RMP Emerging Contaminants Workgroup Meeting

April 11-12, 2022
San Francisco Estuary Institute

Meeting Summary

Science Advisors	Affiliation	Present
Lee Ferguson	Duke University	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

Adam Wong (SFEI)

Alicia Gilbreath (SFEI)

Allie King (SFEI)

Anna Mahony (U. of Minnesota)

Anne-Cooper Doherty (DTSC)

Bernard Crimmins (Clarkson University)

Blake Brown (CCCSD)

Bonnie de Berry (EOA/SCVURPPP/BASMAA)

Bridgette DeShields (Integral Consulting Inc.)

Coreen Hamilton (SGS AXYS)

David Robertson (City of San Jose)

Diana Lin (SFEI)

Don Gray (EBMUD)

Don Yee (SFEI)

Dawit Tadesse (SWRCB)

Karin North (City of Palo Alto)

Ed Kolodziej (U. of Washington)

Eric Dunlavey (City of San Jose)

Erica Kalve (SWRCB)

Eunha Hoh (SDSU)

Ezra Miller (SFEI)

Frances Bothfeld (WA Dept. of Ecology)

Gaurav Mittal (SFBRWQCB)

Greg LeFevre (U. of Iowa)

Hannah Ray (Green Science Policy Institute)

James Chhor (SWRCB)

Jay Davis (SFEI)

Jaylyn Babitch (City of San Jose)

Jennifer Branyan (UC Davis)

Jennifer Teerlink (CDPR)

June-Soo Park (DTSC)

Rebecca Sutton (SFEI)

Kathy Peter (U. of Washington)

Kelly Moran (SFEI)

Kristian Fried (Integral Consulting Inc.)

Lester McKee (SFEI)

Lilly Sabet (SDSU)

Lisa Austin (Geosyntec Consultants)

Luisa Valiela (EPA Region 9)

Lydia Jahl (Green Science Policy Institute)

Maggie Monahan (SFBRWQCB)

Maggie Stack (SDSU)

Manoela de Orte (SWRCB)

Mary Lou Esparza (CCCSD)

Martin Trinh (SFEI)

Mary Cousins (BACWA)

Melissa Foley (SFEI)

Michael Gross (USGS)

Miguel Mendez (SFEI)

Miriam Diamond (U. of Toronto)

Olivia Magana (SWRCB)

Reid Bogert (BASMAA/San Mateo CCAG)

Richard Looker (SFBRWQCB)

Richard Grace (SGS AXYS)

Robert Budd (CDPR)

Robert C. Wilson (City of Santa Rosa)

Sara Huber (SWRCB)

Sarabeth George (SWRCB)

Sarah Amick (U.S. Tire Manufacturers Assoc.)

Simona Balan (DTSC)

Simret Yigzaw (City of San Jose)

Stephanie Jarmu (OEHHA)

Susan Hurley (OEHHA)

Tammy Qualls (Qualls Environmental Consulting)

Tan Zi (SFEI)

Terry Grim (CIL)

Tom Mumley (SFBRWQCB)

Topher Buck (DTSC)

Xueyuan (Helen) Yu (San Diego RWQCB)

DAY ONE - April 11

1. Introductions and Goals for This Meeting

Melissa Foley began by highlighting remote meeting tips, reviewing the Zoom platform functionalities, and giving a land acknowledgment to the Native peoples of the San Francisco Bay Area. She also presented the group with guidelines for inclusive conversations. Melissa then introduced the workgroup advisors and continued with a brief roll call for the various groups present to introduce themselves.

Melissa then reviewed the ECWG two-day agenda and gave an overview of the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), including the program's goals, history, management questions, monitoring structure, and budget. Additionally, Melissa communicated the goals of the meeting, highlighting discussion on the science during updates on current projects, prioritization of special study proposals, and future directions.

