Regulating Copper in San Francisco Bay: Importance of Appropriate Use of Aquatic Chemistry and Toxicology

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Regulation of Copper and Other Heavy Metals in Urban Area Street and Highway Stormwater Runoff

Need for Biogeochemistry and Aquatic Toxicology to Develop Technically Valid, Cost-Effective Regulation of Heavy Metals

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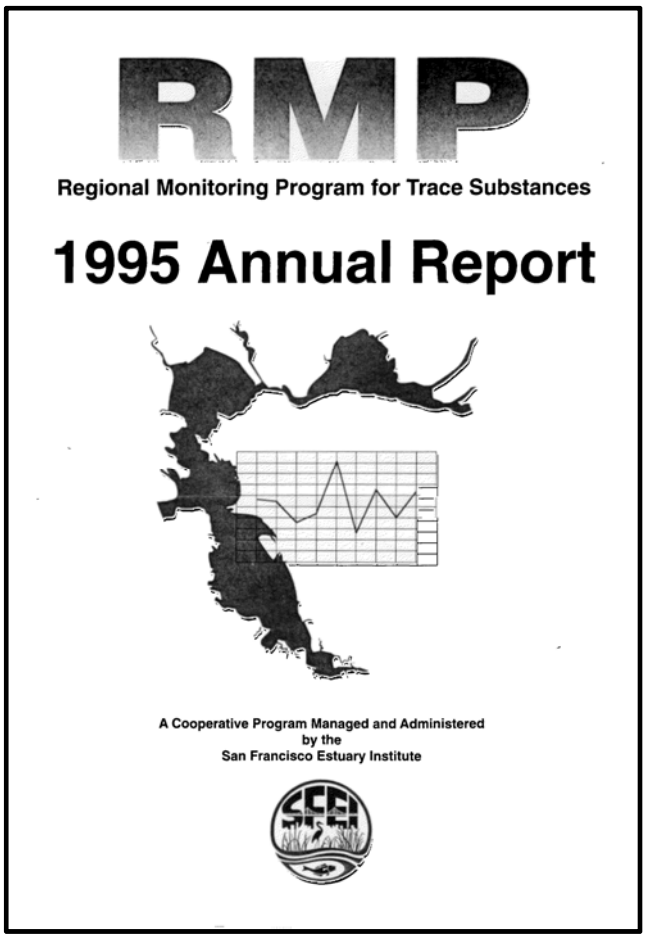
Presented at Fourth International Conference on the Biogeochemistry of Trace Elements, Berkeley, CA, June (1997).



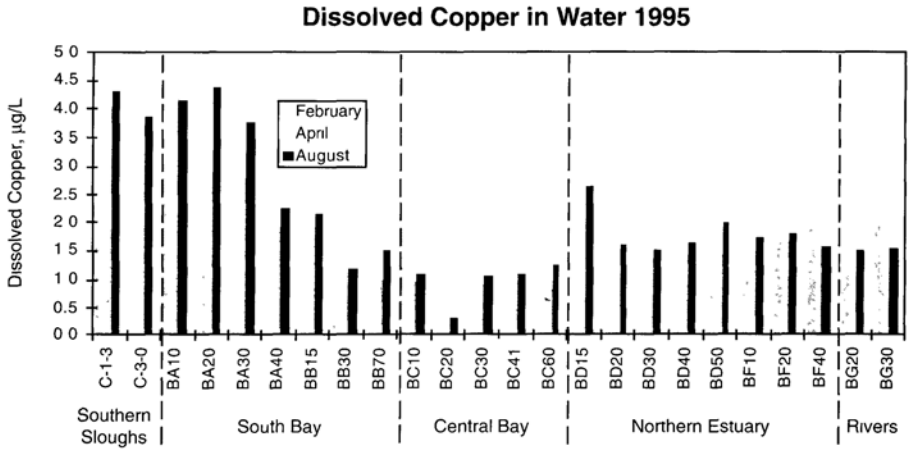


Figure 10. Dissolved copper (Cu) concentrations in water in parts per billion (ppb) at 24 RMP stations sampled in February, April, and August of 1995.

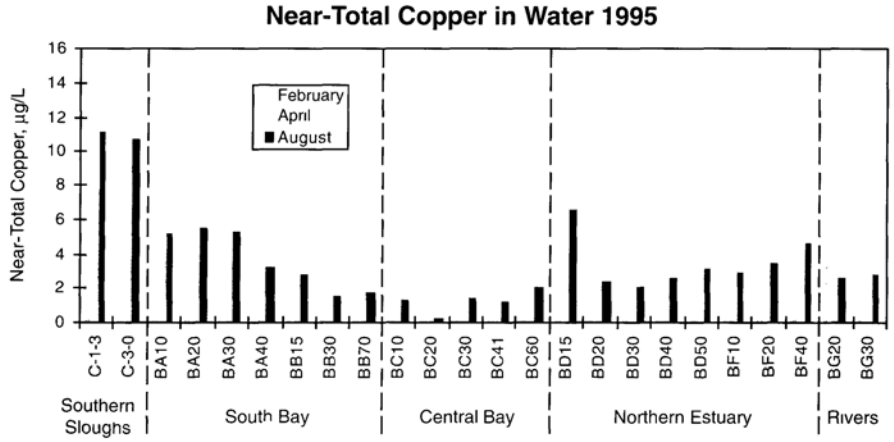
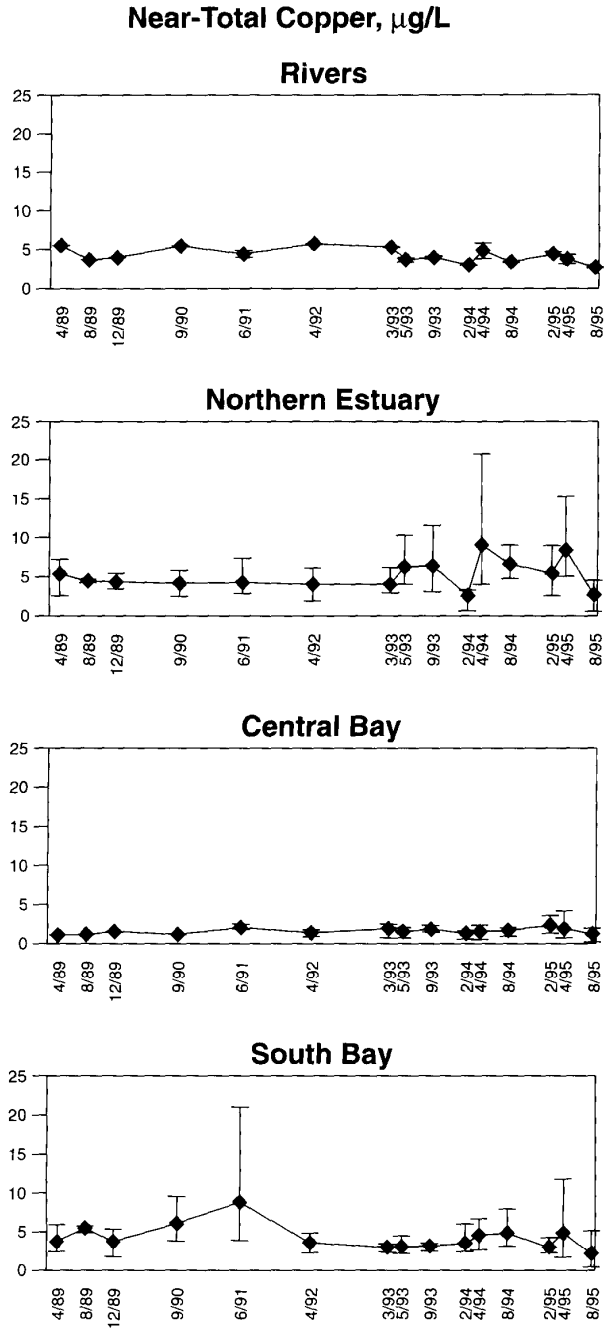


Figure 11. Near-total copper (Cu) concentrations in water in parts per billion (ppb) at 24 RMP stations sampled in February, April, and August of 1995.



