

Regional Monitoring Program

2011 Detailed Workplan

DRAFT

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Table 1 Projected SFEI Costs for 2011

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

2011 Detailed Workplan

Overview

This document is the detailed workplan that describes the major RMP elements and tasks to be completed in 2011. It is the guiding document for planning and allocating funds for 2011. The workplan is divided into Program areas or tasks. For each 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 2011. 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 2011 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 four 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 2011.

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 have been formed to implement strategies for select topics including: mercury, small tributary loading, modeling, dioxins, PCBs, and atmospheric deposition. 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), 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.

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, troubleshooting, scheduling, and implementing course adjustments as necessary, cost-effectiveness/performance evaluations of existing contractors and identifying potential new subcontractors as needed.

1.4 Program Planning

Program planning for the RMP involves several tasks including the development of the Program Plan and the Detailed Workplan and development of scopes of work, both internally and externally for contracts. In 2010, an RMP Master Plan was developed based on information needs of our stakeholders. The plan articulates key studies to be undertaken in the next five years. The RMP Master Plan will be updated annually to reflect new knowledge gained and changes in priorities of our stakeholders. Part of the RMP Master Planning process is conducting an annual workshop in which priorities are articulated. This meeting is scheduled for early February of 2011.

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 2011
Internal Coordination	\$323,000
External Coordination	\$25,000
Contract and Financial Management	\$160,200
Program Planning	\$12,500
Total	\$520,700

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 means 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 2011 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 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 one of the State's Regional Data Centers. Data related to the San Francisco Bay stored in SFEI's database are 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/CEDEN database formats.

Subtask 2.3 Develop and Maintain a database of samples archived through the National Institute of Standards and Technology (NIST)

The RMP is collaborating with NIST to house RMP biological samples in long-term state of the art facilities. A data base has been developed to track these samples, and to maintain this data base as samples are added, removed, and modified.

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, Adam Wong, Shira Bezalel, 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 2011 is presented on the table below.

Subtask	Estimated Labor Cost 2011
Data Formatting, QA/QC, and Upload	\$239,500
Database Maintenance, GIS, and Web Access	\$98,900
Data Management Efficiencies	\$24,400
Total	\$363,000

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 program page; and improving the overall design of the RMP web site.

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 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 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: Jeff Mueller, Linda Wanczyk, Joanne Cabling, Meg Sedlak, Cristina Grosso, 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 2011 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 addition in 2011 the RMP will 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 annual 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.

Newsletter production tasks include: soliciting/planning articles; writing and editing; developing the illustration design and layout; and coordinating mailing of the newsletter.

Subtask 1.2 ESTUARY Insert

The *ESTUARY* Insert is 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.

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. In 2011, we plan to focus on developing factsheets for chemicals of emerging concern (CEC).

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 keeps track of all publications that use mainly RMP data. Each publication is assigned an SFEI Contribution number and entered into an EndNote database in full bibliographic format. Though the contribution list also includes other SFEI programs 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, 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 RMP 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 2010, the RMP Annual Meeting/ Pulse received extensive coverage on the radio, television and in numerous newspapers (e.g., San Francisco Chronicle and San Jose Mercury News). In addition, individual staff members frequently serve as technical resources for reporters for stories of both local and national significance.

Staff Involved

Most SFEI staff are involved in some aspect of Information Dissemination. Technical staff write articles for the Pulse, newsletter, and Estuary insert. Graphics staff are 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
<i>ESTUARY</i> insert	October
Factsheets	On-going
RMP Record of Publications	On-going
Posters and Presentations	On-going
Annual Meeting	September
Press Outreach	On-going

Budget

The estimated budget for information dissemination for 2011 is presented below.

Subtask	Estimated Labor Cost 2011
General Information Dissemination (e.g., presentations, RMP News, <i>ESTUARY</i> insert, posters, factsheets, etc.)	\$61,500
Press Outreach/Program Development	\$5,000
RMP Annual Meeting	\$50,000
Total	\$116,500

2.4 Annual Reporting

Annual reporting consists of the preparation and production of the *Annual Monitoring Results* and the *Pulse of the Estuary*. The *Pulse of the Estuary* is also published in hardcopy.

Subtask 1 2010 Annual Monitoring Results

This report will present eight years of randomized sampling for water and sediment. It will follow a format similar to the *2009 RMP Annual Monitoring Results*. Data will be presented in the form of maps with bubble plots of contaminant concentrations at each site. Box plots and cumulative distribution frequency plots, by segment, will also be reported. The *Annual Monitoring Results* is a web-based report with downloadable maps and figures.

Subtask 1.1 Preparation of the Annual Monitoring Results

Web-ready graphics and various tables, including analyte lists, will be reviewed and updated. Introduction, water, sediment, tissue and QA/QC chapters will be updated to reflect the 2010 data.

Subtask 1.2 2010 Annual Monitoring Results Distribution

The *Annual Monitoring Results* document will be made available through the RMP website *Documents and Reports* link. The 2010 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 2011 Pulse of the Estuary

The theme of this year’s *Pulse* will be “Contaminant Effects on Aquatic Life”. The 2011 *Pulse of the Estuary* will be finished in time for the Annual Meeting (typically the first week in October).

A more detailed outline will be developed under guidance of TRC and SC. First drafts of articles will be sent out for review in April. 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: Amy Franz, Meg Sedlak, John Ross, Cristina Grosso, Jennifer Hunt, and Nicole David. Leads on the *Pulse* will include: Jay Davis, Meg Sedlak, and Linda Wanczyk.

Schedule and Deliverables

A detailed schedule of tasks is presented below.

Deliverable	Target Date
<i>2010 RMP Annual Monitoring Results</i> – Final on web	December 2011
<i>2011 Pulse of the Estuary</i>	September 2011

Budget

The estimated SFEI labor budget for the *Annual Monitoring Results* and the *Pulse of the Estuary* for 2011 is presented on the table below.

Subtask	Estimated Labor Cost 2011
<i>Annual Monitoring Results 2010</i>	\$37,500
<i>Pulse of the Estuary 2011</i>	\$89,000
Total	\$126,500

2.5 Quality Assurance

OVERVIEW

Planned tasks for 2011 include:

- completing the update of the Quality Assurance Program Plan (QAPP);
- analyzing data from special QA studies;
- optimizing metal analyses, and
- culling the short-term archives.

BACKGROUND

The RMP QA 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. The RMP has been involved with method development since its inception in the early 1990s. At that time, the RMP supported trace metal analyses in academic settings; these methods have now become standard methods in commercial laboratories. Similarly, the RMP is working with AXYS Analytical to develop new organic methods for analyzing pharmaceuticals and chemicals of emerging concern (e.g. the CEC analyses sediment, water and biota as part of a pro bono exercise). Where possible, the RMP supports continuous performance evaluation exercises. Most of the RMP contract laboratories participate in NIST intercomparison exercises.

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 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 2011, 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. This task will be completed in 2011.

Subtask 2 Laboratory/Sample Intercomparisons (RMP Status and Trends)

The RMP conducts periodic QA studies such as blind field samples, duplicate field samples collected by different methods, 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 2011.

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 the Lower South Bay 20 to 25 percent higher than in previous years and higher than results reported by City of San Jose (CSJ) laboratory. An extensive QA review was conducted; however the cause of the variation was not

determined. Results in 2008 were more comparable between labs (~5% difference) and 2009 results were similar (average 13% difference), with no consistent bias (some results higher from CSJ and others higher from BRL). A portion of the QA budget will be set aside to continue the comparison.

Subtask 3 Optimizing Trace Element Methods (RMP Status and Trends)

In 2009, a high bias in selenium 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 identified interference issues preventing quantitation for selenium analyses in water by the previous GFAAS method, and has switched to an ICP-MS method. The average and range of selenium concentrations measured by the new method in 2009 were similar to previous years. We will continue to work with the lab on comparing alternative methods for this and other analytes as needed.

Subtask 4 Culling Archives

In 2010, we completed our Archive Sample Protocol and began a collaboration with the National Institute of Standards and Technology (NIST), in which NIST will serve as a long-term repository for our biological samples. We will continue to maintain short-term storage of samples in an off-site freezer in Oakland. Now that the Archive Sample Protocol has been approved, the samples in our existing short-term storage need to be reviewed to assure that it is consistent with our protocol and culled in cases where the samples are compromised or not needed.

