

# **Regional Monitoring Program for Trace Substances in the San Francisco Estuary**

## **2004 Program Plan**

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### **OVERVIEW OF THE 2004 PROGRAM**

In 2004 the RMP enters its twelfth year of monitoring. In each year, the RMP has adapted in response to changes in the regulatory landscape, advances in understanding of the Estuary, and a continual drive to adjust the Program to better meet its objectives. This overview describes the major refinements and new elements of the Program to be implemented in 2004.

One highlight of the 2004 Program will be completion of the second Program Review. The first Program Review was conducted in the fifth year of the Program, and was a very thorough examination of all aspects of the Program (Bernstein et al. 1997). The first Review resulted in a major course correction, including changes in the objectives that provide a foundation for the Program. The changes in Program objectives initiated a multi-year process to change the design of the Program. This process benefited from the energy and insight of many scientists and managers participating in RMP committees and workgroups. In 2002, the redesign process came to fruition, with field implementation of spatially randomized sampling of water and sediment and many new field efforts related to sources, pathways, and loading, and contaminant bioaccumulation and effects. The Program Review process was initially envisioned to occur on approximately a five year cycle. The second Review is of a much smaller scale than the 1997 review. Technical evaluation of the effectiveness of the redesigned Program will not be worthwhile until a few years worth of data are available. The 2003 Program Review will primarily evaluate whether the Program responded to the 1997 Review in an appropriate manner and how the Program is functioning within the present regulatory and technical landscape. The 2003 Review began late in 2003 and will be completed in early 2004.

A recent major change in the scientific and regulatory landscape is the existence of the Clean Estuary Partnership (CEP), a collaboration among the POTWs, stormwater agencies, and the Regional Board that formed in 2001 to provide information needed to facilitate the development of TMDLs and other water quality attainment strategies for the Bay. The CEP has now initiated several projects and established a solidified organizational structure. There is a great deal of overlap between the RMP and CEP. Even though the RMP was created and redesigned before TMDLs became a regulatory focus, much of the RMP is of direct value in the TMDL process. Also, many CEP studies will help to meet RMP objectives. Some concepts for special studies that were developed in the RMP are being funded or considered for funding by

the CEP, including the Small Tributary Loading Study (a study of contaminant loading from the Guadalupe River also known as the “Guadalupe River Study”) and a study to better characterize the active sediment layer of the Bay. Close coordination of the RMP and CEP will be important to the success of both programs.

In 2004 the Guadalupe River Study will become a joint RMP/CEP project, with funding contributed by both programs (\$75,000 from CEP and \$50,000 from RMP). The concept for this study originated in the Chlorinated Hydrocarbon and Sources, Pathways, and Loadings workgroups. The CEP funded the first year, CEP/RMP will fund the second year (2004), and it is anticipated that another source of funding will be found for the third year. This study is providing valuable information on the magnitude of loading of priority contaminants (mercury, PCBs, and others) from small tributaries, and is developing innovative, cost-effective monitoring techniques.

Closely related to the Small Tributary Loading Study is a special study on Contaminant Loads from the Sacramento and San Joaquin Rivers (aka “Mallard Island Study”). This Study, which began in 2002, is gathering data on sediment-related contaminant concentrations at Mallard Island for the purposes of developing statistical relationships between concentrations and continuous suspended sediment concentration measurements. Contaminants being measured include mercury, PCBs, organochlorine pesticides, and PAHs. Although this Special Study is closely aligned with the goals of the Clean Estuary Partnership, it also meets the sources and loadings objective of the RMP, and was initiated as part of the RMP.

Another highlight of the 2004 Program will be the continuation of a special study to evaluate the first ten years of the RMP. For several reasons, this is an appropriate time to perform a retrospective evaluation of the RMP and contamination in the Bay. In 2003, the data from 2001 became available, completing the nine year period employing the original fixed station RMP design. The end of this initial chapter of the RMP is an appropriate time to perform a thorough evaluation of trends indicated by the original Status and Trends Program design. Nine years of monitoring also represents a substantial body of work for the other aspects of the RMP, and a synthesis of these findings from these elements is also worthwhile at this time. In addition, the last comprehensive, synthetic overview of contamination in the Estuary was completed in 1991 (Davis et al. 1991), and Bay contamination, and understanding and regulation of Bay contamination, have changed considerably since that time. The synthesis of data from the first phase of the RMP will provide a general theme for the Program in 2004.