Figures 64 and 65. Plots of average chromium and copper concentrations (parts per billion, ppb) in water in each Estuary reach from 1989–1995.

Water Quality Criteria for Copper in Marine Waters

National Toxics Rule - December 1992
National Cu Criteria For:
Salt water
1 Hour Average 2.9 µg/L
4 Day Average 2.9 µg/L

SFRWQCB Site-Specific Objective 1995
Total Copper Objective 4.9 µg/L/hr average
Based on Water Effect Ratio

US EPA 1995 National Toxics Rule
Convert Salt Water 1 Hr Average Total Copper to Dissolved Copper Multiplied by 0.83
San Francisco Bay Dissolved Copper Site-Specific Objective is 4.1 µg/L

San Francisco Bay Waters in 1995 Showed Exceedances of the Total and Dissolved Copper Site-Specific Objectives

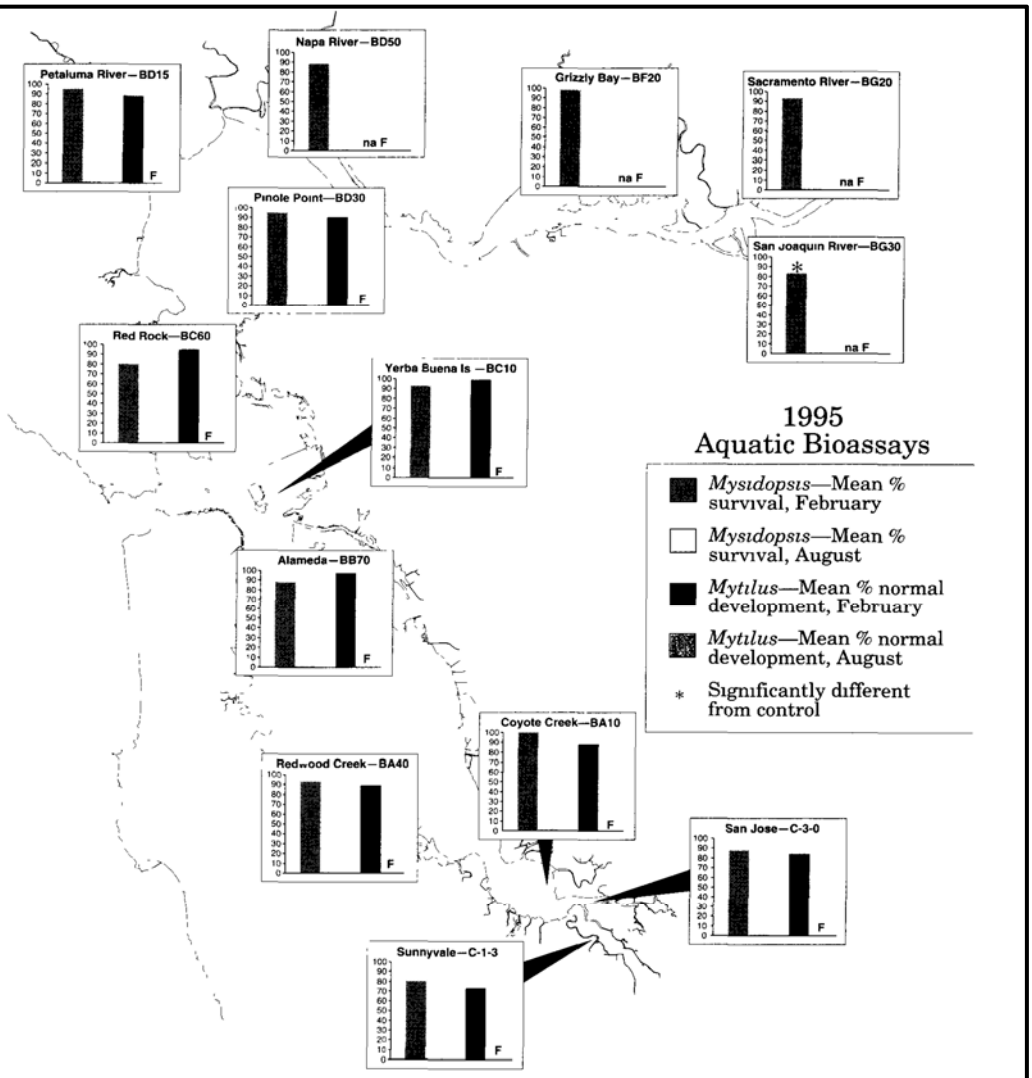


Figure 36. Chart showing results of aquatic bioassays at selected RMP stations.

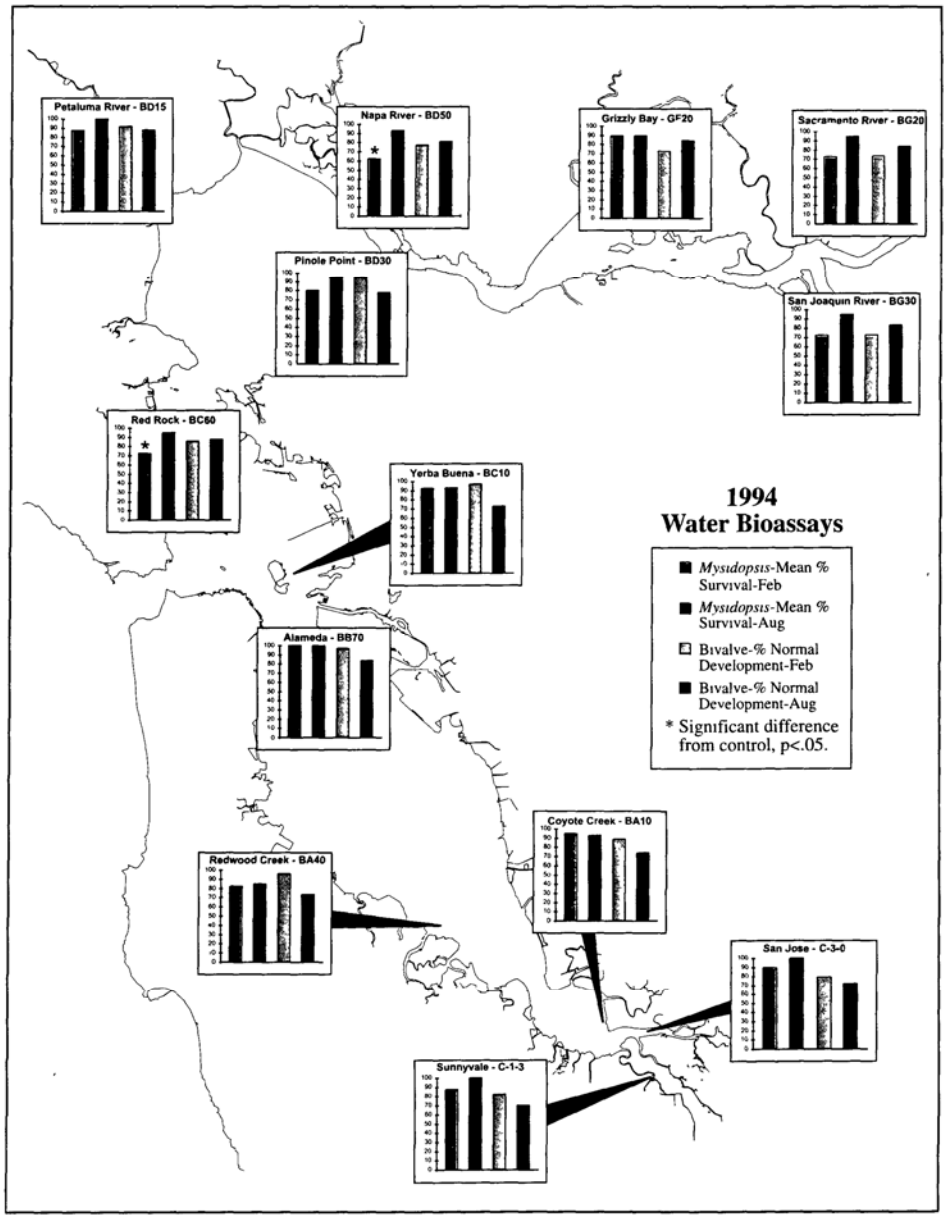


Figure 27. Chart showing results of water bioassay testing at selected RMP stations.