Staff Involved

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

SCHEDULE AND DELIVERABLES

The main QA task for 2011 will be updating the QAPP; we anticipate completing this by December 2011.

BUDGET

The estimated SFEI labor budget for QA/QC is approximately \$29,000.

Task 3 Status and Trends Monitoring

The Status and Trends (S&T) Program is composed of four elements: long-term water, sediment, and bivalve monitoring; sport fish bioaccumulation; bird egg monitoring; and the USGS hydrographic and sediment transport studies. In 2007, the S&T monitoring program underwent a significant redesign in which each aspect of the monitoring program was evaluated by the TRC and SC to determine how well it answered the priority management questions. In response to this exercise, several modifications were made to S&T including: reducing the number of water sites and adding in benthic sampling and bird egg monitoring. In 2011, we will develop a strategy for Status and Trends that summarizes the major findings to date and articulates the strategy for answering the key management questions.

The 2011 RMP sampling will mark the ninth year of using a randomized sampling design. The S&T monitoring program switched from a fixed sampling design to a randomized design in 2002. 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. In 2010, the program switched from a five-year rotating panel to a six-year rotating panel to address wet weather sediment sampling which occurs every other year (e.g., next wet weather sampling event will be 2012). 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?

Randomized sampling provides representative characterization of contamination within each Bay segment to determine whether chemicals are at levels of concern for human health and biota. These data are also used to track trends and to develop models to estimate current and future loadings and concentrations in the Bay.

Beginning in 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 was conducted in 2010 at a reduced number of sites (i.e., 27 vs. 47 for dry weather sampling), and all samples were analyzed for the full sediment triad of chemistry, toxicity, and benthos.

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 of benthic community assessments.

Subtask 1 Water Chemistry

In 2011 conventional water quality, trace metals, and trace organics sampling in water will occur during the summer dry season. As part of the 2007 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 the exception of PBDEs for which limited data exists, organics (i.e., PCBs, PAHs and legacy pesticides) should be analyzed on a biennial basis. In 2011, PCBs, PAHs, legacy pesticides and PBDEs will be analyzed. In 2006, analyses 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

Beginning in 2010, sediment sampling will alternate wet and dry seasons. In 2011, the sediment samples will be collected in the dry season at 40 random sites and 7 fixed sites. The sediment analysis will consist of organic (e.g., PCBs, PAHs, PBDEs, and pesticides) and inorganic contaminants.

Subtask 3 Sediment Benthos

Promulgated by the State in 2009 for marine waters in enclosed bays and estuaries, sediment quality objectives (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 2011.

Subtask 4 Bivalve Bioaccumulation

The redesign workgroup recommended that a biennial plan be implemented for bivalves. Bivalves were sampled in 2010 and will be sampled again in 2012.

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.

Sediment toxicity measurements will be made at 27 sites (20 randomly allocated sediment chemistry stations and seven historical RMP sampling sites). Toxicity tests will be conducted with *Eohaustorius* (a solid phase test with survival as the endpoint) and *Mytilus* (an elutriate test with normal larval development as the endpoint). 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, contingency funding for TIEs will need to be requested.

STAFF INVOLVED

The S&T staff members will include: Meg Sedlak, Susan Klosterhaus, Amy Franz, 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 cruises will occur in September 2011.

BUDGET

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

Subtask	Estimated Labor Cost 2011
S&T Field Sampling and Oversight	\$75,000
S&T Benthos fieldwork/ Data review	\$10,000
Total	\$85,000

3.2 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. Additional species targeted included anchovies, jacksmelt, leopard sharks, and halibut. Samples were analyzed for mercury, PCBs, organochlorine pesticides, PBDEs, dioxins, and perfluorinated compounds.

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 2011, the costs for preparation of the sport fish report will be covered by the SWAMP program.

STAFF INVOLVED

This task will be performed by Jay Davis and Jennifer Hunt.

SCHEDULE AND DELIVERABLES 2011

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

3.3 Bird Egg Monitoring

The Exposure and Effects Pilot Study (EEPS) conducted monitoring of bird eggs from 2002 through 2006. Two species 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 have been 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. Tern eggs have been analyzed for mercury, selenium, and PBDEs. Except for mercury, the eggs were 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.

The results of this study will be summarized in 2011 in a technical report. Approximately \$15,000 from the 2010 budget is allocated for writing the report.

STAFF INVOLVED

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

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Draft Technical Report	March 2011
Final Technical Report	May 2011

SFEI LABOR BUDGET

Subtask	Estimated Cost
Project Management, Coordination, Data Analysis, and Reporting (SFEI labor)	\$15,000
Total	\$15,000

3.4 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 water quality and sediment transport processes. An understanding of these basic processes is essential to interpreting patterns in data 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 has focused 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, 2005, and 2010 editions of the *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 sites for 2011 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.

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 2011

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 Basic Water Quality

The USGS will continue to conduct monthly water quality sampling of basic water quality parameters along the spine of the entire Bay-Delta system. Measurements will include: salinity, temperature and dissolved oxygen (which influence the chemical form and solubility of contaminants); suspended sediments (which influences the transport of contaminants); and phytoplankton biomass (which influences the partitioning of reactive contaminants between dissolved and particulate forms). This information is important for understanding seasonal changes in water quality and estuarine habitats and their influence on biological communities and the distribution of 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 Pulse article, Dr. Cloern and 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 important changes in the Estuary.

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 2011

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

Each year, the RMP undertakes special studies to complement Status and Trends monitoring. These studies are developed under the guidance of the workgroups and committees and seek to answer high priority management questions that are articulated in the RMP Master Plan.

Substantial work has been conducted over the last three years to address the priority questions for mercury, PCBs, and emerging contaminants. As a result in 2011, a number of the special studies are synthesis efforts to evaluate what we have learned and articulate these findings to the RMP stakeholders and managers, and to recommend studies to address priority information needs.

4.1 Mercury Synthesis and Conceptual Model Update

OVERVIEW

The RMP Mercury Strategy has funded a significant body of work to address the first two questions in the Mercury Strategy (listed below). This included three years of intensive monitoring of spatial and temporal patterns in mercury in small fish (a total budget of \$450,000), a two-year study of mercury isotopes (\$115,000), and a two-year study of passive samplers for aqueous methylmercury, referred to as DGTs (\$80,000). The results of these studies are either just being evaluated now (isotopes and DGTs) or will be available shortly as is the case for the three-year dataset on small fish. In addition, extensive monitoring of other indicators of spatial patterns, temporal trends, fate, and effects have been conducted by RMP and other programs and projects in the last few years. Our state of knowledge has been advancing rapidly.

The RMP Mercury Strategy has articulated management questions to guide a long-term program of studies to support the goal of identifying and reducing high leverage pathways and thereby reducing mercury impairment in the Bay. The studies conducted to date are providing partial answers to some of the questions in the Strategy, but it is clear that we have not yet answered all of them. The optimal next steps to take in answering the questions, however, are unclear. A prudent next step to ensure effective use of RMP funds is to thoroughly evaluate and synthesize all of the information acquired in the last several years and to use this synthesis as the basis for a plan for the next few years of mercury studies.

The complex biogeochemistry and spatial and temporal dynamics of mercury and especially methylmercury pose a challenge for such a synthesis effort. A large body of information on the various aspects of mercury science has been generated in the Estuary in the past few years. An interdisciplinary approach to the synthesis is called for, with collaboration of a team spanning the different branches of mercury science. It will be

important to include tidal wetlands within the scope of the review, given their potential influence on regional patterns of contamination in the Bay and the potential importance as a zone of methylmercury impact.

APPLICABLE RMP MANAGEMENT QUESTIONS

The most relevant questions for this synthesis are the questions articulated specifically for the Mercury Strategy.

1. Where is mercury entering the food web?
2. Which processes, sources, and pathways contribute disproportionately to food web accumulation?
3. What are the best opportunities for management intervention for the most important pollutant sources, pathways, and processes?
4. What are the effects of management actions?
5. Will total mercury reductions result in reduced food web accumulation?