A new special study in 2004 will evaluate whether information that addresses RMP objectives and management questions can be gleaned from the datasets generated for dredged material testing. For many years dredgers have collected data on the chemical quality and toxicity of Bay sediments from around the fringes of the Bay from a variety of marinas, ports, and waterside marine related businesses, as well as data from the Corps federally maintained navigation channels. A detailed evaluation of these data will be made. If the data are found to be valuable to the RMP, a subsequent step would be to establish a data management system for them to make them accessible and usable. This effort would meet not only RMP objectives to synthesize information from all sources, but also an objective of the Dredged Material Management Office (DMMO) to make the data publicly accessible.

A major pilot study that is continuing in 2004 is the Exposure and Effects Pilot Study (EEPS). This five year Study is testing a variety of indicators of contaminant accumulation at the top of the food web and contaminant effects on sensitive aquatic species. This Study is being implemented under the guidance of the Exposure and Effects Workgroup and an advisory panel of experts in this field. This will be the third year of the Study. In the first two years, the Study examined contaminant accumulation in cormorants and diving ducks, and contaminant effects in harbor seals, birds, fish, benthic communities, and toxicity test organisms. The elements of the Study for 2004 are in development by the Workgroup and Advisory Panel.

Toxicity testing will receive a large investment (approximately \$400,000) in 2004 through a combination of funds from RMP and grants from the State Board's PRISM program. The RMP will fund continued monitoring of episodic toxicity (approximately \$150,000 as part of the Status and Trends element and a study of the sensitivity of resident species to specific contaminants in sediment toxicity tests under the EEPS (\$60,000). SFEI submitted two successful proposals to the PRISM program. One was for \$188,000 to investigate the toxic effects of pyrethroid pesticides in sediment entering the Estuary through selected tributaries. The other was for \$190,000 to develop new procedures to detect pyrethroids in water and sediment at lower concentrations than is currently possible – this study will also be coordinated with and complement the toxicity testing work.

In other respects, the Program will continue on the new course begun in 2002. Water and sediment will be sampled at a new set of locations as we continue to fill in a picture of the spatial distribution of contamination in the Bay. Emerging contaminants will continue to be examined in a targeted manner. Special studies and data integration efforts will continue, and will include further development of contaminant mass budgets, fate models, bioaccumulation and effects in cormorants and terns, toxicity of Bay water and sediment to sensitive resident species, contaminant loads from the Delta to the Bay, and other valuable studies. Through the continuing efforts of the committees and workgroups that guide the RMP, the Program continues to evolve to meet its objectives in an effective and economical manner.

The 2004 Program Plan is designed to meet the objectives of the RMP:

- 1) describe patterns and trends in contaminant concentration and distribution;
- 2) describe general sources and loading of contamination to the Estuary;
- 3) measure contaminant effects on selected parts of the Estuary ecosystem;
- 4) compare monitoring information to relevant water quality objectives and other guidelines;
- 5) synthesize and distribute information from a range of sources to present a more complete picture of the sources, distribution, fates, and effects of contaminants in the Estuary ecosystem.

A hierarchical framework of focusing questions and management questions that are tied to these objectives has also been established (SFEI 1998).

**The 2004 financial contributions from Program Participants will be a 2% overall increase over the 2002 funding allocation.** In-kind services by the City

of San Jose will be continued in 2004 for the maintenance of the Mercury Deposition Network site near San Jose.

## **TASKS**

### **1. Program Management**

The administration and management of the RMP requires a substantial effort from SFEI staff. Costs for this component of the RMP reflect the staff time required to manage finances and contracts, planning and coordination activities, and technical oversight of RMP products.

#### **1.1 Internal Coordination**

This category provides SFEI staff time for coordination and liaison to program participants, program collaborators, Regional Board, and Steering and Technical Review Committees. This coordination is necessary to keep everyone involved in the RMP satisfied with the organization and efficiency of the RMP, to prepare for and facilitate critical decisions, outline issues, and to ensure that RMP activities complement and enhance other scientific efforts by Program Participants and the Regional Board (e.g., Clean Estuary Partnership). Internal coordination of RMP staff is also covered by this category. This category also includes coordination and technical oversight of different RMP tasks performed by SFEI staff.

