SAN DIEGO COASTKEEPER

COASTAL ENVIRONMENTAL RIGHTS FOUNDATION

September 26, 2014

Board Chair Henry Abarbanel
San Diego Regional Water Quality Control Board
2375 Northside Drive, Suite 100
San Diego, CA 92108

VIA EMAIL
Laurie.Walsh@waterboards.ca.gov

Re: Proposed Prior Lawful Approval Language for Regional MS4 Permit
San Diego Water Board Public Workshop - October 8, 2014

Dear Chair Abarbanel:

Please accept these comments on behalf of Coastal Environmental Rights Foundation (CERF) and San Diego Coastkeeper (Coastkeeper) regarding the upcoming public workshop to consider amendments to the Regional MS4 Permit for the San Diego Region. Unfortunately, representatives from CERF and Coastkeeper are unable to attend the forthcoming workshop, but offer these comments to register our opposition to any proposed weakening of the Regional MS4 Permit. Specifically, though it would be inappropriate for the Board to take any action on un-agendized matters at the workshop, CERF and Coastkeeper believe interested parties may urge the Board to consider amendments to the MS4 Permit to redefine "prior lawful approval".

Should interested parties (developers subject to the new MS4 Permit requirements) suggest a proposed amendment regarding "prior lawful approval" Permit language, we urge the Regional Board to adhere to its prior language and avoid potential backsliding.[1]

If the Regional Board is interested in specifically defining prior lawful approval, a reconsideration should focus on traditional vested rights doctrines. Under the *Avco* line of cases, mere acquisition of a building permit affords a builder no protection against a change in the laws adopted after its issuance. In order to continue the construction of a project initiated prior to a change in the law, a builder must have obtained a vested right by performing substantial work and incurring substantial liabilities in good faith reliance on the permit prior to the effective date of the new law. (*Avco Community Developers, Inc. v. South Coast Reg'l Comm'n*, 17 Cal. 3d. 785, 791 (1976)).

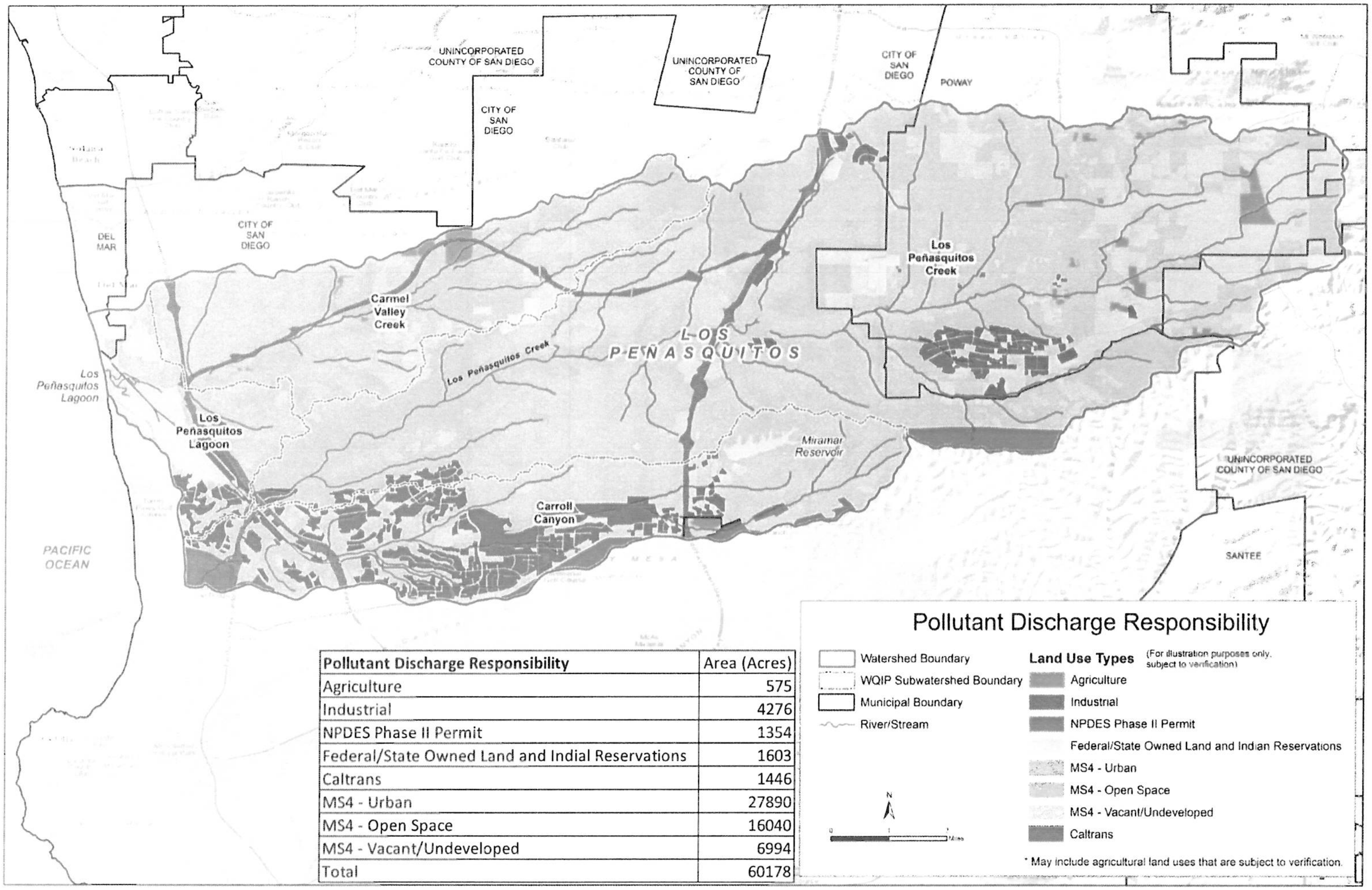
CERF and Coastkeeper therefore urge the Board not to consider such proposed amendments at the forthcoming hearing. However, we understand the upcoming hearing is a workshop – should any such discussions lead to action items for a future hearing, we look forward to working with Board staff to ensure the new MS4 Permit is not weakened.

Sincerely,

Matt O'Malley, Waterkeeper
San Diego Coastkeeper

Livia Borak, Legal Advisor
Coastal Environmental Rights Foundation

[1] Specifically, Footnote 3 on page 17 of Order No. R9-2007-0001 states: "Updated SUSMP and hydromodification requirements shall apply to all priority projects or phases of priority projects which have not yet begun grading or construction activities at the time any updated SUSMP or hydromodification requirement commences. If a Copermittee determines that lawful prior approval of a project exists, whereby application of an updated SUSMP or hydromodification requirement to the project is infeasible, the updated SUSMP or hydromodification requirement need not apply to the project. Where feasible, the Copermittees shall utilize the SUSMP and hydromodification update periods to ensure that projects undergoing approval processes include application of the updated SUSMP and hydromodification requirements in their plans."



Pollutant Discharge Responsibility	Area (Acres)
Agriculture	575
Industrial	4276
NPDES Phase II Permit	1354
Federal/State Owned Land and Indial Reservations	1603
Caltrans	1446
MS4 - Urban	27890
MS4 - Open Space	16040
MS4 - Vacant/Undeveloped	6994
Total	60178

Nancy Palmer

BPA TMDL-

Table 7-48. Receiving Water Limitations for Beaches

Indicator Bacteria	Wet Weather Days [a]		Dry Weather Days [b]	
	Wet Weather Numeric Objective [c] (MPN/100mL)	Wet Weather Allowable Exceedance [d] Frequency	Dry Weather Numeric Objective [e] (MPN/100mL)	Dry Weather Allowable Exceedance Frequency
Fecal Coliform	400	22%	200	0%
Total Coliform	10,000	22%	1,000	0%
Enterococcus	104	22%	35	0%

a. Wet weather days defined as days with rainfall events of 0.2 inches or greater and the following 72 hours.
b. Dry weather days defined as days with less than 0.2 inch of rainfall observed on each of the previous 3 days.
c. Wet weather numeric objectives based on the single sample maximum water quality objectives in the California Ocean Plan (2005). Compliance with the wet weather TMDLs in the receiving water is based on the frequency that the wet weather days in any given year exceed the wet weather numeric objective, but 30-day geometric mean must also be met.
d. The wet weather allowable exceedance frequency is set at 22%. In the calculation of the wet weather TMDLs, the San Diego Regional Board chose to apply the 22 percent allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County. At the time the wet weather watershed model was developed, the 22 percent exceedance frequency from Los Angeles County was the only reference beach exceedance frequency available. The 22 percent allowable exceedance frequency used to calculate the wet weather TMDLs is justified because the San Diego Region watersheds' exceedance frequencies will likely be close to the value calculated for Leo Carillo Beach, and is consistent with the exceedance frequency that was applied by the Los Angeles Regional Board.
e Dry weather numeric objectives based on the 30-day geometric mean water quality objectives in the California Ocean Plan (2005). Compliance with the dry weather TMDLs in the receiving water is based on the frequency that the dry weather days in any given year exceed the dry weather numeric objective.

Table 7-49. Receiving Water Limitations for Creeks

Indicator Bacteria	Wet Weather Days [a]		Dry Weather Days [b]	
	Wet Weather Numeric Objective [c] (MPN/100mL)	Wet Weather Allowable Exceedance [d] Frequency	Dry Weather Numeric Objective [e] (MPN/100mL)	Dry Weather Allowable Exceedance Frequency
Fecal Coliform	400	22%	200	0%
Enterococcus	61 (104) [f]	22%	33	0%

a. Wet weather days defined as days with rainfall events of 0.2 inches or greater and the following 72 hours.
b. Dry weather days defined as days with less than 0.2 inch of rainfall observed on each of the previous 3 days.
c. Wet weather numeric objectives based on the single sample maximum (or equivalent) water quality objectives in the Water Quality Control Plan for the San Diego Basin (1994). Compliance with the wet weather TMDLs in the receiving water is based on the frequency that the wet weather days in any given year exceed the wet weather numeric objective, but 30-day geometric mean must also be met.
d. The wet weather allowable exceedance frequency is set at 22%. In the calculation of the wet weather TMDLs, the San Diego Regional Board chose to apply the 22 percent allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County. At the time the wet weather watershed model was developed, the 22 percent exceedance frequency from Los Angeles County was the only reference beach exceedance frequency available. The 22 percent allowable exceedance frequency used to calculate the wet weather TMDLs is justified because the San Diego Region watersheds' exceedance frequencies will likely be close to the value calculated for Leo Carillo Beach, and is consistent with the exceedance frequency that was applied by the Los Angeles Regional Board.
e. Dry weather numeric objectives based on the 30-day geometric mean (or equivalent) water quality objectives in Water Quality Control Plan for the San Diego Basin (1994). Compliance with the dry weather TMDLs in the receiving water is based on the frequency that the dry weather days in any given year exceed the dry weather numeric objective.
f. A wet weather numeric objective for *Enterococcus* of 104 MPN/100mL may be applied as a receiving water limitation for creeks, instead of 61 MPN/100mL, if one or more of the creeks addressed by these TMDLs (San Juan Creek, Aliso Creek, Tecolote Creek, Forrester Creek, San Diego River, and/or Chollas Creek) is designated with a "moderately to lightly used area" or less frequent usage frequency in the Basin Plan. Otherwise, the wet weather numeric objective of 61 MPN/100mL for Enterococcus will be used to assess compliance with the wet weather allowable exceedance frequency.

EX. REGIONAL PERMIT

(2) Final Water Quality Based Effluent Limitations

(a) Final Receiving Water Limitations

Discharges from the MS4s must not cause or contribute to the exceedance of the following receiving water limitations by the compliance dates under Specific Provision 6.b.(1):

Table 6.2a
Final Receiving Water Limitations Expressed as Bacteria Densities and Allowable Exceedance Frequencies for Beaches

Constituent	Wet Weather Days		Dry Weather Days	
	Single Sample Maximum[a,b] (MPN/100mL)	Single Sample Maximum Allowable Exceedance Frequency[c]	30-Day Geometric Mean[b] (MPN/100mL)	30-Day Geometric Mean Allowable Exceedance Frequency
Total Coliform	10,000	22%	1,000	0%
Fecal Coliform	400	22%	200	0%
Enterococcus	104	22%	35	0%

Notes:
a. During wet weather days, only the single sample maximum receiving water limitations are required to be achieved.
b. During dry weather days, the single sample maximum and 30-day geometric mean receiving water limitations are required to be achieved.
c. The 22% single sample maximum allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objectives in the Ocean Plan.

Table 6.2b
Final Receiving Water Limitations Expressed as Bacteria Densities and Allowable Exceedance Frequencies for Creeks

Constituent	Wet Weather Days		Dry Weather Days	
	Single Sample Maximum[a,b] (MPN/100mL)	Single Sample Maximum Allowable Exceedance Frequency[c]	30-Day Geometric Mean[b] (MPN/100mL)	30-Day Geometric Mean Allowable Exceedance Frequency
Fecal Coliform	400	22%	200	0%
Enterococcus	61 (104)	22%	33	0%

Notes:
a. During wet weather days, only the single sample maximum receiving water limitations are required to be achieved.
b. During dry weather days, the single sample maximum and 30-day geometric mean receiving water limitations are required to be achieved.
c. The 22% single sample maximum allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objectives in the Basin Plan.
d. A single sample maximum of 104 MPN/100ml for *Enterococcus* may be applied as a receiving water limitation for creeks, instead of 61 MPN/100mL, if one or more of the creeks addressed by these TMDLs (San Juan Creek, Aliso Creek, Tecolote Creek, Forrester Creek, San Diego River, and/or Chollas Creek) is designated with a "moderately to lightly used area" or less frequent usage frequency in the Basin Plan. Otherwise, the single sample maximum of 61 MPN/100mL for *Enterococcus* must be used to assess compliance with the allowable exceedance frequency.

(b) Final Effluent Limitations

(i) Discharges from the MS4s containing indicator bacteria densities that do not exceed the following effluent limitations by the compliance dates under Specific Provision 6.c.(1) will not cause or contribute to exceedances of the receiving water limitations under Specific Provision 6.b.(2)(a):

Table 6.2c
Final Effluent Limitations Expressed as Bacteria Densities and Allowable Exceedance Frequencies in MS4 Discharges to the Water Body

Constituent	Concentration-Based Effluent Limitations			
	Single Sample Maximum[a,b] (MPN/100mL)	Single Sample Maximum Allowable Exceedance Frequency[c]	30-Day Geometric Mean[b] (MPN/100mL)	30-Day Geometric Mean Allowable Exceedance Frequency
Total Coliform[d]	10,000	22%	1,000	0%
Fecal Coliform	400	22%	200	0%
Enterococcus	104[e] / 61[f]	22%	35[e] / 33[f]	0%

Notes:
a. During wet weather days, only the single sample maximum effluent limitations are required to be achieved.
b. During dry weather days, the single sample maximum and 30-day geometric mean effluent limitations are required to be achieved.
c. The 22% single sample maximum allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objectives in the Ocean Plan for discharges to beaches, and the Basin Plan for discharges to creeks and creek mouths.
d. Total coliform effluent limitations only apply to MS4 outfalls that discharge to the Pacific Ocean Shorelines and creek mouths listed in Table 6.0.
e. This *Enterococcus* effluent limitation applies to MS4 discharges to segments of areas of Pacific Ocean Shoreline listed in Table 6.0.
f. This *Enterococcus* effluent limitation applies to MS4 discharges to segments or areas of creeks or creek mouths listed in Table 6.0.

B1A

Regional Water Quality Control Board MS4 Permit Workshop

Prior Lawful Approval (PLA) Policy

Wednesday, October 8, 2014
200 Civic Center
Mission Viejo, California

Introductions

- The Coalition
  - San Diego Building Industry Association
  - Building Industry Association of Southern California
  - Associated General Contractors
  - Associated Builders and Contractors
  - San Diego Regional Chamber of Commerce
  - Business Leadership Alliance
  - San Diego Association of Realtors
  - San Diego Apartment Association
  - NAIOP (National Association of Industrial & Office Properties)
  - BOMA (Building Office & Management Association
  - San Diego Chapter of the American Society of Landscape Architects.

Background

- Worked with Copermittees re: meaning of permit section E.3.e.(1)(a)
  - City of San Diego, County, Chula Vista, Carlsbad, San Marcos, Escondido, El Cajon, and Santee
  - Regional Board staff
  - Coast Keeper
- General agreement: the section requires clarification. But no consensus on specific language.
- Time for the Regional Board to weigh in.

Current Permit Language in E.3.e.(1)(a)

Applications **with** lawful approval before the BMP Design Manual is updated...

Copermittee **may** allow previous land development requirements to apply. [Emphasis added.]

Applications **without** lawful approval by the Copermittee by the time the BMP Design Manual is updated...

Copermittee must require and confirm the requirements of E.3 are implemented.

Language Revisions Proposed by Staff

Applications **with** prior lawful approval before the BMP Design Manual is ~~updated~~ implemented...

Copermittee may allow previous land development requirements to apply.

Applications **without** prior lawful approval by the Copermittee by the time the BMP Design Manual is ~~updated~~ implemented...

Copermittee must require and confirm the requirements of E.3 are implemented.

Issues Requiring Clarification by the Board

- What is the purpose of Section E.3.e.(1)(a)?
- What is a "Prior Lawful Approval"?
- When may a Copermittee use its discretion to allow previous land development requirements to apply?

