



Bay RMP Exposure and Effects Workgroup Meeting

April 11, 2018

San Francisco Estuary Institute
Richmond, CA

Meeting Summary

Attendees:

Science Advisor	Affiliation	Present
Steve Weisberg	SCCWRP	Yes
Dan Schlenk	UC Riverside	Yes
Michael Fry	U.S. Fish & Wildlife Service	Yes

Others Present

- Beth Christian (SFBRWQCB)
- Richard Looker (SFBRWQCB)
- Tong Yin (SFBRWQCB)
- Keith Maruya (SCCWRP)
- Alvina Mehinto (SCCWRP)
- Nancy Denslow - (University of Florida)
- Steve Bay (SCCWRP)
- David Gillett (SCCWRP)
- Mike Connor (East Bay Dischargers Authority)
- Jennifer Siu (EPA)
- Mary Lou Esparza (CCCSD)
- John Coleman (Bay Planning Coalition)
- Betty Kwan (Bay Planning Coalition)
- Jessica Donald (San Jose-Santa Clara Regional Wastewater Facility)
- Heather Peterson (SFPUC)
- Scott Bodensteiner (Haley & Aldrich)
- Jeff Cotsifas (Pacific EcoRisk)
- Ryan Mayfield (San Jose-Santa Clara Regional Wastewater Facility)
- Phil Trowbridge (SFEI)
- Jay Davis (SFEI)
- Ila Shimabuku (SFEI)
- Diana Lin (SFEI)
- Rebecca Sutton (SFEI)
- Meg Sedlak (SFEI)

The last page of this document has information about the RMP and the purpose of this document.

1. Introductions and Welcome

Phil Trowbridge commenced the Exposure and Effects Workgroup (EEWG) meeting by quickly summarizing the meeting's agenda, allowing for introductions, and mentioning the two-day Emerging Contaminants Workgroup (ECWG) meeting taking place the following two days, April 12 and 13.

2. Information: Workgroup Mission and Multi-Year Plan

Phil Trowbridge set the stage for this meeting by explaining that the main purpose of the Exposure and Effects Workgroup is to provide technical oversight and stakeholder guidance on RMP studies related to contaminant exposure and biological effects. Phil presented EEWG management drivers, project area overlaps with both the Emerging Contaminant and Sediment Workgroups, and priority questions in relation to EEWG studies. He highlighted that there are \$450,000 worth of proposed special studies with a planning budget of \$125,000 and emphasized the need to prioritize, scale, phase, leverage, archive, etc., in order to reach budget goals.

3. Information/Proposal: Improving Tools for Evaluating Impacts of Sediment Contamination on Fish

In order to set the stage for "Support for Dredging Project Bioaccumulation Evaluations, Part 2," Diana Lin provided some context and reasoning for the "Support for Dredging Project Bioaccumulation Evaluations, Part 1" study which was approved for funding in 2017 and was about 75% complete at the time of this meeting. She proceeded with an update on the status of Part 1 and solicited input on the methods she used to determine standardized toxicity reference values (TRVs) for a list of regulated compounds in dredged sediments.

- Dan Schlenk and Steve Bay commented that, because the study from which Diana based her PCB TRV calculation measured chronic exposure rather than acute, she did not need to use the existing uncertainty factor in her calculation of the PCB TRV. However, because the study only analyzed effects of PCB exposure for one concentration against a control, a true lowest observed effect concentration (LOEC) cannot be determined and, therefore, an uncertainty factor should be used to account for the lack of dose-response data.
- Steve Bay questioned whether limiting the literature review to studies from the Environmental Residue Effects Database (ERED) would provide her with the most extensive current state of knowledge. He suggested looking outside of the ERED.

- There was some concerns about using such strict criteria for acceptable studies that the TRV was based on a single acceptable study.

