DEVELOP AND UPDATE SPREADSHEET MODEL – YEAR 5

Lester McKee, Alicia Gilbreath, Jennifer Hunt, and Jing Wu, SFEI, Richmond, CA

ESTIMATED COST: **$30,000**
OVERSIGHT GROUP: Sources Pathways and Loading Work Group (SPLWG) /
Small Tributaries Loading Strategy Team (STLS)

PROPOSED DELIVERABLES AND TIMELINE

Deliverable	Due Date
Task 1. Refine the model for inclusion of any new GIS source layers and new EMC data	5/1/2014
Task 2. Revise and complete mercury and PCB RWSM V3	7/1/2014
Task 3. Model sensitivity analysis and documentation	9/1/2014

BACKGROUND
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in the San Francisco Bay TMDL have been estimated by the Water Board by combining BASMAA bed sediment data with now outdated estimates of regional suspended sediment loads. In the case of PCBs, the mass loads in the Bay TMDL were derived from scaling loads from the Guadalupe and Coyote Creek watersheds by area up to the region as a whole. Although these methods were arguably appropriate for planning and TMDL development, the implementation plans of these TMDLs call for improvements of regional scale loads estimates and to assess how these loads might be reduced. These needs are now reflected in the municipal stormwater permit (MRP) (SFRWQCB, 2009) and in the 2nd and 4th questions of the RMP Small Tributaries Loading Strategy (STLS).

"Spreadsheet models" of stormwater quality provide a useful and relatively cheap tool for estimating regional scale watershed loads. These models are based on the simplifying factor that unit area runoff for homogeneous sub-catchments have constant concentrations. Spreadsheet models have advantages over models such as HSPF and SWMM since data for many of the input parameters required by those models do not currently exist, and also require large calibration data sets which take money and time to collect. A spreadsheet model was developed for the Bay Area previously (Davis et al., 2000); however, at that time, there was only local land use specific data on pollutants of concern (POCs) for a drought period during the late 80s and early 90s, and there was no local data on Hg and PCBs. More recently, a spreadsheet model was developed for a watershed in Los Angeles that was able to predict 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). Locally Lewicki and McKee (2009) used a combination of methods to make new watershed specific suspended sediment loads estimates, including application of a spreadsheet model for urban areas in which sediment loads were calculated from watershed area and erosion estimates for specific land use classes. In this model, empirical data and regional regression equations were also applied to larger watersheds dominated by non-urban land use. The combination of these

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methods produced estimates of sediment loading to the Bay that are presently deemed to be the best. An improved version of this sediment model will be integrated in to the regional watershed spreadsheet model (RWSM) described further below.

RMP 2010 Year 1 of model development
- Version 1 of the hydrology component of the regional watershed spreadsheet model (RWSM) was developed.
- The year 1 report also presented a review of land use and source areas in relation to PCBs, Hg, dioxins, Cu, and Se and provided recommendations for steps to develop event mean concentration (EMC) data to support the input side of the model. The report recommended the model structure for each pollutant, methods to fill data gaps, and priorities (Lent and McKee 2011).

RMP 2011 Year 2 of model development
- Version 2 included several more calibration watersheds to increase the range of watershed characteristics including % imperviousness character.
- The first versions of the Hg and PCB RWSMs were developed using combinations of SoCal EMC data (Hg only) and world soils data (Hg and PCBs) combined with local SSC EMC data (BASMAA, 1995). The Hg load results were consistent with existing estimates at a regional scale but questionable at the scale of individual watersheds or land uses. For PCBs, the loads were 20x higher than expected on a regional scale but in the right order of magnitude relative to our conceptual models for land uses and source areas.
- In parallel, the BASMAA Monitoring / Pollutants of Concern (POC) Committee has been discussing and prioritizing work products in relation to the MRP. During 2011, project profiles were developed for addressing MRP provisions c8e.vi (sediment delivery estimate / budget) and c.14 (PBDEs and OC pesticides). Subsequently, BASMAA asked SFEI to complete work outlined in these project profiles. The sediment budget estimate is in progress at this time as is the PBDE and OC pesticides profiles.

RMP 2012 Year 3 of model development
- Developed a Copper test case model for RWSM. Copper represents a data rich urban contaminant that follows classical source, build-up, and wash off processes in relation to urban land uses in a similar fashion to PAHs and pesticides and parts of the mercury model process.
- Additionally in 2012, using RMP funds for the EMC development study, we developed improved input datasets that will underlie the refinements to the PCB and Hg models of the RWSM. The outcomes of these efforts are presently about to be used for the next runs of the PCB and Hg RWSM (Year 4 of model development).

RMP 2013 Year 4 of model development
- Refine the RWSM by incorporating spatial data (GIS layers) of PCB and Hg sources (developed with RMP 2012 EMC funding) as input data sets.