Clean Water Act Requirements

Exceedance of Water Quality Standard for More than Once in Three Years

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Water Quality Limited

↓

Waste Load Allocation

↓

Total Maximum Daily Loads

↓

Phased Approach

↓

If the Phase 1 Load Reductions Do Not Result in Achieving Site-Specific Water Quality Objective So There Is No More than One Exceedance of Any Magnitude Every Three Years, Establish New TMDLs for Phase 2

Mass Loading Limits for Copper by 2003

Stormwater Runoff	20%
Riverine Inputs to Bay	25%
Municipal and Industrial Wastewaters	25%

(SFRWQCB, 1993)

Not Based on Copper Load Bay Concentration Response Relationship

Copper Regulatory Issues

Copper of Concern Because of Potential Toxicity to Aquatic Life

National Criterion Based Principally on Copper Toxicity to Mytilus edulis Larvae

San Francisco Bay Water with "Excessive" Copper Non-Toxic to Mytilus edulis Larvae

Where Is the Water Quality Problem?
- "Administrative" Exceedance - Not Related to Water Quality Use Impairment
  - Over-Regulation

Copper in San Francisco Bay Water in Non-Toxic, Non-Available Form

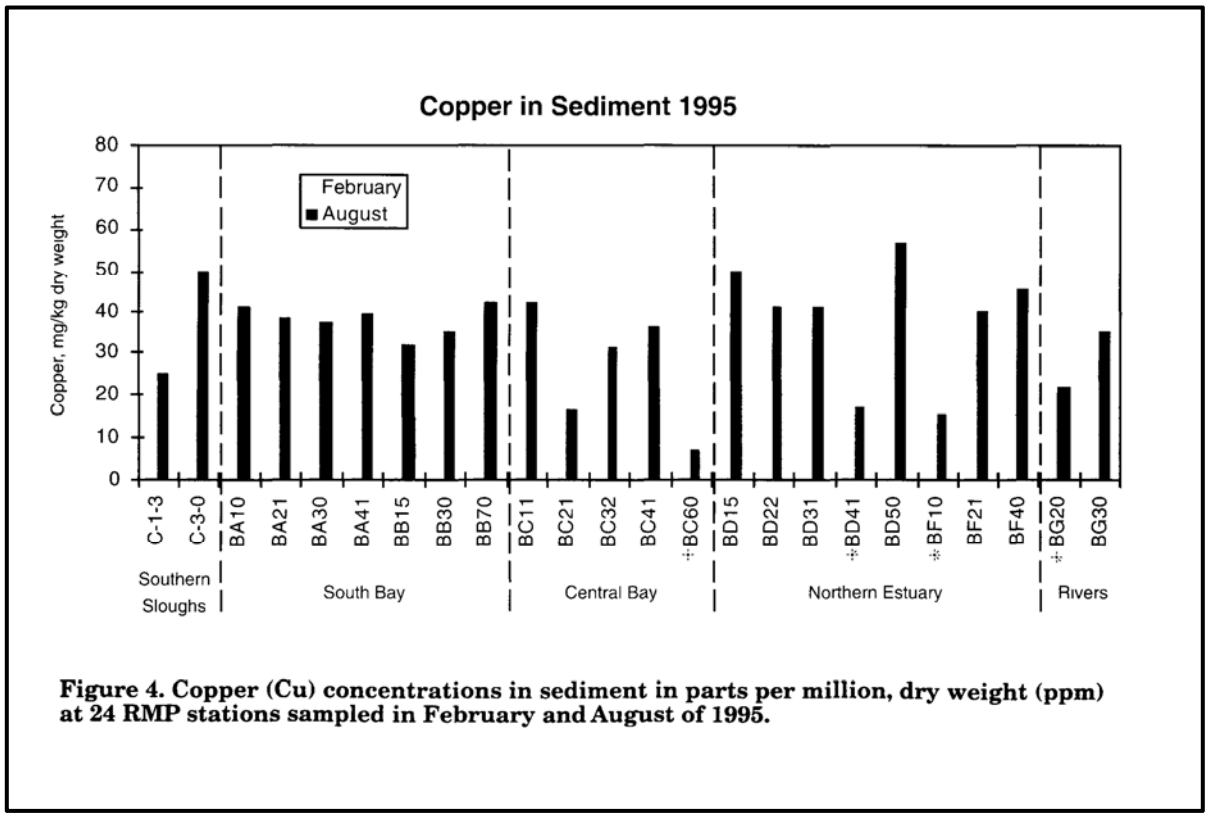
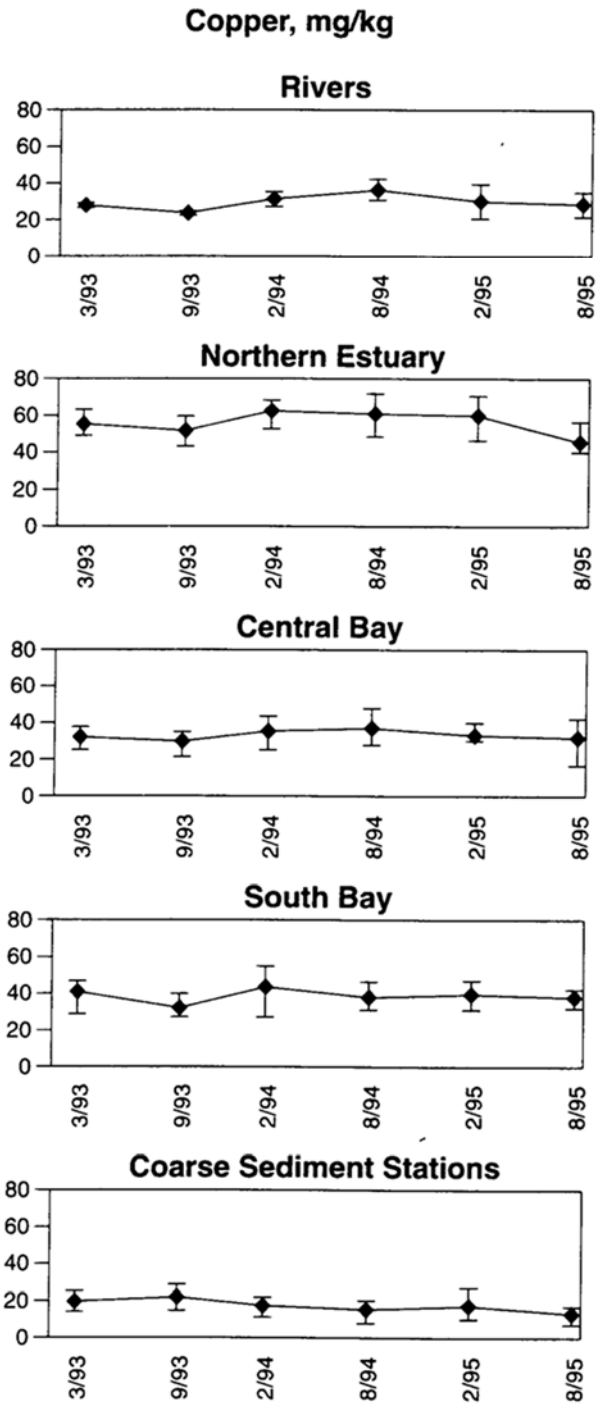


Figure 4. Copper (Cu) concentrations in sediment in parts per million, dry weight (ppm) at 24 RMP stations sampled in February and August of 1995.


