training consists of a series of courses directly addressing the impacts of pesticides on water quality as well as practices to mitigate these impacts (http://www.ipm.ucdavis.edu/training/upr-mitigation.html).

3.2.5 References

San Diego Regional Water Quality Control Board (SDRWQCB). *San Diego Regional Water Board Practical Vision: Healthy Waters, Healthy People.* 2000. http://www.swrcb.ca.gov/sandiego/water_issues/Practical_Vision/docs/PV.pdf

Implementation Schedule – Municipal Infrastructure & IPM

Proposed Municipal Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Municipal Facility Inventory						
Update and maintain GIS based storm drain conveyance inventory	C					
Inspection and Best Management Practice (BMP) Implementation at Municipal Facilities						
Inspect fixed facilities according to established prioritization	C					
Inspect municipal operations/activities annually	C					
Install, inspect and maintain basin inlet markings as necessary	C					
Implement and Track Baseline BMPs – Operations and Activities						
Conduct and track street sweeping activities	C					
Promote, facilitate, and track proper disposal of solid waste	C					
Promote, facilitate, and track HHW collection activities	C					
Promote, facilitate, and track proper collection and disposal of used oil	C					
Maintain debris booms as necessary	C					
Promote, facilitate, and track clean up events	C					
Municipal Training						
Conduct training for staff	C					

Proposed Municipal Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Develop and update BMP Fact Sheet and other training materials as necessary	C					
Develop an Integrated Pest Management Policy						
Develop and initiate the implementation of individualized IPM Guidelines for each Permittee	N			X		
Conduct pilot soil and/or leaf tissue analysis to guide fertilizer use	N			X		
Improve methods for documenting usage of fertilizer and active ingredient of pesticide on an annual basis	E	X				
Expand training to include peer-reviewed online training courses offered by UC IPM and UCCE	E		X			
Municipal Green Infrastructure Program						
Evaluation of opportunities for the development of pilot green street projects for different land use/density configurations	N	X				
Development of a green street WQMP template	N		X			
Development of green streets standard design specifications	N			X		
Implementation of one green street pilot project in the 5th term permit term.	N					X
Examine Retrofit Opportunities BMPs at Municipal Facilities						
Develop water quality models	N			X		
Integration of the previously identified potential BMP retrofit sites into the models and evaluation of use for TMDL compliance and/or LID and/or hydromodification management offset	E					X

1. C = Continue; E = Enhance; N = New

2. X = Performance Standard will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation.

3.3 Public Outreach

The Story: Public Outreach

- Public awareness surveys conducted approximately every three years demonstrate increased levels of awareness regarding stormwater concerns and several positive behavior changes regarding car washing, use of landscape management products, and pet waste.

- The Program achieved over 155 million impressions through various forms of paid media, and over 5.5 million impressions at outreach events from 2008 to 2013.

- Outreach to school-age children provided water pollution prevention education to over 125,000 students and the Permittees helped support several targeted academic programs throughout the Fourth MS4 Permit term.

- The Permittees initiated a strategic behavior-specific outreach program in 2012.

- The Program enhanced partnerships with the Municipal Water District of Orange County, Chapman University and the University of California Cooperative Extension (UCCE) during the Fourth MS4 Permit term.

- Reductions in outdoor water use, retrofitting the residential environment to reduce outdoor water demand and elimination of runoff from irrigation are the foci of action-based outreach efforts initiated in 2013.

3.3.1 Overview

Ongoing education of the public about environmentally protective behaviors is essential foundational to improving water quality. The goal of the Education Program is to build engagement with residents, encourage and document the adoption of BMPs and increase the overall knowledge of Orange County residents and businesses regarding water quality protection. The Education Program was strategically re-branded from "Project Pollution Prevention" to "H_2OC" in 2012 to stress the importance to Orange County residents of water resource stewardship.

3.3.2 Public Outreach Program Accomplishments and Assessment

For the past decade, H_2OC (previously Project Pollution Prevention) has used public awareness surveys to assess awareness of and behavior change regarding stormwater issues. Survey results indicate small but significant increases in awareness around causes and prevention of stormwater pollution and increased levels of participation in BMPs. Most notably, survey results indicate several positive behavior changes among Orange County residents since 2003 including:

- Willingness to use a commercial car wash facility in lieu of home car washing (five percent increase);
- Proper use of lawn and garden fertilizers and pesticides (five percent increase); and
- Picking up waste and droppings from their pet (nine percent increase).

The Permittees will continue to conduct public awareness surveys to measure and assess awareness of Orange County

residents on water quality issues. These surveys will seek to measure water quality knowledge, current participation in stormwater safe behaviors, and willingness to participate in the same. Additional tracking of specific behavior campaigns, as discussed below, will be measured with pre-initiation and post-completion surveys to better evaluate effectiveness. Finally, the Permittees will continue to measure impressions garnered from the mass media campaigns. Collectively, these measures will help evaluate the success of the various public outreach efforts.

Media Outreach and Impressions

The Permittees have consistently improved the reach of paid advertising since the program began in 2003 and exceeded goals for achievement of impressions through media. The Permittees achieved the following from 2008 through 2013:

- 155 million total paid media impressions including traditional print (e.g. newspaper) ads, bus shelter and bus side posters, billboards, internet banner ads, radio, movie theater and television public service announcements, and gas pump banners; and
- More than 5.5 million grassroots impressions including outreach events like environmental fairs, beach and channel clean-up days, newsletters and workshops.

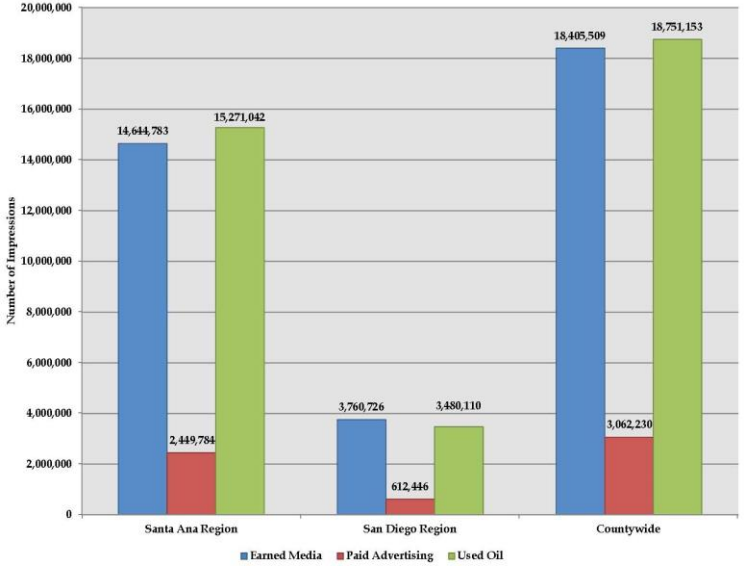
During the 2012-13 reporting year, the Permittees garnered a total of 40,218,892 impressions through various forms of media (**Figure 3.3.1**).

Earned Media

Earned media includes any unpaid publicity through sources like television (e.g. news reports), newspaper articles, social media (e.g. Facebook, Twitter, or blogs), or other media platform (e.g. podcasts, YouTube, etc). The inclusion of earned media into the total impression count provides a more accurate assessment of the true number of impressions earned, and helps increase public trust in the program overall. The Permittees garnered a total of 18,405,509 impressions from earned media during the 2012-13 reporting year **(Figure 3.3.1)**.

The Permittees will examine methods for increasing program presence on social media in the Fifth Term Permit to encourage residential adoption of specific BMPs associated with *action campaigns*. Development and implementation of these campaigns is described in **Section 3.3.4**.

Figure 3.3.1: Media Impressions by Region 2012-13



3.3.3 Youth Outreach

Children are crucial to the dissemination of water quality information as key messengers and influencers of parents' behavior. The 2012 Public Awareness Survey indicated that forty-six percent (46%) of adults with school-aged children at home received information about water pollution prevention, an increase of 20% over the 2009 Survey. Additionally, parents of students who brought home information were three times more likely to engage in 7 out of 7 identified "stormwater safe" behaviors (22% to 7%).

The Permittees have maintained and enhanced a robust school outreach program since 2008, including:

- Direct outreach to more than 125,000 students through provision of workbooks, support and assistance designing watershed education programs and funding of programming focused on addressing water quality issues;
- Achieved more than 400,000 total impressions through programs to educate teachers (i.e. Project WET) and the general public at the Discovery Science Center; and
- Development and support of targeted academic programs through partnerships with educational institutions in the community to ensure a consistent message and increase breadth of outreach (e.g. Municipal Water District of Orange County, Chapman University).

3.3.4. Behavior Specific Campaigns

There are a variety of actions an Orange County resident can take to help protect water quality, ranging from picking up after their dog to reporting illegal dumping. However, studies have shown that people can become easily overwhelmed when presented with multiple options, leading to inaction.

Through behavior-specific campaigns the Permittees will target narrow behaviors most likely to have a positive impact on water quality. Target behaviors will be selected by assessing public awareness survey data, water quality monitoring results and the needs of the Permittees.

Behavior-specific campaigns began in 2012; assessment of these efforts will serve as a robust foundation from which future campaigns are determined. Specific achievements include:

- Development of a comprehensive strategic plan in 2012 (2012 Strategic Plan) including extensive analysis of Orange County residents, ongoing biennial surveys, and independent research; and
- Prioritization of target behaviors based on public awareness surveys and water quality monitoring data.

The Permittees intend to employ best practices to implement behavior-specific campaigns using the Community Based Social Marketing (CBSM) model. CBSM steps include:

- Identifying barriers and motivators to an activity;
- Developing a strategy that utilizes tools to leverage those barriers and motivators in order to affect behavior change;
- Pilot the strategy; and
- Evaluate the strategy and refine it for broader implementation.

The Permittees will use these principles in tandem with mass media outreach efforts to continue fostering general public awareness of stormwater issues.

Targeted Outreach Campaigns

The 2012 Strategic Plan concluded that existing outreach efforts should be supplemented by targeted outreach to small, community-based groups in *action campaigns*. Evaluation of each *action campaign* includes setting baseline measures and conducting follow-up assessments using the CBSM model to create long term engagement and to track success.

Each *action campaign* focus is determined by assessing the following variables:

- *Identification of key pollutants* – the Permittees will examine and prioritize key pollutants based on level of harm they pose to the environment and prevalence in water quality data. Once identified, constituents of concern will be further prioritized by likelihood of education impacting the presence of these pollutants;
- *Determine return on investment (ROI)* – the Permittees will assess which behaviors would produce the largest ROI, predicted by assessing the number of people performing that action (i.e. prevalence) and the likelihood that those people would change that action. This step balances ease of performing a behavior and the potential environmental impact; and
- *Consideration of external opportunities and needs* – the final step considers opportunities to leverage campaign messages and tactics with existing programs and/or messaging elsewhere in the Orange County Stormwater Program or by other agencies or groups.

3.3.5 Runoff Reduction and Water Use Efficiency

Runoff reduction stresses onsite retention of runoff by utilizing BMPs to intercept, capture, and infiltrate rainwater to reduce runoff and pollutant loading. The Permittees will continue to build upon partnerships with water purveyors to marry water use efficiency and runoff reduction messaging, increasing message consistency and breadth. Since 2008, the Permittees have nurtured relationships with other agencies and community groups to accomplish the following:

- Collaborated with water utility providers on water use efficiency messaging by participating in stakeholder meetings and providing presentations on key stormwater pollution issues (e.g. Municipal Water District of Orange County).
- Utilized partnerships with the University of California Cooperative Extension (UCCE) to outreach to plant nursery owners and operators and other landscape representatives.

The Permittees will continue to foster these relationships to promote reductions in runoff and overall water use. Investment in coordination of programs and specific action campaigns will continue with campaigns such as the "Overwatering is Out" initiative launched in 2013.

3.3.6 Website Content and Usability

Public awareness surveys indicate that the number of residents seeking information about watersheds and water pollution prevention from the internet continues to increase. In order to ensure water quality data, watershed information and public education materials are available to the public in an easily accessible online format is important to the success of the program.

Building off of the San Diego Regional Water Quality Control Board *Practical Vision for Proactive Public Outreach and Communication* (SDRWQCB 2013), the Principal Permittee will review the ocwatersheds.com website to assess usability and with the goal of increasing access to mapping tools, water quality data and BMPs to prevent water pollution and urban runoff.

3.3.7 Recommendations

The Permittees intend to focus on the following:

1. **Emphasize outreach to school-age children** to continue building upon existing partnerships and increasing knowledge of the Orange County community as a whole through increasing knowledge of youth.

2. **Incorporate current strategic approach of using public awareness survey results to prioritize outreach efforts** based on behaviors of concern in tandem with water quality results to document small-scale behavior change over time.

3. **Coordinate with water supply agencies** to incorporate water use efficiency and runoff reduction messaging to maximize program reach and ensure requested behavior changes align with water use efficiency techniques supported by other agencies. Coordinate to encourage behaviors and develop programs supportive of building a sustainable local water supply as identified in the Practical Vision; including building social norms around water use efficiency and elimination of irrigation runoff.

4. **Develop focused outreach campaigns based on water quality and survey results** utilizing CBSM techniques to document changes in targeted behaviors. The Permittees will develop focused campaigns supportive of a singular message with the goal of reducing competing messaging that may lead to inaction. CBSM tactics will be utilized to target behaviors associated with water quality priorities identified by the Permittees.

5. **Encourage greater public participation in stormwater pollution prevention and elimination of non-stormwater discharges** through the use of CBSM and increased availability to online resources. *Action campaigns* would encourage residents to take an identified action and to share efforts with others.

6. **Social media calendars will synchronize outreach efforts and encourage direct participation in and sharing of program messaging.** Social media forms of earned media will complement *action campaign* elements by encouraging direct residential participation in programs. Activity on social media significantly increases with boosted posts and paid advertising; these unpaid and paid tools will support CBSM programs.

7. **Review website for usability and revise structure as needed to meet goals of increasing public use of web content.** The goal of the review will be to increase access to mapping tools, water quality data and BMPs to prevent water pollution

3.3.8 References

San Diego Regional Water Quality Control Board (SDRWQCB). *San Diego Regional Water Board Practical Vision: Healthy Waters, Healthy People*. 2000. http://www.swrcb.ca.gov/sandiego/water_issues/Practical_Vision/docs/PV.pdf

Implementation Schedule – Public Outreach

Proposed Public Outreach Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Foundational Program Elements						
Conduct public awareness surveys	C		X			X
Earned and Paid Media						
Develop and place paid media	C					
Develop social media channels	N	X				
Promote programs through social media channels	N					
Outreach to School Age Children						
Support outreach programs for school age children	C					
Website Content and Usability						
Review ocwatersheds.com website for usability	E	X	X			
Explore options for making water quality data more accessible and webpages are user-friendly	E	X	X			
Behavior Specific Campaigns						
Conduct Overwatering Is Out campaign	N					
Assess progress of Overwatering Is Out campaign	N	X	X			
Assess public awareness survey and water quality results	N		X			
Prioritize behaviors for Outreach	N		X			
Develop action campaign #2	N			X		

1. C = Continue; E = Enhance; N = New

2. X = Recommendations will be completed during this fiscal year.

Gray shaded cells indicate ongoing implementation.

3.4 New Development/Significant Redevelopment

The Story: New Development/Significant Redevelopment

- The Permittees developed a significantly revised Model Water Quality Management Plan (WQMP) and Technical Guidance Document (TGD) to implement new requirements for the implementation of Low Impact Development (LID) BMPs.

- The Permittees implemented the new Model WQMP and TGD for all priority projects in north Orange County starting on August 17, 2011, and in south Orange County starting on December 20, 2013.

- The Permittees are implementing region-specific approaches to hydromodification management.

- During the permit term (through the 2012-13 reporting period) 1,369 WQMPs for public and private projects were approved across all of Orange County for a total of 18,749 acres of development now that are now subject to Project WQMPs.

- South Orange County was mapped and a geodatabase was developed that includes conveyance systems, infiltration constraints, land use, and soil types. The County is using the geodatabase to evaluate channel susceptibility to hydromodification, and opportunities and constraints for infiltration and treatment BMP implementation at various scales.

3.4.1 Overview

Development creates rooftops, driveways, roads and parking lots which increase the timing and volume of rainfall runoff (compared to pre-development conditions) and provide a source of pollutants that are flushed or leached by rainfall runoff or dry weather runoff into surface water systems. Since the inception of the Program, it has been recognized that the incorporation of BMPs into a development project in its planning stages offers the most effective opportunity to limit increases in pollutant loads and preserve natural hydrologic processes. Consequently, the Program links new development and significant redevelopment BMP design, construction and site operation to the earliest phases of new development project planning, encompassed by the jurisdictional General Plans, environmental review and development permit approval processes.

The New Development/Significant Redevelopment Program has evolved over successive MS4 Permit terms from a narrow focus on discharge water quality to a broader consideration of the hydrologic impacts of land use change. Routine structural and non-structural BMPs implemented during the first two permit terms aimed to minimize the introduction of pollutants into the drainage system. In the third MS4 Permit term, the Permittees continued to implement routine structural and non-structural BMPs, but they also worked with project proponents to improve site design. The current Fourth Term Permits emphasize use of site design BMPs and bring the concepts of LID and hydromodification control to the forefront.

The Model WQMP describes the process that Permittees employ for developing a Project WQMP for individual new development and significant redevelopment projects, which, minimizes the effects of urbanization on site hydrology, runoff flow rates or velocities and pollutant loads. Following approval of the final project WQMP and construction of the

project, the Project WQMP will also serve to maintain the terms, conditions and requirements with the project proponent and their successors over the entire life of the project. The effects of urbanization will be minimized through implementation of practicable and enforceable project-based controls or stormwater BMPs, or through a combination of project-based and regional BMPs.

3.4.2 New Development/Significant Redevelopment Program Implementation and Assessment

Model Water Quality Management Plan (WQMP)

A new Model WQMP and TGD were developed during an eighteen month stakeholder process. Implementation of the new Model WQMP and TGD commenced on August 17, 2011, in north Orange County and on December 20, 2013, in south Orange County. This Model WQMP identifies appropriate LID practices and BMPs and alternative compliance programs for new development and significant redevelopment projects. LID BMPs must be selected based on a hierarchy of control types and sized to capture the maximum feasible portion of the design capture volume using the highest priority control type (e.g., retention). The next lower priority control type (biotreatment) can only be used for any portion of the design capture volume that cannot be feasibly captured by retention BMPs.

In accordance with the Model WQMP, new development and significant redevelopment projects meeting threshold criteria, are required to develop and implement a Project WQMP that includes LID and hydromodification control BMPs, where necessary, at the earliest conceptual planning stages of a project for early review. Depending upon the project size and characteristics, these may include:

- BMP site design measures;
- Implementing LID BMPs on-site;
- Constructing or participating in sub-regional/regional LID systems;
- Implementing hydromodification control BMPs; and
- Using alternative programs or treatment control BMPs.

In addition, the Model WQMP includes more rigorous requirements regarding assessing and abating hydromodification impacts. The effects of hydromodification can be mitigated with the use of LID strategies, site design and hydrologic source controls.

In south Orange County an interim hydromodification performance standard was applied to development and redevelopment projects starting in December 2010. This performance standard has been superseded by the requirements of the Hydromodification Management Plan (HMP).

Project WQMPs are required for private new development and significant redevelopment projects within Permittees' jurisdictions, and equivalent public agency capital projects undertaken by the Permittees that are either:

- "Priority Projects" meeting one of the criteria identified in the Permit, regardless of project size.

- "Non-Priority Projects" that do not qualify as one of the Priority Project Categories but meet one of the following:

    - Require discretionary action that will include a precise plan of development, except for those

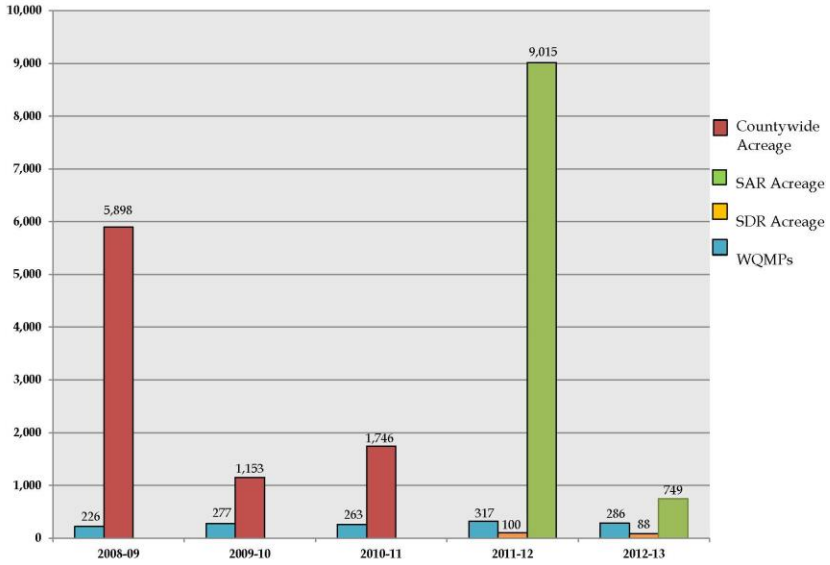
projects exempted by the Water Quality Ordinance (as applicable), or

- Require issuance of a non-residential plumbing permit.

BMP Implementation

Since 2002, a total of 4,152 Project WQMPs have been approved, covering 40,461 acres which represents 9.3% of the area within Orange County subject to subject to the regulatory provisions of the Third and Fourth Term MS4 Permits (681.4 square miles). During the current Fourth Term MS4 permit term 1,369 WQMPs for public and private projects were approved for a total of 18,749 acres of development **(Figure 3.4.2)**.

Figure 3.4.2: Historical WQMPs and Acreage Covered



The Project WQMP for a Priority Project must include:

- Routine structural and non-structural Source Control BMPs;
- Site Design BMPs (as appropriate);
- Runoff retention BMPs, also referred to as LID BMPs – requirements may be met through either project specific (on-site) controls or, in cases of on-site infeasibility, regional or watershed management controls that provide equivalent or better treatment performance, subject to certain conditions described in the Model WQMP; and
- The mechanism(s) by which long-term operation and maintenance of all structural BMPs will be provided.

The Project WQMP for a Non-Priority Project must include:

- Routine structural and non-structural Source Control BMPs;
- Site Design BMPs (as appropriate); and
- The mechanism(s) by which long-term operation and maintenance of all structural BMPs will be provided.

Following approval of the Model WQMP in 2011, 9,764 acres of development in north Orange County have incorporated LID BMPs. Progress with implementation of the LID-based Model WQMP in south Orange County will be discussed in the FY2013-14 Annual Report.

Since each site with an approved Project WQMP may incorporate multiple BMPs, there is now in Orange County a growing inventory across the urban landscape of many thousands of BMPs. The emergence of Geographical Information System (GIS)-based software allows (1) strategically managing an inspection program to ensure the continued effectiveness of these BMPs and (2) evaluation of

the impact of constructing features in the urban landscape intended to be protective of water quality.

Training

To provide land developers, project proponents, and associated consultants and organizations with an overview of the new land development requirements, training for NPDES Program Managers, planners, plan checkers and the development community was provided in July and September 2011 for north Orange County and was repeated for south Orange County in October, 2013. The training provided an overview of the level of detail that must be included at each phase of the WQMP preparation process, site and watershed assessment methods, LID BMP selection and prioritization methods, LID BMP design standards and performance criteria, regional LID BMP options, watershed-based plans and LID alternative compliance options. All of the training modules have been posted to the OC Watersheds website (http://www.ocwatersheds.com/WQMP_FAQs.aspx) and YouTube.

General Plan Assessment and Development Standards Review

In October 2009, the Principal Permittee hosted a workshop for the Permittees to provide guidance on assessing their General Plans and development standards review to ensure the following LID principles are considered in their review, and considered for inclusion in some fashion as appropriate, in the General Plan and Local Coastal Plan (if applicable):

- Limit disturbance of natural water bodies and drainage systems; conserve natural areas; minimize soil compaction to landscaped areas; protect slopes and channels; and minimize impacts from stormwater and urban runoff on the biological integrity of natural drainage systems and water bodies;

- Minimize changes in hydrology and pollutant loading; ensure that post-development runoff rates and velocities from a site have no significant adverse impact on downstream erosion and stream habitat;

- Maximize the percentage of permeable surfaces to allow more percolation of storm water into the ground; construct streets, sidewalks, or parking lot aisles to the minimum widths necessary, provided that public safety is not compromised;

- Preserve wetlands, riparian corridors, and buffer zones and establish reasonable limits on the clearing of vegetation from the project site;

- Encourage the use of water quality wetlands, biofiltration swales, watershed-scale retrofits, etc., where such measures are likely to be effective and technically and economically feasible;

- Provide for appropriate permanent measures to reduce storm water pollutant loads in storm water from the development site; and

- Establish development guidelines for areas particularly susceptible to erosion and sediment loss.

Enhancements in Methodologies

The County of Orange as Principal Permittee participates in a number of collaborative studies and initiatives on behalf of the Permittees that are aimed at the further development of

assessment techniques and methodologies to support more informed and consistent decision making across Southern California. Examples of current studies and initiatives affecting New Development/Significant Development include:

SMC – Phase 1 Hydromodification Study

The primary objective of this study was to find relationships between stream channel type and resistance that would allow prediction of channel response under changed conditions associated with increased impervious cover. Ultimately this effort will contribute to the establishment of stormwater management criteria to help minimize the impacts to stream channels from the conversion of undeveloped (or less developed) areas to residential, commercial, or other intensive land uses.

SMC – Low Impact Development Study

SMC developed a manual of practice for LID that provides:

- Details on how to use LID Principles and LID BMPs to reduce the impacts of land development or re-development on water resources at the project level;

- Guidance for municipalities, land use planners, land developers, consultants, design professionals who prepare stormwater engineering plans and specifications, and others in private industry and public service;

- A site planning and design reference that will facilitate the implementation of LID for projects in Southern California. It is designed to complement the Stormwater BMP Manual(s) that have been developed and are maintained by CASQA;

- A tool that can be applied at the site level for the development of integrated water and stormwater management regulatory compliance and resource protection programs; and

- The SMC LID Manual is available online at the California LID Portal (californialid.org).

SMC – Barriers to Low Impact Development Study

The purpose of this study was to dig deeper into potential barriers to LID by investigating the complex web of codes, processes and perceptions surrounding LID implementation.

<u>Hydromodification</u>

Hydrograph modification, or "hydromodification," refers to the changes in the magnitude and frequency of stream flows and its associated sediment load that can be the consequence of watershed urbanization due to increasing landscape imperviousness. In urban watersheds, hydromodification can become evident as channel erosion and sedimentation resulting in degradation of in-stream habitat. Another consequence of hydromodification can be channel realignment and modification which can similarly lead to degraded ecology.

Concern for the significance to stream ecology of the hydrologic impacts of urban runoff was the rationale for the inclusion of hydromodification control requirements in the Fourth Term Permits. These requirements also align with the Practical Vision's intention of focusing the State's regulatory

tools, in the San Diego region, on realizing the restorative goals of the Clean Water Act. The planning required of the Permittees for pollution prevention, pollution control and MS4 permit compliance, is thus evolving into a more holistic approach that integrates flood control, erosion control and water quality management.

In Orange County, BMP planning occurs on both a watershed scale and a site scale. However, the watershed in most cases is the appropriate scale for developing plans that consider both multiple stream system influences and effects and the setting of ecological objectives and restorative goals. In the absence of a holistic evaluation of the watershed, the benefit of unilaterally applying hydromodification control requirements to all development projects is not clear because it is harder to understand the relationship of a specific project to the surrounding landscape. It is also difficult to effectively evaluate the cumulative influences and effects that are involved[1].

The adverse environmental impacts that can arise from land development must, however, be understood for the lawful requirement of mitigation. Based on the takings clause of the U.S. and California constitutions and the Mitigation Fee Act, hydromodification control requirements applied to development projects must bear a reasonable relationship to the impacts of the project. Requiring hydrologic controls on projects draining to receiving waters not susceptible to hydromodification is contrary to these legal requirements. Such requirements may also be beyond the scope of a mandate intended to control the discharge of pollutants from a point source. The need for all hydromodification control requirements to be informed by a holistic and rigorous watershed analysis is considered in greater detail in **Attachment 3.4.1.**

Integrated Water Resource Management and Regional BMPs

The use of "Regional BMPs," in the Model WQMP is required to be a subordinate choice to on-site mitigation. This LID hierarchy is increasingly being viewed as obstructive, as California adapts to increasing uncertainty regarding the resilience of its water supply infrastructure by seeking to better retain stormwater in the landscape for local water supply augmentation. Regional BMPs are seen to be a key part of this adaptive effort (See Southern California Water Committee www.socalwater.org/).

Following two prior years of scant rainfall, calendar year 2013 closed as the driest year in recorded history for many areas of California. Early in 2014, on January 17, Gov. Edmund G. Brown Jr. declared a drought state of emergency and directed state officials to take all necessary actions in response. The policy framework for these actions is the California Water Action Plan (CWAP) (State of California, 2014).

One of the CWAP's key action items is a shift toward Integrated Water Resource Management approaches (IRWM). IWRM has long been practiced in other areas of the world and is now being championed by USEPA and California water leaders as the preferred management approach for solving the challenges of increasingly stringent water quality regulations and the water supply demands of a growing population.

The America Water Resources Association defines IWRM as:

> *The coordinated planning, development, protection, and management of water, land, and related resources in a*

[1] Urban Runoff Quality Management, WEF Manual of Practice No.23/ASCE Manual and Report on Engineering Practice No. 87.

manner that fosters sustainable economic activity, improves or sustains environmental quality, ensures public health and safety, and provides for the sustainability of communities and ecosystems.

IWRM is a management approach that requires collaboration among key water resources areas such as drinking water supply, wastewater treatment, flood management, and water quality protection to leverage resources and create multi-benefit projects. In the field of stormwater management, the term "multi-benefit projects" is often synonymous with the term "Regional BMPs." Such BMPs are typically conceived as constructed basins, under the management of a special distract, where basin design is optimized for local groundwater augmentation, flood control and runoff treatment and where the basin is receiving runoff from sub-watershed areas often in excess of 50 acres.

Since the use of "Regional BMPs," in the Model WQMP is required to be a subordinate choice to on-site mitigation, the CWAP's mandate for a policy shift toward IRWM in California has clear implications for future MS4 permitting. Indeed, in his observations on the future contribution of stormwater management to IRWM, the Executive Officer of the Santa Ana RWQCB observed (CASQA, 2013[2]) that while Regional BMP solutions potentially offered an opportunity to realize multiple benefits, consistent with IRWM, the "LID Hierarchy" of the Fourth Term Permits presents an impediment to constructing Regional BMPs.

These observations cause the recurring debate about the merits of centralized versus de-centralized approaches, or on-site versus regional controls, to creating a stormwater management infrastructure to be re-visited. While the Fourth Term Permits have required on-site BMPs to be constructed unless they can be determined to be infeasible, the Santa Ana Third Term Permit encouraged examination of regional approaches. The regional BMP emphasis was supported by technical guidance (see WEF/ASCE, 1998[3]) that contemplated stormwater quality being managed across the landscape in a drainage system retrofitted with basins and under the direct management of a special district. This guidance had concluded that constructing fewer regional controls would ultimately be both less expensive than a large number of on-site controls and more effective in the longer term since control outlets are larger and therefore easier to design, build, operate and maintain. Moreover, they could additionally capture the street runoff that would be missed by on-site controls and be large enough to offer opportunities for compatible uses such as recreation and ecological habitat. With the new imperative to have IWRM inform approaches to stormwater management, the permitting framework clearly needs to allow for on-site and off-site BMP "equivalency" to enable IRWM and water quality and restorative goals to be realized and optimized at the watershed level.

Mitigation for Restoration Projects

Rehabilitating highly modified streams, to improve ecological, recreational or water supply augmentation amenities, may require the use of impervious materials to the extent that Project WQMP criteria are met. Requiring mitigation for restoration projects in such instances may threaten project viability. Moreover, such projects would already be subject to regulation by the United States Army Corps of Engineers (USACOE) under CWA Section 404, by the State and Regional Boards under CWA Section 401, and by the Federal

[2] CASQA Quarterly Meeting, November, 2013

[3] Urban Runoff Quality Management, WEF Manual of Practice No.23/ASCE Manual and Report on Engineering Practice No. 87.

USFW and California DFG. Any environmental impacts of these projects will be mitigated as required by these agencies and therefore should be explicitly exempted from Project WQMP requirements.

Public Safety Projects

In specific instances, channel re-construction may need to be undertaken on an emergency basis when there is an imminent threat to public safety. Such projects may involve like-for-like replacement of hardened channels and there will be no time for the development, processing and plan check, and revisions of a Project WQMP for these projects. Emergency projects are provided exempt status in many other MS4 permits including the Santa Ana Region Permit (Order No. R8-2009-0030) and the Los Angeles County MS4 Permit (Order R4-2012-0175).

