Regional Monitoring Program for Water Quality in San Francisco Bay

2014 Program Plan

OVERVIEW OF THE 2014 PROGRAM

In 2014 the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) is entering its 22nd year of monitoring and synthesis. At its inception, the purpose of the Program was to provide ambient water quality information to support management decisions. This continues to be a major goal and is addressed through the annual Status and Trends (S&T) monitoring program and special studies on select topics. The S&T program includes biennial water, sediment, and bivalve monitoring; hydrographic and sediment transport studies; triennial bird egg monitoring; and sport fish monitoring on a five-year cycle.

Until 2012, water and sediment was sampled annually; the reduction in the frequency of S&T sampling has allowed the Program to address a number of urgent information needs in other areas such as nutrient monitoring, tributary loadings, and contaminants of emerging concern. Prioritization of information needs has been articulated through the RMP Multi-year Plan revised each year based on stakeholder needs. The planning and oversight occurs continually throughout the year in committee meetings, workgroup meetings, workshops and peer-review of RMP products. The RMP Multi-year Planning priorities are conveyed to the workgroups and study designs are developed in consultation with Program participants and science advisors. The studies are then reviewed and approved by the TRC and SC. The results of these studies are evaluated to identify further information needs for consideration in the planning process.

In 2014, we will continue to advance our understanding of the potential impacts of contaminants of emerging concern (CECs). In 2013, the Annual Meeting and the Pulse of the Bay will highlight the RMP's substantial progress in monitoring and gathering information about CECs in the Bay. In addition, the emerging contaminant synthesis and the emerging contaminant strategy summarize our research on CECs to date and articulate the direction forward. The CEC strategy outlines a general approach for identifying and prioritizing CECs in the Bay based on their relative risk. For instance, the 2014 pilot study "Monitoring Alternative Flame Retardants in San Francisco Bay Water, Sediment, and Biota" was proposed because many alternative flame retardants have been listed as Tier 1 chemicals in the CEC strategy - high production chemicals of concern for which there is little environmental data. In 2014, the RMP will also be completing special studies that use non-targeted approaches to determine classes of CECs not yet identified in the Bay.

The Sources, Pathways, and Loading Workgroup, through the Small Tributary Loading Strategy (STLS), continues to provide critical information on loads from Bay Area watersheds. This group has developed a spreadsheet model to estimate contaminant loads and will continue to update the model with new information as it becomes available. In 2014, the STLS team will

continue to develop the spreadsheet model for contaminant load estimates of Hg and PCBs. Important for the success of the model is both continued monitoring of different watersheds as well as estimates of pollutant concentrations in stormwater (referred to as event-mean concentrations) corresponding to land use, soil type, and other watershed characteristics. With regard to the former, the RMP will intensively monitor two watersheds in the wet season of 2014 (beginning in late October 2013): Pulgas pump site and the North Richmond site.

Nutrients have become a major focus of the RMP. In 2011, the RMP initiated a stakeholder process to develop a Nutrient Strategy for the Bay. The RMP sponsored a series of meetings regarding the potential role nutrients may play in the possible eutrophication of the Bay and ways in which indicators may be used to monitor changing conditions. Based on work by the RMP and USGS, we know that suspended sediment concentrations in the Bay are decreasing, phytoplankton concentrations are increasing, and dissolved oxygen concentrations are decreasing. In 2013, the RMP Nutrient Strategy team completed the Nutrient Conceptual Model for San Francisco Bay. The conceptual model identified the highest priority issues and goals for nutrients in the Bay, which has informed the nutrient Science Plan. The Science Plan recommends completing modeling, monitoring, and process studies to understand the complex linkages that have made the Bay resilient to the adverse effects of nutrients and future scenarios that may lead to worsening conditions. In 2014, the RMP will fund the planning of the nutrient monitoring program, broadening of the network of moored sensors in the Bay, continuation of stormwater monitoring and load estimates, and hydrodynamic and water quality modeling. RMP resources are being combined with resources from local dischargers, the State Water Board, USGS, the Interagency Ecological Program, and other organizations to complete these studies and help answer the highest priority issues laid out in the Nutrient Conceptual Model.