#### **1.2 External Coordination**

External coordination promotes a comprehensive and coordinated understanding and monitoring of the Estuary through participation in work groups and committees outside of the RMP umbrella. Members of RMP staff participate in the Clean Estuary Partnership, Interagency Ecological Program (IEP), the State-wide Surface Water Ambient Monitoring Program (SWAMP), Regional Board 5 activities, Sacramento River Watershed Program, Northern California SETAC, CALFED, BASMAA, BACWA, LTMS, the Bay Delta Modeling Forum, and various TMDL work groups and committees.

#### **1.3 Contract and Financial Management**

Tasks in this category include all efforts related to tracking progress and expenditures on all budgeted items, including invoicing of Program Participants, tracking incoming and outgoing funds, accounting and working with the SFEI auditor, working with the Fiscal and Administration Subcommittee of the SFEI Board of Directors, providing financial status updates, and communicating with the Steering Committee on financial matters as needed. It also includes initiation of contracts after scopes of work have been negotiated, scientific oversight of products, coordination of field and laboratory components, troubleshooting, scheduling, and implementing course adjustments as necessary, cost-effectiveness/performance evaluations of existing contractors and identifying potential new subcontractors as needed.

## **1.4 Program Planning**

Program planning for the RMP involves several tasks including Program Plan and Project Plan development, updating the five-year plan, proposal writing, RFP development, and development of scopes of work, both in-house and for contracts. With procedures in place for Pilot and Special Study selection and data interpretation, we will continue to place emphasis on documenting planning steps and assisting the Steering Committee and the Regional Board in prioritizing information needs, and adapting the Program to evolving management priorities.

## **1.5 2003 Program Review**

The second Program Review will be completed in 2004. This review will be on a much smaller scale than the Five Year Review. The Five Year Review resulted in a major course correction for the RMP, with the adoption of new objectives and the eventual initiation of several new RMP elements. These changes culminated in 2002 with the implementation of a new sampling design for water and sediment, and new field studies of contaminant loading and indicators of contaminant exposure and effects. Since these designs just began in 2002, it is too early for a meaningful evaluation of their performance. The 2003 Program Review will evaluate the implementation of the 1997 Review recommendations and the institutional effectiveness of the RMP in outreach, communication of results, and coordination with related regulatory programs. A full review is anticipated for 2008.

Estimated cost in 2004: \$0 (funded from the 2003 budget)

## **2. Information Management and Dissemination**

In accordance with the five-year review recommendations related to information synthesis and to meet the RMP Objective: “Synthesize and distribute information from a range of sources to present a more complete picture of the sources, distribution, fates, and effects of contaminants in the Estuary ecosystem”, all activities related to data management, RMP web-site maintenance, development of newsletters, the RMP Annual Meeting, presentations, and information transfer to a variety of audiences, including preparation of the RMP Annual Monitoring Results and the “Pulse of the Estuary”, are included in this category.

### **2.1 Data Management**

The primary objective of this task is to manage, maintain, and improve the RMP database and to enable greater accessibility of data results. In addition to formatting and reporting of the 2004 monitoring results, it is also necessary to maintain data from the Status and Trends Program and Pilot and Special Studies and to incorporate revisions from the QA review process and reanalysis.

## **2.2 RMP Web Site Maintenance**

The RMP web site is assuming an ever-increasing role in making data, technical reports, newsletters, bibliographies, Powerpoint presentations, and other documentation available. This task includes: 1) the publication of RMP Annual Monitoring Results, which is distributed via the RMP web site; 2) conversion of most RMP reports into appropriate publication quality formats for quality printing and/or for distribution on our website, 3) maintenance of web directories and updating the RMP publications list to allow easy access; and 4) maintenance and improving the overall design of the RMP web site.

## **2.3 Information Dissemination**

The RMP will continue to produce newsletters and other public documents. We will continue to take advantage of existing venues for information distribution, such as newsletters of participating agencies, the NEP newsletter, ESTUARY, and the IEP newsletter. As appropriate, fact sheets, briefing papers, and formal presentations to community groups and other organizations, and scientific conferences will also provide information about the RMP and its findings. This task also includes work related to planning and executing the RMP Annual Meeting.

## **2.4 Annual Reporting**

This task involves preparation of the Annual Monitoring Results for distribution on CD and the web, as well as writing, editing, and publishing the "Pulse of the Estuary." In calendar year 2004, the 2002 edition of the Annual monitoring results will be completed, and work on the 2003 edition will begin.