3.4.3 Recommendations:

1. **Implement an approach to hydromodification management that is informed by a watershed analysis and channel-specific protection and restoration goals.** The Permittees understand that, consistent with current published research, a "one-size-fits-all" approach for hydromodification management is not appropriate for highly modified urban stream systems. Pending a comprehensive watershed analysis, land development projects discharging runoff to engineered channels, should not be required to implement hydromodification management controls.

2. **Incorporate an IRWM element into the land planning/land development process.** The Permittees understand that an IRWM approach is needed to optimize attainment of water quality protection, water conservation, flood control, and stream protection goals. The Permittees therefore intend to incorporate an IRWM element into their land planning and land development processes so that as development projects begin entitlement this approach and opportunities to achieve this approach are evaluated. This recommendation will require a modified LID Hierarchy that establishes the equivalency of "On-site BMP" and "Off-Site /Regional BMP" solutions.

3. **Create an exemption from Project WQMP requirements for steam and watershed restoration projects**.

4. **Create an exemption for emergency public safety projects where delay would compromise public safety, public health and/or the environment**.

5. **Develop an internet based regional geodatabase.** To effectively implement an IRWM and watershed management approach, access to information that describes all of the key hydrologic process and landscape characteristics will be critical. The Permittees are developing and starting to use an internet-based regional geodatabase to give developers and municipal staff access to the geotechnical and hydrologic information necessary for evaluating the application of the LID hierarchy to sites.

6. **Pilot the use of technology to better track Project WQMP inspections and follow up actions needed.** To fully utilize the WQMP Submittal Tool and Database WQMP inspections could be performed with tablets or other devices where GIS information and other

information can immediately be uploaded to the database. The Permittees propose piloting the use of tablets or other devices linked to the Database for Project WQMP inspections by a select number of cities.

7. **Enhance the data collected for WQMPs to have a better understanding of water quality benefits on an annual basis.** The Permittees desire to perform a better assessment of the New Development/Significant Redevelopment Program. In order to better understand the effectiveness of the program, the Permittees propose to collect new critical data elements, and enhance data quality by integrating information into the WQMP Submittal Tool and Database. New data would include volumes of water treated, land area treated, and other relevant information needed to evaluate TMDL compliance, to identify developed/redeveloped areas that meet LID and/or hydromodification requirements, and to track BMP maintenance as a measure of effectiveness.

Implementation Schedule – Land Development

Proposed New Development/Significant Redevelopment Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
New Development/Significant Redevelopment Program						
Development of Program Guidance	C					
Develop an internet-based regional geodatabase.	E		X			
Water Quality Management Plans (WQMPs)						
Integrate the use of emerging information technologies to better track WQMP inspections and follow up actions needed.	E			X		
Enhance the data collected for WQMPs to have a better understanding of water quality benefits on an annual basis.	E			X		
BMP Implementation						
Implement Model WQMP	C					
Training						
Deliver Model WQMP & TGD Training Modules	C					
"Help Desk"						
Provide "Help Desk" service	C					
General Plan Assessment and Development Standards Review						
Incorporate an integrated water resources approach element into the land planning/land development process.	M			X		

Proposed New Development/Significant Redevelopment Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Enhancements in Assessment Methodologies and Their Role in New Development/Significant Redevelopment						
Development of technical guidance	C					

1. C = Continuation; E = Enhancement; M=Modification (Requires adjustment to Policy/Permitting)

2. X = Recommendation will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation

3.5 Construction

The Story: Construction

- The Construction Program maintained an inventory of up to 12,060 construction sites, prioritized these sites regarding their threat to water quality, and inspected them at the frequency specified by the permit. Non-compliant sites were educated and required to implement BMPs as required.

- BMP Guidance was updated to address the renewed Statewide General Construction Storm Water Permit, and Permittee construction inspection staff were trained accordingly.

- Three Qualified SWPPP Developer (QSD)/Qualified SWPPP Practitioner (QSP) training sessions were offered during the Permit term. Approximately 150 people attended this training.

3.5.1 Overview

The Permittees regulate construction activities and have responsibility for the construction and reconstruction of municipal facilities and infrastructure within their jurisdictions. Construction sites and activities are a significant potential source of sediment and other pollutants and have been a priority for the Program since the First Term MS4 Permits.

The Program requires effective BMP implementation by construction site owners, developers, contractors, and other responsible parties. All construction projects, regardless of size, must implement an effective combination of erosion and sediment controls and waste and materials management BMPs. To ensure that effective BMPs are implemented, each jurisdiction conducts inspections to verify the appropriateness and implementation of BMPs and takes enforcement action as necessary. Training is provided annually to support consistent countywide implementation.

3.5.2 Construction Program Implementation and Assessment

The Model Construction Program has been implemented since 2002-03. It requires the Permittees to:

- Inventory construction sites;
- Prioritize construction sites based upon water quality threat;
- Prepare BMP guidance;
- Conduct inspections of construction sites;
- Undertake enforcement; and
- Conduct training.

<u>Site Inventories</u>

Between 2008 and 2013, the Permittees reported annual construction site inventories ranging from 7,123 (2012-13) to 12,059 (2008-2009). Order R9-2009-002 does not designate construction sites as high, medium or low priority; rather, prioritization is based on site size and proximity to sediment-impaired receiving waters. However, for the ease of differentiation and reporting, sites will be categorized as

"high" "medium" and "low" priority based on the following factors:

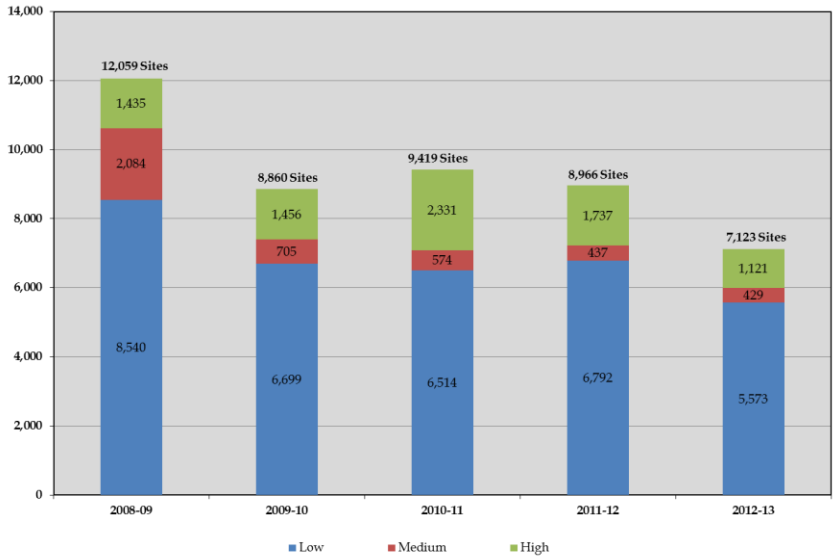
HIGH: Any site 30 acres or larger; any site 1 acre or larger and tributary to a CWA section 303(d) water body segment impaired for sediment or within or directly adjacent to, or discharging directly to, the ocean or a receiving water within an ESA; or other sites determined by the Copermittees or the Regional Board as a significant threat to water quality.

MEDIUM: Construction sites with one acre or more of soil disturbance not meeting the criteria specified for 'high' priority sites.

LOW: Construction sites that are less than one acre in size.

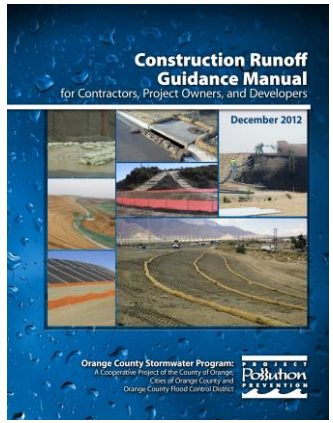
The numbers of construction sites and relative proportions of low, medium, and high priority sites for the past five years are shown in **Figure 3.5.1**.

Figure 3.5.1: Construction Site Inspections & Prioritizations, 2008-09 to 2012-13



BMP Guidance

The Permittees have produced a *Construction Runoff Guidance Manual* and it is available at http://ocwatersheds.com/documents/bmp/constructionactivities. The manual was updated in late 2012 to ensure consistency with the renewed Construction General Permit (Order 2009-0009-DWQ) (CGP), to incorporate findings from an Erosion Control BMP Field Evaluation, and to provide guidance on dewatering activities and BMPs appropriate for small construction sites. The manual is the basis for the pre-wet season construction training held each September. CASQA updated their California Stormwater BMP Handbook for Construction in November 2009 as on online portal and the updated BMP Factsheets provide additional, up-to-date guidance for the Permittees.



Inspection and Enforcement

Inspectors implement their jurisdictional program, which is based on the Model Construction Program, by enforcing compliance with grading or building permits, sediment and erosion control plans, and the Water Quality Ordinance(s). Enforcement actions taken by inspectors include, but are not limited to, education, verbal warnings and administrative actions under the Water Quality Ordinance (notice of violation, administrative compliance order, etc.), and written actions under Building/Grading Ordinances (corrective action notice, stop work order, etc.).

As a result of the inspections, between 2008-2013 the Permittees reported issuing 2,297 educational letters, 1,454 notices of non-compliance, 186 administrative compliance orders, 19 cease and desist orders, and 9 misdemeanor/infractions for a total of 3,965 enforcement actions (**Figure 3.5.2**).

Figure 3.5.2: Enforcement Actions Taken, 2008-09 to 2012-13

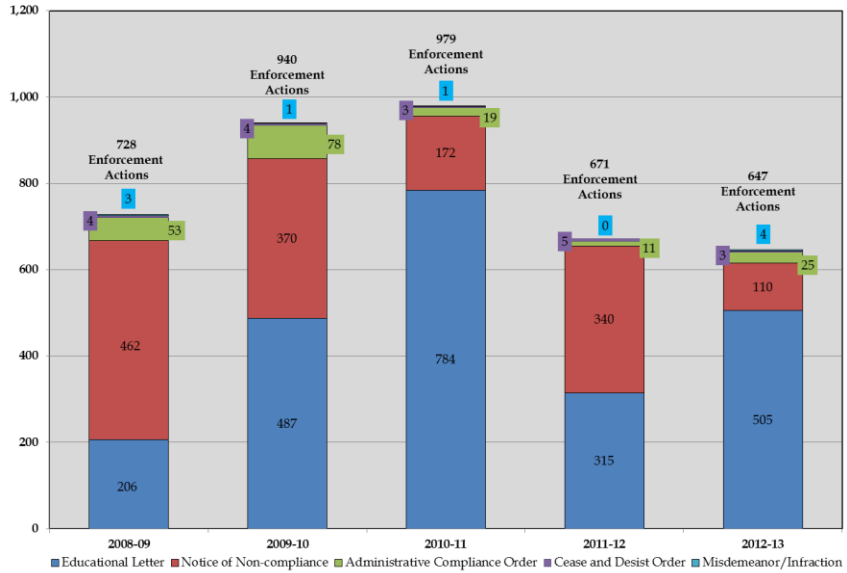
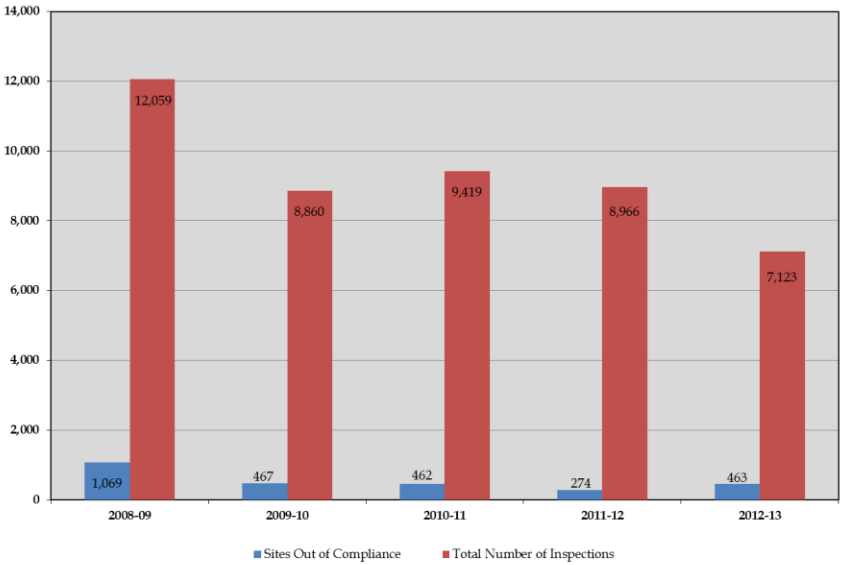


Figure 3.5.3: Construction Sites Out of Compliance, 2008-09 to 2012-13



The number and type of enforcement activities vary greatly from year to year; however, the percentage of construction sites out of compliance is consistently under 10% **(Figure 3.5.3)**. This is a consistently high (i.e. >90%) level of compliance from year to year within the regulated community, which may be attributable to the long term impact of inspection programs, new guidance published by CASQA, and the implementation of the new Construction General Permit requirements, including new requirements for a *Qualified Stormwater Pollution Prevention Plan (SWPPP) Developer* to prepare a construction site's SWPPP, and a *Qualified SWPPP Practitioner* to ensure that the SWPPP is being correctly implemented.

The Fourth Term MS4 Permit requires significant inspection resources for both high priority and medium priority construction sites. Based on **Figure 3.5.2** and **Figure 3.5.3**, enforcement actions per capita and the proportion of construction sites out of compliance have decreased over the permit term. Therefore, it is appropriate to consider revising the inspection requirements and inspection frequency for the Fifth-Term MS4 Permit.

Training

Pre-wet season construction inspection training has been provided to inspectors each September during the permit term. A new module for Construction Inspectors, with a focus on interactive exercises for trainees, was developed and provided in September 2012. Qualified SWPPP Developer (QSD) and Qualified SWPPP Practitioner (QSP) training was provided three times in the permit term to NPDES Program staff and construction inspectors. The first QSD/QSP Training was provided on June 9, 13, and 14, 2011. The second QSD/QSP Training was provided on May 24, 29 and June 5, 2012. The third QSD/QSP Training was provided on April 2, 9 and 16, 2014. Approximately 50 staff attended each round of training.

3.5.3 Recommendations

The recommendations are:

1. **Reduce the frequency of inspection for "high" priority sites** from bi-weekly to twice during the wet season and reduce the frequency of inspection for "medium" priority sites from monthly to once during the wet season.

2. **Pilot a GIS and internet-based database to track construction sites**. In order to provide easier tracking of construction sites on a countywide basis, the Permittees will develop a GIS and internet-based database where information regarding each construction site can be entered. The Permittees would examine the benefits of such a database by piloting implementation with a select number of cities.

3. **Conduct pilot field-testing of personal electronic devices to document inspections onsite**. Use of tablets or other electronic devices during inspections will allow inspectors to immediately upload construction site information to the GIS based database. The Permittees would pilot the use of these technologies with a select number of cities.

4. **Conduct QSD/QSP Training.** The QSD/QSP Training developed by the State Board and CASQA provides a detailed understanding of the Construction General Permit. The Permittees propose providing this training to municipal staff every other year to ensure that inspectors and other municipal staff understand the CGP requirements that are to be implemented for construction projects in their jurisdiction. It is anticipated that with potential changes to the CGP being adopted in 2014 that municipal staff should be aware of these changes and any new or modified requirements for CGP compliance.

Implementation Schedule – Construction

Proposed Model Construction Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Inventory Construction Sites						
Maintain inventory of construction sites	C					
Pilot GIS based database system to maintain inventory of construction sites	E		X			
Prioritize Construction Sites based upon Water Quality Threat						
Prioritize as high, medium, low threat to water quality	C					
Prepare BMP Guidance						
Implement BMPs identified in the OC Construction Runoff Guidance Manual	C					
Conduct Inspections of Construction Sites						
Inspectors to pilot use of tablets or other device during inspections to upload information to the GIS based database	N			X		
Perform inspections for high priority sites twice during the wet season	N					
Perform inspections for medium priority sites once during the wet season	N					
Perform inspections for low priority sites once during the wet season	C					
Enforcement						
Enforcing compliance with grading or building permits, sediment and erosion control plans, and the Water Quality Ordinance	C					

Proposed Model Construction Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Training						
Conduct Training of construction inspectors annually prior to the wet season	C					
Conduct QSD/QSP Training	C	X		X		X

1. C = Continue; E = Enhance; N = New

2. X = Performance Standard will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation

3.6 Existing Development

The Story: Industrial/Commercial

- The Industrial/Commercial Program inventoried 14,000 sites and conducted inspections of these sites at frequencies specified by the permit.

- The Program trained Authorized Inspectors and provided education and enforcement to address facilities lacking effective BMPs.

- A new Mobile Business Pilot Model Program was developed and implemented.

- Residential sources of pollutants were addressed through the Model Residential Program, which included development of new outreach materials and continued outreach to Common Interest Areas and Homeowner's Associations.

3.6.1 Overview

Stormwater discharges from commercial and industrial facilities can become contaminated when material management practices allow exposure of pollutant sources to stormwater and/or there is commingling of runoff with wastes. The Existing Development Model Program provides a programmatic framework to guide Permittees in the regulatory oversight of activities in commercial and industrial areas. Through inspections, outreach and requiring compliance with water quality ordinances, the Permittees are able to effect protection of the quality of urban and stormwater runoff from industrial and commercial facilities. The Model Program also provides a framework, emphasizing education and outreach approaches, for addressing activities in residential and common interest areas that can threaten water quality.

3.6.2 Model Industrial/Commercial Program Implementation and Assessment

The Model Industrial/Commercial Program requires the Permittees to address the following:

- Identify and inventory commercial and industrial facilities;
- Establish model maintenance procedures;
- Develop and implement a program to address mobile businesses;
- Conduct inspections of food service establishments (FSEs);
- Conduct inspections and undertake enforcement
- Conduct training; and
- Conduct education and outreach.

<u>Facility Inventory and Inspection</u>

The Permittees maintain a database of industrial and commercial facilities that have a potential impact to water quality. This database documents all information related to the facility such as outreach, inspection, and any follow up actions required. Industrial and commercial facilities have been identified and inventoried per permit requirements for over ten years.

Following clarification of reporting practices in 2008, the total number of industrial facilities has remained relatively stable.

The significant drop in number of commercial facilities on the inventory between FY 2009-10 and FY 2010-11 is attributable to the removal of the food service establishments (FSEs) from the commercial inventory that year. The gradual decline in the number of both industrial and commercial facilities over the permit term is likely due to the economic downturn.

The Fourth-Term MS4 Permit specifies that a minimum of 20% of the total combined industrial and commercial facility inventories be inspected each year. Since permit adoption in 2009, the annual inspection average for the total combined industrial and commercial inventory has been between 40-46%. **Figure 3.6.1** and **Figure 3.6.2** show the total annual inventory and inspections of industrial and commercial facilities, respectively. This data excludes inspections at Food Service Establishments (FSEs), as these are inspected by the HCA and are tracked separately.

On April 1, 2014, the State Water Resources Control Board adopted a new Industrial General Permit which expands the list of facilities that are required to obtain coverage. The Orange County Stormwater Program will evaluate how this expansion and other changes to the statewide industrial program will impact the Permittees' Existing Development Model Program.

Figure 3.6.1: Industrial Facility Inventory and Inspections from 2008-09 to 2012-13
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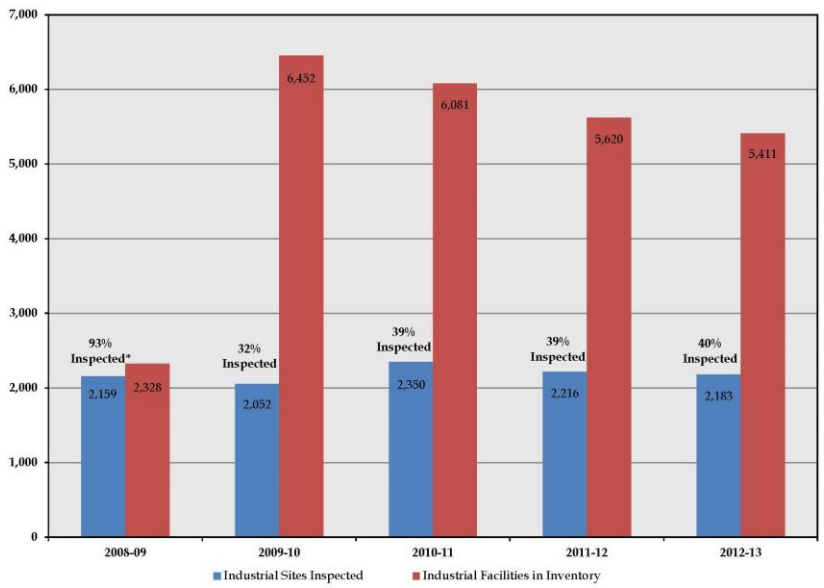
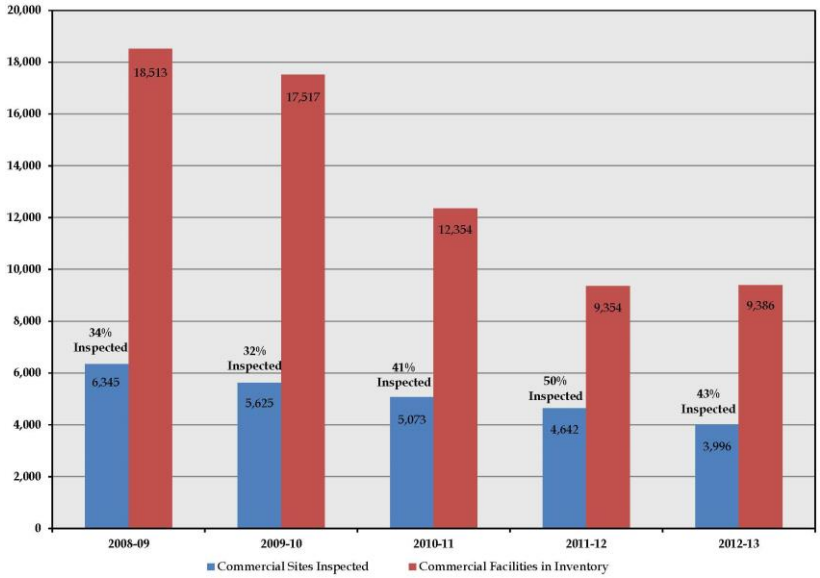


* Low number of industrial facilities in 2008-09 was due to a reporting issue that was subsequently clarified in 2009-10.

Figure 3.6.2: Commercial Facility Inventory and Inspections from 2008-09 to 2012-13

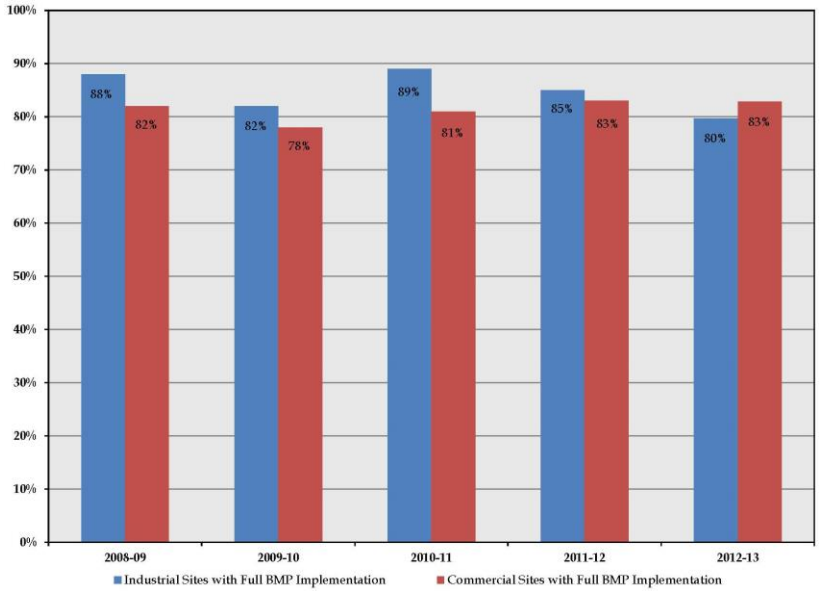


BMP Implementation

Twenty-four (24) model BMP fact sheets have been prepared (available at http://www.ocwatershed.com/IndustrialCommercialBusinesesActivities.aspx) which include a description of specific minimum source control BMPs for common industrial and commercial activities that may discharge pollutants. The California Stormwater Quality Association (CASQA) is currently updating the Industrial BMP Handbook and converting it to a web portal. The Orange County Stormwater Program will be giving consideration to incorporating the updated CASQA BMP fact sheets into the program.

Permittees gauge implementation of the required BMPs through the inspection program. Facilities fall into one of three categories; they have fully implemented, partially implemented, or not implemented any of the required BMPs. As illustrated in **Figure 3.6.3**, the majority (>80%) of industrial and commercial facilities were fully implementing BMPs as required upon inspection.

Figure 3.6.3: Industrial and Commercial Site Compliance Rates (excluding FSEs) from 2008-09 to 2012-13

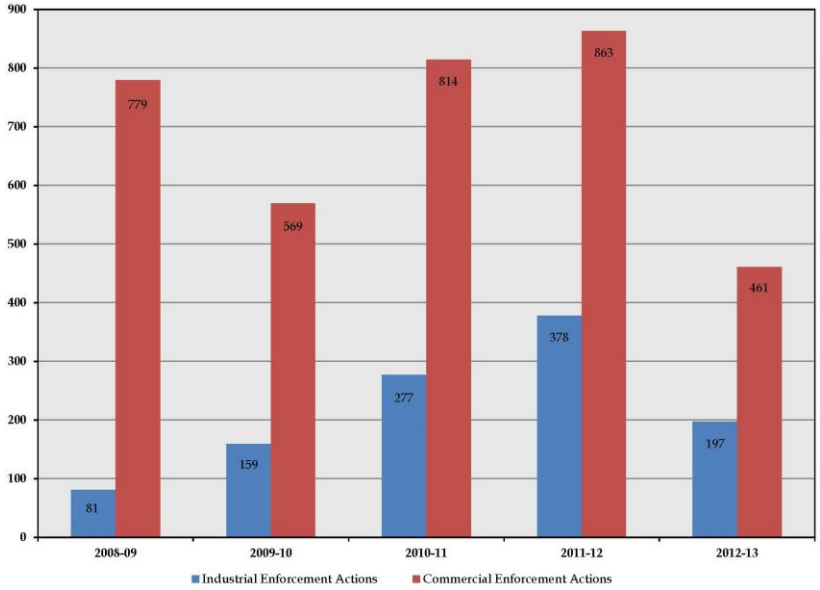


Enforcement Activities

Permittees are required to use a progressive enforcement approach and initiate enforcement actions where commercial and industrial facilities are found to be out of compliance. Enforcement for the industrial and commercial component of the Existing Development Program is the responsibility of

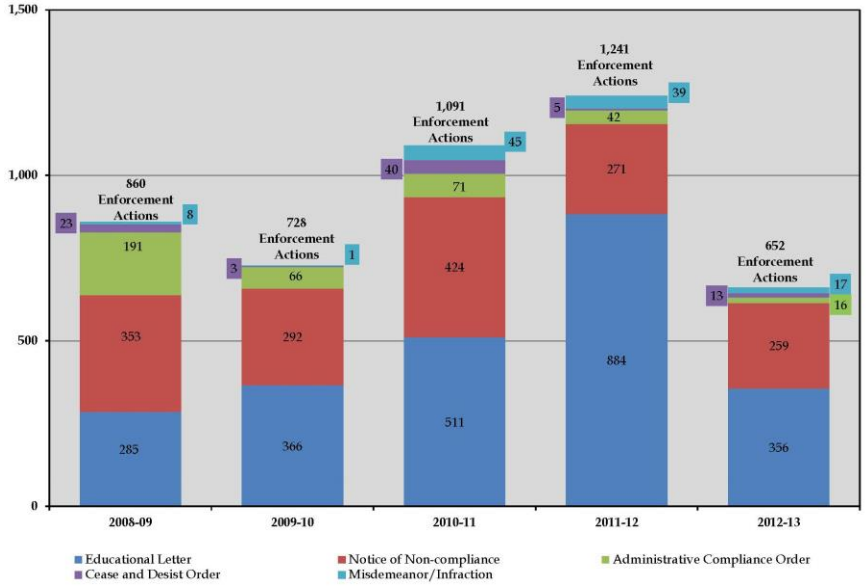
individual Permittees. Each Permittee has several different levels of enforcement to choose from for different types of situations. This includes – from least severe to most severe – issuance of an educational letter, a notice of non-compliance, an administrative compliance order, a cease and desist order, or a misdemeanor/infraction. Over the past five years, the Permittees conducted enforcement as necessary based on the results of the industrial and commercial inspections (**Figure 3.6.4**).

Figure 3.6.4: Industrial and Commercial Enforcement Actions (excluding FSEs) from 2008-09 to 2012-13



Where non-compliance is evident during inspections, inspection frequency and enforcement actions are increased until compliance is achieved. Increased follow-up and enforcement appear to be resulting in increased rates of compliance. **Figure 3.6.5** illustrates the number and type of enforcement actions taken at industrial and commercial facilities over the past five years. It appears that lower level enforcement actions such as educational letters and notices of non-compliance are typically successful in gaining compliance, although nearly every year, there are over 100 higher level enforcement actions taken against industrial and commercial facilities.

Figure 3.6.5: Industrial and Commercial Enforcement Actions by Enforcement Types (Excluding FSEs) from 2008-09 to 2012-13

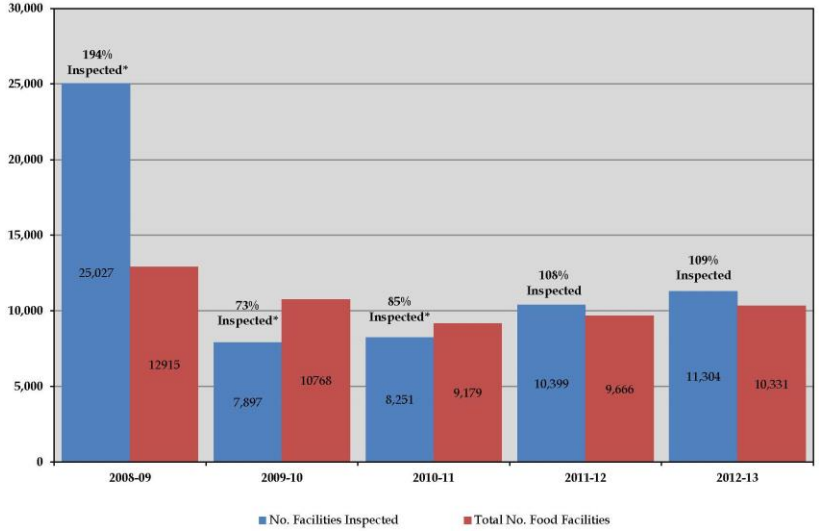


Food Facility Inspection Program

Orange County Health Care Agency (OCHCA) annually conducts up to three inspections of each food service establishment for compliance with the California Uniform Retail Food Facilities Law. The OCHCA inspectors identify NPDES issues during one of these three inspections and they

are forwarded to the respective Permittees for follow up. In **Figure 3.6.6**, a sharp decrease in the number of inspections per year is evident between FY 2008-09 and FY 2009-10, due to a clarification in reporting practices.

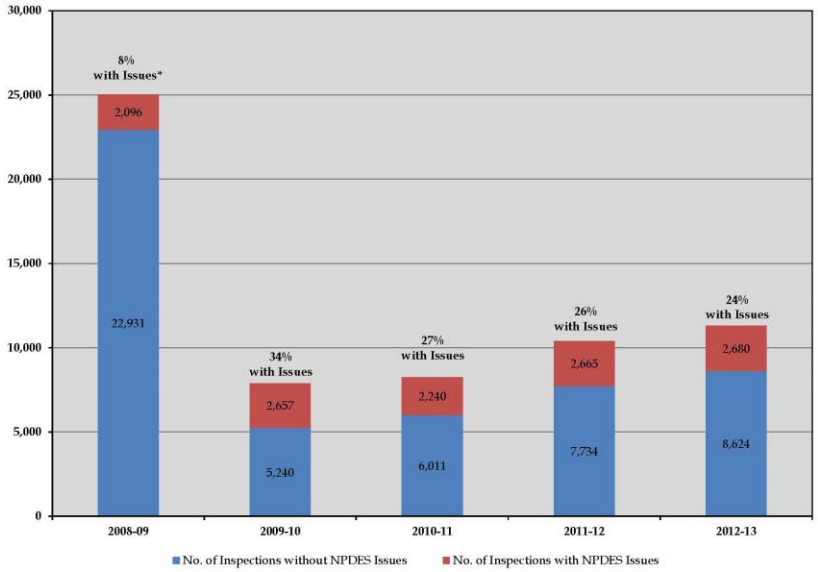
Figure 3.6.6: HCA Annual Inspections at Food Service Establishments from 2008-09 to 2012-13



* High number of inspections in 2008-09, and low numbers of inspections in 2009-10 and 2010-11 due to reporting issues that were subsequently clarified in 2009-10 and 2011-12, respectively.

