



RMP Emerging Contaminants Workgroup Meeting

April 23-24, 2020
San Francisco Estuary Institute

Meeting Summary

Science Advisors	Affiliation	Present
Lee Ferguson	Duke University	Yes
Kelly Moran	TDC Environmental	Yes
Derek Muir	Environment and Climate Change Canada	Yes
Heather Stapleton	Duke University	Yes
Bill Arnold	University of Minnesota	Yes
Miriam Diamond	University of Toronto	Yes
Dan Villeneuve	U.S. Environmental Protection Agency	Yes

Attendees

Abigail Noble (DTSC)	Don Yee (SFEI)	June-Soo Park (DTSC)
Alicia Gilbreath (SFEI)	Ed Kolodziej (UW)	Karin North (City of Palo Alto)
Alicia Gilbreath (SFEI)	Eric Dunlavey (City of San Jose)	Laura McLellan (SWRCB)
Alvina Mehinto (SCCWRP)	Erica Kalve (SWRCB)	Lester McKee (SFEI)
Andria Ventura (Clean Water Action)	Ezra Miller (SFEI)	Lorien Fono (BACWA)
Anne Balis (City of San Jose)	Frances Bothfeld (WA Dept of Ecology)	Luisa Valiela (EPA Region 9)
Anne Cooper Doherty (DTSC)	Gaurav Mittal (SFBRWQCB)	Maggie Monahan (SFRWQCB)
Autumn Cleave (SFPUC)	Gregory LeFevre (U of Iowa)	Mary Lou Esparza (CCCSD)
Bridgette DeShields (Integral Consulting)	Heather Bischel (UC Davis)	Mateo Stormwater Program)
Bryan Frueh (City of San Jose)	Heather Peterson (SFPUC)	Melissa Foley (SFEI)
Charles Wong (SCCWRP)	Holly Wyer (OPC)	Michael Fry (USFWS)
Claire Waggoner (SWRCB)	Jay Davis (SFEI)	Miguel Mendez (SFEI)
Coreen Hamilton (SGS AXYS)	Jaylyn Babitch (City of San Jose)	Nina Buzby (SFEI)
Da Chen (Jinan University)	Jen Jackson (City of SF)	Rebecca Sutton (SFEI)
Dawit Tadesse (SWRCB)	Jennifer Teerlink (CDPR)	Reid Bogert (BASMAA/San
Diana Lin (SFEI)	Jesselle Legaspi (DTSC)	Richard Grace (SGS AXYS)
		Robert Wilson (City of
		Petaluma)

Roman Berenshteyn (BPC)
Sara Huber (SWRCB)
Scott Coffin (SWRCB)
Shoba Iyer (OEHHA)
Simona Balan (DTSC)

Simret Yigzaw (City of San
Jose)
Steve Weisberg (SCCWRP)
Terry Grim (Cambridge Isotope
Labs)

Tessa Fojut (SWRCB)
Thomas Mumley (SFBRWQCB)
Tony Luz (Integral Consulting)

DAY ONE - April 22

1. Introductions and Goals

Melissa Foley began the meeting by going over Zoom platform logistics and introducing the Workgroup advisors. Melissa also briefly introduced the various groups present with individual participants raising their virtual hands via Zoom.

Melissa then gave an overview of the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), which outlined the program's goals, history, management questions, and monitoring structure. Additionally, Melissa summarized the goals of the meeting and noted a focus on the science in updates and special study proposals to gain input from the advisors and ensure alignment with stakeholder needs. Melissa ended by giving an overview of the Emerging Contaminant Workgroup (ECWG) daily agendas.

2. Discussion: CEC Strategy Update

Rebecca Sutton gave an update on contaminants of emerging concern (CEC) efforts and strategy, including an overview of current activities and the potential use of persistence as a secondary factor in classification of CECs within the RMP tiered risk-based framework. It was also noted that the Workgroup's Multi-Year Plan discussion will be deferred to a possible ECWG fall meeting.