## **2.5 Quality Assurance**

This task includes three main elements: 1) evaluating the quality of data generated by analytical labs; 2) updating the QAPP and protocol documentation; and 3) coordinating intercomparisons and other efforts to improve the quality of RMP data. The QA program was modified to accommodate additional analytes in 2002 and the process of refining QA measures for these compounds will continue in 2004.

## **2.6 Data Integration**

This category provides resources for staff activities that focus on integration of data from the RMP and non-RMP studies of contaminants in the Bay, and on synthesis of all of this information in evaluations of past trends, present status, and projected future trends. Other sources of information on Bay contamination include USGS studies, SWAMP, CALFED, EMAP, NOAA's Status and Trends Program, and the Clean Estuary Partnership. Prediction of future trends depends on an ability to model contaminant fate in the ecosystem. A recommendation of the Five Year Review Panel pointed the RMP in the direction of developing mass budget models. Such models are valuable in summarizing the existing state of knowledge, synthesizing information from the RMP

and other programs on contaminants in San Francisco Bay, predicting the response of contaminant concentrations in the Bay to management actions and natural processes, identifying and prioritizing data gaps, and communicating RMP results. This task includes continued refinement of mass budgets for priority contaminants. Food web models combine with mass budget models to allow prediction of trends in the higher trophic level organisms that are high priorities from a regulatory perspective.

Tasks included in the 2003 Program will be continued. These include mass budget model development and integration of data from NOAA/EMAP and other programs (this will include compiling data into compatible formats, and general QA/QC reviews prior to data analyses). Mass budget model work in 2004 will include completion of a multi-box version of the PCB model (developed in collaboration with Dave Schoellhamer of USGS), and incorporation of a quantitative uncertainty analysis. Journal publications on mass budgets for PAHs and organochlorine pesticides will be completed. xx Kuwabara

Estimated cost of this task: \$89,000

### **3. Status and Trends Monitoring**

The Status and Trends monitoring component was significantly revised in 2002. A long term plan for implementing this design, including a 20 year cycle of rotating panels, has been laid out. The new design follows the EMAP example of a randomized design capable of addressing questions related to a representative characterization of contaminant concentrations in water and sediment.

The Status and Trends monitoring component (corresponding with RMP Objectives 1 and 4 above) is distinct from the Loadings and Effects monitoring components (corresponding with RMP Objectives 2 and 3, respectively). As has been the case since the inception of the RMP, Status and Trends monitoring components will be augmented with short-term Special and Pilot Studies designed to answer specific management questions (e.g., what is the potential of currently buried contaminants to emerge from eroding sediment layers and become a contaminant input to the ecosystem?), or to test on a small scale the efficacy of new monitoring approaches or methodologies (e.g., monitoring of contaminants in avian eggs as an indicator of long term trends), for possible inclusion in the Status and Trends Program.

Until 2001, RMP sampling stations were located in the main channel of the Estuary, augmented by a few shallow-water stations close to tributaries and two “local effects monitoring stations” funded by the cities of San Jose and Sunnyvale. In 2000 and 2001 respectively, a decision was made to incorporate fish tissue monitoring and episodic toxicity monitoring into the RMP, each with a very different sampling design from the new proposed Status and Trends (S&T) monitoring component.

Water and sediment sampling for the S&T component now occurs once a year in the summer for both trace elements and trace organic contaminants, as well as concurrent ancillary water quality and sediment quality measurements. Bivalve bioaccumulation sampling also



occurs in the summer. Summer has been selected for sampling because interannual variation due to natural variables, primarily freshwater inflow, is expected to be minimized during this period. In addition, the dry season is a time when low riverine inflow is less likely to dilute certain contaminants, and for some contaminants dry season concentrations might reflect a worst case index period against which to compare trends in water quality over the long term. The number of S&T monitoring stations varies by segment for water and sediment measurements based on current Regional Board management priorities, statistical power achieved for key contaminants, and fiscal considerations. In addition, five historical water stations and seven historical sediment stations are sampled to maintain time series for long term trend analyses.

### **3.1 Water Chemistry**

Conventional water quality, trace metals, and trace organics sampling in water will occur during the dry season at 33 stations throughout the Estuary. The analyte list for trace elements and organics will remain the same as in 2003 including the new classes of compounds, (polybrominated diphenyl ethers, phthalates, nonylphenols, and nitro and aromatic musks) unless the results of the 2002 sampling show that some of these compounds are not a concern in the Estuary. Criteria for inclusion of these analytes will be established prior to this decision-making process.