The numbers of inspections resulting in the detection of NPDES issues at FSEs is illustrated in **Figure 3.6.7**. Where these issues were found, Permittees followed up with the necessary enforcement actions. It appears that the numbers of inspections detecting issues has been slowly declining since 2009, from 34% to 24%.

Figure 3.67: NPDES Issues Discovered During Food Service Establishment Inspections Performed by HCA from 2008-09 to 2012-13



* High number of inspections in 2008-09 due to reporting issues that was subsequently clarified in 2009-10.

Mobile Business Model Pilot Program

Due to their transitory and regional nature, mobile businesses are a challenging component of the Model Existing Development Program. The Mobile Business Model Pilot Program, which was developed in 2009-2010 and commenced in 2010-2011, is a countywide approach to inventorying and regulating mobile businesses. There are five key elements to the Model Program:

1. Develop an inventory of mobile businesses operating within the County;
2. Identify and require implementation of minimum BMPs for mobile businesses;

3. Provide outreach to the mobile businesses;
4. Perform inspections or provide a self-certification process for the businesses; and
5. Conduct enforcement as necessary to ensure compliance.

In 2011, a web-based Mobile Business Database was developed to serve as a countywide inventory and repository for the information for each business pertaining to inspections and/or self-certification, outreach, and enforcement actions. The database allows Permittees to update the inventory with mobile businesses found to operate within their jurisdiction, as well as enter and track enforcement actions in their jurisdiction and countywide. The database tracks over 1,500 mobile businesses and includes information related to the business type, outreach, and enforcement information.

In order to assist surface cleaners in selecting and implementing the appropriate types of BMPs, a Model Surface Cleaner BMP Fact Sheet was developed in 2011. This BMP Fact Sheet provides the minimum control measures required of the mobile businesses.

A mass-mailing notification was distributed in June 2012 to all mobile detailing businesses in the countywide inventory in conjunction with an outreach workshop held on June 27, 2012. The notification included a workshop flier and mobile detailing brochure.

The Permittees implemented appropriate enforcement actions where necessary to ensure that Mobile Businesses were implementing the required BMPs **(Figure 3.6.9)**. The increase in enforcement actions in 2010-11 may be due to improved inventorying countywide after development of the Mobile Business Database (**Figure 3.6.8**).

Figure 3.6.8: Enforcement Actions Issued to Mobile Businesses in Orange County from 2008-09 to 2012-13

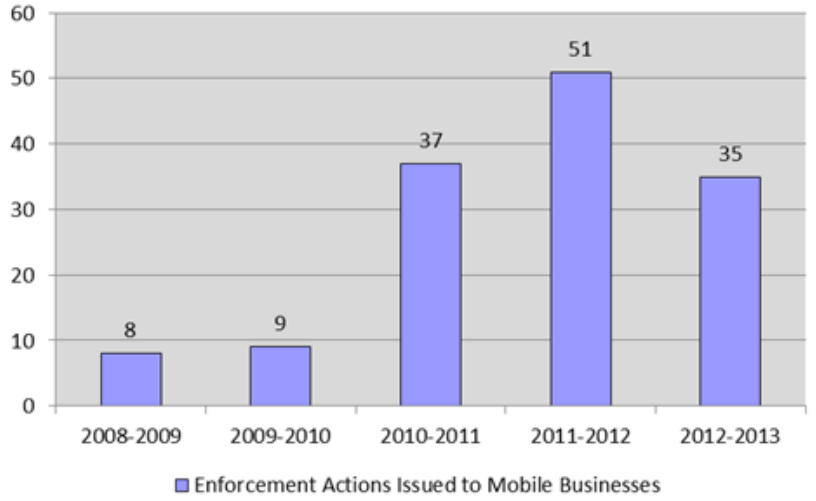
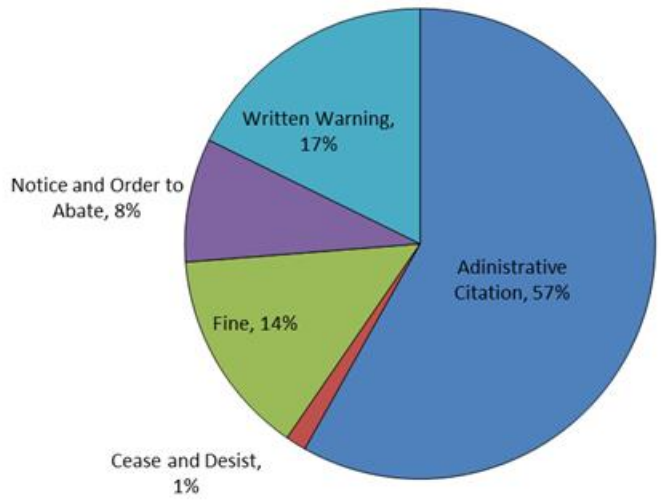


Figure 3.6.9: Types of Enforcement Actions Issued to Mobile Businesses from 2008-09 to 2012-13



Training

Over the permit term the County developed the *Training Program Framework Core Competencies Document*. The *Training Program Framework Core Competencies* document defines the core competencies (knowledge, level of experience, and skills) necessary to ensure the capabilities of individuals carrying out specialized municipal stormwater program compliance responsibilities. It is expected that an individual or group of individuals who has/have developed these competencies will be able to affect jurisdictional conformance with the DAMP/ LIP and the compliance of their jurisdiction.

The Permittees developed and implemented the training program pursuant to Permit requirements and the DAMP. A region-wide training session was held specific to industrial and commercial inspections on April 7, 2009. The NPDES Inspection Sub-Committee also provided training on various subjects relevant to the Existing Development and ID/IC programs. This sub-committee meets quarterly to provide training to inspectors and others on issues related to spill response, inspection and enforcement.

3.6.3 Model Residential Program Implementation and Assessment

Residential areas comprise a significant portion of the land area of each Permittee's jurisdiction. The Model Residential Program was developed to further reduce pollutants potentially released into the environment from residential activities, including efforts to reduce over-watering. It encourages use of pollution prevention practices as the most effective method to protect receiving water quality and comprises:

- Best Management Practice (BMP) Requirements
- Source identification and prioritization
- Facilitation of hazardous waste collection
- Program Implementation
- Enforcement

During the 2012-13 reporting period, the LIP/PEA Sub-committee updated the eight (8) model BMP fact sheets which include a description of specific pollution-prevention activities for residential areas. The BMP fact sheets are available at http://ocwatersheds.com/documents/bmp/residentialactivities. Each fact sheet contains the following sections: targeted pollutants, required activities, and recommended activities.

BMP factsheets have been prepared for the following activities:

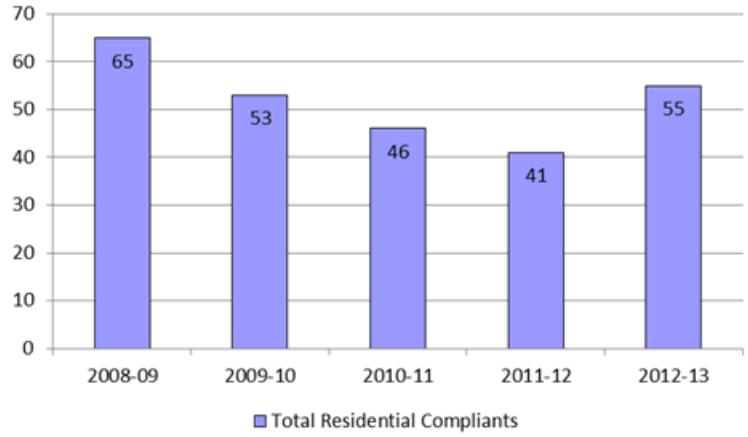
- Automobile Repair & Maintenance
- Automobile Washing
- Automobile Parking
- Home & Garden Care Activities
- Disposal of Pet Waste
- Disposal of Green Waste
- Household Hazardous Wastes
- Water Conservation

Four (4) Household Hazardous Waste Collection Centers, operated by the County of Orange Waste and Recycling Agency, are located at the following sites throughout the county:

- 1071 N. Blue Gum Street, Anaheim, CA 92806
- 17121 Nichols Street – Gate 6, Huntington Beach, CA 92647
- 6411 Oak Canyon, Irvine, CA 92618
- 32250 La Pata Avenue, San Juan Capistrano, CA 92675

The implementation of the residential program relies on education and outreach to notify and urge residents to observe the designated sets of BMPs for each of the high threat activities. Permittees encourage the implementation of the designated BMPs for each residence within its jurisdiction principally through the overall public education element of the Program. The Permittees have also developed a source identification procedure and prioritize residential areas based on proximity to Environmentally Sensitive Areas (ESAs). Over the last five years, the County (as manager of the reporting system) has responded to, or forwarded to Permittees, a total of 260 residential complaints (Figure 3.6.11).

Figure 3.6.10: Residential Complaints, County of Orange, from 2008-09 to 2012-13



Enforcement in residential areas begins with outreach and education and most often compliance is achieved without formal enforcement remedies. However, where necessary, the Permittees have the legal authority to increase the level of enforcement to gain compliance. Where necessary, enforcement actions were taken to achieve compliance. Indeed, between 2008-09 and 2011-12, the County has relied on formal enforcement actions to gain compliance in residential areas in only seven cases. These included two citations, three criminal cases, and two notices of non-compliance. However, many of the residential cases tracked by the County were referred to other agencies for follow-up and enforcement. The analysis of residential enforcement data performed only includes those actions taken by the County.

3.6.4 Common Interest Areas (CIAs) and Homeowner's Associations (HOAs) Program Implementation and Assessment

Orange County is home to over 3,000 CIAs/HOAs and common interest developments account for 80% of all new housing in the County. Within Orange County, approximately 90% of incorporated residential areas lie within 2. the purview of the maintenance associations that govern CIAs/HOAs. Permittees in the San Diego Region have implemented individual CIA/HOA programs since the Third-Term permits.

Nineteen (19) model BMP fact sheets were developed which include a description of specific pollution-prevention activities for CIAs/HOAs. The BMP Fact Sheets are available at http://ocwatersheds.com/documents/bmp/commoninterestactivities.

Enforcement of BMPs in common interest developments relies on the following mechanisms: public reporting hotline, analysis of dry weather/illicit discharge monitoring results, and municipal employee observations. During the permit term, the County responded to, or forwarded to Permittees, 37 complaints related to CIA/HOA issues. When necessary, enforcement may be accomplished in two ways: through enforcement of conditions and restrictions (CC&Rs) enacted by the associations or through the Permittees' enforcement processes.

3.6.5 Recommendations

1. Consider incorporating the updated CASQA BMP fact sheets into the Existing Development Model Program.

Implementation Schedule – Industrial, Commercial, Mobile Program

Industrial, Commercial, and Mobile Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Source Identification and Facility Inventory						
Maintain inventory of required industrial sites	C					
Maintain inventory of required commercial facilities	C					
Maintain inventory of required residential sites	N					
Facility Inspection Activities						
Annually inspect 20%of the industrial and commercial inventory, with 100% of the industrial and commercial inventory inspected over the permit term.	C					
Best Management Practice (BMP) Implementation						
Update BMP Fact Sheets for existing development as necessary	C					
Provide outreach to all industrial commercial facilities during the Permit term	C					
Enforcement Activities						
Conduct follow-up inspections and enforcement as necessary to ensure compliance	C					
Track types of enforcement actions by facility type	E					
Food Facility Inspection Program						
Maintain and update inventory of FSEs	C					

Industrial, Commercial, and Mobile Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Inspect FSEs according to prioritization	C					
Track follow-up and enforcement actions related to FSEs	E					
Mobile Business Model Pilot Program						
Maintain inventory of mobile businesses operating within the County focusing on automobile detailers, carpet cleaners, pet services	E					
Identify and require implementation of minimum BMPs for mobile businesses, focusing on automobile detailers, carpet cleaners, and pet services	E					
Provide outreach to the mobile businesses	C					
Perform inspections or provide a self-certification process for the businesses	C					
Conduct enforcement as necessary to ensure compliance	C					
Training						
Train inspections and field staff as necessary	C					

1. C = Continue; E = Enhance; N = New

2. X = Recommendation will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation.

Implementation Schedule – Residential Program

Residential Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Source Identification and Prioritization						
Update and maintain residential source inventories as necessary	C					
Best Management Practice (BMP) Requirements						
Update BMP Fact Sheets as necessary	C					
Program Implementation						
Respond to notifications of NPDES issues from the public, municipal staff, and other regulatory agencies	C					
Facilitate proper collection and management of used oil and household hazardous waste	C					
Track amounts of used oil and HHW collected	C					
Enforcement						
Enforce ordinances as appropriate	C					
Track enforcement actions	C					

1. C = Continue; E = Enhance; N = New

2. X = Performance Standard will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation.

Implementation Schedule – CIA/HOA Program

CIA/HOA Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Identification of CIA/HOA Areas and Activities of Concern						
Update inventory of CIA/HOAs as necessary	C					
Best Management Practices Implementation						
Update BMP Fact Sheets associated with activities of concern as necessary	C					
Program Implementation Strategy						
Develop guidance for inclusion in CCRs for CIA/HOAs	C					
Require new HOAs to include guidance in CCRs	E					
Perform outreach to CIA/HOAs	C					
Coordinate with UCCE and water districts to enhance approaches to IPM implementation and reducing irrigation runoff	C					
Enforcement						
Enforce ordinances as necessary to ensure BMPs are implemented as required	C					

1. C = Continue; E = Enhance; N = New

2. X = Performance Standard will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation.

Implementation Schedule – CIA/HOA Program

Retrofitting Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Evaluate Opportunities for Retrofit						
Evaluate opportunities for retrofitting existing development to address constituents identified as the highest priorities in the Water Quality Implementation Plan	E					

1. C = Continue; E = Enhance; N = New

2. X = Performance Standard will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation.

3.7 Illegal Discharges/Illicit Connections

The Story: ID/IC

- The requirement to effectively prohibit non-stormwater discharges into the MS4 is one of two fundamental requirements of the Clean Water Act stormwater mandate.

- The Permittees continued to aggressively detect and eliminate Illicit Discharges and Illegal Connections (ID/IC) through discharge monitoring, source investigation, and enforcement.

- A spill reporting hotline (1-877-89-SPILL) provides a resource for public spill and water pollution reporting, and a smartphone reporting application was developed. All reports were responded to and resolved.

- The *Model Investigative Guidance for Orange County Illegal Discharges and Illicit Connections Program* was updated for the Non-stormwater Action Levels (NALs) based monitoring program by inclusion of a new *San Diego Region Dry Weather Numeric Action Level (NAL) Source Identification Guide*.

- Essential elements of the Countywide Area Spill Control Program were completed and implemented.

- The NALs monitoring program was fully implemented.

3.7.1 Overview

It is a specific requirement of the Federal Clean Water Act that non-stormwater discharges, arising from illegal discharges and illicit connections (ID/IC) to the municipal storm drain system, must be effectively prohibited. Since the first term MS4 permit, a programmatic framework for detecting and quickly responding to non-stormwater discharges has been a key integral element of the Program.

3.7.2 Illegal Discharges/Illicit Connections Program Implementation and Assessment

The Model ID/IC Program provides guidance for Permittees when identifying, responding to, and mitigating the effects of non-stormwater discharges**.** The Model Program requires the Permittees to address the following:

- Detect illegal discharges and illicit connections;
- Enable public reporting;
- Investigate illegal discharges and illicit connections;
- Undertake enforcement; and
- Conduct Training.

<u>Detection of Illegal Discharges and Illicit Connections</u>

The Permittees implemented the NALs monitoring program during the Fourth Term MS4 Permit in south Orange County. The NALs monitoring program is outlined in the Fourth Term MS4 Permit and includes numeric action levels derived from Basin Plan objectives that, when exceeded, trigger the need for a source investigation. The NALs monitoring program uses a suite of water quality analyses conducted in the field and through contract laboratories. Field data is entered into the County's CBI MS4 on-line database system to which

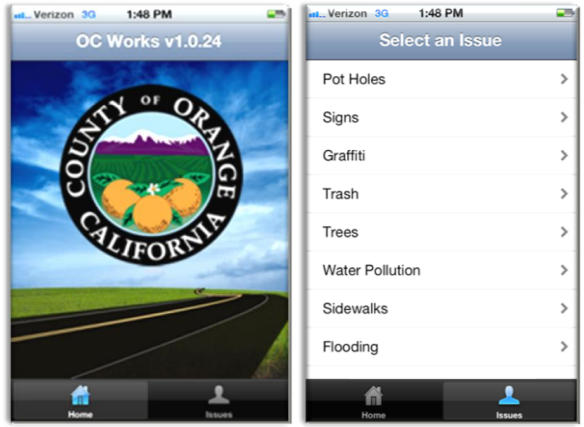
Permittees have been provided with login information and have immediate access to all field data once it is entered into the system.

As part of the NALs monitoring program, outfall sites are visited and sampled twice annually; once in the dry season and once in the wet seasons (preceded by an absence of rain for 72 hours). Over the past four years, the Permittees have conducted a total of 175 site visits at 25 sites.

Reporting

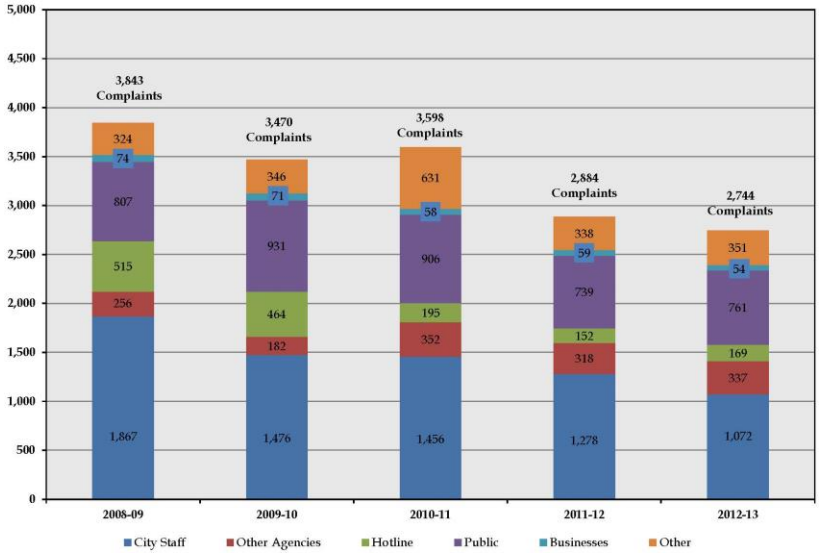
The Permittees continue to field complaints stemming from numerous sources, including the water pollution telephone hotlines. Telephone and web-based reporting systems (both countywide and in individual cities) for the general public have been established and are advertised in the Program's public education materials, Orange County "White Pages" telephone directories, and Permittee websites.

The Permittees' field inspectors are trained to detect illegal discharges as part of their daily activities and, indeed, the majority of illegal discharges continue to be detected by Permittee staff. In addition, the Permittees promote hotline numbers, principally 1-877-89-SPILL, to receive water pollution complaints and incident information from the public and use database software to document the reported incidents which assists with the tracking of water pollution complaints by source. The Permittees also developed a smartphone application to provide another tool for the general public to use when reporting water pollution issues



Over the past five years there has been a decrease in the total number of complaints received (**Figure 3.7.1**).

Figure 3.7.1: Source of Complaints from 2008-09 to 2012-13



Investigate Illegal Discharges and Illicit Connections

Each Permittee has designated Authorized Inspectors to investigate compliance with, detect violations of, and take actions pursuant to their Water Quality Ordinance. Authorized Inspectors follow specific procedures documented in the *Model Investigative Guidance for Orange County Illegal Discharges and Illicit Connections Program* (*Investigative Guidance Manual*). The *Investigative Guidance Manual* was updated by the Permittees during the permit term. The revision included adding resources and tools as appendices and updating key resources, including an attachment specific to South County Permittees, the *San Diego Region Dry Weather Numeric Action Level (NAL) Source Identification Guide*.

The Permittees maintain records of information from a complaint, notification, or response request. To ensure that the necessary information is collected, the Permittees use pre-established forms to collect information. After the initial entry of the information on the Pollution Notification/Investigation Request (PNIR) or related form, the information is generally entered into a database. The data from the Permittees' databases is analyzed to increase the Permittees' awareness regarding the most problematic waste categories and facility activity types.

Figure 3.7.2 and **Figure 3.7.3** display results from the County-maintained PNIR database covering the 2008-09 to 2011-12 reporting periods. **Figure 3.7.2** provides a breakdown of the waste category under which each ID/IC discharge investigation was classified. The frequency of incident appears to be equally distributed all waste categories. **Figure 3.7.3** displays a breakdown of the facility activity type under which each ID/IC discharge investigation was classified. Similarly there is no facility type or single land use that is predominantly the subject of investigations.

The data used in the analysis includes information from the mobile business database which is a shared incident reporting database created specifically to ensure effective application of the Enforcement Consistency Guide to businesses operating from mobile premises across multiple jurisdictions. The experience with this database encourages consideration being given to creating a single countywide ID/IC database with the potential to streamline reporting and enable more detailed analyses to better identify priority activities and facility types of concern.

Figure 3.7.2: Waste Categories Encountered during ID/IC or Mobile Business Discharge Investigations

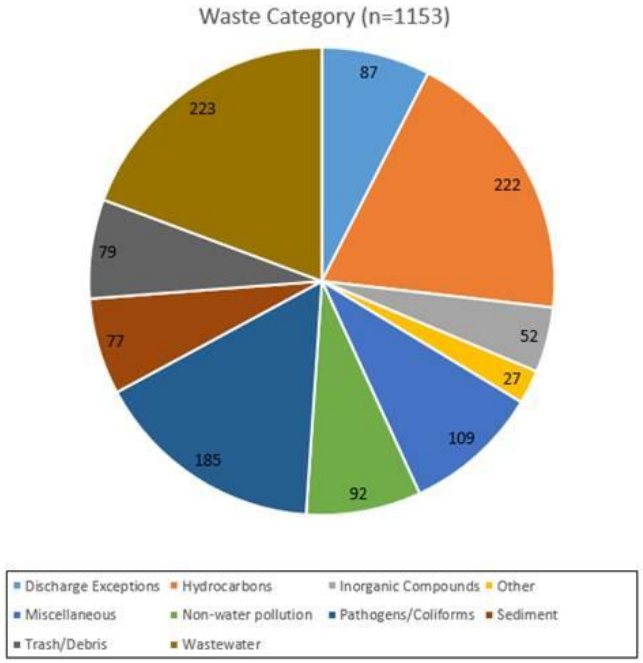
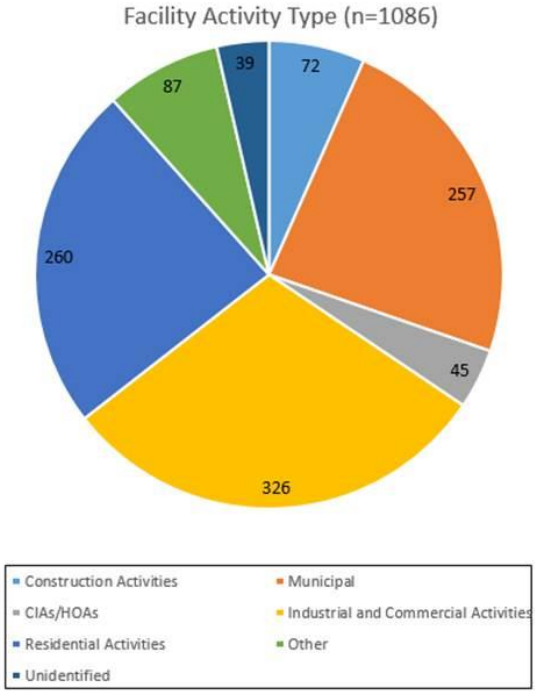


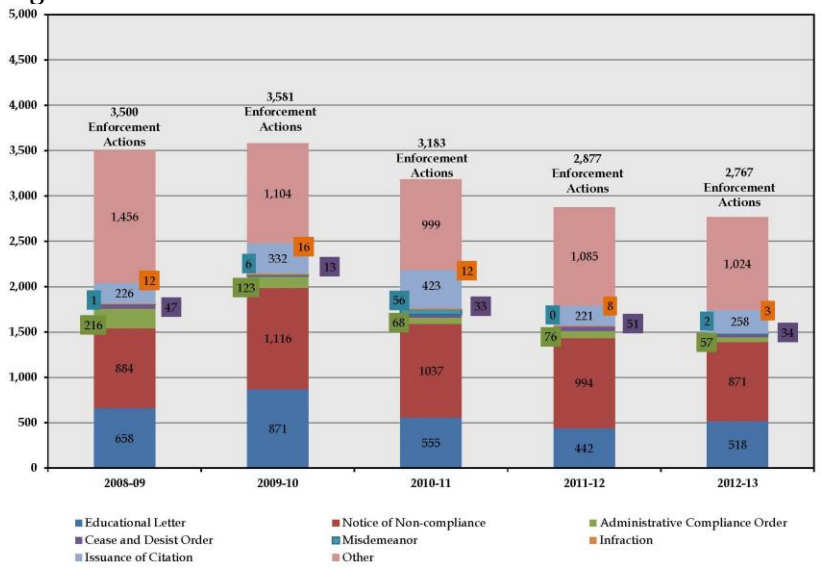
Figure 3.7.3: Facility Activity Types Encountered during ID/IC Discharge Investigations



Enforcement

Enforcement actions are undertaken according to the adopted Water Quality Ordinances and accompanying Enforcement Consistency Guide. In instances of noncompliance, the Permittees adopted one of four types of remedies, including educational letters, administrative remedies, criminal remedies, or other civil or criminal remedies, as appropriate. **Figure 3.7.4** displays the number and type of enforcement actions undertaken during the past five reporting periods. The five year trend largely represents a decrease in the total number of enforcement actions. Given the correlating decrease in the total number of complaints received over the same time period, the decrease in the total number of enforcement actions indicates a change in behavior which is causing a decrease in the total number of ID/IC incidents occurring.

Figure 3.7.4: Enforcement Actions 2008-09 to 2012-13



Training

During the permit term, the Permittees developed a training program, including curriculum content. The training program defined expertise and competency for each key area of jurisdictional stormwater program responsibility, including Authorized Inspectors. Illegal Discharges/Illicit Connections (ID/IC) Training Sessions for Authorized Inspectors and spill responders were conducted on May 18, 2010 (66 attendees) and April 16, 2013 (69 attendees). In addition, the NPDES

Inspection Sub-Committee also provided training on various subjects relevant to the ID/IC program. This sub-committee meets quarterly to provide training to Authorized Inspectors and others on issues related to spill response, inspection and enforcement. It also serves as a forum for the coordination and discussion of ongoing difficult or new enforcement, investigation, or enforcement issues and to profile cases or incidents.

Model Sewage Spill Response Procedures

Starting in 2000, the County and OCSD began development and implementation of a coordinated sewage spill prevention and response demonstration project (i.e. the "Countywide Area Spill Control (CASC) Program").

During the permit term, the CASC Program was activated three times in the San Diego Region: (1) March 23, 2010, to respond to a 1.4 million gallon sewage spill; (2) on June 25, 2010, to respond to a 2,400 gallon sewage spill; and, (3) on April 28, 2014, to respond to a 4,600 gallon biosolids spill. The March 23, 2010 incident was the largest CASC response to date, and the response was a major success – a berm was placed in Tijeras Creek to contain the spill and 2.5 million gallons were pumped from the containment and returned from the Santa Margarita Water District sewer system, minimizing both the beach closure area and the total number of beach closure days. For these reasons, the San Diego Regional Board reduced the *Potential Harm for Discharge Violations* score when assessing the Administrative Civil Liability (ACL) for this spill event.

CASC Response on March 23, 2010, Tijeras Creek

Actions Levels

In 2003, the Permittees began implementing the seasonal *Dry Weather Reconnaissance Program* on a countywide basis to monitor storm drain outfalls for the presence of illegal connections and illicit discharges (ID/IC). This Program's hybrid reconnaissance monitoring design combines probabilistic and targeted sampling and the use of formal statistical tools (tolerance intervals and control charts). This design enables the program to systematically prioritize problematic sites, compare conditions to the regional urban background, and track trends over time.

- A *tolerance interval* bound is the upper or lower confidence-interval bound of a quartile of the background data distribution. Tolerance intervals are

derived from the probabilistic site data and are used to quantify the key aspects of the regional background.

- *Control charts* are used to establish an upper or lower bound on a data distribution, based on previous monitoring data. They are created for each site and provide a means of tracking data at individual sites and identifying when new data values deviate substantially (either upward or downward) from previous experience.
- Used together, tolerance intervals and control charts provide a consistent and quantitative means of identifying sites that exhibit clearly aberrant values.

In its Fourth Term Permit for south Orange County the San Diego Regional Board has modified the dry weather reconnaissance-based monitoring to include NALs), based on Basin Plan objectives. Comparison of the approaches shows that the NALs-based program triggers investigative responses at a much higher frequency for many constituents (e.g. enterococci and reactive orthophosphate as P; **Figure 3.7.6** and **Figure 3.7.7** respectively).

Based upon historical data **(Figure 3.7.6)**, for example, the probability that a sample does not exceed the NAL for enterococci is approximately 3%. As a result, 32 out of 33 sampling events would be required to be investigated. In contrast, the probability that a sample does not exceed the enterococci tolerance interval is 90%, which ensures that investigative resources are applied to the most aberrant prioritized discharges.

Figure 3.7.5: Enterococci Exceedance Frequencies Associated with Dry Weather Reconnaissance Tolerance Intervals Compared with Exceedance Frequencies Associated with NALs.

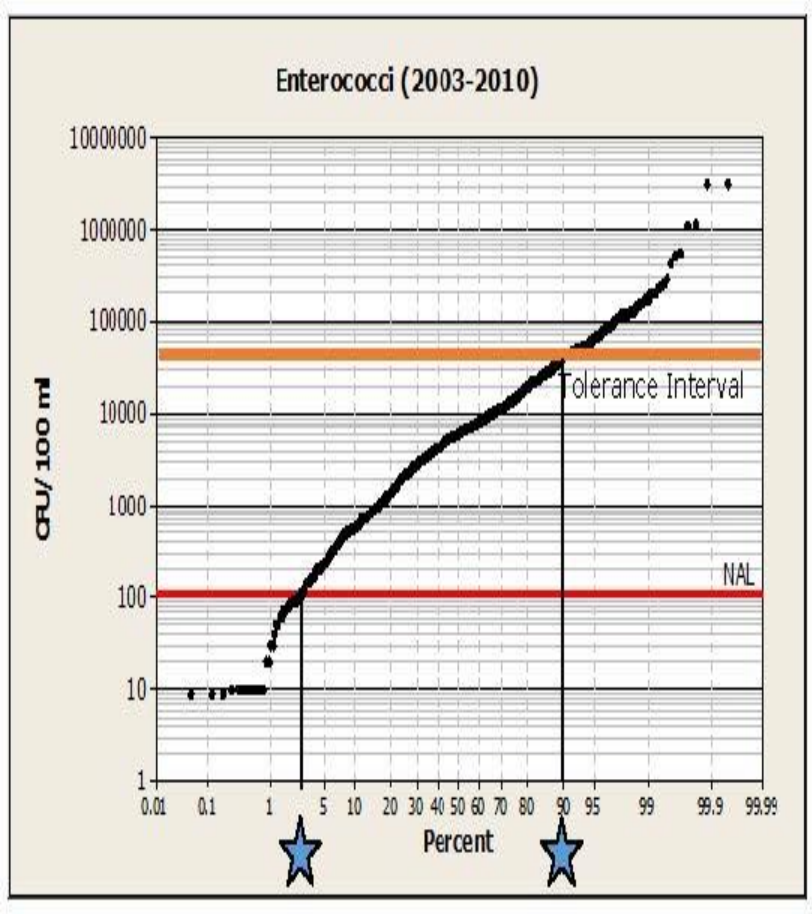
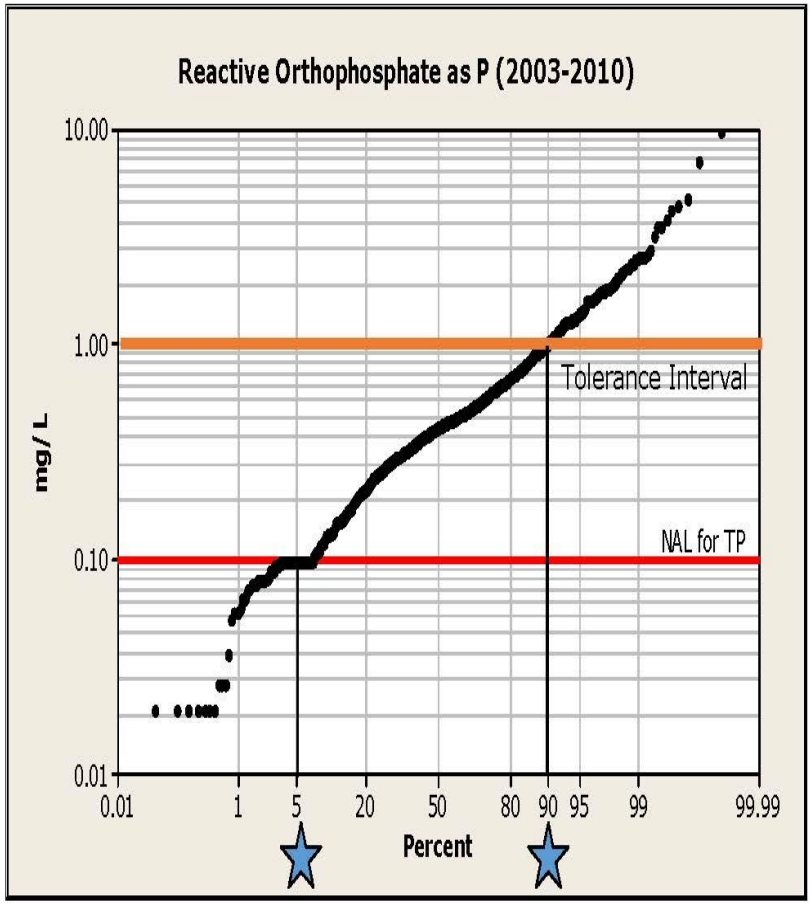


Figure 3.7.6: Reactive Orthophosphate as P Exceedance Frequencies Associated with Dry Weather Reconnaissance Tolerance Intervals Compared with Exceedance Frequencies Associated with NALs



The impact of the switch from "action levels" to "NALs" is demonstrated in **Table 3.7.1**. Under the Dry Weather Reconnaissance Program protocol the Permittees conducted 274 site visits; whereas for the NAL-based program the Permittees conducted 45 site visits. Although the Permittees collected data and information for six times more stations as a part of the Dry Weather Reconnaissance Program, the NALs-based program identified more than six times the number of exceedances, thereby confounding the ability of the Permittees to prioritize investigative efforts.