2. Discussion: CEC Strategy Update

Rebecca Sutton started off the workgroup meeting with the first of two updates, discussing current CECs efforts by the RMP and State Water Board, with further discourse on the 2022 CEC Strategy Revision and future directions occurring on Day 2. She began by introducing the SFEI team, particularly noting the addition of Martin Trinh as an Environmental Analyst.

Rebecca's outline of current CECs 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). Related ongoing projects and activities were noted for each element, respectively. Rebecca began by highlighting the status of Bay monitoring projects, including completion of sample collection for a study of PFAS in Bay water and a new SEP to monitor PFAS and chlorinated paraffins in Bay sediment. She continued by noting efforts in wastewater monitoring, including continuing studies on quaternary ammonium compounds (QACs) and ethoxylated surfactants, as well as PFAS via phase 2 monitoring conducted on behalf of the Bay Area Clean Water Agencies (BACWA). Rebecca also commented on PFAS in stormwater data, which have been held up due to a laboratory issue; analyses will now be completed by Eurofins TestAmerica in the Sacramento area, allowing for analysis of a broader set of PFAS.

Further, Rebecca noted recent conferences (SETAC in Portland and Pacifichem) attended by the CECs group to share findings and learn about global efforts relevant to the RMP. She also identified a recent publication of organophosphate esters (OPEs) and bisphenols (Shimabuku et al. 2022) as well as a non-targeted analysis of margin and ambient sediment (Chang et al. 2021). She mentioned a couple of forthcoming deliverables such as draft manuscripts on chemicals and particles related to tires from the Pacific Northwest Consortium on Plastics and a review of QACs led by the Green Science Policy Institute. In addition, draft RMP reports on bisphenols in various matrices, sunscreens in wastewater effluent, and PFAS in Bay water will be completed this summer.

Rebecca followed up with discussion of two projects connected to the State Water Board (SWB) CEC Program. The first study involves synthesizing and analyzing available state CECs water quality data in CA waters using a tiered risk-based framework similar to that of the Bay RMP to inform high level recommendations for monitoring and management priorities for the state. The overall study is an ambient ecosystem evaluation (not including pathways) using a class-based approach, spotlighting nine specific chemical and use classes to better understand data poor chemicals, with hundreds of identified compounds. This includes review of the latest CECs scientific literature to guide future monitoring targets and use of forward looking tools such as advanced analytical techniques and non-targeted analysis. Rebecca reviewed the tiered risk-based framework with particular focus on the ecotoxicity threshold selection utilizing ecosystem-level thresholds (e.g., PNECs). She noted key differences in the State framework compared to the RMP, including the use of risk quotients from Possible to Very High Concern (i.e., no secondary factors like persistence), with the tiers not linked to specific monitoring recommendations. The report has been completed and will help inform potential refinements in the RMP framework, to be discussed on Day 2.

The second effort, co-funded by the Ocean Protection Council (OPC), is the reconvening of the Ambient Ecosystems CEC Science Advisory Panel ("EcoPanel") to examine the current CEC monitoring and assessment framework. The original EcoPanel was convened a decade ago to suggest CECs for monitoring. Recently, the EcoPanel was reconvened to review state data and overall progress and suggest a tailored monitoring program, including discussion of potential

synergy with other SWB CEC efforts and expansion of recommended analytes to include "new" emerging contaminants. Moving forward, the panel will be discussing the selection framework for SWB CEC database, use of other data sources, potential use of a binning approach at the regional or statewide level, and the process of on- and off-ramping contaminants.

Meeting participants inquired about the specific choice of ecotoxicity thresholds and placement of contaminants within the tiered risk-based framework. Dan Villeneuve commented on the choice of ecotoxicity thresholds, particularly where there were no thresholds available, resulting in a contaminant classified as Possible Concern only. Miriam Diamond continued with a question on the approach for high concern compounds, particularly incorporation of secondary factors, with Rebecca noting that secondary factors are not included in the framework used in the state report, and instead that the monitoring and management recommendations are informed by these factors. Tom Mumley mentioned that the state report is intended to inform a still developing statewide CECs effort, with continued development and discussion of the emerging framework. A future ECWG meeting could feature an update on this state CECs work.