OBJECTIVES AND APPROACH

The goal of the synthesis effort will be to produce a technical report that answers, to the extent possible, the Mercury Strategy questions based on the information that has accumulated to date. Other questions may also be addressed. Stakeholder input on an outline of the report will be obtained as a first step in the project.

A considerable body of information generated by the RMP and other programs has accumulated in recent years. Some of the datasets to be covered in the review are listed below:

- Status and Trends: RMP (e.g., sport fish, avian eggs, sediment, and water)
- USGS Clapper rail feathers;
- RMP Mercury Strategy: small fish, isotopes, DGTs
- Effects:RMP/CALFED avian egg work, USFWS rail work, effects on fish;
- Fate: RMP (cores, methylmercury budget);
- Loading Studies: Central Valley loads (RMP, Region 5), small tributaries (loading studies, BMP study), atmospheric deposition (global, local), POTWs(Region 2, WERF, Sacramento regional); and
- Wetlands: SBSP, Petaluma, Hamilton, Suisun Marsh, Crissy Field, and Twitchell Island.

Stakeholder suggestions on additional datasets to include will also be encouraged. The synthesis will also evaluate progress relative to the Conceptual Model of Mercury in San Francisco Bay developed by Tetra Tech (2006) for the Clean Estuary Partnership.

The findings of this synthesis will be incorporated into an article to be published in a special issue of a journal featuring synthesis papers for seven major ocean regions as part of the Coastal and Marine Mercury Ecosystem Research Collaborative (C-Merc), sponsored by the Dartmouth College Toxic Metals Superfund Research Program. CMerc

has convened a team of scientists and stakeholders to work together over a two-year period to gather and analyze data and publish a series of papers related to the inputs, cycling, and uptake of mercury in marine ecosystems. The other ocean regions to be covered include the Mediterranean, the tropics, the open ocean, the Gulf of Mexico, the Gulf of Maine, and the arctic. Other papers on global mercury topics (e.g., mercury isotopes, climate change, health effects) will also be included in the special issue. The RMP effort will benefit from the synergy that comes from sharing and comparing data from San Francisco Bay with data from other parts of the world. The use of RMP funds will be strictly limited to answering the management questions identified by RMP stakeholders. Any work for C-Merc beyond that scope will be funded by SFEI.

STAFF INVOLVED

Key SFEI staff involved in this project will be: Jay Davis, Lester McKee, Letitia Grenier, Josh Collins, Don Yee and Ben Greenfield.

SCHEDULE AND DELIVERABLES

Deliverable	Due Date
Draft report	May 2011
Final report	August 2011

BUDGET

The estimated budget for this task is \$74,000 for SFEI labor and \$1,000 for direct costs.

WORKGROUP OVERSIGHT

The Contaminant Fate Workgroup will provide oversight.

4.2 Mercury Food Web Uptake (Small Fish)

OVERVIEW

Since 2005, SFEI has been monitoring forage fish in the San Francisco Estuary to assess the sources and pathways of mercury entering the Estuary. Mercury (Hg) in small fish is a TMDL target, and a long-term monitoring program is needed to determine how successful TMDL implementation and management actions are at reducing hazards to Bay piscivorous wildlife.

The monitoring to date has established a clear spatial gradient in food web methyl mercury, with elevated concentrations observed in the Lower South Bay (near Alviso slough) and declining concentrations moving towards the Delta. Seasonal variation has been demonstrated to occur in Hg bioaccumulation in San Francisco Bay and elsewhere. However, seasonal variation differs among locations, with summer Hg peaks in two

South Bay wetlands, spring peaks in Delta tributaries after large storm events, and variable patterns in North Bay salt ponds.

There is a need to better understand the patterns and magnitude of seasonal variation, in order to determine what times of the year present the greatest potential risks to piscivorous wildlife. Assessment of seasonal variation at three long term sites and one recently selected site will continue to provide useful information for interpreting interannual trends. The seasonal variation monitoring is intended to complement previous and on-going work funded by the CalFed program and by the South Bay Mercury Program.

This study will examine methylmercury concentrations in 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 monitor small fish for the assessment of long-term trends in methylmercury bioaccumulation; and
- to provide data on the seasonal variation of methylmercury uptake.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study will assist in answering the following questions that were developed as part of the RMP Mercury Strategy.

Question 1. Where and when is mercury entering the food web?

Small fish are the best tool for assessing inter-annual variation in food-web mercury in aquatic habitats.

Question 2. What are the high leverage processes, sources, and pathways?

Continued long-term and seasonal monitoring may aid in identifying high leverage processes, such as seasonal flooding events in high flow years, which are hypothesized to result in elevated biotic Hg exposure.

Question 3. What effects can be expected from management actions?

Continued long term monitoring is needed to determine whether specific management activities (e.g., source control through the MRP; wetland restoration activities) affect Hg biotic exposure in the Bay.

SUBTASK DESCRIPTIONS

Subtask 1 Fish collection and Mercury Analysis

Fish will be collected from Benicia State Park, Eden Landing, Alviso Slough, and Artesian Slough for seasonal analysis during three periods: January, May/June, and September/October. The Alviso and Artesian Slough sites were selected to leverage sampling scheduled for April through September as part of the South Bay Salt Ponds restoration work, so additional sampling will only be necessary in January. As in prior

years, these seasonal samples will be augmented with fish obtained by the USFWS nearshore beach seining program, to continue the seasonal trend database developed at those sites.

Four composites of whole fish from two species (Mississippi silverside and topsmelt) from each location will be analyzed for total mercury. Five fish will be included in each composite. Total mercury will be analyzed rather than methylmercury, because most mercury assimilated by fish is methylmercury and these species are not likely to have much sediment (containing inorganic Hg) in the gut.

Subtask 2 Minimal reporting

Because the objective is to continue a data set for long-term evaluation, data analysis, interpretation, and presentation will focus on identifying long-term trends and intersite seasonal variability. These graphical analyses will be made available to the RMP community through meeting presentations.

STAFF INVOLVED

This project will be led by Ben Greenfield and Rachel Allen of SFEI. Darell Slotton and Shaun Ayers of UC Davis will perform field sampling and laboratory analysis.

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Draft data	January 31, 2012
Final formatted data	February 28, 2012
Trend reporting to committees	September 30, 2012

BUDGET

\$20,000 has been set aside for this task; \$5,000 will be for SFEI project management and the remainder will be for Darell Slotton and Shaun Ayers of UC Davis (\$15,000).

WORKGROUP

This work will be reviewed by the TRC.

4.3 PCB Conceptual Model

OVERVIEW

The RMP PCB Strategy Team formulated a PCB Strategy in 2009. The PCB Team recognized that a significant body of new information has been generated since the PCBs TMDL Staff Report was prepared. Some of the important new datasets include: surface sediment data using more accurate analytical methods (high resolution mass spectrometry) and the randomized sampling design; additional trend data from sport fish, bivalves, and bird eggs; surprising data from small fish showing higher than expected concentrations; and information on the entire suite of 209 congeners for sediment, water and biota.

The RMP PCB Strategy has articulated management questions to guide a long-term program of studies to support reduction of PCB impairment in the Bay (see below). The PCB Team recommended two studies to begin addressing these questions. The first recommended study was to take advantage of an opportunity to piggyback on the final year of the three-year small fish mercury sampling in 2010. The second study recommended was a synthesis and conceptual model update based on the information that has been generated since the writing of the TMDL Staff Report. The Team considered this a prudent next step to ensure effective use of RMP funds and to form the basis for a plan for the next few years of PCB studies.

APPLICABLE RMP MANAGEMENT QUESTIONS

The most relevant questions for this synthesis are the questions articulated specifically for the PCB Strategy.