The success of the RMP is in large part due to the active involvement of RMP participants, agency staff, and representatives from academia in providing peer review of Program elements. Through workshops, workgroup meetings, and committee meetings, these individuals help to assure that the RMP obtains high quality information on the key issues of concern to the Bay. This information is used by managers to make sound decisions to promote the health of the Bay.

This Program Plan is a summary of activities planned for 2014; a Detailed Workplan and budget are prepared separately and are reviewed and approved by the Technical Review Committee and Steering Committee. A budget summary of the total cost for each program element is included in Table 1. Detailed scopes of work and budgets are presented in the 2014 Detailed Workplan, which will be presented to the TRC in December.

TASKS

1. Program Management

The administration and management of the RMP requires a substantial effort from SFEI staff. Costs for this component of the RMP reflect the staff time required to manage finances and contracts, plan and coordinate internal activities and workgroups, and provide technical oversight of RMP products. A summary of the cost for these activities is included in Table 1.

1.1 Internal Coordination

This category provides SFEI staff time for coordination and liaison to Program participants, Program collaborators, the Regional Water Quality Control Board, and the Steering and Technical Review Committees. This coordination is necessary to prepare for and facilitate critical decisions, outline issues, and to ensure that RMP activities complement and enhance other scientific efforts by Program Participants and the Regional Board. This task also includes the internal coordination of RMP staff (e.g., the coordination and technical oversight of different RMP tasks).

1.2 External Coordination

External coordination promotes a comprehensive and coordinated understanding and monitoring of the Estuary through participation in workgroups and committees outside of the RMP umbrella. Members of RMP staff participate in the Surface Water Ambient Monitoring Program (SWAMP), various Regional Board activities in Regions 2 and 5, Northern California SETAC, the Delta Science Program, BASMAA, BACWA, LTMS, WSPA, and various TMDL workgroups and committees. In addition to the above, RMP staff are frequently asked to present at stakeholder meetings, universities, national and international working group meetings, and to serve on advisory boards. RMP staff also provide peer review of documents from other relevant non-RMP programs and projects.

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 as needed. It also includes preparation of contracts after scopes of work have been negotiated, scientific oversight of products, coordination of field and laboratory components, trouble-shooting, scheduling, and implementing course adjustments as necessary, cost-effectiveness/performance evaluations of existing contractors and identifying potential new subcontractors as needed.

1.4 Program Planning

Program planning for the RMP involves several tasks including Program Plan and workplan development, updating the Multi-year Plan and strategy documents, proposal writing, Program reviews, and development of scopes of work, both for in-house staff and subcontractors. We continue to place emphasis on documenting planning steps and assisting the Steering Committee and the Water Board in prioritizing information needs, and adapting the Program to evolving management priorities.

Since 2008, the RMP has focused considerable attention to develop strategies for high priority needs. Examples of these activities include the modeling strategy, the PCB strategy, mercury strategy, dioxin strategy, small tributary loading strategy and most recently the nutrient strategy. Through strategy team meetings, stakeholders are able to articulate key questions and to identify and prioritize fundamental monitoring and research needs to begin to answer the high priority questions.

These priority questions and the key information needs from RMP stakeholders are articulated in the RMP Multi-year Plan. The Multi-year Plan allows the RMP to prioritize research and monitoring needs over the next five years, to enable long-term financial planning, to assure that the studies are planned and reviewed in close consultation with our external review panels, and to assure that information is being provided for important management decisions in a timely manner (e.g., development of TMDLs, preparation of permits, etc.).

2. Information Management and Synthesis

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." Information management and synthesis includes all activities relating to data management, RMP web site maintenance, development of e-newsletters, *Estuary News* inserts, the RMP Annual Meeting, presentations, and information transfer to a variety of audiences, including preparation of the RMP Annual Monitoring Results and the "Pulse of the Bay." A summary of the cost for these activities is included in Table 1.