3. Discussion: There's PFAS in the Bay: Where is it coming from?

Dr. Miriam Diamond of the University of Toronto presented recent work examining the sources of PFAS in indoor and outdoor settings, with a focus on outdoor materials that are potentially contributing to PFAS in stormwater entering the Bay. Previous studies in the Bay, especially RMP efforts, have found increased levels of PFAS, particularly PFOS, in water, sediment, and biota (seals and cormorants). Concentrations of PFAS have been found to be elevated near sites receiving wastewater effluent and urban runoff, where levels are the highest and with the greatest diversity of detected PFAS. There are a plethora of PFAS uses across indoor and outdoor environments, including over 200 use categories such as cosmetics, food contact materials, medical devices, electronics, personal care products, paints, and many other products. Some outdoor uses of PFAS in coatings and construction materials are marketed with green claims of increased durability due to their persistence. A diversity of PFAS are in commerce, including those released during use as "processing aids" and used as side-chains of polymers. These PFAS are persistent, and many are volatile and mobile in the environment. Current and ongoing research on outdoor sources and transport pathways can inform a conceptual model of PFAS in Bay Area stormwater, as well as the interpretation of data.

Discussion centered around specific PFAS analytes and related uses, with Heather Stapleton noting the potential for the presence of diPAPs in paints, of concern due to potential breakdown to FTOHs. Jennifer Teerlink mentioned the potential for PFAS presence in pesticides, which the State of Maine is in the process of eliminating. Heather Stapleton also mentioned the use of an uncommon biosolids processing treatment known as Zimpro, which can transform precursor PFAS to end products. In the Bay Area, only the San Mateo Treatment Plant had this biosolids treatment process, and it may no longer be in use. Lee Ferguson mentioned PFAS are also used as an emulsifier, and Derek Muir noted polychlorofluoroethylenes as lubricants with high release potential. Miriam Diamond highlighted observations of volatile fluorinated siloxanes in China.

4. Information: Stormwater CECs Monitoring Approach

Alicia Gilbreath and Kelly Moran updated the group on the developing CEC monitoring approach for stormwater, a joint project of the ECWG and SPLWG. Compared to the current methodology for legacy contaminants (PCBs and Hg), the updated approach would expand the focus beyond particles to include dissolved contaminants; include diverse sources and physicochemical properties; monitor contaminants with ongoing use; and move back to simpler monitoring questions. Near-term priority questions were identified: the first to help elucidate the presence of specific CECs in local stormwater runoff, and the second to understand the local watershed runoff load to the Bay compared to other pathways for specific identified CECs. An overview of the monitoring approach focused on the development of a prioritization framework for CECs for stormwater monitoring, and the development of a sampling design process with effective integration of modeling analysis. The project would produce a report to help guide future monitoring efforts in stormwater by describing a generalized approach (expected to be completed in Fall 2023). Ongoing and future RMP projects highlight the focus on combining modeling and monitoring to best and most cost-effectively understand the entire watershed.

Discussion shifted toward the prioritization of CECs for stormwater monitoring and potential high-weight factors to consider, including placement in the RMP tiered risk-based framework, known outdoor use and release, availability of analytical methods, and relevance to anticipated management decisions. Meeting participants discussed the varying factors and potential CECs to begin considering, with Derek Muir highlighting a need for tire-related chemicals and vehicle related fluids as priorities. Ed Kolodziej added PPD antioxidants, which are well known to be contained in rubbers and elastomers. Dan Villenueve asked whether the effort also considered particle bound contaminants, and Kelly Moran noted it was included through a focus on measurements in total water, rather than filtered samples. Lee Ferguson noted the potential for use of NTA data generated for the Bay to help inform monitoring priorities, with many meeting participants agreeing.