The South Orange County Permittees have found strong positive linear relationships between phosphorus and metals associated with seepage and exfiltration of shallow groundwater from the Monterey and Capistrano marine sedimentary formations. Both formations are known to be enriched in trace metals and phosphorus and are prevalent across southern Orange County. This evidence suggests that many exceedances are due to non-ID/IC factors (i.e. local geology - Ni, Cd). These findings underscore the concern of the Permittees that the NALs preclude the Permittees from discriminating between instances of ID/IC and non-ID/IC conditions and is therefore inconsistent with a mandate that requires the effective prohibition through ordinance of non-stormwater discharges arising from ID/IC. See additional discussion of this issue in **Attachment 3.7.1.**

Table 3.7.1: Comparison of the 2011-12 NALs Data Collected in the San Diego Region with the Data from the Dry Weather Hybrid Reconnaissance Monitoring Program for the 2009-10 Reporting Period

Constituent	# of NAL Exceedances	% of NAL Exceedances	# of Reconnaissance Action Level Exceeedances	% of Reconnaissance Action Level Exceeedances
	2011-2012		2009-2010	
pH	1	2	0	0
TDS	42	93	0	0
Dissolved Oxygen	2	4	0	0
Turbidity	3	7	3	1
Surfactants	3	7	14	5
Total Coliforms	24	53	0	0
Fecal Coliforms	19	42	0	0
Enterococcus	42	93	0	0
Unionized Ammonia	3	7	8	3
Total Nitrogen	41	91	0	0
Total Phosphate	38	84	11	4
Cadmium	13	28	0	0
Copper	1	2	0	0
Nickel	7	15	0	0
Zinc	1	2	0	0
Total # of Site Visits	**45**		**274**	

3.7.3 Recommendations

The major elements of the program (e.g. the facilitation of public reporting of complaints, and the designation and training of Authorized Inspectors) continue to be vital and successful pieces of the Program. However, the NALs Program has proven to be less effective than the Dry Weather Reconnaissance Program. The recommendation is:

1. **Reinstate an approach, such as the Dry Weather Reconnaissance Program, that allows investigative resources to be directed toward abating priority aberrant discharges.**
2. **Continue implementation of CASC.**
3. **Consider development of a standardized reporting database potentially accessible by all Permittees.**

Implementation Schedule – ID/IC

Proposed ID/IC Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Detect Illegal Discharges and Illicit Connections						
Implement Dry Weather Reconnaissance Program monitoring approach to prioritize investigations on non-stormwater discharges arising from ID/IC.	N					
Facilitate Reporting						
Advertise telephone, web-based, and applications-based reporting systems	C					
Investigate Illegal Discharges and Illicit Connections						
Investigate compliance with, detect violations of, and take actions pursuant to each Permittee's respective Water Quality Ordinance and the *Investigative Guidance Manual*	C					
Maintain records of information from monitoring, a complaint, notification, or response request in an ID/IC database	C					
Evaluate using a standardized ID/IC record-keeping system and/or database amongst all Permittees	N		X			
Enforce upon Illegal Discharges and Illicit Connections						
Take enforcement actions according to each Permittee's respective Water Quality Ordinances and accompanying Enforcement Consistency Guide	C					

Proposed ID/IC Program Actions	Recommendation[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Track enforcement actions	C					
Conduct Training						
Develop additional training modules as needed	E	X				
Conduct training of Authorized Inspectors	C					
Model Sewage Spill Response Procedures						
Implement CASC Program countywide	C					

1. C = Continue; E = Enhance; N = New

2. X = Recommendation will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation.

4.0 Controlling Pollutant Sources: Watershed Programs

The Story: Watershed Programs

- Extensive watershed mapping of hydromodification susceptibility, infiltration feasibility and regional BMP opportunity sites for the entire south Orange County area has been completed.

- Watershed Workplans for all six San Diego Region Watersheds were developed and implemented. These workplans describe the Watershed Permittees' collective watershed strategies to assess, prioritize and address water quality challenges within each watershed.

- Comprehensive Load Reduction Plans (CLRPs) were developed for Aliso Creek, San Juan Creek and San Clemente Coastal Streams Watersheds. These watershed CLRPs were developed to address bacteria pollutants and other watershed 303(d) listed constituents.

- Dana Point harbor was delisted for Indictor Bacteria and 17 shoreline stations were delisted for *Enterococcus*, Fecal Coliform and Total Coliform.

- Baby Beach TMDL dry weather load reductions have been achieved for total coliform and the 50% load reduction milestones for fecal coliform and Enterococcus have also been achieved. Wet weather data also supports the conclusion that TMDL load reductions have been achieved for total coliform and fecal coliform. Further reductions are needed for Enterococcus.

4.1 Overview

Watershed management is the term used for the approach to water quality planning that places an emphasis on the watershed (the area draining into a river system, ocean or other body of water through a single outlet) as the planning area and looks to multi-jurisdictional solutions to problems that cut across programs and jurisdictional boundaries.

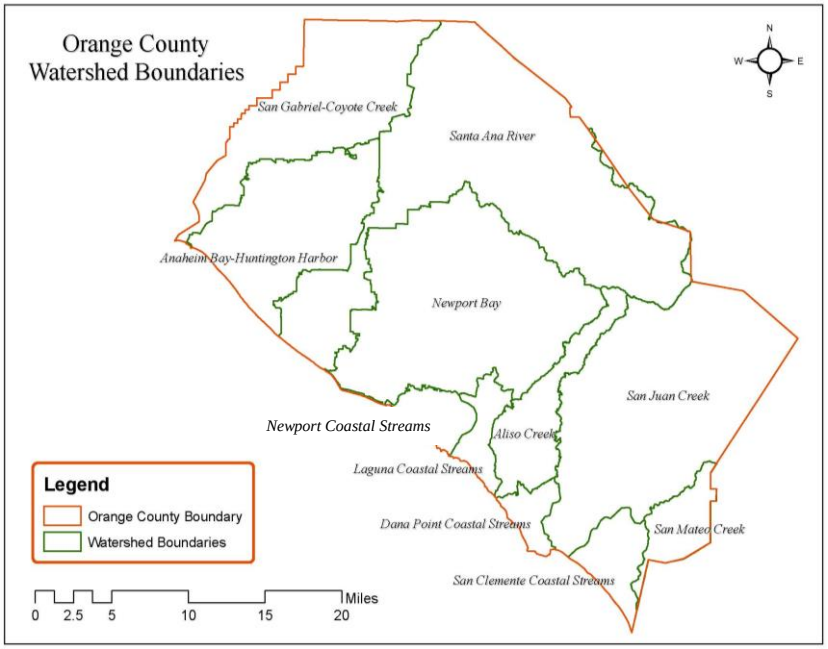
While the focus of watershed planning in south Orange County is on specific pollutants of concern associated with urban stormwater, particularly TMDLs, this management approach is also supportive of broader objectives such as watershed habitat restoration, consistent with the Practical Vision, and integrated water resource management.

There are six distinct watersheds within the San Diego Regional Board area which are identified in **Table 4.1** and shown **in Figure 4.1**

Table 4.1: San Diego Region Watersheds

Watershed Planning Area	**Major Watercourses**
Laguna Coastal Streams	Laguna Canyon Creek
Aliso Creek	Aliso Creek
Dana Point Coastal Streams	Salt Creek
San Juan Creek	San Juan Creek, Oso Creek, Trabuco Creek, Bell Canyon, Verdugo Canyon
San Clemente Coastal Streams	Prima Deshecha, Segunda Deshecha
San Mateo Creek	San Mateo Creek

Figure 4.1: Orange County Watershed Boundaries



4.2 Non-TMDL Watershed Accomplishments

During the Fourth Term Permit, non-TMDL watershed management efforts—supportive of integrated water resource management—have included mapping of the landscape characteristics that are significant for hydrologic processes, adoption of an Integrated Regional Watershed Management Plan for south Orange County, preparation of Watershed Workplans for each of the six San Diego Region Watersheds, and engaging the public regarding local watershed issues.

Watershed Mapping Tool

A key element of watershed planning is identification of opportunities for regional and subregional stormwater management facilities. These facilities can play a critical role in more quickly realizing water quality, hydromodification, water supply and/or habitat goals compared to approaches that are exclusively reliant upon on-site mitigation.

Initial extensive watershed mapping of hydromodification susceptibility, infiltration feasibility and regional BMP opportunity sites for the entire south Orange County area has been completed and is available through the County's land records web-based portal, known as the Land Records 2.0 mapping tool: http://landrecords.ocpublicworks.com/ocsl/.

Integrated Regional Watershed Management Plan

Although it is not a permit requirement, the preparation of an Integrated Regional Watershed Management Plan (IRWMP) provides for a coordinated approach to resource management and capital improvement planning. This coordinated approach also leverages partnerships with regional stakeholders and existing programs and plans, such as TMDLs, and consolidated grants.

The State of California has been promoting integrated regional water management planning, as a means of achieving more sustainable water use. IRWMPs are a more efficient and effective way to manage water resources. It allows for regional prioritization of important watershed issues and for consensus to be reached on how to address those issues. Whereas watershed planning for stormwater management is focused on enhanced BMP implementation targeting specific

constituents of concern within a watershed, an IRWMP is an integrated plan for all water resources projects, including water supply, wastewater, flood management, stormwater and urban runoff, aquatic habitat, and recreation.

Governance for water quality programs is organized around three geographic sub-areas, or watershed management areas (WMAs)--North Orange County, Central Orange County, and South Orange County. Aliso Creek, San Juan Creek, Laguna Coastal Streams, Dana Point Coastal Streams, San Clemente Coastal Streams and San Mateo Creek (within Orange County) watersheds comprise the South Orange County WMA which falls wholly under the jurisdiction of the San Diego Regional Board.

The County of Orange, cities, and water and wastewater agencies of south Orange County formed the South Orange County Integrated Regional Water Management (IRWM) Group in 2004 and subsequently developed and adopted the South Orange County IRWMP in 2005.

In January 2007, the South Orange County IRWMP was one of seven statewide proposals recommended for funding. In July 2007, the South Orange County IRWM Group executed a Prop 50 IRWM Implementation Grant Agreement with the State Water Resources Control Board to receive grant funds in an amount of $25,000,000 for the seven highest ranking projects included in the IRWMP. One of the completed projects for which the water management strategy was water quality was the City of Laguna Beach's Heisler Park Marine Habitat Protection Project. This project was designed to reduce runoff to the ecological reserve. The park improvements include: a controlled and efficient irrigation system; bluff-top landscape grading; surface drain and pathway improvements; storm drain improvements; installation of three (3) urban runoff diversion automation systems in existing Continuous Deflection Separation (CDS) units; and coastal bluff stabilization.

An IRWMP update was initiated in 2012 to meet Prop 84 State guidelines and included a call for projects. 57 project forms were received. These projects were added to previous projects for a total of 139 projects now included in the IRWMP. Five of the top ten projects on the priority project list directly address water quality.

The updated plan was finalized in 2013 and adopted by the South Orange County WMA Executive Committee. The Final and Approved 2013 IRWMP is available at the following link: http://ocwatersheds.com/programs/ourws/wmaareas/wmasouthoc/soc_wma_irwmp

Watershed Workplans

Pursuant to Directive G of Order No. R9-2009-0002, Watershed Workplans were developed for each of the six watersheds in south Orange County. These Workplans describe the Watershed Permittees' development and implementation of a collective watershed strategy to assess and prioritize the water quality challenges within the watershed's receiving waters, identify and model sources of the highest priority water quality challenges, develop a watershed-wide BMP implementation strategy to abate highest priority water quality challenges, and a monitoring strategy to evaluate BMP effectiveness and changing water quality prioritization in each watershed.

The 2012-13 reporting period marked the tenth year of implementation of Watershed Action Plans/Watershed Workplans. The Watershed Workplans build on the considerable work and studies that have been completed collaboratively over a multi-year period. These include the following initiatives:

- Development and implementation of the *Drainage Area Management Plan (DAMP)/Jurisdictional Runoff Management Plans (JRMPs)*.
- *2005 Draft Identification of Retrofitting Opportunities Study* – this study identifies potential retrofit sites adjacent to or near existing flood control infrastructure under public ownership.
- *South Orange County IRWMP* – integrated regional watershed planning fosters development of holistic solutions to problems; addresses problems at the source; and integrates projects and programs throughout the region that have logical overlaps.
- *Southern California Coastal Water Research Project (SCCWRP) epidemiology and microbial source tracking study* – this study examined several new techniques for measuring traditional fecal indicator bacteria, new species of bacteria, and viruses to determine whether they yield a better relationship to human health outcomes than the indicators presently used in California.
- *Hydromodification controls* – these controls seek ways to mitigate erosion impacts by establishing requirements for controlling runoff from new development and significant redevelopment. These plans typically include decentralized storm water management systems and protection of natural drainage features, such as wetlands and stream corridors. Runoff is typically directed toward infiltration-based storm water BMPs, such as those included in the Watershed Workplans, that slow and treat runoff.

The Watershed Workplans consider the findings of the Receiving Waters and MS4 Discharge Monitoring Program in addition to other characterizations of receiving water quality. This data is used to inform management decisions in each of the watersheds, which includes guiding the type and location of BMPs to employ.

Water quality is assessed through a review of water quality standards and objectives, NPDES wet weather and non-stormwater monitoring data, indicator bacteria data for coastal waters collected from the Orange County Health Care Agency (OCHCA) and South Orange County Wastewater Authority (SOCWA), special studies conducted within the region, watershed management plans, and through informal data exchange and discussions with watershed residents, local conservation agents, and government officials.

Indicator bacteria exceedances (as determined by fecal indicator bacteria) at south county beaches and creeks, and the resulting potential for human health impacts, is currently the most significant concern for the region based upon MS4 permit and bacteria TMDL requirements. Consequently, indicator bacteria has been the primary focus of existing watershed water quality monitoring programs. As new data is collected through the Orange County Stormwater Program's regional monitoring efforts, future watershed specific TMDL monitoring and assessment efforts, and pollution source identification monitoring special studies, the characterization of receiving water quality will be expanded to include additional pollutants as priorities.

Changes in receiving water indicator bacteria levels concentrations have seen some positive improvements over the past few years. In general, the number of beach monitoring sites affected by the more stringent *Enterococcus* standard is showing a decreasing trend in the number of sites affected. These changes are attributed partially to 1) the cumulative effects of increasing attention on water conservation and 2) continued education of the public on the pollution prevention, but substantially to 3) implementation of structural BMPs at problematic sites.

Heal the Bay, a nonprofit environmental organization, reports the results of routine monitoring of beaches conducted by local health agencies and dischargers annually in their Beach Report Card. In the 2013 Beach Report Card, water quality in Orange County was reported as excellent with 93% A or B grades. Beach water quality during the winter dry weather was also very good with 86% A or B grades. Wet weather A and B grades (73%) were up four percent from last year and bested the five-year average by 17%.

Examples of special studies on pollutant source tracking for pollutants of concern in addition to and including indicator bacteria include:

Fecal Indicator Bacteria Special Study at Doheny Beach and Poche Beache

The San Juan Creek and San Clemente Coastal Streams Watershed Permittees have invested in source investigation studies and made long term capital investments in additional control measures to reduce runoff impacts on beach water quality at Doheny Beach and Poche Beach. The efforts undertaken during the Fourth Term Permit include:

- Completing the Prima Deschecha watershed study to identify sources and develop plans for additional BMPs to mitigate indicator bacteria levels at Poche Beach;
- Continuing operation of the Poche Beach ultraviolet treatment system to reduce indicator bacteria levels in watershed runoff;
- Conducting a pilot scale falconry project to discourage gulls from congregating at Poche Beach;
- Providing support for the scientific development of new microbial source tracking host-specific fecal source markers through contributions of in-kind services to the Source; and
- Providing support of scientific advancements to identify beaches affected by potential human sources through contributions of in-kind services to the Southern California Bight-13 Regional Monitoring Program Shoreline Microbiology Study.

The goal of the source investigations at Poche Beach and Doheny Beach, which are ongoing, are intended to develop a prioritization effort to identify and ultimately reduce the most important sources that represent a potential health risk for beach visitors.

Origin of Fecal Indicator Bacteria Impairments at Doheny State Beach

This study was designed to answer questions about the origin of bacteria impairments along Doheny State Beach from San Juan Creek. The study found that the native bird population accounts for the single largest percentage of fecal indicator bacteria variability and mass contribution in dry weather flows to the Pacific Ocean Shoreline at the beach.

Additionally, the main sources of fecal indicator bacteria in San Juan Creek appears to be concentrated at the pond at the mouth of San Juan Creek and not from the lower watershed.

Trace Metals

This is an ongoing study in the region, which includes monitoring for trace metals to better understand the nature of sources in runoff. In recent years, efforts lead by the County to characterize natural sources from ambient geology demonstrated that native soil attributes in specific areas are the primary contributor for many constituents of concern such as cadmium, nickel, chloride, sulfate, and selenium. Understanding the true source of naturally derived pollutants is important from not only a scientific basis but also from a management perspective.

Trash & Debris

This special study is ongoing and relates to trash monitoring in San Diego Region watersheds. The goals of the trash monitoring efforts are to help determine the extent of the issue and improve our understanding of managing trash in the environment using multiple efforts on both regional and local scales.

Oso Creek Dissolved Solids Study

This study was conducted to compile information on the impairments and assessed three aspects of water quality in Oso Creek, a subwatershed to San Juan Creek:

1. An evaluation of the current water quality condition of Oso Creek in comparison with three reference streams of similar geological characteristics;
2. Use of stable isotope measurements to assess whether current sulfate levels may be originating from sulfur based fertilizers; and,
3. A review of historic information to examine critical points in the development of the watershed over time that may have contributed to the impairments and may continue as potential barriers to corrective actions.

Three general and somewhat contrary water quality findings from this study are the key points of consideration for future efforts:

1. The dissolved solids are consistent with the geology and reference streams in terms of the concentrations,
2. The process of urbanization appears to have increased dissolved solid levels over the time period of the developed watershed history by increasing groundwater loadings, and
3. Successful efforts to decrease the domestic water runoff appear to have contributed to increases in dissolved solids concentration.

L01S03 Drainage Area Nitrogen and Phosphorus Source Investigation

Water quality data for the L01S03 drainage system in the San Juan Creek watershed has shown that the drainage area has elevated levels of nitrate-nitrogen and phosphorus. This study was conducted to investigate and identify the source of the elevated nutrients. The results of this drainage area source identification and investigation support that the source of

elevated nitrate-nitrogen and phosphorus source in the L01S03 drainage system originates from natural groundwater seepage in contact with the Capistrano Formation geology.

The watershed Permittees use the water quality monitoring data and findings from the special studies to develop BMP action plans. These action plans contribute to attaining receiving water quality objectives. Copies of the BMP action plans are included with each of the Watershed Workplans, which are available at the following links:

Aliso Creek:
http://ocwatersheds.com/programs/ourws/alisocreek/reportsstudies

Dana Point Coastal Streams:
http://ocwatersheds.com/programs/ourws/dpcoastalstreams/reportsstudies

Laguna Coastal Streams:
http://ocwatersheds.com/programs/ourws/lagunacoastalstreams/reportsstudies

San Clemente Coastal Streams:
http://ocwatersheds.com/programs/ourws/coastalstreams/sanclementecoastalreportsstudies

San Juan Creek:
http://ocwatersheds.com/programs/ourws/sanjuancreek/sjreportsstudies

San Mateo Creek:
http://ocwatersheds.com/programs/ourws/sanmateocreek/reportsstudies

Public Outreach and Participation

The governance structure for the WMAs, which was developed at the request of the Orange County Board of Supervisors, includes a variety of methods to engage the general public. The process provides balanced access and opportunity for participation in the IRWM process. It includes participating in stakeholder workshops, inclusion in the IRWM process, communication via email and information sharing via the County's website www.ocwatersheds.com.

Additionally, directive G of Order No. R9-2009-0002 includes a provision for public participation. The first drafts of the Watershed Workplans were posted on the www.ocwatersheds.com website in November 2010 for public review and comment prior to submittal to the San Diego Regional Water Quality Control Board. No comments specific to the plans were received. The south Orange County Permittees held the inaugural annual public stakeholder meeting the following year in December 2012 to identify issues of concern among residents in the watershed. Attendance for the meeting was low. Given the well-established stakeholder structure of the IRWM process, high level of public stakeholder involvement, and in the interest of a truly integrated approach to water resources, all of the south Orange County watershed permittees elected to integrate the annual public update of the Watershed Workplans into the IRWM stakeholder process. This approach also gives the south Orange County watershed Permittees the ability to reach the same stakeholders, as well as a broader audience, including water and sewer agencies and elected officials.

4.3 TMDL Watershed Accomplishments

Through the Fourth Term Permit term, the Permittees have made significant progress addressing the Beaches and Creeks TMDL and the Baby Beach TMDL. Accomplishments include:

Beaches and Creeks Bacteria TMDL

On February 10, 2010, the San Diego Regional Water Quality Control Board adopted indicator bacteria TMDLs for impaired beaches and creeks in the San Diego Region (Beaches and Creeks TMDLs). This TMDL includes over nine and a half miles of County beaches, the entire length of Aliso Creek and the lower mile of San Juan Creek.

As a first step to TMDL compliance, watershed Comprehensive Load Reduction Plans (CLRPs) were developed outlining the BMPs needed to meet TMDL Waste Load Allocations (WLAs) and special studies to identify sources of indicator bacteria and other listed pollutants in the watershed. In October 2012, Aliso and San Juan Creek Watershed Permittees submitted draft CLRPs to the San Diego Regional Water Quality Control Board for review. Subsequently, a draft CLRP for the San Clemente Coastal Streams Watershed was submitted in December 2012.

The CLRPs describe the approach taken by the Watershed Permittees in response to San Diego Regional Water Quality Control Board Resolution No. R9-2010-0001 (Amending the Water Quality Control Plan for the San Diego Basin [9] to Incorporate Revised Total Maximum Daily Loads for Indicator Bacteria, Project I – Beaches and Creeks in the San Diego Region [Including Tecolote Creek]). As described in the resolution, development of a watershed pollutant load reduction plan is a required step in the bacteria TMDL. To fulfill this requirement watershed CLRPs were developed to address bacteria pollutants and other watershed 303(d) listed constituents. Key CLRP elements include: assessing watershed conditions and setting priorities including development of a Watershed Monitoring and Assessment Program; assessing BMP effectiveness and developing a CLRP Implementation Strategy; developing individual Watershed Permittee BMP Action Plans; and, preparing a schedule for loading reductions to be achieved.

The 2010 Clean Water Act Section 303(d) list identifies the following pollutants/stressors for segments in the Aliso Creek Watershed: indicator bacteria, selenium, total nitrogen, total phosphorus, toxicity, Benzo[b]fluoranthene, Dieldrin, and sediment toxicity. San Juan Creek is listed for: indicator bacteria, chloride, sulfates, total dissolved solids, total nitrogen, total phosphorus, toxicity, DDE, Diazinon, and selenium. San Clemente Coastal Streams are listed for: indicator bacteria, phosphorus, turbidity, toxicity, cadmium and nickel. With the exception of indicator bacteria where TMDLs have been developed, current monitoring provides limited data on these other constituents at a watershed scale. Additional monitoring and data analysis is needed to calculate pollutant loads, identify hotspots, better define human health risks, habitat impacts, and in the case of toxicity determine the specific pollutants causing impairment. As a result initial CLRP efforts focus on bacteria TMDLs and a series of additional studies to collect the data necessary to understand the extent of impairment for other watershed pollutants.

The BMP Action Plans contained in the CLRPs detail current and proposed structural and non-structural BMP efforts. Projected watershed bacterial load reductions were calculated

based upon these plans to determine overall progress within the watershed and an expected reduction schedule.

By using an adaptive management approach, it is anticipated that the continual refinement of watershed BMP Action Plans and data gathered through CLRP Monitoring and Assessment Program will result in reductions consistent with bacteria TMDL WLAs and an improved understanding of watershed water quality impairments and the measures needed to address them.

Examples of BMPs in the action plans include two new wetlands constructed during the Fourth Term Permit, the Glenwood Wetland in Aliso Viejo which will treats runoff from 230 acres of golf course, residential and HOA common area and public parks; and the Oso Parkway Southside Wetland in Laguna Hills which treats 30 acres. Wetlands have proven to have high bacteria removal efficiency during dry weather. For example, the Wood Canyon Emergent Wetland at J02P08 in Aliso Viejo has reduced the concentration of indicator bacteria significantly--over 95% or 1 to 2-logs. The level of fecal coliform bacteria dropped to an average of 58 CFU/100 mL, which is lower than REC-1 water quality objective of 200 CFU/100mL. Both the Glenwood Wetland and the Oso Parkway Southside Wetland is expected to achieve similar bacteria removal efficiency.

Another BMP effective at bacterial removal are debris gates. The cities of Laguna Hills, Laguna Niguel and Lake Forest have installed debris gates at a number of catch basins to prevent gross pollutants from entering the MS4. Based on previous projects and studies, the debris gates are anticipated to provide an 85% reduction in debris in basins at pre-wet-season cleanout, and 68% reduction in number of basins containing any pollutant-laden debris that would contaminate influent water during dry weather. During wet weather an average of 85% decrease in debris quantity in catch basins yielding 85% decrease of first-flush pollutant constituents released to MS4 at start of each storm of rainy season has been observed.

The efforts to date to reduce bacteria impairments have proven successful. On October 11, 2011, USEPA issued its final decision regarding the water bodies and pollutants USEPA added to California's 2010 303(d) List, which also included State Water Board staff recommendations for additions, deletions or changes. The following list of segments were recommended for deletion in the 2010 Integrated report and were included in the final approved 2010 303(d) list: Dana Point harbor was delisted for Indictor Bacteria (Note: 0.03 mile was included on the 2010 303(d) list for *Enterococcus* and Total Coliform, and the listing for Total Coliform relates to the SHELL standard and not REC-1); 17 shoreline stations were delisted for *Enterococcus*, Fecal Coliform and Total Coliform; 2 shoreline stations were delisted for *Enterococcus* and Fecal Coliform; 2 shoreline stations were delisted for Fecal Coliform and Total Coliform; and 2 shoreline stations delisted for Fecal Coliform. Note that the 2006 303(d) list included whole segments that were later broken down to stations on the 2010 303(d) list. Several segments/stations were also changed from the all-encompassing Indicator Bacteria on the 2006 303(d) list to Total Coliform, Fecal Coliform, and/or Enterococcus on the 2010 303(d) list.

Baby Beach TMDL

In June 2008, the San Diego Regional Water Quality Control Board adopted indicator bacteria Total Maximum Daily Loads

(TMDLs) for Baby Beach in Dana Point Harbor. The TMDLs require 82.7-96.2% (dependent upon specific indicator bacteria) waste load reductions from the stormdrain system. Total Coliform, Fecal Coliform and *Enterocossus* wet weather reductions have to occur by December 31, 2019. Dry weather reductions for Total Coliform, Fecal Coliform and *Enterococcus* must occur by September 15, 2014.

Through implementation of BMPs to address several suspected bacteria sources, including measures such as manually removing bird feces from the beach, Baby Beach water quality has improved significantly. Data analysis for the 2012-13 reporting period indicates that dry weather TMDL load reductions have been achieved for total coliform and the 50% load reduction milestones for fecal coliform and Enterococcus have also been achieved. Wet weather data also supports the conclusion that TMDL load reductions have been achieved for total coliform and fecal coliform while further reductions are needed for Enterococcus. A recent microbial source tracking special study suggested that a portion of the remaining bacterial exceedances at Baby Beach may be of canine origin, prompting the County to increase enforcement of its policy banning dogs from the beach.

4.4 Recommendations

Aliso Creek Bacteria Investigations

There has been a dramatic reduction in bacteria concentrations in Aliso Creek since 2003 correlating with an increase in watershed Permittee BMP implementation and watershed wide water conservation efforts. This current Aliso Creek Monitoring Program was designed to track Creek bacteria concentrations over a ten year period. 2015 marks the tenth year of implementation of this program, and the following recommendations are made:

1) Reduce current Permittee quarterly progress reporting to an annual basis. Observed watershed bacteria reductions have shifted efforts away from new BMP projects to ongoing BMP maintenance decreasing the benefit of quarterly reporting. This change is consistent with R9-2009-0002 which specifies only an annual assessment of water quality data and municipality programs implemented within high-priority storm drain locations. Permittees will continue to meet quarterly to discuss efforts to reduce bacteria in the Aliso Creek watershed.

2) Continue implementation of monitoring and reporting described in the Revised Aliso Creek Program through December 2015 with 2015 annual reporting to include a reevaluation of the program relative to watershed bacteria TMDLs, the watershed Comprehensive Load Reduction Plan (CLRP), and related NPDES programs. Implementation of the program through 2015 will allow for an evaluation of the data relative to the initial ten year program design and developing fifth term permit NPDES programs.

5.0 Plan Development

5.1 Overview

The Story: Plan Development

- The Permittees have been implementing a strategic management approach that includes model programs specified in the permit and the DAMP, and watershed programs focused on specific water bodies and pollutants.

- The Program employs an iterative, adaptive management approach that includes monitoring, evaluation, program revision, BMP implementation adjustment/enhancement, and continued monitoring.

- The Program conducts annual and permit term (i.e. ROWD) using the guidance from CASQA approach.

- The ROWD recommends an evolution to a more holistic watershed management approach to support integrated water resource management and the optimization of watershed ecosystem services.

The Permittees have developed a strategic approach to stormwater management that is a cyclical process of measurement, analysis and program improvement. This approach is applied at two distinct scales: (1) regionally by the Permittees implementing jurisdictional programs based on the model programs in the DAMP; and (2) in specific watersheds by the Permittees and others participating in watershed programs addressing specific waterbody-pollutant combinations and the restorative goals of the Clean Water Act.

Two basic categories of assessment measure have been used related to (1) the shorter term confirmation of BMP implementation (Implementation or Process Measures, also termed Programmatic Indicators) and (2) the longer term verification of environmental improvement (Validation or Results Measures, including indicators of environmental change). This categorization of measures is intended to reflect two basic assessment questions: (1) are program elements being implemented correctly and effectively? And (2) are environmental improvements being realized?