The Purpose of Section E.3.e.(1)(a)

- Address the disconnect between permit cycles and entitlement cycles
  - Permits are revised every 5 years.
  - Project approvals from inception to building permits are much longer (7 to 10 years)
- Provide predictability for design and financing
- Avoid takings claims against Copermittees over statutory and common-law vested rights

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Permit Cycle Disconnect Example: Redevelopment of Brown Field Airport

- 2006: RFP by City of San Diego
- 2009: Development Department approval of site design including WQTR in conformity with 2007 permit
- 2013: Certification of EIR and approval of Site Development Permit including WQTR
- 2014: Challenge to certified EIR
- 2016: Grading permits and commencement of construction

But, if required to comply w/ 2013 permit...

And if investors walk away, back to Square 1!

- Public is denied:
  - 6,000 new jobs, most at prevailing wage
  - A critical piece of public infrastructure
  - An economic engine in a depressed area
  - Tax revenue
  - Loss of water quality improvements for existing development on airport.

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Defining a "Prior Lawful Approval"

- Currently an undefined term in the permit
  - Creates uncertainty and fear for Copermittees
  - Creates uncertainty for the development of both public and private projects whose entitlement cycles are much longer than permit cycles.
  - Creates funding uncertainties for both public and private projects.
- Other regional boards have addressed this issue.

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Examples of PLA Policies in Other MS4 Permit Regions (see handout)

	Los Angeles County	Central Coast Region	Sacramento	Ventura County
Source	Order # R4-2012-0175	Post Construction Storm Water Management Requirements	Stormwater Quality Partnership Hydromodification Management Plan	Ventura Technical Guidance Manual
Date	November, 2012	July, 2013	February, 2013	July, 2011
• Development Agreements	Silent	Silent	Silent	Exempt
• Vesting Tentative Maps	Exempt	Silent	Silent	Exempt
• Tentative Maps	Silent	Silent	Exempt	Exempt
• Other Discretionary Permit	Exempt (1st permit)	Exempt	Exempt	Exempt
• Other Ministerial Permit	Silent	Exempt	Exempt	Silent
• Commencement of Work	Silent	Silent	Silent	Exempt

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When may a Copermittee allow previous land development requirements to apply?

- Project complies with requirements in previous permit cycle
- The project has a vested right
- Special circumstances requiring Copermittee discretion
  - Health and Safety
  - Other

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Clarity and Consistency Benefit Everyone

- Project applicants
- Copermittees
- Regional Board
- Non-governmental organizations
- Public

Objectives of Clear PLA Language

- Provide a clear minimum standard that each Copermittee can rely on as a basis for MS4 permit compliance.
- Recognize and honor vested rights in order to protect Copermittees from takings claims and to avoid budgetary crisis for CIP, FPPF and assessment district financing.
- Protect Copermittee land use authority by allowing them to impose higher standards required to protect health and safety or to prevent a nuisance.
- Reflect statewide trends in addressing the meaning and implementation of Prior Lawful Approval provisions, which are not unique to this permit.

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Proposed Permit Language
(Replaces Section E.3.e.(1)(a); does not alter (b) through (d))

(a) Each Copermittee must require and confirm that for all Priority Development Project applications that have not received prior lawful approval by the Copermittee by the time the BMP Design Manual is implemented pursuant to Provision E.3.d. the requirements of Provision E.3 are implemented. For project applications that have received prior lawful approval before the BMP Design Manual is implemented pursuant to Provision E.3.d. the Copermittee may allow previous land development requirements to apply.

i. For private development projects, "Prior Lawful Approval" means projects that have entered into a development agreement as defined by the California Government Code or have received a first discretionary approval or ministerial permit prior to the time the BMP Design Manual is implemented. A Prior Lawful Approval shall include any subsequent discretionary or ministerial entitlement necessary to implement the initial Prior Lawful Approval.

ii. For public projects, the Copermittee shall develop and adopt an equivalent approach to that for private projects.

iii. For project applications that have obtained a Prior Lawful Approval before the BMP Design Manual is implemented pursuant to Provision E.3.d. the Copermittee may use its discretion to allow previous land development requirements to apply.

iv. Projects with Prior Lawful Approvals as defined above that predate Order No.R9-2007-0001 for San Diego County Copermittees, Oder No. R9-2009-0002 for Orange County Copermittees, and Order No. R9-2010-0016 for Riverside County, Copermittees shall be required to incorporate Treatment Control BMPs necessary to achieve the water quality standards set forth in the applicable Orders identified above to the Maximum Extent Practicable, as determined by the Copermittee on a case by case basis.

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The Coalition's Request

- Direct staff to incorporate the Coalition's proposed language for E.3.e.(1)(a) into Tentative Order No. R9-2015-0001 for review and comment by all stakeholders prior to consideration for adoption by the Regional Board.

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Questions

?

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B1A

Excerpts from California MS4 Permits and Related Documents describing Prior Lawful Approval (PLA) Policy Requirements: July 16, 2014

(1) ORDER NO. R4-2012-0175 LOS ANGELES COUNTY (Nov. 2012; p. 97)

. . .

(d) In this section, Existing Development or Redevelopment projects shall mean all discretionary permit projects or project phases that have not been deemed complete for processing, or discretionary permit projects without vesting tentative maps that have not requested and received an extension of previously granted approvals within 90 days of adoption of the Order. Projects that have been deemed complete within 90 days of adoption of the Order are not subject to the requirements Section 7.c. For Permittee's projects the effective date shall be the date the governing body or their designee approves initiation of the project design.

(2) POST-CONSTRUCTION STORMWATER MANAGEMENT REQUIREMENTS FOR DEVELOPMENT PROJECTS IN THE CENTRAL COAST REGION (July 2013; p.2)

c) The Permittee shall apply the Post-Construction Requirements by March 6, 2014[1], to all applicable Regulated Projects that require approvals and/or permits issued under the Permittee's planning, building, or other comparable authority. Applicable Regulated Projects include both private development requiring permits, and public projects:

i) Private Development Projects

(1) Discretionary Projects – The Permittee shall apply the Post-Construction Requirements to those projects that have not received the first discretionary approval of project design.

(2) Ministerial Projects – If the project is only subject to ministerial approval, the Permittee shall apply the Post-Construction Requirements to those projects that have not received any ministerial approvals. If the ministerial project receives multiple ministerial approvals, the Permittee shall apply the Post-Construction Requirements to the first ministerial approval. Ministerial approvals include, but are not limited to, building permits, site engineering improvements, and grading permits.

ii) Public Development Projects

(1) The Permittee shall develop and implement an equivalent approach, to the above approach used for private development projects, to apply the Post-Construction Requirements to applicable public development projects, including applicable university development projects

iii) Exemptions – The Permittee may propose, to the Central Coast Water Board Executive Officer, a lesser application of the Post-Construction Requirements for projects with completed project applications dated prior to September 6, 2012. The Permittee must demonstrate that the application of the Post-Construction Requirements would pose financial infeasibility for the project. The Permittee shall not grant any exemptions without prior approval from the Central Coast Water Board Executive Officer.

(3) SACRAMENTO STORMWATER QUALITY PARTNERSHIP HYDROMODIFICATION MANAGEMENT PLAN (rev. Feb. 2013; p. 48)

3.2.5 Approved Projects

Approved projects will not be subject to hydromodification management requirements because the design plans and specifications (including drainage design) have already been completed and it will be unreasonable and cost prohibitive to require a project applicant to re-design the project.

A project with previous conditions requiring hydromodification management will not be eligible for the following "approved project" exemption.

A project shall meet one of the following criteria to be considered an "approved project" for the purposes of this document:

1. A project will be exempt from HMP requirements if the project's site design is approved or established by one of the following methods no later than twelve months after approval of the HMP by the Regional Water Board:

   a. The site has an approved tentative map to construct a single family subdivision[8]; or
   b. The site has an approved Plan Review, Special Permit or Conditional Use Permit, Design Review/Preservation Review entitlement; or
   c. The project has a complete building permit application submitted; or
   d. The project has a valid building permit issued (or approved off-site improvement plan); or
   e. A project being issued a new building permit to complete work commenced under a prior permit may be considered exempt from HMP requirements at the discretion of the local Permitting Agency.
2. A project discharging directly to a segment of a channel or creek with permitted improvements under a 404 permit or 401 certification from the relevant Federal or State regulatory agencies. The applicant's 404 and 401 certification must be currently valid or obtained no later than twelve months after approval of the HMP by the Regional Water Board. This exemption does not apply for projects with 404 permits or 401 certification which require hydromodification management.
3. A public agency project for which design has been completed and/or a contract has been awarded no later than twelve months after approval of the HMP by the Regional Water Board.

(4) VENTURA COUNTY TECHNICAL GUIDANCE MANUAL FOR STORMWATER QUALITY CONTROL MEASURES MANUAL (July 2011 update; p. 1-8)

The new development and redevelopment requirements contained in Part 4, Section E of the Order shall not apply to the projects described in paragraphs 1 through 5 below. Projects meeting the criteria listed in paragraphs 1 through 5 below shall instead continue to comply with the performance criteria set forth in the 2002 Technical Guidance Manual for Stormwater Quality Control Measures under Board Order 00-108:

1) Projects or phases of projects where the project's applications have been "deemed complete for processing" (or words of equivalent meaning), including projects with ministerial approval, by the applicable local permitting agency in accordance with the local permitting agency's applicable rules prior to the Effective Date; or

2) Projects that are the subject of an approved Development Agreement and/or an adopted Specific Plan: or an application for a Development Agreement and/or Specific Plan where the application for the Development Agreement and/or Specific Plan has been "deemed complete for processing" (or words of equivalent meaning), by the applicable local permitting agency in accordance with the local permitting agency's applicable rules, and thereafter during the term of such Development Agreement and/or Specific Plan unless earlier cancelled or terminated; or

3) All private projects in which, prior to the Effective Date, the private party has completed public improvements; commenced design, obtained financing, and/or participated in the financing of the public improvements; or which requires the private party to reimburse the local agency for public improvements upon the development of such private project; or

4) Local agency projects for which the governing body or their designee has approved initiation of the project design prior to the Effective Date; or

5) A Tentative Map or Vesting Tentative Map deemed complete or approved by the local permitting agency prior to the Effective Date, and subsequently a Revised Map is submitted, the project would be exempt from the 2011 TGM provisions if the revisions substantially conform to original map design, consistent with Subdivision Map Act requirements. Changes must also comply with local and state law.

The intent of these guidelines is to ensure that projects for which the applications have been deemed "complete" or the applicants have worked with local permitting agency staff to develop a final, or substantially final, drainage concept and site layout that includes water quality treatment based upon the performance criteria set forth in the 2002 Technical Guidance Manual for Stormwater Quality Control Measures prior to the Effective Date, are not required to redesign their proposed projects for purposes of complying with the new development and redevelopment requirements contained in Part 4, Section E of Board Order R4-2010-0108.

In addition, any project, phase of a project, or individual lot within a larger previously-approved project, where the application for such project has been "deemed complete for processing" (or words of equivalent meaning) that does not have a final or substantially final drainage concept as determined by the local permitting agency or a site layout that includes water quality treatment must comply with the performance standards set forth in the 2011 TGM.

Example – Central Coast Region
"excerpts of Applicability of New Requirements"

Resolution No. R3-2013-0032

ATTACHMENT 1

POST-CONSTRUCTION STORMWATER MANAGEMENT REQUIREMENTS FOR DEVELOPMENT PROJECTS IN THE CENTRAL COAST REGION

July 12, 2013

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION
895 Aerovista Place, Suite 101, San Luis Obispo, California 93401
Phone • (805) 549-3147
http://www.waterboards.ca.gov/centralcoast/

To request copies of this report please contact Dominic Roques at (805) 542-4780, or by email at: droques@waterboards.ca.gov

Documents also are available at:
http://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/docs/lid/lid_hydromod_charette_index.shtml

projects with completed project applications dated prior to September 6, 2012. The Permittee must demonstrate that the application of the Post-Construction Requirements would pose financial infeasibility for the project. The Permittee shall not grant any exemptions without prior approval from the Central Coast Water Board Executive Officer.

If project seeks grandfathering based on "application" rather than "approval," then an infeasibility analysis is req'd.

2) Performance Requirement No. 1: Site Design and Runoff Reduction
   a) The Permittee shall require all Regulated Projects that create and/or replace ≥ 2,500 square feet of impervious surface (collectively over the entire project site), including detached single-family home projects, to implement at least the following design strategies throughout the Regulated Project site:
      i) Limit disturbance of creeks and natural drainage features
      ii) Minimize compaction of highly permeable soils
      iii) Limit clearing and grading of native vegetation at the site to the minimum area needed to build the project, allow access, and provide fire protection
      iv) Minimize impervious surfaces by concentrating improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state
      v) Minimize stormwater runoff by implementing one or more of the following site design measures:
         (1) Direct roof runoff into cisterns or rain barrels for reuse
         (2) Direct roof runoff onto vegetated areas safely away from building foundations and footings, consistent with California building code
         (3) Direct runoff from sidewalks, walkways, and/or patios onto vegetated areas safely away from building foundations and footings, consistent with California building code
         (4) Direct runoff from driveways and/or uncovered parking lots onto vegetated areas safely away from building foundations and footings, consistent with California building code
         (5) Construct bike lanes, driveways, uncovered parking lots, sidewalks, walkways, and patios with permeable surfaces
   b) The Permittee shall confirm that projects comply with Site Design and Runoff Reduction Performance Requirements by means of appropriate documentation (e.g., check lists) accompanying applications for project approval.

3) Performance Requirement No. 2: Water Quality Treatment
   a) The Permittee shall require Regulated Projects, except detached single-family homes, ≥ 5,000 square feet of Net Impervious Area, and detached single-family homes ≥ 15,000 square feet of Net Impervious Area, to treat stormwater runoff as required in the Water Quality Treatment Performance Requirements in Section B.3.b. to reduce pollutant loads and concentrations using physical, biological, and chemical removal.
      i) Net Impervious Area is the total (including new and replaced) post-project impervious areas, minus any reduction in total imperviousness from the pre-project to post-project condition: *Net Impervious Area = (New and Replaced Impervious Area) - (Reduced Impervious Area Credit)*, where *Reduced Impervious Area Credit* is the total pre-project to post-project reduction in impervious area, if any.
   b) The Permittee shall require each Regulated Project subject to Water Quality Treatment Performance Requirements to treat runoff generated by the Regulated Project site using the onsite measures below, listed in the order of preference (highest to lowest). Water Quality Treatment Performance Requirements shall apply to the runoff from existing, new, and replaced impervious surfaces on sites where runoff from existing impervious surfaces cannot be separated from runoff from new and replaced impervious surfaces.

(5) Crack sealing
(6) Resurfacing with in-kind material without expanding the road or parking lot
(7) Practices to maintain original line and grade, hydraulic capacity, and overall footprint of the road or parking lot
(8) Repair or reconstruction of the road because of slope failures, natural disasters, acts of God or other man-made disaster

ii) Sidewalk and bicycle path or lane projects, where no other impervious surfaces are created or replaced, built to direct stormwater runoff to adjacent vegetated areas
iii) Trails and pathways, where no other impervious surfaces are replaced or created, and built to direct stormwater runoff to adjacent vegetated areas
iv) Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics
v) Curb and gutter improvement or replacement projects that are not part of any additional creation or replacement of impervious surface area (e.g., sidewalks, roadway)
vi) Second-story additions that do not increase the building footprint
vii) Raised (not built directly on the ground) decks, stairs, or walkways designed with spaces to allow for water drainage
viii) Photovoltaic systems installed on/over existing roof or other impervious surfaces, and panels located over pervious surfaces with well-maintained grass or vegetated groundcover, or panel arrays with a buffer strip at the most down gradient row of panels
ix) Temporary structures (in place for less than six months)
x) Electrical and utility vaults, sewer and water lift stations, backflows and other utility devices
xi) Above-ground fuel storage tanks and fuel farms with spill containment system

c) The Permittee shall apply the Post-Construction Requirements by March 6, 2014[1], to all applicable Regulated Projects that require approvals and/or permits issued under the Permittee's planning, building, or other comparable authority. Applicable Regulated Projects include both private development requiring permits, and public projects:

i) Private Development Projects
(1) Discretionary Projects – The Permittee shall apply the Post-Construction Requirements to those projects that have not received the first discretionary approval of project design.
(2) Ministerial Projects – If the project is only subject to ministerial approval, the Permittee shall apply the Post-Construction Requirements to those projects that have not received any ministerial approvals. If the ministerial project receives multiple ministerial approvals, the Permittee shall apply the Post-Construction Requirements to the first ministerial approval. Ministerial approvals include, but are not limited to, building permits, site engineering improvements, and grading permits.

ii) Public Development Projects
(1) The Permittee shall develop and implement an equivalent approach, to the above approach used for private development projects, to apply the Post-Construction Requirements to applicable public development projects, including applicable university development projects

iii) Exemptions – The Permittee may propose, to the Central Coast Water Board Executive Officer, a lesser application of the Post-Construction Requirements for

Grandfathered per 1st Discretionary Approval.

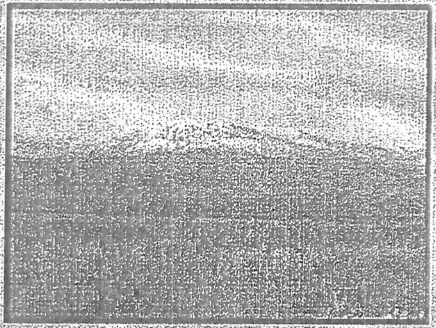
If project didn't have a Discretionary Approval, then its 1st Ministerial approval defines date of grandfathering.

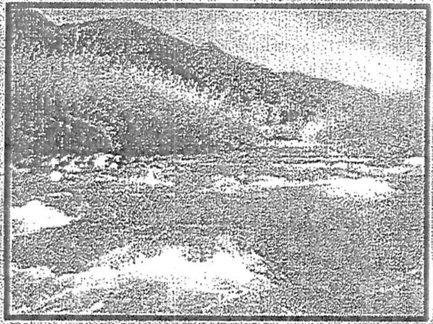
[1] Newly enrolled Permittees Gonzales, Greenfield, and Guadalupe shall apply the Post-Construction Requirements by July 1, 2014.

