Regional Monitoring Program

2010 Detailed Workplan

FINAL

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Regional Monitoring Program (RMP) for Water Quality in the San Francisco Estuary

2010 Detailed Workplan

Overview

This document is a detailed workplan that describes the major Program elements and tasks to be completed in 2010 under the RMP. It is the guiding document for planning and allocating funds for 2010. The workplan is divided into Program areas or tasks. For each Program task, the following information is provided: a description of the task and how it relates to the RMP objectives and management questions; identification of subtasks; a schedule of deliverables; and an estimate of SFEI labor costs. All major tasks and associated costs to complete these tasks are presented on Table 1.

The SFEI labor costs are our best estimate at present as to the level of effort we anticipate that it will take to complete each of the proposed tasks for 2010. It is likely that as the year progresses, adjustments will be made to the individual labor cost and/or subcontractor and direct cost estimates for each task; however, the total budget for 2010 will remain fixed.

The RMP objectives were revised in 2008 to reflect improved understanding and to respond to new priorities. The overarching goal of the Program is to collect data and communicate information about water quality in the San Francisco Estuary to support management decisions. The management questions are in three levels. The core management questions (level 1) are presented below. Level 2 and 3 questions address specific elements of the level 1 questions.

1. Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?
2. What are the concentrations and masses of contaminants in the Estuary and its segments?
3. What are sources, pathways, loadings, and processes leading to contaminant-related impacts to the Estuary?
4. Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?
5. What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?

This document is divided into five chapters that describe the major task areas within the RMP. Task 1 explains the overall management of the Program and the efforts made to coordinate the Program both internally with SFEI staff and stakeholders and externally with the many agencies and organizations that are responsible for stewardship of the

Estuary. Task 2 describes how the results of the RMP studies are reviewed, validated, synthesized, and disseminated to researchers, regulators, and the public at large. The long-term monitoring component of the Program, Status and Trends monitoring, is presented in Task 3. Task 4 describes special studies that will be performed in 2010.

Task 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; track deliverables and project status; coordinate SFEI staff; and plan and coordinate activities among external agencies and organizations that have a vested interest in the RMP. This task is divided into four subtasks that are described below: internal coordination; external coordination; contract and financial management; and Program planning.

1.1 Internal Coordination

The purpose of this task is to coordinate and facilitate among Program participants, subcontractors, collaborators, Regional Water Quality Control Board staff, and members of the Steering and Technical Review Committees. This coordination is essential to enhance the exchange of information, to avoid duplication of efforts, to identify and inform members of critical decisions and important issues, and to ensure that RMP activities complement and improve other scientific efforts by RMP participants, the Regional Board, and others. This task also includes the internal coordination of RMP staff (e.g., the coordination and technical oversight of different RMP tasks).

Internal coordination also includes all of the activities associated with the workgroups. Currently, the RMP has four workgroups: Sources Pathways and Loadings; Contaminant Fate; Exposure and Effects; and Emerging Contaminants. All of these workgroups have advisory panels composed of prominent outside experts which provide peer review to assure that the projects developed and implemented are technically sound.

In addition to these four workgroups, select teams from the workgroup and the RMP stakeholders were formed in 2007,2008, and 2009 to develop strategies for issues of concern. The first strategy developed, the Mercury Strategy, articulated key questions that scientists and manager need answered to best manage mercury in the Bay. Based on the strategy, a request for proposals was sent out nationally to solicit studies to answer these questions. We are currently finishing off the second year of addressing these mercury questions and anticipate that work will carryover into the first half of 2010. Strategies have also been developed for small tributary loading, modeling, dioxins, PCBs, emerging contaminants, and exposure and effects studies. An atmospheric deposition strategy will be developed in 2010. A strategy for Status and Trends monitoring will be developed in 2011.

1.2 External Coordination

External coordination promotes comprehensive and coordinated understanding and monitoring of the Estuary through participation in committees outside of the RMP umbrella.

Members of RMP staff participate in the Surface Water Ambient Monitoring Program (SWAMP), Regional Board 5 activities, Northern California Society for Environmental Toxicology and Chemistry (NorCal SETAC), CALFED, BASMAA, BACWA, LTMS, IEP, and various Total Maximum Daily Load (TMDL) work groups and committees. In addition, RMP staff are frequently asked to present guest lectures at universities and national and international working group meetings and to serve on advisory boards.

Funds from this task are also used to organize the annual Mercury Coordination Meeting. The purpose of this meeting is to facilitate the flow of information among researchers and regulators and to encourage collaboration among the various organizations that are conducting mercury research in the Estuary. This year's meeting will be held on January 27th and will be preceded by the Contaminant Fate workgroup on January 26th to optimize the input by the scientific review committee.

1.3 Contract and Financial Management

Tasks in this category include 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. It also includes development of contracts after scopes of work have been negotiated, scientific oversight of products, coordination of field and laboratory components, trouble-shooting, 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 the development of the Program Plan and the detailed workplan, development of Requests For Proposals (RFPs), and development of scopes of work, both internally and externally for contracts. Five-year Program plans have been prepared for each of the workgroups (e.g., Sources Pathways and Loadings, Contaminant Fate, Exposure and Effects and Emerging Contaminants) as part of an effort to prioritize study ideas and to develop long-term strategies for effectively addressing the RMP management questions. At the same time, we have been developing strategies for select issues that are of high priority to our stakeholders including a dioxin strategy, a modeling strategy, a mercury strategy, a PCB strategy and a small tributary loading strategy. The crosswalk between the workplans and the strategy will be articulated in a five-year Master Plan for the RMP that will be available in January 2010.

1.5 Schedule, Deliverables, and Budget

Program management activities are implemented year round. Deliverables for these tasks also occur year round and correspond to the RMP activities at hand (e.g., contracts are negotiated at the beginning of the fiscal year, invoicing of stakeholders occurs in the summer, and preparation for the quarterly TRC and SC meetings occurs throughout the year). Both technical and administrative staff are involved with project management as this encompasses a wide variety of activities (e.g., negotiation of contracts, preparation of invoices, coordination with external groups, and coordination internally among staff members).

Estimated costs for each subtask are presented below.

Subtask	**Estimated Cost 2010**
Internal Coordination	$300,000
External Coordination (Workgroups and other activities)	$24,000
Contract and Financial Management	$154,000
Program Planning	$12,000
Total	$490,000

Task 2 Information Management and Dissemination

The overarching goal of the RMP is to collect data and communicate information about water quality in the San Francisco Estuary to support management decisions. It is critical that the important findings from the Program are disseminated to managers and the scientific community. The RMP disseminates information using a variety of channels including the web query tool, newsletters, technical reports, annual reports such as the Pulse and Annual Monitoring results, workshops, and conferences.

2.1 Data Management

The primary objectives of this task are to manage, maintain, and improve the RMP database and to enable easy access to RMP data. In addition to the formatting and reporting of the current year's monitoring data, it is also necessary to periodically update and standardize data from prior years. In accordance with these objectives, our information management and dissemination goals for 2010 are as follows (listed in order of priority):

Data Formatting – QA/QC and Upload

- Upload RMP field and analytical results from laboratories into RMP database, which is comparable to the State's SWAMP v.2.5 database.
- Perform QA/QC review of the data to verify they meet the RMP's Data Quality Objectives outlined in the RMP QAPP, which is comparable to the State's SWAMP Quality Assurance Management Plan.

Database Maintenance and Web Access

- Incorporate updates and corrections to data as needed, including reanalyzed results and updates implemented by the SWAMP/CEDEN data management team.
- Add enhancements and updates to the web-based data access tool to make data easier to access by users (e.g., user-defined queries, data download and printing functionality, maps of sampling locations, and visualization tools).

Mapping Assistance (GIS)

- Generate maps of sampling stations for sample collection and display of results.

Data Management Efficiencies

- Develop and/or enhance tools to increase the efficiency of data management tasks, including data collection (e.g., data entry forms created in Access database to collect field data and generate electronic COC forms

and EDD templates), data upload (e.g., web data checker verifies that standard codes are submitted), and QA/QC review (e.g., standard queries for reviewing data quality objectives).

A description of each of these subtasks is presented below.

SUBTASK DESCRIPTIONS

Subtask 1 Data Formatting, QA/QC, and Upload

The data formatting process consists of several steps:

1) Verifying accuracy and completeness of each data submission from the sub-contract laboratories
2) Transferring the electronic data submittals to the SFEI relational database format
3) Conducting a complete QA/QC review of each data submission to ensure data are appropriately qualified according to RMP data quality objectives and consistent with historic data.
4) Contacting laboratories regarding questionable or missing data and ways to improve data quality; and
5) Tracking the various data management and QA/QC procedures for each dataset.

All results are reviewed according to the data quality requirements outlined in the 1999 QAPP and validated before being publicly released on the Institute's website.

Subtask 2 Database Maintenance and Web Access

In addition to managing data for the current monitoring year, data updates and routine maintenance tasks are performed in order to provide reliable and standardized data for all years of the Program. Data are continually updated to comply with reporting requirements. Inconsistencies are identified, qualifiers are updated, and reanalyzed results are added to the database as they are received from the laboratories. This subtask involves contacting laboratory representatives, updating data records and tracking data management processes, and archiving work files.

Subtask 2.1 Update Web Query Tool

Updates and maintenance of the web-based data access tool.

Subtask 2.2 Update and Maintain RMP Database

The RMP Status and Trends database has been converted into a comparable version of the Surface Water Ambient Monitoring Program (SWAMP) database (version 2.5). The main goal of converting the RMP database to a SWAMP-comparable format is to make

the data more accessible to regulators, researchers, and the public by using the same standardized data format required by SWAMP and all State-funded grant projects. The new database design will make it possible to submit RMP data to the California Environmental Data Exchange Network (CEDEN). SFEI is working with CEDEN Information Technology staff to become a Regional Data Center. This will make data related to the San Francisco Bay available through the State's data exchange network, including RMP Status and Trends data.

The SWAMP database conversion process is extremely detailed and must be updated as the SWAMP/CEDEN data management team continues to develop database standards. The RMP will incorporate new changes to the database in order to maintain comparability with SWAMP database formats.

Subtask 3 Data Management Efficiencies

This task will continue the process of developing standards and tools for RMP laboratories to submit their data electronically in standard electronic data deliverable formats (EDDs) and tools for staff to evaluate completeness and accuracy of those data submissions. The tools will perform a preliminary review of the EDDs to ensure that data are submitted in current database formats prior to being parsed into the many relational tables of the RMP database. Additional review queries will evaluate datasets for completeness and provide preliminary QA/QC review summaries.

Several routine calculations and procedures (e.g., summing of organics totals, QA/QC validation procedures, and assignment of QA qualifiers, etc.) could be made more efficient through additional programming. The goal of this subtask is to build additional efficiencies into the RMP QA/QC process and to eventually link these tools to a web-based data submission process as opportunities arise.

Staff Involved

Staff leads for Data Management are Cristina Grosso, John Ross, and Sarah Lowe. Other key staff include: Donald Yee, Susan Klosterhaus, Amy Franz, and Todd Featherston.

Schedule and Deliverables

Data management tasks are ongoing and updates are made available as soon as they are deemed complete. Data are made available for report production and meeting deadlines.

Budget
The estimated budget for data management for 2010 is presented on the table below.

Subtask	Estimated Labor Cost 2010
Data Formatting, QA/QC, and Upload	$224,000
Database Maintenance & Web Access	$101,000
Data Management Efficiencies	$24,000
Total	$349,000

2.2 RMP Web Site

OVERVIEW
The RMP web site has an important role in making data, technical reports, newsletters, bibliographies, Powerpoint presentations, and other documentation available to stakeholders. This task includes: publication of RMP *Annual Monitoring Results* and uploading new documents to the web site (e.g, reports, SC and TRC meeting packages, etc.); maintenance of web directories; updating the RMP page; and improving the overall design of the RMP web site.

In 2009, the RMP launched a new web site with an improved web query tool. As this task was completed late in 2009, we anticipate that there may be minor adjustments that will be necessary in 2010

SUBTASK DESCRIPTIONS

Subtask 1 2009 Annual Monitoring Results
The RMP *Annual Monitoring Results* is published only on the RMP website. The graphics group prepares the web layout.

Subtask 2 General Report Formatting for the Web
RMP reports are formatted and converted to PDF format for access on the RMP web site. Appropriate links are added to the RMP reports page to provide access to the report.

