



Bay RMP Exposure and Effects Workgroup Meeting

May 9, 2017

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

- Naomi Feger (SFBRWQCB)
- Beth Christian (SFBRWQCB)
- Keith Maruya (SCCWRP)
- Alvina Mehinto (SCCWRP)
- Steve Bay (SCCWRP)
- Brian Anderson (UC Davis-Granite Canyon)
- Shannon Alford (Port of San Francisco)
- Brian Ross (USEPA Region 9)
- Mike Connor (East Bay Dischargers Authority)
- Tom Hall (EOA, Inc.)
- Jessica Donald (San Jose-Santa Clara Regional Wastewater Facility)
- Isa Woo (USGS)
- Heather Petersen (SFPUC)
- Joe Dillon (NOAA Fisheries)
- James Haussener (CMANC)
- Scott Bodensteiner (Haley & Aldrich)
- Thang Vuong (Port of Oakland)
- Dianne Heinz (Port of Oakland)
- Jeff Cotsifas (Pacific EcoRisk)
- Phil Trowbridge (SFEI)
- Jay Davis (SFEI)
- Ila Shimabuku (SFEI)
- Diana Lin (SFEI)
- Rebecca Sutton (SFEI)
- Nancy Denslow - (University of Florida), remote access
- Jim Mazza – (USACE), remote access
- Arleen Feng (Alameda County/BASMAA), remote access

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 and allowing for introductions.

2. Discussion: USGS report on Assessing the Impacts of Periodic Dredging on Benthic Habitat Quality

Isa Woo presented the findings of the study in the place of the lead author, Susan De La Cruz, who was not able to attend the EEWG meeting. The main purpose of this impact-assessment study is to look at how the prey of foraging fish, benthic invertebrates, are impacted by dredging by comparing the health of benthic communities in regularly-dredged areas to the health of those in non-dredged areas. Three phases of the study had been completed by May 2017: literature review; power analysis and study design; and a pilot study. The USGS is currently at the tail-end of phase four, data analysis and full-study design, and is in preparation of phase five, the full study.

The main objectives of the pilot study were to conduct trial runs with the selected sample size and benthic community identification methods to evaluate dredged versus non-dredged areas. Five recently-dredged sites were sampled during the pilot study. At each site, samples were collected along transects in dredged areas, in non-dredged "reference" areas, and between the dredged and reference areas. Preliminary results from the pilot study did not detect statistically significant differences between dredged and non-dredged areas. The error bars on benthic community numbers were large, in part because few benthic invertebrates were present in the cores. The cores were 10 cm in diameter. Based on the preliminary results, the authors estimate that 200 cores would be needed to detect a 50% difference in the benthic community.

The EEWG had many questions about how the pilot study was executed and what the current plan is for the final study. Among the discussed topics were whether the designated reference areas are adequate representations of similar *and* non-dredged environments and the importance of quantifying the actual gut contents of fish in the study areas. The general feeling among committee members was an interest in becoming more involved in the final study design as well as there being a need for augmenting the current study plan in order to make this study more robust.

The Committee then brainstormed a couple of suggested add-ons: DNA analysis of the gut-content of foraging fish (which Steve Weisberg offered to help with), use of larger cores to decrease variability of results, and identification of taxa to the species level. Another idea was to conduct a temporal study at a few locations to address the issue of whether reference sites were representative of conditions in the dredged areas. Phil Trowbridge reminded the committee that the RMP had funded phases 1, 2, and 3 of the study and asked if the committee was interested in prioritizing one idea as an add-on for RMP funding. Ultimately, archiving samples of fish stomach contents and cores for analysis later was the prioritized add-on and was discussed along with the other proposals for 2018 funding in the closed session at the end of the meeting.

