Sources Pathways and Loadings - Special and Pilot studies concepts

Study #1

A) Title of proposed project: Small tributaries loading study – watershed two

B) Proponent / study team: Lester McKee and RMP staff (SFEI)

C) Background / rational / need / time line: This project aims to implement a second small tributaries loading study. This is a long standing recommendation from the SPLWG. Davis et al. (2000) recommended that six observation watersheds be picked on the basis of land use and climate. This recommendation remains valid however is should be recognized that stratification based on rainfall and land use is not mutually exclusive. Historic and current industrialized areas are found mainly on the lower-rainfall Bay margin. To-date we have implemented just one loadings study (the Guadalupe River study). Recent literature suggests that methyl Hg is related to %wetland area in a watershed – this could also be used as a ranking criterion for selection of observation watersheds. In any case, it is easy to argue that Guadalupe is not representative of other watersheds in the Bay Area (especially for Hg). The question remains, what magnitude of loads are derived from a) small, low rainfall, but highly impervious, commercial and industrialized "storm drain watersheds" on the Bay margin or b) medium sized commercial and urban land use watersheds or c) mixed land use watersheds that include agriculture and open space. The recent PCB multi-box model suggested that the South Bay is sensitive to loads reductions. Therefore improving our understanding of loads and change through time might be most desirable for South Bay watersheds, however SLPWG members are against a south Bay focus because this might not be true for contaminants other than PCBs. The workgroup support a regional distribution of observation watersheds for loads analysis. Additional loadings studies will provide ability to measure success of management actions through analysis of trends through time, an improvement of estimation of loads from the entire Bay Area watershed to help focus management attention and provide data for improvement of models that describe processes and biological effects in the Bay.

D) RMP Management Questions Contributed to or Answered?

Q1. Describe the distribution and trends of pollutant concentrations in the Estuary (c)

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities (d,e,f,h,j)

Q3. Describe sources, pathways, and loading of pollutants entering the Estuary (e,f,g,h)

E) Method: Field data collection during wet season using "Guadalupe River protocol modified by lessons learned and to suit the characteristics of a new study location. Briefly this includes a real-time turbidity probe, USGS suspended sediment daily loads program, SFEI field sampling for trace contaminants, and lab analysis for the full suit of priority contaminants in the first year (Hg, MeHg, Cu, Se, PCBs, PBDEs, Endocrine Disruptors, Pyrethroids), ancillary parameters (DOC, POC, other TMs), and spot analysis of lower priority contaminants (OC pesticides and PAHs). In subsequent years, the list of parameters would decrease to include only the priority contaminants and ancillary parameters.

F) Expected cost (Rough - can be increased or decreased at a later stage): $150,000

Study #2

A) Title of Proposed Project: Design of a Bay Area Creeks Regional Monitoring Program

B) Proponent: SF Bay Regional Water Quality Control Board

C) Background: This project aim to design a Bay Area Creeks Regional Monitoring Program. The RMP is a well-developed program to the point where we can call the SF Estuary the best studied estuary in the US and perhaps the world. In devoting these resources to the Bay, we have, unfortunately neglected

watersheds, and we have done little regional coordination for assessing watershed stressors, transport pathways of contaminants, and loads.

There is emerging information that the local tributaries, especially the ones flowing through urbanized watersheds contribute as much sediment and contaminant mass as the central valley river systems despite delivering about 4% of the annual water volume (McKee, 2003: UR lit review). In addition there is a number of watersheds around the Bay Area that are listed as impaired for sediment, pathogens, nutrients, and diazinon yet there is generally a lack of data for these watersheds (except through the SWAMP program) or where local studies have been funded. There is an avalanche of information needs associated with these Bay Area watersheds and urban creeks, and the woefully under funded SWAMP program cannot address these needs. Here is just a sampling of what we need to find out or do.

- Urban runoff contributions to WQ problems.
- Tracking progress in implementation of solutions
- Finding sources and problem areas for stressors in the Bay Area landscape
- Addressing other stressors besides TMDL pollutants (hydro-modification (extremely important), sediment, temperature etc.)