> *…. Upon determination by either the permittees of the Regional Water Board that discharges are causing or contributing to an exceedance of an applicable Water Quality Standard, the permittees shall promptly notify and thereafter submit a report to the Regional Water Board that describes BMPs that are currently being implemented and additional BMPs that will be implemented to prevent or reduce any pollutants that are causing or contributing to the exceedances of Water Quality Standards. The report may be incorporated in the annual update to the Stormwater Management Plan unless the Regional Water Board directs an earlier submittal. WQO-99-05*

The planning process has been given particular regulatory significance by the approach to MS4 permitting in California. Indeed, the approach was developed as a model for fulfilling the Receiving Water Limitations and Discharges Prohibitions of the Permits. These provisions are based on State Water Resources Control Board Water Quality order 99-05 which creates an iterative management approach as the basis for compliance.

5.2 Plan Development and Effectiveness Assessment

Strategic Management Approach

The Permittees' strategic approach to stormwater management is defined by a cyclical (iterative) process, or *Quality Loop*, of measurement, analysis, and improvement of the program (Figure 5.1). An analogue for this approach is the formal environmental management system for which ISO 14001 establishes standards. It provides a structure that enables the Permittees to *think* about new ways of working, *measure* existing policies and procedures and/or just *implement* existing activities in different ways. The key is the continual search for improvement in the way that regulatory compliance is maintained and the surface water environment protected and enhanced through implementation of BMPs until protection of beneficial uses is achieved.

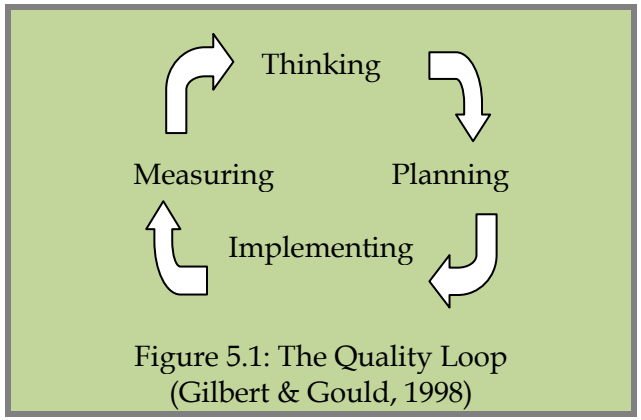


Figure 5.1: The Quality Loop (Gilbert & Gould, 1998)

Due to the episodic and highly variable nature of stormwater, strict compliance with regulatory water quality standards is problematic, especially for wet weather runoff discharges. In recognition of the nature of wet weather discharges, WQO 99-05 requires application of an iterative management process as the basis of compliance with the MS4 permit Receiving Water Limitations provisions. The Permits have required this process be conducted a minimum of once each year. This process is outlined in Figure 5.3.

Plan development occurs at two distinct scales: (1) activities conducted by the Permittees implementing BMPs in their DAMP/LIPs based on the model programs in the DAMP; and (2) activities conducted by the Permittees and others participating in watershed programs addressing specific waterbody-pollutant combinations.

Countywide/Jurisdictional BMPs are specified in the Permits, are applicable on a countywide basis and are proven and cost-effective. They include BMP requirements for municipal maintenance activities, public and business education and outreach, BMP requirements for land development and redevelopment, structural and non-structural BMP requirements for construction projects), BMPs for existing development and identification and elimination of illegal discharges/illicit connections.

For the watershed-based programs, the planning process has been focused principally on specific water quality problems in receiving waters, with impaired waters or TMDLs having a higher priority, and implementation of additional *Watershed BMPs* on an individual and/or collaborative basis. However, watershed-based planning has also led to a number restoration projects.

At both scales the approach uses information obtained from program effectiveness assessment, the countywide baseline water quality monitoring program, and from the additional water quality planning initiatives that have been or are currently being conducted in a number of the watersheds to determine those with beneficial use impairments potentially attributable to urban stormwater. New candidate BMPs can be prevention or removal oriented and can be considered either for updating *Countywide/Jurisdictional BMPs* or for incorporation as *Watershed BMPs*. New BMPs are generally identified from one or more of the following:

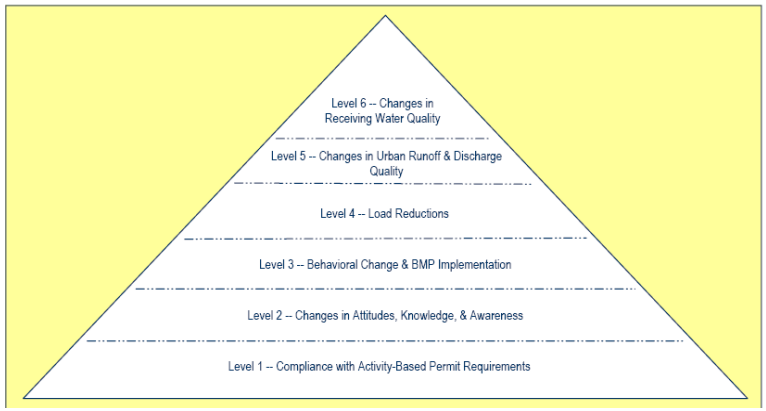
- A review of technical literature (such as the ASCE/EPA database);
- A review of existing control programs;
- Demonstration or research projects;
- Input from consulting firms and municipalities already involved in new BMP implementation; or
- Other sources.

New BMPs, chosen for broad implementation, are selected from candidate BMPs that have been field-tested and evaluated as to their pollutant removal efficiency and cost effectiveness. Methodologies for assessing Program and BMP effectiveness include conventional monitoring (such as water quality monitoring) and non-conventional monitoring. Conventional monitoring can provide a more direct indication of actual BMP performance, but is very challenging for a number of reasons. Water quality monitoring is costly, particularly given the highly variable nature of stormwater runoff, and targeted on a limited number of BMPs. Furthermore, not all BMPs are readily evaluated through water quality monitoring. Therefore, an accurate, quantifiable assessment of the cumulative effectiveness of current BMPs is difficult for a variety of reasons, including:

- A number of BMPs predate the Program which means that there is no "baseline" monitoring data representative of "pre-BMP" conditions;
- Since, to date, no watershed has been uniquely subject to a single BMP, the influence of an individual BMP upon the overall surface water quality cannot yet be readily determined;
- The temporal and spatial variability in water quality, particularly in wet weather, complicates any statistical correlation of the data with storm frequency, storm length and intensity, land use, or land management practices. This confounding factor in statistical analyses has been exacerbated by storm seasons in recent years that have varied much in their intensity, duration and volume;
- Many of the BMPs are implemented to address the issues associated with a specific land use. However, since the land uses are extremely varied within the watersheds, it has not proven possible to characterize the effects of those specific BMPs; and
- Factors other than chemical water quality may be more directly responsible for impairment of beneficial uses, yet all these factors combine in their effects and are difficult to separate one from another.

A method for evaluating overall stormwater program effectiveness on both a programmatic and individual BMP level has been documented by the California Stormwater Quality Association **(Figure 5.1)**. The approach presents a hierarchy of potential outcomes that can be evaluated ranging from programmatic permit compliance assessment to demonstrated changes in receiving water quality. Tiers 1-3 are assessment measures that support the shorter term confirmation of BMP implementation (Implementation or Process Measures, also termed Programmatic Indicators). Tiers 4-6 are assessment measures that reflect the longer term verification of environmental improvement (Validation or Results Measures, including indicators of environmental change).

Figure 5.1: CASQA Assessment Pyramid



In addition, a number of important initiatives are being supported by the Permittees aimed at the further development of assessment techniques and methodologies to support more informed and consistent decision making across Southern California. Notable amongst these initiatives is the Regional Bioassessment Monitoring Program of the Stormwater Monitoring Coalition.

5.3 Watershed Approach

Managing water quality on a watershed basis, rather than jurisdictional basis (see **Table 5.1** for comparison), is generally recognized as offering a more holistic and thereby more effective basis for ultimately achieving meaningful environmental outcomes. Consequently, the ROWD recommends a watershed-based approach as a fundamental structure for the future of the Program.

Watershed

..that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community.

John Wesley Powell, Scientist-Geographer

The development of a Watershed Plan would generally include the following steps:

- Conduct a watershed assessment to identify the watershed issues and establish desired beneficial use and ecosystem service outcomes;
- Establish watershed-specific implementation strategies to address the highest priority issues and concerns; and
- Submit to the Regional Board Executive Officer for review and approval.

A Watershed Plan is consistent with federal regulations regarding the development of NPDES permit conditions, as well as the implementation of storm water management programs, at a watershed scale (40 CFR §§ 122.26(a)(3)(ii), 122.26(a)(3)(v), and 122.26(d)(2)(iv)). This approach is also consistent with USEPA's Watershed-Based NPDES Permitting Policy Statement[1] which explains that, "[t]he utility of this tool relies heavily on a detailed, integrated, and inclusive watershed planning process." USEPA identifies a number of important benefits of watershed permitting, including more environmentally effective results; the ability to emphasize measuring the effectiveness of targeted actions on improvements in water quality; reduced cost of improving the quality of the nation's waters; and more effective implementation of watershed plans, including TMDLs, among others.

The watershed approach requires development and implementation of a comprehensive, collaborative, and prioritized Watershed Plan. A Watershed Plan will allow for the more effective linking of existing stormwater program elements to create an implementation strategy tailored to the needs of the watershed(s). In Orange County, such an approach would also present an opportunity to bring greater cogency to ongoing sub-regional and watershed initiatives, address the current impetus for integrated water resource management, and provide a framework for identifying projects that align with the restorative goals of the Practical Vision.

5.4 Recommendations

The recommendations are:

1. **Continue to implement the Strategic Countywide/Jurisdictional Management approach**.

[1] Memorandum from G. Tracy Meehan, III, Assistant Administrator to Water Division Directors, Regions I-IX, titled "Watershed-Based National Pollutant Discharge Elimination System (NPDES) Permitting Policy Statement," USEPA, December 3, 2002.

2. **Develop a comprehensive Watershed Plan** to evaluate the watershed and to prioritize implementation efforts and associated resource allocation.

3. **Develop pilot program(s) for regional water quality** or groundwater recharge BMPs

4. **Develop model program(s) for water retention credit trading** to facilitate off-site BMP implementation where appropriate and to address existing developed areas.

Implementation Schedule – Plan Development

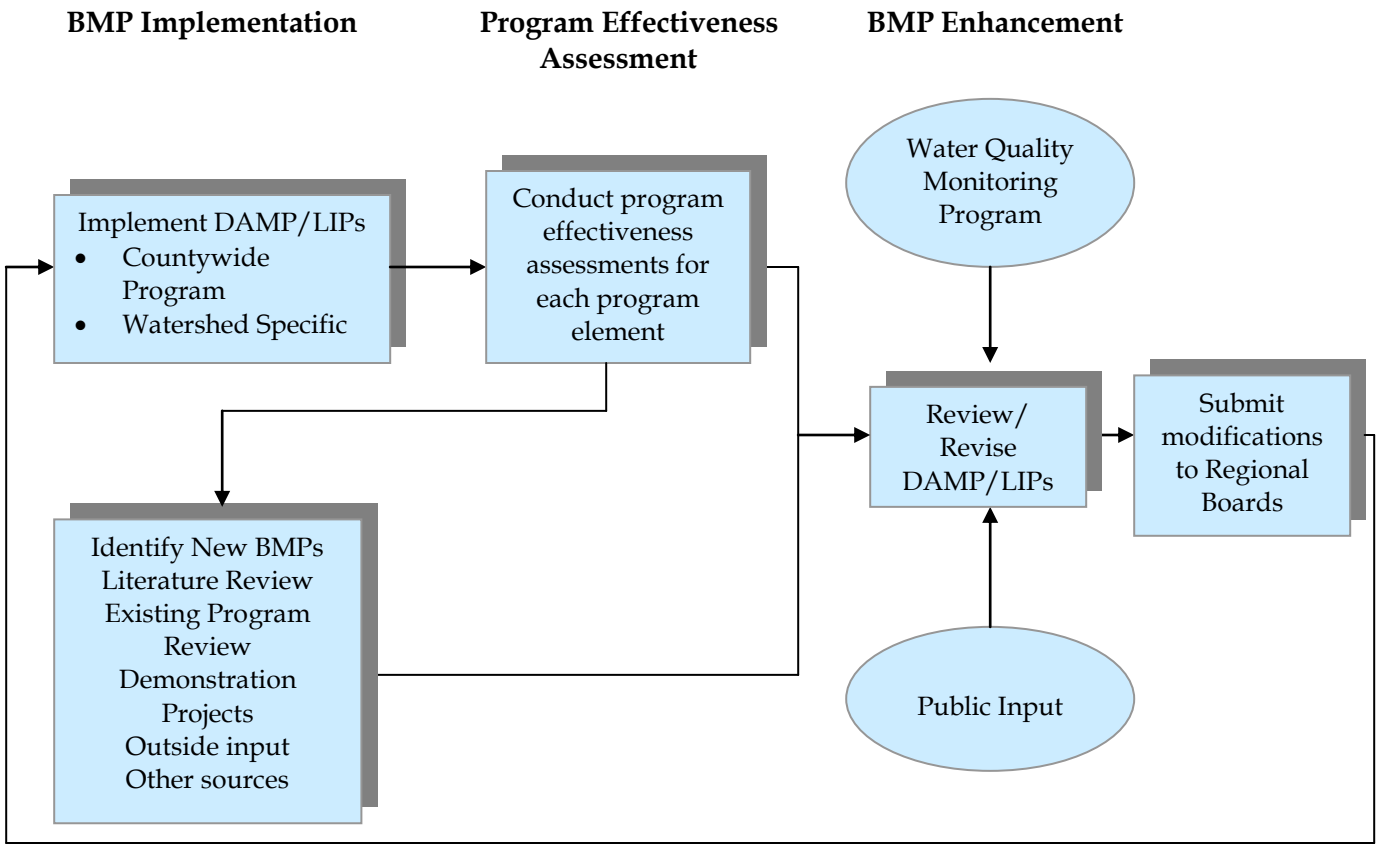
Proposed Plan Development Actions	Recommendations[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Strategic Management Approach						
Countywide/Jurisdictional Management approach	C					
Complete model program for a water quality/quantity trading	E		X			
Complete identification of regional runoff retention BMPs opportunity sites	E		X			
Complete model watershed management plan	N		X			

1. C = Continue; E = Enhance; N = New
2. X = Recommendations will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation

Table 5.1 Comparison of Planning Processes		
	Local Implementation Plan	**Watershed Plans**
Area Covered by Plan	Defined by political (city/county) boundaries	Defined by hydrologic boundaries
Planning Process	Focused on reducing discharges of pollutants in urban runoff and stormwater pollution on a uniform countywide basis. Directed by DAMP/LIP in conformance with NPDES permits requirements.	Focused on improving local receiving water quality where it is adversely impacted by urban runoff and stormwater pollution (or other stressors). Directed by NPDES permit requirements and 303(d) list/TMDLs. Should optimize all watershed attributes and functions (water supply, energy, habitat, economic development, housing, trans…)
Framework	Directed by Orange County Stormwater Program committee structure and Regional Board review. Public consultation principally through California Environmental Quality Act (CEQA) process/Regional Board review.	Directed by broad participation among municipal and public agency stakeholders. Characterized by public participation.
Assessment	Based on information from countywide municipal and regional cooperative investigations of stormwater and receiving water quality	Based on information from watershed-specific investigations and are undertaken on an annual basis, or timescale appropriate

Table 5.1 Comparison of Planning Processes		
	and are undertaken on an annual and 5 year basis.	to the process, impact, or management strategy.
Planning	Broad based approach with emphasis on well established pollution prevention and source control measures.	Includes both pollutant specific approach, with emphasis on treatment controls and consideration of innovative regional solutions, and projects addressing restorative goals of the Clean Water Act.
Implementation	Individually by the Permittees.	Individually and collaboratively by Watershed Permittees and other agencies.
Monitoring	Considers pollutant load reduction.	Considers beneficial use attainment.

Figure 5.2: Strategic management flow diagram



6.0 Program Management and Financing

The Story: Program Management/Financing

- The Program continued to operate with the County of Orange as the Principal Permittee during the permit term.

- The Program operated under a four-tier committee structure with participation at all levels by Permittee staff and management.

- An Implementation Agreement establishes responsibilities and provides a funding mechanism for cooperative activities. Funding has been sufficient to complete common program activities.

- The Program benefitted strongly from cooperation and representation among several regional and statewide groups including the California Stormwater Quality Association and the Southern California Coastal Water Research Project.

- Coordination with Orange County Transportation Authority (OCTA) on development of a Structural BMP Prioritization and Analysis Tool (SBPAT) to support disbursement of Measure M2 funding for water quality projects. SBPAT is a GIS-based decision support tool that is being used to identify and prioritize potential structural BMP retrofit projects throughout Orange County. To date Tier 1 funding of $8.6 million has been awarded to 85 projects and Tier 2 funding of $12.7 million has been awarded to 8 projects.

6.1 Overview

The Program is a cooperative regulatory compliance initiative comprised of 36 separate municipal entities. It addresses Clean Water Act mandates and is focused on the management of urban and stormwater runoff for the protection and enhancement of Orange County's creeks, streams, rivers and coastal waters. The County of Orange is the Principal Permittee and the cities and the Orange County Flood Control District are Co-Permittees on the permits. Principal Permittee and Permittee responsibilities are specified in the permit. Permittee collaboration and cooperation is enabled by an Implementation Agreement. The designation of a Principal Permittee has provided for cost effective management of the overall stormwater program by combining resources to complete those activities which benefit all of the Permittees.

To enable the development and implementation of the Program a program management framework has been established. This management framework comprises a four tier committee structure (Permittees, City Managers' Water Quality Committee, Technical Advisory Committee (TAC)/Planning Advisory Committee (PAC) and Program Committees/Task Forces/Ad Hoc Groups).

6.2 Program Implementation and Assessment

<u>Implementation Agreement</u>

A formal agreement enabling Permittee cooperation is the NPDES Stormwater Permit Implementation Agreement (the "Implementation Agreement") which establishes the responsibilities of the Permittees with respect to compliance with the Permits. The Implementation Agreement also

establishes a funding mechanism for the shared costs of the Program, based on each municipality's area and resident population, and formally recognizes the role of the TAC.

The Implementation Agreement, originally entered into in December of 1990, was amended in October of 1993 to include two additional Permittees (the cities of Laguna Hills and Lake Forest) and formally established the TAC. The Implementation Agreement was amended again, effective June 25, 2002, to include three additional Permittees (the cities of Aliso Viejo, Laguna Woods and Rancho Santa Margarita) and to incorporate modifications to the management structure and cost-sharing formulas.

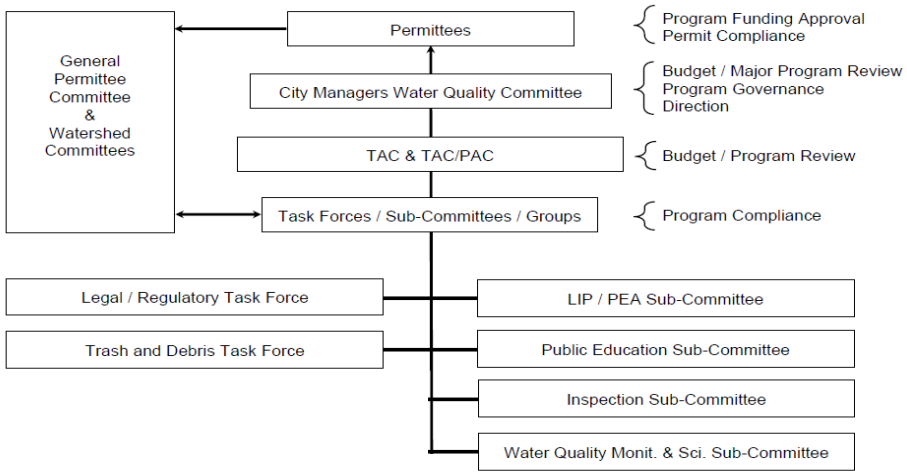
The structure of the Agreement has accommodated the expansion of the Program and the significant escalation of shared costs with the adoption and implementation of the Third- and Fourth-Term MS4 Permits. It has also served as a model for cost sharing collaboration related to the Newport Bay TMDL compliance effort (including the related Nitrogen Selenium Management Program), Aliso Creek TMDL, San Juan Creek TMDL, Coyote Creek TMDL and Regional Harbor Monitoring Program.

Management Framework

The USEPA defines a management framework as "*a lasting process for partners working together. It's a support structure making it easier to coordinate efforts – a structure made of agreed upon standard operating procedures, timelines and forums for communicating with each other*" (USEPA, 2002). The four tier management framework was established in early 2002 to support the development and implementation of the Program.

The Permittee committees, subcommittees, task forces and ad-hoc working groups are shown in **Figure 6.1**.

Figure 6.1: Orange County Municipal NPDES Management Framework



City Manager's Water Quality Committee

The City Manager's Water Quality Committee meets annually and as otherwise needed and provides budget and overall program review and governance direction. The Committee is comprised of several City Managers and is supported by County staff.

City Engineer's Technical Advisory Committee (TAC)/ Planning Advisory Committee (PAC)

The TAC acts in an advisory role to the Permittees and implements policy previously established by the Permittees. The TAC is comprised of one City Engineer, or selected

representative from each of the County Supervisorial Districts and a representative from the County of Orange. The TAC is expanded to the TAC/PAC when matters relating to land development are considered. It meets 4-6 times annually. Meetings of the TAC and the TAC/PAC are subject to the Brown Act.

General Permittee Committee

The General Permittee Committee is the principal forum for disseminating information for program coordinators. The Committee meets monthly (except November). The Committee periodically evaluates the need for creating standing sub-committees and ad hoc committees as needed in order to accomplish the objectives of the Orange County NPDES Stormwater Program.

Sub-Committees/Task Forces

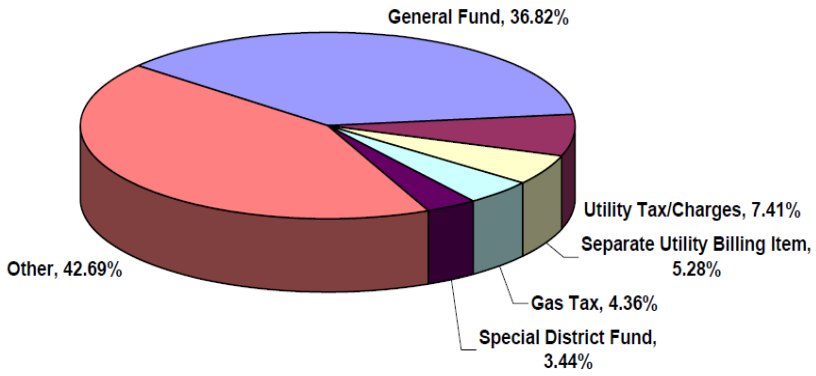
The task forces, sub-committees and ad-hoc working groups provide for the continued development of the Program in specialized areas. The management framework is reviewed annually to ensure it meets program needs. All of the task forces, sub-committees and ad-hoc working groups have brought forward initiatives to meet the requirements of the Fourth Term Permits and to address Program needs under a consensus building process. The frequency (i.e. number of meetings) of meetings is undergoing re-evaluation with respect to the upcoming Fifth Term MS4 Permit as programs attain maturity and require less oversight.

Program Funding

Over the last 10 years the countywide cost of compliance with the permits has almost doubled from approximately $55m in FY2000-01 to $95m in FY2011-12. These costs are anticipated to continue to increase as the Program shifts toward a greater emphasis on watershed management approaches to address burgeoning TMDL requirements.

In FY2011-12, the funding sources used by the Permittees to meet these costs included: General Fund, Utility Tax, Separate Utility, Gas Tax, and Special District Fund, Others (Sanitation Fee, Fleet Maintenance, Community Services District, Water Fund, Sewer & Storm Drain Fee, Grants, and Used Oil Recycling Grants) (See Figure 6.2). While increasingly more stringent regulatory obligations prompt consideration being given to creation of dedicated stormwater funding, there are significant obstacles to overcome.

Figure 6.2: FY2011-12 Funding Sources



In November 1996, California voters approved Proposition 218 which requires that any new or increased property-related fee be subject to voter approval. Proposition 218 has created a significant hurdle for municipalities seeking to levy charges for storm water management programs that, with successive permits are becoming increasingly complex. The Proposition did create an exemption to the voter approval requirement for water, sewer and trash collection fees, and some municipalities adopted the position that stormwater fees were akin to water or sewer fees, and thus exempt from the voter approval requirement. However, the 2002 court decision in *Howard Jarvis Taxpayers Association v. City of Salinas* established definitively that storm water or storm drainage fees are property-related fees subject to Proposition 218, and are not exempt from voter approval requirements. Based on this ruling, any new or increased stormwater fee must be approved by 66% of voters (Office of the Independent Budget Analyst Report, City of San Diego, 2009).

The uncertainty regarding future compliance costs is a concern to the Permittees. Consequently, a costs study, including a review of funding options, will be completed in the next permit term.

6.3 Program Representation and Coordination with Other Agencies

Orange County Transportation Authority (OCTA)

The Principal Permitteee co-chairs the OCTA's Environmental Cleanup Allocation Committee which oversees the Environmental Cleanup Program (ECP). The ECP is intended to support improvements in overall water quality by providing funding for projects addressing transportation-generated pollution. The Committee has been meeting on a monthly basis since November 2007.

The Tier 1 Grant Program is designed to mitigate the more visible form of pollutants, such as litter and debris that collects on roadways and in storm drains prior to being deposited in waterways and the ocean. Tier 1 consists of funding for equipment purchases and upgrades to existing catch basins and related best management practices (BMPs) such as screens, filters, inserts and other streetscale low-flow diversion projects. A total of up to $19.5 million is available for the Tier 1 program over a seven-year window from 2011-12 through 2017-18.

The first Tier 1 call for projects was issued in February 2011. In August 2011, the Board approved the funding of 34 projects to 23 cities and the County of Orange, totaling more than $2.8 million. In August 2012, the Board approved a second round of funding with a total of $2.8 million awarded to 33 projects from 24 cities and the County.

The Tier 2 Grant Program consists of funding regional, potentially multi-jurisdictional, capital-intensive projects. Examples include constructed wetlands, detention/infiltration basins and bioswales, which mitigate pollutants including litter and debris, but also heavy metals, organic chemicals, sediment and nutrients. The Tier 2 program is funded with bond financing revenues with up to $38 million from the EAP allocated through fiscal year 2015-16. Beyond 2015-16, funding will be based on a pay-as-you-go basis.

To date Tier 1 funding of $8.6 million has been awarded to 85 projects and Tier 2 funding of $12.7 million has been awarded to 8 projects.

California Stormwater Quality Association

Since 1989, CASQA has assisted the State of California, USEPA, municipalities, special districts and businesses in developing and implementing effective water quality management programs in California. CASQA is a leader in helping California comply with the municipal and industrial NPDES stormwater mandates of the federal Clean Water Act. The Principal Permittee is active on the Board of Directors, Executive, Program Committee, Policy and Permitting Sub-Committee and Public Information – Public Participation Sub-Committee.

Stormwater Monitoring Coalition

The SMC was formed in 2001 and revised in 2008 by cooperative agreement of the Phase I municipal stormwater NPDES lead Permittees, Caltrans, the NPDES regulatory agencies in southern California, SCCWRP and USEPA Office of Research. The SMC seeks to improve the effectiveness of existing programs, particularly monitoring, by promoting standardization and coordination, and reducing duplication of effort across individual programs.

Southern California Coastal Water Research Project

The SCCWRP is a joint powers agency research institute focusing on the coastal ecosystems of Southern California from watersheds to the ocean. It was formed in 1969 to enhance the scientific understanding of linkages among human activities, natural events, and the health of the Southern California coastal environment; to communicate this understanding to decision makers and other stakeholders; and to suggest strategies for protecting the coastal environment. Current SCCWRP studies of particular significance to the Program include Bight '13, investigations into toxicity, trash and debris and microbiology, and the effort to better coordinate environmental monitoring in the Newport Bay watershed.

The Principal Permittee participated as a Commissioner on SCCWRP's governing board and as the Program's representative on the Commission Technical Advisory Group (CTAG).

6.4 Recommendations

The recommendations are:

1. **Retain the NPDES Stormwater Permit Implementation Agreement**.

2. **Continue the program management framework, albeit with a reduction in meeting frequencies**.

3. **Complete study of future stormwater compliance costs and funding alternatives**.

4. **Continue collaborative regional studies**.

Implementation Schedule – Program Management and Financing

Proposed Program Management and Financing Actions	Recommendations[1]	Implementation Schedule[2]				
		2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Implementation Agreement						
Retain agreement	C					
Program Management Framework						
Retain management framework	C					
Program Costs and Funding						
Complete cost and funding options study	N			X		

1. C = Continue; E = Enhance; N = New
2. X = Recommendation will be completed during this fiscal year. Gray shaded cells indicate ongoing implementation

7.0 Recommendations for Fifth Term Permit

7.1 Overview

Established in 1990, the Program is a cooperative regulatory partnership of the Permittees who operate an interconnected municipal storm drain system which discharges stormwater and urban runoff and at the same time provides flood protection to the United States' sixth most populous county. In Orange County, the impact of urbanization on hydrologic systems and the adverse consequences of both changed hydrology and pollutant source creation are evident today in Orange County's principal drainage systems. However, at the same time, there are very significant water quality successes, such as coastal water quality along the entire length of the Orange County coastline and sources of bacteria contamination having been reduced through targeted actions that can unequivocally be attributed to the impact of the Program and the Permittees.

7.2 Future Program Development and Implementation

During the Fourth Term Permit period there has continued to be a significant allocation of resources the integration of LID and hydromodification control practices into local land development regulation. Going forward, this element of the Program will continue to be a major focus of activity as the Permittees look to create off-site and in-lieu fee options for alternative compliance pathways for land development and re-development. This focus also aligns with broader State Board integrated water resource management goals centered on better use of stormwater for local water supply augmentation, increasing interest in "green infrastructure" solutions and realization of the restorative goals of the Clean Water Act.

Development of a watershed-based planning approach is viewed as the most important next step to take in the development of the Program. Such an approach offers the opportunity for more comprehensively identifying the meaningful environmental and recreational amenities that can be realized in each watershed and the management strategies that will most effectively ensure their realization. These plans will also provide an opportunity, through linkage and integration, for cogency to be brought to a number of related restoration projects and sub-regional water management efforts such as the Integrated Regional Water Management Plans.

With respect to specific water quality constituents of concern, there will be additional effort directed toward pollutant control and research into the environmental significance of pesticide related toxicity, bacteria, and nutrients.

<u>Pesticides</u>

Synthetic pyrethroids have been identified as a significant urban runoff water quality issue on a statewide basis. Directly as a consequence of the efforts of CASQA, the Department of Pesticide Regulation enacted regulations that became effective in July, 2012, specifically intended to limit where structural pest control businesses can apply pesticides in an effort to protect water quality in urban areas. The rules restrict the use of 17 pyrethroid insecticides applied by businesses and significantly limit the amount of pesticides that can be applied outdoors, especially to concrete and other hard surfaces more susceptible to runoff. The regulations also prohibit outdoor pest control applicators and maintenance gardeners from

spraying when it rains or to standing water due to rainfall or watering. An evaluation of the regulations by UC Davis suggested that they could affect an 80% reduction in pyrethroid concentrations in runoff. Nonetheless, the Program will continue to seek to make additional progress with IPM policy implementation and general public education and outreach.

Bacteria

There is significant progress to be reported in Orange County regarding trends in bacterial contamination. Indeed, long-term monitoring of bacterial indicators of contamination shows that exceedances of regulatory standards are low and have been dropping over time and that the annual percentage of Heal the Bay report card grades of A has been between 93% and 97% since 2005. This very significant progress with respect to shoreline water quality underscores the impetus for action that comes from broad societal recognition of a problem, an unequivocally favorable cost-benefit analysis and the ability to implement pragmatic cost effective solutions.

In inland surface waters the issue of systemic elevated concentrations of bacteria persists. However, intensive monitoring of the Aliso Creek watershed appears to show that reductions in dry weather flow have produced significant reductions in bacterial concentrations. This finding points to the value of efforts to curtail outdoor water usage. Consequently, collaboration with water districts on water conservation themed education and outreach will continue to be the focus of efforts to engage the general public and sustain the ongoing reductions in bacteria concentrations being observed in inland surface waters.