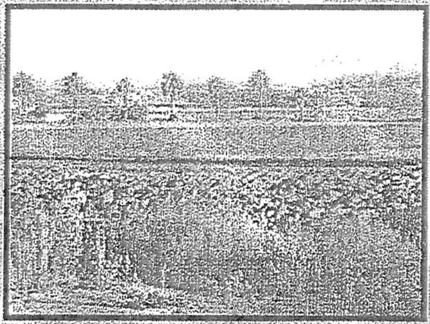
Example — Ventura Region
"Excerpts of Applicability
on Revised Requirements"

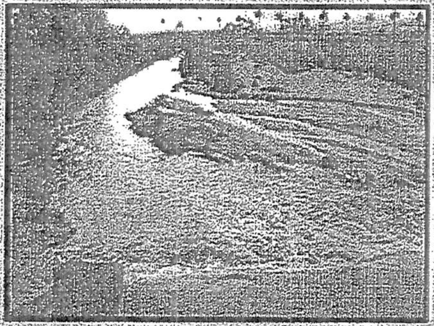
Ventura County Technical Guidance Manual for Stormwater Quality Control Measures

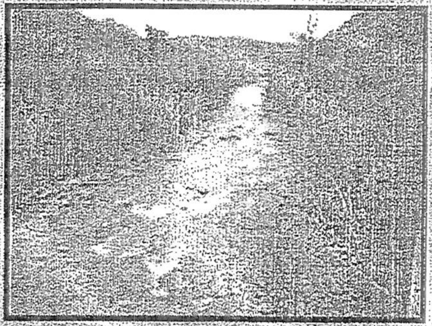
Manual Update 2011











Ventura Countywide Stormwater Quality Management Program

Geosyntec consultants

LARRY WALKER ASSOCIATES

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Oakland, CA 94607

July 13, 2011

Existing single-family dwelling and accessory structure projects are exempt from the redevelopment requirements unless the project creates, adds, or replaces 10,000 square feet of impervious surface area.

Effective Date

The new development and redevelopment requirements contained in Part 4, Section E of Board Order R4-2010-0108 (the "Order") shall become effective 90 calendar days after the Regional Water Quality Control Board Executive Officer approves the 2011 TGM (the "Effective Date"). After the Effective Date, all applicable projects, except those identified below, must comply with the new development and redevelopment requirements contained in Part 4, Section E of the Order.

The new development and redevelopment requirements contained in Part 4, Section E of the Order shall not apply to the projects described in paragraphs 1 through 5 below. Projects meeting the criteria listed in paragraphs 1 through 5 below shall instead continue to comply with the performance criteria set forth in the 2002 Technical Guidance Manual for Stormwater Quality Control Measures under Board Order 00-108:

1) Projects or phases of projects where the project's applications have been "deemed complete for processing" (or words of equivalent meaning), including projects with ministerial approval, by the applicable local permitting agency in accordance with the local permitting agency's applicable rules prior to the Effective Date; or

2) Projects that are the subject of an approved Development Agreement and/or an adopted Specific Plan; or an application for a Development Agreement and/or Specific Plan where the application for the Development Agreement and/or Specific Plan has been "deemed complete for processing" (or words of equivalent meaning), by the applicable local permitting agency in accordance with the local permitting agency's applicable rules, and thereafter during the term of such Development Agreement and/or Specific Plan unless earlier cancelled or terminated; or

3) All private projects in which, prior to the Effective Date, the private party has completed public improvements; commenced design, obtained financing, and/or participated in the financing of the public improvements; or which requires the private party to reimburse the local agency for public improvements upon the development of such private project; or

4) Local agency projects for which the governing body or their designee has approved initiation of the project design prior to the Effective Date; or

5) A Tentative Map or Vesting Tentative Map deemed complete or approved by the local permitting agency prior to the Effective Date, and subsequently a Revised Map is submitted, the project would be exempt from the 2011 TGM provisions if the revisions substantially conform to original map design, consistent with

Subdivision Map Act requirements. Changes must also comply with local and state law.

The intent of these guidelines is to ensure that projects for which the applications have been deemed "complete" or the applicants have worked with local permitting agency staff to develop a final, or substantially final, drainage concept and site layout that includes water quality treatment based upon the performance criteria set forth in the 2002 Technical Guidance Manual for Stormwater Quality Control Measures prior to the Effective Date, are not required to redesign their proposed projects for purposes of complying with the new development and redevelopment requirements contained in Part 4, Section E of Board Order R4-2010-0108.

INTENT OF GRANDFATHERING

In addition, any project, phase of a project, or individual lot within a larger previously-approved project, where the application for such project has been "deemed complete for processing" (or words of equivalent meaning) that does not have a final or substantially final drainage concept as determined by the local permitting agency or a site layout that includes water quality treatment must comply with the performance standards set forth in the 2011 TGM.

1.6 Organization of the 2011 TGM

The 2011 TGM is divided into seven sections and nine appendices:

Section 1	Introduction
Section 2	Stormwater Management Standards
Section 3	Site Assessment and BMP Selection
Section 4	Site Design Principles & Techniques
Section 5	Source Control Measures
Section 6	Retention BMPs, Biofiltration BMPs, and Treatment Control Measure Design
Section 7	Operation and Maintenance Planning
Appendix A	Glossary of Terms
Appendix B	Maps: Watersheds Delineation, Existing Urban Areas, Environmentally Sensitive Areas, and 85th Percentile Rainfall Depth
Appendix C	Site Soil Type and Infiltration Testing

Document	Ventura County	LA County	Sacramento	Central Coast Region	SD Region Proposal
Source	Ventura Technical Guidance Manual	Order # R4-2012-0175	Stormwater Quality Partnership Hydromodification Management Plan	Post Construction Storm Water Management Requirements	Copermittees and Private Parties
Date	July, 2011	November, 2012	February, 2013	July, 2013	August, 2014
Development Agreements	Exempt	Silent	Silent	Silent	Exempt
Vesting Tentative Maps	Exempt	Exempt	Silent	Silent	Silent
Tentative Maps	Exempt	Silent	Exempt	Silent	Silent
Other Discretionary Permit	Exempt	Exempt (1st permit)	Exempt	Exempt	Exempt
Other Ministerial Permit	Silent	Silent	Exempt	Exempt	Exempt
Commencement of Work	Exempt	Silent	Silent	Silent	Silent

2014 REPORT OF WASTE DISCHARGE

SAN DIEGO REGION
STATE OF THE ENVIRONMENT

ORANGE COUNTY STORMWATER PROGRAM

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FOREWORD

I am pleased to present the Orange County Stormwater Program's first State of the Environment Report. This report represents our commitment to periodically present a comprehensive picture of the quality of Orange County's creeks, rivers, bays and coastal waters and the actions being taken by the Orange County Stormwater Program (the Program) to protect and restore them.

The Program is a partnership of the cities of Orange County, the County of Orange and the Orange County Flood Control District. The Program's partners own and operate inter-connected storm drain systems and have been working together since 1990 to mitigate the water quality impacts that can arise from the imprint of urban development on the landscape.

This report is intended to provide a basis for broadening participation and creating common purpose in the actions we need to take to protect and enhance Orange County's highly significant ecological and recreational water resources. With this objective always in mind, we will continue to improve future reports with a focus always on fostering understanding and collaboration.

I hope that you will use this report as a resource for understanding and participating in the progress we are making on protecting water quality in Orange County.

Mary Anne Skorpanich, Director

OC Environmental Resources

STATE OF THE ENVIRONMENT

OVERVIEW

The Orange County Stormwater Program's monitoring, assessment, and environmental research efforts are intended to track progress toward solving existing problems, identify emerging issues that could become concerns 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 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 shellfish beneficial use (SWRCB 2011).

This Report therefore focuses on the two core management questions that are within the 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?

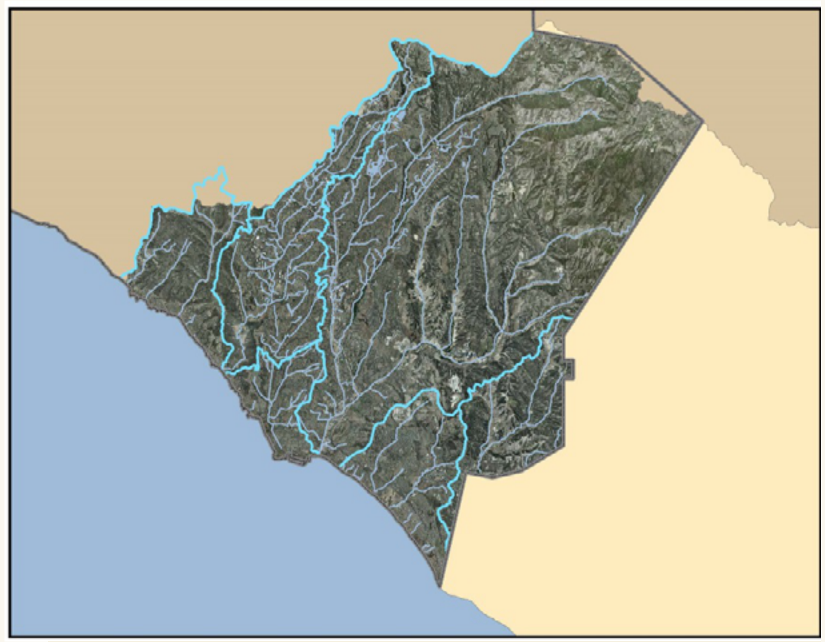

FIGURE 1: The portion of south Orange County that is under the jurisdiction of the San Diego Regional Water Quality Control Board and is the focus of this Report. Blue lines represent watershed boundaries.

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). 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.

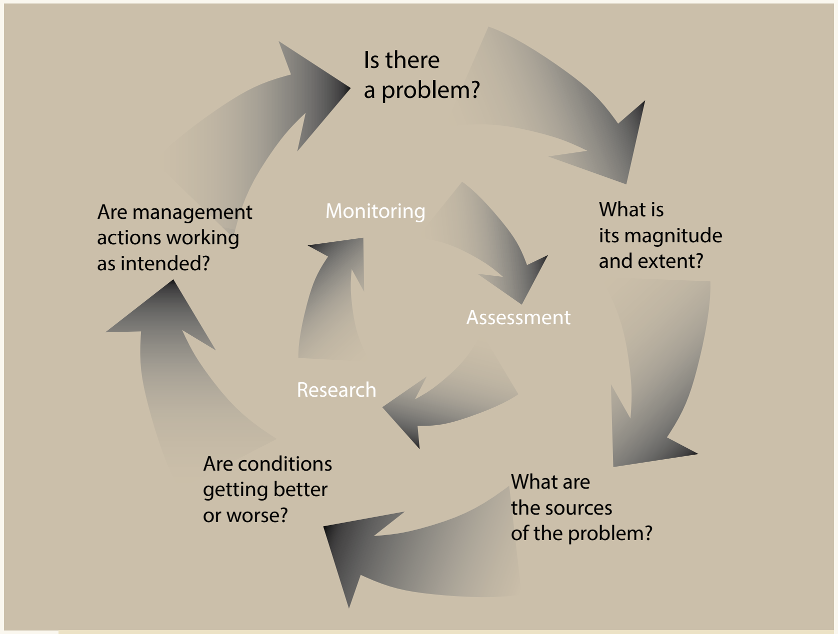

FIGURE 2: Monitoring, assessment, and research provide the data and information required to answer the five key assessment questions. *Attention should shift among questions as information improves and priorities change, and the mix of monitoring, assessment, and research activities should be adjusted 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 efforts 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.

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.

PRIORITIZATION

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 (Table 1). 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).

	BACTERIA	DISSOLVED SOLIDS	NUTRIENTS	TOXICITY	PESTICIDES	METALS	BIOASSESSMENT
CHANNELS							
DRY	red	red	red	green	green	green	red
WET	red	red	red	yellow	yellow	green	NA
COASTAL							
DRY	green	NA	green	green	green	green	NA
WET	yellow	NA	yellow	green	green	green	NA

TABLE 1: Overall summary of results of prioritization analysis. *Red represents persistent and widespread exceedances of regulatory and/or widely used 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.*

Inland Channels

For inland channels, bacteria, dissolved solids, and nutrients are persistent issues over time. The prevalence of toxicity is somewhat higher in wet than in dry weather, but is not substantially above background conditions described in SMC studies (see Tables 2 and 3). High toxicity occurs in only isolated instances in wet and dry weather. 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 3's overall summary ranking of constituents based on monitoring data from receiving waters in inland channels.

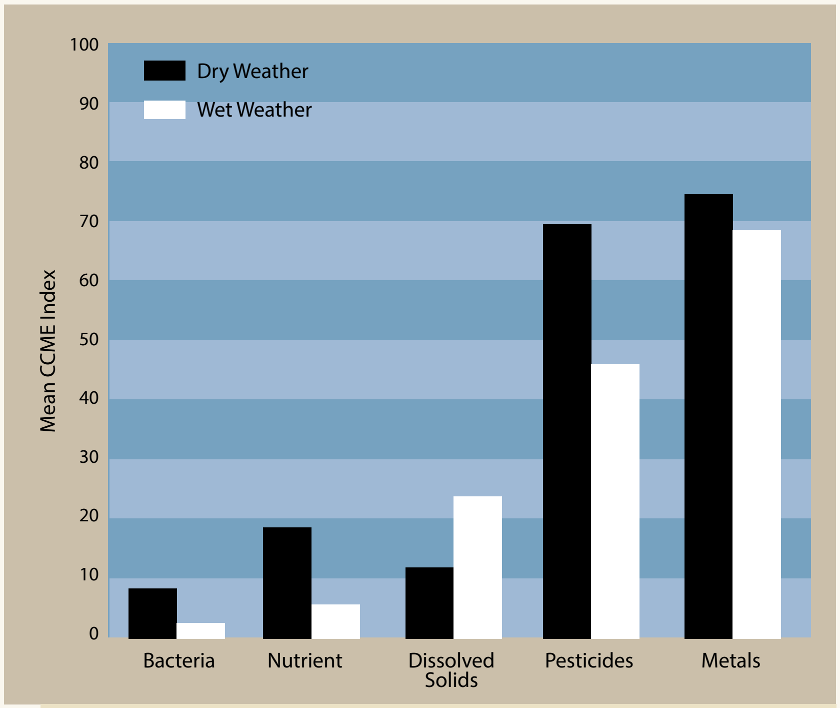

FIGURE 3: Overall exceedance index for core monitoring constituents in inland channels, summarized over the 2003 – 2013 monitoring period. *The bar charts rank constituents based on their respective CCME exceedance indices in both dry and wet weather, with higher values indicating fewer and smaller exceedances. Note: pesticides and metals had considerably lower exceedance rates and magnitudes of exceedance than bacteria, dissolved solids, and nutrients.*

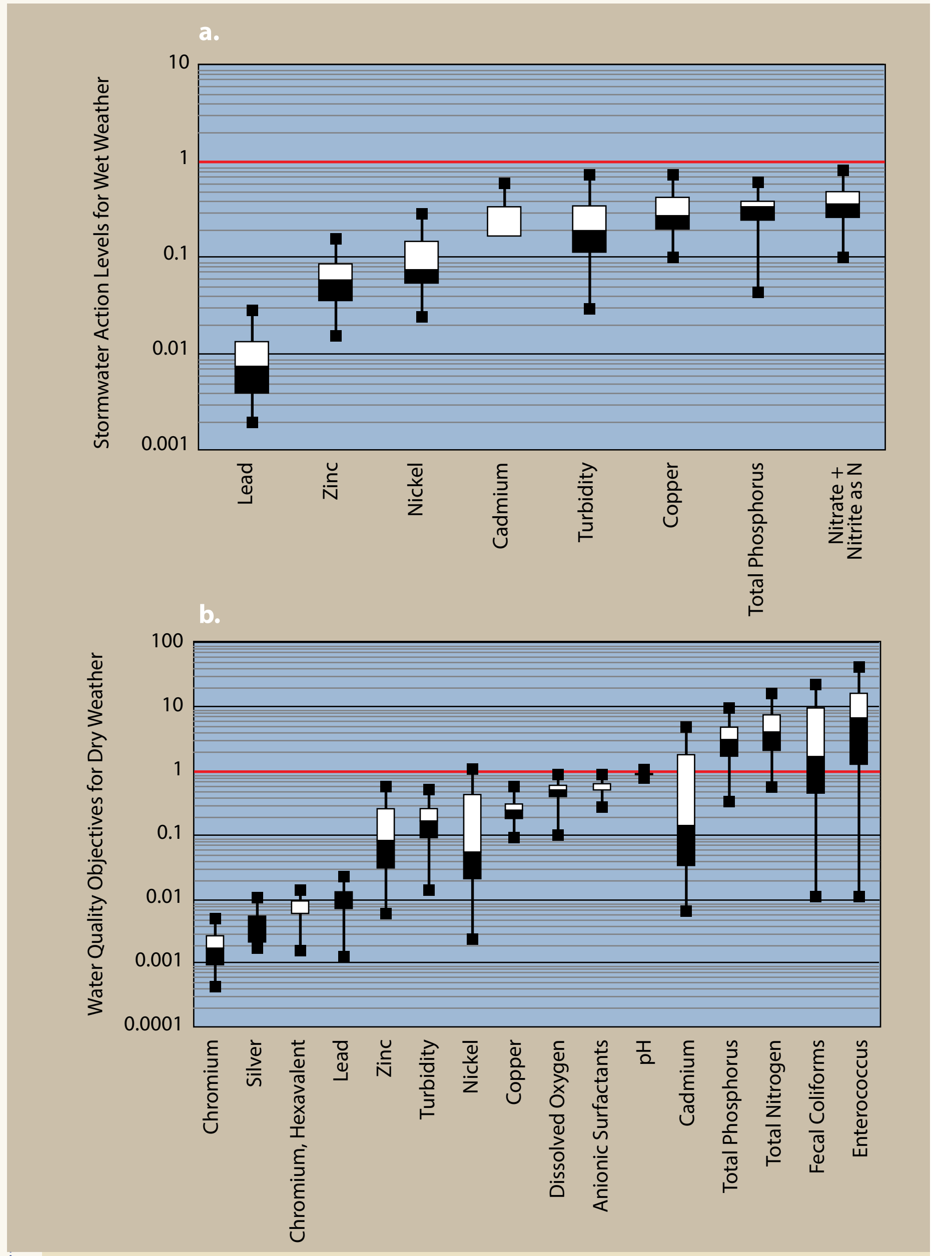

FIGURE 4: Comparison of individual constituent concentrations with a) Stormwater Action Levels (SALs) for wet weather and b) water quality objectives (WQOs) for dry weather. *In the box and whiskers plot, the horizontal bar represents the median, with the upper and lower edge of the box the 75th and 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 WQOs in dry weather.*

TEST SPECIES	DRY WEATHER			WET WEATHER			SEDIMENT		
	n	TOXIC	NON-TOXIC	n	TOXIC	NON-TOXIC	n	TOXIC	NON-TOXIC
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%**

TABLE 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.*

Figure 4 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 4a) which are higher than the Water Quality Objectives (WQO) that apply to dry weather discharges (Figure 4b) and receiving waters in channels (Figure 3). Nutrients and bacteria are persistent issues for dry weather discharges.