Diana continued with Item 3 by presenting a proposal for 2019: “Support for Dredging Project Bioaccumulation Evaluations, Part 2.” Part 2 includes two separate tasks for completion in 2019. The first is to review all the PCB bioaccumulation test results to assess the performance of current bioaccumulation testing trigger (BT) thresholds. The second is to review and recommend a standard set of inputs for bioaccumulation modeling. There was some discussion about how the current PCB BT was calculated and as well as whether RMP funds are appropriate for these kinds of studies. The group also discussed similarities and differences between the bioaccumulation model for sediment testing (Bioaccumulation Risk Assessment Modeling System) and the food web model that was used for the PCB TMDL. The TMDL model was developed with a human health exposure endpoint from fish consumption, while the sediment testing modeling is typically implemented to model ambient fish tissue concentrations. Both models are based on the Gobas food web model and are related. The TMDL model should be included as a reference for recommending standard food web model inputs for the Bay.

4. Information/Proposal: Improving Tools for Evaluating Contaminant Effects on Benthic Infauna

David Gillett began by explaining that there is currently a need for a robust tool to evaluate the health of the benthic community in the San Francisco Bay in order to improve the sediment quality objective (SQO) assessment framework. The main purpose of Phase I of the Multivariate AZTI Marine Biological Index (M-AMBI) project, which was funded in 2018, was to determine whether the M-AMBI tool could be used to accurately measure the health of the benthic community in the Bay. His preliminary findings indicated that, if implemented, this tool would be successful 95% of the time and would work in all five salinity zones of the Bay. David will have a technical memo summarizing his findings from Phase 1 by the end of 2018. He proceeded to present a 2019 proposal for Phase II of the M-AMBI work which would involve using the M-AMBI tool to recalculate SQO assessments for the whole estuary as well as producing an R script which would allow anyone to use the M-AMBI tool.

The group discussed the effects of grain size on the results because grain size has been identified as an important factor for sediment toxicity testing. David responded that grain size was evaluated in the M-AMBI tool but was not a major factor. It does not affect the tolerances of the various organisms to contaminants. Dave agreed to present

the results from the Phase I study grouped by different grain size categories to test whether grain size has any effect on the results for San Francisco Bay.

One stakeholder questioned whether the improved understanding would lead to changes in the SQO assessments that would lead to any management decisions.

Other discussion centered on Heather Peterson's question of whether unknown toxicity that has been assumed to be attributed to grain size may also be caused by dissolved pollutants in the water just above the sediments. David responded that previous assessments of metals in pore water had not explained the toxicity. He also noted an alternative explanation for the "unknown toxicity": sediment chemistry assessments in the Bay have typically focused on legacy pollutants, so newer pollutants such as pyrethroids may be present and responsible for the toxicity. Mike Connor suggested running the SQO assessments in areas with higher concentrations of contaminants in the water column. David Gillett agreed that this could help to answer Heather's question.

5. Proposal: Understanding the Causes of Sediment Toxicity in Mission Creek, San Francisco

Phil Trowbridge provided some background by explaining that there has been interest in looking at sediment toxicity in contaminant hotspots in the hopes that it would answer questions regarding causes of sediment toxicity, which is ubiquitous and not well understood. Steve Bay began by explaining that he is proposing to monitor stormwater suspended sediment (for both legacy and emerging contaminants), sediment, and the benthic community in Mission Creek to assess the influence of both contaminant and non-contaminant stressors on benthic communities. He argued that the current tools used to examine sediment toxicity are not sufficient and that findings from this study could help to improve methods for assessing the impacts of sediment contamination and a causal assessment framework for benthic macrofauna. He stated that these improved methods could be applied to other sites in San Francisco Bay and could help to re-evaluate whether sites included on the 303d listing should be listed as impaired.

Heather Peterson explained that combined sewer discharges, which are limited to around 8 times per year, effectively undergo primary treatment before being discharged to the Bay which means that most of the sediment has previously been settled out before entering the Bay. In addition to difficulties associated with sampling stormwater at this location, she noted the recent changes in land use and stormwater infrastructure and questioned whether the Mission Creek site would be the best hotspot for a study looking to characterize inputs based on historical understanding of the site. Heather

commented that the large number of gradients - interannual, sediment/grain size, seasonal salinity, contaminant, and Mission creek's connection to the ambient Bay - all need to be taken into consideration when creating the sampling design. Dan Schlenk suggested using sediment cores to see if the sediment toxicity matches the temporal profile.

