

# Reflections on 30+ Years of Regional Monitoring

**2023 SF Bay RMP Annual Meeting**

October 12, 2023

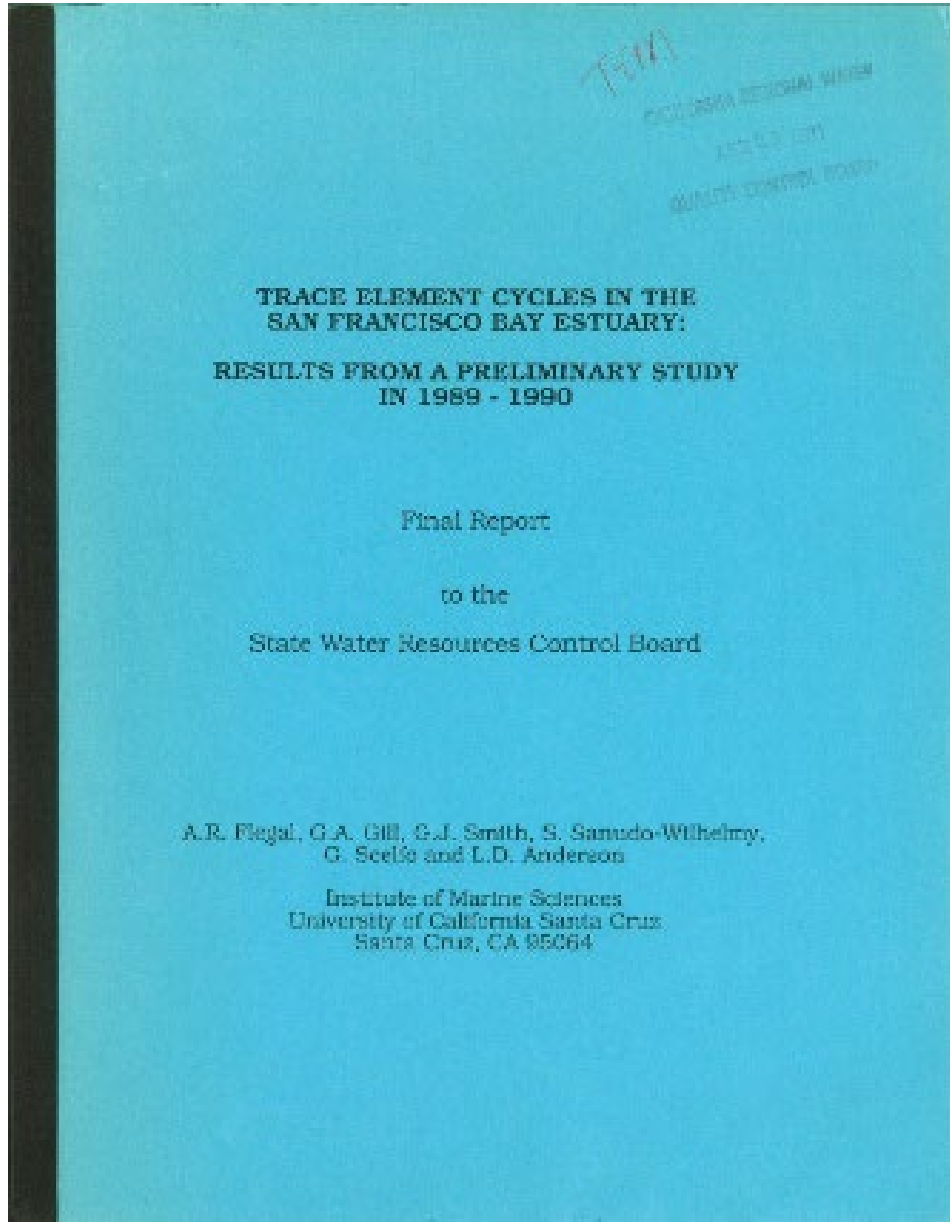
Thomas Mumley  
SF Bay Water Board





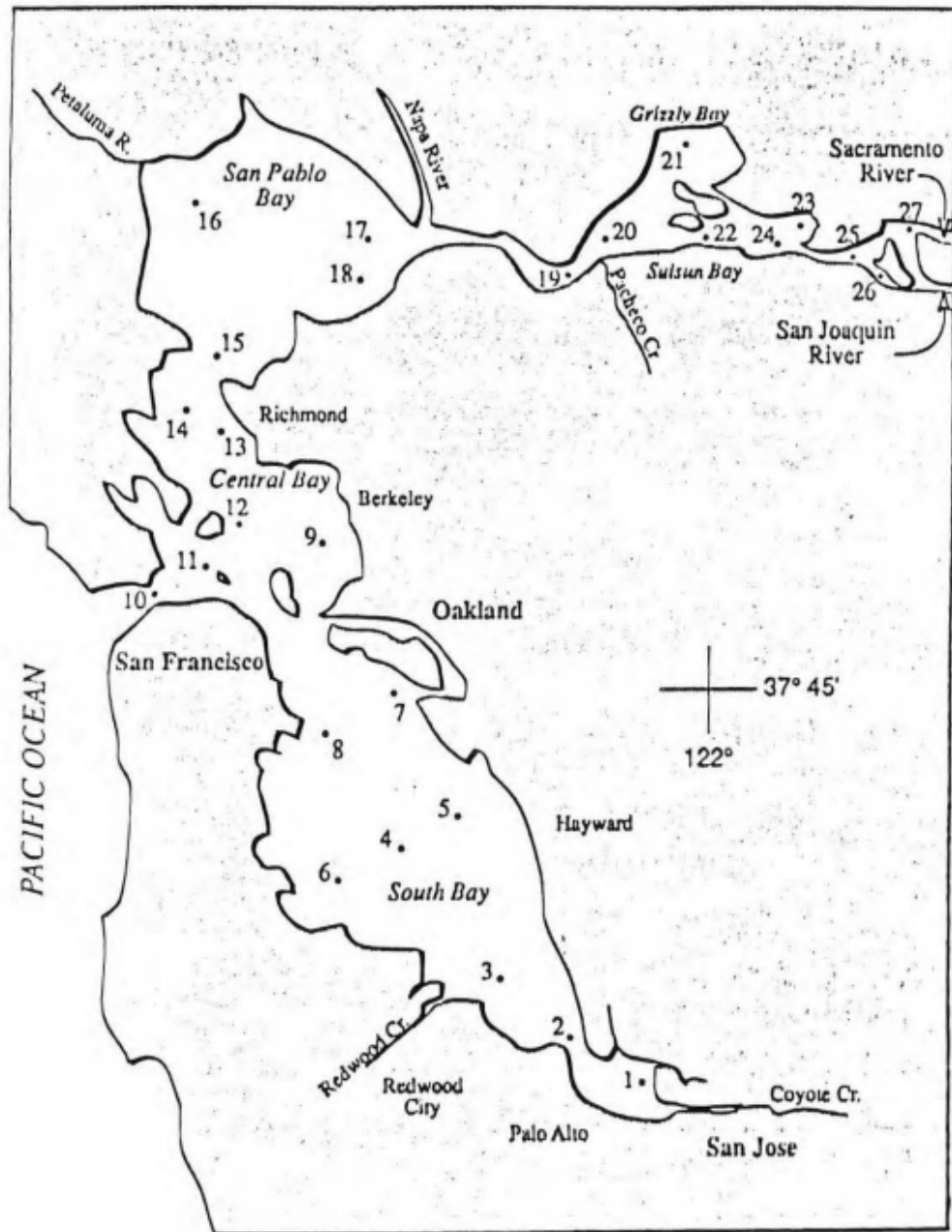
## 1986 Basin Plan Amendment

- 💧 Metals water quality objects based on federal criteria
- 💧 For all Bay segments except Lower South Bay due to its unique conditions
- 💧 Copper excluded due to attainment uncertainties

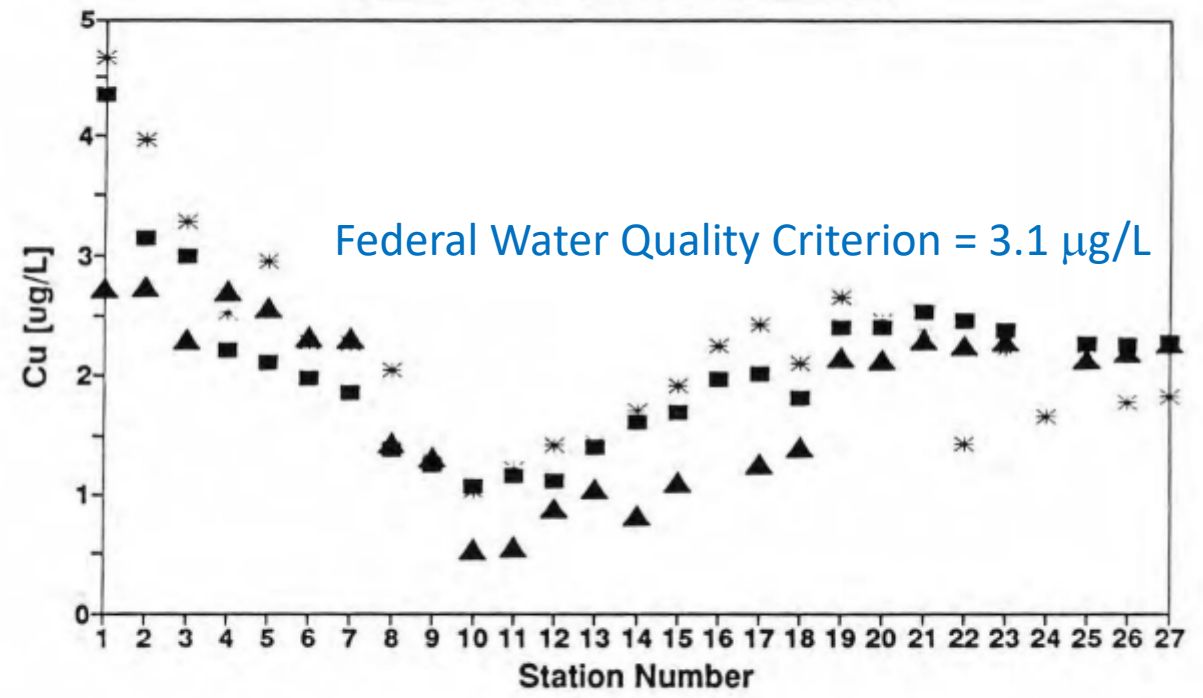


# 1989

- 💧 Water Board contract with Russ Fliegel at UC Santa Cruz
- 💧 Unprecedented monitoring of metals in the Bay using ultra-clean techniques