While toxicity is present in urban channels (Table 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 dry weather, 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.

Biological condition, as measured by macroinvertebrate bioassessment results, is uniformly poor at targeted monitoring sites in south Orange County channels (Figure 5). 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

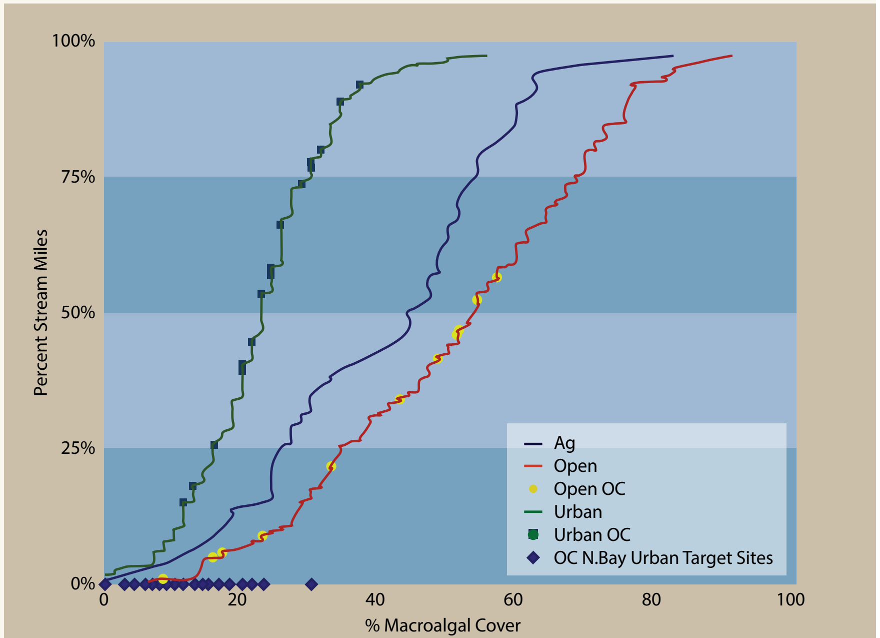

FIGURE 5: Cumulative frequency distribution of SMC bioassessment monitoring results across southern California in three distinct landuses. *The random sites within Orange County sampled as part of the SMC program are indicated on the curves for urban and open landuses. Targeted channel sites are shown 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.*

	% 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

TABLE 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: Acute toxicity patterns in open undeveloped areas are not substantially from those in urban areas.*

(Table 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 SWRCB, would be appropriate and informative.

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 6). 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.

While Figure 6 suggests that bacteria contamination is a moderate problem, particularly in wet weather, two other datasets present a different perspective. The data in Figure 6 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 7) 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 8) shows that bacteria shows continued improvement at some beaches over the past five years. However, Figure 8 does not reflect recent dramatic improvements at these beaches because it summarizes data over the entire 2005 –

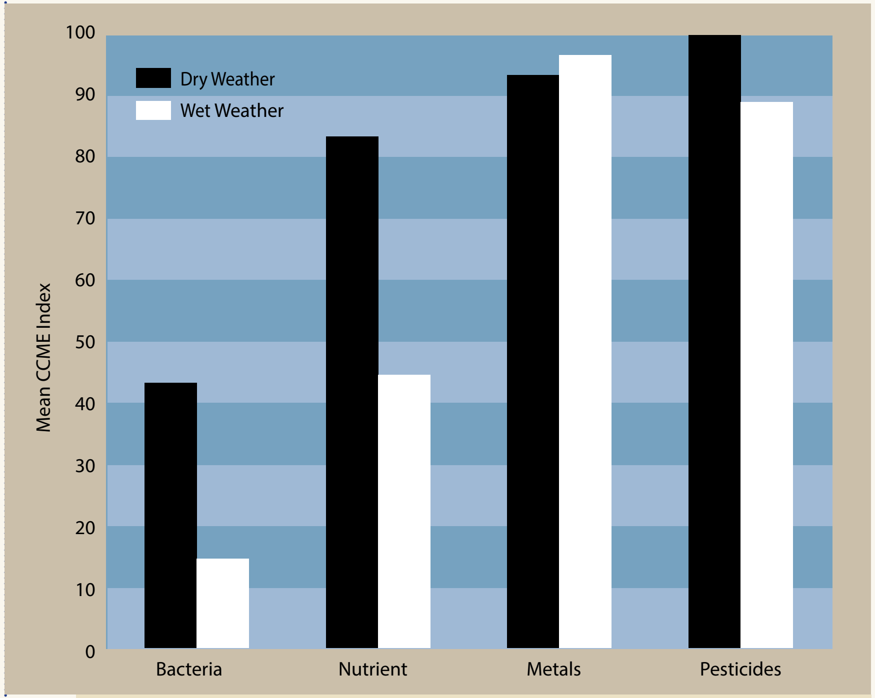

FIGURE 6: Overall exceedance index for core monitoring constituents in the coastal surfzone, summarized over the 2003 – 2013 monitoring period. *Note: Constituents measured at coastal discharge points rarely exceed standards, except occasionally for bacteria and nutrients in wet weather.*

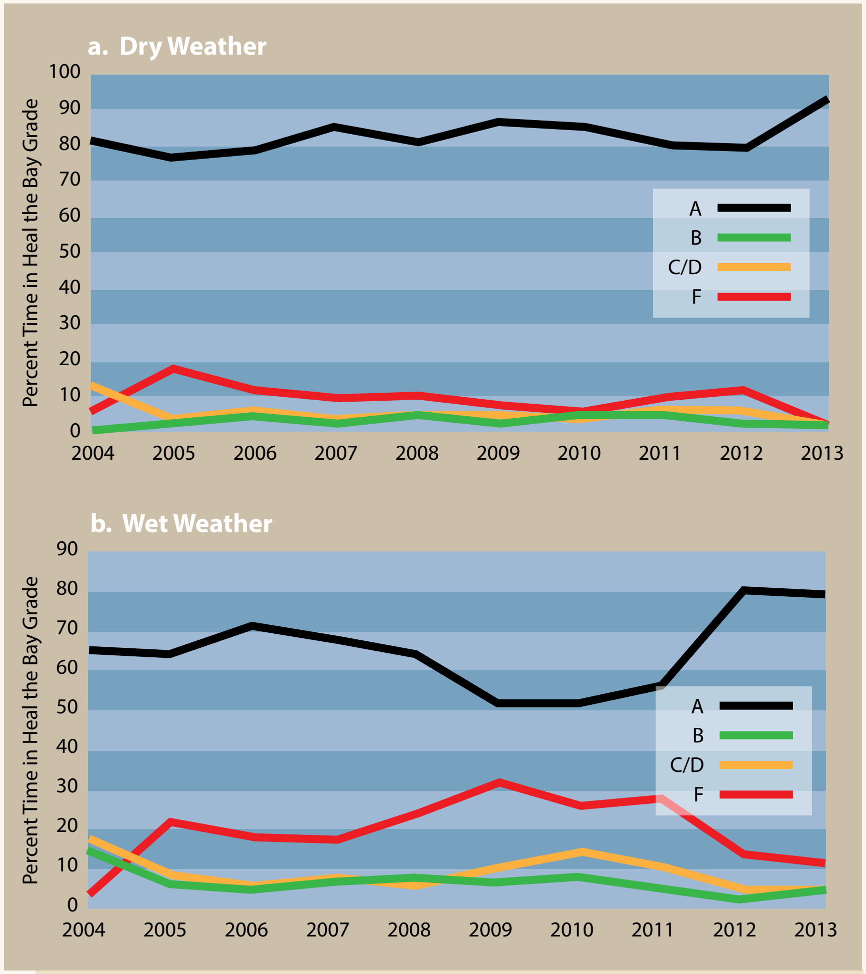

FIGURE 7: Percentage of the time that swimming beaches are in each Heal the Bay report card category, averaged across all monitored beaches. *During (a.) dry weather beaches are in the A grade between 80 and 90% of the time. During (b.) wet weather the percentage of A grades drops, but has remained at about 80% for the past two years.*

2013 period (see Bacteria section 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 6 do not provide the entire context for evaluating bacterial contamination at coastal beaches.

Figure 6 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.

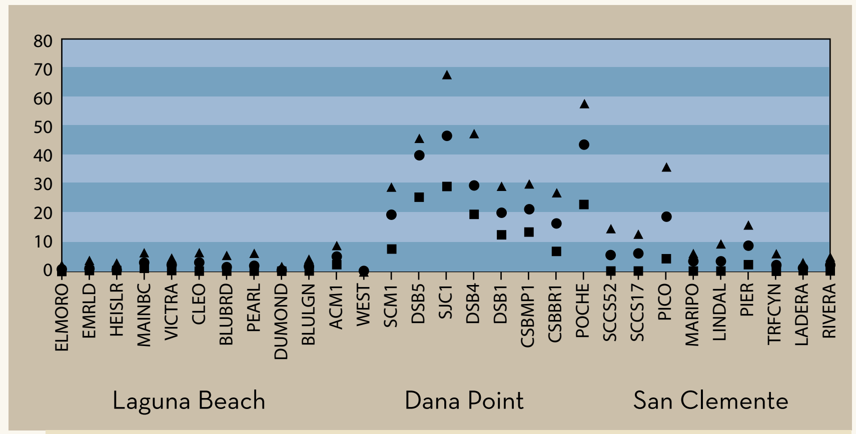

FIGURE 8: The overall percent exceedance of the AB411 Enterococcus standard over the time period 2005 - 2013. *Poche and Doheny, and to a lesser extent Pico, are the only persistent problem beaches and this summary figure overstates the problem because it does not clearly reflect significant recent improvements. 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.*

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).

FIGURE 9: The beach is a popular recreational destination across the region.

A Valued Resource

South Orange County's beaches (Figure 9) 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.

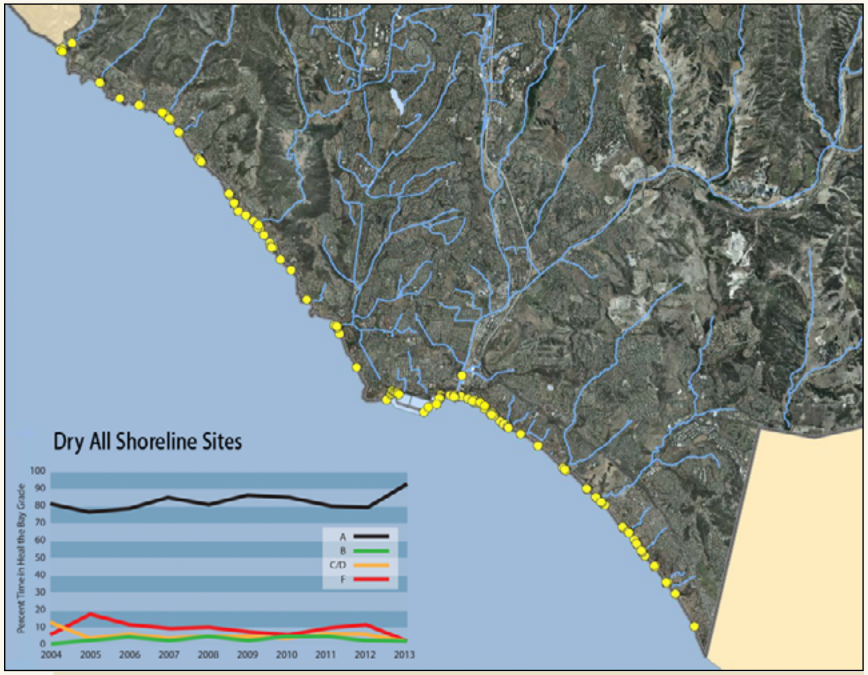

FIGURE 10: A Coordinated beach monitoring program conducted by the County Health Care Agency, the Program, and wastewater treatment agencies regularly monitors a large number of swimming sites. *Heal the Bay prepares weekly beach report card grades (inset figure and expanded Figure 7) that are made available on their web-site (www.healthebay.org).*

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 10). A unified monitoring program that improves coordination among monitoring efforts conducted by the Program, the County Health Care Agency, and the water treatment agencies has been approved by the Regional Water Board and will be implemented shortly.

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 10).

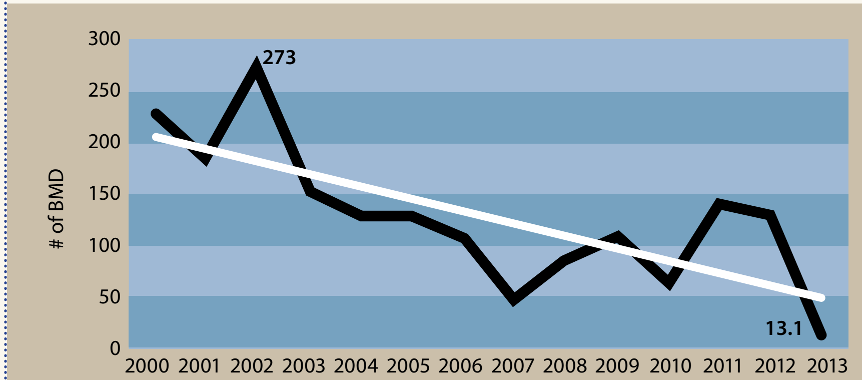

FIGURE 11: The total number of Beach Mile Days (the product of the length of beach posted times the length of beach posted) posted due to exceedances of standards during the April 1 – October 31 summer swimming season. *Beach Mile Days have declined substantially since 2000 and reached an all-time low in 2013. Adapted from HCA (2012).*

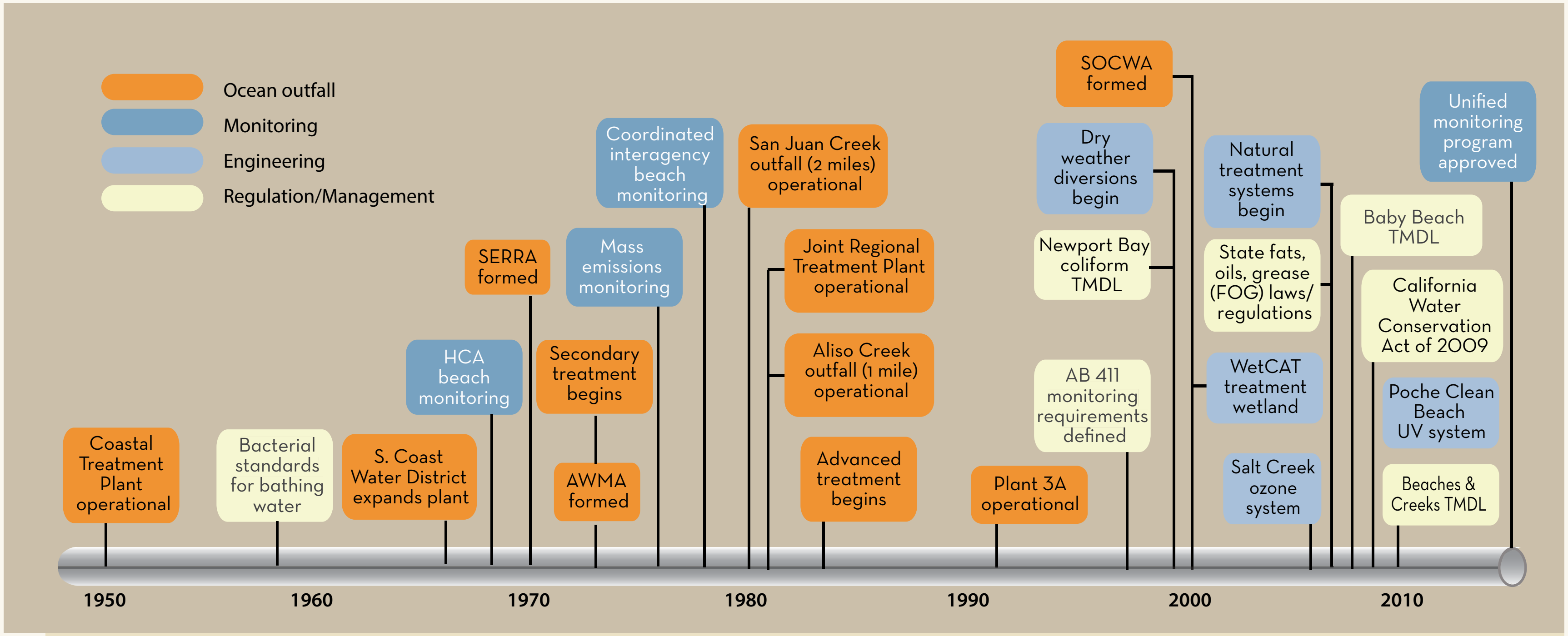

FIGURE 12: Timeline of significant actions in several categories that have contributed significantly to improved beach water quality.