Rebecca's outline of current CEC activities categorized efforts into three strategic elements: (1) targeted monitoring and risk evaluation, (2) learning from others/sharing expertise, and (3) non-targeted analysis (NTA). Multiple projects were noted for each element. The pending development of a monitoring strategy for CECs in stormwater was highlighted in the first strategic element. Rebecca also identified a few deliverables pending finalization, such as a draft manuscript on bisphenols and OPEs in Bay water. In addition, Rebecca discussed related efforts to reconvene the Ambient Ecosystems CEC Science Advisory Panel, and a current project with the State Water Board to analyze statewide CEC data using a tiered risk-based framework to guide recommendations for CEC monitoring and management priorities for the state.

Several attendees indicated the need to monitor quaternary ammonium compounds (QACs) in wastewater to determine the impact of the COVID-19 pandemic on their prevalence in the Bay. There was discussion of the urgency of sampling and opportunities to collaborate with studies collecting samples for detection of SARS-CoV-2. The EPA's list of approved substances to be used as antimicrobials during the pandemic includes QACs that should be targeted for analysis. Outdoor uses of QACs were also noted. Current challenges with laboratory access and personnel could lead to freezing and archiving samples for later analysis, though there are issues associated with freezing. Development of a sampling plan or special study for the duration of pandemic would be particularly useful. Tom Mumley acknowledged this would have to be a special effort due to the limited resource capabilities within the RMP and POTWs.

Rebecca then gave an overview on the possible inclusion of persistence in the environment as a secondary factor within the tiered risk-based framework. A conservative definition of persistence that is consistent with international standards was suggested as those chemicals with half-lives of 6 months or more within a matrix. Persistent chemicals are expected to accumulate in the environment with continued use. It is important to note a contaminant must also be bioavailable, meaning an exposure pathway to wildlife must be identified in order for persistence to be considered a risk. Consideration of persistence has direct implications for short-chain perfluoroalkyl and polyfluoroalkyl substances, known as "Other PFAS" in the risk-based framework, currently classified as Possible Concern. The previous review of the class found limited toxicity data relative to long-chain PFAS, though consideration of persistence as a secondary factor suggests reclassification as Moderate Concern is warranted.

Meeting participants were asked to respond to the suggestion of using persistence as a secondary factor and, if persistence were to be added as a factor, reclassification of "Other PFAS" to Moderate Concern. These recommendations were illustrated in the Draft CEC Strategy 2020 Update, circulated to the workgroup prior to the meeting; feedback is requested by May 29, 2020.

There was broad agreement among attendees to include persistence within the risk-based framework, and to elevate "Other PFAS" to the Moderate Concern tier. The group clarified that the type of persistence discussed relates to half-lives in abiotic matrices rather than within biota. Degradates must be evaluated for persistence as well. Several participants underscored the need to develop a strategy to manage the use of persistence as a secondary factor. Important concerns to consider within such a strategy include: (1) establishment of criteria for persistence, (2) burden of proof for persistence, (3) weighting multiple factors within the risk-based framework, (4) potential

for different monitoring and management approaches for contaminants that are persistent compared to those that exceed toxicity thresholds, and (5) use of persistence as a characteristic to identify new candidates for monitoring. Eric Dunlavey also noted the importance of the tiered risk-based framework as a communication tool, which should be accounted for in further advancements of the framework. Care should be taken to not put everything in the Moderate Concern category, or the framework could lose some of its impact in communicating CEC priorities.

3. Discussion: CEC Toxicology Strategy

Ezra Miller presented a draft strategy to assess the potential toxicological risks of data-poor CECs, including usage of predictive toxicology tools. Ezra also introduced the new ECWG advisor, Dan Villeneuve, who is a research toxicologist at the US EPA's Office of Research and Development Center for Computational Toxicology and Exposure, Great Lakes Toxicology and Ecology Division.

Ezra outlined the framework for the proposed CEC toxicology strategy, highlighting use of predictive toxicology to inform prioritization for data poor-chemicals classified within the Possible Concern tier. Two classes of models, *in vitro* and *in silico*, are currently used within predictive toxicology to forecast chemical interactions within biological systems and resulting adverse effects. There are several available tools for both classes, such as ECOSAR (*in silico*) and EPA CompTox Chemistry Dashboard (*in vitro*), though use of these types of tools will vary based on the particular goals of the study. A "conceptual model" workflow was presented to the Workgroup to illustrate the approach to determine appropriate ecotoxicological thresholds for assessment within the tiered risk-based framework.