### **3.2 Toxicity**

#### **Status and Trends Monitoring of the Estuary**

Since the RMP Status and Trends aquatic toxicity monitoring in the Estuary has shown little toxicity present over the past several years, aquatic toxicity sampling has been scaled back to a screening effort every 4-5 years (next sampling to occur at a subset of random sites in 2005).

RMP Status and Trends sediment toxicity monitoring will continue as in previous years. Sediment toxicity measurements will be made at 27 sites in the Estuary (20 randomly allocated sediment chemistry stations and 7 historical RMP sampling sites). Toxicity tests will be conducted with *Eohaustorius* (a solid phase test with survival as the endpoint) and *Mytilus* (an elutriate test with normal larval development as the endpoint). TIEs will be conducted in samples that show significant toxicity.

#### **Episodic Toxicity Monitoring**

In 2001, the Episodic Toxicity Pilot Study was incorporated into the Status and Trends Program with some minor changes to the monitoring approach. In 2003 this element examined toxicity by measuring survival of the mysid shrimp *Americamysis bahia*, survival of the fish species *Menidia beryllina* (inland silversides), and survival and reproduction in the freshwater crustacean *Ceriodaphnia dubia* in water samples collected during five high flow events at four tributaries (Petaluma River, Sonoma Creek, San Lorenzo Creek, and Coyote Creek). A workgroup of toxicity experts, Regional Board staff, and RMP staff met several times in 2002/2003 to review results of all the RMP

toxicity programs and to develop a plan to re-scope the toxicity components of the RMP to better address current conditions. The workgroup will continue discussions on re-scoping the episodic toxicity component of the RMP in 2004. For now, the episodic toxicity component of the RMP will begin to evaluate the potential toxic effects of sediments in several tributaries around the Estuary. Efforts will be coordinated with the two PRISM grants that SFEI was awarded for 2004.

RMP funding for the episodic toxicity component will be scaled back slightly in 2004.

### **3.3 Tissue Chemistry**

#### Transplanted Bivalves

The bivalve monitoring component maintains the long-term database started by the State Mussel Watch Program. Because of logistical complexities, a randomized design is not economically feasible. Transplanted bivalves will be deployed at 14 stations, with one of two species (*Mytilus californianus* or *Crassostrea gigas*) sampled at each station, depending on salinity. As has been done since 1999, resident *Corbicula* will be collected from the Sacramento and San Joaquin River stations (BG20 and BG30) because a source of clean *Corbicula* for transplanting could not be identified. As with sediment and water, it is sufficient to analyze tissue concentrations in bivalves once per year during the dry season when Estuary conditions are more consistent on an interannual basis, to meet the trend evaluation and guideline comparison objectives. The trace organic analyte list has recently been expanded to include characterization and bioaccumulation potential of emerging contaminants – results from 2002 will be reviewed to determine which emerging contaminants should continue to be measured on an annual basis.

#### Sport Fish

Sport fish sampling in the RMP began in 1997 and occurs on a three year cycle. Sampling was performed in 2003. In order to facilitate temporal comparisons, the sampling design in 2003 was generally the same as that employed in previous rounds. Popular sport fish species were sampled at several popular fishing locations, and analyzed for mercury, PCBs, and organochlorine pesticides. Due to potential human health concerns, rising concentrations, and their inclusion on the 303(d) watch list, polybrominated diphenyl ethers (PBDEs) were analyzed in these samples. Other new RMP analytes identified in 2001 may be analyzed in fish tissue, pending results of sampling in 2002. In 2004, funds will be allocated to interpretation of and reporting the 2003 data.

Cost in 2004: \$30,000

### **3.4 Sediment Chemistry**

Sediment samples will be collected during the dry season. Sediment chemistry will be analyzed at 40 random sites and 7 fixed sites. As part of the rotating panel design, one

pair of the random stations in each segment will be revisited in 2003 and will be revisited again in 2004. The analyte list for metals and organics will remain the same as in 2003 including the new classes of compounds, (polybrominated diphenyl ethers, phthalates, nonylphenols, and nitro and aromatic musks) unless the results of the 2002 sampling show that some of these compounds are not a concern in the Estuary.