Overall, advisors were skeptical that Mission Creek was the right location for this type of study. They placed emphasis on the need for caution in creating this kind of sampling design but agreed that studying hotspots is important due to the large gaps in knowledge regarding more dynamic issues related to stormwater contaminant exposure. Steve Bay agreed with EEWG attendees that SFPUC and SFEI stormwater experts should be consulted when designing the sampling plan. A quick brainstorm revealed Islais Creek and San Leandro Bay as other potential study locations.

6. Information/Proposal: Developing Bioanalytical Tools for Evaluating the Effects of Mixtures of Contaminants (Part 1)

Phil Trowbridge introduced Emerging Contaminants Workgroup advisors, Derek Muir, Heather Stapleton, and Lee Ferguson, who arrived during lunch.

Phil proceeded to introduce Nancy Denslow and her work with developing the estrogen receptor (ER) bioanalytical tool. In 2017, the RMP funded Nancy to develop Phase III of the ER bioassay. Her goals included establishing tighter linkages between in vitro assays and in vivo endpoints as well as using the assay to screen San Francisco Bay waters and sediments for estrogenic contaminants. A number of problems occurred during the experiments and she plans to redo them as soon as possible. However, despite the experimental issues, several advisors and attendees thought her findings still accomplished her original goal of refining the dose-response curve and encouraged Nancy to integrate her findings into her existing data-response curve to re-evaluate whether she needs to repeat the study. The evaluation of Bay water and sediment revealed that estrogenic activity in Bay samples was, for the most part, at concentrations below the detection limit.

One of the triplicate samples from a single Bay location showed an effect that indicated the presence of higher levels of estrogenic contaminants, which Nancy suggested must have been caused by laboratory contamination. This led Lee Ferguson to consider whether there is heterogeneity upon reconstitution of the extract into cell media whereby particle-bound compounds that are in close proximity to the cells may include different levels of contaminants. He has previously come across issues with ensuring uniform contaminant concentrations upon reconstituting sediment extracts into aqueous

systems. Dan Schlenk guessed that the outlier was caused by issues with dilution and recommended concentrating the sample as much as possible.

Lee Ferguson has performed non-targeted analyses on Coyote Creek and would like to share his findings (and POCIS extracts) and compare his results with Nancy's.

Heather Stapleton noted that Nancy's results suggest antagonism. Heather is interested in characterizing the antagonistic activity since it could mask adverse impacts.

Nancy Denslow transitioned to presenting her 2019 proposal for next steps. She argued that, in order to use this tool on a macro scale, the extraction efficiencies need to be further refined, and a better understanding of the analytes that cause estrogenic effects needed to be developed. She's proposing to improve her extraction efficiency in addition to repeating her linkage experiments alongside targeted analyses of estrogenic compounds. Only the repeated linkage experiments and targeted analysis were included in the proposal sent out in advance of the EEWG meeting. Therefore, the Workgroup requested that Nancy prepare a revised proposal for review by email. Overall, advisors were happy with the sensitivity of the tool and its developmental progress, and were optimistic about its applicability to the Bay.

Action Item:

- Prepare a revised ER proposal that includes improving the method for sediment extraction. (Nancy Denslow, 5/1/18)

7. Information/Proposal: Developing Bioanalytical Tools for Evaluating the Effects of Mixtures of Contaminants (Part 2)

Phil Trowbridge introduced Alvina Mehinto and her work with the glucocorticoid receptor (GR) bioassay.

Alvina's 2019 study proposal would involve taking the GR assay from stage 3 to stage 4 by refining in vitro/in vivo linkages and developing bioscreening thresholds. She plans to do this through identifying ecologically relevant toxicity endpoints, establishing impact thresholds, and using the GR assay to screen Bay water samples. Because glucocorticoids, as well as *Menidia* and closely related fishes (such as threatened and endangered smelt species), are seen in the Bay, Alvina argues that this assay should be of particular interest to Bay managers and researchers. Alvina highlighted the GR's EEWG-applicable nexus between biology and contaminants of emerging concern (CECs). She also noted existing leveraging opportunities with statewide initiatives for CECs, Southern California Bight, and an ongoing EPA-funded study with *Menidia*.