Subtask 3 Maintenance of RMP Data Access Page
Data Access via the Web Query Tool, csv files (e.g. pilot studies), and the QA Summary Tables

The graphics group is responsible for maintaining the data access homepage and making sure it effectively provides access to the data associated with RMP reports including the Status and Trends data, Pilot and Special Study data, and QA/QC summary reports. The

Data Access Page also has links to associated reports, provides contacts for assistance, and links to additional information.

Subtask 4 Overall RMP Web Site Maintenance

Overall maintenance of the RMP directory includes:

1) updating the RMP Homepage for calendar items and other "new" elements;
2) updating the data query pages and source database;
3) maintaining the links in the site;
4) generating new graphics (buttons, etc.) as needed;
5) updating content and adding pages as necessary;
6) reviewing overall site architecture and maintaining an intuitive hierarchy; and
7) reviewing "like-minded" web sites for improvement ideas.

Staff Involved

Key staff involved with this task include: John Oram, Linda Wanczyk, Joanne Cabling, Meg Sedlak, and Rachel Allen.

Schedule and Deliverables

Maintenance of the web site is an on-going activity. The site is updated as new reports become available and new events are planned.

Budget

The cost for web-site maintenance in 2010 is estimated to be $5,000.

2.3 Information Dissemination

The primary purpose of this task is to communicate information about water quality in the San Francisco Estuary to scientists and managers. RMP results are synthesized and disseminated by a variety of means including the RMP Newsletter, conferences, guest presentations, and journal publications. In 2010, the RMP will begin to disseminate significant findings from reports through summary factsheets.

The RMP will continue to take advantage of existing venues for information distribution, such as the ESTUARY newsletter. As appropriate, press outreach, 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.

Subtask 1 Newsletters/Inserts/Factsheets

Subtask 1.1 RMP Newsletter

The newsletter provides RMP participants, and the wider community interested in Bay water quality with regular news on the Program that is not covered in the *Pulse* or *Annual Monitoring Results*, such as announcing new projects or findings, discussing related background topics for pilot studies, and disseminating special interest news articles

contributed by guest authors. In 2007, the newsletter switched from a semi-annual publication to an annual publication.

Newsletter production tasks include: soliciting/planning articles; writing and editing; developing the illustration design and layout; and coordinating mailing of the newsletter. Staff members include: graphics (production), RMP manager (editorial review and developmental editing), RMP senior science staff (editorial review), Administrative staff, and other members of the RMP staff for article contributions.

Subtask 1.2 Estuary Insert

The *ESTUARY* Insert is generally produced in the late Fall as a four-page supplement to *ESTUARY* newsletter and is essentially a "mini" issue of *RMP News*. These inserts are used to provide updates on the Program. *ESTUARY's* audience is broader than *RMP News*, thus providing the Program with an opportunity to reach new readers. Insert production consists of planning, writing, editing, layout of articles and pre-press collaboration with *ESTUARY* staff. Staff members consist of the *RMP News* staff and in some cases, outside writers with expertise in communication of scientific issues to lay audiences.

Subtask 1.3 Factsheets

At the request of our stakeholders, the RMP will begin developing factsheets summarizing important findings from recent monitoring and research efforts. These one to two page factsheets will provide managers and lay persons with a quick overview of the topic and the key findings. The factsheets will be disseminated through email and the SFEI web site.

Subtask 1.4 Other media opportunities

RMP staff assist other organizations and news services with articles about the RMP and RMP data. When feasible, the Production department may provide assistance in writing, editing and layout of article submissions.

Subtask 2 Record of Publications

The RMP will keep track of all publications that use mainly RMP data. Each publication will be assigned an SFEI Contribution number and entered into an EndNote database in full bibliographic format. Though the contribution list also includes other SFEI programs (Wetlands, CMR etc.), and will be used as a means of presenting SFEI reports on the SFEI Web site, RMP publications will be independently tracked by means of a “profit center” field in EndNote. SFEI's Production/Graphics team is responsible for assigning contribution numbers and maintaining the publications list in EndNote.

Subtask 3 Posters

Subtask 3.1 Posters

The RMP produces posters for display at poster sessions at various conferences (e.g., SETAC, CalFed, State of the Estuary, etc.). Staff members involved include RMP technical staff and the graphic design group.

Subtask 4 Presentations

RMP staff present technical and non-technical talks at various venues (e.g., conferences, lectures, and meetings).

Subtask 5 Annual Meeting

The RMP Annual Meeting is an important means of describing the latest findings from the Program to stakeholders. The Annual Meeting requires preparation by RMP technical and administrative staff. RMP technical staff members are responsible for developing a variety of presentations; the Art Director is responsible for flyers, postcards, photos, and web site announcements; and administration is responsible for meeting logistics (e.g., venue, food, setup, etc.) and for mailings of printed matter.

Subtask 6 Press Outreach

The RMP will seek appropriate opportunities for disseminating RMP information through the media. In 2009, the RMP was featured in a number of news stories including a front-page San Francisco Chronicle story on the Annual Meeting. In addition, individual staff members serve as technical resources for reporters on select topics.

Staff Involved

Most SFEI staff are involved in some aspect of Information Dissemination. Technical staff write articles for the RMP News and Estuary insert. Graphics staff is critical for the production of inserts, posters, and presentations. Senior staff and the Executive Director are involved in conducting media outreach.

Schedule and Deliverables
Key deliverables for this task are presented below.

Deliverable	Target Date
RMP News	Spring
ESTUARY insert	October
Factsheets	To be determined based on reports
RMP Record of Publications	On-going
Posters and Presentations	On-going
Annual Meeting	September
Press Outreach	Periodic

Budget
The estimated budget for information dissemination for 2010 is presented below.

Subtask	Estimated Labor Cost 2010
General Information Dissemination (e.g., presentations, RMP News, ESTUARY insert, posters, factsheets, etc.)	$68,000
Press Outreach/Program Development	$4,600
RMP Annual Meeting	$40,000
Total	$112,000

2.4 Annual Reporting

Annual reporting consists of the preparation and production of the *Annual Monitoring Results* and the *Pulse of the Estuary* that are posted on the SFEI website. The *Pulse of the Estuary* is also published in hardcopy.

Subtask 1 ***2009 Annual Monitoring Results***
This report will present seven years of randomized sampling for water and sediment. It will follow a format similar to the *2008 RMP Annual Monitoring Results*. Data will be presented in the form of maps with bubble plots of contaminant concentrations at each site and an indication of which sites are above water quality criteria (WQC) or sediment guidelines. Box plots and cumulative distribution frequency plots, by segment, will also

be reported. As shown in the 2008 Annual Meeting, the RMP is moving towards a web-based format for the Annual Monitoring Results. .

In years past, the *Annual Monitoring Results* report was prepared concurrently with the Pulse; however, preparation of both reports and holding the Annual Meeting has presented a logistical challenge for staff. As a result, we will stagger the reporting of the *Pulse* and the *Annual Monitoring Results* with the *Pulse* being reported out in time for the *Annual Meeting* and the *Annual Monitoring Results* approximately two months later (December 1).

Subtask 1.1 Preparation of the Annual Monitoring Results
Web-ready graphics and various tables, including analyte lists and regulatory criteria and guidelines, will be reviewed and updated. Introduction, water, sediment, tissue and QA/QC chapters will be updated to reflect the 2009 data.

Subtask 1.2 2009 Annual Monitoring Results Distribution
The *Annual Monitoring Results* document will be made available through the RMP website *Documents and Reports* link. The 2009 data and QA/QC summaries will be made available on the RMP website through the *Data Access* link. Additional tasks include public outreach and mailings.

Subtask 2 *2010 Pulse of the Estuary*
The 2010 *Pulse* will summarize RMP monitoring, highlighting results from 2009. The 2010 *Pulse of the Estuary* will be finished in time for the Annual Meeting in the fall. The Technical Review Committee (TRC) and Steering Committee (SC) are currently discussing the theme of the 2010 *Pulse* .

A more detailed outline will be developed under guidance of TRC and SC. First drafts of articles will be sent out for review in May. The articles will be revised in response to comments. A laid-out version of the report will be distributed to the SC and TRC for a second review in June. The report will be printed by early September, and distributed at the Annual Meeting. An electronic PDF file will be posted on SFEI's web site.

Staff Involved
The production of the *Annual Monitoring Results* will include: John Oram, Amy Franz, Sarah Lowe, Meg Sedlak, John Ross, Cristina Grosso, Jennifer Hunt, and Nicole David. Leads on the *Pulse* will include: Jay Davis, Meg Sedlak, and Linda Wancyzk.

Schedule and Deliverables
A detailed schedule of tasks is presented below.

Deliverable	Target Date
2009 RMP Annual Monitoring Results – Final on web	December 2010
2010 Pulse of the Estuary	September 2010

Budget
The estimated SFEI labor budget for the *Annual Monitoring Results* and the *Pulse of the Estuary* for 2010 is presented on the table below.

Subtask	Estimated Labor Cost 2010
Annual Monitoring Results 2009	$39,000
Pulse of the Estuary 2010	$79,000
Total	$117,000

2.5 Quality Assurance and Quality Control (QA/QC)

OVERVIEW
Planned tasks for 2010 include:

- completing the update of the Quality Assurance Program Plan (QAPP);
- finishing the sample archive protocol;
- analyzing data from special QA/QC studies; and
- optimizing metal analyses.

BACKGROUND
The RMP QA/QC program ensures the consistency and reliability of data generated by various subcontractor laboratories and among different facets of RMP estuarine monitoring. The requirements presented in the RMP QAPP are intended to ensure data comparability among different laboratories and different years.

The RMP quality assurance component has been recognized as one of the most thorough and systematic efforts of any ambient monitoring program. For example, ultra-clean field sampling techniques, first developed and refined by one of the RMP team members, are now the standard and are EPA approved (Flegal and Stukas, 1987; EPA Method 1669). In addition, the continuous performance evaluation exercises are useful for most RMP contract laboratories in sharing expertise, method refinement, and maintaining the rigor of the data collection and analysis effort.

The QA element includes the following tasks:

1. Routine data verification and validation procedures to determine if laboratories are able to meet data quality guidelines specified in the current RMP QAPP and to determine if the data quality meets the expectations of the data users.

2. Updates of the QAPP to meet evolving management priorities and incorporate new components (e.g., new analytes, or new data acceptability criteria).

3. Special QA/QC projects that are limited in scope and that may assist in the evaluation of data accuracy among different laboratories, or in the development of new field collection or analytical methods (e.g., evaluation of samples split among labs or intercalibration exercises).

This section outlines the annual data quality assurance procedures to be conducted in 2010, the periodic review of RMP contract laboratories to ensure high quality performance, and the general evaluation of factors contributing to analytical variation and other causes of measurement uncertainty.

SUBTASK DESCRIPTIONS

Subtask 1 QA Management and Revision of the QAPP

This task includes review and updating of the Field Operations Manual (FOM) and QAPP to reflect new measurements added to the RMP. A number of improvements in analytical techniques have occurred since the 1997 QAPP was prepared. In 2008, we began the process of revising the QAPP by convening meetings with both the organics and inorganics laboratories. In addition, revisions were made to the RMP QAPP to make it more consistent with the SWAMP QAPP, starting with the dioxin studies QAPP written in the SWAMP style. We will build on the dioxin QAPP adding tables and text for remaining analytes and study components as needed. We anticipate finishing this task in 2010.

Subtask 2 Finalizing a Sample Archive Protocol

Sample archives are extremely valuable in identifying long-term trends of emerging contaminants, re-evaluation of trends with improved analytical methods, and providing insurance in case of analytical problems that may arise. As one example, Dr. Ron Hites was able to identify a significant increase in PBDEs in the Great Lakes since the 1980s using archival materials.

In 2008, SFEI staff developed a draft sample archive protocol for documenting what materials will be archived, how they will be stored, and under what circumstances they might be used. In 2009, we began discussions with the National Institute of Standards and Technology (NIST) for storing RMP archived samples in the National Environmental

Specimen Bank at the NIST laboratory in Charlestion, SC, which maintains samples at -150 °C. In 2010, we anticipate beginning the process of storing RMP samples in long-term storage at the NIST facility and culling our existing sample archive storage to reflect the new draft archive protocol.