Ezra also provided details regarding proposed next steps including: (1) evaluation of the quality of available thresholds and use of predictive methods to calculate thresholds for contaminants without published thresholds, (2) screening studies to estimate the effects of unknowns and contaminant mixtures by assessment of biological activity of environmental samples using a battery of high-throughput bioassays, and (3) development of predictive toxicology tools specific to important Bay species.

Ezra then asked for comments from the workgroup members on the proposed strategy and recommended next steps. Participants were supportive, though several comments indicated the need to develop a conceptual model and decision-making framework for toxicology. In particular, Dan Villeneuve suggested considering *in silico* methods as complementary to *in vitro* methods, and further development of the screening study to strategically identify use of assays to probe contaminants. Anne Cooper Doherty noted

that the use of *in silico* tools requires caution and knowledge of what they are and are not capable of because of which compounds were used to develop them. Lee Ferguson suggested expanding this effort beyond toxicology to include exposure-relevant factors such as chemical use classification, production volume information, and number of patents for individual chemicals. Kelly Moran noted the need for Ezra's expertise to guide future monitoring priorities.

Miriam Diamond and Heather Stapleton suggested working towards a SF Bay-specific focus within the toxicology framework, and considering additional stressors such as climate change. Dan mentioned the possibility of providing exposure information, including existing data gaps, to other organizations/programs such as the US EPA that are looking for collaborations to help guide wider data collection and high-throughput analysis of chemicals efforts. He and Heather also indicated the need to have a clear plan for what to do with any information generated using *in vitro* methods; Dan encouraged development of clearly focused study questions and a plan for how to use different lines of evidence to classify CECs within the tiered risk-based framework. In particular, predictive tools may be useful in de-prioritizing contaminants from further study. Derek Muir noted that for contaminants with established toxicity thresholds, there is often disagreement among the agencies that calculate thresholds due to different approaches, and an assessment of these differences would be useful. He also asked whether it might be possible to address mixtures using the approach of summing toxic equivalents, which Dan suggested is reflected in the *in vitro* exposure activity tools. Tom Mumley and Karin North indicated strong support for this effort and the urgent need for effects-based information for stakeholders.

4. Discussion: Update on Monitoring of CECs in Urban Stormwater

Rebecca Sutton reviewed findings from the pilot year of monitoring CECs in urban stormwater, focusing primarily on preliminary results of per- and polyfluoroalkyl substances (PFAS), while also including partial results on bisphenols and organophosphate esters (OPEs). Rebecca explained to the workgroup that initial findings prompted changes to the PFAS sample collection methods.

While updating the workgroup on year 2 of the study, Rebecca noted that the expected intensive collection and analysis did not occur due to a drier winter and impacts from COVID-19. Rebecca outlined the potential to extend the study to a fourth year to obtain more results for analysis, noting time for further discussion the following day.

Related to the first year's PFAS TOP assay work, Rebecca informed the workgroup of issues related to replicate variability due to variation in sediment loads and field blank

contamination. These results led to a suggested change in PFAS sampling design. Rebecca asked the participants for feedback on the revised sampling plan to focus on dissolved phase measurements and limit use of the TOP assay. There was agreement among the workgroup that the updated sampling design made sense.

Derek Muir suggested expansion of the current list of PFAS examined, noting in particular that trifluoroacetic acid would be an interesting analyte, though it does have multiple sources. Lee Ferguson and Bill Arnold advised a more thorough analysis of which PFAS to consider in each matrix. Tom Mumley wanted further clarification on sample site determination with a clear presentation within the proposals. Rebecca noted that proposed sites are reviewed each fall with the Small Tributaries Loading Strategy team to assure they are appropriate for the study. Andria Ventura mentioned a current State Water Board investigation of soils and groundwater around airports that could provide data.