This improvement in conditions during dry weather has been mirrored by a decrease over the past several years in beach postings due to the exceedances of bacteriological standards, as measured by Beach Mile Days (Figure 11). 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 12) initially focused on wastewater treatment plant improvements and treatment upgrades and have more recently expanded to include a wide range of localized BMPs (Figure 13) that have dramatically reduced the level of contamination at beaches and in the streams that discharge 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.

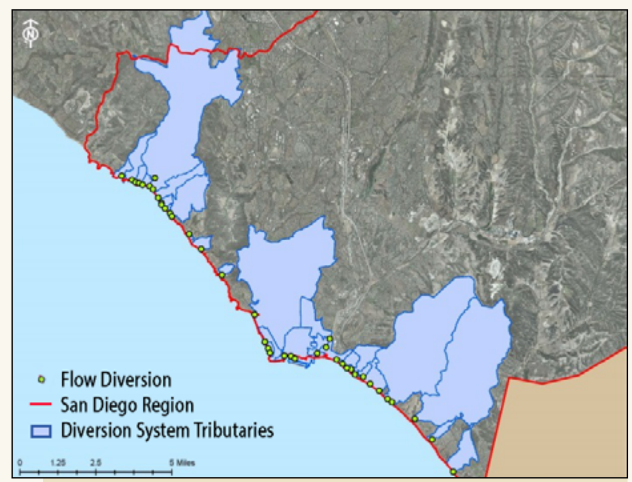

FIGURE 13: Coastal flow diversions that reroute dry weather flow to treatment plants that affect flow and/or bacterial loads.

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 14). 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 late 1990s.

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 8). 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 14)), 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 13), Aliso Creek and Poche and Doheny Beaches provide representative examples of the diversity

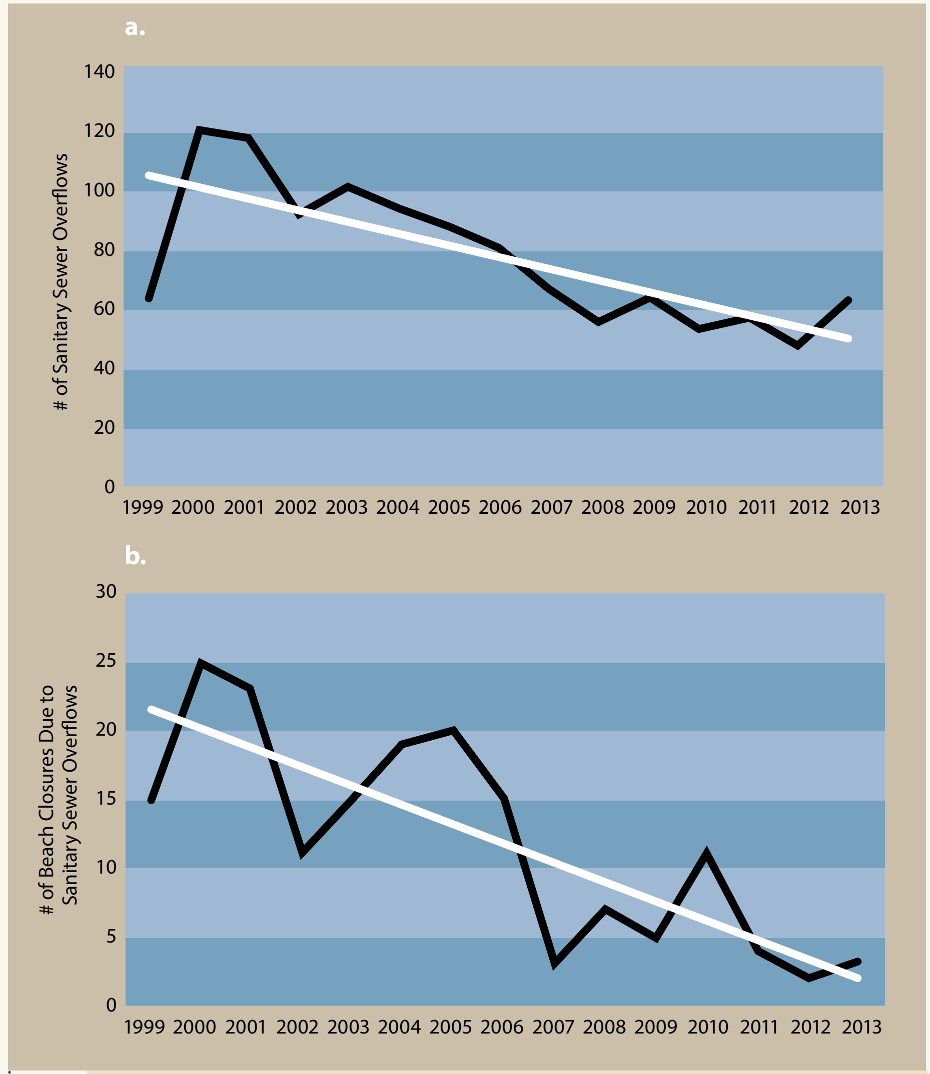

FIGURE 14: Two key metrics track the decreasing impact of sewage spills on beach condition in south Orange County over time. *a) The number of reported sewage spills from 1999 through 2013. The number of spills peaked in 2000 and has declined steadily since then (regression significant at p = 0 .001), 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).*

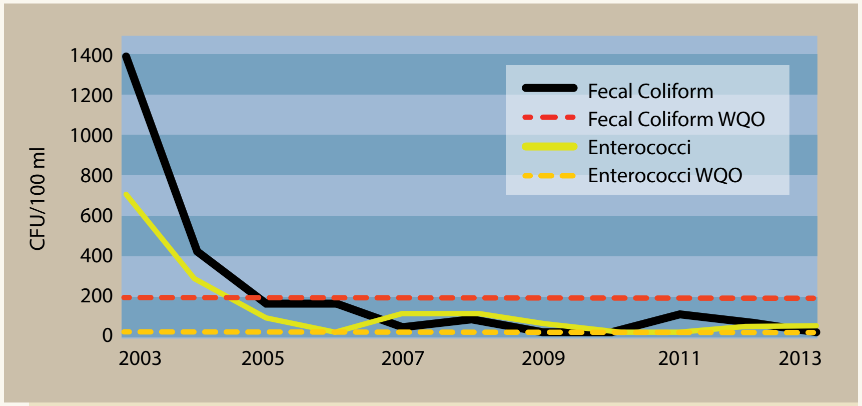

FIGURE 15: Fecal indicator bacteria concentrations at Aliso Creek monitoring site CTPJ01 have significantly declined and now meet recreational water quality objectives (WQOs) for fecal coliform.

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 15).

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 16). 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.

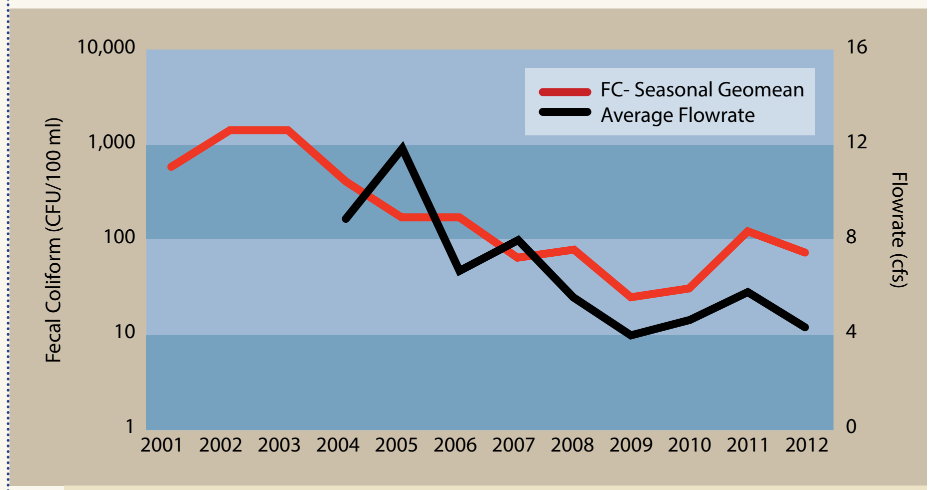

FIGURE 16: The fecal coliform seasonal geomean in the Aliso Creek watershed plotted in comparison to the average dry weather flow rate in the creek. *Note: Fecal coliforms have declined in concert with reductions in flow of urban runoff to Aliso Creek.*

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 2007-08, a source identification pilot project (or SIPP) identified leaking sanitary sewer infrastructure as a source of human fecal markers

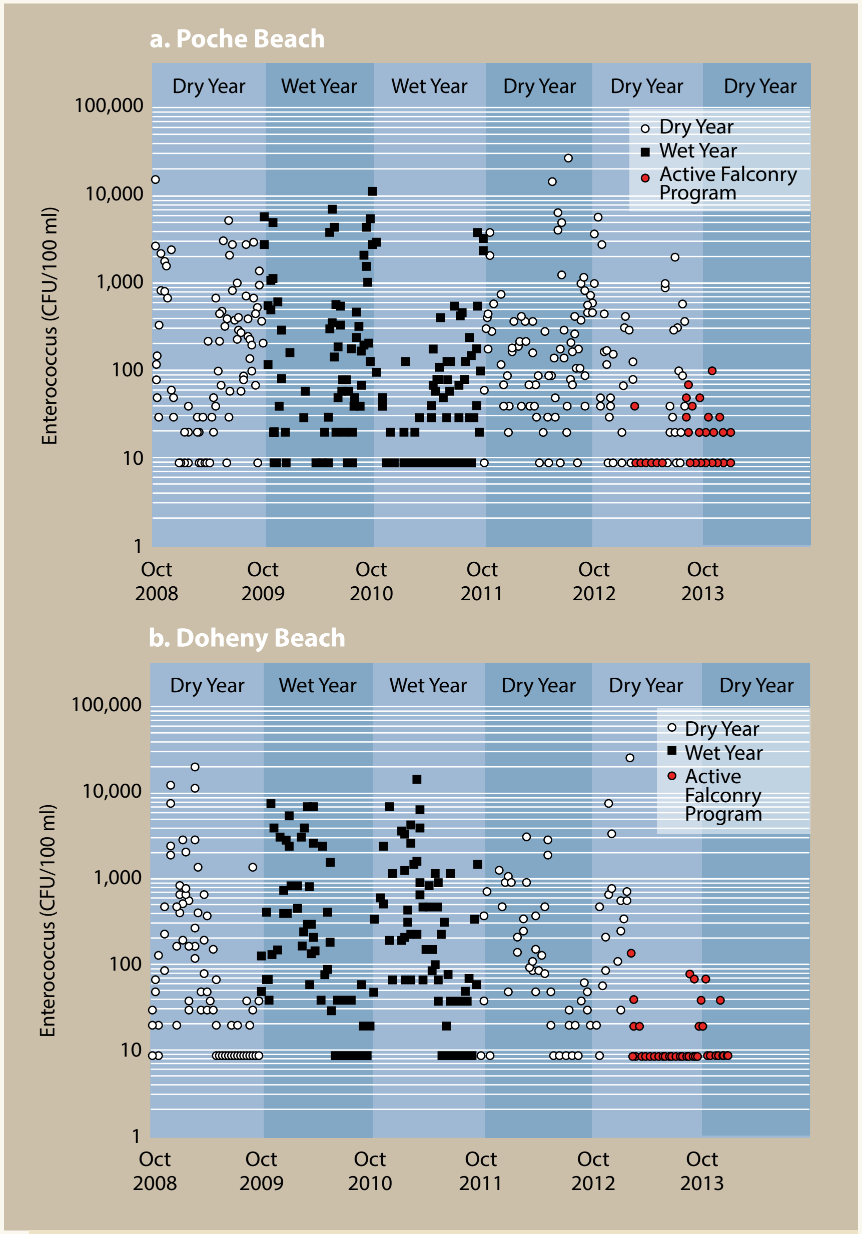

FIGURE 17: The presence of an active falconry program to deter seagulls is associated with significant declines in bacterial contamination levels at both Poche (a) and Doheny (b) beaches. *Note: Falconry programs help reduce contaminant inputs from seagulls.*

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.

Additional studies identified another source of human fecal makers, this one airborne. Projects that involved genetic characterization 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 17). Thus, the combination of modern genetics methods and the ancient practice of falconry provided an effective solution at Poche and Doheny Beaches.

Ongoing efforts by cities 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 13) 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.

FIGURE 18: 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.*

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 18a vs. 18b) 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 18c), 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 19). Nevertheless, the annual percentage of A grades for wet weather on the Heal the Bay report card has reached 70% in recent years (Figure 19). 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 18d), primarily by surfers taking advantage of the larger surf that often accompanies winter storms.

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

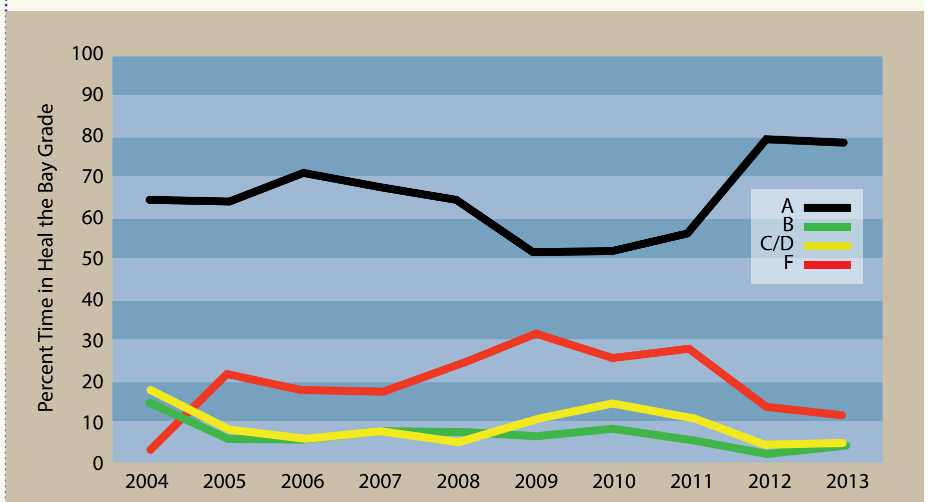

FIGURE 19: The percentage of poor Heal the Bay report card grades at swimming beaches is much higher in wet weather than in dry weather (see insert in Figure 10), although the annual percentage of A grades in wet weather has increased gradually in recent years to 80% and the percentage of F grades has 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.*

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.

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 the Bight '13 large-scale regional monitoring program 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 microbial 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.

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 20 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.

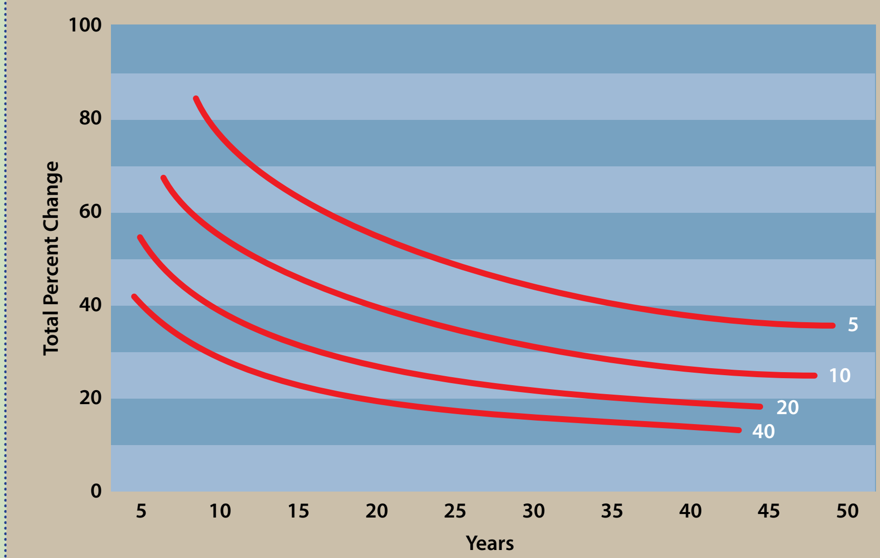

FIGURE 20: Example analysis run with pesticide data to demonstrate statistical power analysis for a trend monitoring program. *The number of years of data required to detect varying amounts of change with different numbers of samples per year (5, 10, 20, 40) next to respective curves). This figure illustrates 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.*

THE STORY: DISSOLVED SOLIDS

- Persistent and widespread exceedances of total dissolved solids objective occur in channels and at discharge outfalls.
- Dissolved solids are 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.