Subtask 3 Laboratory/Sample Intercomparisons (RMP Status and Trends)

The RMP conducts periodic limited QA/QC studies such as blind field samples, duplicate field samples, and inter-comparison studies among laboratories to evaluate data quality. These samples are included in the Status and Trends sub-contracts and reported, validated, and reviewed as part of the Status and Trends task. We plan to continue these exercises in 2010.

With AXYS Analytical now using new extraction procedures for XAD columns, some evaluation of extraction yield by comparison to split (whole) water samples at selected sites will be used to assure continued acceptable recoveries for water analytes. In addition, in 2010, AXYS Analytical will conduct a pro bono study evaluating bivalves samples for chemicals of emerging concern. A presentation of the results of this study will be given at a TRC meeting. Lastly, CDFG is currently validating a new method for analysis of PBDEs. Results of this validation exercise will be presented to the TRC.

Results for dissolved copper concentrations in the first year of analysis (2007) with a new contract laboratory (BRL) raised some concerns about comparability to previous results, with average concentrations in LSB 20 to 25% higher than in previous years and compared to City of San Jose laboratory, approaching the LSB the copper trigger level. Results in 2008 were more comparable between labs (~5% difference), with 2009 results pending. A portion of the QA budget will be set aside to continue the comparison.

Subtask 4 Optimizing Trace Metal Methods (RMP Status and Trends)

In 2009, a high bias in Se recovery in tissue samples was identified, and follow-up with the lab revealed a matrix interference that was overcome by switching to a new ICP-MS-DRC (dynamic reaction cell) methodology. The lab has identified some potential interference issues with Se analyses in water leading to elevated DLs by the current GFAAS method, and have suggested a switch to an ICP-MS method. The lab has offered to reanalyze some samples by the new method for comparison, and we will continue to work with the lab on comparing alternative methods for this and other analytes as needed.

Staff Involved

The leads on the QA/QC task will include: Don Yee, Susan Klosterhaus, Meg Sedlak, Sarah Lowe, and Cristina Grosso. Other staff members involved in this task will include: John Ross, Jen Hunt, and Amy Franz.

SCHEDULE AND DELIVERABLES

A detailed schedule of tasks is presented below.

Deliverable	Target Date
Validated 2009 S&T data and other studies as needed	On-going
Implementing the Sample Archive Protocol and culling existing samples	October 2010
Update RMP Status and Trends QAPP	October 2010

BUDGET

The estimated SFEI labor budget for QA/QC is approximately $28,000.

Task 3 Status and Trends Monitoring

In 2005, RMP staff, and members of the TRC and SC began a process to review the Status and Trends (S&T) program for several reasons. First, new findings are changing our understanding of the Bay and as a result, it is important that the Program adapt and respond to these changes. Second, the regulatory focus is changing from establishing thresholds for contaminants in water to establishing thresholds for concentrations in biota. An example of this is the mercury marine water quality objective which was vacated in place of two criteria for biota (i.e., sport fish and small fish). Again it is important the Program respond and provide data that are of use to the regulated community and regulators. The redesign of S&T was completed in 2007 with major changes that began in 2008. A report summarizing the results of the redesign is available on the SFEI web site (Melwani et al., 2008 Power Analysis and Optimization of the RMP Status and Trends Program (http://www.sfei.org/sites/default/files/Report555_Power_Analysis_FINAL.pdf).

Prior to 2007, the S&T Program was composed of four program elements: long-term water, sediment, and bivalve monitoring; causes of sediment toxicity (previously known as episodic toxicity); sport fish bioaccumulation; and the USGS hydrographic and sediment transport studies. In 2007, as part of the redesign, the TRC and SC elected to also include the following elements in S&T: small tributary loading (annual); large tributary loading (triennial); Guadalupe tributary loading (triennial); small fish (annual); and bird egg monitoring (triennial).

The 2010 RMP sampling will mark the ninth year of the randomized sampling design. The S&T monitoring program for water and sediment was significantly revised in 2002, moving from a fixed sampling design to a randomized design. A long-term plan for this design, including a 20-year cycle of rotating panels, is being implemented. The 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 bivalve program uses a fixed station, rather than random, sampling design.

The S&T monitoring component of the RMP addresses elements of all of the Level 1 management questions:

- Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?
- What are the concentrations and masses of contaminants in the Estuary and its segments?
- What are sources, pathways, loadings, and processes leading to contaminant-related impacts to the Estuary?
- Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?

- What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?

With regard to the management questions, the S&T randomized sampling design allows for representative characterization of contamination within each Bay segment. It also enables RMP staff to assess the potential for impacts on human health and aquatic life. Data from the S&T monitoring are used to develop models to estimate current loadings, to predict future concentrations and loadings, and to assess impacts of chemical contamination on biota.

The S&T monitoring program is augmented by short-term Special and Pilot Studies that are 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, for possible inclusion in the S&T program. The 2010 Special Studies are discussed in more detail in Chapter 5.

Since 2002, water, sediment, and bivalve bioaccumulation sampling for the S&T monitoring program were conducted in the summer. Summer was selected for sampling because inter-annual variation due to natural variables, primarily freshwater inflow, is minimized during this period. However, significant toxicity is observed in the winter in sediments. To better understand the causes of toxicity and the variability that may be observed in the rainy season, the TRC and SC recommended as part of the redesign of S&T that sediment be sampled in alternating years in the summer and winter. Winter sediment sampling will commence in 2010.

Five historical water stations and seven historical sediment stations are sampled to maintain time series for long term trend analyses. The Annual Monitoring Results reports further describe the scope of work, analytes measured, and the analytical and reporting expectations for the S&T monitoring program.

Much of the S&T monitoring effort consists of sample collection and laboratory analysis that is undertaken by subcontractors (e.g., AXYS Analytical, and Applied Marine Sciences). SFEI provides oversight, coordination with the laboratories, sample collection and field assistance.

3.1 Status and Trends: Long Term Monitoring of Water, Sediment, Bivalves, Benthos, and Toxicity

In 2005, the RMP began a process to redesign the Status and Trends program element. This was completed in 2007 and a summary report documenting these changes was prepared in 2008 (http://www.sfei.org/sites/default/files/Report555_Power_Analysis_FINAL.pdf). A number of changes were implemented in 2008 and 2009 including the reduction of

organic analyses in water and inclusion in benthic assessments. More changes will be implemented in 2010 as we begin the wet weather sampling for the large tributaries and sampling of sediment in the winter. These changes are discussed in more detail below.

Subtask 1 Water Chemistry

Conventional water quality, trace metals, and trace organics sampling in water will occur during the summer dry season. As part of the redesign, the number of stations was reduced from 31 to 22, including four random stations per segment with the exception of the Lower South Bay segment which has five. In addition to the randomized sites, five fixed historical stations will be maintained.

In 2006, the TRC recommended that with one exception, organics (i.e., PCBs, PAHs and legacy pesticides) should be analyzed on a biennial basis. Because of the greater interest in PBDEs, PBDEs will continue to be analyzed annually. In 2008, with the exception of PBDEs and PAHs, organics were not analyzed in water. PAHs were included in 2008, instead of 2009, as a result of the Costco Busan spill which occurred in November 2007. In 2009, the following organics were analyzed: PBDEs, PCBs, and pesticides. In 2010, only PBDEs will be analyzed, and in 2011 all organics will be analyzed, per the original plan.

In 2006, analysis of dissolved and particulate organic contaminant concentrations were eliminated in favor of total organics. Current water quality objectives are based on total concentrations.

Subtask 2 Sediment Chemistry

Sediment samples were collected in the dry season in 2000 and will alternate wet and dry seasons starting in 2010 with the wet season. In the wet season, sediment chemistry with be analyzed at 27 sites (20 random sites and 7 fixed sites). During the dry season, sediment chemistry will be analyzed at 40 random sites and 7 fixed sites.

In 2010, the sediment analysis will consist of organic (e.g., PCBs, PAHs, PBDEs, and pesticides) and inorganic contaminants.

Subtask 3 Sediment Benthos

In 2008, sediment quality objectives (SQOs) were promulgated by the State. The SQOs are based on sediment chemistry, toxicity, and benthic assessments. To provide the data needed for sediment triad evaluation, the RMP began collecting samples for benthic community analysis in 2008. This will continue in 2010.

Subtask 4 Bivalve Bioaccumulation

The bivalve monitoring component maintains the long-term database started by the State Mussel Watch Program in the early 1980s. Because of logistical complexities, a randomized design is not economically feasible, nor is it technically desirable for this long-term trend monitoring tool. Bivalves are excellent trend indicators particularly for organic contaminants. The redesign workgroup recommended that a biennial plan be

implemented. In 2008, bivalves were sampled for organics and inorganics; in 2010, bivalves will be sampled for organics. Inorganics are being analyzed on a longer-term five year cycle and were most recently analyzed in 2008.

This year's bivalve sampling coincides with a pilot study being initiated by the NOAA National Mussel Watch Program. NOAA has elected to forego analysis of bivalves nationally to focus on a pilot study of emerging contaminants in resident bivalves in California. The California pilot will analyze native bivalves from approximately 80 sites for emerging contaminants such as pharmaceuticals, hormones, nonylphenols and nano particles. The sample sites and specific analytes will be determined in the first quarter of 2010. It is possible that the RMP transplant stations will augment this study by including semi-permeable membranes at some of the RMP sites.

Subtask 5 Toxicity (Aquatic and Sediment)

After the RMP S&T aquatic toxicity monitoring showed little toxicity over several years, aquatic toxicity sampling was scaled back to a screening effort every five years. The next aquatic toxicity testing is scheduled for 2012.

RMP S&T sediment toxicity monitoring will continue as in previous years. This year the sediment cruise will occur in the winter. Sediment toxicity measurements will be made at 27 sites in the Estuary (20 randomly allocated sediment chemistry stations and seven historical RMP sampling sites). Part of the rationale for the wet weather sampling is to evaluate the causes of toxicity observed in the Northern portion of the estuary which has in the past been attributed to divalent metal cations such as copper.

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). In 2008, the Program switched to the sediment-water interface test from the elutriate test to be consistent with the SQOs. If needed, TIEs will be conducted in samples that show significant toxicity; however, a request for contingency funding to cover this element will need to be made.

In the past, the toxicity tests have used two species to evaluate sediment toxicity across the Estuary (*Eohaustorius* and *Mytilus*). Questions have arisen regarding the validity of tests using these saltwater organisms in RMP samples with low salinity. As a result in 2009, the Toxicity workgroup (a subgroup of the Exposure and Effects workgroup) recommended that side-by-side tests be conducted using potential alternative freshwater species (*Hyalella* and *Chironomus)* and the existing saline species (*Eohaustorius* and *Mytilus)* at the Rivers stations (BG20, BG30, and the Suisun Bay stations (including the 4 random stations and one historic-RMP station (BF21)). These analyses were conducted on select sediment samples from the 2009 sediment cruise. Pending the results of this study, further modifications to sediment toxicity tests may be warranted. In addition, a literature review to compile LC-50s for these species will be conducted. These results will be summarized at the March 2010 Exposure and Effects workgroup meeting.

STAFF INVOLVED
The leads on the S&T long-term monitoring task will include: Meg Sedlak, John Oram, Susan Klosterhaus and Don Yee. Other staff members involved in this task will include: Amy Franz, Sarah Lowe, Nicole David, Jen Hunt, and Rachel Allen.

SCHEDULE AND DELIVERABLES
The S&T field sampling cruise will occur in February 2010 (sediment) and September 2010 (water). Monitoring of loads from small tributaries will commence as part of the 2009/2010 rainy season.

BUDGET
The estimated SFEI labor budget for S&T long-term monitoring task is presented below.

Subtask	**Estimated Labor Cost 2010**
S&T Field Sampling and Oversight	$53,500
Total	$53,500

3.2 Causes of Sediment Toxicity

OVERVIEW

As articulated in benthic biota chapter of the Exposure and Effects Strategy, a priority for the RMP is determining the causes of toxicity observed in sediment in the Estuary. Sediment toxicity has been observed at a high proportion of RMP sampling locations since the Program began in 1993. Reducing this toxicity depends on determining which pollutants or other factors are responsible. The annual SQO assessments will provide information about sediment condition in the Estuary, but will not identify causes of the observed toxicity or benthic community impacts. This component will investigate causes of observed sediment toxicity and benthic impacts. "Stressor identification" is a key element of the Water Quality Plan for implementation of the SQOs.