Currently, we have an adhoc, uncoordinated approach to these pressing issues and this slows progress. Plus, because of limited resources and multiple priorities, UR programs find it difficult to do adequate surveillance. While they have expertise that would aid a watershed regional monitoring program and need to participate in that way, it would be better if they could focus their attention on solving the problem (an area where they have very high expertise) and leave aside the job of assessing progress to a coordinated effort. Coordination and centralization of this monitoring will take pressure off UR programs so they can focus on implementing solutions.

Now is the time to build a Bay Area tributaries RMP. Fortunately, we do not have to start from scratch. We have some examples to follow and build on like SWAMP, Guadalupe River loads assessment, the Southern California Stormwater Monitoring Coalition program, the Napa River sediment TMDL (and associated technical studies by SFEI, Stillwater Sciences and others, the Tamales Bay pathogen TMDL, and various monitoring elements executed by our local urban runoff programs such as BAMBI, BASMAA urban bed sediment monitoring, and most recently the BASMAA street sweeper studies. We must first design the program in terms of objectives, methods, level of effort and staffing and then perhaps implement a pilot program.

D) RMP Management Questions Answered?

Q1. Describe the distribution and trends of pollutant concentrations in the Estuary (c)

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities (b,d,e,f, h,j)

Q3. Describe sources, pathways, and loading of pollutants entering the Estuary (a,b,c,d,e,f,g,h)

E) Method: Literature Review, interviews, paper exercises, conceptual model development

F) Expected cost ($30 - 60k?)

Study #3

A) Title of proposed project: Improving Bay Area Hydrography for Characterization and Modeling

B) Proponent / study team: Eric Zhang / Mike May (SFEI)

C) Background / rational / need / time line: This project aims to complete the storm drain GIS for existing maps in the OMC storm drain and watershed boundary maps series. Future efforts to characterize watersheds for sources, removal, transport, and loadings of TMDL contaminants require watershed specific and regional understanding of stormwater routing and watershed boundaries. SFEI and USGS has now

completed the 1:24,000 contiguous blue line data set (NHD) for the Bay Area as a base layer and Oakland Museum of California (OMC) and William Lettis and Associates (WLA) have completed or have funding to complete the 24 inch storm drain map series for the Bay Area with the exceptions of Bayside Marin, Vallejo Bayside Contra Costa and Fairfield/Suisun. SFEI's Proposition 13 project will compile and conflate blue lines, storm drains and watershed boundaries for the Peninsular and Richmond however this is needed for the rest of the map series. Included in this effort is the improvement of the existing storm drain coverages up to FGDC metadata standards by WLA. The final product would be a GIS data set of flow paths with built-in routing attributes and watershed boundary polygons provided to the Bay Area community free of charge on the RMP web page. This GIS would form the basis for the development of watershed and regional models for interpreting and extrapolating / modeling stormwater loadings of contaminants, understanding and modeling watershed response to management practices and providing better spatial and temporal loading data for input into modeling efforts in the Bay. In addition, it would build upon the Bay Area Regional GIS Council (BARGC) and CALWATER effort to update the state watershed boundary layers. This project would be timely in 2007.

D) RMP Management Questions Answered?

Q1. Describe the distribution and trends of pollutant concentrations in the Estuary (c)

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities (b,d,e,f,h,j)

Q3. Describe sources, pathways, and loading of pollutants entering the Estuary (a,b,c,d,e,f,g,h)

E) Method: Data compilation and analysis using GIS

F) Expected cost (Rough - can be increased or decreased at a later stage): $45,000

Study #4
A) Title of proposed project: Storm Drain Outfall Sediment Characterization

B) Proponent / study team: Lester McKee / Sarah Pearce (SFEI)

