

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

### **2005 Program Plan**

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### **OVERVIEW OF THE 2005 PROGRAM**

In 2005, the Regional Monitoring Program for Trace Substances (RMP) enters its thirteenth year of monitoring and research. Each year, SFEI has adapted the RMP in response to changes in the regulatory landscape, advances in our understanding of the Estuary, and a continual drive to adjust the Program to better meet its objectives. Part of this adaptation process includes a periodic review of the RMP objectives and management questions that are the foundation for all of the Program's activities. In 2004, a review of the objectives and management questions adopted in 1998 was undertaken to evaluate whether they adequately addressed current information needs. Based on this review and input solicited from scientists, regulators, and interested stakeholders, the following revised objectives were developed:

1. Describe the distribution and trends of pollutant concentrations in the Estuary;
2. Project future pollutant status and trends using our current understanding of ecosystem processes and human activities;
3. Describe sources, pathways, and loading of pollutants entering the Estuary;
4. Measure pollution exposure and effects in the Estuary ecosystem (including humans);
5. Compare monitoring information to relevant standards and other guidelines; and
6. Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, and effects of pollutants in the Estuary ecosystem.

It is anticipated that the revised RMP objectives will be formally adopted in early 2005. The 2005 RMP has been specifically designed to address these objectives. Following this overview, the remainder of this Program Plan describes the major elements of the 2005 RMP. Further details are presented in the Detailed Workplan (available upon request).

To address the new RMP objective to project future trends (Objective 2) in 2005 the RMP will continue to refine and expand the applications of the multi-box PCB model that was developed in 2004. This will be part of a multi-year effort jointly funded by RMP and CEP to further develop the multi-box model through additional testing and review, inclusion of quantitative uncertainty analyses, and improvement of graphical output. This will result in the production of version 2.0 of the Multibox PCB Model in 2005. Other parts of the joint multi-year scope address further documentation of the multi-box model by USGS, a two-phase field

study of sediment dynamics, and application of the model to three other pollutants. Work on one of the additional pollutants will occur in 2005. The pollutant to be modeled next will be determined through discussions of the TRC. The joint scope also calls for sampling to fill information gaps on the distribution of pollutants at depth in sediment and the dynamics of sediment mixing and exchange with the water column. The CEP will fund the first round of sediment sampling in 2005. If deemed necessary by the TRC, a second round of sampling funded primarily by the RMP will occur in 2006.

Three special studies in 2005 will enhance our understanding of the inputs to the Bay from tributaries. First, the Mallard Island Study is a study of contaminant loads from Sacramento and San Joaquin Rivers. This Special Study enters its fourth year in 2005. Sampling in 2005 and 2006 is being scaled back from that in previous years, and will characterize the loading of pollutants during the “first flush” - the first major flows of the year that carry a large proportion of the total annual load of pollutants. A report on the first three years of the study (2002-2004) will also be prepared in 2005. Plans are for the Mallard Island Study to then be dormant until another full scale sampling effort is conducted in 2009.

A second loading study is being conducted on the Guadalupe River to develop a better understanding of loads from small tributaries due to transport during storm events. Urban runoff is a primary source of pollutants in runoff from Bay Area small tributaries, and this study is providing critical information on the magnitude of urban runoff loads. This study began in 2003 with funding from the CEP, continued in 2004 with funding from the CEP and RMP, and is continuing in 2005 with funding from RMP, the US Army Corps of Engineers, and SCVURPPP. The RMP has earmarked funds for this study again in 2006.

The third tributary loading study is a small effort to identify sampling locations in watersheds that might be studied in the same manner that we are currently studying the Guadalupe River watershed.

Contaminated sediments are resuspended during dredging activities. At present, little quantitative information exists regarding the contaminant load delivered to the Estuary as a result of dredging and dredged material disposal, and subsequent uptake into the food web. A special study this year will quantify the importance of dredging and dredged material disposal on contaminant bioaccumulation in the San Francisco Bay food web. The study will build a conceptual model of contaminant transfer to benthic-foraging fish species from dredging activities, including in-Bay disposal, and identify the steps necessary to estimate the contribution of dredging activities to contaminants detected in fish.