Heather Stapleton commented on the results of OPEs data, noting the different OPEs present and suggesting to alter the analyte list and examine components of newly identified commercial mixtures. Derek noted the high proportion of OPEs associated with particles; Lester McKee reminded the group that suspended sediment in stormwater is likely not at equilibrium with the water, such that sediment-bound contaminants are derived from the landscape rather than partitioning from the water. Lee noted observation of OPEs derived from PVC plastic water pipes.

DAY TWO - April 23

1. Summary of Day 1 and Goals for Day 2

Melissa Foley reminded attendees of Zoom features and allowed time for an abbreviated roll call of the day's attendees. Melissa then reviewed the events of Day 1 of the meeting, noting interest from Jennifer Teerlink in having interested parties contact her regarding QACs monitoring and methods. Melissa also informed the meeting participants that the day's focus was on updates on the Status and Trends monitoring review as well as prioritization of special studies proposals.

2. Information: Status and Trends Monitoring Review

Melissa Foley began by outlining the motivations and objectives of the Status and Trends monitoring program review. Notably, CECs are partially driving this effort in order to develop an approach to incorporate CECs into Status and Trends monitoring. The goal for the revision is to develop a nimble sampling design that allows CECs to go in and out of the program as needed, likely at a higher frequency than legacy

contaminants. Functional traits and pathways into the Bay, rather than specific contaminants, are critical factors to consider in determining the best monitoring methodology.

Melissa then went over the timeline of the redesign work, noting the kickoff meeting occurring the following week. Within the ECWG, Derek Muir is involved as a panel expert and the panel will likely reach out to the ECWG for input on the developing Status and Trends sampling plan. Tom Mumley is also actively involved, similarly noting a need for ECWG input, as this will ideally create more robust and agile programs for Status and Trends as well as ECWG. An update on the review will be provided at the 2021 ECWG meeting.

3. Summary of Proposed ECWG Studies for 2021

Rebecca Sutton gave an overview of all proposed special studies, highlighting the motivation and approach for each study, as well as associated budgets and deliverables. Meeting participants were allowed a few clarifying questions after the presentation of each proposal, though it was noted that more time would be available for discussion later in the meeting. The focus of discussion was on four high priority studies, with a more brief review of three lower priority proposals intended for inclusion on the Supplemental Environmental Projects (SEP) list.

The proposal for the third sampling year of the stormwater CECs screening study builds upon the work of the previous two years with the motivation to fill existing stormwater data gaps. The current approach targets sites with > 80% urban land use. Sampling also includes reference samples from less urban sites. There is a desire to also sample at sites with unique sources of contaminants such as airports. As prefaced the previous day, this work could be extended for another year to create a more robust data set, particularly given limited sampling in year 2. There are budget concerns to adding a fourth year, however, as there are fewer leveraging opportunities with other RMP projects compared to the first three years. Funds from reduced work in Year 2 will be applied to sampling in year 3, and year 4, if included. Initial discussion began on the potential extension of the study to a fourth year with questions on the budget and necessity of more data. In response to a question about adaptation of the analyte list, Ed Kolodziej clarified that his lab would soon update it with special attention to more causative agents.

Presentation of the study on PFAS in Bay water followed. The motivation for this study is to better understand risks in the Bay, updating a similar 2009 study with use of an embayment-wide approach and standardized methods including more analytes. This study would also review the toxicity of PFAS, including consultation with additional

PFAS experts. In response to a question on the connection to the model, Rebecca clarified it is used more as a tool to check if understanding of contaminants is correct, rather than driving design of the study. Derek Muir noted that the model predicted levels of PFOA and PFOS below method detection limits in some embayments. Rebecca noted that there are few differences between the lab for this study compared to the analytical partner for the stormwater study, which does not have capacity to analyze estuarine samples. Lee Ferguson expressed the value of sampling the same sites as the previous sampling effort, especially for those identified as significant sources.