3. Information: Update on Causes of Sediment Toxicity Studies

Phil Trowbridge introduced Brian Anderson and his talk on the current state of sediment toxicity in the Bay. Brian quickly covered the history of sediment toxicity in the Bay by explaining that moderate (~50% - 60% survival) toxicity has been observed since the testing began in 1993 and no causes of the toxicity, contaminant or otherwise, have been successfully identified. One important organism in sediment-toxicity testing is the amphipod *Eohaustorius estuarius* which is a benchmark species for sediment quality objectives (SQOs) and is also a free burrower, which means it's exposed to dissolved contaminants in interstitial water. Brian explained that scientists in the Bay have not succeeded in identifying the chemical causes of *E. estuarius* mortality and suspect that fine-grained sediments are responsible for some fraction of the mortality. Brian conducted a RMP-funded special study which exposed *E. estuarius* to varying amounts of fine-grained sediments by spiking their habitats with kaolin clay. He was able to confirm that fine grained sediments cause mortality and was able to determine that younger *E. estuarius* were more resilient to fine-grained sediments. Brian concluded this item by stressing the importance of toxicity identification evaluation (TIE) method development and growth of the dose-response library.

4. Discussion: Current and Future RMP work on Bioanalytical Tools

Phil Trowbridge introduced Alvina Mehinto by giving a brief background on Alvina's and Keith Maruya's work on bioanalytical tools and the RMP's involvement. Alvina began her talk by stating that there is a surplus of contaminants of emerging concern (CECs) to monitor (upwards of 50,000) and a deficit of monitoring methods. Bioanalytical tools have the potential to help to bridge this gap.

Keith then gave a quick summary of the estrogen receptor (ER) bioassay work. The Phase II linkage study, funded by the RMP, compared the response of the bioassay to responses in a model fish, *Menidia*. The results showed similar responses in both the bioassay and fish. The bioassays were more sensitive. Fish showed a similar response to that of the bioassays when the whole animals were exposed to ~10x - 15x contaminant concentrations. A Phase III study is underway, with RMP funds, to fill holes in the dose-response curve, evaluate reproductive effects, and screen some water samples from the Bay. Keith estimated that another \$50-100k of investment would be needed to get the ER assay method fully developed.

Phil Trowbridge switched gears by asking about other bioassays that the RMP should consider. Alvina presented recommendations for developing a new glucocorticoid receptor (GR) assay. The GR assay would measure exposure to anti-inflammatory steroids. This is a large class of chemicals of which only a few are monitored directly. The GR assay protocol has been validated in freshwater, and chemical exposures explain the majority of the response. The approach to develop the GR assay method would mimic what was done to develop the ER assay. Some targeted monitoring for dexamethasone (a potent glucocorticoid) in the Bay could be part of the initial work. The estimated cost to develop this method is

\$350k over three years. \$150k of RMP funds would be needed and the rest of the cost could be borne by other agencies/organizations with an interest (State Board, LA Sanitary District).

Other potential bioassays discussed were the androgen receptor assay (AR) and the aryl hydrocarbon receptor assay (AhR). The AhR assay is fairly well developed. The signal from this assay may be dominated by legacy contaminants such as PCBs so it may not be useful as a screening tool for emerging contaminants in the Bay.

There was some discussion of the State Board's interest in bioanalytical tool development as well as their possible interest in funding studies in this line of work. Workgroup members wanted to get more information about what the State Board will be doing in this topic area before proceeding.

5. Decision: S&T Sediment Toxicity and Benthos Monitoring Strategy

Phil Trowbridge commenced the discussion on sediment toxicity work and benthos by reminding the workgroup of the background of the RMP's sediment toxicity and benthos work and explaining that a strategy was currently in the works. Sediment toxicity was not measured during the last sediment cruise in 2014 and it's now or never to decide whether to continue monitoring sediment-toxicity trends in the 2018 sediment cruise. He ran through the proposed objectives which included ensuring the absence of high toxicity in the Bay, proving or disproving the hypothesis that sediment toxicity is chemical-contaminant related, supporting the sediment quality assessments with sediment toxicity and benthic community data, and supporting hotspot management. The workgroup wanted to see the words "trends" as part of the objectives.