Nutrients

Eutrophication of estuaries and coastal waters has been linked to anthropogenic changes in watersheds and is of concern because of the potential for harmful algal blooms, hypoxia, and impacts on aquatic food webs. Across Orange County's watersheds nutrients continue to present a regulatory concern although the environmental significance of nutrients and the specific contribution of urban sources is less understood in these other areas. Nutrient thresholds are frequently exceeded in the County's streams and channels. However, there are many less frequent occurrences of impacts, such as macroalgal overgrowth, due to these exceedances. Moreover nutrient problems are not limited to the urban portion of the County; regional monitoring data show nutrient enrichment and impacts such as increased macroalgal cover and/or lower dissolved oxygen in streams and estuaries in undeveloped regions. Pending further research, the Program will continue to effect reductions in municipal fertilizer use through implementation of the Program's IPM policy and encourage water quality-sensitive landscape maintenance practices in the general population through education and outreach.

7.3 Proposed Management Program

Based upon the prior discussion and in response to the findings of the environmental quality monitoring program, the Program proposes the following management program for the period of the Fifth Term MS4 Permit:

State of the Environment: Bacteria

- Continue targeted data analyses of monitoring data to prioritize problem areas. Conduct additional source

tracking studies as needed, using new monitoring methods based on genetic markers to identify potential sources of these problems such as infiltration into the MS4 from sewage lines. This effort should build on results of the Bight '13 Microbiology Study (**see Section 2.3.6**);

- Continue identifying opportunities to reduce and prevent flows in dry weather, where monitoring and source tracking data suggest the presence of human fecal contamination (**see Section 2.3.6**);

- Conduct statistical power analysis and optimization studies to improve existing monitoring program designs to improve efficiency and take advantage of available information about patterns and trends of contamination (**see Section 2.3.6**);

- Shift resources from routine monitoring to targeted source tracking and adaptive response, using new tools such as genetic markers of human fecal contamination as these become available (**see Section 2.3.6**);

- Continue supporting regional and collaborative research into better monitoring and source tracking tools (**see Section 2.3.6**);

- Improve understanding of health risk related to high wet weather flows, for example, through the Bight '13 Microbiology Study; follow results of the pilot wet weather epidemiology study planned for San Diego and consider supporting the larger, follow-on study planned for 2014-15 (**see Section 2.3.6**); and

- Conduct pilot mass balance studies to determine their utility for improving the prioritization of management actions (**see Section 2.3.6**).

State of the Environment: Dissolved Solids

- Conduct a mass balance study, even if at a crude level, to determine the extent to which the MS4 contributes to dissolved solid levels in the creek (see **Section 2.4.2**);

- Prepare a summary report on historic and contemporary conditions of dissolved solids across south Orange County (see **Section 2.4.2**);

- Invest effort into understanding whether dissolved solids are important stressor on macroinvertebrate communities in the creeks to evaluate the environmental significance of elevated dissolved solid concentrations (see **Section 2.4.2**); and

- Continue evaluating changes in dissolved solids at key locations such as Oso Creek in concert with water conservation efforts to track changes in dissolved solids over time (see **Section 2.4.2**).

State of the Environment: Nutrients

- Conduct an assessment of sources and practices that input to the MS4 to assess the significance of each to downstream issues (**see Section 2.5.5**);

- Continue identifying opportunities to reduce and prevent flows in dry weather (**see Section 2.5.5**);

- Pilot a regional mass balance nutrient model, even if elementary, to help prioritize monitoring and management attention; the Newport Bay watershed and SCCWRP coastal ocean nutrient mass balance models provide useful examples (**see Section 2.5.5**); and

- Use available time series of data to streamline monitoring to improve its statistical and economic efficiency. Sampling effort could be reduced by identifying stations that essentially mimic each other and/or by reducing the spatial and/or temporal intensity of sampling. Monitoring could shift to a sentinel program with a lower frequency of monitoring intended to ensure conditions do not worsen (**see Section 2.5.5**).

State of the Environment: Toxicity

- Reassess management concerns and priorities about metals impacts in freshwater channels, bays and estuaries, and the nearshore coastal zone (**see Section 2.6.5**);

- To the extent that metals, particularly copper, remain a concern because of potential impacts in bays and harbors, recognize that inputs from antifouling paint, which are not an urban runoff issue, are likely a more important source than watershed input (**see Section 2.6.5**);

- Improve information on the use of pesticides in the County, particularly by the largest applicators (**see Section 2.6.5**);

- Work with other interested parties to fill the data gap related to retail sales of pesticides (**see Section 2.6.5**);

- Examine the CDPR database to develop a more thorough picture of trends in reported pesticide use (**see Section 2.6.5**);

- Use this information to expand and focus cooperative outreach efforts about proper pesticide application and the use of alternatives such as botanical oils that are effective, but nonlethal, insect deterrents (**see Section 2.6.5**);

- Use available data to streamline monitoring and improve its statistical and economic efficiency. Consider reducing the current focus on metals monitoring and targeting pesticide monitoring on less expensive representative constituents or surrogates. Consider reducing the frequency of sampling for sediment associated constituents to the Bight Program's sampling frequency (**see Section 2.6.5**);

- Given the overall low level of observed toxicity, consider increasing the use of adaptive responses (e.g., TIEs and other types of causal assessment) in place of intensive routine monitoring (**see Section 2.6.5**);

- Continue taking advantage of opportunities to reduce dry weather runoff to channels (**see Section 2.6.5**); and

- Continue the productive relationship the University of California's South Coast Research and Extension

Center and take advantage of opportunities for its Director to communicate the stormwater management perspective to CDPR (**see Section 2.6.5**).

Controlling Pollutant Sources: Watershed Programs – Aliso Creek

- Reduce current Permittee quarterly progress reporting to an annual basis. Observed watershed bacteria reductions have shifted efforts away from new BMP projects to ongoing BMP maintenance decreasing the benefit of quarterly reporting. (**see Section 4.4**); and

- Continue implementation of monitoring and reporting described in the Revised Aliso Creek Program through December 2015 with 2015 annual reporting to include a reevaluation of the program relative to watershed bacteria TMDLs, the watershed Comprehensive Load Reduction Plan (CLRP), and related NPDES programs. (**see Section 4.4**).

Municipal Infrastructure and Integrated Pest Management

Continue current model programs and:

- Enhance municipal training to address common issues encountered through municipal related complaints and to utilize innovative education formats to encourage effective discussion-based learning. The four most common issues that occur are: trash/debris, pathogen/bacteria, hydrocarbons and exempt discharges. Training will focus on in-classroom engagement of concepts learned prior to the training session and focus on reducing issues and pollutants of concern through specific actions (e.g. runoff reduction to reduce bacteria loading) (**see Section 3.2.3**);

- Develop a municipal green infrastructure program that could include evaluation of opportunities for pilot green street projects of different land use/density configurations and development of a green street guidance manual (**see Section 3.2.3**);

- Examine public land retrofit opportunities for regional BMPs and propose a program to evaluate previously identified regional retrofit opportunities in jurisdictionally owned areas for use in TMDL compliance and LID and/or hydromodification management alternative compliance. This effort will involve the development of watershed models and evaluation of the previously identified potential BMP retrofit sites. Previous reviews (e.g. 2005 RBF retrofit study) will be integrated with current mapping (**see Section 3.2.3**);

- Develop and initiate the implementation of individualized IPM Guidelines for each Permittee with the goal of demonstrating significant and consistent reductions in fertilizer and pesticide applications based on the mission and goals outlined in jurisdictional IPM Policies (**see Section 3.2.3**);

- Conduct pilot soil and/or leaf tissue analysis to guide fertilizer use to ensure nitrogen is not applied at annual rates above those recommended by UCCE research. The Permittees would identify the most fertilizer-intensive area by type (e.g. sports fields) and select one site for analysis. The analysis would assist Permittees in fine-tuning nitrogen application based on

the needs of plants at the highest use areas (**see Section 3.2.3**)

- Improve methods for documenting usage of fertilizer and active ingredient of pesticide on an annual basis to allow for more reliable data on the acreage receiving fertilizer applications. In collaboration with the UCCE, a standardized reporting method would be developed, improving reporting accuracy on both the amount of nitrogen and pesticides applied by Permittees on an annual basis. The objective would be to minimize fertilizer applications where annual rates exceed those recommended by UC research (174 -261 lbs. N/acre) while more accurately capturing the acreage to which fertilizer is applied (**see Section 3.2.3**); and

- Expand training to include peer-reviewed online training courses offered by University of California IPM (UC IPM) and UCCE to ensure the IPM and water quality message reaches as many field staff as possible. Possible options include the UC IPM Urban Pesticide Runoff and Mitigation online training series developed by UC academics across the state to provide a more suitable method to reach field staff unable to attend in-person training. The online training consists of a series of courses directly addressing the impacts of pesticides on water quality as well as practices to mitigate these impacts (http://www.ipm.ucdavis.edu/training/upr-mitigation.html) (**see Section 3.2.3**).

Public Outreach

Continue current model program and:

- Emphasize outreach to school-age children to continue building upon existing partnerships and increasing knowledge of the Orange County community as a whole through increasing knowledge of youth (**see Section 3.3.7**);

- Incorporate current strategic approach of using public awareness survey results to prioritize outreach efforts based on behaviors of concern in tandem with water quality results to document small-scale behavior change over time (**see Section 3.3.7**);

- Coordinate with water supply agencies to incorporate water use efficiency and runoff reduction messaging to maximize program reach and ensure requested behavior changes align with water use efficiency techniques supported by other agencies. Coordinate to encourage behaviors and develop programs supportive of building a sustainable local water supply as identified in the Water Quality Implementation Plan; including building social norms around water use efficiency and elimination of irrigation runoff (**see Section 3.3.7**);

- Develop focused outreach campaigns based on water quality and survey results utilizing CBSM techniques to document changes in targeted behaviors. The Permittees will develop focused campaigns supportive of a singular message with the goal of reducing competing messaging that may lead to inaction. CBSM tactics will be utilized to target behaviors associated with water quality priorities identified in the Water Quality Implementation Plan (**see Section 3.3.7**);

- Encourage greater public participation in stormwater pollution prevention and elimination of non-stormwater discharges through the use of CBSM and increased availability to online resources. Action campaigns would encourage residents to take an identified action and to share efforts with others (**see Section 3.3.7**);

- Social media calendars will synchronize outreach efforts and encourage direct participation in and sharing of program messaging. Social media forms of earned media will complement action campaign elements by encouraging direct residential participation in programs. Activity on social media significantly increases with boosted posts and paid advertising; these unpaid and paid tools will support CBSM programs (**see Section 3.3.7**); and

- Review website for usability and revise structure as needed to meet goals of increasing public use of web content. The goal of the review will be to increase access to mapping tools, water quality data and BMPs to prevent water pollution (**see Section 3.3.7**).

New Development / Significant Redevelopment

- Implement an approach to hydromodification management that is informed by a watershed analysis and channel-specific protection and restoration goals. The Permittees understand that, consistent with current published research, a "one-size-fits-all" for hydromodification management is not appropriate for highly modified urban stream systems. Pending a watershed analysis, land development projects discharging runoff to engineered channels, should not be required to implement hydromodification management controls (see **Section 3.4.3**);

- Incorporate an IRWM element into the land planning/land development process. The Permittees understand that an integrated water resources management approach is needed to optimize attainment of water quality protection, water conservation, flood control, and stream protection goals. The Permittees therefore intend to incorporate an integrated water resources management element into their land planning and land development processes so that as development projects begin entitlement this approach and opportunities to achieve this approach are evaluated. This recommendation will require a modified LID Hierarchy that establishes the equivalency of "On-site BMP" and "Off-Site /Regional BMP" solutions (see **Section 3.4.3**);

- Create an exemption from Project WQMP requirements for steam and watershed restoration projects (see **Section 3.4.3**);

- Create an exemption for emergency public safety projects where delay would compromise public safety, public health and/or the environment (see **Section 3.4.3**);

- Develop an internet based regional geodatabase. To effectively implement an IRWM and watershed management approach, access to information that describes all of the key hydrologic process and landscape characteristics will be critical. The

Permittees are developing and starting to use an internet-based regional geodatabase to give developers and municipal staff access to the geotechnical and hydrologic information necessary for evaluating the application of the LID hierarchy to sites (see **Section 3.4.3**);

- Develop an internet based Project WQMP Submittal Tool and Database potentially in collaboration with Riverside and San Bernardino. The Permittees spend a significant amount of time plan checking and tracking Project WQMPs and so the permittees propose development of an internet based Project WQMP review tool to streamline the submittal and review of WQMPs, allow for enhanced tracking of WQMPs and WQMP inspections, and help with effectiveness assessments and annual reporting (see **Section 3.4.3**);

- Pilot the use of technology to better track Project WQMP inspections and follow up actions needed. To fully utilize the WQMP Submittal Tool and Database WQMP inspections could be performed with tablets or other devices where GIS information and other information can immediately be uploaded to the database. The Permittees propose piloting the use of tablets or other devices linked to the Database for Project WQMP inspections by a select number of cities (see **Section 3.4.3**); and

- Enhance the data collected for WQMPs to have a better understanding of water quality benefits on an annual basis. The Permittees desire to perform a better assessment of the New Development/Significant Redevelopment Program. In order to better understand the effectiveness of the program, the Permittees propose to collect new critical data elements, and enhance data quality by integrating information into the WQMP Submittal Tool and Database. New data would include volumes of water treated, land area treated, and other relevant information needed to evaluate TMDL compliance, to identify developed/redeveloped areas that meet LID and/or hydromodification requirements, and to track BMP maintenance as a measure of effectiveness (see **Section 3.4.3**).

Construction

Continue current model program and

- Reduce the frequency of inspection for "high" priority sites from bi-weekly to twice during the wet season and reduce the frequency of inspection for "medium" priority sites from monthly to once during the wet season (see **Section 3.5.3**);

- Pilot a GIS and internet-based database to track construction sites. In order to provide easier tracking of construction sites on a countywide basis, the Permittees will develop a GIS and internet-based database where information regarding each construction site can be entered. The Permittees would examine the benefits of such a database by piloting implementation with a select number of cities (see **Section 3.5.3**);

- Conduct pilot field-testing of personal electronic devices to document inspections onsite. Use of tablets

or other electronic devices during inspections will allow inspectors to immediately upload construction site information to the GIS based database. The Permittees would pilot the use of these technologies with a select number of cities (see **Section 3.5.3**); and

- Conduct QSD/QSP Training. The QSD/QSP Training developed by the State Board and CASQA provides a detailed understanding of the Construction General Permit. The Permittees propose providing this training to municipal staff every other year to ensure that inspectors and other municipal staff understand the CGP requirements that are to be implemented for construction projects in their jurisdiction. It is anticipated that with potential changes to the CGP being adopted in 2014 that municipal staff should be aware of these changes and any new or modified requirements for CGP compliance (**see Section 3.5.3**).

Existing Development

Continue current model program and

- Consider incorporating the updated CASQA BMP fact sheets into the Existing Development Model Program (see **Section 3.6.6**).

Illegal Discharges/Illicit Connections

- The major elements of the program (e.g. the facilitation of public reporting of complaints, and the designation and training of Authorized Inspectors) continue to be vital and successful pieces of the Program. However, the NALs Program has proven to be less effective than the Dry Weather Reconnaissance Program. The recommendation is (see **Section 3.7.3**):
    - Reinstate an approach, such as the Dry Weather Reconnaissance Program, that allows investigative resources to be directed toward abating priority aberrant discharges;
    - Continue implementation of CASC; and
    - Consider development of a standardized reporting database potentially accessible by all Permittees.

Plan Development

- Continue to implement the Strategic Countywide/Jurisdictional Management approach (**see Section 5.4**);
- Develop a comprehensive Watershed Plan to evaluate the watershed and to prioritize implementation efforts and associated resource allocation (**see Section 5.4**);
- Develop pilot program(s) for regional water quality or groundwater recharge BMPs (**see Section 5.4**); and
- Develop model program(s) for water retention credit trading to facilitate off-site BMP implementation where appropriate and to address existing developed areas (**see Section 5.4**).

Program Management and Financing

- Retain the NPDES Stormwater Permit Implementation Agreement (**see Section 6.4**);

- Continue the program management framework, albeit with a reduction in meeting frequencies (**see Section 6.4**);

- Complete study of future stormwater compliance costs and funding alternatives (**see Section 6.4**); and

- Continue collaborative regional studies (**see Section 6.4**).

Attachment 1.1:
Permittee
Contact List

NPDES Permittee Contact List
San Diego Region

	Aliso Viejo	Dana Point	Laguna Beach	Laguna Hills	Laguna Niguel	Laguna Woods	Lake Forest
Name	**Moy Yahya**	**Lisa Zawaski**	**Tracy Ingebrigtsen**	**Ken Rosenfield**	**Nancy Palmer**	**Chris Macon**	**Devin Slaven**
Title	Environmental Programs Manager	Senior Water Quality Engineer	Senior Water Quality Analyst	Director of Public Works	Senior Watershed Manager	Special Projects Manager	Water Quality Specialist
Address	12 Journey, Suite 100	33282 Golden Lantern	505 Forest Ave.	24035 El Toro Rd.	30111 Crown Valley Parkway	24264 El Toro Road	25550 Commercentre Dr. Ste.100
City,CA Zip	Aliso Viejo, CA 92656	Dana Point, CA 92629	Laguna Beach, CA 92651	Laguna Hills, CA 92653	Laguna Niguel, CA 92677	Laguna Woods, CA 92637	Lake Forest, CA 92630
Alternate Name	**Shaun Pelletier**	**Brad Fowler**	**Mike Phillips**	**Humza Javed**	**JC Herrera**	**Moy Yahya**	**Angel Fuertes**
Title	Director of Public Works/City Engineer	Director of Public Works	Environmental Specialist	Associate Civil Engineer	Civil Engineer Tech/WQ Analyst	Code Enforcement & Water Quality Mgr	Assistant City Engineer
Address	12 Journey, Suite 100	33282 Golden Lantern	505 Forest Ave.	24035 El Toro Rd.	30111 Crown Valley Parkway	24264 El Toro Road	25550 Commercentre Dr. Ste 100
City,CA Zip	Aliso Viejo, CA 92656	Dana Point, CA 92629	Laguna Beach, CA 92651	Laguna Hills, CA 92653	Laguna Niguel, CA 92677	Laguna Woods, CA 92637	Lake Forest, CA 92630

	Mission Viejo	Rancho Santa Margarita	San Clemente	San Juan Capistrano	Countywide Program	County of Orange	OC Flood Control District	Regional Water Quality Control Board
Name	**Joe Ames**	**Rae Beimer**	**Tom Bonigut**	**Ziad Mazboudi**	**Richard Boon**	**Chris Crompton**	**Greg Yi**	**James (Jimmy) Smith**
Title	Assistant City Engineer	Stormwater Program Manager	Assistant City Engineer	Senior Civil Engineer/NPDES Coord.	Stormwater Program Manager	Manager, Environmental Resources	Project Manager	Assistant Executive Officer
Address	200 Civic Center Drive	22112 El Paseo	910 Calle Negocio, Suite 100	32400 Paseo Adelanto	2301 N. Glassell Street	2301 N. Glassell Street	300 N. Flower Street, Suite 716	9174 Sky Park Court, Ste. 100
City,CA Zip	Mission Viejo, California 92691	Rancho Santa Margarita, CA 92688	San Clemente, CA 92673	San Juan Capistrano, CA 92675	Orange, CA 92865	Orange, CA 92865	Santa Ana, CA 92703	San Diego, CA 92123-4340
Alternate Name	**Richard Schlesinger**	**E. (Max) Maximous**	**Mary Vondrak**	**Keith Van Der Maaten**	**Chris Crompton**	**Tony Olmos**	**Vincent Gin**	**Tony Felix**
Title	City Engineer	City Engineer	Management Analyst II	Utilities Director	Manager, Environmental Resources	Assistant Director of OC Engineering	Admin Manager II	Water Resource Control Engineer
Address	200 Civic Center Drive	22112 El Paseo	910 Calle Negocio, Suite 100	32400 Paseo Adelanto	2301 N. Glassell Street	300 N. Flower	300 N. Flower Street, Suite 315	9174 Sky Park Court, Ste. 100
City,CA Zip	Mission Viejo, CA 92691	Rancho Santa Margarita, CA 92688	San Clemente, CA 92673	San Juan Capistrano, CA 92675	Orange, CA 92865	Santa Ana, CA 92702-4048	Santa Ana, CA 92703	San Diego, CA 92123-4340

Attachment 3.4.1: Recommendations for Fifth term Permit - Hydromodification

Recommendations for Fifth term Permit: Hydromodification

The Fifth Term Permit should include an initial or time limited exemption for conveyance channels that are engineered and regularly maintained for the capacity to convey peak flows from the 10-year or greater storm for ultimate build out condition from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean. The proposed exemption is necessary to provide adequate time to develop a prioritized approach informed by a holistic watershed analysis

Discussion

The Program has expended significant resources to map and characterize the County's drainage systems and create a geodatabase that includes significant information regarding channel attributes. The geodatabase identifies the susceptibility of channel and stream systems to hydromodification from increased flow rates and durations. These efforts have categorized three basic channel conditions;

1. Natural condition or minimally modified;
2. Large river channels that are highly engineered and modified; and
3. Channels with substantial modification for flood control, most of which are engineered and maintained.

The Program proposes to prioritize the hydromodification management approach to identify and fully protect near-natural condition channels. Engineered channels with substantial modification and flood control function will have a lower priority for hydromodification management. A holistic watershed analysis will evaluate and prioritize channel reaches or basins regarding their potential for rehabilitation or potentially improving their ecological functions. An initial limited time exemption will provide the time to determine which modified channels have potential for rehabilitation to a more natural state, as well as channels with more constraints that reduces their potential for rehabilitation. Highly modified channels require further evaluation for several reasons:

- Engineered channels were installed for the purpose of flood control and protection of public safety and property. Alterations to these channels may conflict with their primary function in the built environment. Additionally, engineered flood control channels generally have limited options for modification as they must provide their mandated service of flood control within a right-of-way constrained by adjacent development. In virtually all cases, it is likely to be cost prohibitive to purchase additional right of way so that flood control channels could modified to approximate a natural state.
- Studies[1] have shown that hydromodification is caused by storms up to the 10 year event. Engineered channels designed to convey the 10-year ultimate build out condition will therefore not experience hydromodification impacts. and if impacts or damage does occur, the Flood Control District is legally obligated to repair the channel and restore the design function.
- The pre-development stream channel pathways were dynamic and changed through time. These natural washes were modified to provide flood protection for developed areas, fundamentally changing the slope and composition of the bed material. This modification is evident in south Orange County as identified for both Prima Deshecha identified in **Figure**

1 and Segunda Deshecha identified in **Figure 2** below. In both cases the historic paths of these streams were straightened, and development in the area was built as close to the modified channel right-of-way as possible. There are few opportunities to change the condition of these streams as most changes would require additional right-of-way acquired through condemning existing development.

The adverse hydrologic impacts to stream systems that can arise from land development must, be understood as a basis for the lawful requirement of mitigation. Based on the takings clause of the U.S. and California constitutions and the Mitigation Fee Act, hydromodification control requirements applied to development projects must bear a reasonable relationship to the impacts of the project. Requiring hydrologic controls on projects draining to receiving waters not susceptible to hydromodification is contrary to these legal requirements. An initial exemption for engineered channels is consistent with this mitigation concept of relationship and nexus to impacts.

In addition to legal concerns regarding the overly broad application of hydromodification management controls, significant fiscal constraints confront restorative goals. The Prima Deshecha and Segunda Deshecha watersheds (**Figures 1 & 2**), for example, demonstrate the quite profound changes to these channel systems that have attended development of the landscape. Moreover, it is evident in **Figures 1** and **2** that a re-configuration of these channels toward more natural channel alignments will require more land. Because of the costs identified in **Table 1** it will be fiscally infeasible to restore in many instances. The watershed analysis is needed to identify modified channels that genuinely present opportunities for restoration or rehabilitation in south Orange County and which will benefit from hydromodification management.

Table 1 Average Property Costs in Orange County

Property Type	Cost (per square foot)	Cost (per acre)
Retail	$355.52	$15,486,451.20
Office	$249.47	$10,866,913.20
Industrial	$179.39	$7,814,228.40

Source: Loopnet.com

A final consideration is another aspect of state law. The Orange County Flood Control District has been delegated authority by the Legislature to construct channels and infrastructure for flood control purposes. These engineered channels are intended for the protection of public safety and property and are mandated by the Orange County Flood Control Act of 1927. Engineered channels serve the public health and safety through flood control protection. A significant portion of Orange County lies in a flood plain and the public needs the benefits of these flood control channels for protection of public safety and property.

Based on the above information a time limited (i.e. pending completion of a watershed analysis) exemption for engineered channels is warranted and should be provided in the Fifth Term Permit for all engineered channels in South Orange County. Provided below are **Figures 3-14** that identify the engineered channels and associated drainage areas in South Orange County, including specific jurisdictions, that would be exempt for discharges to an engineered channel conveyance system with the capacity to convey the 10-year ultimate condition that extends from the point of discharge to water

storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.

The approach to hydromodification management should be to protect the highest quality streams from future impacts of increased volume and velocity of runoff that will cause hydromodification impacts. A secondary goal of hydromodification management can be restoration or rehabilitation of stream channels where it is feasible, however the watershed analysis needs to be completed first, to identify which streams restoration or rehabilitation is practical.