In 2010, the RMP will embark on methods to develop new techniques for identifying causes of toxicity. In recent years, the RMP has investigated causes of sediment toxicity using the Toxicity Identification Evaluation (TIE) method. This method works well in environments in which one contaminant is present in high concentrations (e.g., pyrethroids in urban creeks). However, many Bay sites in which sediment toxicity is observed are characterized by multiple contaminants present at low to moderate concentrations. Under these conditions, it is very difficult to determine the causes of toxicity using TIEs.

Researchers at the SCCWRP and University of California are currently developing a gene microarray to determine chemicals responsible for causing toxicity in the amphipod, *Eohaustorius estuarius*. In 2010, this microarray will be applied to environmental samples and laboratory-dosed samples to determine the efficacy of the tool.

The project is divided into three tasks.

Task 1: Calibration of molecular TIE for sediment contaminants

The first task is to determine a set of gene expression profiles for individual contaminants under controlled laboratory conditions. Based on research conducted to date, it is likely that a specific contaminant will elicit a unique response from a number of genes (e.g., on the order of hundred of genes will be expressed as a result of an exposure to a contaminant). The research team will then identify a set of these unique genes for each contaminant using dose-response experiments. A set of controlled experiments will be conducted for comparative purposes.

This task will utilize amphipods *E. estuarius* obtained from laboratory exposure studies conducted by SCCWRP and UC-Granite Canyon for contaminants of high concern for sediment toxicity identification (e.g., pyrethroid pesticides, chlordane, polycyclic aromatic hydrocarbons, etc). Experiments using a range of exposures will be conducted (e.g., from no effect to 50% mortality).

Deliverables: The end-product will be a specific gene expression profile for each contaminant.

Task 2: Gene expression analysis of evaluation samples

Analyses conducted in this task will help determine whether the contaminant-specific gene markers identified in Task 1 are reliable and sensitive indicators of sediment toxicant exposure. This task will be accomplished by analyzing RNA from blind laboratory test samples, where the contaminant type and dose level are not known by the analyst. Comparison of the analyst's determination of the toxicant type (based on gene expression pattern matching) to the actual contaminant used in the sample will indicate the accuracy of the microarray component of the molecular TIE approach.

Samples from exposures containing a range of concentrations of one contaminant (i.e., chlordane or PAHs) will be tested. Additional samples of amphipods exposed to other stressors, such as ammonia or low salinity, will also be evaluated to assess the potential for confounding factors. The goal of this task will be to determine whether a gene expression profile of the unknown sample can be used to infer the contaminant exposure and exposure dose.

Deliverable: The end-product will be an analysis of the degree of match with the known contaminant type for each set of test samples.

Task 3: Evaluation of molecular TIE

The results from Task 2 will be evaluated to assess the potential utility of using gene expression as a molecular TIE approach for contaminated sediments. Statistical analyses and comparisons will be conducted to examine the variability; accuracy; and robustness.

A report and journal manuscript will be prepared that summarizes the results of these comparisons and discusses the potential of the molecular approach for use in sediment TIEs.

STAFF INVOLVED

This element of the Causes of Sediment of Toxicity will be conducted largely by researchers at UC-Berkeley and SCCWRP. The Exposure and Effects workgroup will provide oversight and input. The main SFEI staff lead will be Aroon Melwani.

SCHEDULE AND DELIVERABLES

Deliverable	Due Date
Task 1. Molecular TIE calibration	July 1, 2010
Task 2. Gene Expression analysis of evaluation samples	November 1, 2010
Task 3. Evaluation of molecular TIE results	December 1, 2010
Draft report, EEWG review, final report	December 30, 2010

BUDGET

The estimated SFEI labor budget for the 2010 work related to this project is $2,800. UC-Berkeley and SCCWRP have been awarded a contract for $57,200.

3.3 Sport Fish Bioaccumulation Monitoring

Sport fish sampling in the RMP began in 1997 and occurs on a three-year cycle. In 2009, sport fish were successfully collected from five popular fishing locations within the Estuary. The trend assessment species included shiner surfperch, white croaker, striped bass, and white sturgeon. The additional species targeted included anchovies, jacksmelt, leopard sharks, and halibut. Samples are currently being analyzed for mercury, PCBs, organochlorine pesticides, polybrominated diphenyl ethers (PBDEs), dioxin, perfluorinated compounds, and omega 3 fatty acids.

This task addresses RMP management question one (i.e., describe patterns and trends in contaminant concentration and distribution) by evaluating the temporal trends in impairment of the fishing beneficial use of Bay waters. In addition, some fish species (especially shiner surfperch) are valuable for analysis of spatial patterns. The collection of fish will be compared to thresholds for protection of human health, representing a key impairment indicator for the Estuary.

RMP sport fish sampling in 2009 was part of a larger a two-year statewide evaluation of bioaccumulation in sport fish along the entire coast of California by the State Water Board's Surface Water Ambient Monitoring Program (SWAMP). Year 1 of the SWAMP effort (2009) focused on the Southern California Bight and the northern California coast near San Francisco Bay. Year 2 will cover remaining areas of the state. A similar sampling design to that used in the Bay by the RMP will be used for the entire state, allowing comparison of Bay data to data in similar species in nearby coastal areas of northern California, as well as more distant areas.

Coordination of RMP sampling with SWAMP sampling creates efficiencies between the programs. The data for San Francisco Bay will be reported as part of a SWAMP report presenting a statewide assessment of sport fish contamination. The SWAMP report will include a chapter on San Francisco Bay, and will assess Bay data in a manner that is consistent with the statewide assessment. Relying on the SWAMP report for documenting the 2009 Bay work, the RMP was able to collect and analyze additional species including jacksmelt, leopard shark and California halibut.

In 2010, the costs for preparation of the sport fish report will be covered by the SWAMP program; the RMP will contribute approximately $9,000 to cover data management costs.

STAFF INVOLVED
This task will be performed by Jay Davis, Jennifer Hunt, Cristina Grosso, and John Ross.

SCHEDULE AND DELIVERABLES 2010
A detailed schedule of deliverables is presented below.

Deliverable	**Target Date**
Draft Report on Year 1 of the SWAMP Coastal Bioaccumulation Survey (Including San Francisco Bay and the Adjacent Coast)	January 2011
Final Report on Year 1 of the SWAMP Coastal Bioaccumulation Survey (Including San Francisco Bay and the Adjacent Coast)	May 2011

3.4 Small Tributary Loading – Hayward Zone 4 Line A

OVERVIEW

In 2009, the Small Tributary Loading Strategy Team (RMP stakeholders, SFEI staff, and RWQCB staff) developed a Small Tributary Loading Strategy to identify and prioritize the information that is most urgently needed by managers to reduce loads and impacts of pollutants of concern (POC) entering the Bay from small tributaries. The group articulated the following high priority management questions.

- Which are the "high-leverage" small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?

- What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?

- How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?

- What are the projected impacts of management actions on loads or concentrations of pollutants of concern from the high-leverage small tributaries and where should management actions be implemented in the region to have the greatest impact?

In addition to the management questions, a key outcome of the Strategy was assuring that RMP monitoring of small tributaries is consistent with and complemented by monitoring that will be completed as part of the Municipal Regional Permit for stormwater agencies (MRP). Two of the tributaries included in the MRP, the Guadalupe River and Zone 4 Line A, will be monitored as part of the RMP in 2010. The Zone 4 Line A study is discussed in more detail below; the Guadalupe River study is discussed with the special studies in Chapter 4.

This is our fourth year of study at Zone 4 Line A, an industrial watershed in Hayward. This watershed was recommended by the Workgroup because of its high industrial usage and small size (~4 km^2) in contrast with Guadalupe River. Zone 4 is one of the smallest zones in the Alameda County Flood Control and Water Conservation District (ACFCWCD). It is wholly situated on a coastal plain made up of sand, silt and mud that was deposited over several thousand years by water flowing to the San Francisco Bay during historic seasonal floods.

The first three years of study have been relatively dry years. Nonetheless, as shown in the Pulse article (2008), some very interesting findings were noted with regard to mercury loads from urban watersheds as compared to loads from historic mining areas. Using area-normalized data, the loads of methylmercury were higher from Zone 4 Line A than from the Guadalupe River.

Objectives

a) To improve our knowledge of the magnitude of contaminant loads entering the Bay from local small tributaries (in this case a small industrial watershed with an added mix of commercial and residential use)
b) To provide loadings data to improve our knowledge on processes in the Bay (such as described by the Hg, PCB, PAH, and OC pesticide models for the Bay) thereby assisting in the development of Bay TMDLs
c) To demonstrate a methodology for use in other watersheds and make recommendations on how best to sample other watersheds
d) To provide input data for the eventual development of a watershed based model to predict loads on a regional scale

Study of this small watershed in industrial/commercial Hayward will provide valuable information on loads derived from small, low rainfall, but highly impervious, commercial and industrialized "storm drain watersheds" on the Bay margin. This is particularly important for updating regional TMDL estimates of Hg and PCBs loads derived from urban runoff. In addition, loadings studies will provide baseline data so that trends through time can be assessed, and provide data for models that describe biological effects in the Bay.

APPLICABLE RMP MANAGEMENT QUESTIONS

What are sources, pathways, loadings, and processes leading to contaminant-related impacts to the Estuary?

- The information from this study with help to quantify one of the major loadings of contaminants to the Estuary and aid in the general description of which of the sources or pathways for each specific contaminant are most important in terms of managing or designing studies for maintaining or improving environmental quality of the Bay.

SUBTASK DESCRIPTIONS

Subtask 1 Field Sampling

All sampling will be carried out on Zone 4 Line A at Cabot Blvd. in Hayward. At that location, the County of Alameda granted us an encroachment permit to build a sampling platform across the channel on the upstream side of the road convert. We have installed a range of automatic recording equipment including a pressure transducer for measuring stage, a Forest Technology Systems Ltd. DTS 12 turbidity sensor attached to an articulated boom, an ISCO auto sampler with Teflon tubing for sampling SSC and Hg, a Campbell Scientific rain gauge, and Campbell data logger and a cellular modem for transmitting data real-time. This location flow rises to peak within 2 hours of peak rainfall and responds to rainfall within 15 minutes. Sampling crews will be deployed when rain is forecast and work while it is raining and for 3 hours post rain. Water samples during non-wading stages (>1.6 ft at the gauge) will be taken using our D-95 trace-metal clean depth-integrating water quality sampler and during wadable stages by hand dipping to mid-depth in the center of the channel. Velocity measurements will be

taken at 1 foot intervals at up to three depths using a Marsh McBirney Flo-Mate 2000 velocity meter and used to develop a stage-flow relationship.

Subtask 2 Chemical Analysis

Chemical analysis will be carried out for PCBs, PBDEs, PAHs, OC pesticides, pyrethroid pesticides, organic carbon, suspended sediment concentration (SSC), total mercury, dissolved mercury, reactive mercury, methyl mercury, dissolved methyl mercury, and a range of trace metals including copper and selenium. New this year will be analysis of selenium species and nutrients. Analyses of organic compounds will be conducted by AXYS Analytical laboratory. Analysis dissolved and particulate organic carbon will be conducted by CAS Analytical. Analyses for SSC, mercury and trace metals will be conducted by MLML and Brooks Rand Laboratories.

Subtask 3 Data Management

SFEI staff will carry out data management and QA/QC management. The subtasks will involve review of the lab protocols, review of the QA/QC reports issued with the data and primary data quality checking. Data will go through a secondary QA/QC process as it is synthesized and interpreted. Once these processes are complete, the data will be prepared for upload onto SFEI's website.

Subtask 4 Project Management and Reporting

The project will be managed by SFEI staff. Management tasks will include addressing contract and budget issues, preparing and coordinating field sampling and laboratory deliverables, and organizing workgroup participation with the SPLWG. A report summarizing the four years of sampling will be prepared in October 2010.

STAFF INVOLVED

SFEI staff involved include: Cristina Grosso, Donald Yee, Lester McKee, John Ross, Nicole David, Sarah Pearce, Jennifer Hunt, Meg Sedlak, John Oram, Kat Ridolfi, Rachel Allen, Amy Franz, Lawrence Leung, and Alicia Gilbreath.