Phil moved on to the proposed 5-year plan which included both Status and Trends monitoring and Special Studies. One of the proposed actions was to switch to a different index for assessing the benthic community: the mAMBI. The mAMBI (Multivariate AZTI Marine Biological Index) is based on a universal ranking of species' sensitivity to pollution. The mAMBI would provide for more robust assessments than the current IBI (index of biologic integrity) because it is less sensitive to variations in salinity and other habitat factors. The EPA plans to use the mAMBI for the 2020 National Coastal Condition Assessment across the country.

Workgroup members proposed that, if sediment toxicity and benthos work is to continue, a broad range of studies would be needed to allow for the data to be interpreted. Ideas discussed were:

- Further synthesis of SQO data that already exists;
- Examining stressors besides chemicals to tease out or determine more possible causes of toxicity (one pathway would be the *Eohaustorius* Special Study to be discussed in Section 7A);
- Adding current use pesticides to the chemical analytes tested in sediment to investigate the link between current use pesticides and neurotoxicity in benthos;
- Adapting the mAMBI indices for use in the Bay; and
- Evaluating sediment toxicity and benthos data in hotspots.

One of the reasons given for continuing the sediment triad work was that, whether the tests are flawed or not, the Bay is known to be toxic and that is reason enough to continue monitoring efforts. Also, the National Coastal Condition Assessment (NCCA) will collect sediment triad data in 2020 and, it would be better for the RMP to have a plan ready for how to analyze the data.

The discussion came to a close without reaching a conclusion. Naomi Feger requested additional time to review the draft strategy before it is considered by the TRC.

Action Items

- Change the first objective of the sediment toxicity and benthos monitoring strategy to something like “Quantify the trends in sediment toxicity and ensure the absence of high toxicity in Bay sediments.”
- Use the term “sediment quality assessments” rather than “sediment quality objectives” in the sediment toxicity and benthos monitoring strategy.

6. Decision: Management Drivers and Priority Research Questions

Jay Davis began by presenting the multi-year plan for the RMP, as well as its management questions and charges specific to the EEWG. Jay continued by discussing the concern by the Steering Committee and Technical Review Committee about the eclectic, low-impact studies conducted by the EEWG recently. The SC and TRC are also concerned about overlapping responsibilities between the EEWG, the Emerging Contaminants Workgroup (ECWG), and Sediment Workgroup. However, the SC and TRC have stated that the EEWG is still justified as long as management questions are kept as a focal point. Jay passed around a copy of the management and priority questions and requested any feedback. Jay also proposed a “mission statement” for the EEWG as: “Provide technical oversight and stakeholder guidance on RMP studies addressing questions related to contaminant exposure and biological impacts.”

Regarding the skepticism surrounding the EEWG, Steve Weisberg stated that without the EEWG, the unanswered questions and data needs identified in the last Program Review would still exist. The initial charge for the group - to interpret trends in chemical data through understanding the biological implications - is still extremely relevant. Good progress has been made on fish and bird assessments but not for benthos nor sediment toxicity. He suggested that the mission statement emphasize biological endpoints. He also mentioned the necessity for a group that looks at the stressors and effects of ocean acidification. Naomi Feger built on Steve’s words by saying that a clearer mission statement could help encourage collaboration between workgroups.

The workgroup also expressed interest in looking at the impacts of other stressors besides chemical contaminants, for example phycotoxins from harmful algal blooms.

Action Items

- Switch the order of “biological effects” and “contaminant exposure” in the EEWG mission statement.

- Replace “criteria” with “factors” in the “Proposed New Questions” column in the question about exposure to contaminants in dredged material.

7. Discussion: Presentation of Special Study Proposals for 2018

Phil introduced this agenda item by summarizing Brian Anderson’s amphipod mortality special study proposal and Diana Lin's sediment bioaccumulation evaluation special study. Phil also proposed that the EEWG consider the USGS archiving of samples of fish stomach contents and cores for later analysis as an add-on to the dredging impacts on the benthic community special study.