Kelly Moran continued by noting the differences between monitoring and modeling, highlighting the complex and iterative process of incorporating both together, building from simple conceptual models and limited monitoring data to obtain early answers to management questions. In areas where more detail is needed, initial data will be used to build dynamic models (again a process integrated with monitoring design) to provide refined answers to management questions. She also presented a draft conceptual model for the fate and transport of pollutants from sources to different matrices across the Bay Area including water, land, and air. In order to best obtain a large amount of samples in a cost effective manner, remote automated samplers, potentially a microsampler developed by the EPA and USGS, would be an important addition to this study. Kelly discussed the potential timeline for this foundational work from approach development in 2022 to actual studies integrating monitoring and modeling beginning in fall 2023. She also noted the choice to pilot PFAS for this approach due to the class being of moderate concern, a potential issue in Bay sport fish, interests of varying stakeholders and state agencies, and early data indicating the stormwater load is important to understanding PFAS contamination in the Bay. She ended by opening the discussion to the preliminary approach for stormwater CECs and the choice of PFAS as a pilot.

While there was general support for trialing this stormwater monitoring approach on PFAS, several participants suggested consideration of other contaminants to pilot concurrently. Tom Mumley expressed a management need for including other contaminants, with Lee Ferguson noting the potential utility of comparing relative ratios of contaminants. Melissa Foley highlighted the value of the contaminant class by class approach, and potential concerns for sampling multiple types of CECs when these have not yet been evaluated in terms of sources and pathways via conceptual models. Derek Muir wondered about the additional costs associated with adding tire contaminants to the pilot, given the potential toxicity and availability of a conceptual model. Kelly Moran acknowledged that expansion of the contaminants piloted would readily increase costs and lead to a longer wait to answer the prioritized questions for the stormwater study design. Anne Cooper Doherty indicated the need for identifying important pathways for contaminant discharge to inform DTSC selection of priority products within the Safer Consumer Products program. Tom Mumley expresses interest in exploring expansion of the study and allocating additional funds in an effort to streamline monitoring design and understand contaminant loads into the Bay.

Multiple experts highlighted the need to test the remote samplers and containers rigorously prior to full deployment (e.g., through analysis of field blanks), mentioning possible contamination from use of OPEs in tubing and PFAS in multiple components. Ed Kolodziej recommended future consideration of time-resolved sampling. Miriam suggested ancillary measurements such as metals could be useful for interpretation, and Derek suggested archiving stormwater samples for future analyses.

5. Information: Ethoxylated Surfactants in Bay Water, Wastewater, and Stormwater – Method Development Update

Dr. Lee Ferguson of Duke University updated the group on development of the most comprehensive ethoxylated surfactants analytical method, aiming to also analyze short-chain compounds in San Francisco Bay water, wastewater, and stormwater. Ethoxylated surfactants are commonly detected in the aquatic environment, with widespread uses in consumer products such as paints and detergents. Fatty alcohol ethoxylates (AEO) and alkylphenol ethoxylates (APEO) are two groups known to exist in the environment, with longer chain length varieties frequently used in products. Long-chain APEOs are likely to transform to higher persistence short-chain APEOs and alkylphenols. Already, these have been detected in previous studies of wastewater effluent, stormwater, and ambient water with different analytes in the class detected. There are several challenges with the simultaneous analysis of alkylphenols and AEO/APEOs, with different techniques being used for method development. Mixed-mode size exclusion chromatography has been used to allow for chromatographic resolution of ethoxylates. The use of high-resolution selected ion monitoring has enhanced method sensitivity and allowed for concurrent quantification of ethoxylated surfactants. Additionally, polarity switching has also allowed for consecutive elution of AEO/APEOs and octylphenol and nonylphenol. Moving forward, method development will continue with use of isotope-labeled standards and calibration of ethoxylated surfactant mixtures for accurate detection of short-chain compounds. This novel method will be used to re-analyze previously collected aqueous samples in the Bay

(wastewater, stormwater, and ambient Bay water) as well as newly collected stormwater samples. Derek Muir asked about the detection limits for these techniques and if they are below monitoring trigger levels, which Lee noted are generally in the ng/L range (well below noted trigger levels for those compounds). Anne Cooper Doherty expressed enthusiasm for the new data in beginning to fill important data gaps identified by DTSC.