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Year 2006 through 2010 – RMP Technical Report Draft	August 2010
Final Report	October 2010

BUDGET

Subtask	Estimated Cost 2010
Field sampling, data management, project management and reporting	$55,800
Direct costs	$13,000
Subcontractors	$81,200
Total	$150,000

REFERENCES

Leatherbarrow, J.E. Hoenicke, R. and McKee, L.J., 2002. Results of the Estuary Interface Pilot Study, 1996-1999, Final Report. A Technical Report of the Sources Pathways and Loading Work Group (SPLWG) of the San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP). San Francisco Estuary Institute, Oakland, CA. March 2002. 90pp.

McKee, L., Leatherbarrow, J., Eads, R., and Freeman, L., 2004. Concentrations and loads of PCBs, OC pesticides, and mercury associated with suspended sediments in the lower Guadalupe River, San Jose, California. A Technical Report of the Regional Watershed Program: SFEI Contribution #86. San Francisco Estuary Institute, Oakland, CA. 79pp.

McKee, L., 2005. Sources, Pathways, and Loadings: Five-Year Work Plan (2005-2009). A Technical Report of the Sources Pathways and Loading Workgroup (SPLWG) of the San Francisco Bay Regional Monitoring Program for Trace Substances (RMP): SFEI Contribution #406. San Francisco Estuary Institute, 30 Oakland, CA. 21pp.

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McKee, L., Oram, J., Leatherbarrow, J., Bonnema, A., Heim, W., and Stephenson, M., 2006. Concentrations and loads of mercury, PCBs, and PBDEs in the lower Guadalupe River, San Jose, California: Water Years 2003, 2004, and 2005. A Technical Report of the Regional Watershed Program: SFEI Contribution 424. San Francisco Estuary Institute, Oakland, CA.

3.5 Bird Egg Monitoring

The Exposure and Effects Pilot Study (EEPS) conducted monitoring of bird eggs from 2002 through 2006. Two different species of birds have been monitored. Cormorant eggs provide a valuable regional indicator of contamination on the open waters of the Bay and Forster's tern eggs are indicators of more localized contamination in shallow water habitats around the margins of the Bay. Forster's terns are also more sensitive to contamination. As part of the Status and Trends redesign, it was recommended that bird egg monitoring be included as a triennial element. Eggs were scheduled to be collected in 2008; however, the USGS was unable to obtain a collection permit for terns and was unable to collect cormorant eggs at two of the three sites. As a result, this element was deferred until 2009.

Under EEPS, cormorant eggs were collected in 2002, 2004, and 2006. At three locations in the Bay, two composites from ten eggs were analyzed for PCBs, PBDEs, musks, phthalates, mercury, selenium, pesticides, nonylphenol, and dioxins. Starting in 2006, eggs were also analyzed for perfluorinated compounds. In 2009, cormorant eggs were collected at the following three sites (consisting of three composites from each site): Wheeler Island; Richmond Bridge and Pond AB2 located in the South Bay. The eggs are currently being analyzed for PCBs, PBDEs, Hg, Se, pesticides, and perfluorinated compounds. The dioxin strategy team recommended deferring bird egg dioxin analysis to 2012.

EEPS monitored tern eggs for mercury in 2002 and 2003. Recent work, in part funded by the RMP, has shown that levels of mercury in Forster's terns are sufficiently high that they appear to be significantly affecting the reproductive success of the birds. The eggs will be analyzed for mercury, selenium, and PBDEs. Except for mercury, the eggs will be composited with three composites per site and seven eggs per composite.

Six tern colonies were sampled successfully in 2009: Eden Landing, Napa Marsh, Napa Marsh, Hayward Shoreline and Ponds A2W, AB2, and A16 in the South Bay. For the tern eggs, each egg will be individually analyzed for THg concentrations and then three composites of seven eggs will be made for all six sites.

The results of this study will be summarized in 2010 in a technical report. Approximately $16,000 has been set aside for writing the report as a carryover task.

STAFF INVOLVED

SFEI staff involved include: Jennifer Hunt, Jay Davis, Cristina Grosso and John Ross.

SCHEDULE AND DELIVERABLES

Deliverable	**Target Date**
RMP Draft Technical Report	October 2010
Final Technical Report	November 2010

SFEI LABOR BUDGET

Subtask	**Estimated Cost (Carryover from 2009)**
Project Management, Coordination, Data Analysis, and Reporting (SFEI labor)	$16,000
Total	$16,000

3.6 Small Fish Monitoring

Small fish are a valuable indicator of spatial and temporal variability in contaminants in the Bay food web. This study will examine methylmercury concentrations in pelagic and benthic fish less than one-year in age. Small fish tend to have small ranges in habitat and are a dominant food-source for piscivorous fish. The purposes of this study are:

- to provide information of the accumulation of methylmercury into the food web;
- to determine the impacts of management actions on biota (e.g., restoration of wetlands in the South bay), and
- to provide data for food web modeling of exposure to wildlife.

This study began in 2005 under the Exposure and Effects Pilot Study and was considerably expanded in 2008 to address the newly developed Mercury Strategy. Although the primary focus of this study has been on mercury; in 2007, small fish were collected for analysis of trace organic concentrations (i.e., PCB, pesticide, and PBDEs). Particularly elevated concentrations of PCBs were observed in some of the small fish collected. As a result, a pilot study for this year provides funding for the small fish program to analyze small fish for PCBs.

The goal of this element is to determine areas of high and low methylmercury bioavailability by monitoring mercury concentrations in small fish and sediments. For a variety of reasons, fish and sediments are considered to be appropriate monitoring tools.

Using a randomized design, the small fish program is addressing the following questions: (1) What factors (i.e., site characteristics) appear to be important for causing increased mercury concentrations in Bay biota? and (2) Where are the highest mercury concentrations found in the nearshore portions of the system? Each year, 12 sites will be selected based on site characteristics such as enclosed embayments, open bay sites, wetlands with differing mercury concentrations, sites in close proximity to mercury mines, and sites near wastewater treatment facilities.

STAFF INVOLVED

SFEI staff involved include: Ben Greenfield, Kat Ridolfi, Jennifer Hunt and Jay Davis.

SCHEDULE AND DELIVERABLES

Deliverable	**Target Date**
RMP Technical Report Draft	December 2010
RMP Technical Report Final	January 2011

SFEI BUDGET

Subtask	**Estimated Cost 2010**

Project Management, Coordination, Data Analysis, and Reporting (SFEI labor)	$54,000
Subcontractor and direct costs	$96,000
Total	$150,000

3.7 RMP-Sponsored United States Geological Survey Studies

The United States Geological Survey (USGS) 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. Because these tasks are undertaken entirely by the USGS, no SFEI labor costs are associated.

Subtask 1 Factors Controlling Suspended Sediment in San Francisco Bay
Since 1993, this element of the RMP focused on monitoring and understanding suspended sediment dynamics in the Estuary through the monitoring of suspended sediments at key locations in the Estuary. This work has yielded many insights into sediment and contaminant dynamics in the Estuary, as summarized in articles by Dr. Schoellhamer in the 2003 *Pulse of the Estuary* and the 2005 *Pulse of the Estuary*.

In 2005, faced with a significant funding shortfall, USGS reduced the number of sites at which it measured suspended sediment concentrations from ten to six (five fixed sites and one temporary site in the vicinity of the aquatic transfer station for Hamilton Air Force base). The proposed sites for 2010 are: Alcatraz, Mallard, Benicia, Richmond Bridge, Hamilton ATF and Dumbarton Bridge. The Richmond Bridge site replaced the Point San Pablo in 2006 because the pier was structurally unsound.

The USGS is also measuring water discharge and sediment flux at the Dumbarton Bridge that is funded by a USGS pilot study for a water quality network for coastal waters (the RMP assisted the USGS in obtaining this funding through our participation in the pilot study).

STAFF INVOLVED
Dr. David Schoellhamer of the USGS in Sacramento, California is the lead investigator for this project. SFEI staff members are not directly involved in this task.

Schedule and Deliverables

Deliverable	Target Date
Progress reports	Quarterly
Annual summary report	December 2010

BUDGET

Because this work is entirely conducted by USGS, no SFEI labor hours are allocated to this task. The total budget for this task is $250,000 (provided by the US Army Corps of Engineers).

Subtask 2 Hydrography and Phytoplankton

This study will continue its measurement program in support of the RMP, with monthly water sampling in 2010 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 at the 2009 Annual Meeting as well as an article in the 2006 *Pulse of the Estuary*. In the 2006 publication, Dr. Cloern and his colleague, Dr. Alan Jassby documented the dramatic change that has occurred in the estuary with the advent of a fall phytoplankton bloom and larger spring blooms. We will continue to monitor these changes.

STAFF INVOLVED

Dr. Jim Cloern of the USGS in Menlo Park, California is the lead investigator for this project. SFEI staff is not involved in this task.

Schedule and Deliverables

Deliverable	Target Date
Annual summary report	December 2010

BUDGET

Because this work is entirely conducted by USGS, no SFEI labor hours are allocated to this task. The total subcontract budget for this task is $110,000.

Task 4 Special Studies

4.1 Understanding the Relative Sensitivity of Terns to PBDEs

OVERVIEW

San Francisco Bay is critical habitat for many birds including several rare and endangered species such as the Least Tern. Some of the highest polybrominanted diphenyl ether (PBDEs) concentrations identified to date have been measured in Bay Area Caspian, Least and Forster's terns. At present, we have very little information to determine whether these concentrations are causing significant effects.

Recent research by the USGS Patuxent Wildlife Research Center suggests that significant effects on the hatching success of American Kestrels can occur at injected concentrations as low as 1.8 ug/g (wet weight). In contrast, mallards were relatively insensitive to exposure to PBDEs. A number of uncertainties exist with these studies as they are egg injection studies rather than a maternally-derived exposure. Nonetheless, maximum concentrations in tern eggs from the Lower San Francisco Bay are in the range of the injected concentrations that elicit effects.

This egg injection study will determine the sensitivity of terns to PBDEs as measured by the hatching, pipping, and survival of the east coast common tern, a surrogate for the San Francisco Bay area Least, Caspian and Forster's terns. It will also evaluate the terns for sublethal effects such as deformities, growth, hepatic, thyroid and immune organ histopathology, and biochemical effects.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study directly addresses the first RMP Level 1 Management Question.

- Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?

Understanding the relative sensitivity of terns to PBDEs is important for interpreting the current Status and Trends egg data for San Francisco terns. In addition this information will be important for determining whether listing for PBDEs is needed.

SUBTASK DESCRIPTIONS

Subtask 1 Egg Collection

Eggs will be collected from a clean site in Chesapeake Bay. The site of collection will likely be Poplar Island, an island created by the US Army Corps of Engineers using clean dredged sediments. Access to the island is restricted by the US Army Corps of Engineers. Once collected, the eggs will be transported to the Patuxent Wildlife Research Center where they will be artificially incubated. Eggs will be candled to determine fertility.

Subtask 2 Injection of PBDEs
Eggs will be randomly assigned to groups of corn oil vehicle control or PBDE treatment (DE-71 formulation) groups receiving analytically verified concentrations of 0.2, 2 and 20 ug PBDE/g egg. Vehicle or DE-71 will be administered at a constant volume (0.5 µl/g egg) into the air cell. Eggs will be monitored by candling and a viability-detecting instrument at 3 day intervals to determine survival through 90% of incubation, and pipping and hatching success.

Embryos that die during development or fail to hatch will be evaluated for stage of development and abnormalities. Day-old hatchlings will be weighed, examined for evidence of edema and teratogenicity, and sacrificed via decapitation. Sex will be determined by examination of the gonads, and the liver, paired thyroid glands, Bursa of Fabricius, spleen and thymus individually weighed. Portions of these tissues will be formalin-fixed for subsequent histopathological examination. Portions of liver will also be stored in liquid nitrogen for biochemical measurements (cytochrome P450 induction, oxidative stress). The remaining carcass will be cleared, and the skeleton stained by the method of Karnofsky for determination of crown-rump, humerus, radius-ulna, femur, tibiotarsus, and metatarsus lengths. Ten eggs (corn oil injected control eggs and eggs cracked or infertile eggs) will be chemically analyzed to determine background concentrations of organochlorine pesticides and pesticide metabolites, PCBs and PBDEs.