2.1 Data Management

The primary objective of this task is to manage, maintain, and improve the RMP database and to enable greater accessibility of data results. The information management and dissemination goals for 2014 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.

Database Maintenance and Web Access

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

Mapping Assistance (GIS)

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

Data Management Efficiencies

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

2.2 RMP Web Site

The RMP web site has an important role in making data, technical reports, meeting materials, workshops, Powerpoint presentations, and other documents available to stakeholders and the public. In 2014, SFEI will be updating its website format and layout; RMP staff will be working in collaboration with the Environmental Data, Information and Technology team to improve the RMP web site.

2.3 Information Dissemination

In 2014, the RMP will assist in funding the *Estuary News* magazine and as a result will have articles in the magazine as well as an insert in the Fall. Where possible, RMP staff use existing publications for information distribution, such as newsletters of participating agencies and the *Estuary News* magazine. As appropriate, formal presentations to community groups and other organizations, and scientific conferences also provide information about the RMP and its findings. This task also includes work related to planning and executing the RMP Annual Meeting.

2.4 Annual Reporting

This task includes preparing the Annual Monitoring Results for distribution on the web and writing, editing, and publishing *RMP Update* (*The Pulse* was produced in 2013 and is planned again for 2015). It continues to be a goal for the Program to report out data within a one-year time frame.

2.5 Quality Assurance and Quality Control

This task includes three main elements: 1) evaluating the quality of data generated by analytical labs; 2) updating the QAPP and protocol documentation; and 3) coordinating intercomparisons and other efforts to improve the quality of RMP data.

4. Status and Trends Monitoring

In 2011, the RMP reviewed the Status and Trends monitoring to evaluate the information that Status and Trends is providing and the frequency at which this monitoring needs to occur. Based on this review, the TRC and SC recommended a reduction in the frequency of sediment and

water monitoring to a biennial program. In addition, the frequency of organic analyses in water was reduced to a four-year cycle. At the writing of this plan, the TRC and SC are considering additional changes to the program including a reduction in monitoring of organics in water and potentially expanding the program to include margin and small fish sampling.

3.1 Sediment

Sediment Chemistry
Monitoring for contaminants in surface sediments (top 5 cm) will occur during the dry season at 47 sites in 2014. In 2013, the Exposure and Effects Workgroup (EEWG), TRC, and SC agreed to suspend the toxicity and benthos portion of the 2014 S&T sediment cruise and direct funds to analyzing the cause of moderate toxicity in the Bay. Therefore, only sediment chemistry will be sampled during the 2014 cruise.

As in prior years, SFEI staff will assist in the collection of sediment samples. Contracts to conduct the sediment chemistry work will be with the same laboratories that have performed well in recent years and include: Moss Landing Marine laboratories (grainsize), Columbia Analytical Services (TOC, nitrogen, etc.), the East Bay Municipal Utilities District (organics), the California Department of Fish and Wildlife Water Pollution Control Laboratory (pyrethroids), and Brooks Rand Laboratory (inorganics). Applied Marine Sciences will continue to serve as our logistics coordinator and will continue to be a sole source of services for us to as a result of their expertise.

3.2 U.S. Geological Survey Studies

The United States Geological Survey (USGS) has been collaborating in the RMP since the beginning of the Program and has contributed in-kind services through Department of Interior funding, IEP funding, and other sources to enhance the RMP financial contributions designed to address basic hydrographic and sediment transport processes. An understanding of these basic processes is necessary to interpret the spatial and temporal trends that are emerging from the RMP monitoring of chemical indicators of water quality condition, and to understand fundamental ecological processes in the Estuary that affect water quality.

3.2.1 Sediment Dynamics in San Francisco Bay

This element of the RMP focuses on understanding suspended sediment dynamics in the Estuary. Recent findings suggest that suspended sediment concentrations in the Bay declined sharply beginning in 1999. This work is conducted by Dr. David Schoellhamer of the USGS in Sacramento.