1. What potential for impacts on humans and aquatic life exists due to PCBs?
2. What are appropriate guidelines for protection of beneficial uses?
3. What is the total maximum daily load of PCBs that can be discharged without impairment of beneficial uses?
4. What are the rates of recovery of the Bay, its segments, and in-Bay contaminated sites from PCB contamination?
5. What are the present loads and long-term trends in loading from each of the major pathways?
6. What role do in-Bay contaminated sites play in segment-scale recovery rates?
7. Which small tributaries and contaminated margin sites are the highest priorities for cleanup?
8. What management actions have the greatest potential for accelerating recovery or reducing exposure?
9. What is the most appropriate index for sums of PCBs?

APPROACH

The goal of the synthesis effort will be to produce a technical report that answers, to the extent possible, the PCB Strategy questions based on the information that has been

compiled to date. Other questions may also be addressed. Stakeholder input on an outline of the report will be obtained as a first step in the project. A considerable body of information generated by the RMP and other programs has accumulated in recent years.

Some of the datasets to be covered in the review are listed below:

- Status and Trends: RMP (e.g., sport fish, bivalves, avian eggs, sediment, and water);
- RMP Special Studies: small fish PCB data;
- Effects: USFWS avian egg work, UC Davis effects on fish;
- Fate: RMP (cores, multibox model); and
- Loading Studies: Central Valley loads (RMP), small tributaries (loading studies, BMP study), atmospheric deposition (global, local), POTWs (Region 2).

Stakeholder suggestions on additional datasets to include will also be encouraged.

The PCB Team also recommended reviewing and making recommendations related to several other sources of information.

- TMDLs and abatement actions from elsewhere to evaluate lessons learned and whether there are rules or thumb for what works and what doesn't work.
- Information on a newly identified PCB, PCB 11. The presence of PCB-11 appears to be a by product of the manufacture of dyes. A related issue is the most appropriate index of total PCBs -- whether to include PCB 11 and how many congeners to include in routine measurements and sums.
- The linkage between sediment and sport fish, including an evaluation of why concentrations appear to have declined in bivalves and sediments, but not in sport fish.
- Evaluation of sources using congener profiles.
- Updated estimates of nearshore ambient average concentrations and the inventory of PCBs in various compartments of the Bay ecosystem.
- An update of the Gobas food web model using the new sediment data.
- A review of literature on estuarine degradation rates, which have a large influence on predictions of the rate of recovery of the Bay.
- A review of literature on rates of attenuation of PCB loads from watersheds, which also have a large influence on Bay recovery.

The synthesis will also evaluate progress relative to the report: PCBs in San Francisco Bay: Impairment Assessment/Conceptual Model Report developed by SFEI for the Clean Estuary Partnership (Davis et al. 2006).

STAFF INVOLVED

SFEI staff will be Jay Davis, Ben Greenfield, Don Yee, Lester McKee, Rachel Allen and John Ross.

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Draft Report	December 2011
Final Report	March 2012

BUDGET

The budget for this task is \$53,000, which is exclusively SFEI labor.

WORKGROUP

The Contaminant Fate Workgroup will review this element.

4.4 Dioxin - Analysis of Water and Sediment

OVERVIEW

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 'dioxin') in fish. RMP studies of contaminants in Bay sport fish conducted every three years since 1994 have found that dioxin concentrations have remained unchanged over this time period and in some species, continue to greatly 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 reducing concentrations in Bay fish and resultant health risks to fish-eating humans and wildlife.

DIOXIN STRATEGY QUESTIONS

Recognizing that there was a dearth of information, 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. The RMP has conducted analyses of dioxin in sport fish, tributaries, surface water and shallow sediments and sediment cores to begin to address the Dioxin Strategy questions. In 2011, we will focus on analysis of water samples from the Bay during the Status and Trends water cruise and surface sediment samples collected in 2008 (dry season) and 2010 (wet season).

The following Dioxin Strategy questions will be addressed through this study of Bay surface water and surface sediment samples:

1. Are the beneficial uses of San Francisco Bay impaired by dioxins?
2. What is the spatial pattern of dioxin impairment?
3. What is the dioxin reservoir in Bay sediments and water?
4. Have dioxin loadings/concentrations changed over time?
5. What is the relative contribution of each loading pathway as a source of dioxin impairment in the Bay?

APPROACH

Water samples will be collected as part of the Status and Trends cruise that will occur in the summer of 2011. Samples will be collected from the 22 sites and sent to AXYS Analytical for analyses.

The Dioxin Workgroup proposed that a hybrid analysis be conducted of surface sediments from 2008 (dry season) and 2010 (wet season) to provide information on the reservoir of dioxin in sediments and seasonal variability. The SC and TRC have approved the analysis of all 27 sites from the 2010 wet season including 7 historical and 4 repeat sites, and 15 sites from the 2008 dry season including 7 historical and 8 repeat sites. The RMP will select and ship 42 sediment samples to AXYS for dioxin analysis.

SCHEDULE AND DELIVERABLES

Sediment samples will be obtained from short-term RMP storage and shipped to AXYS Analytical in December/January 2011. Samples will be analyzed by March and undergo QA review in April and May. Water samples will be collected in August as part of the Status and Trends cruise and shipped to AXYS for analysis in the Fall of 2011. Assuming results are available, preliminary results will be reported to the TRC in December 2011.

STAFF INVOLVED

This task will be led by Susan Klosterhaus and Don Yee with assistance from the RMP water cruise staff.

SCHEDULE AND DELIVERABLES

Deliverable	Date
Ship sediment samples to AXYS	December 2012
Collect and ship water samples to AXYS	Summer 2011
Data validation	Fall/Winter 2011
Summary presentation to TRC	December 2011

BUDGET

The budget for the water portion of this task is \$28,000: \$7,000 for SFEI labor to coordinate shipping of samples, data review, and preliminary reporting; \$1,000 in direct costs for shipping; and \$20,000 for analytical costs.

The budget for the sediment portion of this task is \$52,000: \$12,000 for SFEI labor to coordinate shipping of samples, data review, and preliminary reporting; \$1,000 in direct costs for shipping; and \$39,000 for analytical costs.

WORKGROUP OVERSIGHT

The TRC will review this work.

4.5 Screening of SF Bay Mussels and Seals for Anthropogenic Pollutants – Year 2

OVERVIEW

Significant advances in analytical techniques present an excellent opportunity for the RMP to conduct broad non-targeted scans of San Francisco Bay biota to identify chemicals of emerging concern. Recent advancement in two-dimensional gas chromatography Time of Flight Mass Spectrometry (GC-GC TOF/MS) at the National Institute for Standards and Technology (NIST) has allowed NIST to screen human samples. NIST will apply a similar broadscan approach to San Francisco Estuary samples to identify previously unmonitored anthropogenic chemicals. While labor-intensive, this approach has the potential to identify and direct our monitoring efforts to previously unmonitored chemicals that are accumulating in biota.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study will address the following RMP Management Question:

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

It will also focus on some of the main questions of the Emerging Contaminants workgroup:

- Which chemicals have the potential to impact humans and aquatic life and should be monitored?
- What potential for impacts on humans and aquatic life exists due to contaminants in the Estuary ecosystem?

SUBTASK DESCRIPTIONS

The project was divided into a two-year effort. The first year (2010) was aimed at:
(1) developing protocols for the collection of samples from dead, stranded harbor seals and mussels for analysis;
(2) developing analytical methods for the screening of harbor seal liver and blubber for non targeted compounds;
(3) applying the methods to the screening of harbor seal blubber and liver from dead, stranded harbor seals for chemical contaminants.

In 2010, seal and mussel samples were collected from San Francisco Bay and sent to NIST.

The effort in the second year will build on the year 1 effort. The major tasks for year 2 are as follows.

Subtask 1 Develop methodology for the analysis of mussel tissues by GC-GC TOF/MS

A modification of the methods developed in year 1 will be required for the analysis of mussel tissue. Chemical contaminants are typically present in mussel tissue in lower concentrations than marine mammal tissue hence a larger mass of tissue (several times that of harbor seal tissue) will be needed for analysis. A new cleanup protocol and possibly additional fractionation will be needed.

Subtask 2. Apply methods to the screening of mussel samples from San Francisco Bay

Samples from at least two sites will be analyzed and compared to pre-deployed mussels. To compare sites, sample peaks will be classified and the results compared using statistical software to allow for factor analysis.