Copper, mg/kg
Rivers
Northern Estuary
Central Bay
South Bay
Coarse Sediment Stations
80
60
40
20
0
3/93
9/93
2/94
8/94
2/95
8/95

San Francisco Bay Sediment Copper Issues

San Francisco Bay Sediments, In General, Do Not Contain Elevated Concentrations of Copper
Average Copper in California Soils – 50 mg/kg

San Francisco Bay Shallow Sediments Stirred into the Water Column with Each Storm Will Not Achieve Water Quality Standards with Only One Exceedance Every Three Years, Even if All Copper Inputs to the Bay Terminated

Phased Approach for Copper Control for San Francisco Bay Technically Invalid and Could Result in Expenditures in Excess of $1 Billion to Try to Meet Regulatory Requirements, Ultimately Failing to Achieve Them

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Toxicity of San Francisco Bay Sediments Not Related to Copper Content

- Exceedance of Copper Water Quality Objective is Not Causing Discernible Water Quality Impairment in Bay Waters and Sediments

DESIGNING
FOR
CLEAN
WATER

BRAKE PAD PARTNERSHIP

Common Ground for the Environment

Stanford University

Sustainable Conservation

We need your support to form the Brake Pad Partnership.

In the 1980's, the U.S. Environmental Protection Agency and state agencies across the nation began to address water pollution from copper and other toxic metals as a top priority. Initially these efforts focused primarily on point sources, such as industrial operations and publicly owned waste water treatment facilities. As a result, significant reductions in pollutants from individual point sources were achieved and, in some cases, water quality improved substantially. However, many major water bodies continue to fall far below water quality objectives. To realize further significant gains in water quality, regulatory agencies, industry, and environmental organizations are broadening their attention to water pollution from nonpoint sources.

Copper pollution is a nationally significant problem occurring in major water bodies such as: the Chesapeake Bay, the Delaware Estuary, New York-New Jersey Harbor, and the San Diego Bay. Recent studies on the San Francisco Bay demonstrate the relative importance of nonpoint sources, and automotive brake pads, in particular, to controlling copper levels. Controlling copper levels in brake pads could potentially reduce copper flowing to surface waters around the nation.

Common Ground for the Environment is requesting your support and participation in convening a national Brake Pad Partnership. The goal of the Partnership is to identify and implement a voluntary, business solution to reduce the levels of copper entering water bodies from brake pads.

A partnership presents the opportunity to address the issue of copper from brake pads in a manner that can benefit industry, government, and environmental concerns. Benefits include:

- Moving beyond traditional command and control regulation toward a cooperative, voluntary solution;
- Anticipating environmental concerns through a proactive approach that directly incorporates market, economic, and technical issues;
- Meeting or creating market preferences in lieu of regulatory requirements.

Common Ground is prepared to bring together stakeholders in this process to:

- Better define and understand the environmental problem;
- Identify the best means of approaching that problem; and
- Develop a voluntary business solution to that problem.

If you have any questions regarding this effort, or would like to send a letter of support, please contact Greg Schwartz, Common Ground for the Environment, at Sustainable Conservation: 415-238-0380.

TECHNICAL

Solving the Copper Problem: The Brake Pad Partnership

Kelly D. Moran, Ph.D., City of Palo Alto

Elevated copper levels are a priority concern for storm water runoff. Copper is toxic to aquatic life in very low concentrations (parts per billion). Runoff copper levels typically exceed both acute and chronic water quality criteria for both fresh water and salt water (see Figure 1) [1,2]. The Nationwide

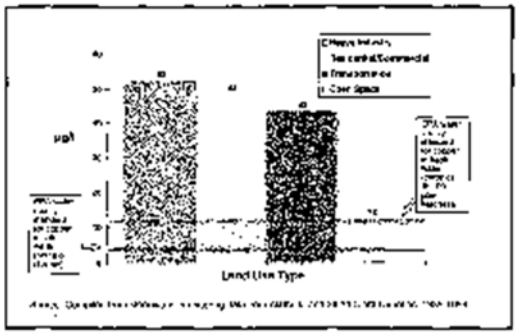


FIGURE 1
Average Storm Water Runoff Total Copper Concentrations in Two California Counties.

Urban Runoff Program found that copper was one of the biggest concerns for urban storm water runoff [2].

Urban storm water runoff is a major contributor of copper to surface water bodies near urban areas. Many of the nation's major water bodies, particularly estuaries, exceed water quality standards for copper [3]. The United States Environmental Protection Agency (U.S. EPA) has evaluated available data from its STORET database regarding copper levels in U.S. surface waters and has concluded that copper exceeds water quality criteria in many watersheds, especially estuaries, around the country [4]. The contribution of copper from storm water runoff has been investigated in the south San Francisco Bay, where copper levels exceed water quality criteria [5], and urban storm water runoff is the major source of copper discharge [6].

Studies for the Santa Clara Valley Nonpoint Source Pollution Control Program conducted by Woodward-Clyde Associates have investigated sources of copper in urban storm water runoff [6,7]. While these studies are based on somewhat limited data, they shown that automobile brake pads are probably the largest single source of copper in urban storm water runoff (see Figure 2) [6]. The Palo Alto Regional Water Quality Control Plant has found significant amounts of copper in sewer discharges from car washes and vehicle service facilities, and in storm water inflow to the sewer system. Much of this copper, which contributes to violation of the wastewater treatment plant's copper effluent limitation, may be from brake pads [8].

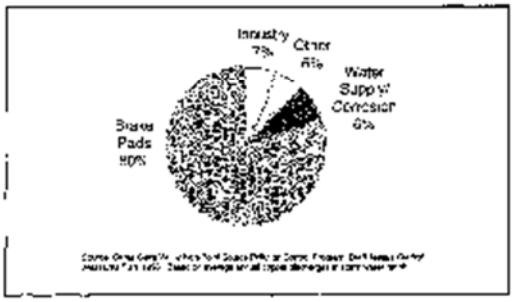
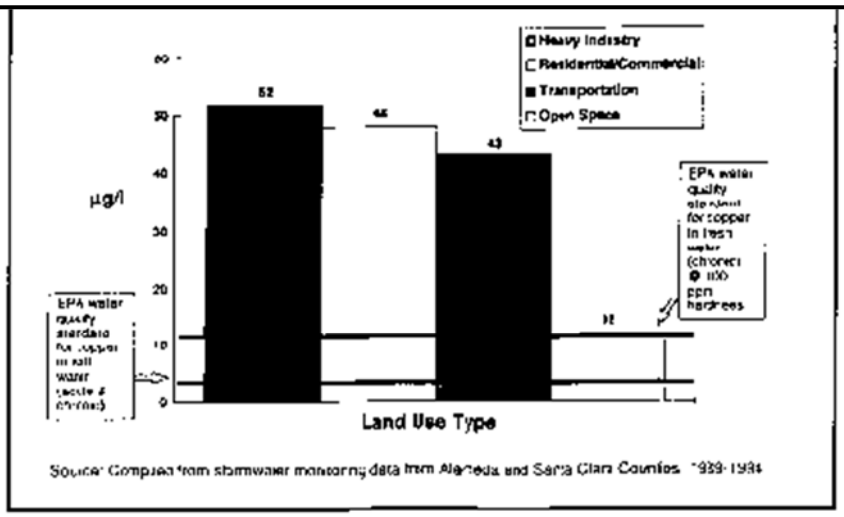


FIGURE 2
Urban Storm Water Copper Sources

Some, but not all, brake pads contain copper and other heavy metals. Copper content can vary from manufacturer to manufacturer and even among pads made by the same manufacturer. The range of copper content in a group of 20 disc brake pads analyzed by the Santa Clara Valley Nonpoint Source Pollution Control Program was from essentially zero to 20.5 percent [7].

Braking, which forces disc brake pads against a metal rotor mounted behind the wheel of a car or truck (see Figure 3), releases fine dust from wear of the pad materials into the environment. Once brake pad dust comes off a car, it can fall on a road or travel through the air. Either way, the dust can be deposited into or be washed into surface water bodies. In most areas, storm drains flow directly to surface water bodies without wastewater treatment.