### **3.5 U. S. Geological Survey Participation**

The United States Geological Survey has been a collaborating agency in the RMP since the beginning of the Program and has contributed in-kind services through Department of Interior funding, IEP funding, and other sources to enhance the RMP financial contributions designed to address basic hydrographic and sediment transport processes. An understanding of these basic processes is necessary to interpret the patterns and dynamics that are emerging from the RMP database on chemical indicators of water quality condition. The funds contributed by the RMP are generally less than half of the overall USGS costs to conduct both monitoring components outlined below.

#### **3.5.1 Sediment Dynamics in San Francisco Bay**

This study will be conducted by the USGS in Sacramento. The Principal Investigator is Dr. David Schoellhamer.

From 1993 to 2003, this element of the RMP focused on monitoring and understanding suspended sediment dynamics in the Estuary. This work has yielded many insights into sediment and contaminant dynamics in the Estuary, as summarized in an article by Dr. Schoellhamer in the 2003 Pulse of the Estuary. In 2004 this component is being evaluated to determine whether it can be modified in response to improvements in understanding over the past 10 years and the increased emphasis in recent years on modeling the long term fate of contaminants in the Estuary. One area where better information is clearly needed is bedded sediment dynamics, include long term trends in deposition and erosion and mixing of the active sediment layer. A shift in this direction may occur for this element in 2004. Another aspect of this element will be continued development of a multi-box model of contaminant fate, with USGS providing the foundation of the model by describing water and sediment movement and assisting SFEI in linking this to contaminant movement.

#### **3.5.2 Hydrography and Phytoplankton**

This study will be conducted by the USGS in Menlo Park. The principal investigator is Dr. Jim Cloern.

This study will continue its measurement program in support of the RMP, with monthly water sampling in 2004 to map the spatial distributions of basic water quality parameters along the entire Bay-Delta system. Measurements will include salinity, temperature and dissolved oxygen, which influence the chemical form and solubility of some trace contaminants; suspended sediments and phytoplankton biomass, which influence the

partitioning of reactive contaminants between dissolved and particulate forms. This basic information is required to follow the seasonal changes in water quality and estuarine habitat as they influence biological communities and the distribution and reactivity of trace contaminants. Highlights from this work were described by Dr. Cloern in the 2003 Pulse of the Estuary. Hydrographic and phytoplankton sampling will be coordinated with other elements of RMP sampling.

### **3.6 Field Work**

This work element includes SFEI staff involvement in Status and Trends Monitoring on board ship and general sampling support. SFEI staff collect water samples for analysis of trace organics, and assist with sediment collection and bivalve retrieval operations.

## **4. Pilot Studies**

### **4.1 Mercury Deposition Network**

The Air Deposition Pilot Study was suspended after metals and PAH/PCB data were incorporated into the mass budget models. The only remaining component is the measurement of rain samples for mercury to continue as part of the national Mercury Deposition Network through 2004, after which a decision will be made as to whether or not to continue data collection. The project includes SFEI staff time for sampling and trouble-shooting assistance, participation in site audits, and coordination with City of San Jose staff as necessary. The City of San Jose is providing in-kind sampling assistance, with samples being shipped to the MDN laboratory.

Estimated funding level: \$18,000 per year; in-kind services estimated at \$45,000.  
Decision point concerning continuation or suspension of study: 2005.

### **4.2 Exposure and Effects Pilot Study**

In response to the revised RMP objectives and the recommendations of the redesign workgroups, the RMP is developing a new component for the S&T Program to monitor contaminant exposure and effects in the Bay. The RMP is implementing this 5 year Pilot Study to develop several indicators, using resident species, that can provide measures of contaminant exposure and effects at several trophic levels, at different levels of biological organization (biochemical, individual, population, and community levels), and at different spatial scales (locally or regionally).

An Exposure and Effects Workgroup (EEWG) with a 4 member Advisory Panel (Bob Spies, Steve Weisberg, Harry Ohlendorf, and Don Weston) is guiding this Pilot Study. The EEWG has developed a draft five year workplan. The Study is multifaceted, including a variety of different exposure and effects indicators of beneficial use impairment to be tested over the course of five years. Indicators being tested include diving duck muscle (a human exposure indicator), cormorant and Forster's tern eggs (chemical trend indicators), hatchability of Forster's terns, least terns, and clapper rails

(effects indicators), blood chemistry and biomarkers in harbor seals (exposure and effects indicators), biomarker and effects studies in fish, aquatic and sediment toxicity testing of resident species (effects), and benthic community evaluations using a multimetric approach (effects). Elements to be tested in 2004 are the subject of continuing discussion by the EEWG side-by-side comparison of EPA-laboratory and resident species in dose response studies for aquatic or sediment toxicity tests.