Subtask 3. Build library of new chemicals to augment existing library

The list of non-target chemicals put forth by Howard and Muir (2010) will be used as guide for the production of an electron impact spectra library for this project. This will be a “user library” and will be generated by comparing the Howard and Muir list to the NIST library to determine which compounds are not present in the NIST library. Missing chemicals will be purchased if a commercial source is available. These compounds will be acquired, put into solution and evaluated to see if they are amenable for GC analysis. Furthermore, a spectrum for the compound will be derived either by GC-MS quadrupole or GC-MS-TOF. The spectrum will be added to the “user library.” Once developed, previously run samples (harbor seals, mussel tissues) will be screened against the library to look for compounds in the “user library.”

Subtask 4. Quantify nontarget compounds

If nontarget compounds are identified in samples, NIST will attempt to acquire the compound from a commercial source and produce a method for estimating the concentration of the compound in the sample. The analysis will likely be by quadrupole MS and not GC-MS-TOF, as the former is more sensitive and selective.

During the first year of the project, the possibility of using liquid chromatography quadrupole TOF/MS as an analytical platform was discussed for the analysis of polar samples. After further consideration, the use of this technique is outside the scope of the project unless a partner can be identified to assist with method development. The technique will require intensive work with a Q-TOF instrument using different sources and optimizing conditions for analysis.

STAFF INVOLVED

This project will be led by Susan Klosterhaus (SFEI) and John Kucklick (NIST).

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Draft Report	February 2012
Final Report	April 2012

BUDGET

\$70,000 has been set aside for this task; \$20,000 will be for SFEI labor; \$50,000 will be for NIST. NIST will provide in-kind contributions for travel, training and some NIST salaries. SCCWRP will contribute an additional \$50,000 in funding and resources.

WORKGROUP

The Emerging Contaminant workgroup will review this element.

4.6 Chemicals of Emerging Concern Synthesis

OVERVIEW

Since 2006, the RMP has been collecting data on contaminants of emerging concern (CECs) to proactively identify unregulated chemicals that have the greatest potential to adversely affect the health of San Francisco Bay wildlife and humans that are linked to the Bay food chain. With guidance from the Emerging Contaminants Work Group (ECWG), RMP pilot and special studies have focused on preliminary monitoring of pharmaceuticals, perfluorinated chemicals (PFCs), and flame retardants in Bay samples. Pro bono analyses of a variety of CECs by other laboratories have substantially augmented this work. In 2011, other information generated by the RMP, the State Water Board, and the NOAA Mussel Watch Program will be available that is expected to influence the management of CECs in San Francisco Bay and the entire state. A summary document that synthesizes these data and other information in the context of CECs management in San Francisco Bay is needed to guide future monitoring efforts by the RMP.

The objective of this study is to prepare a summary report that

- (1) synthesizes the CEC occurrence data available for San Francisco Bay,
- (2) relates these data to recommendations provided by the expert advisory panel for prioritization and monitoring of CECs in discharges to coastal waters, and

(3) recommends next steps for monitoring CECs in San Francisco Bay.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study would address the following RMP management question (MQ):

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

- Which chemicals have the potential to impact humans and aquatic life and should be monitored?
- What potential for impacts on humans and aquatic life exists due to contaminants in the Estuary ecosystem?

APPROACH

The report will include occurrence data, including a comparison of Bay data to other locations, and conclusions/recommendations from the projects and information sources listed below.

RMP Preliminary Monitoring Studies

- South Bay surface water pharmaceutical study (2006)
- PFCs in mussels (2010), small fish (2009), sportfish (2009), harbor seals (2006-2008), and bird eggs (2006-2009)
- Non-PBDE, current-use flame retardants in sediments and wildlife (2008-2009)
- Triclosan in sediments (2008)
- Chlorinated paraffins in wildlife (2008)
- Nonylphenol in small fish (2009)
- PFCs in tributary waters, ambient surface water, sediment, and wastewater effluent
- PPCPs, alkylphenols, and PFCs in mussels, water, sediment (2010)
- Single-walled carbon nanotubes in sediment (2010)
- Screening of biological tissues for CECs (2010-2011)

Other Peer-Reviewed Studies of CECs in San Francisco Bay

In addition to those conducted by the RMP, other research groups have conducted studies on CECs in the Bay. Studies on PFCs, the antifoulant Irgarol, and others are available in the peer-reviewed literature and will be summarized in this report.

NOAA Mussel Watch California CEC Pilot Study

A pilot study is being conducted in 2010/2011 by state and federal agencies to determine which CECs should be added to the list of target analytes for the national NOAA Mussel Watch Program. Pharmaceuticals and personal care products (PPCPs), PBDEs, polybrominated biphenyls (PBBs), alternative flame retardants, PFCs, alkylphenols, and pesticides (pyrethroids, organochlorines, organophosphates, other current use pesticides) will be analyzed in resident mussels throughout the State. In San Francisco Bay, resident mussels were collected from the four core Mussel Watch sites (Yerba Buena Island,

Dumbarton Bridge, San Mateo Bridge, and Emeryville). Resident mussels, caged mussels and/or passive samplers were deployed near three wastewater treatment plant outfalls and three agriculturally influenced sites in the Bay and analyzed for CECs. These data are currently being reviewed with a report available in 2011.

Advisory Panels on Recycled Water and CECs Discharges to Coastal Waters

Expert advisory panels have been convened by the Water Board to provide recommendations on the incorporation of current knowledge of CECs into regulatory activities related to the Recycled Water Policy and the discharge of CECs to ambient coastal waters. These recommendations will include strategies for inclusion of CECs in monitoring programs and processes for determining thresholds of concern. The final recycled water report was made available in the summer of 2010 and the coastal water policy is expected in 2011. Findings from these reports will be included in the synthesis document and data gaps will be identified.

SCHEDULE AND DELIVERABLES

This project is a two-year project that will commence in June of 2011 and finish in March 2012. It is anticipated that the synthesis will begin in the second half of 2011 as results from studies in 2010 become available.

BUDGET

The budget for this task is \$45,000 (all SFEI labor hours) with \$30,000 being allocated in 2011 and \$15,000 (pending approval) for 2012.

WORKGROUP OVERSIGHT

The Emerging Contaminant Workgroup will review this element.

4.7 Regional Loading Spreadsheet Model

OVERVIEW

To accurately assess total contaminant loads entering San Francisco Bay, it is necessary to estimate loads from local watersheds. Presently Hg loads entering the Bay from urban stormwater described in the San Francisco Bay TMDL have been estimated by the Water Board by combining BASMAA bed sediment data with estimates of regional suspended sediment loads. In the case of PCBs, the mass loads in the Bay TMDL were derived from scaling existing data by area (from the Guadalupe and Coyote Creek watershed) up to the region as a whole. Although these methods were appropriate for initial planning and TMDL development, part of the implementation plan of these TMDLs is to improve estimates of regional scale loads and to assess how these loads might be reduced. These needs are now reflected in the municipal regional stormwater permit (MRP) and in the second and fourth questions of the RMP Small Tributary Loading Strategy (STLS).

Spreadsheet models of stormwater quality provide a useful and cost-efficient tool for

estimating regional scale watershed loads. These models are based on the simplifying assumption that unit area runoff for homogeneous sub-catchments have constant concentrations, and thus have advantages over models such as HSPF and SWMM that require large calibration data sets which are expensive to collect and compile. Such a model was developed for the Bay Area previously (Davis et al., 2000); however, at that time, there were only local land use-specific data on pollutants of concern (POCs) for a drought period late 1980s and early 1990s, and there were no local data on Hg and PCBs. More recently, a spreadsheet model was developed for a watershed in Los Angeles that predicted mass emissions to within 8% of measured Zn loads and described options for loads reduction through a focus on high leverage areas (Ha and Stenstrom, 2008).