6. Information: Quaternary Ammonium Compounds (QACs) in Wastewater

Dr. Bill Arnold of the University of Minnesota presented the preliminary findings of the QACs in wastewater and the environment study, with a focus on wastewater effluent data from Minnesota and Bay Area treatment plants and Bay Area surface water. QACs are a broad category of compounds separated into several subclasses of ammonium compounds: benzalkyldimethyl (BACs), dialkyldimethyl ammonium compounds (DADMACs), ethylbenzylalkyl (EtBACs), and alkyltrimethyl (ATMACs). These compounds have been used since the 1930s in a wide range of industrial, agricultural, and consumer products, especially as antimicrobials. The emergence of the COVID-19 pandemic has increased the use of QACs, known to be toxic to aquatic species and contribute to the development of antibiotic resistance in bacteria. Bill briefly reviewed the extraction methods, noting that the compounds stick to filter materials requiring additional steps to accurately discern concentrations in samples.

This study is important to understand the most common QACs in wastewater and ambient water as well as understand the temporal trends of QACs in wastewater throughout the pandemic. Of five wastewater treatment plants examined in Minnesota and the Bay Area, the most visible trends in total QAC load in influent and effluent were increases in Plant A throughout the pandemic, while Plant D showed total QAC loads were highest during and after COVID cases spiked. In contrast, QAC levels in Plants Y and Z fluctuated throughout the pandemic and Plant X remained relatively consistent throughout. Compared to prepandemic concentrations, QACs have increased or stayed the same since previous detections in 2019. Overall, these results showed roughly > 98% of QACs are removed during treatment, though µg/L concentrations are reaching the environment, with BACs and then DADMACs the most commonly detected QACs. Preliminary results of Bay ambient water show low levels of QACs are present. Moving forward, Bill has obtained additional National Science Foundation (NSF) funding to expand the study for an additional two years (through 2023). Due to this development, the CECs team is recommending a change to the deadline for the RMP project deliverable, a technical memo, from August 2022 to August 2024.

Several meeting participants asked questions about the study, with Miriam Diamond inquiring about other potential sources of QACs, due to the widespread use of surfactants, including potential outdoor sources. Anne Cooper Doherty noted DTSC is currently doing a systematic look to understand where QACs are being used. Derek Muir inquired about the potential effects of detected concentrations, with Bill highlighting the uncertainty of current trigger levels and a need for further development of toxicological thresholds for QACs. Jay Davis also noted that Bill will study QACs in sediment to understand its fate in the ambient environment, and echoed the

benefits of continued sample collection. The group unanimously agreed with the extension of the RMP deliverable.

7. Information: Status and Trends Monitoring Review

Melissa Foley introduced the item by outlining the motivations and objectives of the Status and Trends monitoring program review. Notably, the sampling design will be tailored to efficiently incorporate CECs into S&T monitoring, ensure data are relevant to management needs, and identify opportunities to strengthen connectivity between matrices. Melissa highlighted the variety of expert advisors and stakeholders involved to effectively redesign monitoring efforts towards CECs. She briefly reviewed the priority CEC and S&T management questions, and identified the five monitoring matrices water, sediment, and biota (sport fish, bird eggs, and bivalves). Melissa reviewed the different elements that make up the program, including pilot studies, core monitoring, and piggyback studies.

For water, CECs will be added to dry season Bay-wide sampling in order to assess their status and trends. CEC wet weather pilot sampling will be added to evaluate the importance of the stormwater pathway at near-field stations, while persistence will be evaluated at ambient stations. Wet and dry season monitoring of CECs in Lower South Bay will allow for comparisons where different pathways are present, and will focus on urban CECs. Non-targeted analysis will be added to screen for CECs at the recommendation of the advisors. For the sediment matrix, the outlined goals are the assessment of the status and trends for emerging contaminants, and testing conceptual models that indicate urban CEC concentrations decrease from near-field to margins to open Bay stations. Sediment will be analyzed for CECs every five years across identified categories of stations. Based on recommendations from the Emerging Contaminants Workgroup, PBDE sampling is expected to end in 2023, while fipronil and legacy pesticide sampling will cease immediately.