The effects of contaminants on the San Francisco Estuary is an important area that will be addressed through several RMP elements in 2005 including the Episodic Toxicity element of the Status and Trends and the Exposure and Effects Pilot Study. Supplemental funding for work on episodic toxicity was obtained from the State Water Resources Control Board’s PRISM Program to expand an evaluation of the impacts of changing pesticide usage (i.e., phasing out of chlorpyrifos and increase use of pyrethroids) in urban and rural watersheds on sediments in tributaries around the Bay. This project will specifically address sediment toxicity to freshwater

and estuarine amphipods. The first round of sampling occurred in November 2004; the second will occur in April 2005.

The Exposure and Effects Pilot Study (EEPS) represents a second area of study on the effect of contaminants on the Estuary. As an indication of the importance of this work, the Steering Committee has extended funding for EEPS for two more years to 2008. Major elements of the EEPS for 2005 will include: an analysis of diving ducks for selenium, mercury, and organochlorines; a field study of mercury risks to clapper rails; funding of research on fish effects; and an assessment of sediment toxicity, benthos, and sediment chemistry. It is anticipated that the Exposure and Effects Workgroup will meet in early 2005 to develop a new multi-year plan.

In 2005, the RMP will continue to investigate emerging contaminants and their potential impact. This year, the RMP is jointly funding with the CEP a study of polybrominated diethers (PBDEs). The project will consist of a literature review to develop a conceptual model of the sources, pathways, and loading of PBDEs. Due to a dearth of information regarding the sources of PBDEs in the environment, the RMP will fund analysis of field samples to characterize inputs to the Bay. This project will also be coordinated with existing projects to obtain samples from small tributaries (i.e., the small tributary loading project will analyze stormwater for PBDEs and the Episodic Toxicity sampling will analyze sediment for PBDEs).

Another highlight of the 2005 Program will be the completion of a special study to evaluate the first ten years of the RMP. In discussions in 2004, it was decided to publish this technical synthesis as a special issue of the journal *Environmental Research*. Dr. Russ Flegal of UC Santa Cruz has agreed to edit the issue, which will include approximately 13 articles on water quality in San Francisco Bay. These articles will address an objective of the Program that has not yet been adequately addressed: the synthesis of RMP and non-RMP data into an integrated assessment of status and trends in contamination of the Bay and the effective communication of this information. The special issue will effectively communicate RMP information to the scientific community. These articles will also provide a rich resource for development of communication material for nontechnical audiences.

A highlight of the Status and Trends element of the RMP in 2005 will be the publication of the latest round of data from sampling pollutants in Bay sport fish. This sampling is performed on a three year cycle. Data from sampling conducted in 2003 will be published in 2005, and planning will begin on the next round to be conducted in 2006. Popular sport fish species, including striped bass, white croaker, and halibut were sampled for mercury, PCBs, organochlorine pesticides, and PBDEs. Additional sampling in 2003 was performed to determine mercury and PCB concentrations in additional fish species including brown smoothhound shark, Chinook salmon, brown rockfish, anchovy, black surfperch, and walleye surfperch.

In other respects, the Program will continue on the new course (i.e., the initiation of the randomized sampling design) begun in 2002. Water and sediment will be sampled at a new set of locations as the RMP continues to fill in a picture of the spatial distribution of contamination

in the Bay. Additional elements of the on-going program are discussed in more detail in the remainder of the Program Plan.

Guided by the new objectives and management questions, the RMP in 2005 will continue to strive to provide scientists, regulators and interested stakeholders with relevant and timely information that provides a sound basis for policies to protect water quality in the Bay.

## **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). This task also includes the internal coordination of RMP staff (e.g., the coordination and technical oversight of different RMP tasks and training, as needed).

#### **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 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. In addition, RMP staff is frequently asked to present guest lectures at universities and national working group meetings and to serve on advisory boards.

#### **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.

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

To meet the RMP Objective: “Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, 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 2004, the RMP Status and Trends database was converted into the Surface Water Ambient Monitoring Program (SWAMP) database format. The goal of converting the RMP database to SWAMP format is to make the data more accessible to regulators and researchers through the use of a standardized format.

The information management and dissemination goals for 2005 are as follows (listed in order of priority):

- Upload RMP analytical results from laboratories into the new database format (the State SWAMP database format) and continue to QA/QC these data to assure they are of high caliber;
- Continue maintenance of the web-based data access tool that was developed in 2004;

- Develop a method for Status and Trends laboratories to submit data via the web;
- Develop tools to increase the efficiency of QA/QC review;
- Upload select datasets from RMP Pilot & Special Studies (or other studies) into the new RMP SWAMP database.