The overall objective of this proposed study is to calculate mass emissions for the local watersheds draining into the San Francisco Bay, to provide the basis for refined annual load estimates. A GIS-based model is being developed to calculate stormwater volumes and POC loads on a long-term average monthly basis. (Eventually the model should operate on a storm event basis, but a massive precipitation data compilation effort will be necessary to achieve this on a regional scale.) In the face of limited land use-specific POC concentration data for the Bay Area, recent stormwater literature will be used to provide these estimates. In 2010, a project is being conducted that will develop the rationale and a plan for land use-specific monitoring and loads estimates. In 2011, substantial effort will be made to monitor multiple watersheds to better understand the variation of stormwater loads based on watershed types. These advances in modeling and monitoring will make it possible in 2012 to make great improvements in the spreadsheet model and the first dynamic model (being developed for the Guadalupe watershed due to the richness of the local data set). The ultimate objective of both of these models is to improve regional loads estimates and to provide tools to simulate (in time and space) the potential applications of suites of BMPs or management scenarios. In 2010, the first version of the spreadsheet model will be completed for water, sediment, and total mercury (the richest local data sets at a regional scale). In 2011, we will improve the model by adding literature data (mixed with some local data) on other trace contaminants (priority determined by WG) (see details below).

APPLICABLE RMP MANAGEMENT QUESTIONS

The following RMP management questions will be addressed in this project.

- What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?
 - Q3C: What is the effect of management actions on loads from the most important sources, pathways, and processes?
- What is the watershed-specific and regional total water flow, load of sediment, and load contaminants entering the Bay from the urbanized small tributaries and non-urban areas draining to the Bay from the nine-county Bay Area and are there trends through time?
- What are the annual loads or concentrations of pollutants of concern from small tributaries to the Bay?

APPROACH

The base rainfall-runoff model is currently being developed as an update and refinement of the regional loads model developed by Davis et al. in 2000. Once the base model is completed, some MRP category 1 contaminants (e.g., suspended sediment and mercury) will be incorporated. Funds in 2011 will allow for further development and refinement of the model, such as extending the model to include the rest of the MRP category 1 contaminants. The actual uses of the 2011 funds will depend on the results of year 1 of the project and on the priorities set by the WG. Some potential uses of continuation funds include:

- Testing more runoff coefficients
- Calibrating runoff coefficients to local conditions
- Adding more POCs into model
- Testing a range of land-use specific EMCs from literature
- Updating model with local land-use specific EMCs
- Developing BMP modeling capabilities

SCHEDULE AND DELIVERABLES

This project will commence in January with the refinement of the runoff model and the extension of the model to new pollutants. Mid-May, BMP practices will be incorporated into the model. The results of this project will be presented to the SPLWG and TRC in the Fall of 2011.

BUDGET

The budget for this task is \$20,000 (all SFEI labor hours).

WORKGROUP OVERSIGHT

The SPLWG will review this element.

4.8 Load Monitoring in Representative Watersheds

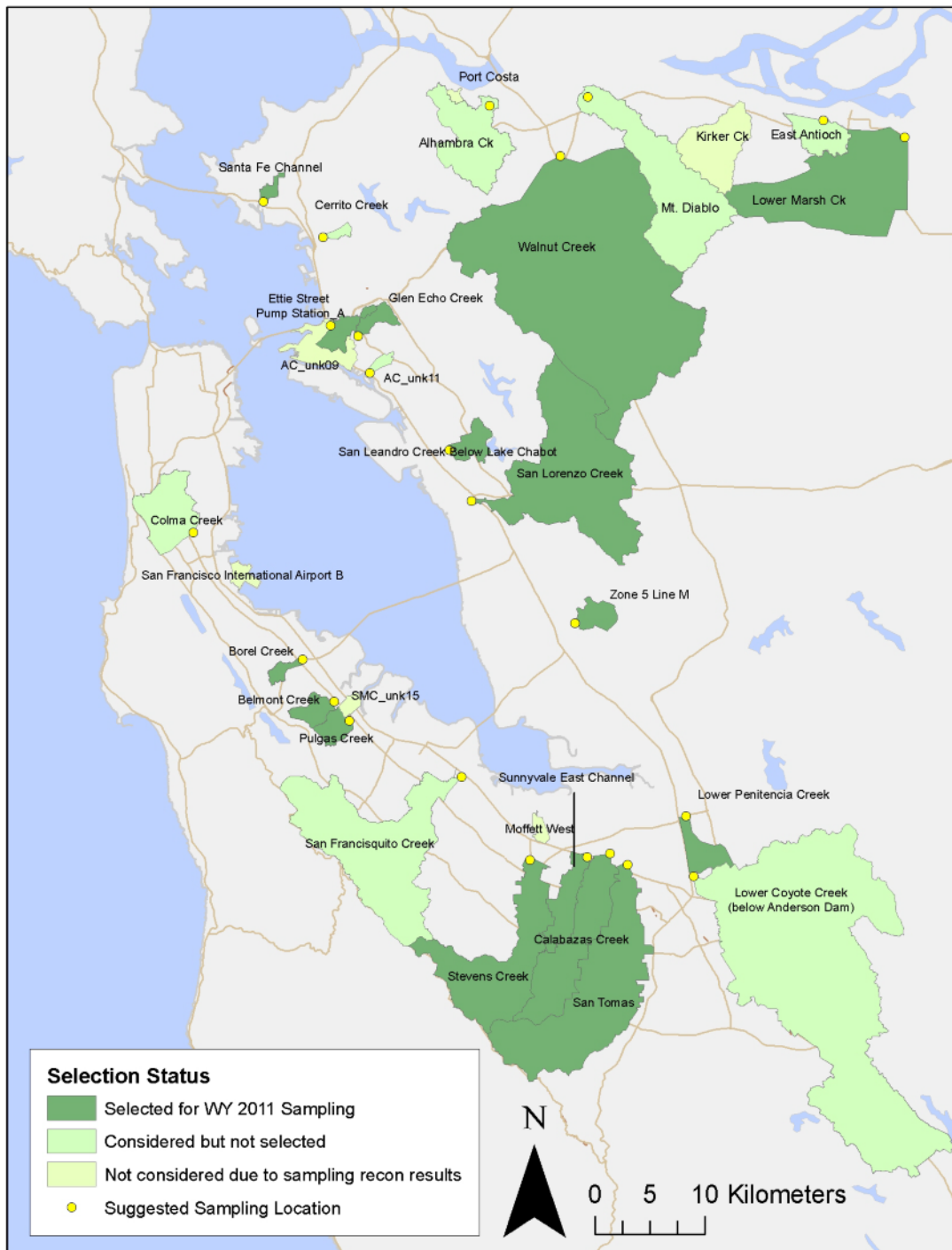
OVERVIEW

There is an urgent need for estimates of stormwater loads by watershed and by region. The recently adopted Municipal Regional Permit (MRP) specifically requires generations of additional information on the loads of sediment and contaminants. In addition, the Mercury and PCB TMDLs require reductions in watershed loads by 50 and 90 percent, respectively. Understanding the loads from representative watersheds will be critical for addressing these information needs and achieving these load reductions.

In 2010, the RMP conducted an evaluation of approximately 30 watersheds and identified 16 high priority watersheds (figure 1) to be monitored in 2011. These 16 watersheds were identified based on a screening evaluation of the land use (e.g., agricultural, urban, residential, etc.), size of watershed, percent imperviousness of the surface, population

density, presence of likely sources such as railroads and transformers, and rainfall. In addition, a reconnaissance to each of the potential sites was made to evaluate logistical considerations such as site access and safety.

Figure 1. The 16 watersheds shown in dark green will be sampled during 2011 as part of the Load Monitoring in Representative Watersheds study.



APPLICABLE RMP MANAGEMENT QUESTIONS

This study addresses the following RMP management question:

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

It also assists in answering the following management questions from the Small Tributary Loading Strategy and the Municipal Regional Permit:

1. **Impairment:** Which are the “high-leverage” small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
2. **Loads:** What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?
3. **Trends:** How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?

SUBTASK DESCRIPTIONS

Subtask 1 Project Management and Equipment Preparation

Prior to sampling, the team will prepare subcontracts for the sample analyses at the commercial labs, purchase and prepare all sampling equipment, and obtain permits for monitoring at the selected sites. The team will also be continuously tracking the budget and managing field staff.