Subtask 3 Reporting
The results of this project will be summarized in a RMP technical report.

Staff Involved
This work will be completed by Dr. Barnett Rattner of USGS Patuxent Wildlife Research Center; Dr. Gary Heinz of USGS Patuxent Wildlife Research Center; and Dr. Robert Hale of the Virginia Institute of Marine Sciences (VIMs).

SCHEDULE AND DELIVERABLE

Deliverable	Target Date
Draft Report	November 1, 2010
Final Report	December 1, 2010

BUDGET
The cost to conduct this work is $48,421 and will exclusively be preformed by USGS and VIMs.

WORKGROUP OVERSIGHT
Exposure and Effects workgroup will review this element.

4.2 Sediment Quality Objectives

OVERVIEW

In 2009, the State of California adopted Sediment Quality Objectives that incorporate multiple lines of evidence to assess the health of the Estuary's sediment (i.e., sediment chemistry, sediment toxicity and benthos). At that same time, the RMP began monitoring benthos to provide all three lines of evidence to assess the sediment quality of the Estuary.

Although SQO for bays and estuaries have been adopted, staff from the RMP, SCCWRP, the State Water Resources Control Board, Regional Water Quality Control Board, the USGS, and Department of Water Resources have been meeting to determine how additional SQO assessments will be conducted. The RMP has convened a number of benthic workshops to discuss the development of benthic indices for the oligohaline (freshwater) and mesohaline (moderately saline) portions of the Estuary.

In 2009, the RMP began revising the mesohaline benthic tools for San Francisco Bay. A standardized benthic dataset for San Francisco Bay was reviewed, classification analysis of benthic assemblage data has now been performed; and a best professional judgment exercise commenced. The results of the best professional judgment exercise will be completed in late 2009.

In 2010, we will complete the mesohaline index for the Estuary and develop a chemical score index for San Francisco Bay (a correlation between chemistry and benthos). At present, the chemical score index has been developed for Southern California and it has a poor correlation for San Francisco Bay.

APPLICABLE RMP MANAGEMENT QUESTIONS

- Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?

A. Which chemicals have the potential to impact humans and aquatic life and should be monitored?
B. What potential for impacts on humans and aquatic life exists due to contaminants in the Estuary ecosystem?
C. What are appropriate guidelines for protection of beneficial uses?

SUBTASK DESCRIPTIONS

Subtask 1 Complete mesohaline index
Two existing benthic indices (IBI, RBI) have been previously applied to the mesohaline habitats in the Estuary, and two others (RIVPACS and BRI) are available for testing. These existing mesohaline indices will be evaluated using a standardized dataset of benthic macrofauna data in the Estuary, and index formulations tested. Results from the best professional judgment gradient in the 2009 effort will be used as the benchmark for the mesohaline index performance.

Subtask 2 Conduct workshops to review and communicate results
Two benthic workshops will be held in spring and summer 2010 to communicate results of the mesohaline benthic index work and discuss the potential for development of an oligohaline index for use in SQO assessments.

Subtask 3 Refine relationship between chemistry and toxicity/benthos specifically for the San Francisco Estuary
To date, the CSI chemistry indicator used in SQOs has been developed only using the relationship between chemistry results and benthic indices in southern California. In a recent RMP data integration study, the existing CSI showed weak correlation with San Francisco Estuary benthic data. Therefore, this task will evaluate the relationships between matched chemistry and benthos data specifically in the Estuary. The same approach used in formulation of the CSI for southern California will be used, and applied to those chemicals recommended for use in sediment quality assessment in the SQO Guidance Document. The anticipated product from this task will be a set of CSI thresholds for potential use in the SQO chemistry line of evidence in the San Francisco Estuary.

Subtask 4 Develop RMP capability for analyzing SQO data
In 2008, the RMP began collection of triad data for the use in future SQO assessments. This goal of this task is to develop the capability for the RMP to calculate the SQO assessment scores. RMP staff will work with colleagues at SCCWRP to acquire and adapt software and procedures for the San Francisco Estuary.

Subtask 5 Technical reports
Dr. Thompson will assist Aroon Melwani with two draft technical reports that will summarize the findings of the data analysis and workshops. These documents will be reviewed by SFEI staff, the Exposure and Effects Scientific Advisory Panel, and the Technical Review Committee (TRC). The comments from these groups will be compiled, and Aroon Melwani will be responsible for revising the report based on the comments.

The two reports will be:

a) Benthic Index Development for Mesohaline habitats of the San Francisco Estuary (to be completed by December 31, 2010) and

b) A Status Report that includes a summary of the CSI refinement, and RMP assessment of SQO data (to be completed by December 31, 2010).

STAFF INVOLVED
SFEI leads are Aroon Melwani and Sarah Lowe. Dr. Bruce Thompson will serve an external consultant to the project.

SCHEDULE AND DELIVERABLES

Deliverable	Due Date
Task 1 Complete mesohaline index	August 2010
Task 2 Conduct two workshops	Spring 2010 and Summer 2010
Task 3 Refine CSI	Septermber 2011
Task 4 Develop SQO capability	December 1, 2010
Task 5 RMP technical report Draft and Final	December 1, 2010

BUDGET
Approximately $30,000 has been set aside for this task; $19,200 will be for SFEI labor and the remainder will be for Dr. Thompson ($10,200).

WORKGROUP OVERSIGHT
The Exposure and Effects Workgroup will provide oversight. A benthic workgroup has been formed and will provide guidance and oversight for this ongoing work. The workgroup will also assure consistency with the SQO Phase II efforts in the Delta.

4.3 Developing Land Use Classification Scheme for Monitoring

OVERVIEW
A critical need for prioritizing watersheds to monitor and model is an evaluation of land use characteristics that influence stormwater loads to the Estuary. Eight land use types have been identified as important for Southern California; however, the geology, contaminants of concern, and land use for the San Francisco Bay region are sufficiently different that it is not possible to use this classification system for the Bay Area. The Southern California study observed statistically significant differences for the following land use categories with regard to metal loadings: industrial, recreational, and open space land use.

This project will develop land use classifications (e.g., urban, open space, industrial, etc.) for the Bay Area. In addition to land use, consideration of age and condition of the development (e.g., cracked pavement, poorly maintained facilities, gravel or dirt roads, etc.) will be included in the assessment. The project will identify the highest priority

land use types to be monitored in the future in support of loading studies and will survey these monitoring sites to determine which sites are logistically feasible.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study will aid in the development of models of local watersheds and will inform the design and implementation of land-use specific monitoring. It addresses the following core management questions:

- What are the sources, pathways, loadings and processes leading to contaminated-related impacts in the Estuary?

In addition, it assists in answering the following questions that were developed as part of the Small Tributary Loading Strategy.

- Which are the "high-leverage" small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?

- What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?

- How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?

- What are the projected impacts of management actions on loads or concentrations of pollutants of concern from the high-leverage small tributaries and where should management actions be implemented in the region to have the greatest impact?

SUBTASK DESCRIPTIONS

Subtask 1 Identify land use classes

This task will identify land use classes in relationship to the contaminants that are of high concern for the Bay Area. The classification will likely be based on correlations to mercury, PCBs, copper, and BDEs. The analysis will include an evaluation of age, condition, and the homogeneity of the land use. Where possible, this analysis will be supplemented by literature studies of contaminants in soil and stormwater runoff.

Subtask 2 Develop a list of land use monitoring sites

A list of sites will be developed and evaluated using information from GIS analyses and in consultation with BASMAA. A reconnaissance study will be made to each site to document site specific logistical constraints.

Subtask 3 Summarize findings

A report summarizing the findings of this exercise will be prepared.

STAFF INVOLVED
SFEI staff will undertake this project. Key leads will be Lester McKee, Michelle Lent, Sarah Pearce and John Oram.

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Draft Report	July 2010
Final Report	August 2010

BUDGET
The budget for this task is $30,000, which is almost exclusively SFEI labor.

WORKGROUP
The Sources Pathways and Loading Workgroup will review this element.

4.4 Reconnaissance of High Priority Watersheds

OVERVIEW
The Small Tributary Loading Strategy (STLS) team is currently stratifying watersheds in broad categories in which one or two of the watersheds could be sampled to categorize the loads from the watersheds. Once this list is developed and prioritized, it will be important to assess the watersheds to determine how logistically feasible it is to sample the tributaries (e.g., channel form, access, lighting, safety, etc.)

SCHEDULE AND DELIVERABLES
The deliverable for this task will be a short memorandum and a presentation to the Sources Pathways and Loading workgroup. We anticipate completing this task by June 2010.

STAFF INVOLVED
The following SFEI staff will be involved in this project: Lester McKee and Sarah Pearce.

BUDGET
The budget for this task is $12,000.

WORKGROUP OVERSIGHT
The Sources Pathways and Loading Workgroup will review this element.

4.5 Stormwater Regional Loading Spreadsheet Model

OVERVIEW
One of the priority questions for the Small Tributary Loading Strategy and the Municipal Regional Stormwater Permit is:

- What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?

This project will begin to answer this question by using a model to estimate the mass loadings from Bay Area watersheds. A simple spreadsheet model will be developed using information on such factors as rainfall, land use, and soil type. Because the model assumes that unit area runoff values remain constant for homogenous sub-catchments, the data needs for model are relatively easy to obtain. The model will help evaluate which watersheds are priority watersheds to monitor and to model. It is anticipated that the model will be updated annually to reflect changes in our understanding.

APPLICABLE RMP MANAGEMENT QUESTIONS
In addition to the more specific Small Tributary Loading Strategy listed above, this project will help address the larger RMP management question presented below.

- What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?

SUBTASK DESCRIPTIONS

Subtask 1 Compile local GIS layers
This model will be based on the work by Ha and Stenstrom which requires information such as rainfall, land use type, and hydrologic soil groups. GIS information will be compiled and collated for the model.

Subtask 2 Refine input data
Runoff coefficients, slope and land use data will be adjusted to reflect field data. Precipitation data may only be available at limited locations within a given watershed and as a result, it may be necessary to spatially interpolate the data.

Subtask 3 Model calibration
Once the model is compiled, it will be calibrated using local runoff data for watersheds with differing land use, slope and soil characteristics

Subtask 4 Model documentation
The model will be documented in a report. It is anticipated that the model will be updated annually as new information becomes available.

STAFF INVOLVED
SFEI staff will undertake this project. Key leads will be Lester McKee, Michelle Lent, Sarah Pearce and John Oram.

SCHEDULE AND DELIVERABLES
The RMP technical draft will be completed by November 2010 with a final report available December 2010.

BUDGET
The budget for this task is $35,000 which is solely for RMP staff.

OVERSIGHT WORKGROUP
The Sources Pathways and Loading Workgroup will track this project and review the summary report.

4.6 Conceptual Model for Bioaccumulation

OVERVIEW
The RMP is about to embark on a new multi-year modeling initiative to predict recovery under different management scenarios. This program will develop a set of models that link inputs from watersheds, fate at the Bay margins, and fate in the open Bay. Biota are the key indicators of impairment due to the pollutants of concern. Ultimately, the models must therefore be able to predict contaminant exposure in target indicator species. The Contaminant Fate Workgroup has advised that it is critically important to ensure linkage of the abiotic models to the food web from the start of model development. This linkage would aid in focusing future investments in modeling effort. A clear conceptual linkage between the abiotic and food web processes will help to generate useful model output. The CFWG Advisory Panel has indicated that overlooking this linkage in other regions has resulted in unsuccessful modeling efforts.

There are many gaps in our understanding of how contaminants of concern move into the Bay food web. These include the processes of contaminant flux from abiotic compartments (sediments and water column) to biota (e.g., plants, invertebrates, fishes, birds, mammals, and humans). These gaps also include the relationships between spatial movements of sediment and of biota, and contaminant bioaccumulation processes. Even for mercury and PCBs, which have received much attention through the TMDL process, where, when, and how these contaminants enter the food web is not well known. The Mercury Strategy Team has placed a major emphasis on gathering empirical information (through the small fish monitoring) to address this information gap. The PCB Strategy Team has also identified this as a critical gap in understanding why PCBs in sport fish are not declining and do not seem to be tracking general declines in sediment. The food web model developed for PCBs as part of the TMDL was not spatially or temporally explicit. A more precise understanding of the entry of mercury, PCBs, and other contaminants of concern into the food web will provide a sharper focus for management actions to reduce

impairment. This understanding should result in more cost-effective management decisions. In summary, we must develop and document our conceptual understanding of bioaccumulation to devise appropriate predictive models and management strategies.