### SAN FRANCISCO BAY DISSOLVED COPPER



■ April 1989 \* Aug. 1989 ▲ Dec. 1989

SAN FRANCISCO BAY PILOT REGIONAL MONITORING PROGRAM 1991-1992

SUMMARY PROGRESS REPORT

BY

KAREN TABERSKI

MICHAEL CARLIN

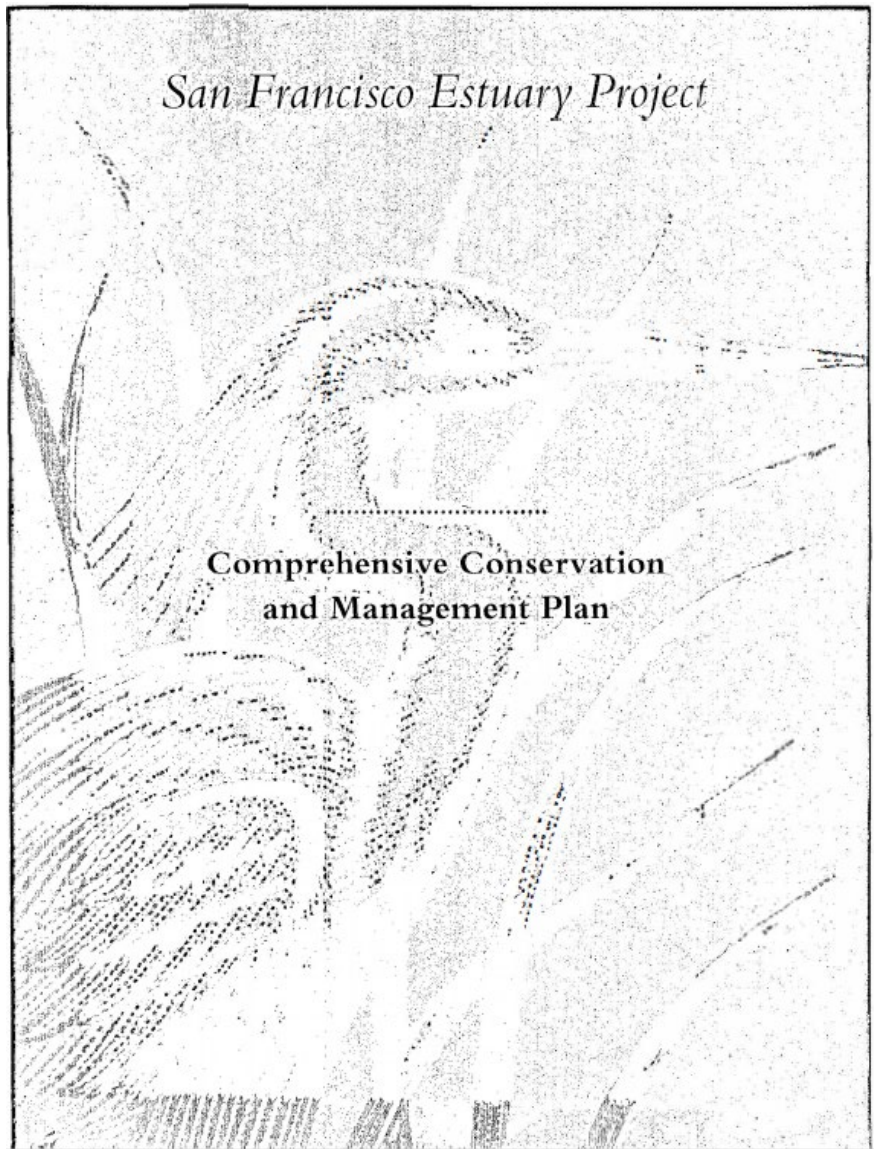
JESSICA LACY

SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD

DECEMBER 1992

## Bay Protection and Toxic Cleanup Program 1989/1990

- 💧 Funding for a position (Karen Taberski)
- 💧 Funding to develop monitoring program
  - ❖ Water, sediment, biota
  - ❖ Hydrocarbons (Bob Risebrough, UC Berk.), metals, toxicity



## 2003 CCMP Research and Monitoring Actions

RM-1.1 = Establish SF Estuary Institute

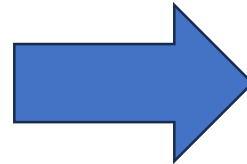
RM-2.1 = Establish Regional Monitoring Program

# April 1992 Resolution

## RESOLUTION NO. 92-043

### IMPLEMENTATION OF THE REGIONAL MONITORING PLAN WITHIN THE SAN FRANCISCO BAY REGION

- I. WHEREAS, the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Board) has adopted a Water Quality Control Plan, San Francisco Bay Basin (Basin Plan) which recognizes the need for cost-effective, coordinated regional monitoring and surveillance to evaluate the effectiveness of its water quality control program; and
- II. WHEREAS, the State Water Resources Control Board has adopted the Pollutant Policy Document which stated the need for a multi-media regional monitoring program to assess pollutant trends in the Bay-Delta; and
- III. WHEREAS, the Regional Board since 1989 has implemented regional monitoring pilot studies through funds from the Bay Protection and Toxic Cleanup Program, Basin Planning Program, and grants from the U.S. Environmental Protection Agency; and
- IV. WHEREAS, the results of the Regional Board's pilot studies have demonstrated the ability to conduct cost-effective regional monitoring that addresses water quality management objectives; and
- V. WHEREAS, the Regional Board under the Bay Protection and Toxic Cleanup Program has developed a Regional Monitoring Plan (Attachment A) that covers the entire estuarine system and is designed to evaluate its water quality control program through the collection of information on the concentrations of pollutants in water, sediment and biota; and
- VI. WHEREAS, the San Francisco Estuary Project (SFEP), a State/Federal cooperative endeavor, is currently developing a comprehensive monitoring strategy and conducted a Regional Monitoring Workshop to begin identifying long-term program elements of the strategy including institutional arrangements and research needs; and



# June 1992 §13267 Order

HPY-15-2008 09:48 SU37 510 832 2856 P.02  
STATE OF CALIFORNIA

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
SAN FRANCISCO BAY REGION  
2101 WEBSTER STREET, SUITE 500  
OAKLAND, CA 94612  
(510) 464-1233