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- Refine the RWSM by incorporating back calculations of land use-specific EMCs (developed with RMP 2012 EMC funding) as input data sets.
- Revise and complete Hg and PCB RWSM v2 testing and calibration. We will also evaluate model weaknesses through a sensitivity analysis (combinations of more and less source area classes and reasonable ranges of EMCs for each source class, hybrid models) and make any obvious or within budget improvements.

Objective:
The overall objective of this 2014 proposed effort (Year 5 of model development) is to continue to develop and refine mass emissions estimates of Hg and PCBs for the region as a whole draining into the San Francisco Bay using single watersheds for calibration and verification purposes In 2014, we should have data available from Pulgas Creek watershed, a key monitoring site for calibration of the RWSM for PCBs.

APPLICABLE RMP MANAGEMENT QUESTIONS
Level I RMP, Q3:   What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?
Level II RMP, Q3C: What is the effect of management actions on loads from the most important sources, pathways, and processes?
Level III SPL Q2:   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?
Level IV STLS Q1: Impairment: Which are the "high-leverage" small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
Level IV STLS Q2: Loads: What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?
Level IV STLS Q4: Support management actions: 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?

METHODOLOGY

In 2014, we propose to:

- Refine the RWSM by incorporating any new spatial data (GIS layers) of PCB and Hg sources (developed with RMP 2013 EMC funding) as input data sets.
- Refine the RWSM by incorporating back calculations of land use-specific EMCs (developed with RMP 2013 EMC funding) as input data sets.
- Revise and complete Hg and PCB RWSM v3 testing and calibration. We will also evaluate model weaknesses through a sensitivity analysis (combinations of more and less source area classes and reasonable ranges of EMCs for each source class, hybrid models) and make any obvious or within budget improvements. Assumption: The model and documentation will not be packaged for external users. Such packaging and creation of supporting documentation (i.e., a user manual) may be a prioritized as a further step.
- Deliverable: 10 page technical memo

There are two other project components developed through the STLS that will add value to the RWSM. Pending available non-RMP funding, the tasks are:

- Update the sediment RWSM by developing an erosional rates classification scheme and updating the model with known sediment outputs (model and report due August 2013.
- Begin to develop the RWSM for PBDEs and OC pesticides to estimate regional scale loads.

BUDGET (TO BE ADJUSTED AS NEEDED)

Proposed Cost (all labor)		
Task 1	Refine the model for inclusion of any new GIS source layers and new EMC data	$5,000
Task 2	Revise and complete mercury and PCB RWSM V3	$17,500
Task 3	Model sensitivity analysis and documentation	$7,500
Total for the 5th year		$30,000
Subsequent years		?

REFERENCES

Davis, J.A., L. McKee, J. Leatherbarrow, and T. Daum. 2000. Contaminant Loads from Stormwater to Coastal Waters in the San Francisco Bay Region: Comparison to Other Pathways and Recommended Approach for Future Evaluation. San Francisco Estuary Institute, Richmond, CA.

Ha, S.J. and M.K. Stenstrom. 2008. Predictive Modeling of Storm-Water Runoff Quantity and Quality for a Large Urban Watershed. *J. Environ. Eng*., 134(9), 703-711.

Lent, M.A. and McKee, L.J., 2011. Development of regional suspended sediment and pollutant load estimates for San Francisco Bay Area tributaries using the regional watershed spreadsheet model (RWSM): Year 1 progress report. A technical report for the Regional Monitoring Program for Water Quality, Small Tributaries Loading Strategy (STLS). Contribution No. 666. San Francisco Estuary Institute, Richmond, CA.

Lent, M.A., Gilbreath, A.N., and McKee, L.J., 2012. Development of regional suspended sediment and pollutant load estimates for San Francisco Bay Area tributaries using the regional watershed spreadsheet model (RWSM): Year 2 progress report. A technical progress report prepared for the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), Small Tributaries Loading Strategy (STLS). Contribution No. 667. San Francisco Estuary Institute, Richmond, California.

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Lewicki, M., and McKee, L.J., 2009. . Watershed specific and regional scale suspended sediment loads for Bay Area small tributaries. A technical report for the Sources Pathways and Loading Workgroup of the Regional Monitoring Program for Water Quality: SFEI Contribution #566. San Francisco Estuary Institute, Oakland, CA. 28 pp + Appendices.

Schueler, T., 2003. "Impacts of impervious cover on aquatic systems," *Rep. to Watershed Protection Research Monograph #1*, Center for Watershed Protection, Ellicot City, Md.

SFRWQCB, 2009. California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit, Order R2-2009-0074, NPDES Permit No. CAS612008. Adopted October 14, 2009. 279pp.
http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2009/R2-2009-0074.pdf