7A. Causes of Amphipod Mortality: Clay vs. Contaminant Effects - Brian Anderson (UCD), Steve Bay (SCCWRP)

Brian Anderson introduced this study by explaining that the main objective is to better understand and tease out the effects of fine-grained sediments on the amphipod, *Eohaustorius*. Brian presented the study design and the schematic of the ex-situ exposure chamber. The purpose of the chamber is to expose the amphipods to chlorpyrifos and copper in bulk sediment and in interstitial water from the bulk sediment and compare the results. He explained that he will further use the body of knowledge on interstitial water to fine-tune the chamber design.

A few technical questions were raised including how the water quality in the chamber will be analyzed, methods for breaking up high-clay sediments, and whether using the chamber to conduct a side-by-side comparison with younger and older amphipods could validate the previously-shown trend in an increase in amphipod mortality with age.

After some clarifying questions and discussion about the study design, Phil shifted the discussion to whether this is the next logical step to answer relevant management questions. Brian Ross said that he’s seen similar ideas proposed elsewhere. Michael Fry commented that, if successful, this chamber could prove to be very useful for future tool-development studies and TIEs. Brian Anderson said that the design team has kept expense and ease of transport in mind when designing the chamber so that it could be widely used in the future.

7B. Sediment Bioaccumulation Guidance - Diana Lin (SFEI), Jay Davis (SFEI)

Diana Lin began by explaining that, during routine dredging evaluations of sediment, toxicity reference values (TRVs) are conservative values used to signal whether bioaccumulative contaminant levels in sediment are of concern and warrant further tests. At this time, the Bay does not have an official list of TRVs nor a standardized method for calculating these values. The main purpose of this study would be to (1) develop a list of recommended TRVs for key bioaccumulative compounds that could be widely used to assess bioaccumulation for dredged materials, and (2) appropriate inputs for higher trophic level bioaccumulation models. Methods would include literature reviews and a stakeholder review process. The

study could save dredgers and regulators time and money by cleaning up the current US Army Corps Environmental Residue-Effects Database (ERED) of TRVs, developing recommended TRVs, and providing standardized methods.

Brian Ross explained when a bioaccumulative compound of concern is elevated in sediment chemistry, different contractors, consultants, etc., have been left to develop their own methods to arrive at a TRV which has caused inconsistency as well as increased time spent for review by regulatory agencies.

8. Closed session

For the closed session, the Principal Investigators for the proposed studies were asked to leave the room to avoid a conflict of interest. Remaining workgroup members were asked to rank the proposals 1 to 5, with 1 being the highest priority and 5 being the lowest priority. In addition to the two proposals discussed in Item 7, three other proposals were added:

- Strategic planning for the EEWG
- Add-ons to the USGS Benthic Recovery Study
- Synthesis of Benthos Data with Application of mAMBI

The table below summarizes the results of the group ranking exercise.

Study Name	Proposed Budget	Modified Budget (if necessary)	Priority	Notes
EEWG Strategic Plan	\$10,000	\$10,000	1	Steps to determine if we have faith in sediment toxicity and benthos. Overall objectives for meeting the mission of EEWG.
Sed Tox Ex-Situ Study	\$54,170	\$35,000	2	Want to see prelim data, proof of concept as a first step. Complete objectives 1&2 with check-in before objectives 3&4.
Sediment Bioaccumulation Evaluations	\$50,000	\$30,000	2	Evaluate TRVs first, followed by higher trophic model inputs. Scale back the list of pollutants to fit the budget. Correcting ERED database should be a USACE responsibility. Future work should be to evaluate beneficial reuse thresholds.
Synthesis of Benthos Data with Application of mAMBI	\$50,000	\$50,000	3	Synthesis of existing data. (1) Test the mAMBI compared to sedtox and to existing IBI in a limited dataset. (2) If working, apply mAMBI to full dataset.
Benthic Recovery Study Add-Ons	??	\$0	5	Recommendation: USGS should consider archiving samples for DNA analysis of fish stomach contents and cores for later analysis. Interpretation is potentially a "can of worms". Possible collaboration with SCCWRP. RMP to look into this new tool for multi-year planning.
Total Amount	\$154,170	\$115,000		

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.