USGS maintains five suspended sediment stations in the Estuary (i.e., Alcatraz, Mallard Island, Benicia, Richmond Bridge, and Dumbarton Bridge) and funding for a temporary site (formerly the Hamilton transfer station). The USGS used the temporary site funding for 2013 for better understanding the sediment flux at the Golden Gate. We are currently working with USGS to determine how funding for the temporary station will be allocated in 2014.

In addition, in 2013, USGS will place oxygen probes at the following sites: Dumbarton Bridge (already deployed); Alviso Slough; San Mateo Bridge (near bottom); mouth of Corte Madera Creek; Benicia Bridge (near-bottom); and Richmond Bridge (near bottom). At this time, it is not clear whether USGS will continue this work as much of this was acheived through use of external funds.

3.2.2 Hydrography and Phytoplankton

This work is currently conducted by Dr. Jim Cloern of the USGS (Menlo Park). The study completes monthly water sampling to map the spatial distributions and temporal trends of basic water quality parameters along the entire Bay-Delta system. Measurements include salinity, temperature, and dissolved oxygen, which influence the chemical form and solubility of some trace contaminants; and suspended sediments and phytoplankton biomass, which influence the partitioning of reactive contaminants between dissolved and particulate forms. This basic information is required to follow the seasonal changes in water quality and estuarine habitat as they influence biological communities and the distribution and reactivity of trace contaminants.

USGS funding for this monitoring program has decreased in the last several years and it is anticipated that in the upcoming years it will experience even larger decreases. Currently, it is unclear which agency will oversee the monitoring program if the USGS no longer continues to maintain the program. The RMP cannot fund the work in its entirety, but future RMP nutrients monitoring will likely overlap with the measurements taken by this study.

4. Special Studies

The following studies were reviewed by the TRC and SC and approved for incorporation into the 2014 Program Plan.

4.1 Monitoring Alternative Flame Retardants in San Francisco Bay Water, Sediment, and Biota

Following management actions to eliminate production and use of PBDEs, manufacturers have begun using alternative (non-PBDE) flame retardants in many products. Contamination from these alternative flame retardants may be on the rise in the San Francisco Bay ecosystem, and this potential increase in exposure could pose risks to aquatic life and humans.

This study will monitor alternative flame retardants of highest concern for the Bay to assess contamination levels and provide a basis for classifying them according to the tiered prioritization scheme for CECs. The flame retardants will be analyzed in multiple matrices including ambient Bay water, effluent, stormwater, sediment, bivalves, and harbor seal blubber. The concentrations will be compared to past screening efforts in the Bay, to concentrations published in the literature from other locations, and to known effect thresholds to determine whether there are ecological and human health risks. The alternative flame retardants sampled will differ between each matrix based on the

chemical properties of the contaminant. The results of this monitoring will be reported as either aRMP technical report in early 2015.

The funding for this project is $107,000.

4.2 Updating the Emerging Contaminant Strategy

The RMP has completed a synthesis document summarizing the occurrence of contaminants of emerging concern (CECs) in San Francisco Bay (Klosterhaus et al. 2013) and has prepared a draft CEC strategy document (Sutton et al. 2013). The CEC strategy outlines the priorities for CEC monitoring in the next five years. Given that these are compounds of emerging concern, our understanding of their importance and our ability to monitor them is rapidly evolving. Throughout 2014, new information, new analytical methods, and new collaborations will become available As a result, it is imperative that RMP staff continue to read the literature and actively engage with researchers on this topic.

The RMP strategy document articulates three approaches for identifying CECs for monitoring. These approaches are based on:

1. Existing information (known or suspected use, occurrence or toxicity from other locations, best professional judgment),
2. Effects (i.e., bioassays), and
3. Occurrence (non-target analyses such as the RMP-funded project with NIST or fate modeling).

The objective of this task is to ensure the RMP is keeping up with the state of the science regarding CECs and to keep the CEC Strategy document relevant and timely. RMP staff will review newly published articles in peer-reviewed journals, reports produced by other programs, and abstracts and proceedings from relevant conferences. The outcome of this effort will be to provide the ECWG with updates on relevant information to possibly update the tiered prioritization framework, suggest additions or removal of CECs on the 'Unmonitored CEC Candidate List', and propose special studies for monitoring new CECs.