Figure 1: Prima Deshecha Watershed – 1947 vs. 2012 Alignment

Figure 2: Segunda Deshecha Watershed – 1947 vs. 2012 Alignment

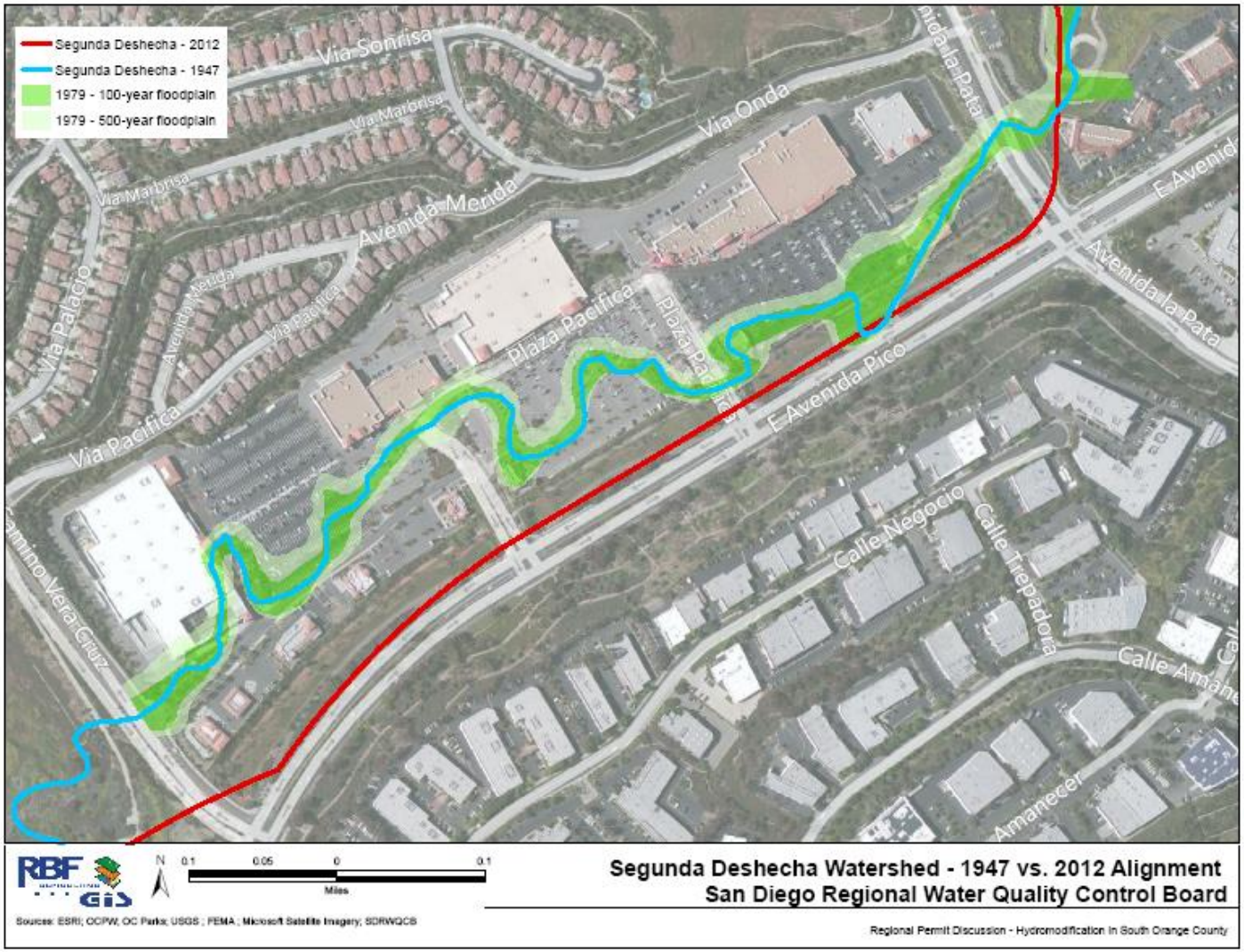


Figure 3: South Orange County Engineered Channels Exemption Areas

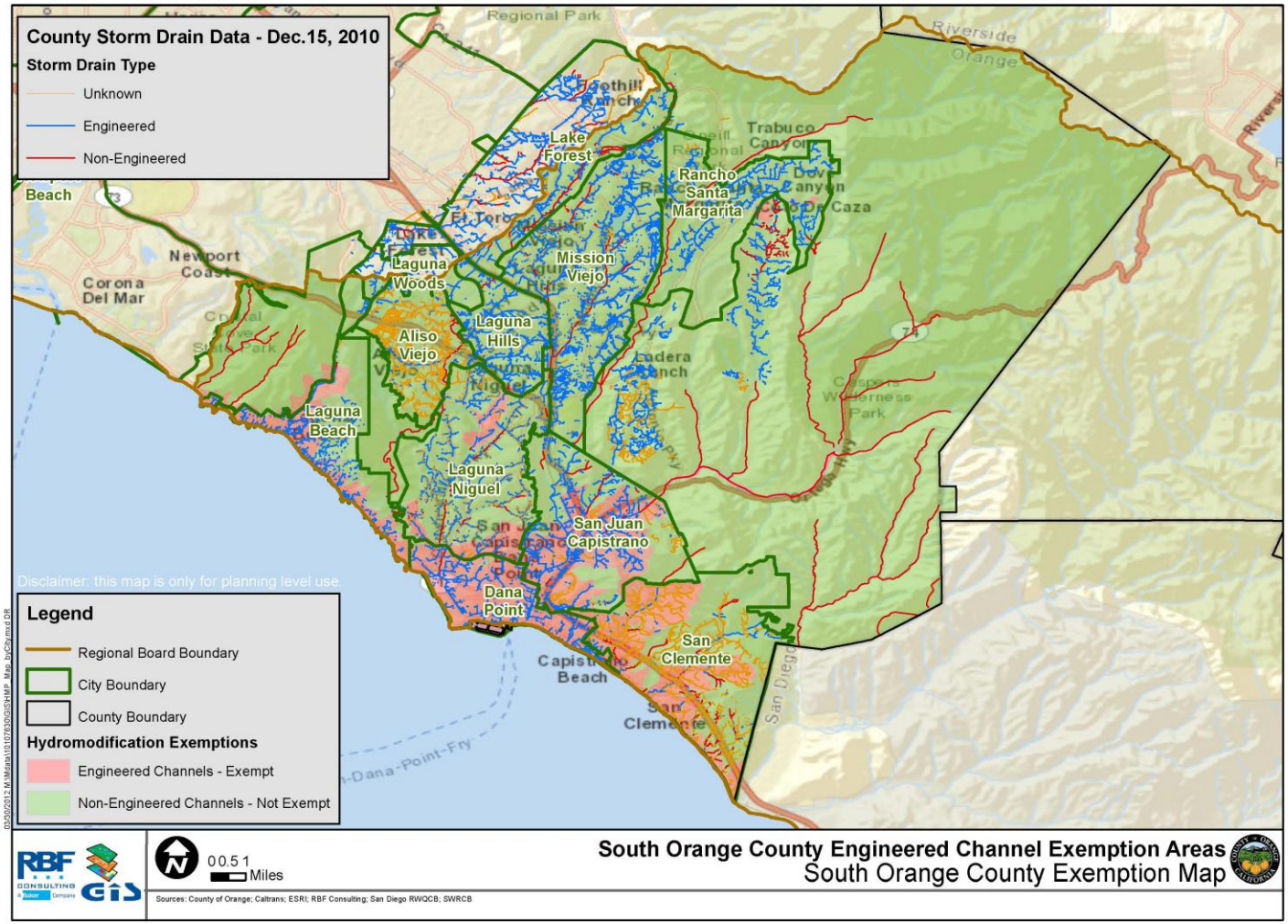


Figure 4: Lake Forest - South Orange County Engineered Channels Exemption Areas

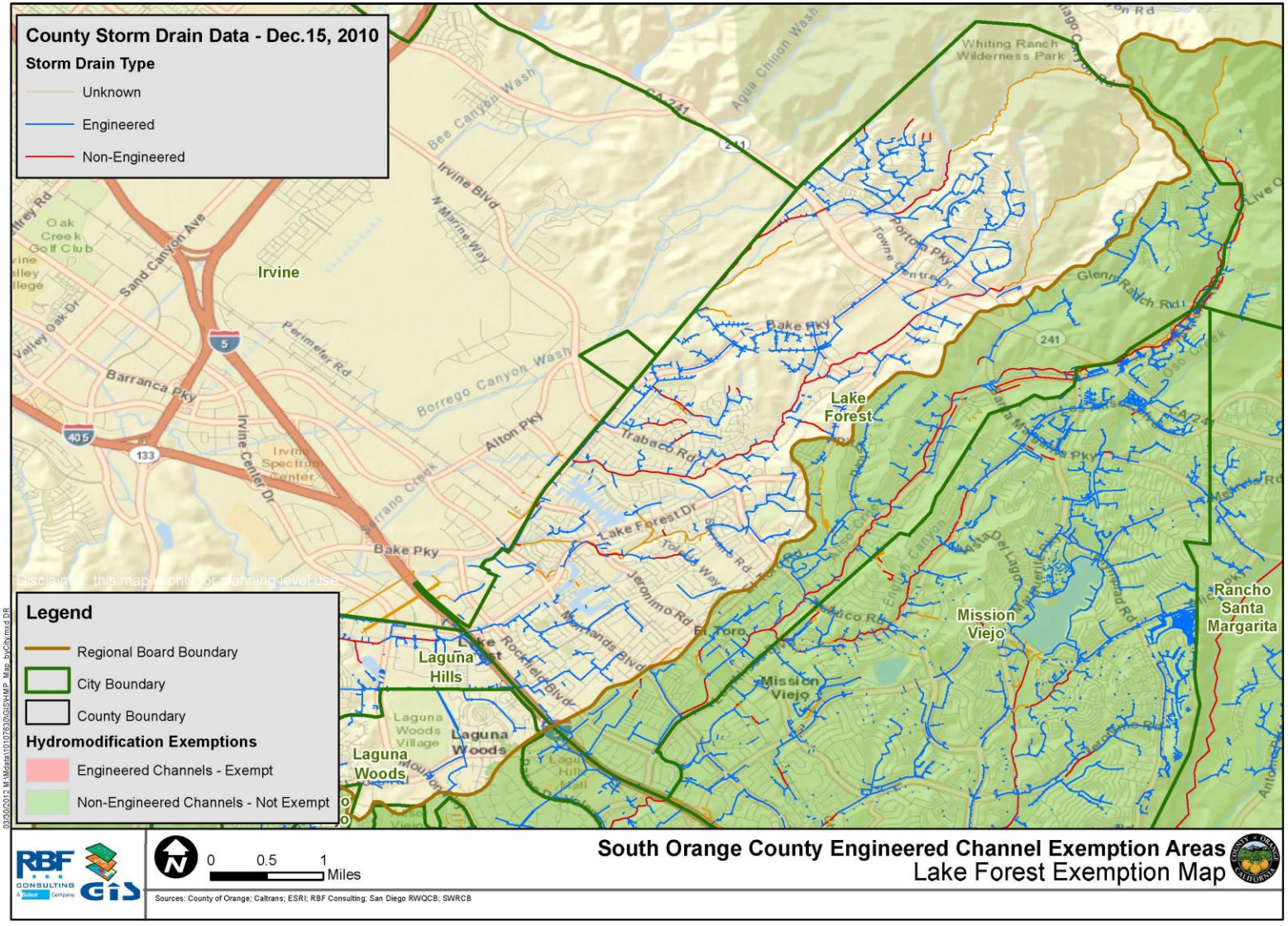


Figure 5: Laguna Woods - South Orange County Engineered Channels Exemption Areas

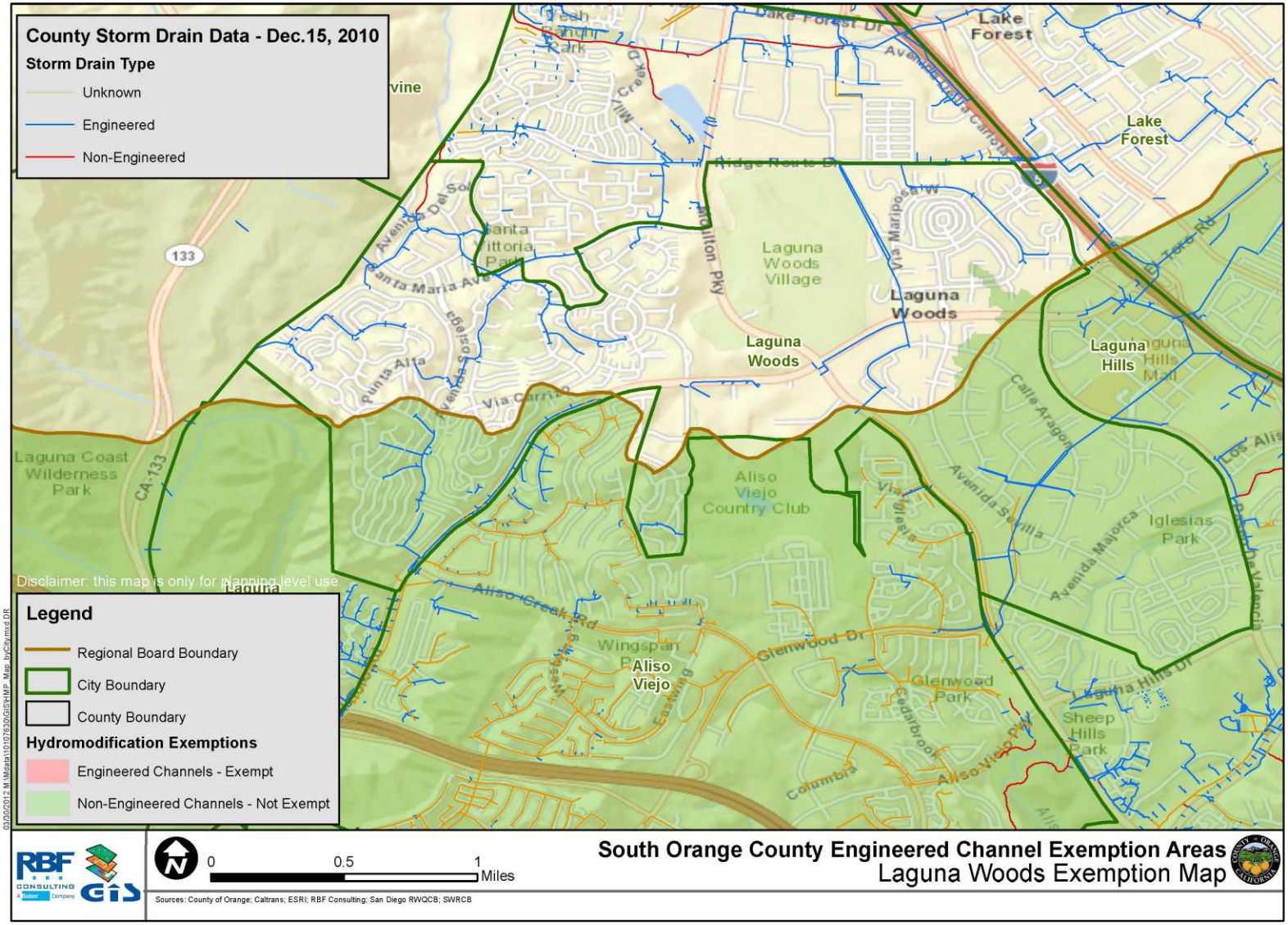


Figure 6: Rancho Santa Margarita - South Orange County Engineered Channels Exemption Areas

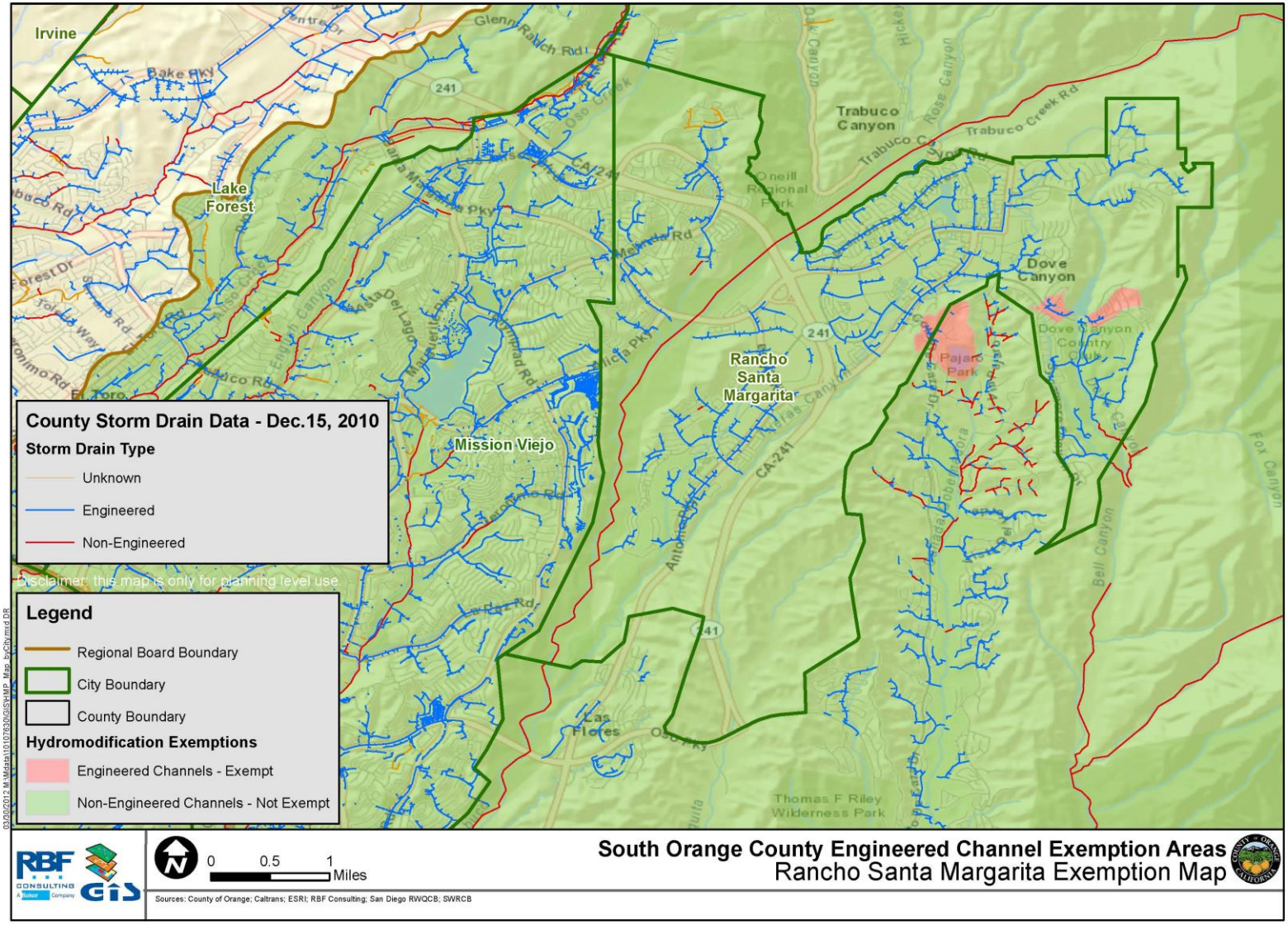


Figure 7: Mission Viejo - South Orange County Engineered Channels Exemption Areas

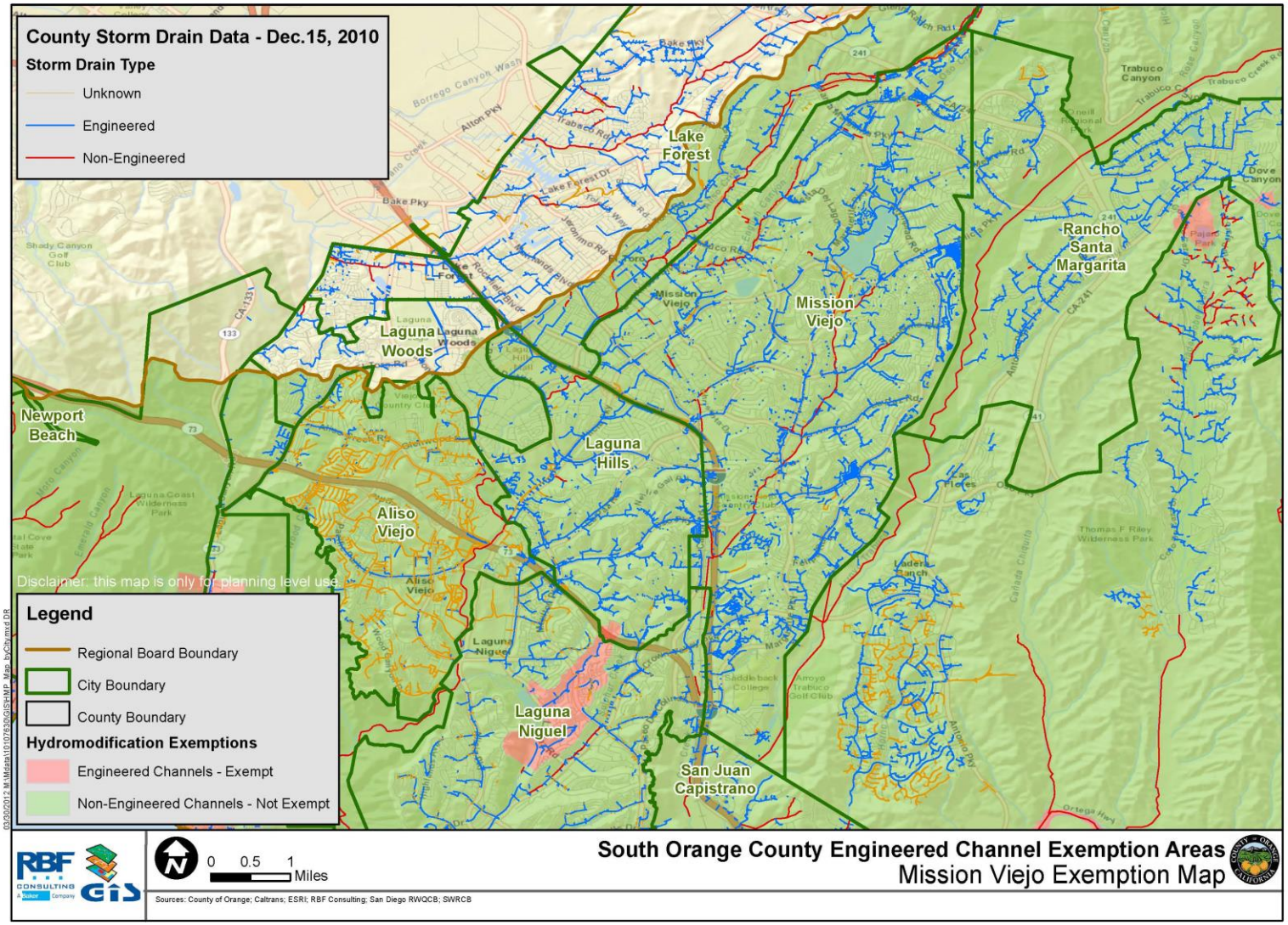


Figure 8: Laguna Hills - South Orange County Engineered Channels Exemption Areas

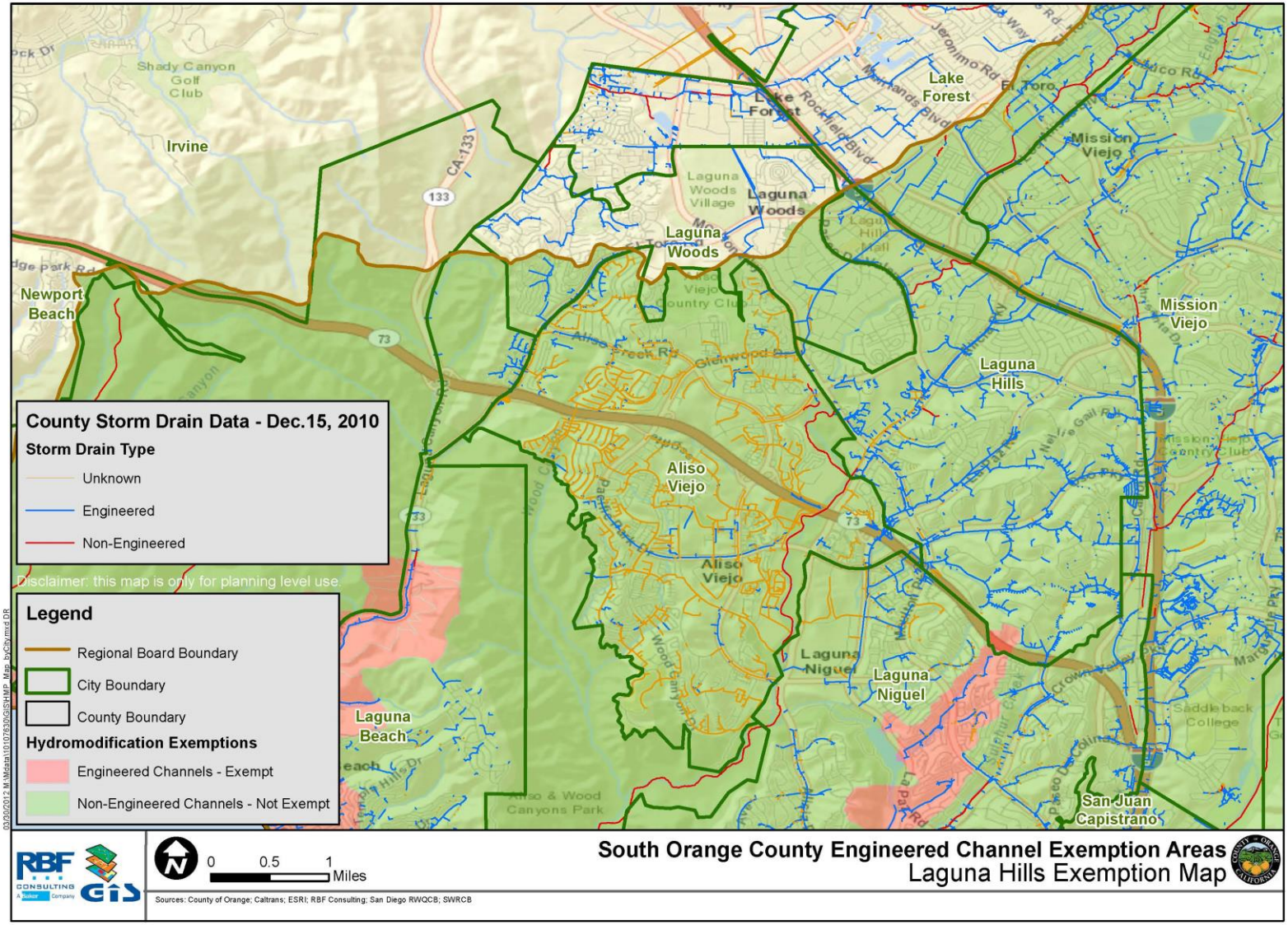


Figure 9: Aliso Viejo - South Orange County Engineered Channels Exemption Areas

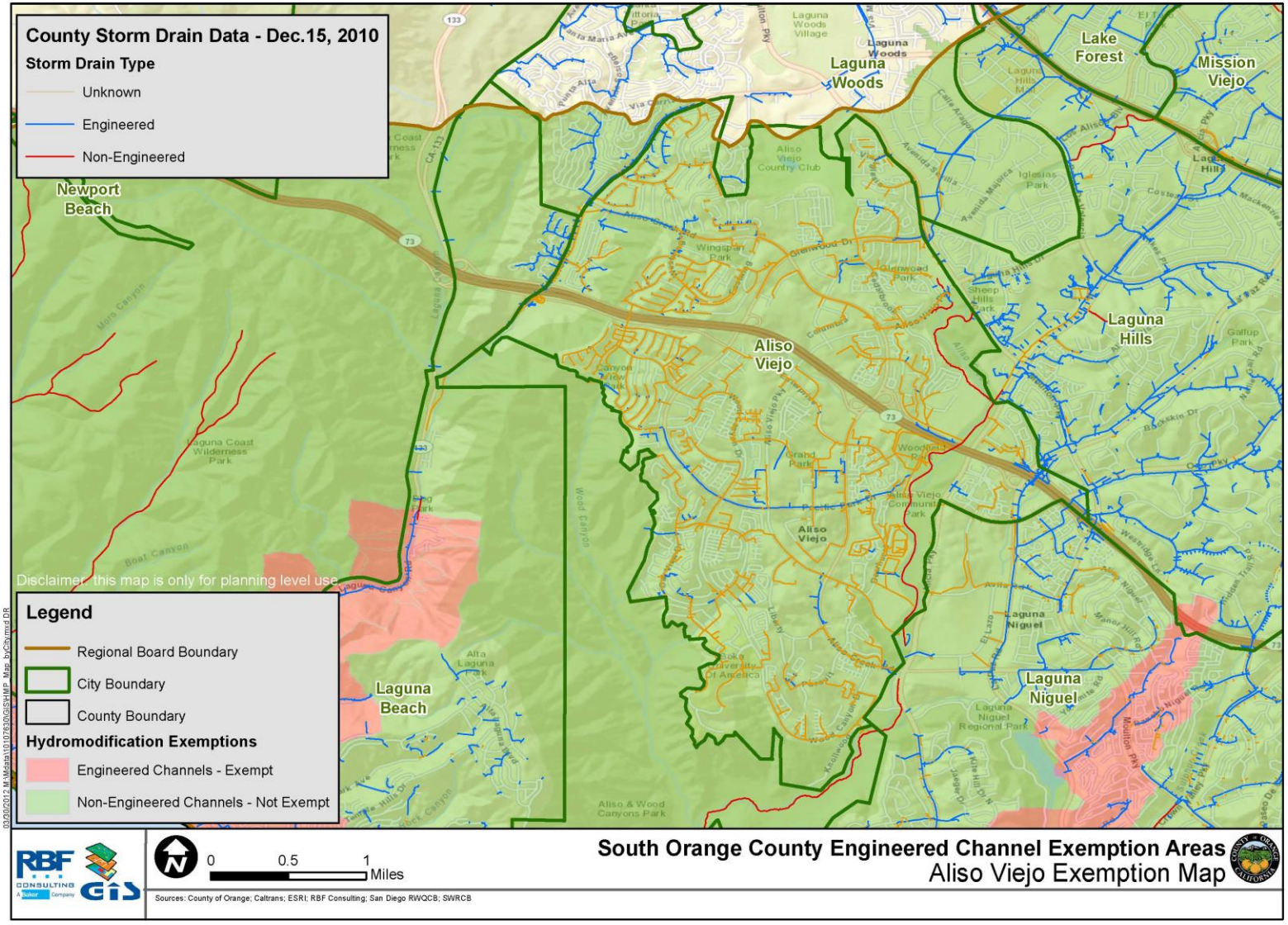


Figure 10: Laguna Beach - South Orange County Engineered Channels Exemption Areas

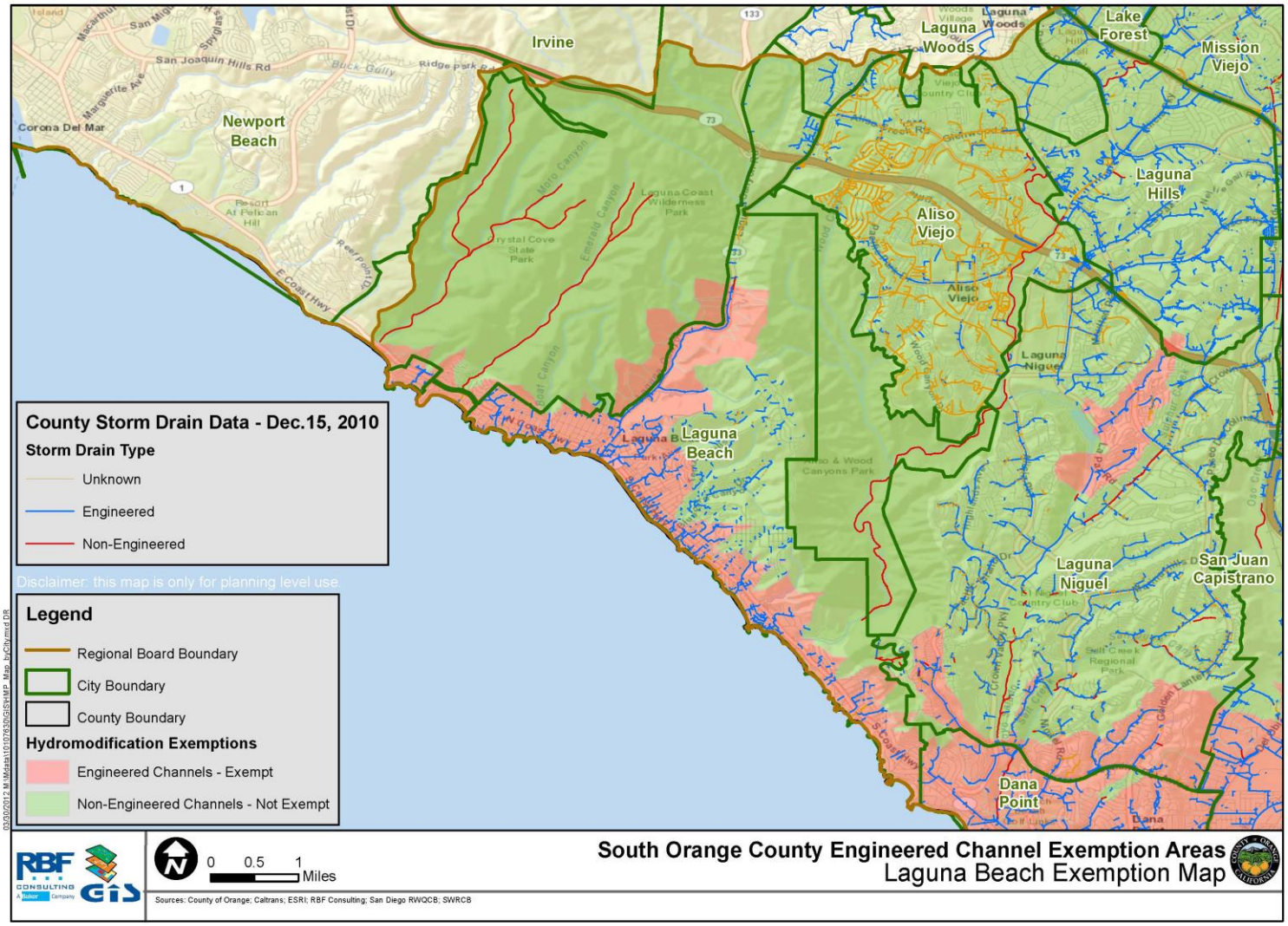


Figure 11: Ladera Ranch & Unincorporated County - South Orange County Engineered Channels Exemption Areas

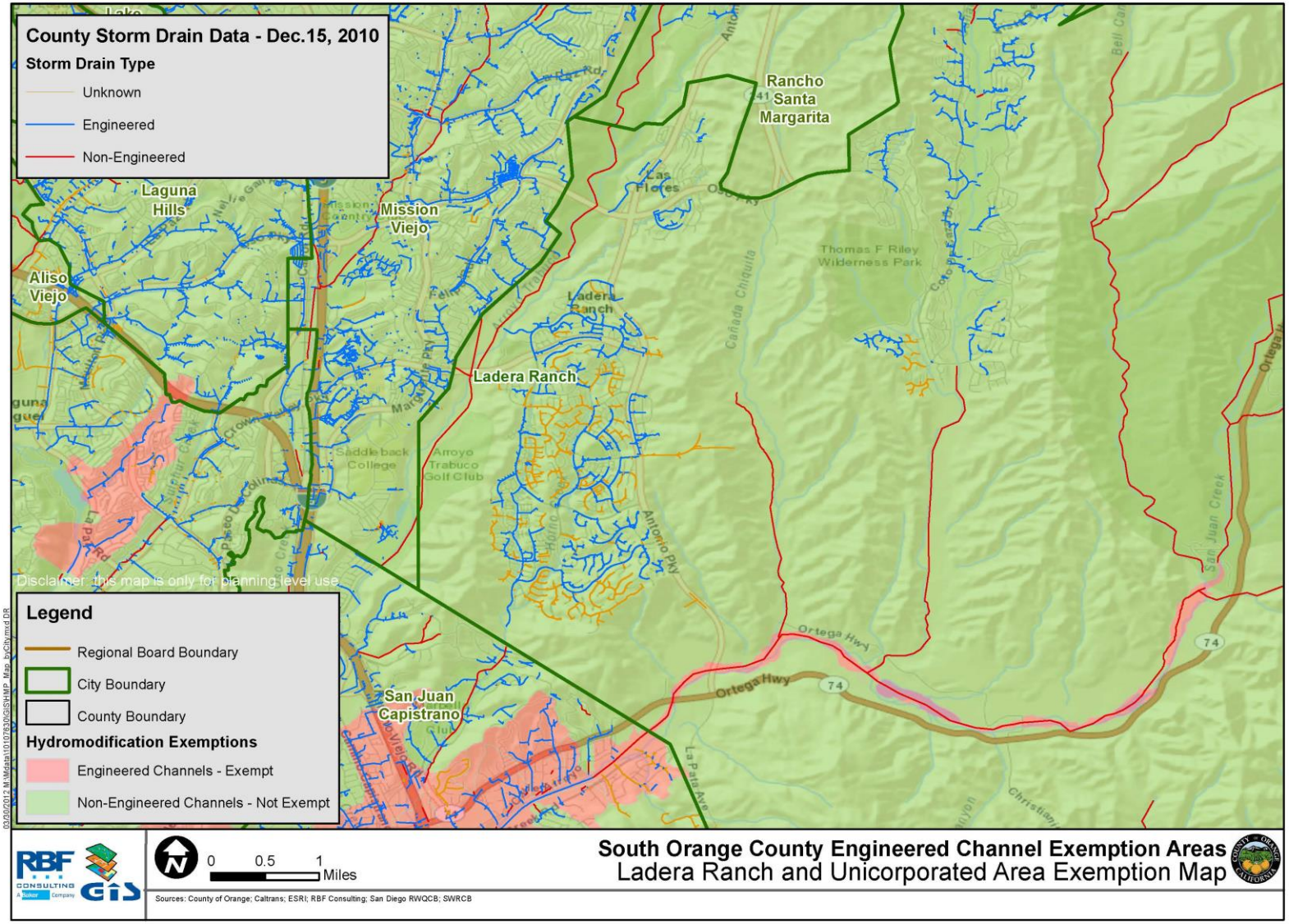


Figure 12: Laguna Niguel - South Orange County Engineered Channels Exemption Areas