## **2.2 RMP Web Site**

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 the web and compact disk (as requested), as well as writing, editing, and publishing the "Pulse of the Estuary." In calendar year 2005, the 2003 edition of the Annual Monitoring Results will be completed, and work on the 2004 edition will begin.

## **2.5 Quality Assurance and Quality Control**

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. A review of the data from the "new analytes" (e.g., PBDEs, nitro musks, and nonylphenols) will be conducted and recommendations regarding the continued monitoring of these substances will be made.

## **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 (CEP). Prediction of future trends depends on an ability to model contaminant fate in the ecosystem. For the past several years, the RMP has been developing mass budget models of priority contaminants. 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.

Some tasks begun in 2004 will be completed in 2005. In 2004, a significant advance was made with the development of a draft technical report on a multibox model for PCBs. A final report and a journal manuscript on this work will be produced in 2005. A journal manuscript on the one box model for legacy pesticides will also be completed.

A multi-year scope of work for fate modeling and field studies in support of fate modeling has been developed that is proposed for joint funding by the RMP and CEP. This scope calls for close coordination between these programs. Part of this scope includes further development of the multibox model for PCBs in 2005. Development of version 2.0 of the model is planned, with the key improvements being a thorough testing and review of the model, the addition of a quantitative uncertainty analysis, and continued development of graphics. The lead on this work will be Tetra Tech (funded by CEP), with support from SFEI (funded by RMP) for running the model and creation of graphics. Other parts of the joint multi-year scope address further documentation of the multibox model by USGS, a two-phase field study of sediment dynamics, and application of version 2.0 to other pollutants – modeling of two pollutants would be funded by RMP and one would be funded by CEP. Work on one of the additional pollutants (funded by RMP) would begin in 2005. Total mercury is proposed as the pollutant, subject to TRC and TC discussion and approval.

Other tasks to be completed under data integration include: developing a San Francisco Estuary Contamination Index and evaluating wetland benthic data that were collected as part of the West Coast EMAP program to determine whether new benthic assessment tools are needed.

Estimated cost of this task: \$85,000

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

The Status and Trends (S&T) Monitoring Program is comprised of four program elements: long-term water, sediment, and bivalve monitoring; Episodic Toxicity monitoring; Sport Fish Bioaccumulation, and the USGS hydrographic and sediment transport studies.

The 2005 RMP sampling will mark the fourth year of the new sampling design. The S&T monitoring program for water and sediment was significantly revised in 2002. A long-term plan for implementing this design, including a 20-year cycle of rotating panels, has been implemented. 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. With two minor exceptions, the bivalve bioaccumulation component of the S&T, however, remains largely unchanged (i.e., the bivalve program will continue to sample the historical sites). First, as a result of sampling only in the summer, only one test species (*Mytilus*) will be used. At the two river sites, the resident clam species (*Corbicula*) will be used. Second, analyses of trace elements has been reduced.

The S&T monitoring program is supplemented by the short-term Special and Pilot Studies that are designed to answer specific management questions or to test on a small scale the efficacy of new monitoring approaches or methodologies, for possible inclusion in the S&T program.

Water, sediment, and bivalve bioaccumulation sampling for the S&T monitoring program now occurs once a year in the summer. Summer has been selected for sampling because inter-annual variation due to natural variables, primarily freshwater inflow, is minimized during this period. 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 and Sediment Chemistry and Bivalve Bioaccumulation**

#### *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 2004 with the exception that all but one of the “new analytes” measured in 2002 and 2003 will be dropped (PBDE will be retained.) Pending approval by the TRC, polycyclic nonylphenols, octylphenols, and alkylphenol polyethoxylates may also be included.

#### *Sediment Chemistry*

Sediment samples will be collected during the dry season. Sediment chemistry will be analyzed at 40 random sites and seven fixed sites. The 2005 analyte list for sediment will be similar to 2004 with the exception that all but one of the “new analytes” will be eliminated (PBDEs). Nonylphenols, octylphenol, and alkylphenol polyethoxylates may be added pending TRC approval.