Subtask 2 Sampling at 16 watersheds and laboratory analysis

Sampling will occur at the 16 watersheds that were identified as high priority. These sites include: four sites in Alameda County (Glen Echo Creek, Zone 5 Line M, Ettie Street Pump Station, and San Leandro Creek below Lake Chabot); four sites in Contra Costa (San Lorenzo Creek, Santa Fe Channel, Lower Marsh Creek, and Walnut Creek); three sites in San Mateo County (Pulgas Creek, Borel Creek, and Belmont Creek); and five sites in Santa Clara County (Lower Penitencia Creek, Sunnyvale East Channel, Calabazas Creek, Stevens Creek, and San Tomas Creek). Each site will be monitored for one storm event, where between four and seven samples will be collected. The samples will be analyzed for total mercury, suspended sediment, PCBs and TOC at all sites, as well as PBDEs, PAHs, and Se (dissolved and total) at all of the Contra Costa sites and PBDEs and PAHs at Ettie Street Pump Station and Zone 5 Line M. The samples will be sent to AXYS Analytical for organics analyses and Moss Landing Marine Labs for metals and SSC. Columbia Analytical Services will perform the TOC analysis. Turbidity, stage and velocity (where possible) will be recorded along with sample collection.

Subtask 3 Draft and Final Report

The collection of stage data will enable rudimentary flow-weighting of the contaminant results. Watersheds will then be ranked based on these storm data from most contaminated to least contaminated for each analyte. A report summarizing the data will be produced by May 2011, per MRP requirements.

STAFF INVOLVED

The project will be led by Lester McKee, with field work, project management, and reporting by Alicia Gilbreath, Jen Hunt, Rachel Allen, David Gluchowski, Ben Greenfield, Don Yee, Chuck Striplen, and Erika Houtz (UC-Berkeley).

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Task 1. Project Management and Equipment Preparation	Sep 2010 – May 2011
Task 2. Sample Collection and Analysis	Oct 2010 – Mar 2011
Task 3. Draft and Final Report	Mar 2011; May 2011

BUDGET

The approximate budget for this project is \$300,000, of which \$147,500 is for SFEI labor, \$139,000 is for laboratory analyses, and the remainder is for equipment and direct costs.

WORKGROUP

This project will be overseen by the Small Tributaries Loading Strategy Team, as part of the Sources, Pathways, and Loadings Workgroup.

4.9 STLS Management Support

OVERVIEW

In 2010, the RMP funded the development of a regional storm water loads model and an assessment of land use-based event mean concentrations. It will be important to assure that the results from the latter inform the former and that the key stakeholders are able to provide input and guidance on both the work products and the path forward. The purpose of this task is to assure that these work products are placed in context with other data and information (e.g., the outcomes of the wet weather loadings and on-going BASMAA monitoring studies).

This task will consist of a series of short STLS meetings to obtain input and a longer STLS meeting in which stakeholders would review the regional loads model, vet the use

of land-based event mean concentrations and their application to Bay Area watersheds and recommend a list of candidate “land-use” monitoring sites.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study will aid in understanding the following RMP management question:

- What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?
 - a. What is the effect of management actions on loads from the most important sources, pathways, and processes?

It will also aid in addressing the following Small Tributaries Loading Strategy questions:

- What is the watershed-specific and regional total water flow, load of sediment, and load contaminants entering the Bay from the urbanized small tributaries and non-urban areas draining to the Bay from the nine-county Bay Area and are there trends through time?
- Which are the “high-leverage” small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
- What are the annual loads or concentrations of pollutants of concern from small tributaries to the Bay?

SUBTASK DESCRIPTIONS

Subtask 1 Local STLS meetings

On-going local stakeholder STLS meetings will be held to obtain input on progress made in the land-use based monitoring and modeling efforts.

Subtask 2 Preparation for and convening full STLS stakeholder meeting

The full STLS meeting is where stakeholders would review the outcomes of the first version of the spreadsheet model, vet the rationale presented in the report on the choice of “land-use” classes, and review results of preliminary reconnaissance and the justification for an initial list of candidate "land use" monitoring sites. If these tasks do not produce recommendations for further "land use" based EMC development, the funding for this meeting would not need to be spent in 2011.

Subtask 3 Expert Review

Eric Stein and Mike Stenstrom will provide peer review for the reports produced by the STLS team.

STAFF INVOLVED

This project will be led by Lester McKee, with contributions from Michelle Lent, Jennifer Hunt, Alicia Gilbreath, and Sarah Pearce, along with other SFEI staff.

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Task 1 Local STLS meetings	Jan 2011 – Jun 2011
Task 2 Preparation for and Holding Full STLS stakeholder meeting	March 2011
Task 3 Expert review	March 2011

BUDGET

The approximate budget for this task is \$20,000, with \$16,000 for SFEI staff and \$4,000 for expert review. If the full STLS meeting is not needed, some of the funding will not be spent.

WORKGROUP

This project will be overseen by the Small Tributaries Loading Strategy Team and the SPLWG.

4.10 Olfactory Effects of Copper on Salmonids

OVERVIEW

Copper has been a priority concern due to its acute toxicity to aquatic life. As a result of a significant body of work demonstrating that much of the copper in the Bay is not bioavailable and the on-going observations of concentrations below water quality objectives, the Bay was delisted for copper. Site-specific objectives (SSO) for copper were developed in 2007 that establish criteria for various segments within the Bay. The site-specific objective specifically called for further study on the potential toxicity of copper to the olfactory system of salmonids.

Exposure to dissolved copper has been shown to cause olfactory impairment at relatively low concentrations in freshwater fish, resulting in an impaired avoidance response to predators. These effects are seen at concentrations near 3 µg/L; which are lower than the current SSO. However, aquatic chemistry in saltwater systems is dramatically different from freshwater systems; according to the Biotic Ligand Model, dissolved organic matter

in seawater may be protective against copper neurotoxicity. Also increasing the uncertainty are the different life stages of salmon found in salt water than in fresh water.

The goal of this study is to determine the impact of dissolved copper on the olfactory system of fish in estuarine systems. The work will be conducted by NOAA Marine Fisheries, which will also contribute significant matching funds.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study addresses the following Level 1 RMP management question:

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

In addition, it aids in understanding the following Level 2 RMP management questions:

- 1.B. What potential for impacts on humans and aquatic life exists due to contaminants in the Estuary ecosystem?
- 1.C. What are appropriate guidelines for protection of beneficial uses?

SUBTASK DESCRIPTIONS

Subtask 1 Setup, exposure to copper, and electrophysiological readings

This study will be based on previous NOAA studies that measured copper olfactory toxicity in freshwater-phase juvenile salmon (Baldwin et al. 2003; Sandahl et al. 2007; McIntyre et al. 2008). As was conducted in these previous studies, the impact of copper exposure on the sensitivity of the salmon olfactory system to odors will be measured using direct electrophysiological recordings (electroolfactograms; EOGs) from the olfactory epithelium (Baldwin et al. 2003). The experiments will be performed at the Northwest Fisheries Science Center (NWFSC) Mukilteo Field Station (Mukilteo, WA) using Chinook salmon (*Oncorhynchus tshawytscha*). Fertilized eggs will be obtained from a local hatchery and reared in freshwater at Mukilteo until the fish are the appropriate age for smolting. The majority of the fish will then be transitioned to seawater and maintained in seawater for the duration of the experiment, while a subset will remain housed in freshwater. Water samples will be collected for analyses of water chemistry parameters (e.g. salinity and DOC) and copper concentrations.

To determine the effect of copper on the olfactory system, odor-evoked EOGs will be obtained from fish using a standard odorant, the amino acid L-serine. Fish will be either unexposed to copper (controls) or exposed for a short period (30 minutes) to one of at least 3 copper concentrations (ranging from 2-20 µg/L, but higher if needed). Copper-induced changes in the sensitivity of the olfactory system will be measured as a dose-dependent reduction in the amplitude of the odor-evoked EOGs from which an effect threshold for copper can be determined.