C) Background / rational / need / time line (1 paragraph please): This project aims to determine if sediment removal at stormwater outfalls on the Bay Margin is a suitable means for addressing water quality problems in the Bay. Stormwater maintenance activities represent a potential method for reducing loads of contaminants entering the Bay and improving water quality in the Bay. Where storm drains outfall to the Bay margin, sediments can build up and form deltaic sediment deposits that contain contaminant mass that could be removed by dredging. We recently measured one such deposit at the Sausal Creek outfall. This deposit has a volume in excess of 6,000 m^3 and may contain 0.5 kg of PCBs and 5 kg of Hg. There are many such deposits occur on the Bay margin and inside the flood control channels at the salt/fresh interface. These may represent a great opportunity to capture and remove a large mass of contaminants that would otherwise enter the larger Bay system. Further they offer a watershed scale BMP that probably captures many smaller contaminated "hotspots" in a single place. However, there are many unknowns. A potential flaw in this management solution is that the majority of the mass of PCBs and Hg is probably carried in the very fine grain size fractions. It is possible that tidal reworking each year disperses some sediment and contaminants away from the outfall point. A screening level survey of a number of these deltas including the measurement of volume, TOC, and grainsize could be used to develop a list of priority sites. A detailed field study of 3-5 priority outfall locations over a wet season would determine if removal is a viable option for improving water quality in the Bay. This type of study could be completed along side a new small tributaries loading study to gain an understanding of the portion of load that is stored in the delta. An addition outcome of this study should be an analysis of what it would cost BASMAA agencies to implement such a control measure – this might require partnering outside of SFEI to ensure a defensible outcome.

D) RMP Management Questions Answered?
Q1. Describe the distribution and trends of pollutant concentrations in the Estuary (c)

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities (d,e,f,h)

Q3. Describe sources, pathways, and loading of pollutants entering the Estuary (c,g)

E) Method: Identify 20 such deposits on the Bay margin and inside flood control channels focusing on industrial watersheds but including a variety of watershed types. Collect 3 cores from each to be analyzed for grainsize, bulk density, and organic carbon. Select 3-5 deltaic deposits that have small grain sizes and high organic carbon present and monitor size over a single wet season to determine dynamics in relation to storm events and tidal processes. Complete laboratory analysis for the TMDL contaminants in the bulk sediment (Hg and PCBs, and other high priority contaminants with TRC consultation). Calculate contaminant mass in each deposit and interpret the data collected with reference to land use, sediment processes and hydrology of the upstream watershed. Estimate the cost of removal and disposal of such deposits. Consult with stakeholders throughout the pilot study and make recommendations on how to proceed into the future.

F) Expected cost (Rough - can be increased or decreased at a later stage): $50-80k

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Study #5
A) Title of proposed project: Determining the Ability of Loadings Studies to Observe Change

B) Proponent / study team: Lester McKee / RMP staff

C) Background / rational / need / time line (1 paragraph please): This project aims to determine the feasibility for loads studies to determine trend through time in response to TMDL recommendations. TMDLs have called for load reductions from urban stormwater. This will likely be achieved through the

additional application of various urban BMP and stormwater conveyance maintenance programs and other activities that might result in measurable load reductions. A recent analysis by McKee and Leatherbarrow on Guadalupe River data showed that 5-year averaged stormwater loads of Hg in the Guadalupe River watershed have likely varied from 6-440 kg per year over the past 30 years of climatic variability. Thus, it is a difficult prospect for permits to be managed on loads alone. There is presently no local knowledge on how long it will take before a load reduction in relation to increased management effort might be realized and secondly how change could be quantified. This study aims to address both of these questions by 1. Performing a brief literature review of other watersheds around the world where trends in response to management have been observed, 2. using the literature review to determine what kind of parameters (physical, chemical, and biological) might suit the needs of the Bay Area, and 3. Using USGS historical suspended sediment data and 4-5 years of recent data on the Guadalupe River, perform a power analysis of sediment Hg concentrations in water to determine the sensitivity of such data for measurement of trends. In addition we would review the BASMAA monitoring data (1989-1995) and the Stormwater Environmental Indicators Demonstration Project (SEIDP) outcomes. We will aim to answer the following questions: Q1. Under what circumstances are trends (positive and negative) observed in urban systems and receiving waters in other parts of the world where management initiatives to reduce loads or concentrations have been defined and applied? Q2. What measurements are made in other systems to observe the trend – are biological indicators the best? Q3. What magnitude of loading change or particle concentration change would need to occur before we observe a trend in the Guadalupe River system?

D) RMP Management Questions Answered?