The funding for this project is $20,000.

4.3 Bioanalytical Tools: Linkage of *In Vitro* Assay Results With *In Vivo* End Points

One of the three approaches for identifying CECs for monitoring, communicated in the CEC strategy, is using bioanalytical tools to see which contaminants may be causing cellular and organismal effects. Beginning in 2013, the RMP had a unique opportunity to partner with researchers at the University of Florida and at SCCWRP to evaluate the effects of endocrine disrupting compounds on an estuarine fish (Mississippi silverside). One of the unique and important points of this research is that it will link *in vitro* cellular effects to whole organism (*in vivo*) endpoints such as reproduction, growth, and mortality.

During the first year of this two year study (2013), researchers evaluated the effects of four endocrine disrupting compounds (estrone, bisphenol A, 4-nonylphenol, and galaxolide) on cellular function by identifying molecular biomarkers for silversides and developing *in vitro* bioassays. The presence of biomarkers associated with growth, sexual differentiation, brain development, and reproduction (e.g., vitellogenin) will be correlated with exposure to endocrine disruptors.

During the second year of study (2014), researchers will conduct the same *in vitro* bioassays using field samples from San Francisco Bay, both WWTP effluent and receiving waters. *In vivo* assays will then be completed using silversides exposed to the same Bay area effluent and receiving waters. The *in vitro* assays will be compared to the *in vivo* assay results to correlate endocrine disruptor effects at the molecular level to effects at organismal level. This study is relevant because it is examining estuarine organisms and endocrine disruptors that the state recommended monitoring in the 2009 EC Panel report.

The 2014 funding for this project is $56,000.

4.4 Impacts of Dredging on Benthic Habitats

The benthic communities of the Bay are fundamental components of foraging habitat for many fish species. However, there is a lack of scientific information specific to the Bay about the degree of benthic community disruption caused by periodic maintenance dredging, about rates of benthic community recolonization and recovery following dredging, and about how these possible benthic disturbances affect fish foraging success or quality. Therefore, a benthic disturbance study in Central Bay was one of the highest priorities under the 2011 Programmatic Essential Fish Habitat Agreement.

The objective of this pilot study is to assess the quality of benthic assemblages from a fish foraging standpoint, in areas that are periodically dredged in Central Bay compared to non-dredged areas. The study will attempt to determine if the quality of benthic habitat for fish foraging is lower in areas that are dredged every one to three years than in areas that are undredged, defined by the structure and function of the benthic invertebrate assemblage.

The study will be completed in three phases:

- Literature review to understand what the target fish are eating and to group benthic assemblages into functional groups (based on their value to fish feeding)
- Creation of a statistically robust study design to evaluate differences between treatment and control samples.
- A pilot field study to ensure that the study design will answer stakeholder questions.

The funding for this study is $150,000 ($50,000 RMP; $100,000 from America’s Cup).

4.5 The Effects of Particle Size and Shape and Animal Health on Toxicity Test Results

Pervasive moderate toxicity has been identified in Bay sediments. The cause for this toxicity remains unclear. The RMP convened a workshop last year with approximately 25 national experts to review Bay data and to develop hypotheses as to why Bay sediments exhibit toxicity. This element addresses three high priority hypotheses that may affect the health of test organisms (specifically amphipods): grain size, grain shape, and health of the test organism.

One hypothesis is that amphipod's survival rates are reduced in fine sediments. To evaluate this idea, a dose-response curve will be developed for sediments by varying the percent fines present. In a second experiment, grain shape will be evaluated to determine whether shape affects the health of the amphipods. Lastly, lipid content will be measured across seasons to assess the viability and health of the test organisms throughout the year.

The 2013 funding for this study is $80,000 with $30,000 being provided by the RMP and the remaining $50,000 being provided by the State Water Board.