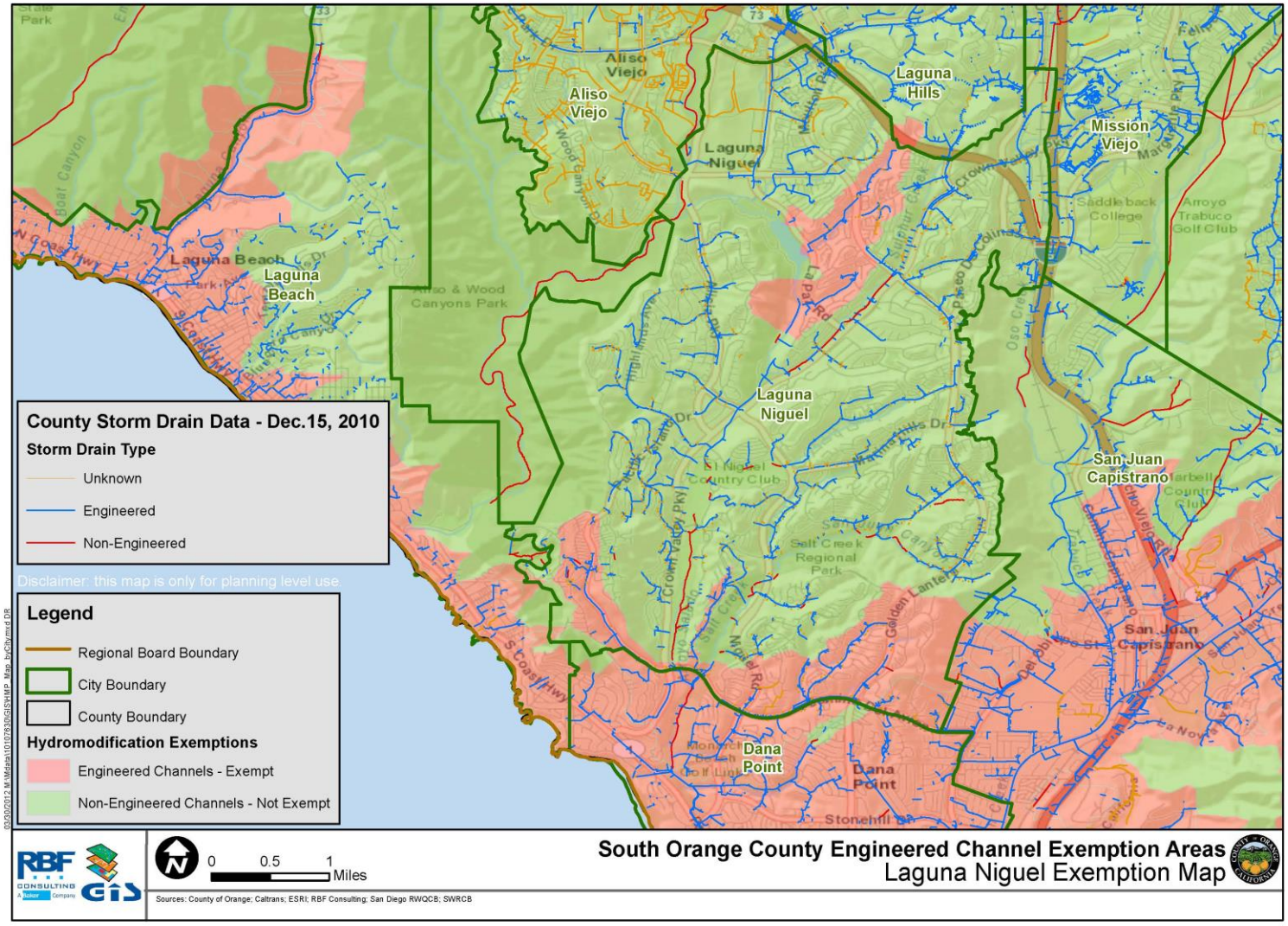


Figure 13: San Juan Capistrano - South Orange County Engineered Channels Exemption Areas

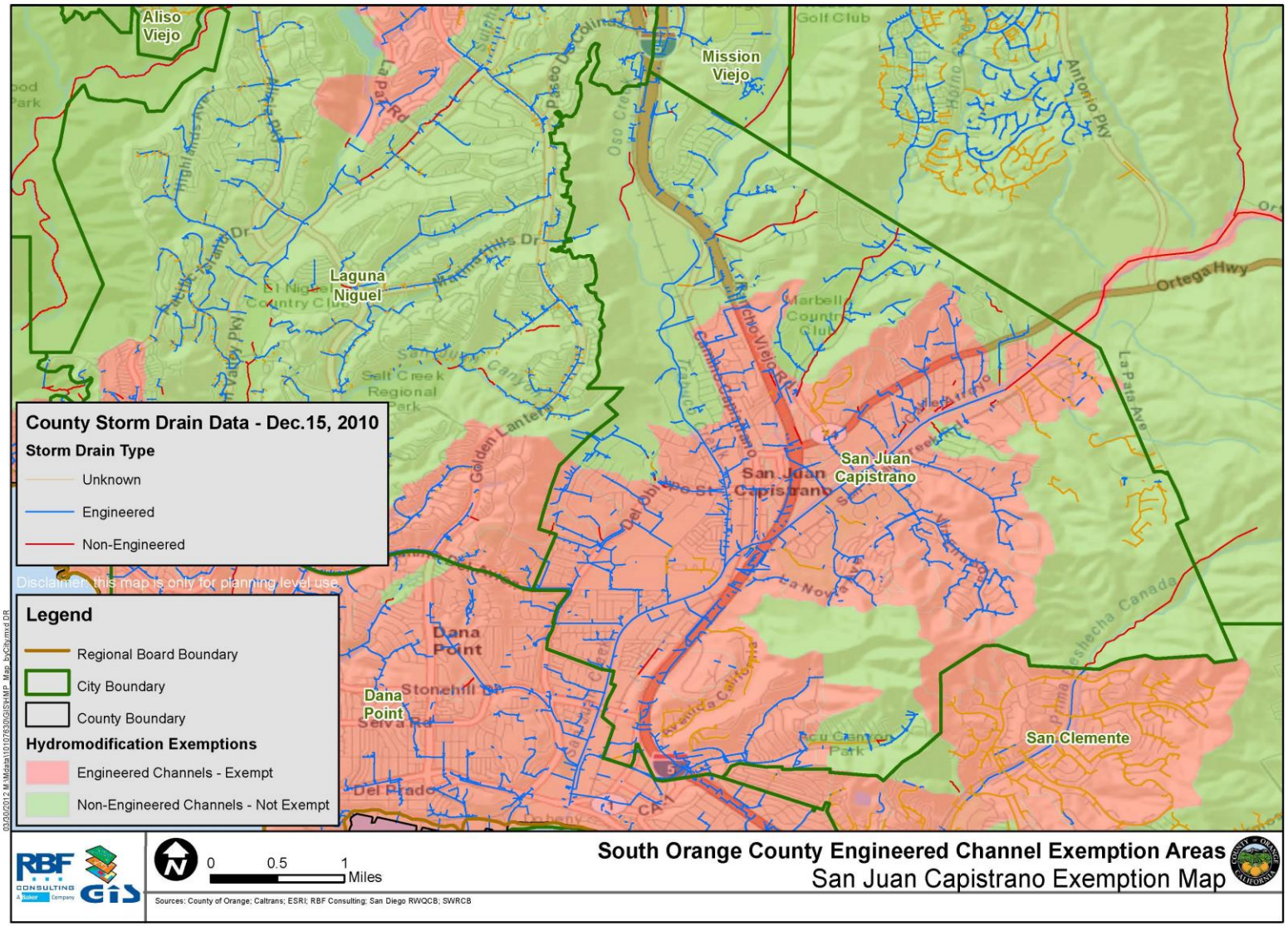


Figure 14: Dana Point - South Orange County Engineered Channels Exemption Areas

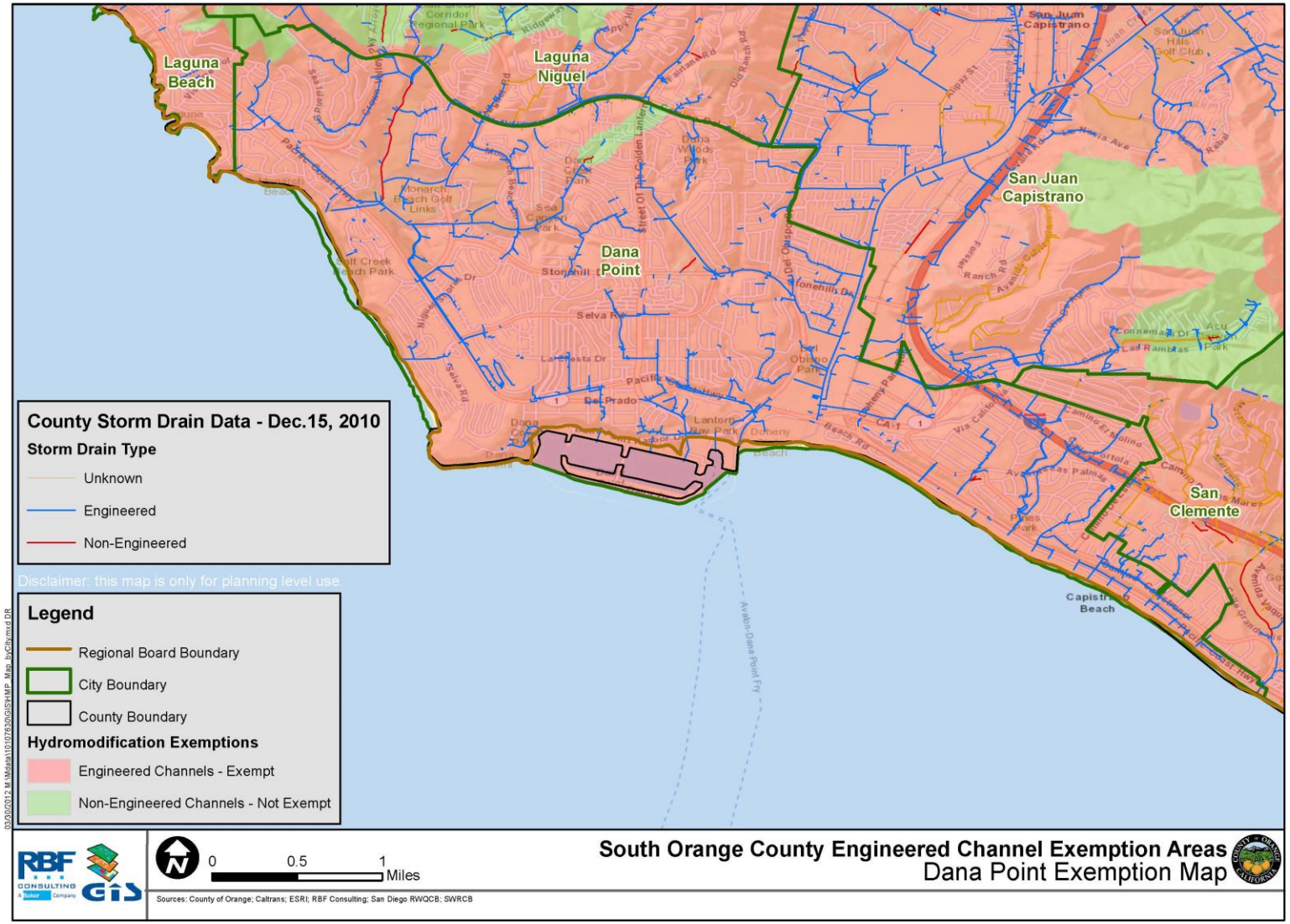
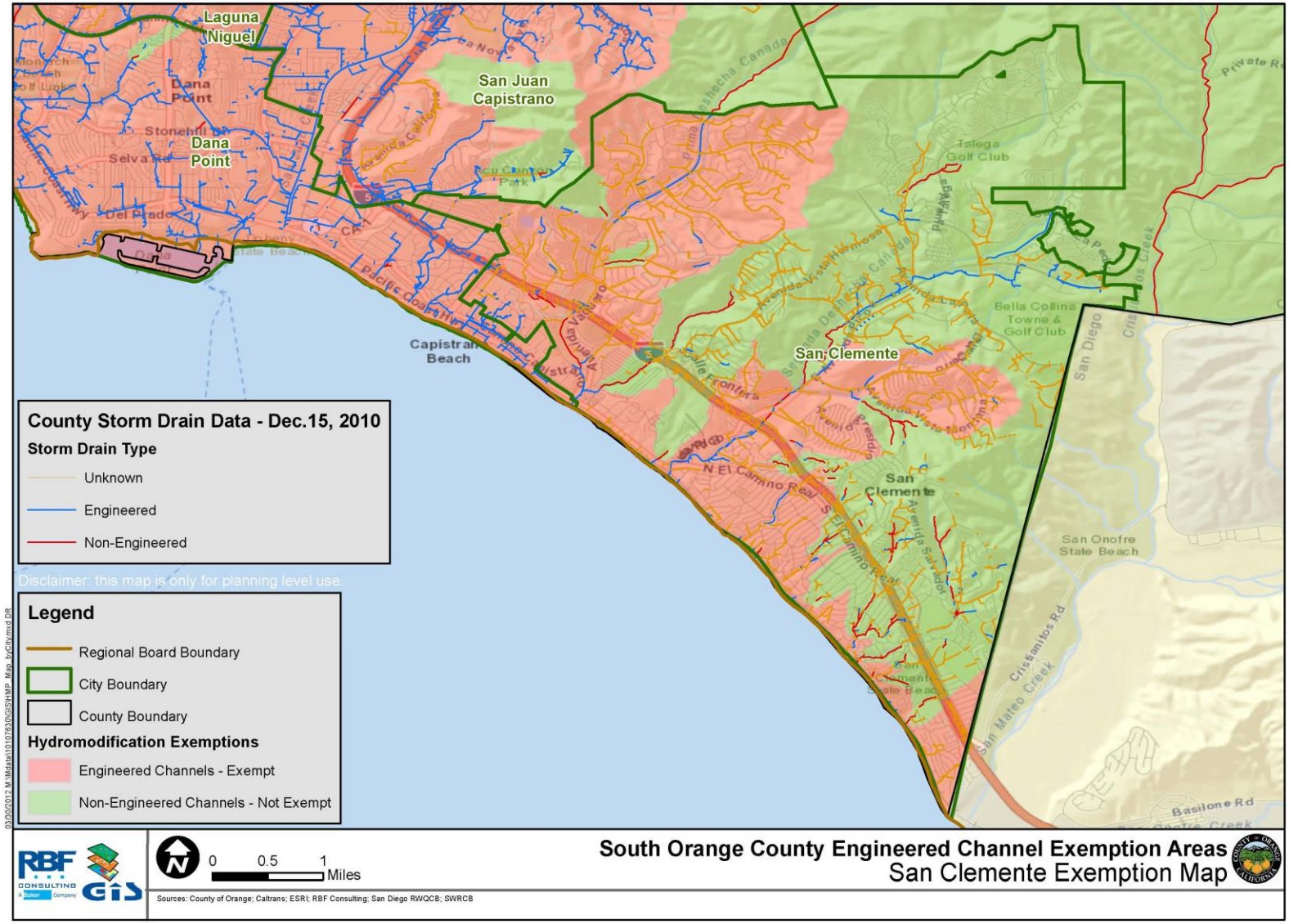


Figure 15: San Clemente - South Orange County Engineered Channels Exemption Areas



Attachment 3.7.1: Dry Weather Monitoring Rationale and Recommendations

The Fifth Term Permit must recognize that all discharges of pollutants from the MS4 are subject to the MEP standard.

Clean Water Act Sections 402(p)(3)(B)(ii) and (iii) require the Copermittees implement controls to effectively prohibit non-stormwater discharges into the MS4 and that such controls reduce pollutants to the maximum extent practicable (MEP). While federal law regulates "non-stormwater discharges" into the MS4, Section 402(p)(3)(B)(iii) expressly states that the "discharge of pollutants" shall be reduced to MEP. In drafting this section of the CWA, Congress expressly intended all discharges from MS4s to be subject to MEP as it used the term "pollutant" and did not differentiate between stormwater and non-stormwater, as the current Permit attempts to do. Therefore, the duty of the Copermittees to reduce the discharge of pollutants from the MS4 to MEP applies to both stormwater and non-stormwater pollutants.
Furthermore, the focus of the CWA and federal regulations is on a management program that includes a comprehensive planning process to reduce the discharge of pollutants to MEP.[1] One of the elements of the management program is the illicit discharge prevention program.[2] The control and limitation of illicit discharges into the MS4 is intended to achieve the overall MEP standard for discharges from the MS4. This is confirmed by the preamble to EPA regulations that discuss the required elements of the management program.

According to EPA:

> [Copermittees are required] to develop management programs for four types of pollutant sources which discharge to large and medium municipal storm sewer systems. Discharges from large and medium municipal storm sewer systems are usually expected to be composed primarily of: (1) Runoff from commercial and residential areas; (2) storm water runoff from industrial areas; (3) runoff from construction sites; and **(4) non-storm water discharges**. Part 2 of the permit application has been designed to allow [Copermittees] the opportunity to propose **MEP control measures for each of these components of the discharge**. 55 Fed Reg at 48052 (emphasis added).
> *See also* 55 Fed Reg at 48045 (stating "Part 2 of the proposed permit application [which includes the illicit discharge prevention requirement] is designed to . . . provide municipalities with the opportunity of proposing a comprehensive program of structural and non-structural control measures that will **control the discharge of pollutants, to the maximum extent practicable, from municipal storm sewers**.") (Emphasis added).

EPA's position is consistent with existing State Water Resources Control Board policy which states that discharges into the MS4 are to be controlled through an iterative, BMP based approach.[3] The State Board held:

> An NPDES permit is properly issued for "discharge of a pollutant" to waters of the United States. (Clean Water Act § 402(a).) The Clean Water Act defines "discharge of a pollutant" as an "addition" of a pollutant to waters of the United States from a point

[1] 40 CFR 122.26(d)(2)(iv).
[2] 40 CFR 122.26(d)(2)(iv)(B)(1).
[3] Specifically in State Board in Order No. WQ-2001-15, *In the Matter of the Petitions of Building Industry Assoc. of San Diego County and Western States Petroleum Assoc*. (2001).

> source. (Clean Water Act section 502(12). Section 402(p)(3)(B) authorizes the issuance of permits for discharges "from municipal storm sewers."
> We find that the permit language is overly broad because it applies the MEP standard not only to discharges "from" MS4s, but also to discharges "into" MS4s. . . [T]he specific language in this prohibition too broadly restricts all discharges "into" an MS4, and does not allow flexibility to use regional solutions, where they could be applied in a manner that fully protects receiving waters. It is important to emphasize that dischargers into MS4s continue to be required to implement a full range of BMPs, including source control. In particular, dischargers subject to industrial and construction permits must comply with all conditions in those permits prior to discharging storm water into MS4s.[4]

The State Board's decision in the Building Industry Association (BIA) matter makes clear that the CWA does not include a blanket prohibition on discharges of non-stormwater into the MS4. Fifth Term PermitFifth Term Permit
It is also technically infeasible in some cases to differentiate between non-stormwater or stormwater pollutants discharged from the MS4. Thus, just as the discharge of non-stormwater into the MS4 is subject to the effective prohibition standard, the discharge of pollutants in non-stormwater from the MS4 is subject to the MEP standard. Fifth Term Permit

The Fifth Term Permit must not seek to include language that creates an overly broad use of the term "prohibit."

The Fifth Term Permit should require the Permittees to "effectively prohibit non-stormwater discharges" but may exempt certain discharges that are not significant sources of pollutants from the prohibition. Section 402(p) does not require a full prohibition but rather an effective prohibition. The operative word is "effective", which recognizes the constraints of owning and operating a stormwater drainage system, which includes hundreds of miles of open channel. In addition, discharges that are not significant sources of pollutants are exempted from the prohibition. In a practical sense, the use of word "effective" also provides flexibility to assess the impacts of relatively benign discharges such as air condition condensate, individual car washing, and non-emergency fire-fighting flows or non-anthropogenic sources before instituting a prohibition.

The Fifth Term Permit should enable the Permittees to develop program specific action levels that meets the objectives of the IDDE program.

Future NALs for the IDDE program should not be based on water quality objectives at the 'end of pipe' . Instead, these values should be based on 'upset' values that reflect an abnormality for typical urban runoff. The State's own Blue Ribbon Panel, which was convened specifically to examine the feasibility of incorporating numeric effluent limits in stormwater permits, ultimately concluded that numeric limits were generally infeasible across all three stormwater activities,

[4] Id., at 9-10.

with few exceptions[5]. However, the Panel did agree that "upset values" or "action levels" could be established to assist Copermittees in identifying "bad actor" catchments which are clearly above the normal observed variability.

The rationale for this is provided in additional detail below.

Dry Weather Reconnaissance Program Approach

As a part of the IDDE program, the Copermittees had developed and implemented an innovative Dry Weather Reconnaissance Program, based upon statistically derived benchmarks to identify illegal discharges and illicit connections during the typically dry summer months of May through September using a suite of water quality analyses conducted in the field at designated random and targeted drains. A brief summary of that program is provided below.

- The Dry Weather Reconnaissance Program collected significant amounts of data and utilized a hybrid monitoring design that combined probabilistic sampling, targeted sampling, and formal statistical tools (tolerance intervals and control charts). This design enabled the program to systematically prioritize problematic sites, compare conditions to regional urban background, and track trends over time.
    - A *tolerance interval* bound is the upper or lower confidence-interval bound of a quantile of the background data distribution. Tolerance intervals are derived from the probabilistic site data and are used to quantify the key aspects of the regional background.
    - *Control charts* are used to establish an upper or lower bound on a data distribution, based on previous monitoring data. They are created for each site and provide a means of tracking data at individual sites and identifying when new data values deviate substantially from previous experience. The tolerance intervals are supplemented with control charts that track specific historical data, providing a second till to detect results that are out of the ordinary for the specific site.
    - Used together, tolerance intervals and control charts provide a consistent and quantitative means of identifying sites that exhibit excursions in pollutant values.
    - Tolerance intervals and control charts provide the means to discern between typical site conditions and illicit discharges.

The 2010-11 reporting period marked the ninth season of dry weather monitoring in the San Diego Region. Monitoring in the San Diego Region under the Dry Weather Reconnaissance Program was replaced in August 2011 with the NALs Monitoring Program (pursuant to Order No. R9-2009-0002). In order to demonstrate the effectiveness of the Dry Weather Reconnaissance Program, a comparison of this program and the NALs-based program is provided below.

Comparison of the Dry Weather Reconnaissance Program Approach and the NALs-based Approach

[5] *The Feasibility of Numeric Effluent Limits Applicable to Discharges of Stormwater Associated with Municipal, Industrial and Construction Activities, June 19, 2006*

First, a comparison of the probability of an exceedance using the tolerance interval-based approach compared to the NAL-based approach shows that the NALs-based approach requires increased resources since investigations are triggered at a much higher frequency for many constituents (e.g., enterococci and reactive orthophosphate as P – **Figures 1** and **2** below, respectively).

- The Dry Weather Reconnaissance Program is designed to detect "abnormal" results that are indicative of illicit discharges, typically short term, transient, non-stormwater discharges. The Permittees perform many more site visits but initiate fewer investigations, as they are able to discern between discharges that are most likely to be illicit and those that are not. These focused investigations are based on statistically valid data assessments, historical data for the site, and are most likely to be associated with illicit discharges.
- In contrast, the NAL-based program is designed to compare urban runoff from an outfall to a water quality objective that has been established for a receiving water. As demonstrated in the ROWD, chemistry results trigger exceedances of the NALs the majority of the time, which does not allow the Permittees to differentiate between typical site conditions and illicit discharges.
- For example, based on historical data, the probability that a sample does not exceed the NAL for enterococci or orthophosphate is ~ 3-5%. As a result, roughly 31 out of 33 sampling events would be required to be investigated for one or both constituents.
- In contrast, the probability that a sample does not exceed the enterococci or orthophosphate tolerance interval is 90%, which results in only 1 out of 10 sampling events requiring an investigation.
- Thus, the tolerance intervals allow for a true prioritization of the investigations whereas the NALs result in almost all events requiring investigations.

Figure 1: Enterococci Exceedance Frequencies Associated with Dry Weather Reconnaissance Tolerance Intervals Compared with Exceedance Frequencies Associated with NALs.

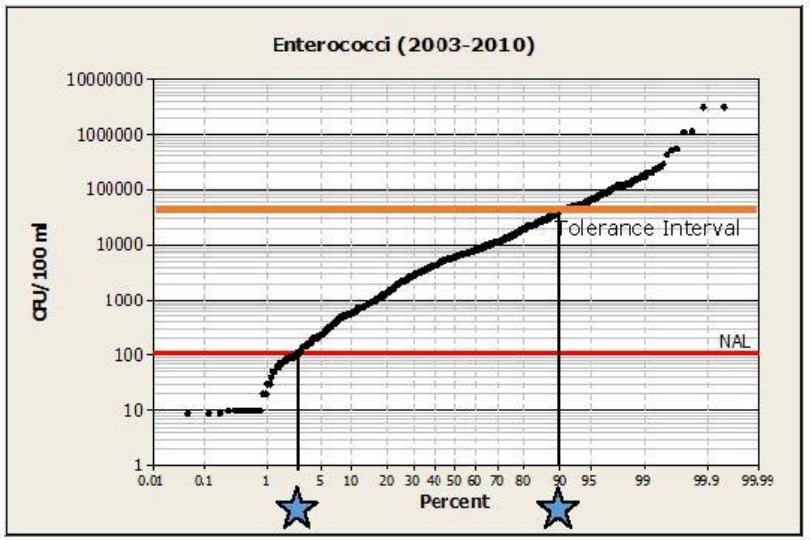
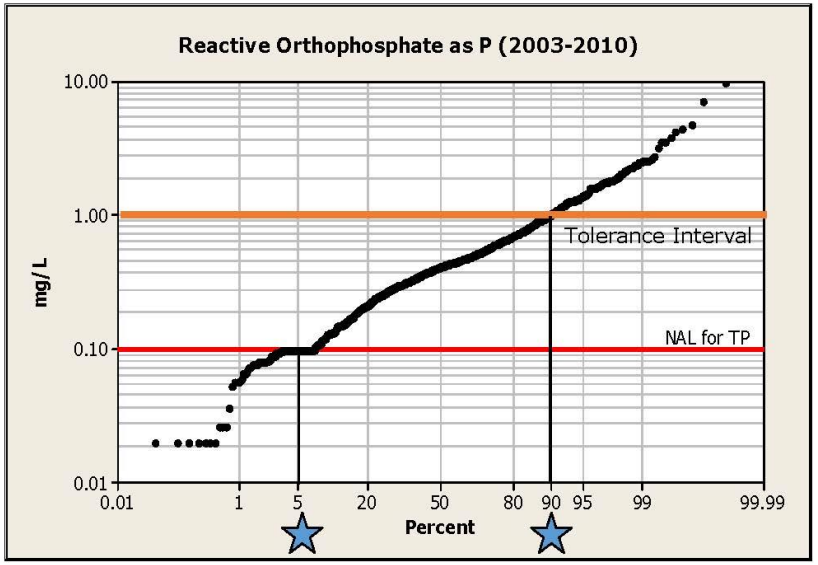


Figure 2: Reactive Orthophosphate as P Exceedance Frequencies Associated with Dry Weather Reconnaissance Tolerance Intervals Compared with Exceedance Frequencies Associated with NALs.



Second, efforts lead by the County to characterize natural sources from ambient geology have demonstrated that natural sources in specific areas are the primary contributor for many constituents of concern such as cadmium, nickel, total dissolved solids, chloride, and sulfate.

Monitoring and special studies show that many of the creeks in south Orange County have elevated levels of several constituents that do not appear to be related to the urban landscape. These constituents correlate poorly with urban attributes such as residential, industrial, and commercial land uses.

The Orange County Stormwater Program has monitored water quality for several years and found that naturally derived pollutants in surface waters can often exceed water quality criteria both in undeveloped catchments as well as in developed watersheds. In recent years, efforts led by the Program to characterize natural sources related to ambient geology have demonstrated that natural sources in specific areas are the primary contributor for many constituents of concern. The concentration ranges measured from the natural sources are shown in the table below.

Constituent	Concentration Range	Water Quality Criterion
Arsenic	<1 - 53 ppb	36 ppb[2]
Cadmium	<1 - 200 ppb	7.3 ppb[2]
Copper	1.2 - 23 ppb	18 ppb[2]
Nickel	6.4 - 1300 ppb	169 ppb[2]
Selenium	<1 - 220 ppb	5.0 ppb[2]
Zinc	<1 - 1800 ppb	379 ppb[2]
Chloride	470 - 2400 ppm	250 ppb[1]
Sulfate	1200 - 11000 ppm	250 ppb[1]
Total Dissolved Solids	3700 - 22000 ppm	500 ppb[1]
Total Nitrogen as N	<0.1 - 38 ppm	1.0 ppb[1]

Notes:
1) Basin Plan Water Quality Objective
2) California Toxics Rule, Criterion Continuous Concentration at hardness of 400 mg/L

Additionally, the Program is currently collaborating with the University of Southern California (USC) to develop a modeling approach that could "fingerprint" water sources based on their patterns of constituent concentrations. Such a

fingerprint, or chemical signature, for groundwater provides information about its source(s) and potential conveyance mechanism for constituents of concern. Physiographic conditions under which rain falls in Sierra Nevada or Colorado River watersheds are very different from those in Orange County's low elevation coastal watersheds. As a result, these differences impart unique isotopic fractionation on the water - a signature that acts as a fingerprint for various sources.

The Program's efforts, in collaboration with USC, recently have focused on sampling these new water quality tests for fingerprinting sources that provides a better approach for assessing natural contributions from anthropogenic, or human based activities. This work focused on collecting samples from natural streams, groundwater springs, domestic water sources, and urban channels to compare and contrast differences between the various water body types. Together with the information on constituent levels from ambient geology and source fingerprinting , this approach will provide a much better understanding about natural and anthropogenic sources of both water and contaminants to streams in south Orange County.

This effort is providing a more robust approach to interpret measured pollutant concentrations against in the context of natural background levels as well as to determine relative loading contributions from natural and anthropogenic inputs. This work is still underway, but will provide important information and assist in understanding the origin of non-stormwater discharges within the stormdrain system. Until this work is completed, the Program will be unable to discriminate between instances of illicit discharges and conditions that are essentially artifacts of a constructed storm drain system and/or the local geology. The Program has found strong positive linear relationships between levels of metals associated with runoff and groundwater seepage from the Monterey and Capistrano marine sedimentary formations. Both formations are known to be enriched in trace metals and are common across southern Orange County. This evidence suggest that many exceedances of water quality criteria are due to non-illicit discharge factors (i.e., local geology).

Third, after the implementation of the NAL-based program for over a year, some clear differences between the previously established Dry Weather Reconnaissance Program and the NAL-based program have been evident (see **Table 1** below). Comparison of the 2011-2012 NALs data collected in the San Diego Region with the data from the Dry Weather Reconnaissance Monitoring program for the 2009-2010 reporting period shows how the ability to prioritize the IDDE investigations has been diminished.

Table 1: Comparison of 2011-2012 NALs Data Collected in the San Diego Region with the Data from the Dry Weather Reconnaissance Monitoring Program for the 2009-2010 Reporting Period

	NAL Exceedances 2011-2012		DW Pgm Action Level Exceedances 2009-2010	
Constituent	**Number**	**%**	**Number**	**%**
pH	1	2	0	0
TDS	42	93	0	0
Dissolved Oxygen	2	4	0	0
Turbidity	3	7	3	1
Surfactants	3	7	14	5
Total Coliform	24	53	0	0
Fecal Coliform	19	42	0	0
Enterococcus	42	93	0	0
Unionized Ammonia	3	7	8	3
Total N / Nitrate	41	91	0	0
Total P / Ortho PO4	38	84	11	4
Cadmium	13	28	0	0
Copper	1	2	0	0
Nickel	7	15	0	0
Zinc	1	2	0	0
Total # of Site Visits	**45**		**274**	

For the Dry Weather Reconnaissance Program, the Permittees conducted 274 site visits, whereas for the NAL-based program, the Permittees conducted 45 site visits.

- Although the Permittees collected data and information for six times more stations as a part of the Dry Weather Reconnaissance Program, the NALs-based program identified more than six times the number of exceedances.
  - Dry Weather Reconnissance Program – 274 site visits/36 exceedances (13%)
  - NALs-based Program – 45 site visits/240 exceedances (5x the number of visits)
- The Dry Weather Reconnaissance Program provides better spatial and temporal coverage than a NAL-based program. The number of sites visited during implementation of the current program was six times greater than the number of sites visited during implementation of the NAL-based program.

- The Dry Weather Reconnaissance program identified exceedances for four (4) constituents: turbidity, surfactants, unionized ammonia, and total phosphate
- The NALs-based program identified exceedances for all fifteen (15) constituents, with the top three associated with TDS, enterococcus, and total nitrogen
- For the NALs-based program, there was no ability to prioritize discharges for follow up investigation since many of the constituents exceeded the NALs 20-40% of the time.

The conclusions from the implementation of the Orange County NAL-based program to date are:

- The NAL program replaced an previously existing and effective program (the Dry Weather Reconnaissance program);
- The Dry Weather Reconnaissance Program resulted in focused source investigations for key constituents indicative of illicit discharges;
- The NAL program has required increased resources and has resulted in everything being a priority (thus, nothing is a priority). In addition, the NAL-based triggers have, in many cases been the result of constituents attributable to natural sources within the watersheds;
- There have been many exceedances that have been due to non-IDDE factors such as local geology (especially for nickel and cadmium);
- It has been very difficult to determine the endpoints, the sources, of the various non-stormwater discharges since the discharges are so co-mingled; and
- There is a strong need for a regionally-based prioritization so that there is not a mis-direction of limited resources.

Recommendations

The Regional Water Board staff review the results of the Orange County program to date and consider the revisions as proposed in order to assist with the prioritization of resources and water quality issues. If the Copermittees are required to continue to use the NAL-based program, they will lose the ability to prioritize the water quality issues and discriminate between true instances of IDDE and ambient urban conditions in a storm drain systems draining landscapes underlain by marine sedimentary formations containing phosphorous and a number of metals. The Copermittees fundamentally recommend that they be able to reinstate the Dry Weather Reconnaissance Program.