Preventing pollution by eliminating the use of copper in brake pads would be substantially more effective than attempting to control this pollution once dispersed in the environment. Street sweeping, while costly, is not particularly effective at collecting fine particulate matter like the material released from brake pad wear. Similarly, other operational and structural controls, while costly, have not been demonstrated



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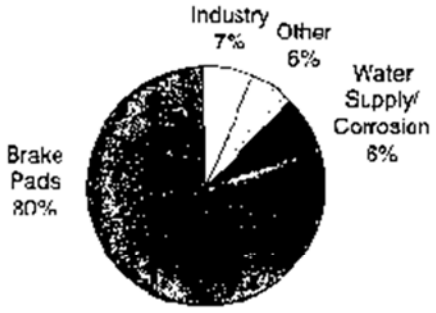
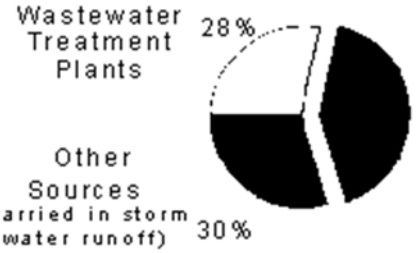
Average Storm Water Runoff Total Copper Concentrations in Two California Counties



Source: Santa Clara Valley Non-Point Source Pollution Control Program

FIGURE 2
Urban Storm Water Copper Sources



Source: Santa Clara Valley Non Point Source Pollution Control Program. Draft Impacts Control Measure Plan 1996. Based on average annual storm water copper discharge.

FIGURE 4
South Bay Copper Sources

Auto Brake Pad Copper Substitution Issues

Based on Current Information, Auto Brake Pad Copper Substitution is a Mis-Directed Effort
- Where is the Real Water Quality Use Impairment Due to Copper Exceedance of Water Quality Objectives?
  - Administrative
  - Will Disappear If Independent Applicability Policy Terminated

Substitute for Copper Could Cause Real Water Quality Problems
- Alternatives Not Properly Evaluated for Public Health and Environmental Impacts

Should Focus Water Pollution Control Resources on Finding Real, Significant Water Quality Use Impairment–-i.e. Organophosphorus Pesticides
- Search for Problems Due to Copper in Auto Brake Pads
  - If Found, Implement Control After Proper Evaluation of Alternative Materials

Pollution Prevention

Removal of Copper from Auto Brake Pads Advocated As a “Pollution Prevention” Activity
- Pollution Is an Impairment of the Designated Beneficial Uses of a Waterbody
  - No Pollution Found for Copper Currently Present in San Francisco Bay Water and Sediments

Pollution Prevention Should Be Based On Pollution Control and Not Chemical Constituent Control
- Requires Comprehensive Investigation of Aquatic Chemistry and Toxicology of Potential Pollutants

http://www.gfredlee.com/Runoff/copper_brakepads.pdf

Automobile Brake Pad Copper: Is There a Real Water Quality Problem?

An Example of an Inappropriate Approach for Developing a Stormwater Runoff Source Control BMP

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June 1996

With the implementation of the US EPA national NPDES urban stormwater runoff water quality management program in 1990, stormwater managers in urban areas in many parts of the US have begun to monitor urban area and highway stormwater runoff for a variety of chemical constituents and pathogenic organism indicators. These studies are confirming the findings of similar types of monitoring efforts that were conducted in the 1960's as well as the US EPA's National Urban Runoff Program (NURP) studies conducted in the late 1970's and early 1980's that urban stormwater runoff contains elevated concentrations of a variety of chemical constituents that are of potential concern because of toxicity to aquatic life.

It has been known since the 1960's that several heavy metals, such as copper, lead, zinc and cadmium, are present in urban area street and highway runoff at concentrations that exceed US EPA water quality criteria/state standards in the runoff waters. These exceedances, therefore, could be considered "water quality impairments" under current federal and state regulatory requirements where the exceedance of a water quality standard in ambient waters for an NPDES permitted discharge is labeled, albeit inappropriately, a "use impairment" that requires control.

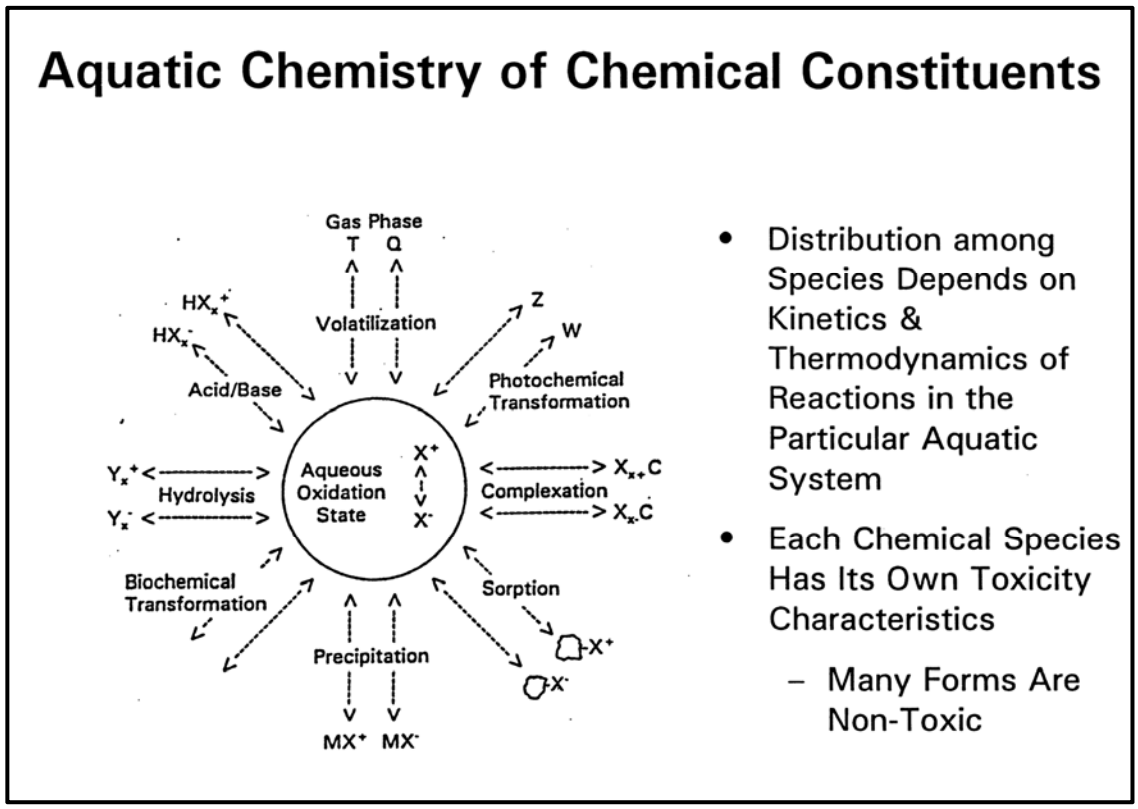
In the early 1990's, the state of California Water Resources Control Board and its regional water quality control boards worked with major urban stormwater dischargers (with populations greater than 100,000) to develop early, compared to most of the rest of the country, stormwater runoff NPDES permits. This situation has led to the development of data from a number of stormwater runoff monitoring programs. These programs have demonstrated that copper and several other chemical constituents are present in urban and highway stormwater runoff at concentrations above water quality standards in the South San Francisco Bay area. The Bay has been found to contain both total and dissolved copper concentrations above the site-specific copper standard (called "objective" in California) developed by the San Francisco Bay Regional Water Quality Control Board. This situation has led to the Bay being classified as "water quality limited" and has, in accord with current regulations, caused the regulatory agencies to develop the wasteload allocation for copper and Total Maximum Daily Loads (TMDL's) for the various sources of copper to the Bay.