12 June 1992

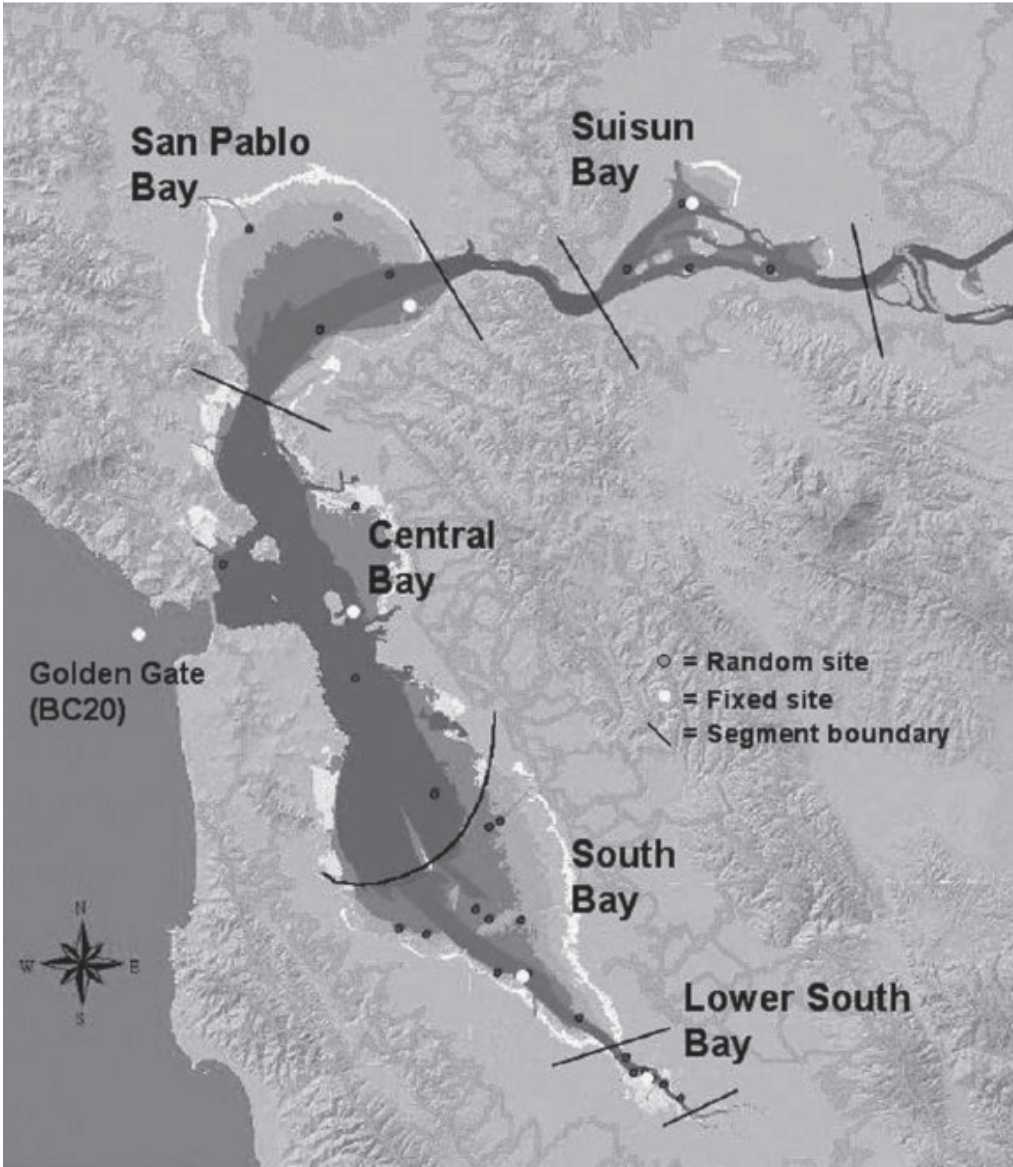
TO: Attached Mailing List

SUBJECT: Implementation of a Regional Monitoring Program for the San Francisco Estuary.

On April 15, 1992, the San Francisco Bay Regional Board adopted Resolution 92-043 directing the Executive Officer to implement the Regional Monitoring Plan for San Francisco Bay. The Regional Monitoring Plan is designed to collect information on the concentrations of pollutants in water, sediment and biota from throughout the estuary. The RMP will allow the Regional Board to evaluate the effectiveness of its water quality control program.

This letter is a formal request under Section 13267 of the California Water Code that your agency participate in the implementation of the baseline portion of the RMP. It is imperative that the implementation be as a collective rather than individual monitoring. A reply by July 7, 1992 on your intention to implement the RMP is requested. Failure to comply could result in an enforcement action under Section 13268 of the California Water Code. I intend to inform the Regional Board at the July 15, 1992 monthly meeting on the progress of implementing the RMP.

There are several operating principles I will be following in implementing the RMP. First, portions of the RMP will be phased in over time and thus costs may increased in future years. Second, there will be linkage to existing or proposed programs by other agencies to eliminate duplication and thereby keep costs reasonable. Third, the RMP in future years will be examining cause and effect relationship which dictates that a certain portion of future efforts be categorized as research. Finally, the program must be accountable and credible to the regulatory agencies, sponsoring agencies and the public. Therefore, we will continue to provide a strong leadership and technical role in the implementation of the RMP.



# 1997 External Review

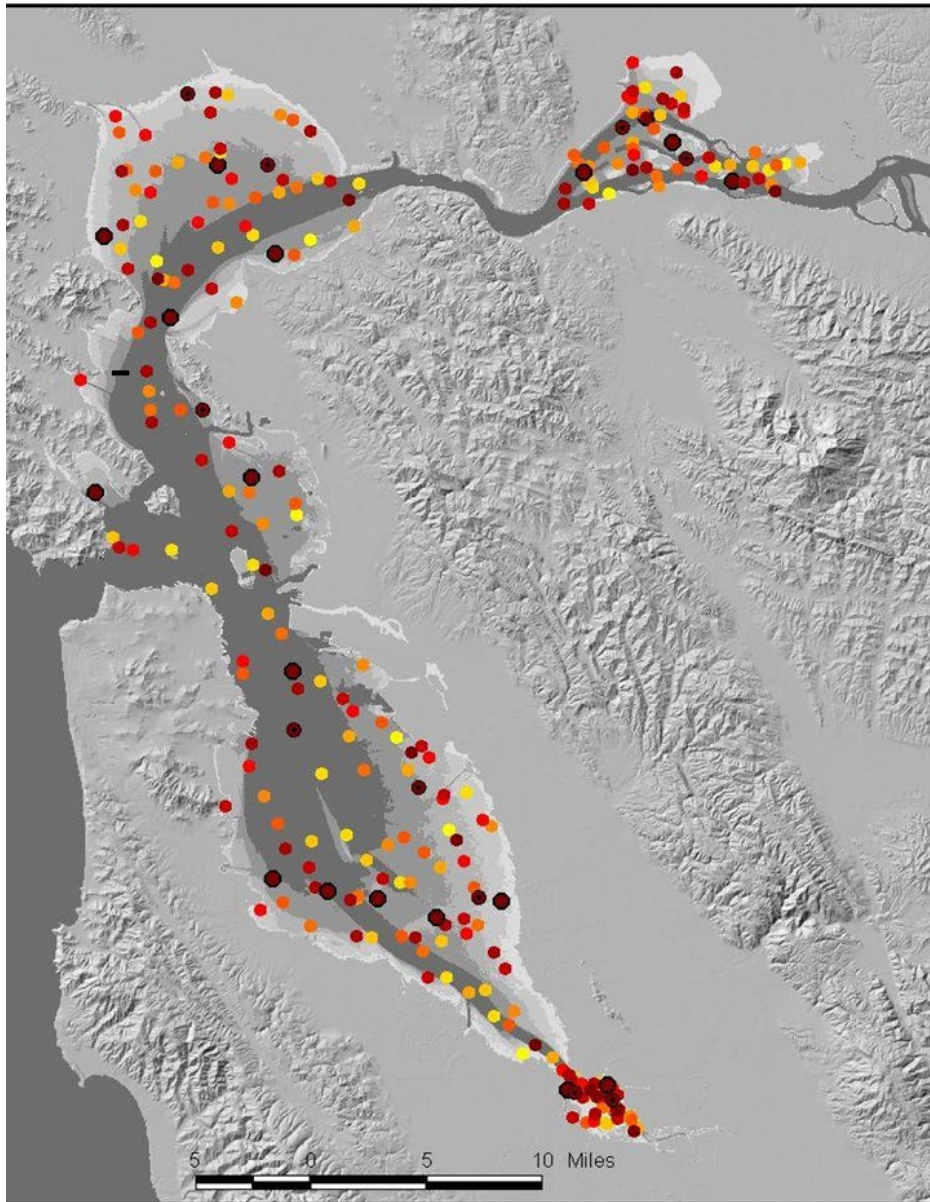
## Revise program objectives to answer specific management questions

- Describe patterns and trends in contaminant concentration and distribution
- Compare monitoring information to relevant water quality objectives and other guidelines
- Describe sources and loading of contamination



**2002 RMP redesigned from deterministic to probabilistic**





# Status & Trends Revisions

**1997** Added sport fish (every 3 yrs)

**2002** Reduced frequency (e.g., w = 3→1/yr)

**2007** Reduced # of stations; added bird eggs

**2009** Reduced sport fish to every 5 yrs

**2010** Reduced frequency (e.g., w = biennially)

**2013** Reduced sediment to every 4 yrs

**2020** Discontinued bivalves

**2022** CECs-based redesign

*Technical Report*

of the Sources,  
Pathways  
and Loadings Workgroup

March 2001

Jay A. Davis, SFEI  
Khalil Abu-Saba, SFBRWQCB/SFEI  
Andrew J. Gunther, Applied Marine Sciences