4.6 STLS: Stormwater Loads Monitoring in Representative Watersheds

There is an urgent need for estimates of stormwater loads by watershed and by region. The Municipal Regional Stormwater Permit (MRP) specifically requires better quantification of sediment and contaminant loads at the watershed scale. In addition, the Mercury and PCB TMDLs require reductions in local watershed loads by 50 and 90 percent, respectively. Understanding the loads from representative watersheds is critical for addressing these information needs and achieving these load reductions.

The RMP Small Tributary Loading Strategy (STLS) outlines four priority management questions:

1. Which are the "high leverage" small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
2. What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?
3. How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?
4. What are the projected impacts of management actions on loads or concentrations of pollutants of concern from the high-leverage small tributaries and where should management actions be implemented in the region to have the greatest impact?

Monitoring in representative watersheds will provide information to assist in answering these questions.

The STLS team conducted a statistical analysis of existing information and developed an optimal sampling plan for watersheds. Based on this work and reconnaissance sampling in 16 watersheds, the STLS team decided to focus monitoring efforts on six Bay Area watersheds: Richmond Pump Station, Lower Marsh Creek, San Leandro Creek, Pulgas Creek, Guadalupe River, and Sunnyvale East Channel.

For planning purposes it was assumed that during one water year, four storms will be sampled in each of the six watersheds (two watersheds monitored by RMP staff and the remaining four by consultants). However, water year 2013 continued the dry weather pattern seen in recent water years. At the Sunnyvale site, for example, in water years 2012 and 2013 only four out of the eight required storms were sampled. During water year 2014, any additional storms will be carried into the water year 2014 sampling plan. Therefore, over the 3 year period, representative samples will be taken at each site for a total number of 12 storms. The RMP will sample at the Richmond Pump Station and Sunnyvale East Channel. These watersheds will be monitored for a variety of constituents including: PCBs, PAHs, PBDEs, pyrethroids, mercury, copper, selenium, suspended sediment, nitrate, and toxicity. A report summarizing these results will be prepared.

The funding level for this study is $352,000.

4.7 STLS: Develop and Update Spreadsheet Model – Year Five

A high priority for the Small Tributary Loading Strategy (STLS) is to develop models to estimate the loads from local watersheds to the Bay and how these loads may be reduced. STLS resources over the last several years have been directed to address this need by developing a regional spreadsheet model of stormwater quality. The model is useful because of its simplicity; the unit area runoff for homogeneous sub-catchments is produced based on rainfall and the soil type, land-use, and slope of the area. The regional spreadsheet model is a significant improvement over the simple rainfall/ runoff model that was developed in 2000 to calculate regional stormwater volumes and contaminants. The improved model can calculate average monthly storm water volumes and better estimates of regional loads through improved spatial and temporal coverage.

In 2013, the model was refined by incorporating spatial data on PCB and Hg sources as input data sets. The overall objective for 2014 is to continue to develop and refine mass emissions estimates of Hg and PCBs for the region, using single watersheds for calibration and verification purposes. The model and documentation will not be packaged for external users and a 10 page technical memorandum will be written.

The funding level for this study is $30,000.

4.8 STLS: POC Loads Monitoring –Land Use/Source Area Specific EMC Development

A critical input parameter for the Regional Watershed Spreadsheet model is the event mean concentration (EMC) for POCs. Although EMCs have been developed for Southern

California, these data are not directly applicable to the PCB and mercury emissions in the Bay Area. EMCs differ based on land use; therefore, in 2011 the STLS team began compiling land use/source area specific EMC data.

The objective of this study is to continue generating EMC data for input to the Regional Watershed Spreadsheet Model. The framework for the development of EMCs will differ by contaminant. In general, the following approach is used: perform literature review for each contaminant to identify available EMC data and to characterize EMC values based on soil type, land use, etc.; use soil data to calibrate the suspended sediment spreadsheet model; evaluate loadings based on land use/source areas; develop GIS databases for proposed contaminant-specific land use or source area using literature values and current loads estimate Bay Area specific EMCs; and lastly, monitor specific land use/source areas during wet weather events to confirm EMCs.