Validity of US EPA Water Quality Criteria
to Estimate Toxic Concentrations of Chemical

Criteria Assume Worst-Case Conditions - 100% Toxic/Available Forms and Chronic - Extended Periods of Exposure

Only Small Part of the Total Copper Toxic

Aqueous Chemistry and Toxicology of Copper in Marine Waters Such That Worst-Case Assumptions Over-Estimate Actual Toxicity



Water Effect Ratio Adjustment

Measure Toxicity of Copper in Standard Lab Water and in Bay Water, Use Ratio to Adjust Water Quality Objective

Water Effect Ratio = Site Water LC50 / Lab Water LC50

Only Considers Short-Term Equilibration, Does Not Consider Total and Dissolved Slow Equilibration

Underestimates Water and Specific Chemical Form Impacts

Relationship between Analytical Chemistry and Water Quality

Poor Relationship Between Analytically Measured Concentrations and Water Quality Impacts

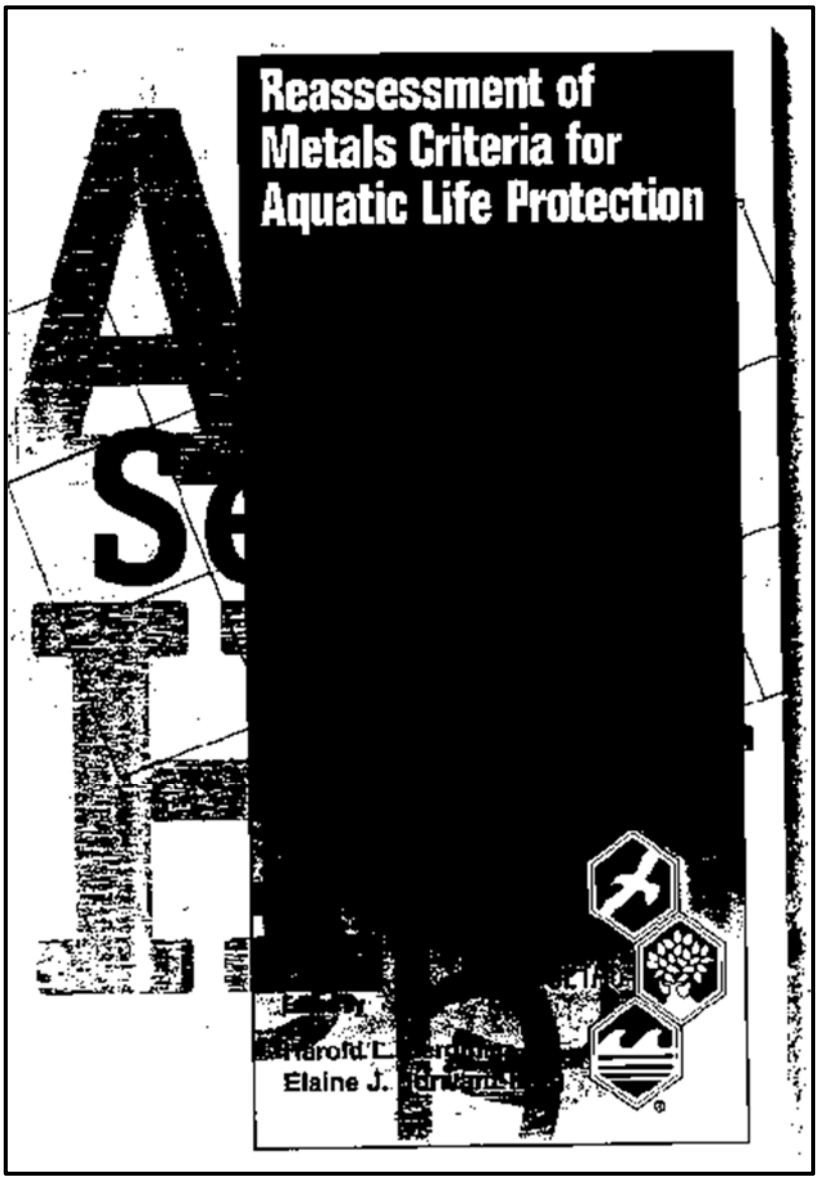
Purpose of Water Pollution Control

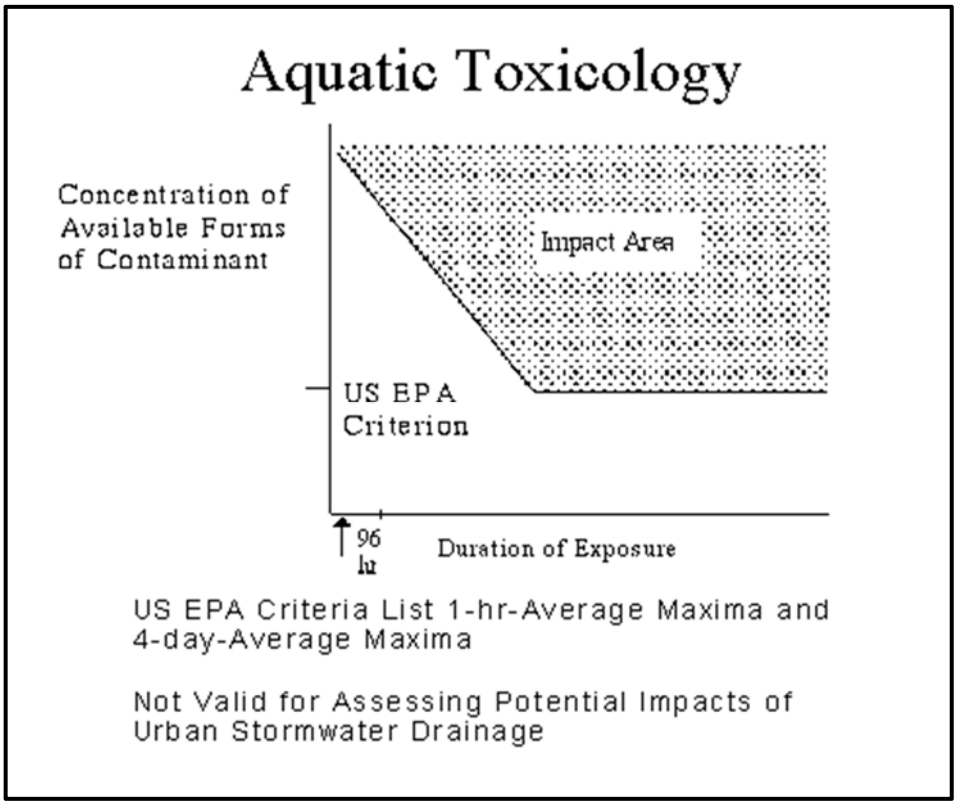
Protect and Where Degraded, Enhance Designated Beneficial Uses of Waterbody for Aquatic Life-Related Beneficial Uses

Cannot Use Chemical Analysis to Predict Toxicity

Must Use Bioassays - Toxicity Test as Primary Regulatory Tool

Need Research on Chemical Species Toxicity Test Results





Urban Stormwater Runoff Water Quality Impacts
New Regulatory Area

US EPA 1990 Stormwater Runoff Water Quality Management Program Requires Controlling **Pollution** of Receiving Waters for Stormwater Runoff to the Maximum Extent Practicable Using Best Management Practices (BMPs)

Urban Area Streets and Highway Stormwater Runoff Contains Several Heavy Metals Such as Cu, Pb, Cr, Zn, Hg and As at Excessive Concentrations Compared to US EPA Water Quality Criteria

If Urban Stormwater Runoff Regulated to the Same Degree as Domestic Wastewaters–No Exceedance of Water Quality Standard Outside of Mixing Zone, Will Cost Urban Dwellers $1 to $2 per Person per Day

Must More Reliably Evaluate Real Water Quality Impacts of Stormwater Runoff-Associated Constituents

Rarely Are the Heavy Metals In Stormwater Runoff from Urban Area Streets in a Toxic-Available Form

Independent Applicability Policy

US EPA Adopted Independent Applicability Policy in Early 1990s
No Public Review

Requires Attainment of Chemically-Based Water Quality Criteria/Standards Even If Biological Assessments - Toxicity and/or Organism Assemblages Show No Impacts Due to the Chemical Present in Excess of Criterion/Standard

Leads to Administrative Exceedances of Criterion/Standard Without Adverse Impacts on Beneficial Uses of Water