For biota, CECs will be added to assess bioaccumulation, track trends, archive samples for future analyses, and collaborate with efforts across other matrices. For sport fish, PFAS will be added to the regular suite of analytes monitored every 5 years. For bird eggs, the proposal is to maintain cormorant monitoring and discontinue tern monitoring. Sampling would be conducted every three years at three core stations throughout the Bay. Per the recommendation from the Emerging Contaminants Workgroup, PBDEs will be monitored in 2022 for a final time, while PFAS analysis will continue. Prey fish will be piloted with collections concurrent with near field and margins sediment samples. This would occur every five years with a focus on PFAS and bisphenols for the pilot project. The bivalve design will forgo sampling in channel stations in favor of switching to archiving tissue from shore-based collections, leveraging current efforts by the Nutrient Management Strategy. Harbor seals may be considered as an additional tissue matrix, beginning as a special study to explore potential inclusion into S&T, likely with sampling done every five to ten years. The RMP has collected seal tissue samples over the years, including via live capture and archived tissue. A special study has been proposed for 2023 to inform longer-term designs. Melissa ended with a review of the revised sampling schedule, highlighting the opportunity to look for CECs close to pathways in the coming year of sampling with sediment, prey fish, and seals occurring the following year.

Participants discussed the S&T review, with Jay noting that for NTA in water, there is not an established sampling frequency. Tom also added that there is still opportunity for inclusion of North Bay open water monitoring to add further data to this effort. Miriam Diamond wondered what criteria are guiding sampling frequency, noting the importance of establishing guidelines to help best make decisions. She noted the need for a flexible sampling design to fit the needs of the changing chemicals landscape, particularly if intermediate sampling may be needed to observe the impacts of management decisions.

8. Information: Strategy for Development of an In-Bay Fate Model to Support Contaminant and Sediment Management in San Francisco Bay

Jay Davis reviewed the In-Bay Modeling Strategy he helped develop with Craig Jones and Don Yee, which is a product of the PCBWG. This modeling strategy marks the beginning of a major multi-year endeavor that is also connected with the EC and Sediment Workgroups. This effort builds on previous work, leveraging NMS modeling and establishing a foundation for future collaboration. There is a focus on PCBs due to their established contamination of fish species, especially shiner surfperch, known to be most contaminated in Bay margin areas. A simple one-box model of PCBs in San Leandro Bay suggested that reduction of inputs from the watershed would help advance recovery. The recently drafted strategy highlights the desired outputs to address management questions, which include distribution fields for contaminant loads, sediment recovery depth profiles, rates of sediment accumulation in areas of interest, sediment contaminant concentrations over time, surface sediment and contaminant distributions, and biota contaminant concentrations. Jay highlighted important management questions for ECWG to help predict spatial and temporal extent of potential impacts of CECs and areas of interest to monitor CECs through the S&T in water and sediment. Funds from the EPA Water Quality Improvement Fund could help jump start this project in the coming years.

There were a few questions regarding the strategy, with Derek noting the potential inclusion of non-aroclor PCBs and working with SGS AXYS to use their high quality methods. Jay confirmed that all 209 PCB congeners are monitored. Heather Stapleton inquired about a potential explanation for shiner surfperch having such high levels of PCBs compared to other fish. Jay commented that concentrations are correlated to sediment levels, with the small home ranges for this species focused in the margins where sediment is relatively highly contaminated.