DISSOLVED SOLIDS

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 is a general description of the amount of salt in water and the most common chemical constituents are 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 21) 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 22). 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

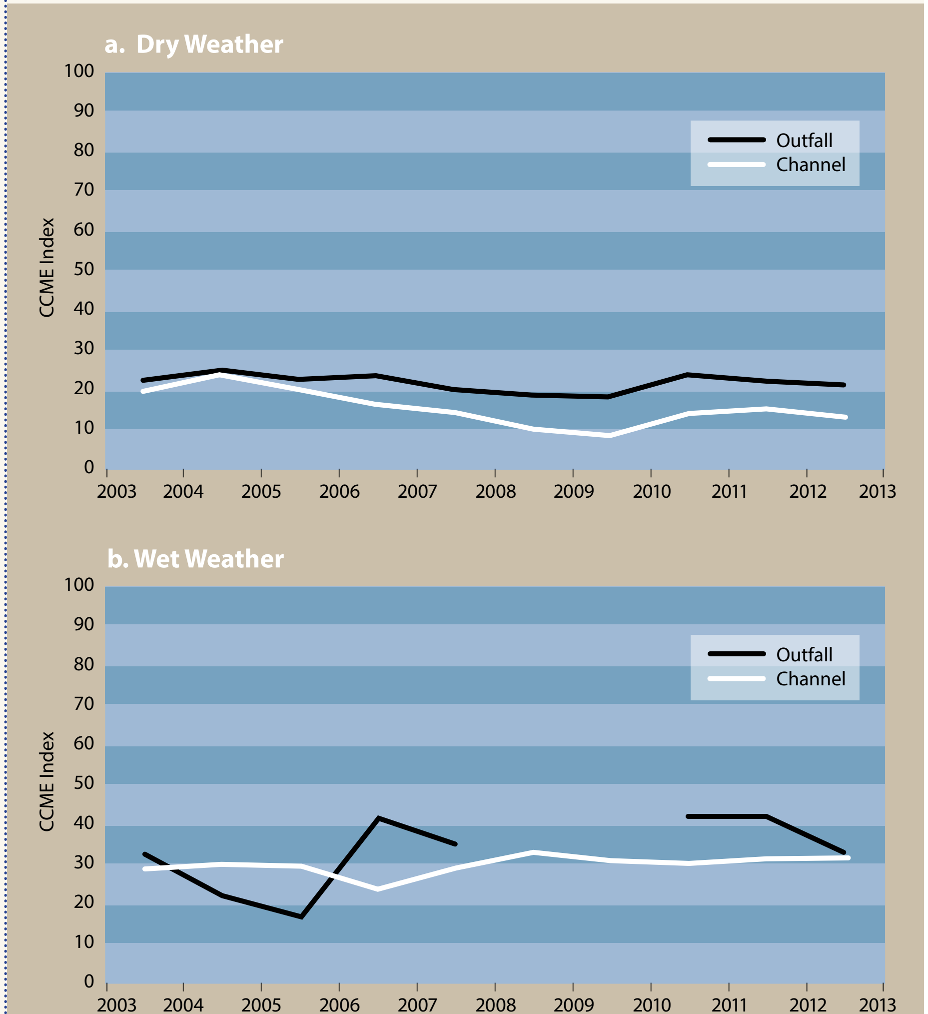

FIGURE 21: An overall exceedance index *of the extent to which total dissolved solids meet regulatory standards in both a) wet and b) wet conditions is low (which means poor conditions) and has remained fairly steady since 2004.*

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. Conversely, 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.

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, as a consequence of the area's marine sedimentary geology. 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 22a).

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 exhibit an entirely different geochemistry and impart lower levels of dissolved solids (Figure 22b).

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 23a), although loads of dissolved solids to Oso Creek were higher than those in natural streams (Figure 23b).

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

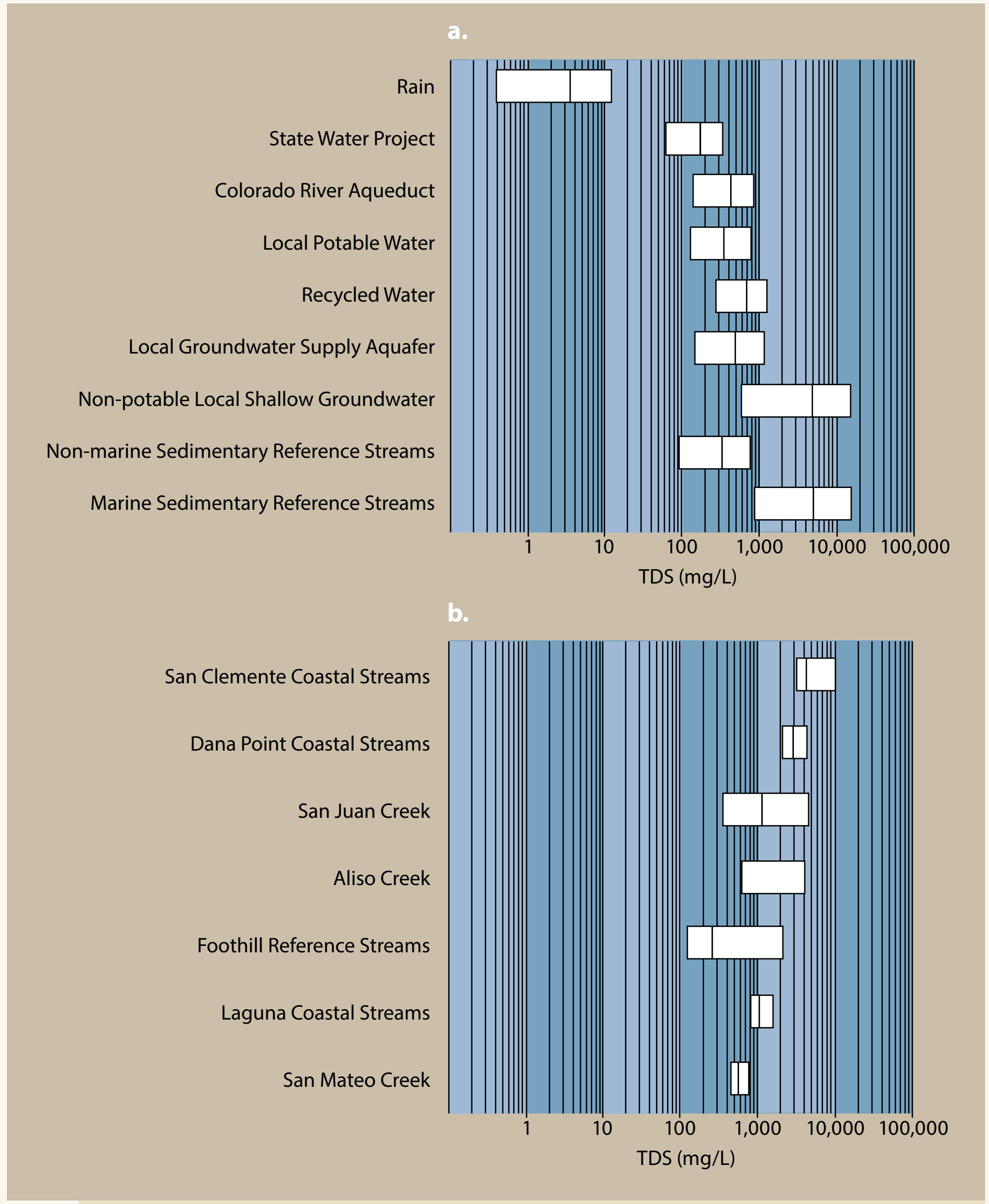

***FIGURE 22: Means and ranges of dissolved solids concentration** in a) various water sources including rainwater, local potable, Colorado River potable, recycled, groundwater, and b) streams. Data from these sources provide context as to which water source(s) most closely resemble surface waters with elevated dissolved solids.*

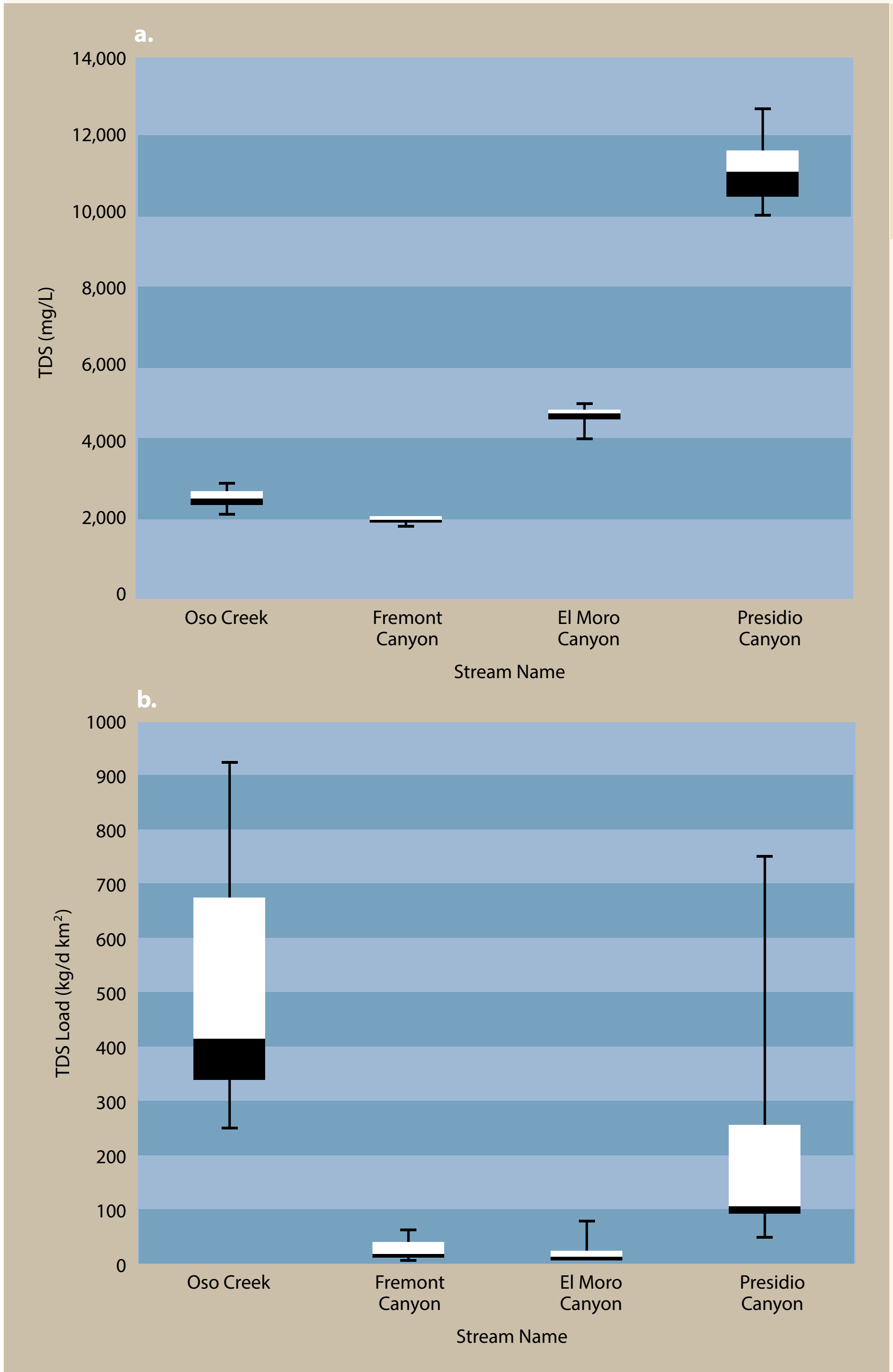

FIGURE 23: Ranges of dissolved solid concentrations *(a) and loads (b) in Oso Creek in comparison to three reference streams of similar geology.*

River watershed 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.

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 24). The shallow groundwater in urban areas reflects conditions more similar to rainwater and reference streams than to an imported source of water.

These three pieces of information have important implications for the Program's efforts to

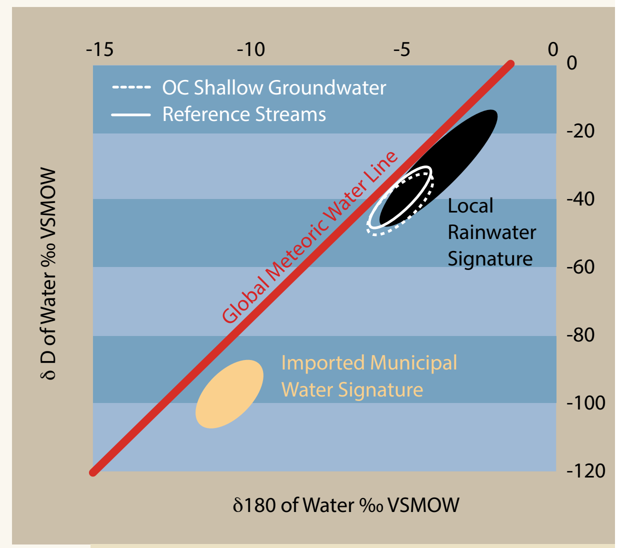

FIGURE 24: Hydrogen and oxygen stable isotope compositions of shallow groundwater *in urban creeks across south Orange County in comparison to rain, water from reference streams in undeveloped watersheds, and imported municipal water from Colorado River and the Sierra Nevada mountains.*

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.

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 an 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.

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.

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 25) and estuaries (Figure 26) 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 27). 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.

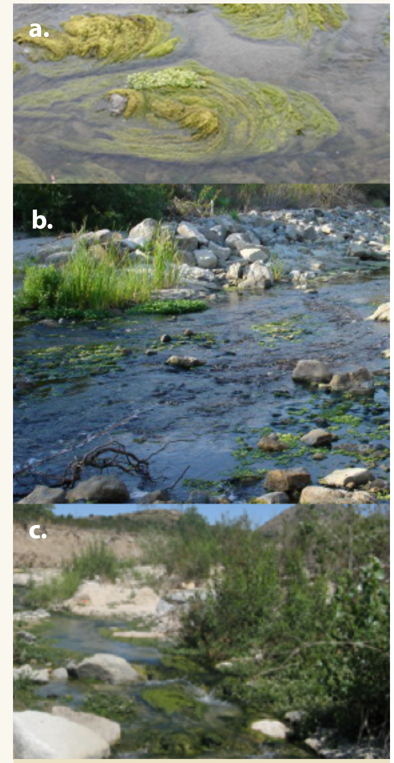

FIGURE 25: Nutrient enrichment causes overgrowth of algae in streams, particularly in warmer, low flow conditions. *a) algal mats in a slow moving stream. Urban and natural watershed areas can supply excessive nutrients, so algal overgrowth and its secondary impacts (e.g., low dissolved oxygen) occur in both urban channels (b) and streams in undeveloped open space (c).*

Unlike most other pollutants, nutrients are involved in complex biological transformation and cycling processes (Figure 28) 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.

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.

FIGURE 27: Bloom of the alga Lingulodinium polyhedrum in the coastal ocean off southern California. *This alga can be toxic to marine organisms.*

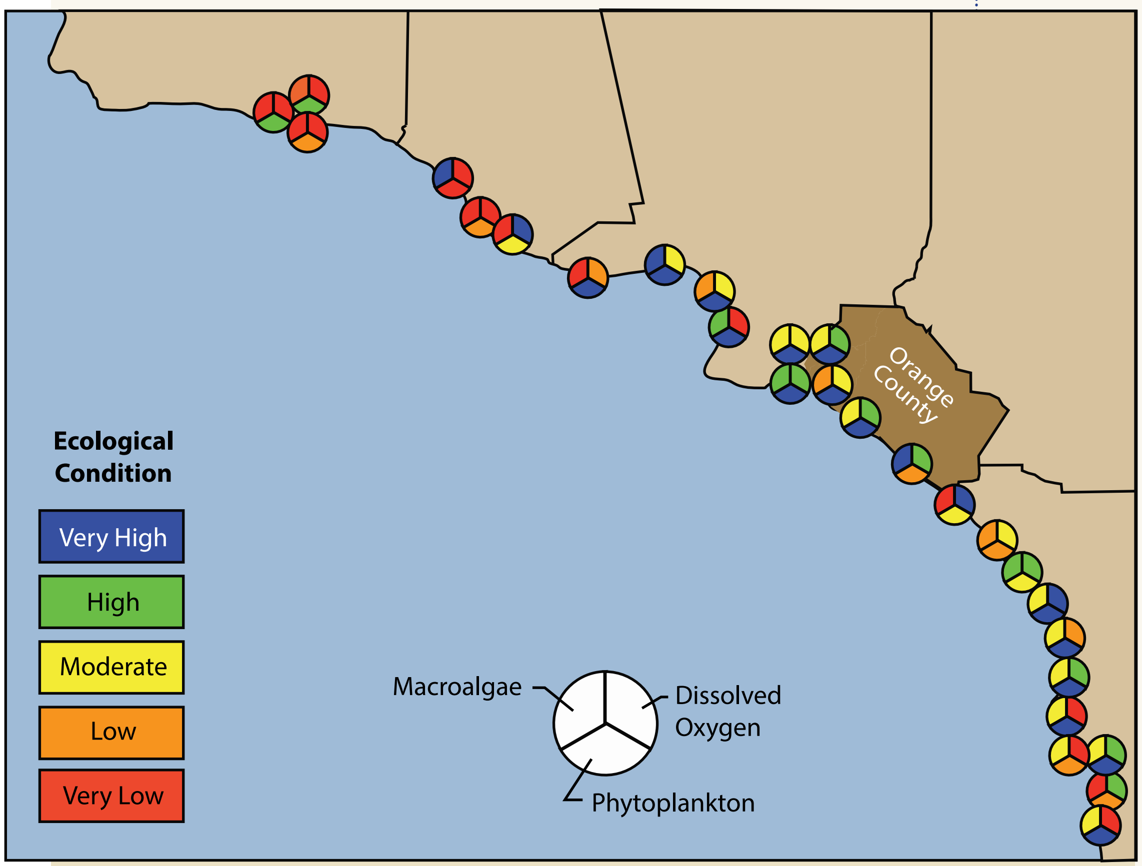

FIGURE 26: Almost all estuarine segments in the Southern California Bight show some degradation *on at least one of the three response indicators of eutrophication: macroalgal cover, phytoplankton, and dissolved oxygen concentration. Adapted from Bight '08 program data.*