# 1998 Sources, Pathways, and Loadings Workgroup

**2000** and **2001** Loading reports

**2001** Guadalupe River work

**2009** Small Tributaries Loading Strategy

**2011** Watershed Spreadsheet Model

**2015** Reconnaissance monitoring

**2019** Watershed Dynamic Model

**202X** Integrated monitoring and modeling

## Copper Site-Specific Objectives in San Francisco Bay

Proposed Basin Plan Amendment  
and Draft Staff Report



Richard Looker

California Regional Water Quality Control Board  
San Francisco Bay Region

June 6, 2007

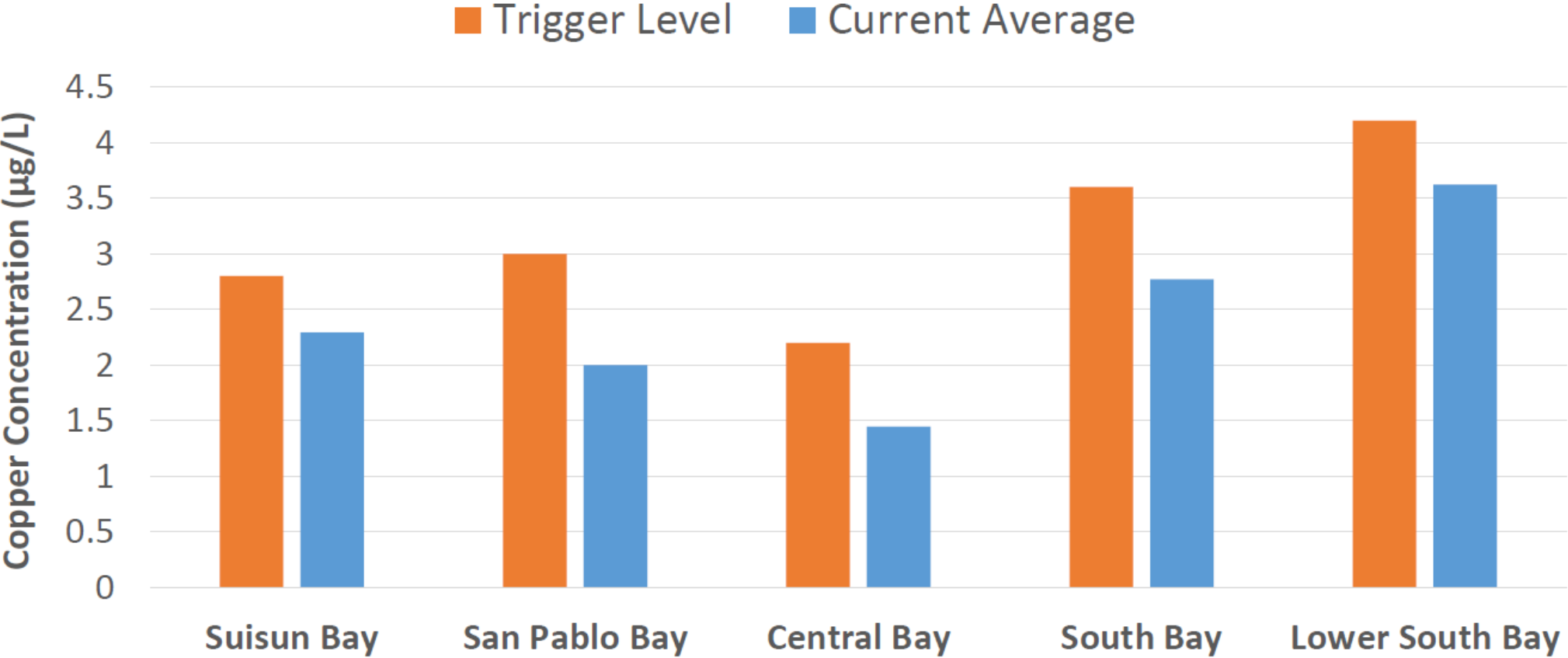
## Site Specific Objectives

- Lower South Bay: Copper and Nickel 2002
- Rest of Bay: Copper 2007

## RMP Contributions

- Action triggers
- Future monitoring and studies

# Copper Results 2011, 2013, & 2015



Rest of Bay: Water Quality Objective = 6.0

Lower South Bay:  
Water Quality Objective = 6.9

# Mercury in San Francisco Bay

Total Maximum Daily Load (TMDL)  
Proposed Basin Plan Amendment  
and Staff Report



Richard Looker / Bill Johnson

California Regional Water Quality Control Board  
San Francisco Bay Region

September **2004**

# SF Bay Mercury TMDL

## RMP Contributions

- Fish consumption study
- Fish tissue & bird egg targets
- Source analysis
- Mass budget
- Future monitoring and studies to inform adaptive implementation

# Mercury in San Francisco Bay

Proposed Basin Plan Amendment and Staff Report for  
Revised Total Maximum Daily Load (TMDL) and  
Proposed Mercury Water Quality Objectives

## Mercury Water Quality Objectives



California Regional Water Quality Control Board  
San Francisco Bay Region

August 1 **2006**

# SF Bay Mercury TMDL

## RMP Contributions

- Fish consumption study
- Fish tissue water quality objectives
- Source analysis
- Mass budget
- Future monitoring and studies to inform adaptive implementation

## Total Maximum Daily Load for PCBs in San Francisco Bay

Final Staff Report  
for Proposed Basin Plan Amendment



California Regional Water Quality Control Board  
San Francisco Bay Region  
February 13, **2008**

# SF Bay PCBs TMDL

## RMP Contributions

- 💧 Fish consumption study
- 💧 Fish tissue target
- 💧 Source analysis
- 💧 Food web model
- 💧 Mass budget model
- 💧 Future monitoring and studies to inform adaptive implementation

# SF Bay PCBs TMDL

## RMP Contributions

- 💧 Fish consumption study
- 💧 Fish tissue target
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- 💧 Food web model
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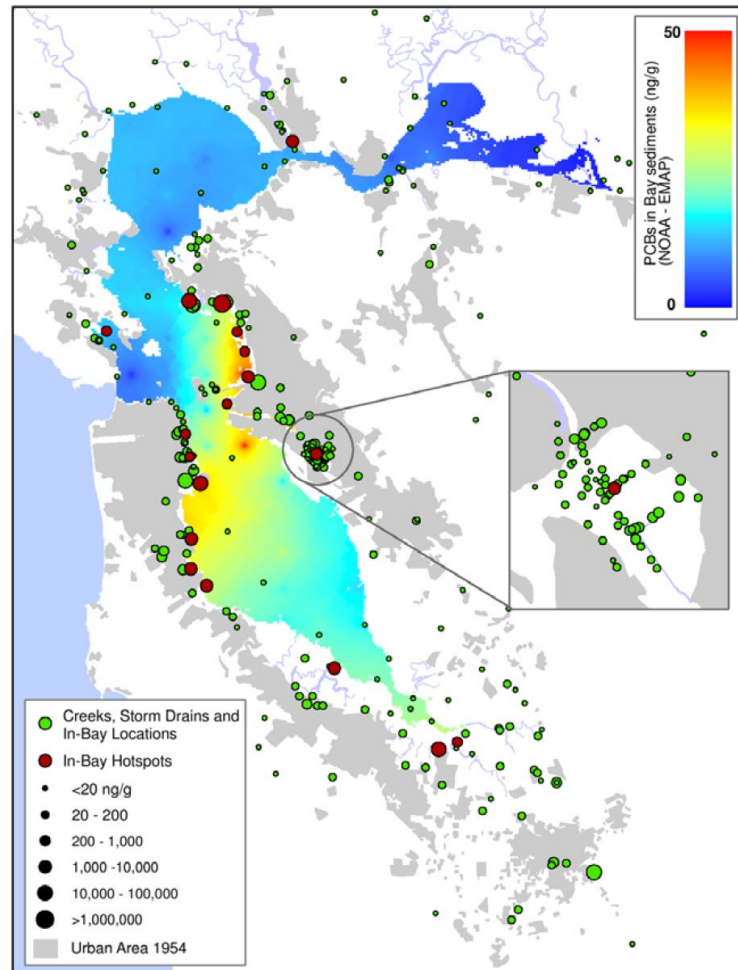
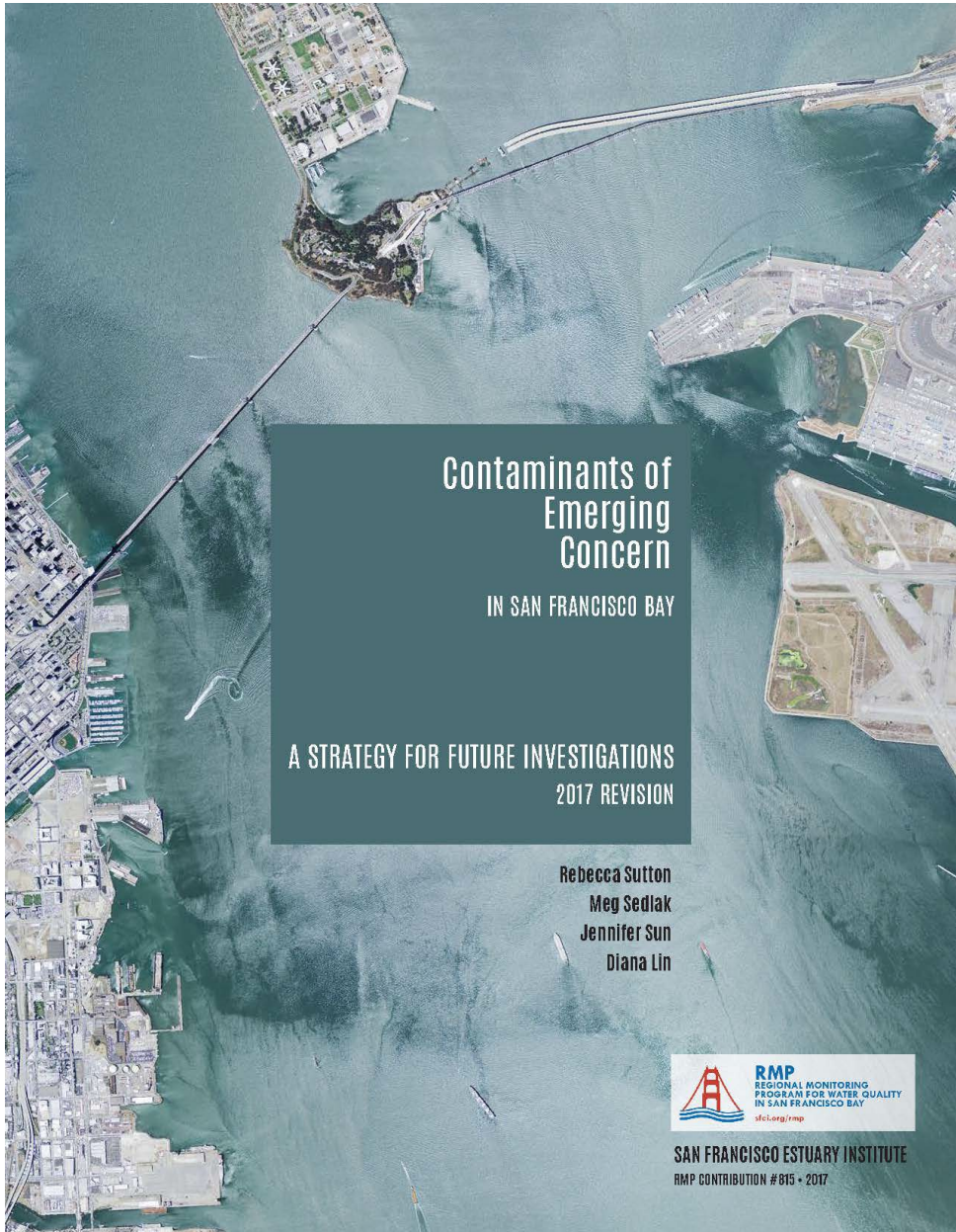