9. Information: Integrated Watershed Bay Modeling Strategy and Pilot Study

Tan Zi presented on the integrated watershed Bay modeling strategy and pilot study, an important effort across four workgroups: ECWG, PCBWG, Sediment WG, and SPLWG. The primary motivation of this study is to have a systematic view (from watershed to Bay) of the Bay water quality by effectively integrating current watershed and in-Bay modeling capacities and to identify priorities of future modeling studies to support different RMP workgroups. In the first year, this project will develop a strategy to integrate different models to better support future

modeling and monitoring. For the second year, this project will implement and test the strategy on one or more pollutants associated with one or more management questions through the pilot study. The development of this strategy will help elucidate the current capabilities of available models (and related confidence in the model), planning for near future efforts with enhanced capacity, and setting out long-term goals. Overall, this should produce an integrated modeling framework with a roadmap identifying connections with ECWG for the next five years. There are a variety of models currently available and this project will aid in identifying what will work best to answer ECWG management questions, including a focus on sources, pathways, and loadings, as well as the related processes that may affect transport and fate. Miriam Diamond noted the importance of evaluating the models using data-rich compounds to verify they are mechanistically sound, and would be interested in further discussion with those working on the project.

10. Information: Setting the Stage for Day 2

Rebecca Sutton thanked the group for their focused, productive discussion, and then reviewed the schedule and goals for the following day. She spotlighted the beginning of the discussion on the 2022 CEC Strategy Revision, update on the tires strategy, and the review and prioritization of special study proposals.

DAY TWO - April 12

11. Information: 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 as well as the agenda and goals for Day 2, with a particular focus on prioritization of special study proposals.

12. Discussion: 2022 CEC Strategy Revision - Management Questions, Tiered Risk-based Framework, Future Priorities

Rebecca Sutton began the second day of the meeting with discussion on the revision of the CEC strategy. This is a direct result of increased funding available to revise the strategy this year, and already an ECWG Strategy Subgroup of stakeholders and experts met in February to discuss potential pathways to consider for the strategy revision. She reminded the group that this is one of several opportunities for feedback on the revision (deadline 06/30/22). Rebecca highlighted the three significant components of the revision: management questions, tiered risk-based framework, and future priorities. Overall, this is a preliminary discussion for a larger group, with a goal for today to identify topics to bring to the ECWG Strategy Subgroup.

Rebecca briefly reviewed each of the management questions, spotlighting how each contributes to guiding the CECs framework and projects. The Strategy Subgroup noted the questions were generally good, though further information on the context of each question would be useful. This could include a small paragraph detailing the interpretation of each management question to RMP work. The Subgroup also recommended improvement of the temporal trends question to

include pathways and expand on understanding the reason for any noted trend. Dan Villenueve considered the revision a good idea and wanted to understand the implication of the inclusion of the additional text to RMP work. Derek Muir posited that trends in pathways could include examination of concentrations and/or loads. Tom Mumley agreed with a broader examination of the Bay and addition of this as a driver. Lee Ferguson wondered if the data are there, or would be there, to assess temporal trends in a systematic way, as there is a clear disparity in data availability across classes.

Rebecca continued with a review of the potential revisions to the tiered risked-based framework, focused on the impacts to prioritization as a whole, and noting continued discussion on this topic via the Subgroup. The first revision is to add a very high concern tier to provide better nuance concerning prioritization of contaminants and to correlate with the state framework. Redefinition of risk-based thresholds, especially clear identification of a risk quotient, with secondary factors (persistence, cumulative impacts, and trends) also informing classification. Elevation of fish consumption concerns is another important addition to risk characterization. The addition of the three noted revisions so far would likely lead to a change in some CECs of moderate concern to high concern (PFAS and OPEs). Another revision would differentiate the low and possible concern tiers by monitoring priority. This would create two possible concern groups: one for CECs recommended for periodic screening and another for those that have been deprioritized. The low concern tier would be split into three groups, including the two noted in possible concern plus a transitional group for CECs to help indicate level of priority for follow up work. The final revision would modify existing monitoring recommendations and remove the management recommendation for each tier.