This project will develop a detailed conceptual model of contaminant uptake by biota. The conceptual model will emphasize the roles of sediment and biota movement, drivers of spatial and temporal variation in contaminant exposure, variability in food web uptake, and attributes of local organisms (e.g., lipid and body size). The goals of the conceptual model development include:

- Summarize currently available information on how contaminant movement and biological processes influence bioaccumulation in the Bay
- Identify key processes with high importance and uncertainty, as priorities for future research
- Help to focus stakeholder and manager attention on specific questions to be addressed by future modeling and management intervention.

APPLICABLE RMP MANAGEMENT QUESTIONS

The primary question addressed by this proposal is the following.

- What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?

Specifically the project will address the following questions.

Question 1: How do spatial movements of contaminants and biota affect bioaccumulation? The conceptual model will consider the impact of contaminant and biota movement patterns on bioaccumulation. For example, the model will consider which spatial scales of biota movement (e.g., tidal mixing of plankton vs. sport fish and bird migration) are most likely to cause differences in contaminant uptake at relevant scales for management. The study will also evaluate spatial movements of well-characterized species of concern (e.g., harbor seals, least tern, and green sturgeon), in comparison to Bay contaminant distribution.

Question 2: What are primary determinants of spatial and temporal variation in contaminant bioavailability and bioaccumulation? Understanding where and when contaminants enter the food web is critical in determining how to reduce human and wildlife exposure. Previously, we have hypothesized that watershed sources (e.g., industrial watersheds, mines), legacy contaminated sediments, and within-bay processes (e.g., mercury methylation) each contribute to food-web uptake of priority pollutants. The conceptual model would refine these hypotheses and identify which potential drivers seem to be most important, based on recent literature and local studies.

Question 3: What are the key linkages and mechanisms for food-web contaminant uptake? Prior research has demonstrated that specific processes strongly influence contaminant bioaccumulation. For mercury, net methylation has been demonstrated to

strongly control food web biomagnification (Wiener et al. 2002). For chlorinated organic pollutants, partitioning between sediments and porewater is an important driver (Clark et al. 1988). The conceptual model will incorporate the current state of knowledge of these processes, with particular emphasis on the growing body of local research (e.g., Cho et al. 2007, Conaway et al. 2008). Important and locally uncertain rates will be identified as potential areas for future study.

Question 4: How should a biota model be linked to the abiotic model of contaminant flux in sediments and water? The Gobas food web model has been successfully applied to persistent organic pollutants in the Bay, including a probabilistic treatment of spatial and temporal variation in contaminant food web uptake (Gobas and Arnot 2005). However, there are further opportunities to evaluate spatial and temporal variation in biota uptake of contaminants, in a combined contaminant transport and biota uptake model. A clear vision must be developed on the appropriate management questions and scale of analysis for linking the food web and contaminant fate models. Potential approaches include: 1. linking separate food-web simulations in different parts of the Estuary to spatially explicit output of contaminant fate models; 2. incorporating an individual based modeling approach to evaluate variability in expected dietary uptake patterns, based on local fish and wildlife migration patterns; and 3. building in temporal variation in uptake patterns based on seasonal differences, age-specific physiology changes, or long-term changes in contaminant bioavailability. The conceptual model development will consider which of these approaches are likely to be feasible and beneficial, based on our current understanding of the key drivers of contaminant uptake in the Bay.

Question 5: What are priorities for future study and management attention? Based on the findings from the conceptual model development, we will make recommendations on how the RMP and related programs should focus their limited resources. This will emphasize research studies that would have practical consequences for forecasting or controlling future biotic exposure to priority pollutants. This will result in a multi-year plan for integrating food web modeling with the abiotic modeling.

APPROACH

We will develop a conceptual model that evaluates the relative importance of different sources and spatial locations in determining contaminant fate and bioaccumulation to the San Francisco Bay food web. Four general activities are proposed.

Subtask 1: Literature review The literature review will evaluate the latest findings from the Bay and elsewhere on food web transfer pathways for contaminants. The review will build upon relevant components of previous conceptual models (Davis et al. 2006, Tetra Tech 2006). It will also include consultation with experts on their unpublished findings and their conceptual understanding of key drivers.

Subtask 2: Synthesis of recent RMP information This component of the study focuses on applying data recently collected by the RMP to the specific questions of this

study (refer to previous section). Data to be examined will include relevant field data on spatial patterns and drivers of pollutant exposure (Ackerman et al. 2008, Greenfield and Jahn 2009, Melwani et al. 2009), as well as results of relevant modeling studies (Gobas and Arnot 2005, Oram and Melwani 2006, Oram et al. 2006). On a limited basis, new simulations will be performed using readily available models, such as the PCB food web model, and the PCB and mercury fate models.

Subtask 3: Develop conceptual model Based on the findings of the first two tasks, a conceptual model will be developed. The conceptual model would particularly emphasize areas of uncertainty that interfere with understanding of contaminant movement and uptake.

Subtask 4: Technical report of findings Once Tasks 1 through 3 are complete, a short (15 – 20 pp) Technical Report will be drafted. This Technical Report will outline the results from the literature review and synthesis exercise, as well as a graphical presentation of the resulting conceptual model. It will also propose a multi-year plan for the future course of action integrating food web and contaminant fate modeling. This document would be made available to the TRC and other RMP participants for peer review and revised according to review comments.

SCHEDULE AND DELIVERABLES

A draft report will be prepared by August 2010 and the findings will be presented to the Contaminant Fate Workgroup. Based on the comments from the group, the document will be revised and a final report will be made available in September.

BUDGET

The budget for this task is $40,600 (RMP staff).

WORKGROUP OVERSIGHT

The Contaminant Fate Workgroup will review this element.

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4.7 Monitoring Small Fish for PCBs

OVERVIEW

As demonstrated through the small fish monitoring described under Status and Trends, small fish are an ideal indicator of short term uptake of contaminants into the food web. Small fish integrate contaminant exposure over a one-year period and have high site fidelity. In 2010, we begin our last year of a three-year intensive monitoring of small fish for mercury. This sampling exercise presents a unique opportunity to augment the analyses of these small fish for PCBs. Although the RMP routinely monitors sport fish for organics including PCBs (every three years), very little contaminant information is available for prey fish.

A small number of small fish were analyzed as part of an RMP pilot study in 2007 (six composite samples) and surprisingly high concentrations of PCBs were observed in these fish (averaging 198 ng/g, well above the TMDL target of 10 ng/g). These concentrations were on par with concentrations that we have observed in much higher trophic-level fish.

This project would provide funding for analyzing PCBs in small fish that will be collected at 44 sites as part of the small fish mercury project. In addition, a compilation of existing small fish surveys from other studies (e.g., Superfund site remedial

investigations and characterizations, Montezuma Wetlands Restoration program, etc.) will be conducted as part of this project.

APPLICABLE RMP MANAGEMENT QUESTIONS

- Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?
- What are the concentrations and masses of contaminants in the Estuary and its segments?
    - Do spatial patterns and long-term trends indicate particular regions of concern?
      Small fish are sensitive indicators of PCB accumulation and will provide information on finer temporal and spatial scales than other biota monitored in the RMP – information that is more directly indicative of high leverage pathways.
- What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?
    - Which sources, pathways, and processes contribute most to impacts?
      Small fish are sensitive indicators of PCB accumulation and will provide information on finer temporal and spatial scales than other biota monitored in the RMP – information that is more directly indicative of high leverage pathways.

In addition, this element will help to specifically address questions articulated in the PCB Strategy including the following.

1. **What management actions have the greatest potential for accelerating recovery or reducing exposure?**
    - Studies that improve our understanding of linkage of high leverage pathways to beneficial use impairment
        - Small fish (similar to mercury strategy)

2. **What potential for impacts on humans and aquatic life exists due to contaminants in the Estuary ecosystem?**
    - Wildlife exposure: Small fish are a valuable indicator of exposure for piscivorous wildlife.

SUBTASK DESCRIPTIONS

Subtask 1 Prey Fish Collection and Analysis

Forage fish would be targeted at all 44 locations to be sampled in 2010. The collection locations are shoreline areas distributed throughout the San Francisco Estuary. A single-species composite sample will be targeted at each available collection location, with the emphasis on collecting the most abundant pelagic prey species in each location. A composite from a secondary species will also be collected, where available. In two locations, triplicate samples will be collected to aid in determining variability in concentrations within a location.

Based on the previous collection effort, inland silverside are likely to be available in polyhaline locations of salinity 20 to 26 psu, and topsmelt are likely to be available in the more euhaline locations (27 to 30 psu). Additional collection effort will be made to obtain composites including the necessary tissue amounts for these samples (10 – 30 g fresh tissue mass per sample).

Pending feedback from relevant review committees, the samples will either be analyzed for 209 congeners or 40 congeners. Analyzing for 209 congeners is more expensive so fewer samples will be analyzed.

Subtask 2 Synthesize and compile data from other relevant studies and write a report

The data will undergo data validation and review. Once collated, a review of relevant Bay area literature will be conducted to identify other relevant small fish data (e.g. Superfund site remedial investigations and characterizations, Montezuma Wetlands Restoration program, etc.). The results from these studies will be synthesized in a report. The primary reporting objective will be to document spatial patterns in total PCBs in the Bay. The findings on tissue concentrations will be reported by SFEI staff, along with the mercury concentration findings of the project. This would include patterns in both RMP data and other available data sets. Additionally, the congener profile data would be evaluated and compared to other RMP data to assess spatial patterns in sources.

SCHEDULE AND DELIVERABLES

Deliverable	Due Date
Task 1 Sample Collection	Fall 2010
Task 2 Synthesis of San Francisco Bay knowledge	Winter 2010
Task 3 Preparation of a draft and final report	Spring 2011

BUDGET
The budget for this task is $50,000; $17,000 for SFEI labor and $33,000 for subcontractors.

Workgroup Oversight
The Contaminant Fate and Exposure and Effects workgroups will review this element.

4.8 Dioxin in Tributaries

San Francisco Bay was placed on the State of California's 303(d) list of impaired waters in 1998 as a result of elevated concentrations of dioxins and furans (commonly referred to as only 'dioxin') in fish. RMP studies of contaminants in Bay sport fish conducted every three years since 1994 have found that dioxin concentrations have remained relatively unchanged over this time period and in some species, continue to exceed screening values for human consumption. Our understanding of dioxin in the Bay is extremely limited however and improving this is a necessary first step in the process to reduce concentrations in Bay fish and resultant health risks to fish-eating humans and wildlife. One of the most significant areas of uncertainty is the load from the tributaries. In the Dioxin Conceptual Model/ Impairment Assessment the highest load by a factor of five is stormwater from tributaries, but this was based on monitoring of a single storm event.

This year presents a unique opportunity to sample two major tributaries to the Estuary, the San Joaquin/Sacramento River (Mallard Island) and the Guadalupe River, for dioxin. Whole water samples will be collected for dioxin analysis during four storm events per year. Dioxin concentrations in water samples from these studies will be used to refine the loading estimates provided in the CEP Conceptual Model/Impairment Assessment report by providing additional data on loadings from the Central Valley watershed and small tributaries that receive primarily urban runoff.

DIOXIN STRATEGY QUESTIONS

Recognizing that there was a dearth of information, the RMP stakeholders developed a Dioxin Strategy in 2008 that prioritized the information needs and articulated a series of studies to be undertaken over the next five years. In 2010, two tributaries have been targeted for sampling and analysis: Guadalupe River and the confluence of the Sacramento and San Joaquin rivers (Mallard Island). The following Dioxin Strategy questions will be addressed through the study of these two tributaries:

2. What is the spatial pattern of dioxin impairment?

The distribution of dioxin concentrations in the Bay presently represents a major information gap. Information on spatial variation in sediment and/or wildlife concentrations may allow management actions to focus on regions of the Bay where

concentrations are highest and provide information on the influence of different dioxin loading pathways (e.g., runoff from the Central Valley watershed vs. highly-urbanized Central and South Bay).