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(1mg/l for total Nitrogen; 0.1mg/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 29a and 29b shows that nutrients (total nitrogen and total phosphorus) commonly exceed thresholds in channels and that a frequency-based

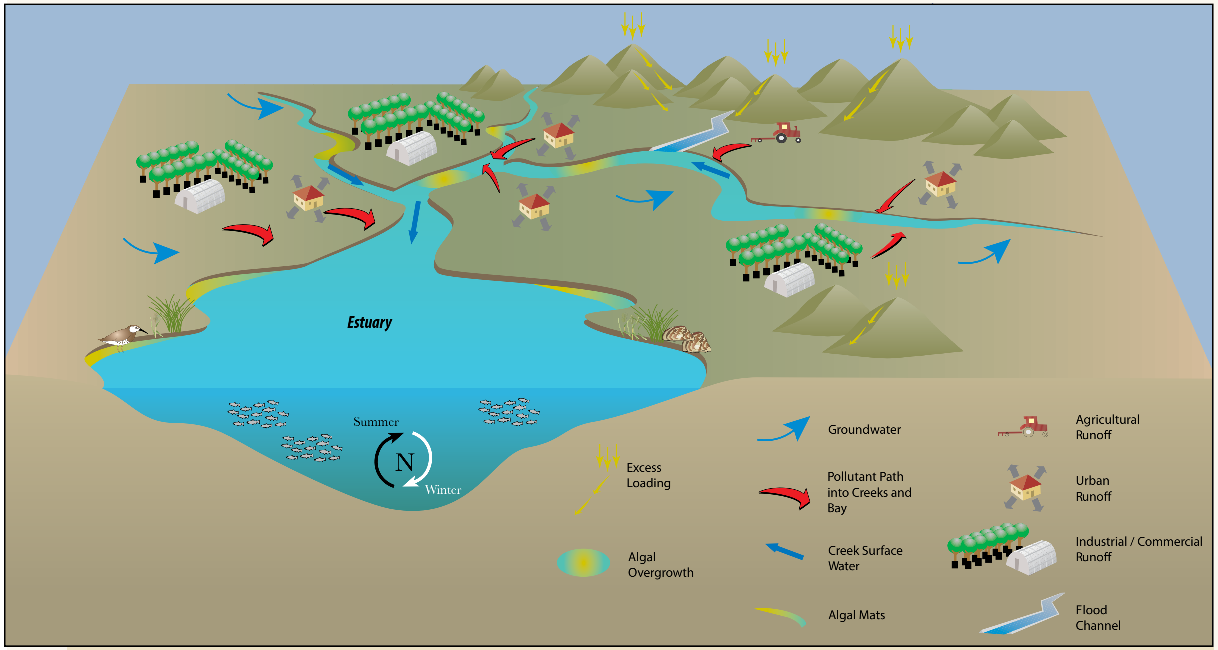

FIGURE 28: A graphical conceptual model of nutrient dynamics in a generalized estuarine system. *Nutrients derive from multiple sources, both natural and anthropogenic, spread across the watershed. Atmospheric deposition can exceed the carrying capacity of upland soils, leading to nutrient loading to 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.*

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 25c and 30). 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 30 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 30 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 landscape, this problem also occurs in undeveloped streams in the region.

Figure 29 shows that elevated nutrient levels are pervasive in south County channels but Figure 30 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 *New Management Approaches*).

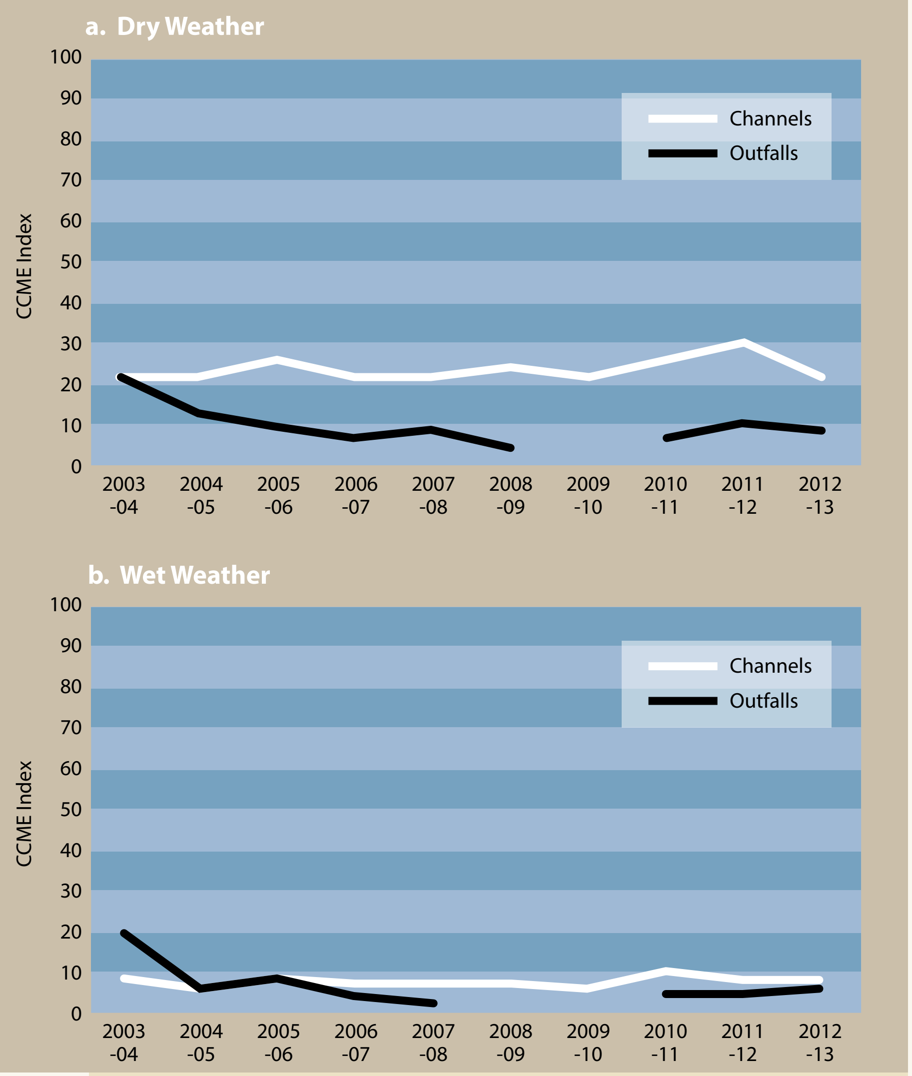

FIGURE 29: An overall index of the extent to which nutrients (total nitrogen and total phosphorus) meet thresholds in channels and outfalls, *in both dry (a) and wet (b) weather is low (which means poor conditions) and has remained low over the monitoring period. The index integrates the number of indicators 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.*

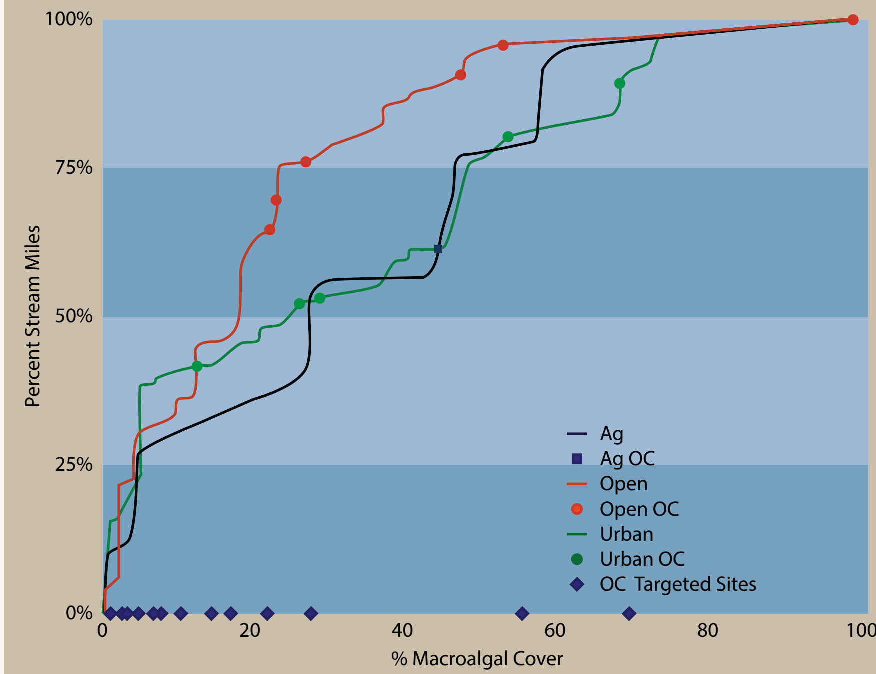

FIGURE 30: The cumulative frequency distribution function of macroalgal cover in the three landuse types *sampled by the Stormwater Monitoring Coalition's (SMC) regional program. Fifty percent of the stream miles in the open landuse had about 20% or less macroalgal cover, while about 50% of the stream 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.*

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

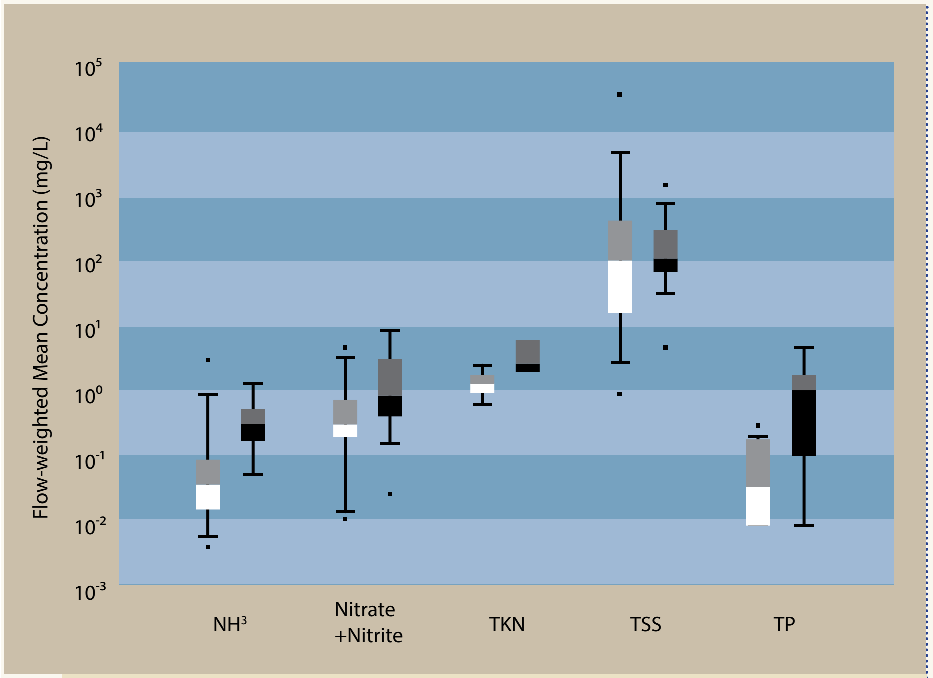

FIGURE 31: Wet weather flow-weighted mean concentrations of several forms of nutrients *at urban (shaded boxes) and undeveloped open space (clear boxes) sites, as measured in the SCCWRP Natural Loadings Study. These data document that natural areas are sources of nutrients at concentrations that are 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). NH+ refers to ammonia, TKN to total Kjeldahl nitrogen, TSS to total suspended solids, and TP to total phosphorus.*

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 31 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.

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 32) 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.

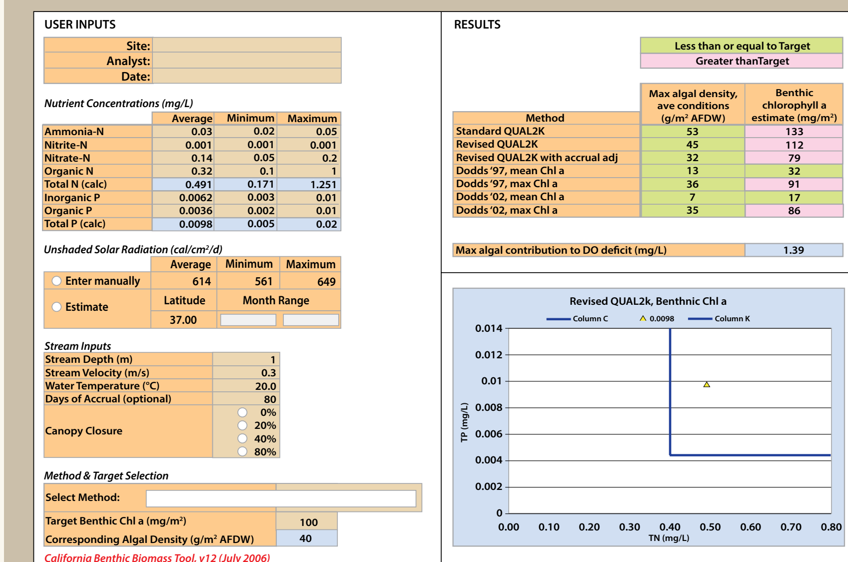

FIGURE 32: The main user interface for the current version of the freshwater Nutrient Numeric Endpoint (NNE) *biomass estimation spreadsheet tool. In this figure, data fields are loaded with example data for illustrative purposes.*

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.

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.

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 33) 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 33: 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) 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 summarizes the results of 2548 separate toxicity tests performed since 2003. The overall prevalence 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

TEST SPECIES	DRY WEATHER			WET WEATHER			SEDIMENT		
	n	TOXIC	NON-TOXIC	n	TOXIC	NON-TOXIC	n	TOXIC	NON-TOXIC
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%**

TABLE 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 is generally low except for one organism in wet weather that is susceptible to pesticides.*

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 times, with high toxicity occurring in only isolated instances; 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.

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 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

	% 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

TABLE 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.*

that high levels of dissolved solids (see Dissolved Solids section), 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 region-wide 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.

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 Identification 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.

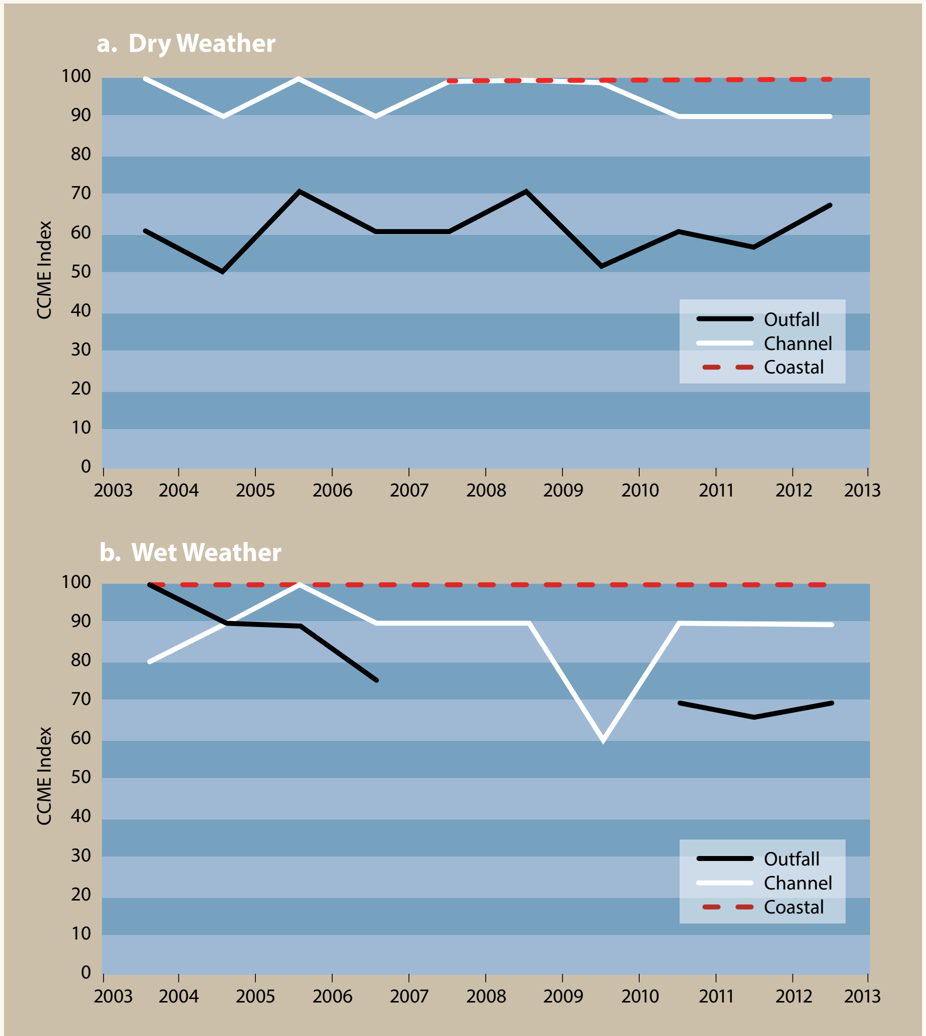

FIGURE 34: An overall index of the extent to which metals meet regulatory standards in channels and embayments is high (meaning few exceedances) and has remained steady since 2003, in all samples for both dry (a) and wet (b) weather. *This index accounts for the number of metals that exceed standards 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.*

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 suggest 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 34) 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 3), a regional study of loadings from natural areas (Figure 35), 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.