Estimated funding level: \$200,000 for 2004, 2005, and 2006. Expected decision point for incorporating selected effects and exposure indicators in Status and Trends Monitoring program: 2007

## **5. Special Studies**

### **5.1 Contaminant Loads from the Sacramento and San Joaquin Rivers**

As outlined in the Sources, Pathways, and Loadings Report issued in 2001 (Davis et al. 2001), fairly large uncertainties exist with regard to loading estimates from the two large rivers, and these loads are potentially significant components of the mass budgets for many contaminants. McKee et al. (2002) determined that USGS data on suspended solids concentrations are suitable for estimating suspended solids loads with reasonable confidence, and that these data, if coupled with data on sediment-associated contaminants of concern, could be used to develop estimate contaminant load estimates entering the Bay from the Central Valley in a manner that includes characterization of the large loads that occur during large runoff events. The USGS and other partners currently have funding to continue sampling at Mallard Island until 2004, and at that time, there will be a total of 10 years of nearly continuous data.

In this Special Study (the “Mallard Island Study”), which began in 2002, SFEI is gathering data on sediment-related contaminant concentrations at Mallard Island for the purposes of developing statistical relationships between concentrations and optical back-scatter measurements. These relationships can be used to estimate time-continuous concentration data that would then be combined with estimates of discharge to estimate loads. Contaminants being measured include mercury, PCBs, organochlorine pesticides, and PAHs. This work is being performed in collaboration with other groups already carrying out fixed-time and flood-response water sampling (Interagency Ecological Program) so that costs can be reduced and lessons already learned can be readily incorporated into the sampling design. Although this Special Study is closely aligned with the goals of the Clean Estuary Partnership, it also meets the sources and loadings objective of the RMP, and was initiated as part of the RMP.

In 2004, the third and final planned year of sampling will be conducted. Report writing will carry over in 2005.

Funding level: \$85,000 in 2004, \$30,000 in 2005.

## 5.2 Ten Year Synthesis of Contaminant Status and Trends

After ten years of RMP monitoring, it is an appropriate time to perform a retrospective evaluation of the RMP and contamination in the Bay. In 2003, the data from 2001 became available, completing the nine year period employing the original fixed station RMP design. The end of this initial era of the RMP marks an appropriate time to perform a thorough, definitive analysis of the data generated with the original Status and Trends Program design. A decade of monitoring also represents a substantial body of work for the other aspects of the RMP, and a synthesis of these findings from these elements is also worthwhile at this time. In addition, the last synthetic overview of contamination in the Estuary was completed in 1991 (Davis et al. 1991), and Bay contamination, and understanding and regulation of Bay contamination, have changed considerably since that time.

The synthesis of data from the first phase of the RMP will continue to provide a general theme for the Program over the next 2 years. An integrated series of products and events are planned to accomplish an evaluation and long term summary of the many components of the Program. In chronological order, these are:

1. **2003 Pulse: Ten Year Synthesis Part 1** (long term syntheses on RMP work on Hydrography and Phytoplankton, Sediment Dynamics, and Water and Sediment Toxicity)
2. **2003 Annual Meeting** (similar to 2003 Pulse)
3. **RMP Overview: 1993-2001** (a non-technical overview of the success of the Program in meeting all of its objectives)
4. **2004 Pulse: Ten Year Synthesis Part 2** (include summaries of trace elements, organics, USGS contaminant studies)
5. **2004 Annual Meeting** (similar to 2004 Pulse)
6. **Technical report: Contaminant Status and Trends Report Update – 2001** (including a rigorous analysis of trends from the Base program and incorporation of non-RMP data into an overall assessment of contamination in the Bay)

These activities will address two objectives of the Program that have not yet been adequately addressed, including a rigorous evaluation of long term trends and the synthesis of RMP and non-RMP data into an integrated assessment of status and trends in contamination of the Bay.

The activities that will occur in 2004 are 4, 5, and 6. Workplans and budgets for the developing the Pulse and holding the Annual Meeting are already covered in the 2003 Monitoring Plan under tasks 2.3 (Information Dissemination) and 2.4 (Annual Reporting).