Figure 23-Overview of in-Bay and on-Land Sediment PCBs Concentrations





# Strategies

**2007** Mercury

**2008** Dioxin

**2009** PCBs

**2009** Small Tributary Loading

**2013** Emerging Contaminants

**2014** Selenium

**2020** Sediment Monitoring and Modeling

**202X** Integrated Monitoring and Modeling

➔ **2012 RMP Multi-Year Plan**

2013

A Report of the Regional Monitoring Program for Water Quality in San Francisco Bay

# THE PULSE

CONTAMINANTS OF EMERGING CONCERN

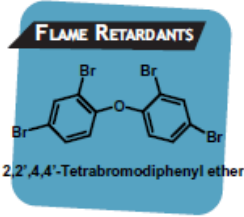
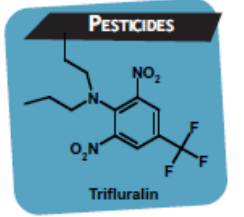
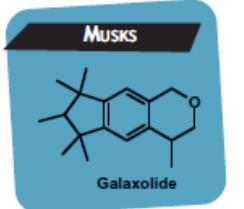
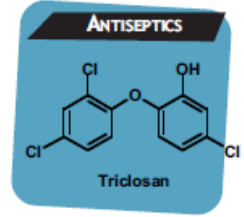
# OF THE BAY



Daniel Oros →

# RMP DETECTIVE WORK: IDENTIFYING NEW ORGANIC CONTAMINANTS IN THE ESTUARY

by Daniel R. Oros



The recent addition of a surveillance component to the Regional Monitoring Program for Trace Substances (RMP) was prompted by a need to make the regulatory system more proactive in anticipating potential problem contaminants in the San Francisco Estuary. Our efforts have focused mainly on identifying as many as possible of the "unknown" organic compounds that were resolved by combined gas chromatography-mass spectrometry (GC-MS).

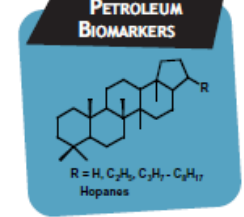
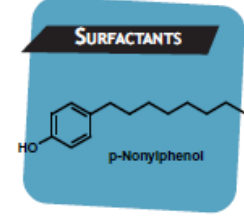
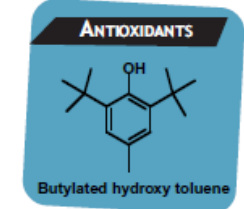
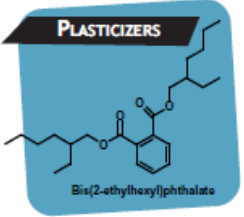
All samples were collected by the RMP and during the earlier SEDQUAL program from 1990 to the present year. Water samples were extracted in-situ with polyurethane foam or XAD resin. Foam plugs and resin, sediment, and biota tissue samples were each spiked with surrogate standards then extracted with organic solvents (MeOH and CH<sub>2</sub>Cl<sub>2</sub>). Sample extracts were combined and then subjected to Florisil column chromatography for separation into PCB/aliphatic (F<sub>1</sub>), pesticide/aromatic (F<sub>2</sub>) and polar fractions (F<sub>3</sub>). Fractions were analyzed by GC-MS.

Preliminary findings show the presence of both natural (e.g., terrestrial and marine plants) and anthropogenic (e.g., biomass burning, meat cooking, petroleum, synthetics, etc.) organic compounds and their decomposition products in environmental samples.

The anthropogenic organic compounds that are of immediate concern to the RMP include antioxidants used as preservatives (butylated hydroxy toluene, butylated hydroxy anisole), flame retardants (tetra- and pentabromo diphenyl ethers), surfactants (nonylphenol and alkylbenzenes), organophosphate pesticides (oxadiazon, diazinon and chlorpyrifos), industrial polymer plasticizers (di-N-butyl phthalate, butyl benzy phthalate and bis(2-ethylhexyl) phthalate), a flame retardant plasticizer (triphenylphosphate), and fragrance compounds (musk ketone, galaxolide, and versalide).

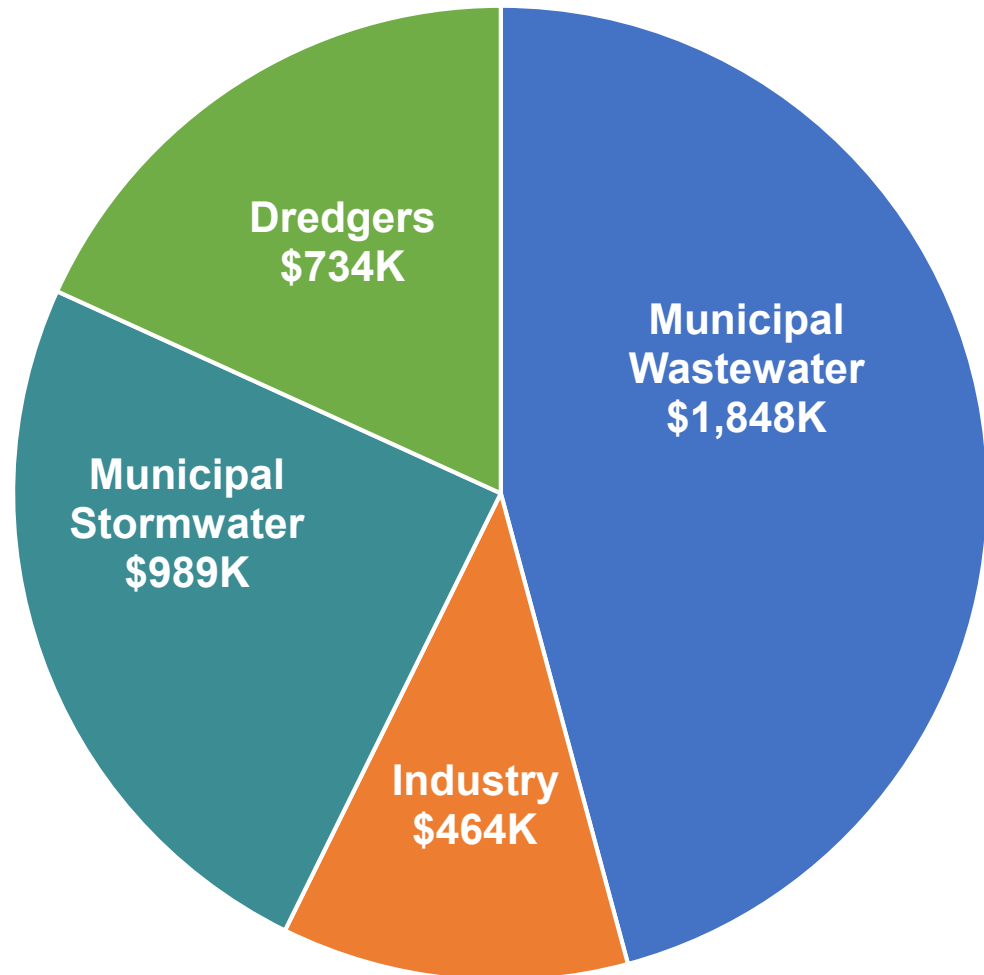
Recent evidence suggests that some of these synthetic compounds and their metabolites may induce toxicity, disrupt endocrine systems, and accumulate in marine biota (fish, crabs, and bivalves) and in higher food chain consumers (birds, marine mammals, and humans). Herein, we demonstrate that a monitoring program can incorporate a surveillance component that is useful for identifying past, current, and potential problems in the environment. Studies to confirm contaminant spatial and temporal distributions, and link these newly identified compounds to adverse impacts in the Estuary are warranted to ensure these contaminants do not become the legacy pollutants of the future.