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 36). Sampling during a storm event of runoff from homes with and without architectural copper features showed that the

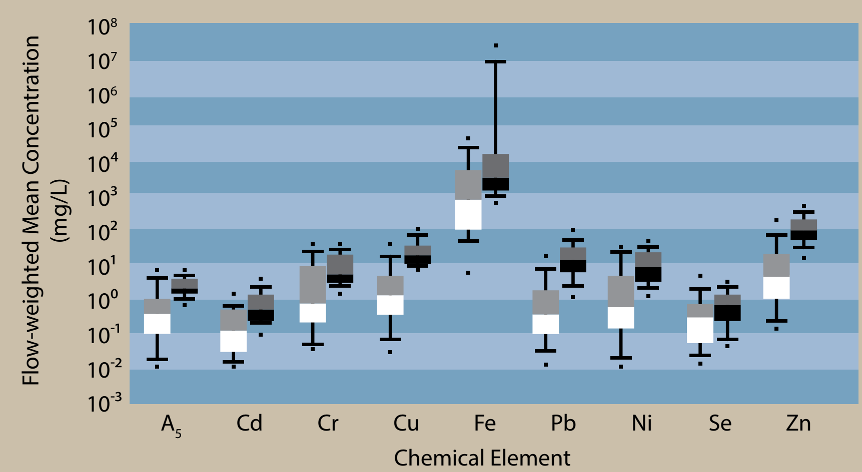

FIGURE 35: Wet weather flow-weighted mean concentrations of metals at urban (shaded boxes) and undeveloped open space (clear boxes) sites, as measured in the regional study of runoff characteristics from natural drainages *(Stein and Yoon 2007). These data document that natural areas are sources of metals, 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.*

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.

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 (Anderson et al. 2010). 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 37). 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

FIGURE 36: Aerial photograph of a portion of the Irvine Cove drainage area *identifying various types of structural architectural copper uses.*

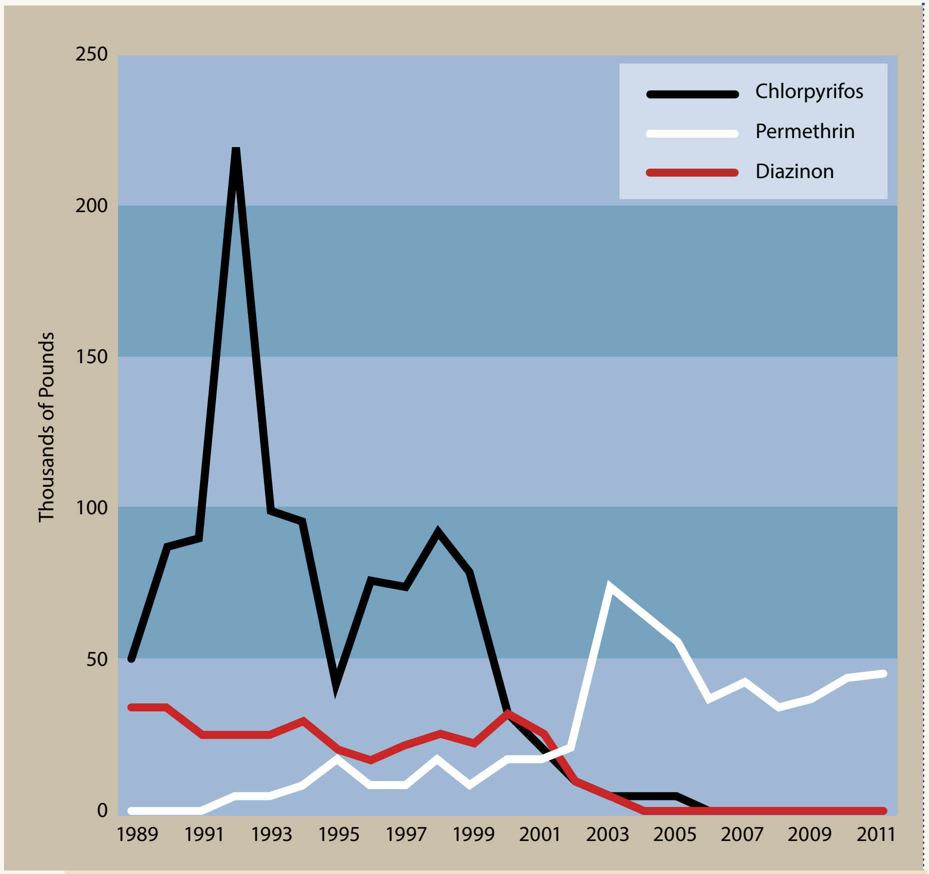

FIGURE 37: Trends in the use of the two most widely used organophosphate pesticides, diazinon and chlorpyrifos, and permethrin, the most widely used of the newer synthetic pyrethroids. *The organophosphates have virtually disappeared from the County after their residential use was banned by the USEPA, in 2001 for chlorpyrifos and 2004 for diazinon. Trends for all three pesticides are significant at the p <0.001 level.*

sensitive methods with lower detection limits. In addition, new pesticides often change the nature of toxicity and the types of organisms affected. This ever-changing cast of characters poses a constant challenge to monitoring methods and the understanding of toxic processes. Figure 37 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 38). 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 37), 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.

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 39). 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.

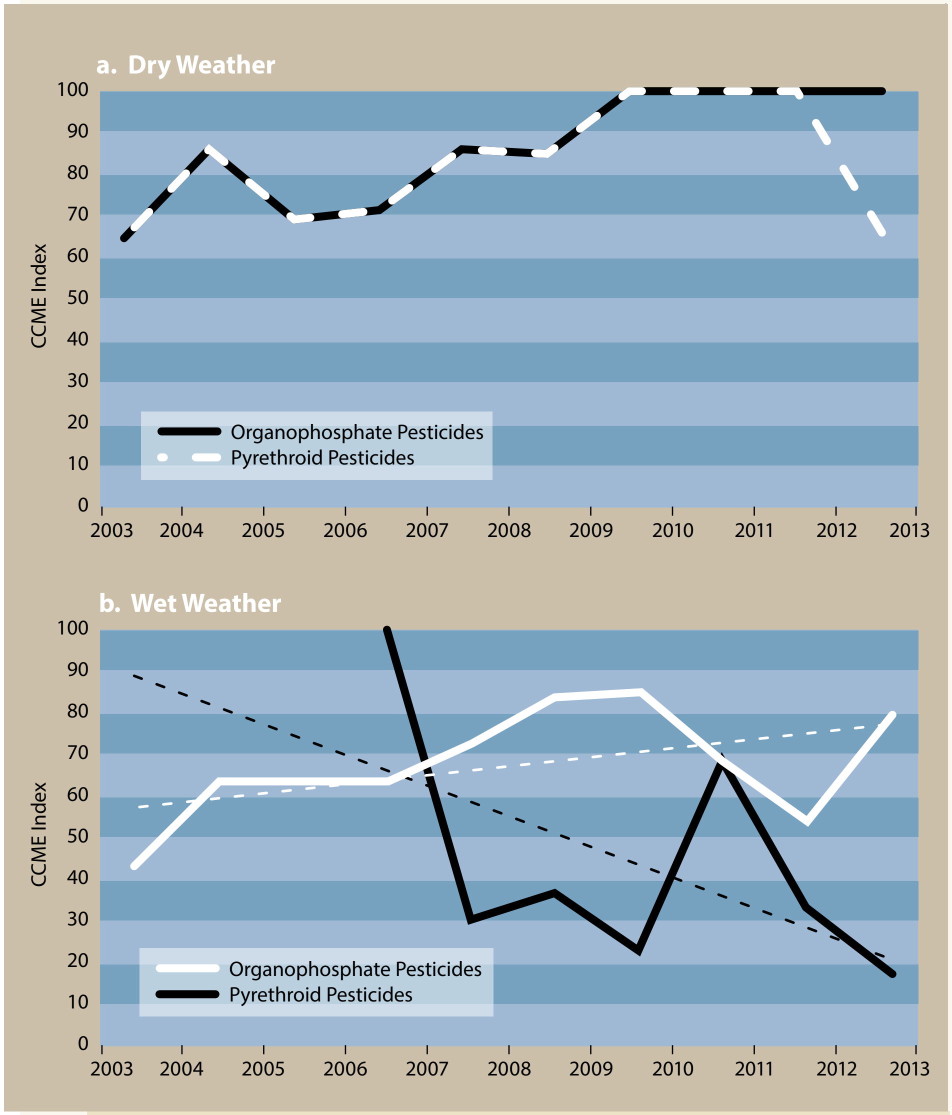

FIGURE 38: Trends over time in the exceedance index for a) organophosphate pesticides in dry weather and b) both organophosphate and pyrethroid pesticides in wet weather. Higher values of the index indicate better conditions. *Organophosphate pesticides reach an index value of 100 (no exceedances) in 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), trends for these pesticides in both wet and dry weather are improving.*

However, the chemicals that contributed most to the decline shown in Figure 39 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. 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.

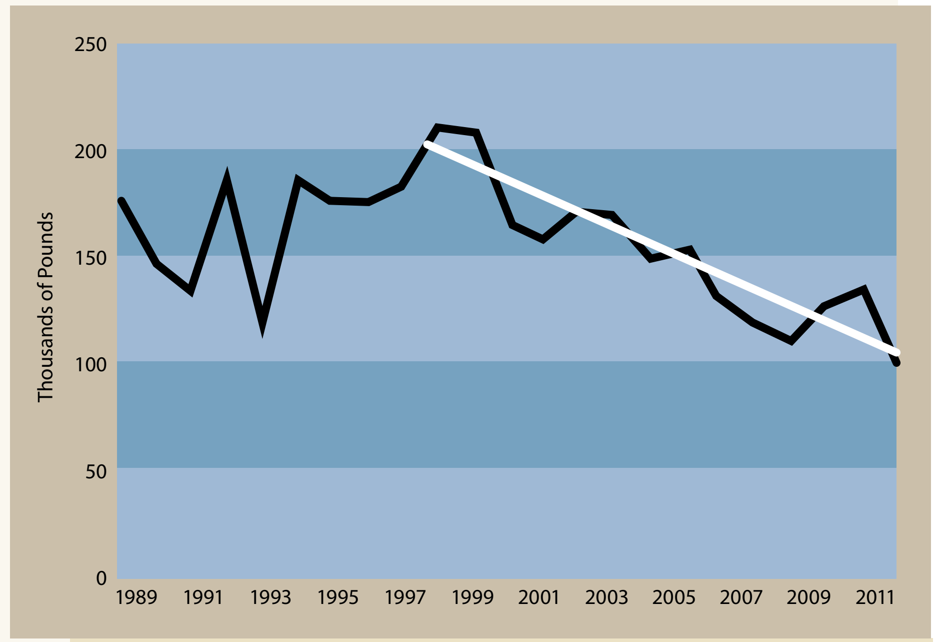

FIGURE 39: Total reported pesticide use in Orange County, drawn from the California Department of Pesticide Regulation's website (www.cdpr. ca.gov). *The amount applied annually has declined by over 50% since 1998 (regression significant at p <0.001). Note: Overall pesticide use appears to be declining.*

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.

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.

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.

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 (Schiff et al. 2011), 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

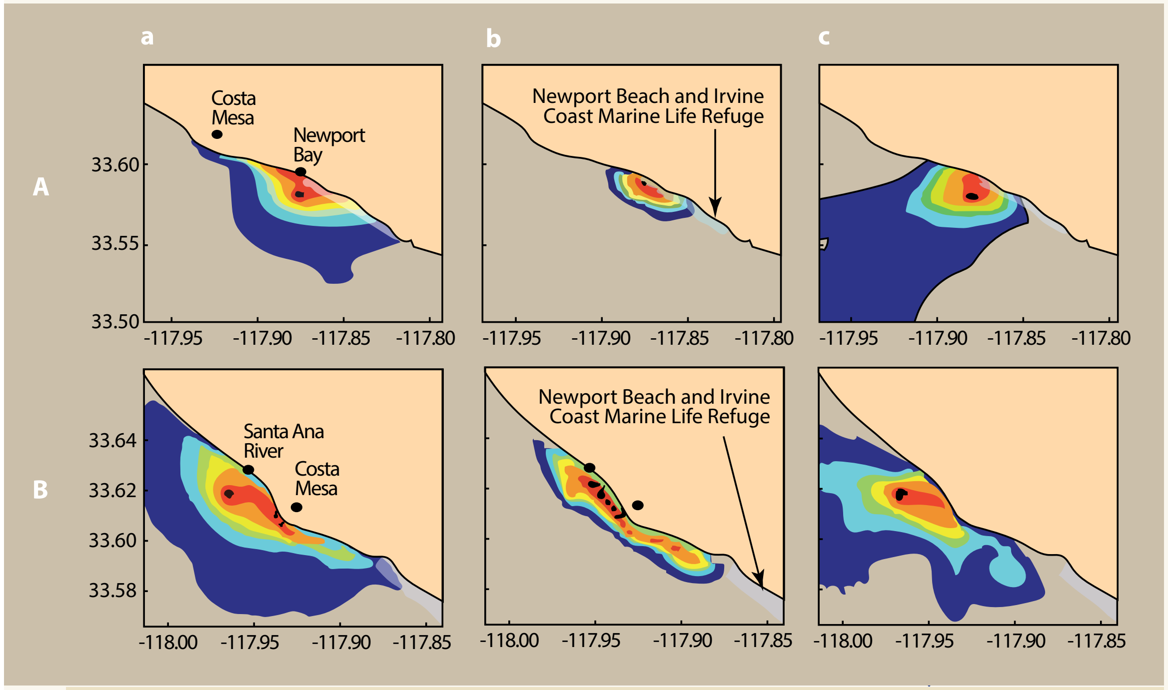

FIGURE 40: Illustration of the use of coastal discharge flow and coastal current data to produce probability exposure maps for a series of discharges and nearby protected areas in southern California. *The figure is organized by rows for (A) Newport Bay, and (B) Santa Ana River. Additionally, each column 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).*

The pollution index was based on a plume dispersion model (Figure 40) (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 41) and pollution on the status of biological communities.

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.

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 42).

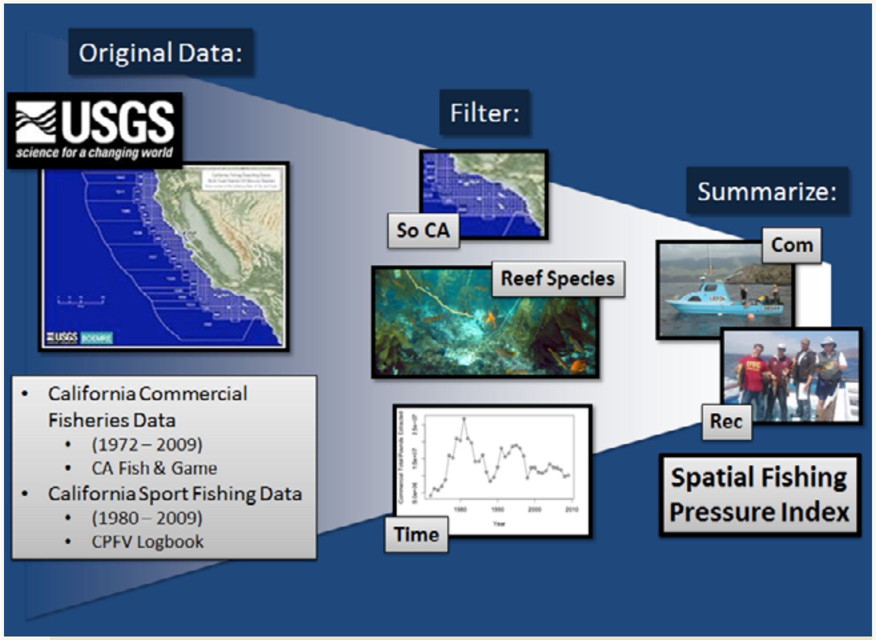

FIGURE 41: Schematic of the data integration and synthesis steps involved in producing an index of fishing pressure on protected areas in southern California. *This project illustrates the need to integrate data from multiple sources into more complex assessments in order to answer questions about the relative impacts of stormwater discharges. From Update on Fishing Pressure Index presentation by SCCWRP, Ocean Science Trust, and Occidental College Vantuna Research Group, March 2, 2014.*

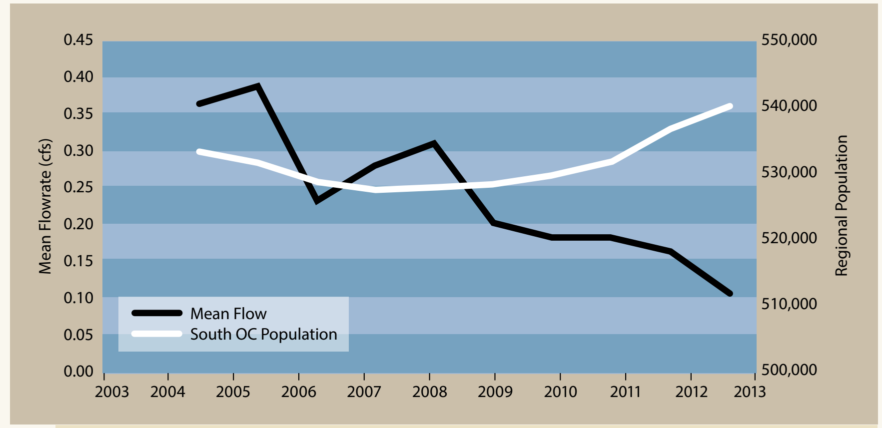

FIGURE 42: Discharge of dry weather flow to channels and creeks from urban outfalls has declined dramatically despite an increase in regional population. *The decline spans both wet and dry years and is therefore not simply a result of drought conditions.*

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