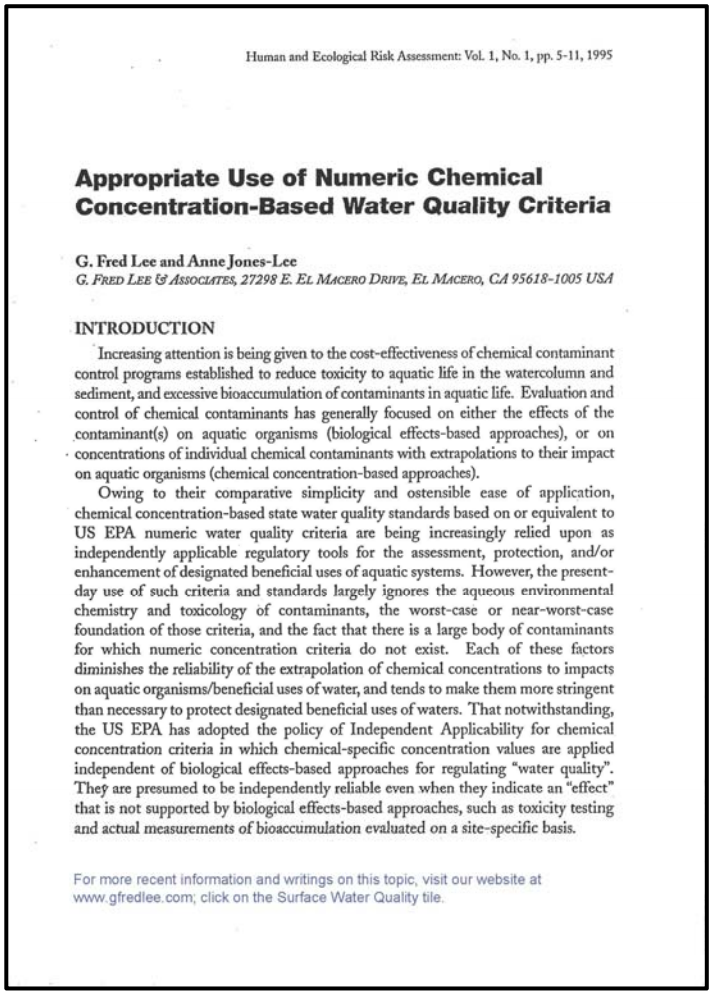
- Technically Invalid and Wasteful of Public Funds
- Focuses on Chemicals Rather than Chemical Impacts
  Ignores Purpose of Water Quality Management
  Protection of Beneficial Uses

US EPA Announced Proposed Rulemaking
Possible Change Independent Applicability Policy

Lee, G. F., and Jones-Lee, A., "Independent Applicability of Chemical and Biological Criteria/Standards and Effluent Toxicity Testing," The National Environmental Journal 5(1):60-63 (1995); Part II "An Alternative Approach" 52(2):66-67 (1995).
http://www.gfredlee.com/SurfaceWQ/tnej.pdf

Independent Applicability of Chemical and Biological Criteria/Standards and Effluent Toxicity Testing

Lee, G. F. and Jones-Lee, A., "Appropriate Use of Numeric Chemical Water Quality Criteria," Health and Ecological Risk Assessment, 1(1):5-11 (1995).
http://www.gfredlee.com/SurfaceWQ/Use_Chemical_WQ_Criteria.pdf



Human and Ecological Risk Assessment: Vol. 1, No. 1, pp. 5-11, 1995

Appropriate Use of Numeric Chemical Concentration-Based Water Quality Criteria

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INTRODUCTION

Increasing attention is being given to the cost-effectiveness of chemical contaminant control programs established to reduce toxicity to aquatic life in the watercolumn and sediment, and excessive bioaccumulation of contaminants in aquatic life. Evaluation and control of chemical contaminants has generally focused on either the effects of the contaminant(s) on aquatic organisms (biological effects-based approaches), or on concentrations of individual chemical contaminants with extrapolations to their impact on aquatic organisms (chemical concentration-based approaches).

Owing to their comparative simplicity and ostensible ease of application, chemical concentration-based state water quality standards based on or equivalent to US EPA numeric water quality criteria are being increasingly relied upon as independently applicable regulatory tools for the assessment, protection, and/or enhancement of designated beneficial uses of aquatic systems. However, the present-day use of such criteria and standards largely ignores the aqueous environmental chemistry and toxicology of contaminants, the worst-case or near-worst-case foundation of those criteria, and the fact that there is a large body of contaminants for which numeric concentration criteria do not exist. Each of these factors diminishes the reliability of the extrapolation of chemical concentrations to impacts on aquatic organisms/beneficial uses of water, and tends to make them more stringent than necessary to protect designated beneficial uses of waters. That notwithstanding, the US EPA has adopted the policy of Independent Applicability for chemical concentration criteria in which chemical-specific concentration values are applied independent of biological effects-based approaches for regulating "water quality". They are presumed to be independently reliable even when they indicate an "effect" that is not supported by biological effects-based approaches, such as toxicity testing and actual measurements of bioaccumulation evaluated on a site-specific basis.

Suggested Regulatory Approach

Do Not Regulate Based on Worst-Case Criteria/Standards Where Exceedances Require Establishing TMDLs

Use Exceedance of Criterion as an Indicator of Potential Water Quality Problems

If Exceedance of Water Quality Criteria Found for Potentially Toxic Chemicals, Allow Discharger/Source Option of Complying With the National Chemical Criteria or Demonstrating Lack of Biological Impact-Toxicity

Problems With Conventional Water Quality Monitoring of Stormwater Runoff

Conventional Monitoring of Runoff/Discharge Water for Suite of Chemical Parameters Produces Little Useful Information on Water Quality Impacts

Focus on Exceedance of Water Quality Criteria

Urbonas & Torno, ASCE Stormwater NPDES Related Monitoring Needs (1994) Conference Summary,

> "Very little meaningful monitoring is being directed toward measuring the actual effect of stormwater discharges on the short- or long-term health of the environment. Furthermore, there is no consensus on how this monitoring should be done."

Roesner in Same Conference Discussion,

> "....the course we are taking with the NPDES stormwater permitting program is going to cost municipalities a lot of money, but is not going to result in any significant improvement in the quality of our urban receiving water systems."

Factors that Must Be Considered in Translating Runoff Concentrations to Potential Aquatic Life Water Quality Impacts

Stormwater runoff

- Need information:
  - measured concentration of constituent during runoff event - concentration time profile
  - discharge of the runoff waters during runoff event - hydrograph
  - analytical chemistry of the method used for analyses - what chemical species are measured

Receiving waters

- Physical factors - need information:
  - Currents, tides - transport-advection
  - Mixing-dispersion

- Biological factors - need information:
  - Duration of organism exposure to toxicant
  - Organism movement - locomotion
    Diel migration
  - Sensitivity to toxicants
  - Organism assemblages - resident populations relative to habitat characteristics

Chemical factors - need information:

- Aquatic chemistry
  - Kinetics and thermodynamics of reactions

    - Additive, synergistic and antagonistic reactions and impacts
- Toxic and non-toxic, non-available forms
- Background concentrations of constituents of concern

Evaluation Monitoring As An Alternative to Conventional Water Quality Monitoring and Management

Need Alternative Monitoring/Evaluation Approach to Determine if Real Water Quality Use Impairments Are Occurring in Receiving Waters for Urban Stormwater Runoff

Metals and Many Other Constituents in Urban Area and Highway Stormwater Runoff in Particulate, Non-Toxic Forms

Episodic, Short-Term Exposures Occur with Stormwater Runoff Events

Rare that Real, Significant Water Quality Use Impairments Will Occur from Urban Area and Highway Stormwater Runoff-Associated Constituents

Evaluation Monitoring

Find a Real Water Quality Use Impairment in Receiving Waters for Stormwater Runoff that is Due to Stormwater Runoff-Associated Constituents

Rather Than Measuring Suite of Potentially Toxic Chemicals, Measure Toxicity in Runoff Waters and Receiving Waters

- If Significant Toxicity Found, Determine Its Cause through TIEs
- Determine Sources of Toxic Constituents through Forensic Studies
- Develop Control Programs for Toxic Constituents at Source

Technically Valid, Cost-Effective Approach

SETAC NEWS March 1997

Learned Discourses: Timely Scientific Opinions

Lee, G. F., and Jones-Lee, A., "Evaluation Monitoring as an Alternative to Conventional Stormwater Runoff Monitoring and BMP Development," *Learned Discourses: Timely Scientific Opinions*, *SETAC News* 17(2):20-21 March (1997).