Author: Daniel Oros (510) 746-7386; daniel@sfef.org



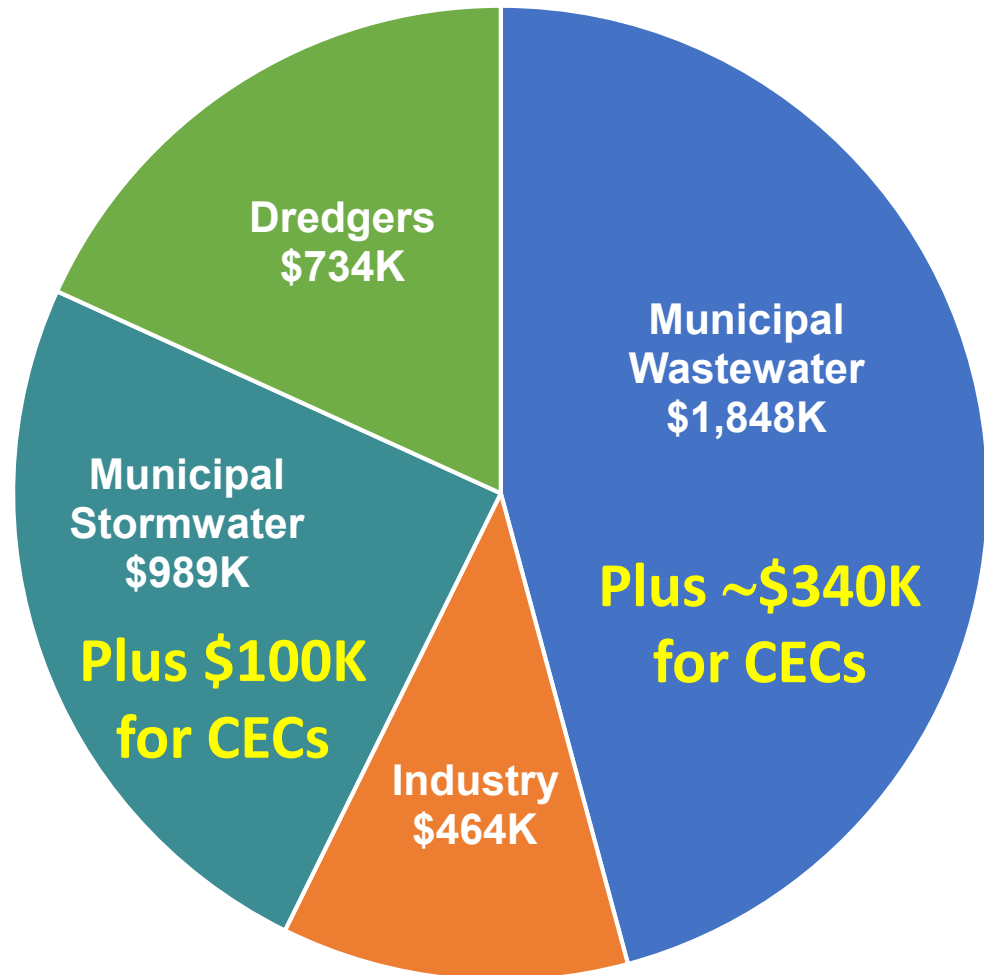
← 2001

# SF Bay RMP Annual Funding



**Start ~\$1.2 million**  
**Now ~\$4.5 million**

# SF Bay RMP Annual Funding



**CECs > 15 yrs**  
**Start ~\$100,000**  
**Now ~\$800,000**

# SF Bay Tiered Risk CECs

## **Very High Concern**

None currently

## **High Concern**

Organophosphate esters; PFAS

## **Moderate Concern**

Ethoxylated surfactants; Bisphenols; Fipronil\*; Imidacloprid\*; Microplastics

## **Low Concern**

PBDEs & HBCD; Pharmaceuticals; Personal care & cleaning products; Pyrethroids\*;  
Brominated dioxins & furans;

## **Possible Concern**

Alternative flame retardants; Plastic additives; Siloxanes; Quaternary ammonium compounds;  
Amine antioxidants; Ultraviolet stabilizing agents; Tire & roadway contaminants; many others

\* High or Very High Concern in urban creeks

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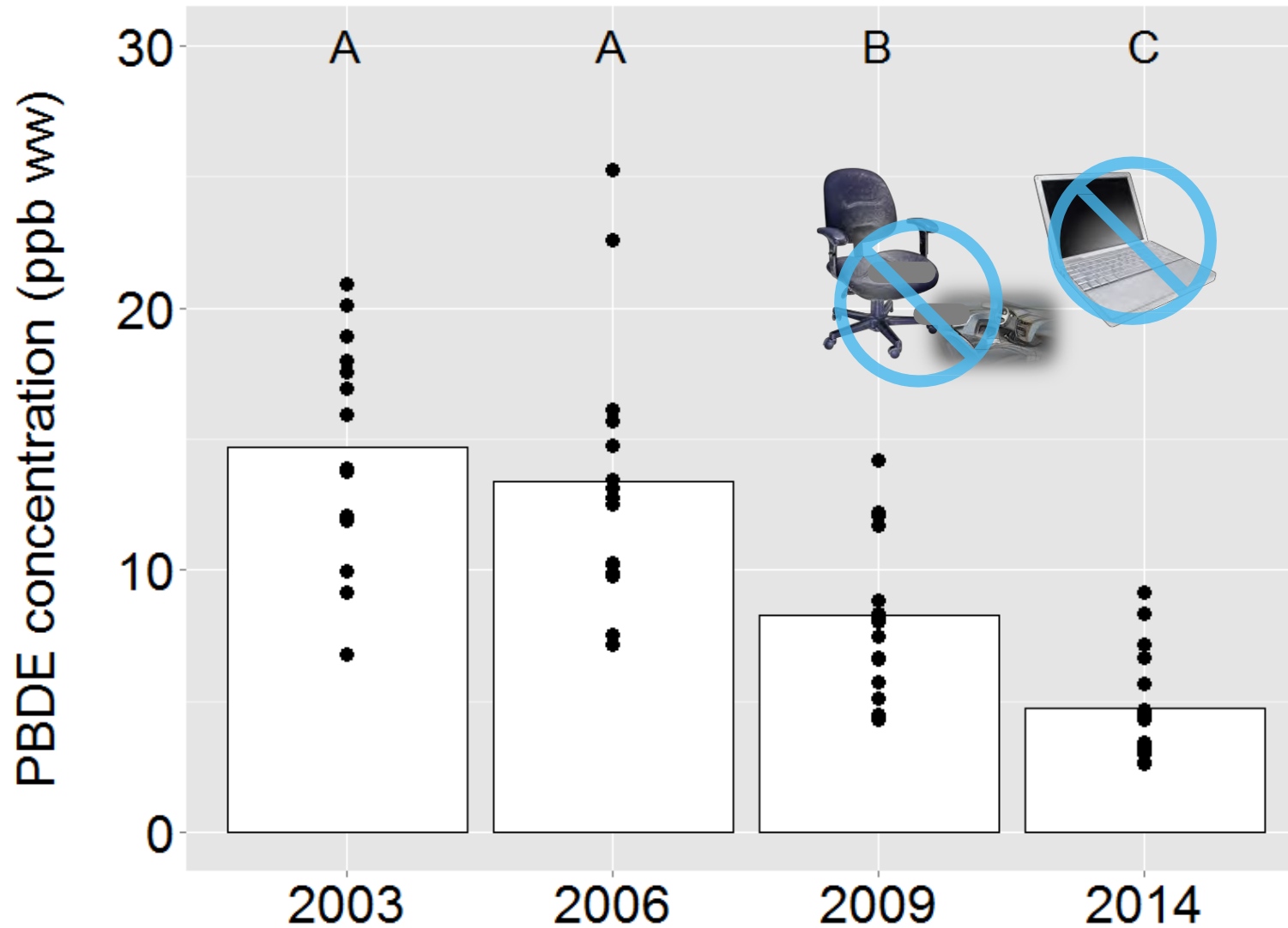
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# PBDE Recovery

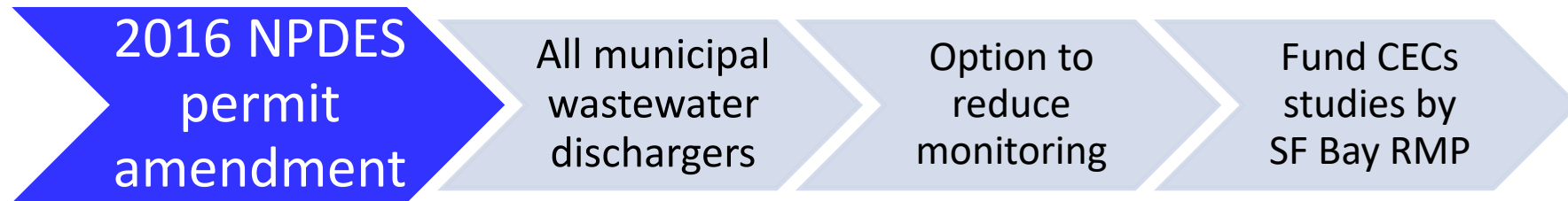
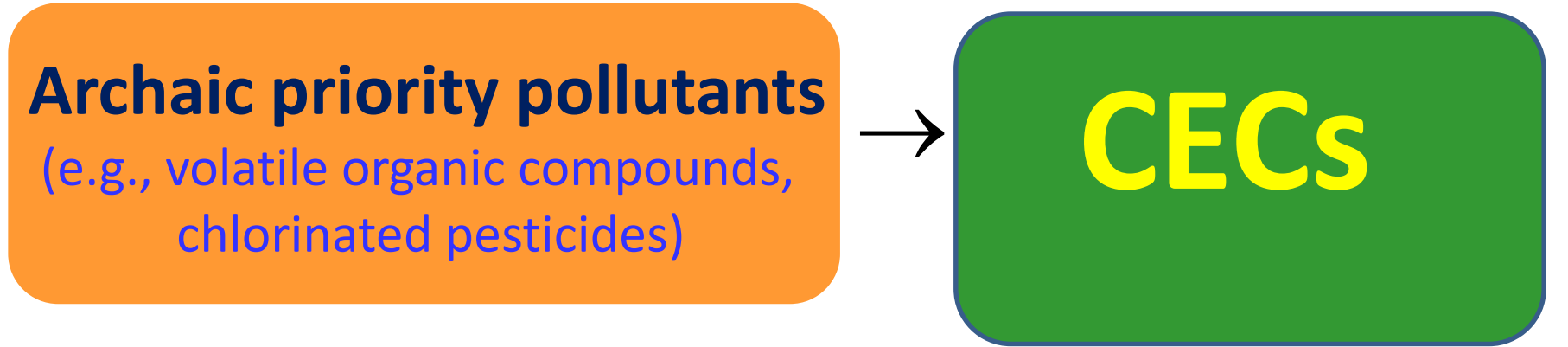