A study comparing seasonal concentrations of bisphenols and OPEs in Bay water was introduced. This proposal would monitor sites during both wet and dry seasons to help understand the seasonal influence of stormwater and wastewater pathways, while also informing a potential Status and Trends study design. Sampling would occur once per month over three months of the wet and dry seasons. Samples would be analyzed by a different lab than the stormwater study in order to use standardized methods available in a commercial lab. The current analyte list for the commercial lab is more limited, though there may be opportunities to expand the list based on the results of the stormwater study. Rebecca clarified that the focus would be on sites in Lower South Bay, where higher levels were observed in previous work. Tom Mumley commented on the potential to cut back costs, particularly related to the large amount of QA samples.

The toxicological thresholds for emerging contaminants proposal was then presented, aiming to synthesize and assess the quality of available thresholds and calculate thresholds for data-poor contaminants that have been measured in the Bay. This project would also help establish a process that could be used to identify thresholds for future RMP studies and prioritize CECs within the tiered risk-based framework. A “living document” would be produced to continue to update these thresholds as new data emerges. Ezra also noted that the study will include all thresholds available, not limited in scope to the Bay, and would begin the task of addressing thresholds for stormwater contaminants. Miriam Diamond asked about the potential use of species sensitivity distributions in predicting PNECs, and Ezra responded that these would be used when possible, but many CECs have insufficient data for this approach.

The three SEP proposals were briefly outlined, noting that these studies are important to conduct in the Bay but are not currently suggested as top priorities for RMP funding. The study of PFAS in North Bay margins would look at archived sediment samples to better understand occurrence and risks in an area close to likely PFAS sources. Depending on the budget, the project could be expanded to include archived sediment samples from the South Bay margins (2017) and analysis using the TOP assay. A project on halogenated azo dyes in archived South Bay margins sediment followed,

aiming to study the occurrence of these toxic CECs in the Bay for the first time. Hui Peng of the University of Toronto would be the analytical partner for this project, which could also include North Bay margins samples as an add-on option. Lee Ferguson suggested examining microplastics in addition to halogenated azo dyes because these contaminants may be riding on microfibers, which Miriam Diamond noted she is currently conducting, along with Hui Peng, and could provide complementary data. Bridgette DeShields asked if azo dyes could be compared to PCBs 11, 52 and 209, which were analyzed in South Bay Margin sediment samples. A non-targeted analysis of Bay harbor seal tissue was the final study presented, with a goal to determine if there are other contaminants of concern in the Bay. This would be a two-part study including screenings for both unexpected PFAS and lipophilic nonpolar contaminants.

3. Discussion of Recommended Studies for 2021 - General Q&A

Meeting attendees took the time to ask any remaining questions while proposal PIs were still in attendance. The discussion focused on the four high priority studies previously presented.

Stormwater

Discussion of the stormwater study noted general approval of planning for a fourth year, though the idea can be revisited after the third year of sampling. Kelly Moran suggested further description of the overlap between this effort and other monitoring efforts to inform recommendations for a third or fourth year of the study. Miriam Diamond suggested providing further information on the selection of sampling sites, especially for larger watersheds. Rebecca Sutton noted the study's focus on majority urban land use sites tends to exclude these larger watersheds, though there is a minimum watershed size requirement. Derek Muir expressed interest in the addition of sediment analysis to the study, though there were concerns about costs and analyte contamination. Bill Arnold suggested a fourth year could be scoped to include only those contaminants considered to be a higher priority. Related to leveraging other RMP efforts, Tom Mumley discussed the anticipated activities of the Small Tributaries and Loading Strategy team (STLS) and Sources Pathways and Loadings Workgroup (SPLWG). As the focus on legacy contaminants begins to fade, the possible opportunities for CEC work could increase, pointing to the need for a CEC monitoring strategy for stormwater. Tom also advised consideration of an interim report if four years of sampling are conducted to inform regional and statewide applications and give insight on continuing efforts with STLS.

PFAS in Bay Water

Derek Muir was concerned about the relatively high detection limits of the method and limited suite of analytes. Richard Grace, representing the study's analytical partner SGS

AXYS, noted lowering detection limits and expansion of the analyte list could be further explored. Tom Mumley thought there could be fewer sampling sites to enhance the number of analyses and save on costs. Additionally, Tom commented on the high reporting budget, though Rebecca Sutton highlighted new PFAS are likely to be identified and require more extensive toxicological review.