This study began in 2003 and will continue into 2004 and 2005. The estimated funding levels for the remaining two years are: \$75,000 for 2004 and \$50,000 for 2005.

## 5.3 Small Tributary Loading Study

The Sources, Pathways, and Loadings Workgroup (SPLWG) concluded that small tributaries probably represent a significant pathway for contaminant loading to the Bay (Davis et al. 2001). The SPLWG recommended that a study be performed to gather empirical data on small tributary loading. The recommended study was identified as an appropriate project for CEP funding, and the CEP initiated the project in 2003. This project meets the overlapping objectives of both the RMP and CEP.

This Study is applying the same basic technique as in the Mallard Island Study (see 5.1 above), combining continuous monitoring of suspended sediment concentration with strategic collection of samples for chemical analysis. The tributary selected for sampling is the Guadalupe River, which has a major source of mercury in its watershed and suspected sources of PCBs and organochlorine pesticides. The study will accurately measure contaminant loads from a small tributary representative of those that may contribute significant loads to the Bay and demonstrate an innovative method for measuring these loads. Contaminants being measured include mercury, PCBs, organochlorine pesticides and PAHs.

In 2003, several runoff events occurred and were successfully sampled. Preliminary interpretation of the data obtained indicate that the Guadalupe River was a significant pathway for transport of PCBs, mercury, and other contaminants to the Estuary in an average flow year. How large loads would be in a high flow year remains a major question.

In 2003, this project was funded completely by CEP (\$150,000). In 2004, the project will be jointly funded by both programs (\$75,000 by CEP and \$50,000 by RMP). The source of funding for the planned third year of the study has not yet been determined.

#### **5.4 Dredged Material Testing Data Evaluation**

This new special study will evaluate whether information that addresses RMP objectives and management questions can be gleaned from the datasets generated for dredged material testing. For many years dredgers have collected data on the chemical quality and toxicity of Bay sediments from around the fringes of the Bay from a variety of marinas, ports, and waterside marine related businesses, as well as data from the Corps federally maintained navigation channels. This Study will evaluate these data in detail. If the data are found to be valuable to the RMP, a subsequent step would be to establish a data management system for them to make them accessible and usable. The data management system would be included in the 2005 RMP. This effort would meet not only RMP objectives to synthesize information from all sources, but also an objective of the Dredged Material Management Office (DMMO) to make the data publicly accessible. Making these data available would benefit future dredging proponents, the regulatory agencies, interested environmental groups, researchers on overall environmental state of the Estuary, and Estuary habitat restoration entities.

Tasks in this Study will include data compilation, data interpretation, reporting, and development of the beginnings of a data management system. Most of the effort will go

to data interpretation and reporting. Data interpretation will include a thorough evaluation of several technical issues with the data, including what data are collected, whether the data are of sufficient quality for rigorous interpretation, and what the samples analyzed are really telling us about the Bay. For example, one question to be answered would be: Is the contamination measured in sediment samples from harbor channels an index of local or regional contamination? While the dredged material testing data may not be directly comparable to RMP data, they may still contain valuable information about contamination and sediment dynamics in the Bay.

This study will be funded at \$30,000 in 2004. If the dredged material testing data are found to be of value to the RMP, additional funding will be allocated in subsequent years to establish a data management system for these data.

### **5.5 Sediment Remobilization of Mercury in South San Francisco Bay**

This project integrates an existing USGS study by Jim Kuwabara and colleagues with information needs identified by the Clean Estuary Partnership, San Francisco Estuary Institute, San Francisco Regional Water Resources Control Board and local stakeholders. Specifically, it will provide initial determinations of dissolved total and methyl-mercury flux from the sediments into the water column of South Bay. These determinations will be made at two times in the year: once following the spring phytoplankton bloom in the South Bay, and the other during late summer when, in contrast, surficial settling of biogenic material would be minimal. The time-series of concentration data will be used for flux calculations that directly include bioturbation effects. Quantifying and understanding the magnitude and variability of these fluxes are critical to the accurate assessment of sources and loads of biologically reactive forms of contaminants as well as to the development of process-integrated water-quality models for this Estuary. A progress report on the 2003 sampling will be provided in summer 2004. The final report on this effort will be provided to SFEI by June 2005.

Estimated Cost: \$0 in 2004 (\$23,000 in 2003 - piggyback on existing project)