Q1. Describe the distribution and trends of pollutant concentrations in the Estuary (c)

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities (b,d,e,f,h,j)

Q3. Describe sources, pathways, and loading of pollutants entering the Estuary (c,g)

E) Method: Literature review and power analysis on Guadalupe existing data from multiple sources (SFEI, BASMAA, CSJ?, and SEIDP)

F) Expected cost (Rough - can be increased or decreased at a later stage): $30,000

Study #6

A) Topic: Enhanced Isohyetal Analysis of the San Francisco Bay Area

B) Proposed by: Jan Null, Golden Gate Weather Services

C) Description: The objective is to develop a detailed up-to-date isohyetal analysis for the entire Bay Area with monthly resolution. Possible data sources to obtain and analyze include data from the National Weather Service, Department of Water Resources and local water and flood control agencies. This would be done with existing gauge data. A survey and analysis of existing rainfall source data would create a database upon which the graphical isohyetal analysis would be developed. Additionally, point analysis could be derived for key locations. Currently the "standard" is an annual-regional scale analysis by Rantz from 1969 which underestimates Bay Area seasonal precipitation by as much as 10 percent. The final product would be a key tool for the hydrologic modeling inflow to San Francisco Bay. This is fundamental data for the development of accurate models of inflow through the SF Bay Estuarine system thus it should be accomplished at least in parallel with modeling efforts.

D) RMP Management Questions Answered?

Q1. Describe the distribution and trends of pollutant concentrations in the Estuary (c)

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities (b,d,e,f,h,j)

Q3. Describe sources, pathways, and loading of pollutants entering the Estuary (a,b,c,d,e,f,g,h)

E) Methods: Compile all local rainfall data with a suitable length of record/quality, complete graphical analysis

F) Estimated Cost: $25,000

Study #7

A) Title of Proposed Project: Stormwater storm-sewershed outfall sampling

B) Proponent: Lester McKee

C) Background: This project aims to quantify concentrations and loads at the outfall of a range of storm sewersheds in the lower Guadalupe River watershed that contribute Hg load to the Guadalupe River. The Guadalupe River TMDL has been developed with little information on the contribution of urban stormwater to Hg loads. A better understanding of stormwater mercury loads entering Guadalupe River from the urban, industrial, and commercial areas will assist managers to make decisions about how to address TMDL goals such as targeted sediment removal, demonstrating concentrations in sediment to not exceed 0.2 mg/kg or stormwater loads reductions. Although there is a need for this kind of data in the Guadalupe River watershed, the interpretation of such data has regional significance and will allow better estimation of loads in other urban areas. Other analytes could be monitored including PCBs PBDEs, PAHs, dioxins, furans, and diazinon but clearly, measuring extra analytes have budget implications.

D) RMP Management Questions Answered?

Q1. Describe the distribution and trends of pollutant concentrations in the Estuary (c)

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities (b,d,e,f, h,j)

Q3. Describe sources, pathways, and loading of pollutants entering the Estuary (a,b,c,d,e,f,g,h)

E) Method: Field sampling and flow measurements

F) Expected cost: $20k (Hg only)-100k (Hg, PCBs, PBDEs)?

Study #8

A) Title of proposed project: Guadalupe River Watershed Model Development

B) Proponent / study team: John Oram, Lester McKee, RMP staff (SFEI)

C) Background/ rational / need / time line: This project aims to begin development of numerical model of the Guadalupe River Watershed. Three years of monitoring concentrations of suspended sediments, metals, and trace organic contaminants in the Guadalupe River has greatly improved our understanding of the system. Our conceptual models of how the watershed responds to changes in weather patterns and land use have likewise improved over the years. It is now time to test these conceptual models with a numerical hydrologic model. At this time the proposed model development is limited to hydrology, though its ultimate use will be as a modeling tool for simulation of contaminant transport to support TMDL calculations. The model will have the additional benefits of allowing for the quantification of various management scenarios and providing load estimates for Bay water quality models.

D) RMP management questions answered:

Q1. Describe the distribution and trends of pollutant concentrations in the Estuary.

Q2. Project future contaminant status and trends using best understanding of ecosystem processes and human activities.

Q3. Describe sources, pathways, and loadings of pollutants entering the Estuary.

E) **Method:** Review existing EPA watershed models and select most appropriate. Compile existing data for model input: land use maps, precipitation, topography, flow diversions, etc. Develop, calibrate, and validate model using existing monitoring data.

F) **Expected cost:** $100K, rough estimate with potential match funds from SCVWD