In 2013, STLS recommended allocating funds to compile PCB and Hg EMC data using inverse optimization methodologies for the land-use and source areas developed in the GIS layers. This work is underway. The STLS Team will evaluate the 2013 work and make a recommendation for tasks to be completed in 2014.

The funding for this task is $80,000.

4.9 STLS: Management Support for Spreadsheet Model Outreach and "Land Use" Based Monitoring

A substantial amount of coordination is required to assure that the STLS activities are in alignment with other monitoring partners, BASMAA, the Regional Water Quality Control Board, and in accordance with the Municipal Regional Permit. This task will support STLS meetings to collaborate on WY2014 monitoring and to provide updates and solicit input on the spreadsheet model and EMC development.

The funding level for this activity for 2014 is $25,000.

4.10 Nutrients: Hydrodynamic and Water Quality Model Development

San Francisco Bay has long been recognized as a nutrient-enriched estuary, but one that has historically proven resilient to the harmful effects of nutrient enrichment, such as excessive phytoplankton blooms and hypoxia. The published literature suggests that the accumulation of phytoplankton biomass in the Bay is strongly limited by tidal mixing, grazing pressure by invasive clams, light limitation from high turbidity, and potentially, in the North Bay, ammonium inhibition of diatom uptake of nitrate. However, evidence is building that, since the late 1990s, the historic resilience of the Bay to the harmful effects of nutrient enrichment is weakening (Cloern et al., 2007; Dugdale et al, 2007). In response to the apparent changes in the Bay's resilience to nutrient loading, the RMP Nutrient Strategy team completed the Nutrient Conceptual Model for San Francisco Bay. The conceptual model identified the highest priority issues and goals for nutrients in the

Bay. Many of these high priority science questions will need to be addressed in part through modeling and the report recommends the development of integrated models of hydrodynamic and water quality to inform nutrient management decisions.

The primary goal of this proposed work is to launch the development and refinement of a set of integrated Bay-wide hydrodynamic, nutrient cycling, and ecosystem response models to inform nutrient management decisions. By the end of 2013, criteria for model selection, recommendations for a model platform, and input on appropriate model platforms for addressing relevant management questions will be finalized. A modeling report will be completed by Q4 of 2013 that identifies appropriate model platforms for addressing the selected management questions. In 2014, work on model development will begin. An initial Bay-wide hydrodynamic model, built using information from existing work in the Bay, will be developed and the features and parameters of an existing water quality model will be appropriately modified to carry out initial modeling experiments.

The total cost for this work is $150,000.

4.11 Nutrients: Combined Nutrients Proposals - Monitoring and Program Management

The indications of decreased Bay resilience to high nutrient loads described above have come at a time when the availability of resources to continue monitoring the Bay's condition is uncertain. The USGS has monitored basic water quality parameters in the Bay since the late 1960s. These data have been critical for determining the effects of nutrients on the Bay and will be essential for future modeling efforts. However, at the present time, the future of the USGS long-term water quality monitoring is uncertain. It will be important for the RMP to begin to evaluate options for cost-efficient monitoring.

The Nutrient Strategy Team, with support from other agencies, will work to develop a nutrient monitoring program, expand the moored sensor network in the Bay, and continue the collection and analysis of stormwater samples for nutrient analytes. The objectives for these tasks in 2014 include:

1. Creating a monitoring program working group and technical advisory team to guide the development of the nutrient monitoring program. This group will consist of regulators, stakeholders, and technical experts working together to produce a monitoring program development plan.
2. Expanding the moored sensor network in Lower South Bay South Bay by adding two additional stations (one moored sensor was deployed at Dumbarton Bridge in 2013) measuring chl-a, pH, DO, turbidity, fluorescent dissolved organic matter, depth, and nitrate. Existing monitoring data will be analyzed to help optimize placement of moored sensors.
3. Continuing collection and analysis of stormwater samples for nutrient analytes that are not currently required as part of the Municipal Regional Stormwater

Permit (NH_4^+, TKN, and NO_2^-) in the six watersheds being sampled by the STLS during water year 2014.