#### *Bivalve Bioaccumulation*

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 feasible. Transplanted bivalves will be deployed at nine stations, with the mussel species (*Mytilus californianus*). As has been done since 1999, resident *Corbicula* will be



collected from the Sacramento and San Joaquin River stations (BG20 and BG30). 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 analyte list for organics for 2005 will be similar to 2004 with the same changes in the “new analyte” list and the possible addition of polycyclic nonylphenols, octylphenol, and alkylpolyethoxylates pending TRC approval.

#### *Toxicity*

Because the RMP S&T aquatic toxicity monitoring in the Estuary has shown little toxicity over the past several years, aquatic toxicity sampling has been scaled back to a screening effort every four to five years. The next sampling is set to occur at a subset of random sites in 2005. Details of this sampling effort will be developed in the spring of 2005.

RMP S&T 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 seven 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.

### **3.2 Episodic Toxicity Monitoring**

In the 2004/05 wet season, the Episodic Toxicity Program of the RMP began a study to evaluate the potential toxic effects of sediments in six tributaries around the Estuary. This project is part of a combined study that is partially funded with a state PRISM grant awarded to SFEI in September of 2004. The purpose of the study is to investigate potential sediment toxicity to both freshwater and estuarine amphipods to sediments from six tributaries around the Estuary whose land uses include varying combinations of urban and agricultural practices. Bedded surface sediments will be collected targeting recently deposited sediments for toxicity and chemical analyses. A suite of California Toxics Rule priority pollutants, sediment grain-size, total organic carbon, and additional pollutants of concern (including pyrethroids and polybrominated diphenyl ethers (PBDEs)) will be characterized for each tributary.

In the Fall of 2005, the RMP toxicity workgroup will continue discussions on re-scoping the episodic toxicity component after reviewing the preliminary results from the 2004/05 sediment tributary study.

### **3.3 Sport Fish Bioaccumulation Monitoring**

Sport fish sampling in the RMP began in 1997 and occurs on a three-year cycle. Sampling for 2003 was completed in August 2003. Popular sport fish species, including striped bass, white croaker, and halibut will be analyzed for mercury, PCBs, and organochlorine pesticides. Due to potential human health concerns, rising

concentrations, and their inclusion on the 303(d) watch list, PBDEs will also be analyzed in 2003 in some of the species. A special study in 2003 will also determine mercury and PCB concentrations in additional fish species that may pose hazards due to human consumption. The additional species targeted include brown smoothhound shark, Chinook salmon, brown rockfish, anchovy, black surfperch, and walleye surfperch. Resources for the 2003 fish tissue monitoring component were set aside in 2001 and 2002 to lessen the budgetary impact in the 2003 monitoring year.

### **3.4 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.

#### **3.4.1 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 2004, 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 2005, 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. Another aspect of this project 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.

#### **3.4.2 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 2005 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.

### **3.5 Status and Trends Monitoring 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 annually as to whether or not to continue data collection. For 2005, the TRC has elected to fund this project. 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.

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

The RMP in 2005 will continue a Pilot Study of contaminant exposure and effects in the Bay. The Exposure and Effects Advisory Panel assembled to guide this study has recommended a narrowed focus on the following topics: fish, birds, seals, benthos, and toxicity. The 2003 RMP Program Review Panel recommended an increase in the Exposure and Effects Pilot Study (EEPS) budget and stated that biological effects research should be a priority. In response to this concern, the SC allocated \$200,000 for the EEPS for 2005. This includes funds for SFEI labor, subcontractors (e.g., analytical laboratories), and grant proposal development. Also in response to the Review Panel recommendation, the SC and TRC extended the duration of the study for another two years (through 2008).

The Study is multifaceted, and has included a variety of different exposure and effects indicators of beneficial use impairment. In 2003 and 2004, EEPS work was scaled back.

In 2004, indicators tested included cormorant eggs (chemical trend indicators), mercury concentrations in harbor seals (exposure and effects indicators), sediment dose-response sensitivity testing comparing laboratory and resident amphipod species, and benthic community evaluations using a multi-metric approach (effects). Diving duck samples (human health indicator) were also collected in 2004. However, due to a freezer malfunction, the samples were compromised and it was decided not to analyze these samples. In 2004 the Exposure and Effects Advisory Panel met and provided input on a conceptual framework for the study that was developed at the Panel's request.