Rebecca Sutton also mentioned a synergy with an ongoing emerging contaminants effluent study and a pharmaceutical study that are currently planned for 2020.

Dan Schlenk asked Alvina to consider measuring white blood cells or phagocytosis as an immune function response rather than the simple immune challenge, which has proven to be much more difficult.

Michael Fry mentioned that glucocorticoids are of concern because the use of these drugs has increased and they are very potent.

Heather Stapleton suggested that, since glucocorticoids are linked to adipogenesis and Alvina's fish gained weight, Alvina should look into using the "Fab 4" biomarker or studying hormone levels to determine whether adipogenesis is a cause of weight increase. Nancy Denslow commented that she has a robust method that uses liquid chromatography-mass spectrometry to measure hormones in fish.

Advisors and stakeholders discussed the significance of the bioassays and how the RMP should be involved. The cost caused a few stakeholders to hesitate before agreeing that the work is necessary. There was some discussion about reviewing other methods for assessing effects or issuing a RFP to solicit other ideas. Others asked if it is the RMP's role to develop bioanalytical tools or to apply them after they are developed by the State. Science advisors and other attendees argued that the potential for gain, due to both future use of the tool as well as being involved with developing such an impressive methodology, far outweighs the up-front investment. A lot of the tool development is already done. The linkage analysis is the last step. The RMP could make a small investment to leverage a huge amount of resources from other parties. In response to the question about a RFP, Lee Ferguson countered that the best experts on this topic (Denslow et al.) are already recommending the GR tool. Steve Weisberg argued that the RMP should invest in tool development to be ahead of the curve and proactive. Dan Schlenk argued that glucocorticoids are environmentally relevant. The GR response is high in contaminated sediments in the Bight. Investing in the development of this tool is well within the scope of the Exposure and Effects Workgroup and not much of a gamble given how much others have already invested in it.

8. Discussion of Proposals

Phil Trowbridge introduced Item 8 by reminding the workgroup of the purpose of the EEWG, mentioning that the budgets for the current list of proposals add up to \$450,000 whereas the planning budget is about \$125,000, and by summarizing the proposal approval process.

Steve Weisberg began the discussion by stating that being proactive should be prioritized over being reactive and that contributing to the advancement of bioanalytical tools gives the EEWG an important opportunity to do so. He also stated that the RMP should have a clear framework of how the bioassays will be applied to the Bay. Lee Ferguson agreed on the importance of bioassay development and added that the bioassay tools provide the missing link between our understandings of CECs and their effects on biology, with which Heather Stapleton agreed.

John Coleman said all of the proposed studies are, either directly or indirectly, beneficial to the dredging community and that he is, therefore, in support of all proposed studies.

Richard Looker had concerns about the utility of the M-AMBI tool. He was also skeptical of the Mission Creek hotspot study due to its complexity and his lack of confidence in the passive sampler technology.

Mike Connor suggested using the terms “practical” and “visionary” instead of “reactive” and “proactive.” He was skeptical of the bioaccumulation testing guidance (not appropriate for RMP funding) and the Mission Creek Study (wrong location). He would prioritize the M-AMBI study over the bioanalytical tools because it will produce usable results sooner.

Overall, advisors and attendees were impressed with the list of projects and thought they were all relevant and important to the EEWG and RMP.

9. Closed Session - Decision: Recommendations for 2019 Special Studies Funding

John Coleman led the closed session discussion whereby the Principal Investigators for the proposed studies were asked to leave the room to avoid a conflict of interest. Remaining workgroup participants were asked to rank the proposals 1 to 6, with 6 being the highest priority and 1 being the lowest priority. Before ranking the proposals, the existing ER proposal, which included Nancy repeating her experiments alongside targeted analyses of estrogenic compounds, was replaced with the idea for a new ER study aimed at improving the extraction efficiency of the ER test.