Evaluation Monitoring as an Alternative to Conventional Stormwater Runoff Monitoring and BMP Development

G. Fred Lee and Anne Jones-Lee
G. Fred Lee & Associates

There is growing agreement (Urbanas and Torno 1994, Heaticke 1995, Lee and Jones-Lee 1994, 1996a) that conventional stormwater runoff monitoring for a suite of chemicals at the storm sewer outfall or edge-of-the-pavement is of limited value in defining real water quality problems caused by chemicals in stormwater runoff. There is also increasing recognition that conventional best management practices (BMPs) such as detention basins, filters, etc. are not real BMPs for controlling water quality use impairments in waterbodies receiving urban area street and highway stormwater runoff. An alternative monitoring and BMP development approach is "Evaluation Monitoring."

Evaluation Monitoring assesses the impact of stormwater runoff-associated constituents from a water quality use impairment perspective. Conventional monitoring develops chemical data via edge-of-the-pavement sampling and tests, usually with little or no success, to extrapolate to receiving water impacts. Evaluation Monitoring is a watershed-based water quality evaluation and management program in which the stakeholders concerned about water quality in a particular waterbody work together to define the water quality use impairments that are occurring in a waterbody and the cause of the use impairments. They then work to develop control programs to limit the amounts of the constituents responsible for the use impairments entering the waterbody of concern.

For example, many heavy metals and organics are of concern in urban area street and highway stormwater runoff because of their potential toxicity to aquatic life. Conventional stormwater runoff monitoring generates data that indicate that potentially significant elevated concentrations of heavy metals are present in urban area street and highway runoff. However, the chemical data developed from such monitoring cannot be used to determine whether the concentrations found in the runoff are in toxic, available forms and whether the toxicity associated with these constituents will be present at toxic levels in the receiving waters for a sufficient time to be significantly toxic to receiving water aquatic life.

Evaluation Monitoring measures the amount of toxicity in the stormwater runoff as it enters the waterbody of concern using U.S. EPA standard ambient water toxicity tests. Where potentially significant toxicity is found in the runoff waters entering a waterbody, site-specific studies are conducted to determine whether the toxicity in a stormwater runoff event is of sufficient magnitude and duration to be potentially adverse to the receiving water aquatic life. If such conditions are found, then through toxicity investigation evaluations (TIEs) the constituents responsible for the toxicity are determined and through forensic studies the sources of these constituents within the watershed are evaluated.

In the Evaluation Monitoring approach, rather than assuming that conventional BMPs, such as detention basins and filters, are effective in controlling potential water quality use impairments in the receiving waters for stormwater runoff, site-specific BMPs are developed to control real water quality use impairments to the maximum extent practicable (MEP). Typically, these BMPs focus on source control that manages the input of the chemical species of concern using BMPs to the MEP. These BMPs, in most cases, will be significantly different from the conventional stormwater runoff BMPs used today since they will focus on dissolved, toxic/available forms rather than particulate, non-toxic forms.

In order to manage water quality problems due to potential bioaccumulatable chemicals such as the chlorinated hydrocarbons and mercury, the focus of Evaluation Monitoring is on determining whether excessive concentrations of these chemicals are found in receiving water fish. Fish tissue analysis is used to determine whether there is a water quality problem due to excessive bioaccumulation. In contrast, conventional stormwater monitoring tries to extrapolate from the constituents in stormwater runoff to ascertain concentrations. This approach is normally of limited reliability since there are a variety of factors that influence whether a chemical contaminant in runoff waters bioaccumulates to excessive levels in receiving water aquatic organisms. For example, for mercury, the conventional monitoring approach extrapolates from stormwater runoff mercury concentrations to receiving water concentrations of methylmercury which accumulate in fish tissue to excessive levels. Such approaches have limited reliability because of the complex aqueous environmental chemistry of mercury.

Evaluation Monitoring is a cost-effective, technically valid approach for evaluating whether regulated heavy metals and organics as well as unregulated constituents in urban area street and highway stormwater runoff are adverse to the designated beneficial uses of the waters receiving the runoff. The various potential water quality use impairments of concern such as aquatic life toxicity, domestic water supply, excessive bacteriological chemical bioaccumulation, excessive eutrophication, sanitary quality, petroleum hydrocarbon - oil and grease, litter, and excessive sediment accumulation or impacts are evaluated in the Evaluation Monitoring program in terms of their significance in impairing the beneficial uses of the waterbody (Lee and Jones-Lee 1996b,c).

Where significant receiving water beneficial use impairment occurs, the waterbody stakeholders work together to define through forensic analysis the sources of constituents responsible for impairment and then develop programs to control the impairment to the MEP. A three-year demonstration project is currently underway in Orange County, California for stormwater runoff water quality management in Upper Newport Bay. This program is being conducted in cooperation with the Orange County Environmental Management Agency and the Santa Ana Regional Water Quality Control Board as well as other stakeholders within the Upper Newport Bay watershed.

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Assessing Water Quality Impacts of Stormwater Runoff

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Abstract

Current "water quality" monitoring of non-point source runoff typically involves periodically measuring a laundry list of chemicals in the runoff waters. This approach, while satisfying regulatory requirements, provides little to no useful information on the impact of the chemicals in the runoff on the real water quality - designated beneficial uses of the receiving waters for the runoff. There is need to focus water quality monitoring on investigating the receiving waters in order to assess whether the chemicals in the runoff are adversely affecting beneficial uses. This paper presents an evaluation monitoring approach for monitoring receiving waters that determines whether the runoff is a significant cause of water quality - use impairments. For each type of use impairment, such as aquatic life toxicity, excessive bioaccumulation of hazardous chemicals, excessive fertilization, etc., highly focused site-specific studies are conducted to determine the use impairment that is likely occurring due to a stormwater runoff event(s) and the specific cause of this impairment.

Introduction

There is growing recognition that domestic and industrial wastewater and stormwater runoff "water quality" monitoring involving the measurement of a suite of chemical "pollutant" parameters in discharge/runoff waters is largely a waste of money. For stormwater runoff, such programs generate more data of the type that have been available since the 1960's on the chemical characteristics of urban area, highway and street runoff. It has been known since that time that runoff from these areas contains a variety of regulated chemical constituents and

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Possibility of Copper-Caused, Non-Detected, Subtle
Water Quality Impacts

While No Identified Water Quality Problems - Use Impairments Have Been Found – No One Can State With Certainty that No Subtle Problems Will Be Found in the Future

Evaluation Monitoring Requires that Funds Be Made Available to Search for Subtle Water Quality Use Impairments

Prioritize Water Quality Use Impairments - Focus on Most Important Problems
With Limited Financial Resources Available for Water Pollution Control, Focus the Funds Available on the Most Significant, Readily Discernible Water Quality Use Impairments
Search for More Subtle Problems

Conclusions

- Traditional Regulatory Approaches for Heavy Metals Such as Copper Fail to Reliably Incorporate Aquatic Chemistry of Regulated Constituents into Regulatory Approach
- Leads to Over-Regulation and Waste of Public and Private Funds in Unnecessary Waste Treatment Facilities/Control Programs
- Need to Shift Regulatory Approach from Control of Chemicals to Managing Water Quality of Concern to the Public
- Use Toxicity Tests to Determine if Toxicity Present. If Present, Determine Cause and Sources
- Urban Stormwater Runoff New Regulatory Area Where There Is Need to Integrate Use of Aquatic Chemistry and Toxicology to Define Real Water Quality Problems