The EEPS will return to its full funding and activity level (\$200,000) in 2005. The Exposure and Effects Workgroup will meet in early 2005 to develop a new multi-year plan. Several projects discussed by the Workgroup in the past will be considered for funding in 2005:

- Diving duck analyses for Selenium (Se), Hg and organochlorines;
- A field study on mercury risks to clapper rails;
- Funding of work on fish effects (an RFP for this will be developed early 2005);
- Report on sediment toxicity, benthos, and sediment chemistry in San Francisco Bay from RMP and EMAP (possibly NOAA) data.

Estimated funding level: \$200,000 for 2005, 2006, 2007, and 2008.

### **4.3 Winter Pilot Study**

The primary purpose of this Pilot Study in 2005 is to comply with an NPDES permit provision for ambient water monitoring for dischargers in the San Francisco Bay area. Estuarine water will be sampled at three historical RMP stations (i.e., Sacramento River (BG20), Yerba Buena Island (BC10), and Dumbarton Bridge (BA30)) during the 2005 winter season (February 2005). These water samples will be analyzed for contaminants on the California Toxics Rule priority pollutant list.

Wet weather S&T contaminant monitoring is an important element of the RMP. At the present time, the core monitoring program, S&T, occurs during the dry season, and seasonal variation is not captured by this sampling plan. The results from this Pilot Study will enable SFEI to evaluate the importance of seasonal variation. Seasonal contaminant monitoring results have been an important resource provided to environmental managers of Region 2 for use in NPDES permitting and the 303(d) listing processes.

A workgroup will be convened in 2005 to determine additional needs for winter sampling within the RMP.

## **5. Special Studies**

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

As outlined in the Sources, Pathways, and Loadings Workgroup Report (Davis et al. 1999), large uncertainties exist with regard to loading estimates from the Sacramento and

San Joaquin rivers. During 2004, nine years of sediment data were analyzed and sediment loads estimated. The results were written up in a revised sediment section of the “*Mallard Island Progress Report*” and also submitted to the *Journal of Hydrology* for review and publication. In addition, we completed a chapter in the progress report on Hg and a further chapter on trace organics loads. These new analyses suggest that our previous estimates for both suspended sediment load and Hg load were high and this has greatly affected the implementation recommendations in the recently released Hg TMDL report (Johnson and Looker, 2003). The question remains as to how accurate are our estimates. The San Francisco Bay is listed (Clean Water Act 303(d)) as impaired for mercury, selenium, PCBs, and chlorinated pesticides. This study aims to address information gaps associated with loadings of these substances (with the exception of selenium) so that a better understanding of relative inputs from urban point and non-point sources, erosion and resuspension in the Bay, and the inputs from the Central Valley rivers can be developed. The RMP TRC endorsed the continuation of the study in future years with the following work plan:

Water Year 2005	Sample “first flush” only and use contingency funds to sampling floods larger than 150,000 cfs as necessary (\$21,000 subcontracts + \$5,000 SFEI labor)
Calendar Year 2005	Complete “final report” on the first three years of the study (data from WY 2002, 2003, and 2004) (\$30,000 SFEI labor)
Water Year 2006	Sample “first flush” only and use contingency funds to sampling floods larger than 150,000 cfs as necessary (\$21,000 subcontracts + \$5,000 labor) and report the results and interpretation for five years of data (\$35,000)
Water Year 2009	Sample all floods during the season and report results and interpretation (\$115,000)

Funding level: \$51,000 for 2005.

## 5.2 Ten Year Synthesis of Contaminant Status and Trends

In 2003, the RMP status and trends 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. 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 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.

In 2005, this special study will be completed. The final part of this study is a technical synthesis. In the 2004 workplan this was identified as a technical report: Status and Trends Report – 2001. In discussions in 2004, it was decided to publish this technical synthesis as a special issue of the journal *Environmental Research*. Dr. Russ Flegal of UC Santa Cruz has agreed to edit the issue and is performing much of the coordination.

These activities will address an objective of the Program that has not yet been adequately addressed: the synthesis of RMP and non-RMP data into an integrated assessment of status and trends in contamination of the Bay and the effective communication of this information. The special issue will effectively communicate RMP information to the scientific community. These articles will also provide a rich resource for development of communication material for nontechnical audiences.

The estimated funding level for 2005 is \$50,000.