The table below summarizes the results of the group ranking exercise. The bolded studies were recommended by the EEWG for consideration by the TRC. The new proposal idea for “Sediment Extraction for Bioassays” may be recommended for consideration by the TRC pending EEWG review of a written proposal.

Study Name	Budget	Modified Budget	Priority	Comments
Support for Dredging Project Bioaccumulation Evaluations, Part 2	\$48,000	\$48,000	1	
Exposure and Effects Workgroup Strategy Coordination and Technical Support	\$5,000	\$5,000	2	
Synthesis of Benthic Community Data in the Whole of San Francisco Bay using the M-AMBI Index Phase II	\$29,000	\$29,000	3	
Developing Bioscreening Thresholds for the Glucocorticoid Receptor Cell Assay	\$50,000	\$50,000	4	Funding for the second and third year depend on results from 2019.
Sediment Extraction for Bioassays	??		5	Requesting a new written proposal
Evaluation of Stressors Affecting Sediment Quality in Mission Creek, San Francisco Bay	\$170,000		6	Not recommending as is. Focus on novelty & site selection for consideration next year.
Total	\$302,000	\$132,000		
Planning budget	\$125,000			

10. Report out on Recommendations

John Coleman reported out on the final recommended rankings. For the one study that was not recommended, the group explained that there is interest in a hotspot study but the monitoring tools and site selection should be reconsidered. Jay Davis, Richard Looker, and Tom Mumley (volunteered by Richard) agreed to help Steve Bay develop a hotspot study for consideration next year.

Action Item

- Distribute new proposal from Nancy Denslow about Sediment Extraction Methods to the EEWG for review and prioritization. (Phil Trowbridge by 5/1/18)

11. Adjourn

About the RMP

RMP ORIGIN AND PURPOSE

In 1992 the San Francisco Bay Regional Water Board passed Resolution No. 92-043 directing the Executive Officer to send a letter to regulated dischargers requiring them to implement a regional multi-media pollutant monitoring program for water quality (RMP) in San Francisco Bay. The Water Board's regulatory authority to require such a program comes from California Water Code Sections 13267, 13383, 13268 and 13385. The Water Board offered to suspend some effluent and local receiving water monitoring requirements for individual discharges to provide cost savings to implement baseline portions of the RMP, although they recognized that additional resources would be necessary. The Resolution also included a provision that the requirement for a RMP be included in discharger permits. The RMP began in 1993, and over ensuing years has been a successful and effective partnership of regulatory agencies and the regulated community.

The goal of the RMP is to collect data and communicate information about water quality in San Francisco Bay in support of management decisions.

This goal is achieved through a cooperative effort of a wide range of regulators, dischargers, scientists, and environmental advocates. This collaboration has fostered the development of a multifaceted, sophisticated, and efficient program that has demonstrated the capacity for considerable adaptation in response to changing management priorities and advances in scientific understanding.

RMP PLANNING

This collaboration and adaptation is achieved through the participation of stakeholders and scientists in frequent committee and workgroup meetings (see Organizational Chart, next page).

The annual planning cycle begins with a workshop in October in which the Steering Committee articulates general priorities among the information needs on water quality topics of concern. In the second quarter of the following year the workgroups and strategy teams forward recommendations for study plans to the Technical Review Committee (TRC). At their June meeting, the TRC combines all of this input into a study plan for the following year that is submitted to the Steering Committee. The Steering Committee then considers this recommendation and makes the final decision on the annual workplan.

In order to fulfill the overarching goal of the RMP, the Program has to be forward-thinking and anticipate what decisions are on the horizon, so that when their time comes, the scientific knowledge needed to inform the decisions is at hand. Consequently, each of the workgroups and teams develops five-year plans for studies to address the highest priority management questions for their subject area. Collectively, the efforts of all these groups represent a substantial body of deliberation and planning.

PURPOSE OF THIS DOCUMENT

The purpose of this document is to summarize the key discussion points and outcomes of a workgroup meeting.