Shiner Surfperch



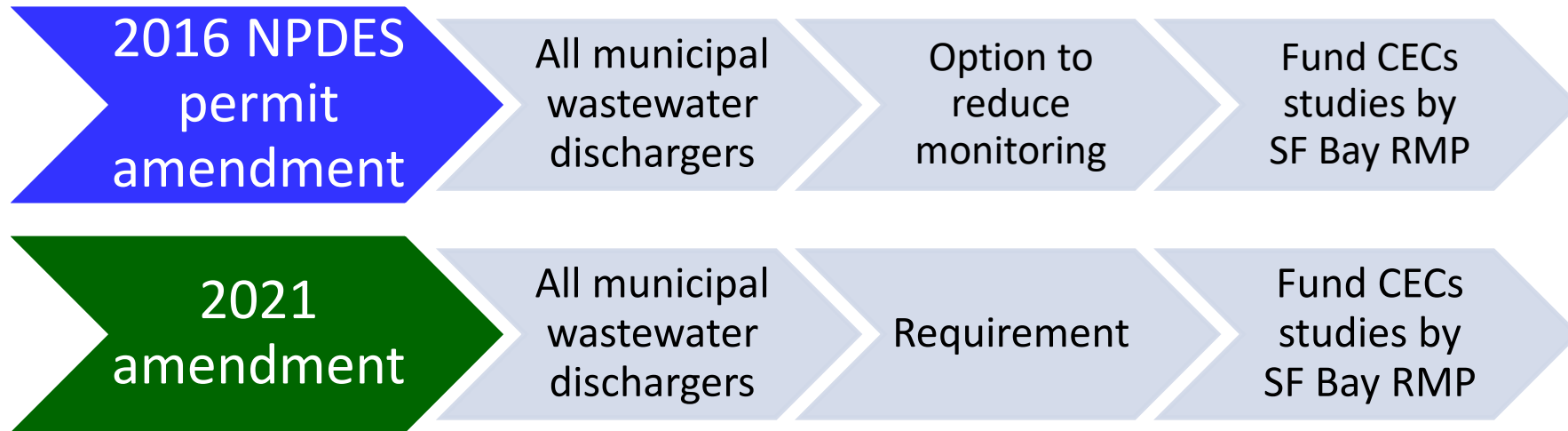
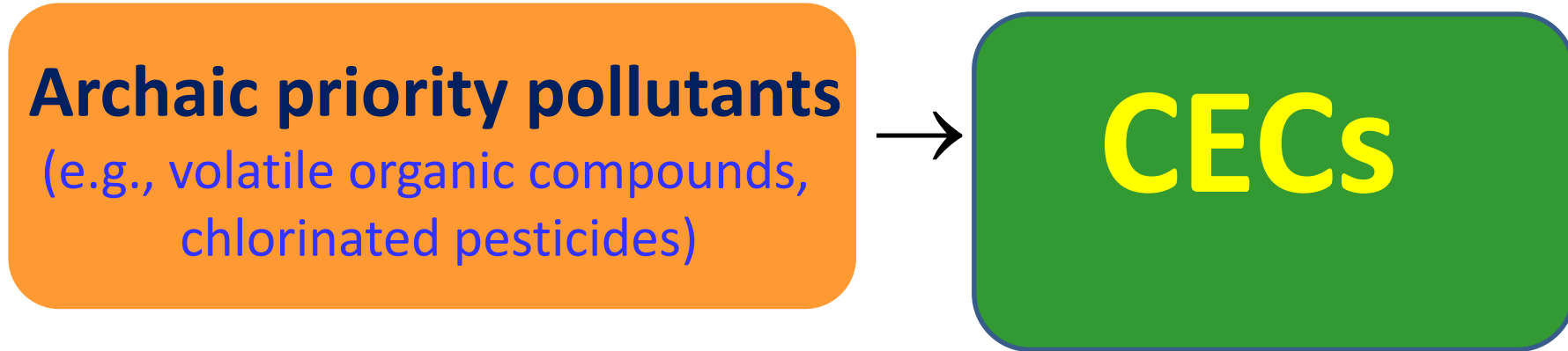


# Alternative Monitoring Requirements



~ \$270 thousand/year

# Alternative Monitoring Requirements



~ \$320 thousand/year

# Nutrients

November 2012

San Francisco Bay Nutrient Management Strategy

San Francisco Bay Regional Water Quality Control Board

# Sediment

**SEDIMENT FOR SURVIVAL:**  
A Strategy for the Resilience of Bay Wetlands in the Lower San Francisco Estuary

SFEI  
SAN FRANCISCO ESTUARY INSTITUTE

# Microplastics

**MICROPLASTIC CONTAMINATION IN SAN FRANCISCO BAY**

Contribution No. 770

RMP  
REGIONAL MONITORING PROGRAM FOR WATER QUALITY IN SAN FRANCISCO BAY  
www.sfei.org/mmp

- Microplastics are tiny particles of plastic five millimeters or smaller, and they enter the environment through human use. Beauty products with microbeads, synthetic clothing, plastic bags, polystyrene foam packaging, and disposable plastic items can all contribute to microplastic pollution.
- Wildlife mistake microplastics for food. When eaten, the tiny particles expose them to pollutants within the plastics or absorbed from their surroundings.
- In a pilot study, microplastic pollution appeared to be greater in San Francisco Bay than in the Great Lakes and Chesapeake Bay. Microbeads from beauty products and tiny fibers, likely from synthetic clothing, were found in all nine Bay water samples.
- Microparticles passed through Bay Area wastewater treatment plants, even those using the most advanced technologies. Bay Area wastewater typically had more of these particles than wastewater in other parts of the US, but data are extremely limited. Fibers made up most of the particles released into the Bay via treated wastewater. Not all of these fibers are known to be plastic.

1 MM EXAMPLE

ACTUAL SIZE

WHAT DO THEY LOOK LIKE?

FILM

FIBER

PELLET

FOAM

FRAGMENT

Microscopic view of microplastic particles found in the Bay. Courtesy: Sherril A. Mason.

**KEY TYPES OF MICROPLASTIC POLLUTION**

**FOAMED PLASTIC PARTICLES**  
from packaging, cigarette filters, and other items

**FIBERS**  
derived from clothes and fabrics made with synthetic materials (polyester, acrylic) or fishing lines

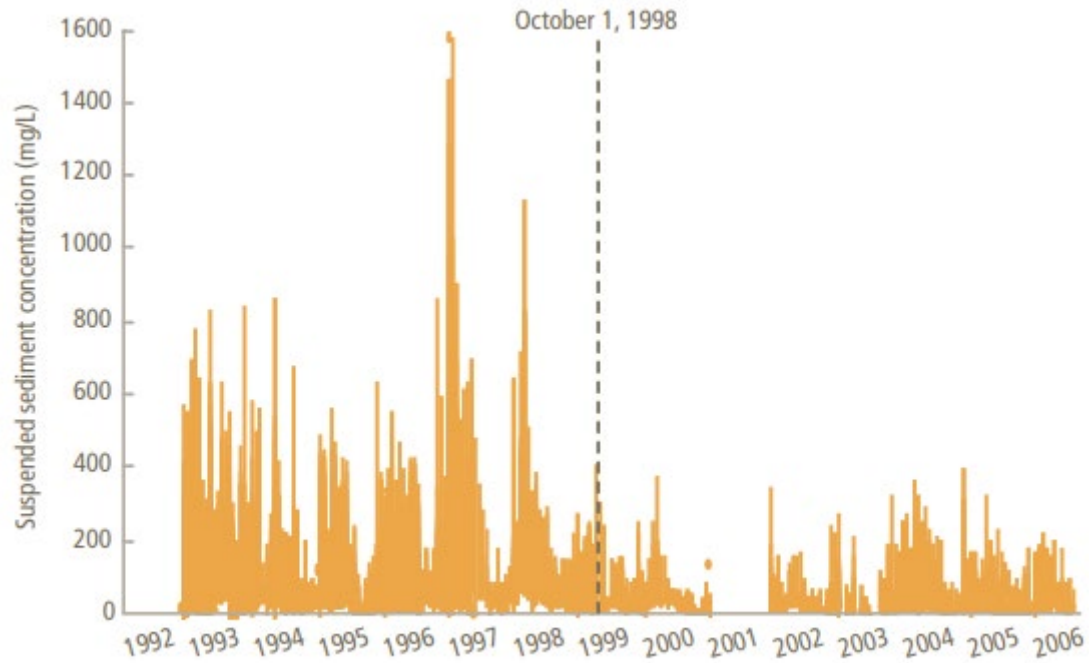
**MICROBEADS**  
pellets and fragments used in personal care products such as facial scrubs and toothpastes