The funding level for these tasks and general nutrient program management is $320,000.

4.12 Nutrients: Improved Quantification of Stormwater Nutrient Loads and Uncertainty Analysis

In 2013, the RMP developed initial estimates for nutrient stormwater loads, which suggest that the loads have the potential to be substantial nutrient sources during the wet season in certain Bay segments (e.g. San Pablo Bay). However, these initial estimates, made with the Regional Watershed Spreadsheet Model (RWSM), are highly uncertain because 1) land-use specific nutrient concentrations used for agriculture may not be accurate for the type of agriculture in these regions (vineyards, not crops or livestock); and 2) the model was not necessarily developed for nutrients, and while it has been calibrated/validated for hydrology, a nutrient calibration is not possible due to sparse data. As a result, there is a need to further explore these estimates, and, to the extent possible, refine them.

The objectives for this 2014 study are to:

1. analyze additional Bay Area stormwater nutrient data, and compare RWSM estimates to other model-derived or empirical load estimates;
2. improve load estimates and uncertainty analysis using a hydrological simulation model, focused on the Napa River or Sonoma Creek; and
3. consequently recommend a series of next steps to further evaluate the potential importance of stormwater nutrient loads.

A range of potential model platforms will be considered for the hydrological simulation model and will depend on data availability and whether calibrated/validated hydrological (and, if possible, nutrient) models are available.

The total cost for this work is $50,000.

4.13 Analysis of Dioxin in Sport Fish

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. Every five years the RMP studies contaminants in Bay sport fish; since 1994, dioxin concentrations have remained unchanged, but continue to greatly exceed screening values for human consumption in some sport fish species. Therefore, in 2014 dioxins in sport fish will once again be evaluated.

The funding level for this study is $24,000 for 2014.

Table 1
Cost Summary of Program Elements

A budget summary for each of the program elements is listed below.

	Labor	Direct Costs/ Subcontractors	Total
1. Program Management	$568,000	$98,000	$666,000
2. Information Management and Synthesis	$398,500	$67,000	$460,500
3. S&T Monitoring	$244,000	$1,044,700	$1,288,700
4. Special Studies			
4.1 Alternative Flame Retardants	$52,300	$54,700	$107,000
4.2 Updating RMP Emerging Contaminants Strategy	$20,000		$20,000
4.3 Bioanalytical Tools: Linkage of In Vitro Assay Results With In Vivo End Points		$56,000	$56,000
4.4 Impacts of Dredging on Benthic Habitats		$50,000	$50,000
4.5 The effects of particle size and shape and animal health on toxicity test results		$30,000	$30,000
4.6 Stormwater Loads Monitoring in Representative Watersheds	$190,000	$162,000	$352,000
4.7 Develop and Update Spreadsheet Model- Year 5	$30,000		$30,000
4.8 POC Loads Monitoring – Landuse/Source Area Specific EMC Development	$40,000	$40,000	$80,000
4.9 Management Support for Spreadsheet Model Outreach and "Land Use" Based Monitoring	$25,000		$25,000
4.10 Hydrodynamic and Water Quality Modeling	$150,000		$150,000
4.11 Combined Nutrients Proposals: Monitoring and Program Management	$107,000	$213,000	$320,000
4.12 Nutrient Stormwater Modeling	$50,000		$50,000
4.13 Analysis of Dioxin in Sport Fish	$24,000		$24,000
5. Set Asides			$211,100
Totals	**$1,913,000**	**$2,044,850**	**$4,168,950**

Table 2 Revised Status and Trends Schedule

	2012	2013	2014	2015	2016	2017	2018	2019
Bivalve	X		X		X		X	
Water		TE		Org, TE		TE		Org, TE
Sediment	Org,TE, wet		Org, TE, dry		Org,TE, wet		Org, TE, dry	
Bird Egg	X			X			X	
Sport Fish			X					X
USGS WQ	X	X	X	X	X	X	X	X

Org - Organics
TE - Trace elements
Wet – 27 sites
Dry - 47 sites