4. Have dioxin loadings/concentrations changed over time?

Due to the potentially large historical releases of dioxins, an estimate of the historical loadings is needed to put current dioxin loads in perspective. Changes over time in dioxin loadings and concentrations in wildlife have the potential to influence management actions to reduce dioxin impairment in the Bay.

5. What is the relative contribution of each loading pathway as a source of dioxin impairment in the Bay?

Management of dioxin loadings requires an understanding of the relative contribution of each potential loading pathway to the Bay from external sources (inputs from the Central Valley watershed, municipal and industrial wastewater discharges, urban and non-urban stormwater runoff, and direct atmospheric deposition). Estimates of dioxin loading from each pathway are needed for assigning load allocations as part of a strategy for reducing impairment in a dioxin TMDL.

SUBTASK DESCRIPTIONS

The dioxin strategy is a multi-year strategy. In 2010, the major focus will be on the collection of tributary samples from two systems (i.e., Guadalupe and Mallard). Sixteen water samples will be collected as part of the watershed monitoring. This sampling will occur in the wet season of 2009/2010.

STAFF INVOLVED

This task will be led by Susan Klosterhaus and Don Yee with assistance from the wet weather sampling team.

SCHEDULE AND DELIVERABLES

Deliverable	Date
Fieldwork	Fall- Winter 2009/ 2010
Data validation	Spring 2010
Summary presentation to TRC	Summer/Fall 2010

BUDGET

The budget for this element is $68,000. Approximately $26,000 of this is SFEI labor to coordinate activities, conduct limited field work, conduct data validation, and summarize results to the TRC; $6,000 is for direct costs (shipping of samples); and $36,000 is for the laboratory analyses.

4.9 Three-Dimensional Model of San Francisco Bay

Developing models to predict the effect of different management alternatives on loads from watersheds, the recovery of contaminated areas on the Bay margin, threats from emerging contaminants, and the recovery of the Bay as a whole has been identified as a high priority by RMP stakeholders. This capacity will be gained through the development of conceptual and numeric models of the physical, chemical, and biological processes governing the fate of water, sediment, and pollutants of concern in San Francisco Bay and its associated watersheds. RMP modeling will allow managers to predict, prioritize, and optimize the impacts of actions aimed at improving water quality. The overarching goal of the RMP, and the intent of the RMP modeling strategy, is to provide the information needed to support water quality management decisions.

A five-year workplan for Bay modeling that provides a detailed description and rationale for model development is currently being written in preparation for the December TRC meeting. The plan for tasks in 2010 is described below.

Modeling San Francisco Bay on a flexible grid represents the best potential for addressing the management questions for the Bay and Bay margins. A key advantage of a flexible grid is its ability to increase 'accuracy' in dynamically important areas (through grid refinement) and reduce it in other areas. Modeling the Bay with a flexible model would thus implicitly allow for the interaction of fine-scale processes occurring at the Bay Margins with the larger-scale processes of the Bay proper.

Researchers from Stanford and University of California at Berkeley are currently developing a model of San Francisco Bay with special emphasis on the South Bay Salt Pond restoration efforts. The model (named SUNTANS) is being developed under the open-source software development paradigm. Under this task, we will develop a South Bay SUNTANS grid that includes local tributaries and Bay margins.

APPLICABLE RMP MANAGEMENT QUESTIONS

- Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?
- What are the concentrations and masses of contaminants in the Estuary and its segments?
- What are sources, pathways, loadings, and processes leading to contaminant-related impacts to the Estuary?
- What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?

In addition, this model will begin to develop the capacity to answer the following questions articulated in the Modeling Strategy.

1. **Recovery of the Bay**
   What patterns of exposure are forecast for major segments of the Bay under various management scenarios?

   - Addressing this priority question requires knowledge of the physical, chemical, and biological processes occurring at a regional spatial scale and a long-term temporal scale.

SUBTASK DESCRIPTIONS

The primary goal of this task is to incorporate Bay watersheds into the SUNTANS Bay model. The rationale for incorporating Bay margins into the model is to develop an understanding of how sediments and contaminants from small, local watersheds that drain into South San Francisco Bay are transported and distributed under the influence of tidal, wind and buoyancy forcing. As the SUNTANS model is refined, we anticipate applying the sediment transport module to the analysis of this transport. In this first year, we will assess possible locations for the studies, develop the necessary grid and forcing information, and perform preliminary transport studies for passive scalars and Lagrangian particles defined to approximate the movement of watershed-sourced sediment.

Subtask 1 Identification of study sites

The first three months of the project will be focused on assessing possible study sites. Candidates include the Coyote Creek-Guadalupe Slough complex, small eastside tributaries (such as Zone 4 Line A), the Alameda Flood Control Channel, and San Leandro Bay. Considerations for the choice of sites will include the availability of bathymetry data, data from the watershed for freshwater and, eventually, sediment fluxes, and the management importance of the sites. Our goal is to identify 3 sites that can be the emphasis for future studies. Specific tasks include:

- Assess available data in candidate habitats around perimeter of South SF Bay;
- Establish which three sites will be the focus of the study; and
- Evaluate which historical periods will be simulated at each site.

Subtask 2 Initialization of bathymetric grid

Model input data will be processed and analyzed in order to initialize the bathymetric grid and the velocity and scalar fields, and to provide boundary forcing. Grid generation will focus on the highest priority of the three sites identified in the first quarter. Specific tasks for second quarter:

- Acquire and process data as needed for bathymetry and forcing and
- Generate grid for highest priority site.

Subtask 3 Simulations
Under this subtask, we will begin simulations on the grid generated for the first of the 3 sites and generate the grid for the 2nd site. Particle tracking modeling, including settling particles, will begin for the first site. Specific tasks for third quarter:

- Simulate hydrodynamics and passive scalar transport for first site
- Particle tracking modeling for first site
- Analysis of particle tracking and scalar transport will examine deposition patterns
- Generate grid for second site

Subtask 4 Analysis of Particle Tracking
Simulations will be done during this final quarter on the first two grids for the periods of interest. A third grid will also be generated which focuses on the third site identified to be of interest. Particle tracking model results will be analyzed from the first two sites. Specific tasks for fourth quarter:

- Analyze and present results from first site
- Simulate hydrodynamics and passive scalar transport for second site
- Particle tracking modeling for second site
- Using particle tracking and scalar transport results, develop description of sediment transport from small perimeter watersheds
- Generate grid for third site

SCHEDULE AND DELIVERABLES

Deliverable	**Due Date**
Subtask 1 Identification of potential study sites	April 1 2010
Subtask 2 Initialization of the bathymetric grid	July 1 2010
Subtask 3 Simulations	October 1 2010
Subtask 4 Analysis of particle tracking and summary report of findings. Presentation to the TRC and workgroup	December 2010

BUDGET
The budget for this task is $100,000; $20,000 for SFEI labor and $80,000 for subcontractors (model partners).

WORKGROUP OVERSIGHT
The Contaminant Fate Workgroup will review this element.

4.10 Screening of Biological Matrices for Anthropogenic Pollutants

Significant advances in analytical techniques present an opportunity for the RMP to conduct broad non-targeted scans of San Francisco Bay biota to potentially identify chemicals of emerging concern. Recent advancement in Gas Chromatography (GC)-GC time of flight and GC-Liquid Chromatography (GC-LC) time of flight at the National Institute for Standards and Technology (NIST) has allowed NIST to screen human samples to determine which chemicals of emerging concern are accumulating in humans. NIST will apply a similar broad scan approach to San Francisco Estuary samples to identify previously unmonitored anthropogenic chemicals. While labor intensive, this approach has the potential to direct our monitoring efforts to the chemicals that are actually accumulating in biota, rather than conducting extensive and expensive monitoring of biota without an indication that the contaminants are bioaccumulating.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study will address the following RMP Management Questions.

Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?

- A: Which chemicals have the potential to impact humans and aquatic life and should be monitored?

What are the concentrations and masses of contaminants in the Estuary and its segments?

- A: Do pollutant spatial patterns and long-term trends indicate particular regions of concern?

SUBTASK DESCRIPTION

Tissue samples from mussels and harbor seals will be used to characterize chemical exposure to the entire Bay foodweb. Samples from harbor seals, which represent exposure to the entire Bay foodweb, will be collected by personnel from The Marine Mammal Center (TMMC) using a protocols developed by NIST. Because tissues may accumulate different types of pollutants, samples of blubber, liver and blood will be collected. Only samples collected from stranded seals or seals that died at the TMMC will be used because of the large amount of sample required. Samples of mussels will be analyzed to characterize exposure to chemicals that are metabolized by higher trophic level species. Mussels that are deployed as part of the 2010 RMP Status and Trends monitoring will be used. Rather than analyzing samples from several individual seals or mussel deployment sites, analyses of harbor seal tissues and mussels will be conducted on a limited number of pooled samples so that a sufficient amount of material is available for a variety of analytical approaches.

Samples of mussels and seals collected from reference locations will also be analyzed so that chemical exposure specific to Bay processes can be determined. Reference site

mussel samples will be collected from Bodega Bay, CA, coinciding with RMP monitoring in 2010. Samples collected from the Arctic, currently in storage at NIST or available from Derek Muir (Environment Canada), will likely be used as the reference site for the seals.

The samples will be screened for as many anthropogenic pollutants as possible using a variety of analytical techniques. The compounds to be screened or determined in the samples will include: brominated flame retardants (e.g., PBDEs and HBCD as well as new BFRs); perfluorinated compounds; phenolic compounds (e.g., hydroxylated metabolites of PCBs and PBDEs); methyl sulfone metabolites of PCBs and DDE; and nonpolar compounds (e.g., cyclic siloxanes and musk compounds).

This project is a two-year project as it is somewhat exploratory in nature and will require additional method development for screening samples. Screening of samples by mass spectrometry requires a high level of expertise and is labor intensive.

SCHEDULE AND DELIVERABLES

The primary outcome of this work will be a list of previously unmonitored chemicals present in Bay organisms which will be used to inform future RMP monitoring efforts.

A progress report outlining significant findings will be made to the Emerging Contaminant workgroup and the TRC.

BUDGET
The budget for this task for the first year is $55,000 of which $5,000 is for SFEI labor.

WORKGROUP OVERSIGHT
The Emerging Contaminant workgroup will review this element.

4.11 Atmospheric Deposition Strategy

At the September 2009 Technical Review Committee meeting, it was requested that RMP staff develop a strategy for assessing atmospheric loads to the Estuary. Interest in atmospheric loads is driven by recent studies that suggest atmospheric loads of some contaminants such as mercury can be significant. Because it is difficult to accurately measure atmospheric deposition, the Committee recommended that a strategy be developed that articulates which contaminants should be included and how the loading will be measured.

Staff Involved
This task will be led by Don Yee and will be reviewed by the Contaminant Fate Workgroup.

Budget and Deliverables

The budget for this element is $10,000. A written draft Atmospheric Deposition Strategy will be prepared for the Contaminant Fate workgroup and TRC in the spring.

Table 1 Projected 2010 Budget

Task	Labor Cost	Subcontracts and Direct Costs
Program management	$491,000	$70,000
Data management	$349,000	
RMP website	$5,000	
Information dissemination	$112,000	$22,000
Annual reporting	$117,000	$30,000
QA/QC	$28,000	
Status & Trends (S&T) Fieldwork	$53,500	$570,000
S&T Benthos	$10,000	$50,750
S&T Sport fish monitoring	$9,000	
S&T Small trib. Monitoring	$55,800	$94,200
S&T Large trib. Monitoring	$64,400	79,220
S&T Sediment toxicity (Molecular TIE)	$2,800	$57,200
S&T Small fish	$54,000	$96,000
S&T Vessel		$50,000
S&T USGS Monitoring		$360,000
PS: PBDEs: Relative sensitivity in terns		$48,500
PS: Monitoring small fish (PCBs)	$17,000	$33,000
PS: SQO Development	$19,200	$10,800
PS: Scoping needs for land use	$29,500	$500
PS: Reconnaissance of representative watersheds	$11,500	$500
PS: Develop stormwater regional loading model	$35,000	
PS: Conceptual bioaccumulation model	$40,600	
PS: Dioxin in tributaries	$26,000	$42,000
PS: 3D Model	$20,000	$80,000
PS: Screening of biological matrices for EC	$5,000	$50,000
PS: Atmospheric deposition strategy	$10,000	
Carryover Tasks 2009	TBD	
Total Cost	**$1,564,300**	**$1,541,120**