Because DOC is known to affect the toxicity of copper to the olfactory system (McIntyre et al. 2008), exposures will be performed at three different DOC concentrations representative of the SF Bay (e.g. 2, 4, and 6 mg/L). To the extent possible, the source of DOC used to amend the local seawater (which is ~2 mg/L DOC) will have copper binding properties similar to that of DOC from the San Francisco Estuary. The aim of the study will be to determine the effects threshold for the olfactory toxicity of copper in seawater-phase juvenile salmon at various DOC concentrations in order to compare this with thresholds measured from freshwater-phase salmon and with the copper SSOs in the SF Bay estuary.

The proposed studies are expected to be initiated in June 2011 and should be complete by the end of the fiscal year (October 2011).

Subtask 2 Preparation of report

A report detailing the effects thresholds of copper on salmon in seawater and the influence of DOC will be prepared.

STAFF INVOLVED

This project will be performed by David Balwin and staff of the Environmental Conservation Division of the NOAA Northwest Fisheries Science Center.

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Task 1 Setup, exposures, electrophysiological recordings, and data analysis	June – Sep 2011
Task 2 Preparation of draft report	Nov 2011
Task 3 Preparation of final report	Feb 2012

BUDGET

The budget for this project is \$37,000 allocated to NOAA Marine Fisheries.

WORKGROUP

This project will be overseen by the Exposure and Effects Workgroup.

4.11 Sediment Quality Assessment of Toxic Hot Spots in SF Bay

OVERVIEW

In 2009, the State Water Resources Control Board adopted Sediment Quality Objectives (SQOs) for marine (polyhaline) waters in Enclosed Bays and Estuaries. The SQOs are based on a triad evaluation of sediment chemistry, benthos, and sediment toxicity. A fundamental challenge in SQO implementation has been the interpretation of the results of these assessments. Contingent upon the development of an acceptable workplan, this project will evaluate six previously identified hotspots within San Francisco Bay. The list will include sites from Central Basin; Islais Creek; Mission Creek; San Leandro Bay; and two sites from Oakland Inner Harbor (Fruitvale and Pacific Dry Dock). The specific sites within these areas will be selected based on consultation with the Water Board, RMP stakeholders, and the Benthic Workgroup. These regions are all located in areas with polyhaline benthic assemblages which allows for application of the current SQO guidance. Results from these evaluations will be compared to the similar evaluations of the 27 RMP sites for which there are similar data.

APPLICABLE RMP MANAGEMENT QUESTIONS

This study will aid in understanding the following EEWG benthic effects management questions:

What are the spatial and temporal patterns of impacts of sediment contamination on benthic biota?

The proposed study will employ the SQO methods for Enclosed Bays and Estuaries to assess ecological condition, and if there is a potential concern of degraded conditions due to pollution. This study will focus on impaired sites located in the Estuary margins and SQO assessment scores will be compared to the RMP Status and Trends scores from the ambient survey design. To evaluate temporal patterns, BPTCP sites that were sampled in 1997 may be re-assessed to investigate to what extent sediment conditions have improved.

Which pollutants are responsible for observed impacts on benthic biota?

If the TIE study is authorized, due to significant toxicity observed in one or both toxicity tests, this study will address this specific benthic effects management question from the EEWG Five Year Work Plan (2008). TIE methods are currently being developed by the RMP and SCCWRP for both SQO test species. Employing these new developing TIE procedures on highly toxic ambient sediments begins to inform managers of the environmental stressors that may be causing the observed toxicity and provides an opportunity to improve TIE procedures.

Are the toxicity tests, benthic community assessment approaches, and the overall SQO assessment framework we are using reliable indicators of impacts on benthic biota?

The SQO methods for Enclosed Bays and Estuaries will be implemented to investigate sediment conditions at sites that are the most impaired in the Estuary which will help to inform us on how sensitive these tools are and if they can detect changes in sediment conditions over time or after remediation efforts have been completed.

SUBTASK DESCRIPTIONS

Subtask 1 Convene focus group and develop final plan

To select the sampling sites, a summary of the status of the sites of interest will be compiled. A focus group comprising the Water Board, RMP stakeholders, and the Benthic workgroup will use this review to provide guidance on the final workplan. The group will decide which sites to sample, the number of samples to be collected per site, and the contaminants to be analyzed. Up to six samples will be collected under the current budget. If the focus group chooses to study a site previously visited by the BPTCP, it may be possible compare SQO assessment scores from results from the earlier study.

A review document for the candidate sites will summarize information about sediment conditions, the rationale for a site being listed on the 303(d) list, and outline any remediation efforts that may have taken place.

Subtask 2 Sample collection and analyses

This study will coordinate with the RMP Status and Trends sediment monitoring effort scheduled in the summer of 2011 to leverage logistical, analytical, and information-management costs.

Surface sediment will be sampled and analyzed for the full suite of RMP Status and Trend measures:

- Sediment and water quality - grain-size, TOC, TN, and a CTD cast will be taken to record water quality conditions near the bottom.
- Trace metals
- Trace organics
- Toxicity to two test species (*Eohaustorius estuarius* and *Mytilus galloprovincialis*)
- Benthic macrofauna

Subtask 3 Reporting

Sediment assessment scores will be compared among sites and to the scores of sites collected through the RMP Status and Trends program. The Status and Trends program began conducting SQO assessments in 2008 at a subset of the long-term sediment monitoring sites, which are located throughout the Estuary and represent ambient

conditions. Comparing the study sites to those representing ambient conditions will provide perspective about the respective ecological condition of sediments in the Estuary as a whole and near pollution sources. If previously sampled BPTCP study sites are selected for this study, it may be possible to further evaluate if sediment quality conditions have improved by using the SQO assessment scores to compare historic condition to this new study.

A report detailing the SQO assessment results and the conclusions from these comparative analyses will be prepared.

Contingency TIE Study for Stressor Identification

If either the amphipod or bivalve tests show significant toxicity, a phased TIE study to determine the causes of toxicity on the samples will be proposed. If this task is deemed necessary, funding will be requested from the RMP contingency fund.

STAFF INVOLVED

SFEI plans on hiring a senior staff member to focus on sediment quality and benthic ecology in early 2011. This staff member will lead this project. Aroon Melwani will also work on this project.

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Task 1a Summary report on BPTCP sites status	Mar 15, 2011
Task 1b Focus group meeting to develop final plan	Apr/ May 2011
Task 2 Sample Collection and Data Analysis	Aug 2011
Task 3 Draft and Final reports	Aug 2012, Oct 2012

BUDGET

The funding level for this study is \$60,000 for 2011 and \$30,000 for 2012. Of the \$90,000 total funding for the project, about \$29,000 is for SFEI labor, \$46,000 is for sample analysis, and \$15,000 is for logistical expenses.

WORKGROUP

This project will be overseen by the Benthic Workgroup and the Exposure and Effects Workgroup.

Table 1 Projected 2011 Budget

Task	Labor Cost	Subcontracts and Direct Costs
Program management	\$520,700	\$71,000
Data management	\$363,000	
RMP website	\$5,000	
Information dissemination	\$116,500	
Annual reporting	\$126,500	\$24,500
QA/QC	\$29,400	\$32,500
Status & Trends (S&T) Fieldwork/Vessel/Logistics	\$75,000	\$215,000
S&T Chemistry (water/sediment)		\$350,000
S&T Benthos	\$10,000	\$50,000
S&T Sediment Toxicity		\$50,000
S&T USGS Monitoring		\$360,000
SS: Mercury Synthesis	\$74,000	\$21,000
SS: Mercury in Foodweb (preliminary)	\$5,000	\$15,000
SS: PCB Synthesis	\$53,000	
SS: Analysis of Dioxin in Water	\$7,000	\$1,000
SS: EC Broadscan Scan of Biota	\$20,000	\$50,000
SS: EC Synthesis	\$30,000	
SS: Regional Loading Model	\$20,000	
SS: Loading Monitoring in Representative Watersheds	\$147,000	\$153,000
SS: STLS Management Support	\$16,000	\$4,000
SS: Effects of Copper on Salmonids		\$37,000
SS: Followup on Bay Hotspots	\$4,600	\$55,400
SS: Analysis of Dioxin in Sediments	\$12,000	\$40,000
Set Asides (e.g., sportfish, bird eggs, and bivalves) and Contingency		\$199,500
Total Budget (SC Approved)	\$1,640,900	\$1,523,400