**FRAGMENTS**  
from the photodegradation of larger plastic items such as plastic bottles

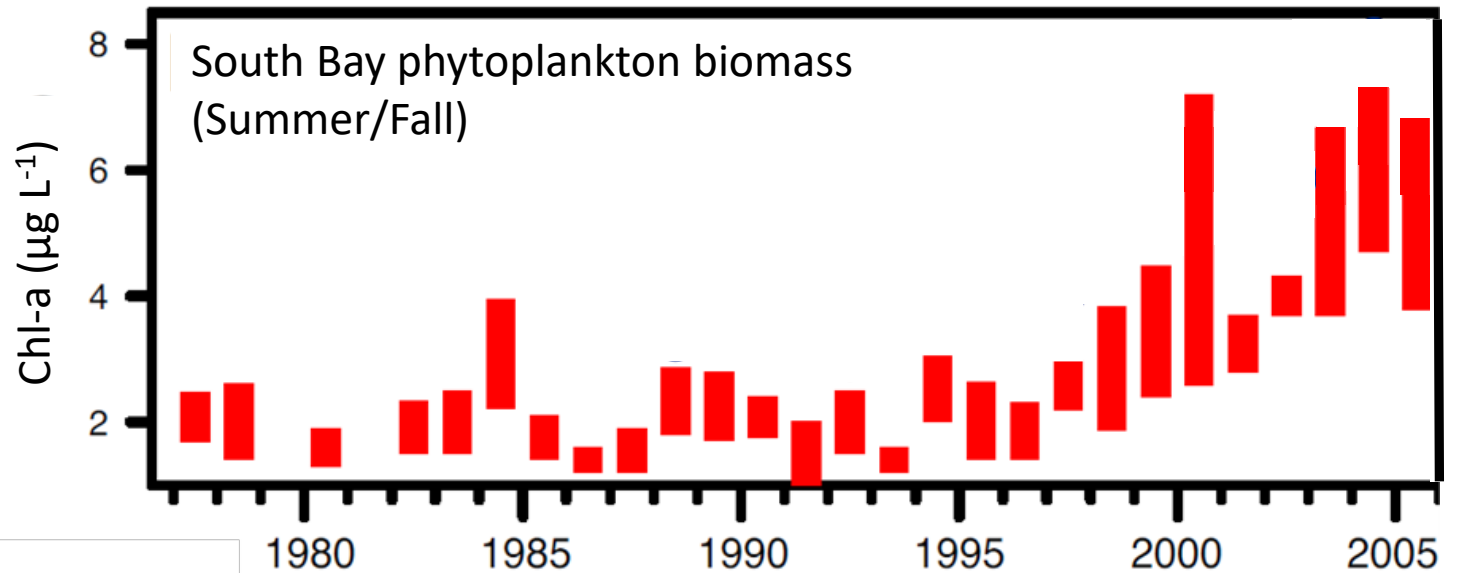
**NURDLES**  
pre-production plastic pellets that are molded into larger plastic products

THE REGIONAL MONITORING PROGRAM FOR WATER QUALITY IN SAN FRANCISCO BAY (RMP) is an independent, long-term monitoring program providing policymakers with the information they need to protect the vital urban ecosystem. The RMP is an innovative collaboration between the San Francisco Estuary Institute, the San Francisco Bay Regional Water Quality Control Board, and regulated dischargers.

# USGS Partners

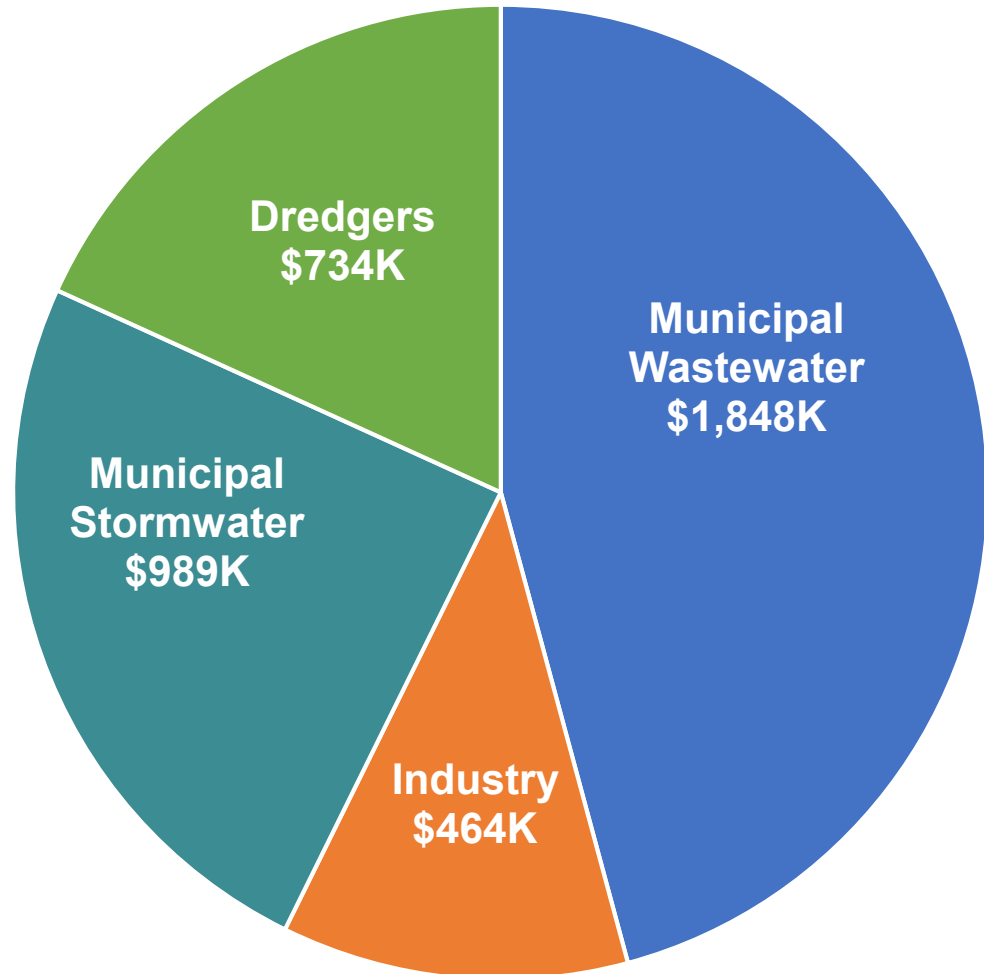


Schoellhamer et al



Cloern et al

# SF Bay RMP Annual Funding



**~\$4.5 million**

**~\$500K for nutrients**

**Bay Area Clean Water  
Agencies Partners**

**+ \$2.2M for Nutrients**

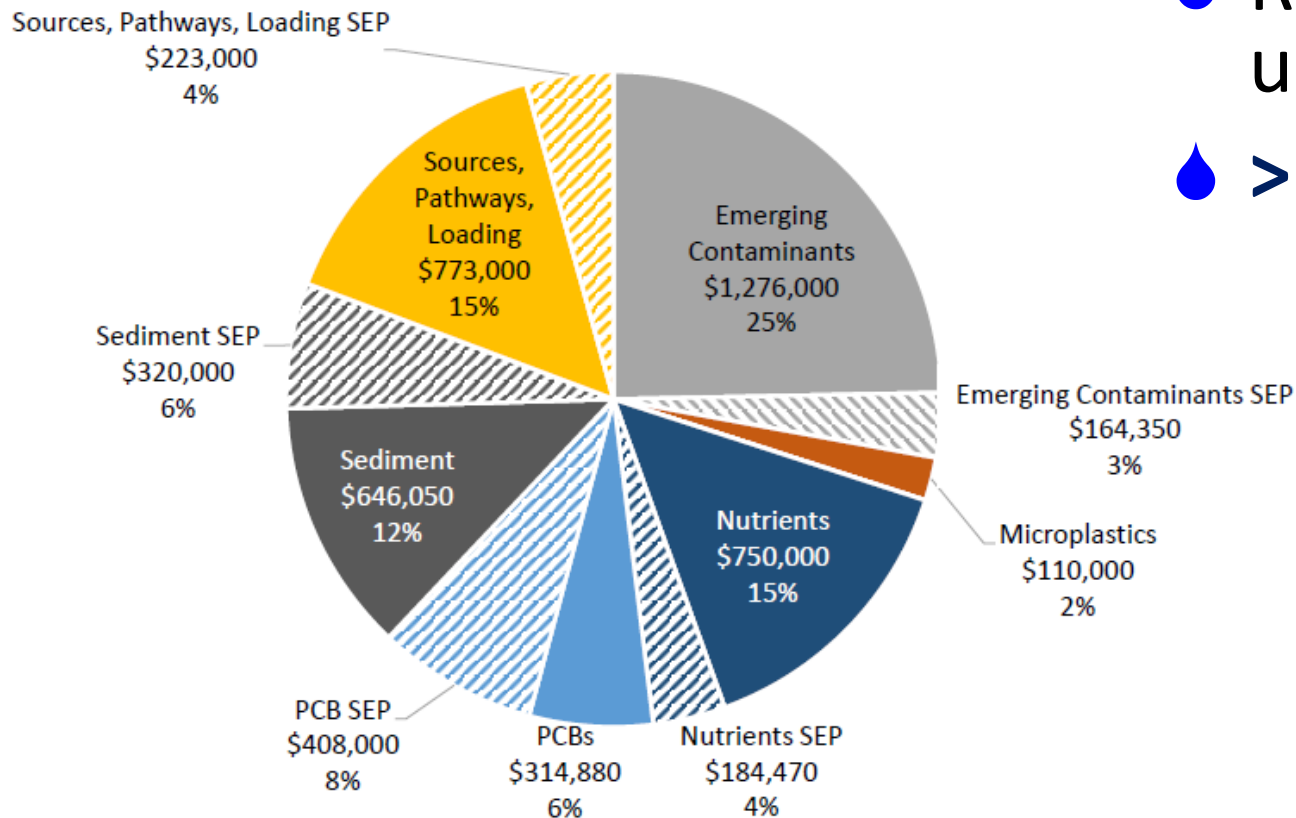
# (SEPs) Supplemental Environmental Projects

2021-2023

Special Studies (solid pies) and  
**SEPs (hashed pies, 25%)**

Σ \$5,169,750

- 💧 2017 State Water Board SEP Policy
- 💧 Resolution No. 2018-0015 okayed use of SEP funds for RMP projects
- 💧 **> \$3.8 million to date**



# Adaptive Implementation

From National Academy of Science Report \*

“... Adaptive implementation is the application of the scientific method to decision making.”

\* Assessing the TMDL Approach to Water Quality Management (2001)

 **Hypotheses = answers to management questions based on regulatory, science, and political information**

**Opportunities ↔ Constraints**  
**Boundary Conditions**



**Water Board**



**RMP**



**Collaboration  
& Trust**



A Lot More Fun to Come!