### **5.3 Small Tributary Loading Study**

Small tributaries form a major pathway for loads of contaminants that enter the Bay each year. Models developed for the Bay are highly sensitive to the magnitude of loads from small tributaries but present load estimates for this pathway lack accuracy and precision. This study will accurately measure contaminant loads from a small tributary representative of one that may contribute significant loads of sediment and associated contaminants to the Bay, help evaluate the significance of this load as a means of prioritization of further loadings studies, demonstrate a new methodology, and compare these accurate loads measurements to existing simple model estimates.

During WY 2003, the study was funded by the CEP. In WY 2004, the CEP funded the labor portion of the budget (\$75k out of \$125k). The RMP funded the laboratory analysis portion of the budget (\$50k). In WY 2005 USACE has provided \$100k for analysis of total, dissolved Hg and total and dissolved MeHg, fieldwork and reporting. SCVURPPP has provided \$23k for bed load sampling and Hg analysis, and RMP has provided \$50k for trace organics analysis and reporting. The total budget is \$173,000, greater than ever before and perhaps an indication of the interest in the study.

During water year 2003 and 2004, the study successfully sampled flood events during the wet seasons for trace contaminant concentrations (Hg, TMs, PCBs, and OC Pesticides), made continuous measurements of turbidity (~22,000 data points per year) and suspended sediment data were collected during floods amassing >300 samples. In WY 2003, 10,800 tonnes of suspended sediment passed by our sampling location carrying with it 116 kg Hg and 1.5 kg PCBs, In WY 2004, 8,500 tonnes of SS passed through (estimated for contaminants are not yet completed).

The estimated funding level for 2005 is \$50,000.

#### **5.4 Dredging Effects on Contaminant Bioaccumulation in the San Francisco Bay Food Web**

The question of incremental contaminant loads to the ecosystem from dredging and in-Bay disposal activities is frequently raised in discussions regarding regulatory policy development (e.g., TMDLs, etc.) suggesting that substantial effects could result. However, to date, the RMP has done little to put numeric bounds on just how much mass of a given contaminant is incorporated into the food web as a result of dredging and in-Bay disposal of dredged sediment. Impairment assessments for the Bay (e.g., mercury, PCBs, dioxins) have focused on accumulation of contaminants in sport fish, and several of the most contaminated fish are benthic foragers that frequent harbors and marinas. The proposed study will build a conceptual model of contaminant transfer to benthic-foraging fish species from dredging activities, including in-Bay disposal, and attempt to identify the steps necessary to give a first-order estimate of the incremental contribution of dredging activities to identified impairments. By focusing on pathways, the proposed work will help refine the box models that have, to now, been the main tool for understanding the fate of contaminants in the Bay. The conceptual model will incorporate the alternative to dredging, which is not dredging, to summarize what is known and needs to be known about availability to the food chain of contaminants associated with sub-surface sediments in depositional areas. The study will synthesize existing knowledge of dredged-sediment quality, suspended sediment dynamics, chemical pathways in bedded sediment, fish distribution, and food-web structures, and will include a review of available literature on these topics.

The estimated funding level for 2005 is \$20,000.

#### **5.5 Reconnaissance Work to Identify Appropriate Sediment Loading Sites**

This project will make recommendations on potential sampling locations in “representative observation watersheds” that could be used to form a “regional network” of contaminant loads monitoring stations. We will synthesize pertinent existing information on contaminant sources and pathways, hydrology, watershed physiography, and land use to prioritize potential representative watersheds for water quality and loads observations. We will then carry out a site reconnaissance in the top six prioritized watersheds to re-rank the watersheds according to on-site logistical constraints. The results will be presented in a technical memo and verbally in a SPLWG meeting.

The estimated funding level for 2005 is \$7,500.

#### **5.6 Filling PBDE Information Gaps**

This is a joint project between the Clean Estuary Partnership (CEP) and the RMP to develop a conceptual model and impairment assessment (CM/IA) for polybrominated diphenyl ethers (PBDEs) in the San Francisco Bay. The CEP has allocated \$30,000 for

SFEI labor to prepare the CM/IA, while the RMP has contributed \$25,000 to cover costs of sample analyses to fill in critical data gaps.

The work to be conducted is an impairment assessment and development of a PBDE conceptual model. Given the limited resources and time, this effort will have to be completed by SFEI staff over a 12-month period with oversight from the CEP Technical Committee. The project will include chemical analyses of various field samples to fill critical information gaps, submission of a draft CM/IA report to the CEP Technical Committee for peer-review, and the delivery of a final CM/IA report.

The estimated funding level for 2005 is \$25,000.