Bisphenols and OPEs

The discussion centered on the budget and scope of the project. Heather Stapleton suggested excluding bisphenols, though Miriam Diamond noted that previous study of bisphenols resulted in detections at levels in the range of PNEC values. Lee Ferguson expressed interest in expanding the analyte list to include the diol hydrolysis product of BADGE. Heather Stapleton advocated for changing the current OPEs list, which Richard Grace agreed to explore. Tom Mumley reiterated a need to lower costs, highlighting potentially fewer sites or QA samples. Rebecca Sutton noted a higher than average number of QA samples was included due to previous blank contamination and accurate comparison between wet and dry seasons.

Toxicology

When discussing the toxicology study, there were multiple comments on the scope of the project. Dan Villeneuve underlined the necessity of a decision framework for a consistent approach to how we use threshold quality assessment within the tiered risk-based framework. Ezra Miller clarified that several factors are being considered to help rank compounds within the tiered risk-based framework, including bioaccumulation and the types of species affected. Miriam Diamond indicated that toxicity data and thresholds specific to sediment would be challenging. In response to a comment from Tom Mumley regarding the urgent need for information derived from this project, Melissa Foley noted the possibility to release funds earlier to help begin work to inform future multi-year planning.

General

There were also some comments on the general program as a whole. Kelly Moran brought up the decision to reduce strategy funds, which Rebecca Sutton clarified was due to changes from last year where the budget was increased to account for added toxicology work. Kelly Moran also commented on the decision-making process regarding specific contaminants. Becky noted discussion with DTSC and potential synergy, as well as future plans to discuss building information on Moderate Concern contaminants. It was also noted that RMP modeling efforts are ongoing, though there are no CEC-specific modeling proposals at this time.

4. Closed Session - Decision: Recommendations for 2021 Special Studies Funding

Karin North led the closed door discussion. Following extensive discussion, studies were prioritized. A Zoom poll was conducted to help rank proposals. The resulting recommendations are shown in the following prioritization tables:

Study Name	Budget	Modified Budget	Priority	Comments
CECs in Stormwater (Year 3)	\$148,000		1	Work with Tom to identify optimum sampling for year 3 with a contingency plan for year 4. Provide interim reporting at 2021 ECWG if proceed to year 4 (and/or to possibly help determine if proceed with year 4)
PFAS in Bay water	\$66,000	<i>potentially lower</i>	3	Look into reducing number of QA samples and stations; lower budget could allow for QAC monitoring with extra funds
Seasonal Influence of Bisphenols and OPEs	\$115,000	<i>\$85,000 (loose estimate)</i>	4	Modify budget based on four stations (3 minimum); adjust analyte list based on in-Bay findings and WG expert recommendations
Toxicology Strategy (followup)	\$60,000		2	New approach for the WG that could inform/incorporate stormwater efforts; hope to start in fall 2020 to advance timeline

SEP Project Ideas			
Study Name	Budget	Priority	Comments
PFAS in North Bay Margin Sediment	\$40,000 - \$125,000	3/4	Less potential for new information or important information for management
Azo dyes in South Bay Margin Sediment	\$65,000 – \$95,000	1	DTSC interested; important, new information; inform how much effort needed; consider including microplastics (fibers) in the study design
NTA for Perfluorinated and Nonpolar Contaminants in Seal Tissue	\$75,000 – \$250,000	3/4	Important to develop a comprehensive view of PFAS in the Bay including trends over time

COVID-19 Related QAC monitoring	<i>Discuss and develop with Bill Arnold and Jennifer Teerlink</i>	2	Should not miss this opportunity; DPR may not be able to solely cover this; develop a sampling plan or a contingency plan; San Jose and Palo Alto are able to collect samples
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5. Report Out on Recommendations

After the closed door session, proposal authors were invited back to the meeting to hear the final prioritization decisions. Karin North summarized the discussed suggestions, highlighting possible reduction of costs and interest in developing a QAC proposal. Tom Mumley noted further discussion on the extension of the stormwater study is pending.

Adjourn