The resulting discussion began with talk of the use of the 90th percentile concentration in the risk quotient as an updated risk screening, with Heather Stapleton noting the assumption of a normal distribution of data, and suggesting it would be useful to discuss with a statistics expert to ensure it is protective enough. Dan Villeneuve had concerns about the use of 90th percentiles because they may not be completely representative, particularly for using risk quotients based on 90th percentiles for some thresholds and medians for others. He also recommended developing guidance on the minimum amount of data needed. Miriam echoed Dan's concern about using a mixture of risk quotients based on 90th percentile and median concentrations, and noted the possibility of datasets that have similar medians but significantly different 90th percentiles. Her experience suggests the range of concentrations is more meaningful for exposure to biota, relative to the median. Because management actions take time to develop, it is important to identify concerns early. Derek Muir supported a more precautionary approach like using 90th percentile concentrations, and highlighted issues with method detection limits and uncertainty in both the numerator and denominator of a quotient. Bill Arnold further commented as to whether the level of uncertainty from the risk quotient calculation could be determined and considered. Don Yee responded to some of the concerns about data quantity and quality, suggesting that use of a 90th percentile concentration might be considered sufficiently protective particularly when monitoring is biased towards higher exposure scenarios such as in the Lower South Bay, and that issues could arise should these data become "diluted" by additional monitoring across subembayments. Nevertheless, if sufficient data are available, if 10% exceed

a toxicity threshold, that can indicate concern. Jennifer Teerlink commented on a need for further thought on what pathways (or matrices) are the most useful for risk assessment, especially as it relates to acute versus chronic exposure and toxicity. Tom Mumley noted the importance of data quantity and quality, spotlighting the need for data handling to be informed by best available practices. In particular, concerns relating to fish consumption should be consistent with regulatory frameworks for other contaminants. Tom Mumley and Miriam Diamond disagreed with the suggestion to remove recommendations concerning management, since it is important for ongoing monitoring to inform management decisions. Careful attention to the language in the revision is appropriate because the RMP is a monitoring program, not a management program.

Moving forward, Rebecca commented on the wide variety of potential CECs special study proposals expected at next year's meeting, indicating themes including pathways monitoring, marine mammals, tire and roadway contaminants, non-targeted analysis, toxicology, PFAS, OPEs, and bisphenols. She also discussed the themes that will be evident in the ECWG Multi-Year Plan (MYP): leveraging the S&T study redesign to monitor CECs, continued focus on PFAS across multiple matrices, strategic use of NTA, and greater consideration of the air pathway, especially as it relates to stormwater. The MYP is in development, and will be shared with the Strategy Subgroup for discussion at a later date.

13. Discussion: Tires Strategy Update

Kelly Moran discussed the update to the RMP Tires Strategy, a cross-workgroup multi-year plan to address tire-related water pollution. She began by spotlighting the importance of examining tire wear particles for contaminants, such as 6PPD that can transform to 6PPD-quinone in the environment and be toxic to wildlife (particularly coho salmon). She continued by showcasing the recent projects done at SFEI, especially the "Synthesis of Microplastic Sources and Pathways to Urban Runoff," funded jointly by the Ocean Protection Council (OPC) and RMP. There has also been a plethora of requests for presentations on the microplastics work across a variety of national and international conferences as well as state and federal agency discussions. With the increasing interest in microplastics and tire particles, Kelly commented that these presentations are normally very well attended.

This further correlates with the rapid rise of tire research, with more papers on tires published in the first four months of 2022 than the entire year of 2021 combined. Most emerging research on tires focuses on aquatic toxicity, though there is a growing body examining runoff treatment options. Already several tire chemicals beyond 6PPD-quinone have been identified as of interest to DTSC to help better understand contamination from tires.

Alicia Gilbreath discussed the preliminary chemical results obtained from monitoring studies of ambient Bay water and stormwater. In these studies, various sites were sampled across the Bay including open Bay, nearfield Bay, and urban runoff sites. The amount of data available to review was limited due to a dearth of storm events. In the Bay summer and stormwater reference sites, only trace concentrations of tire contaminants were found. In urban stormwater samples and samples from nearfield Bay sites (post-storm), concentrations of both

6PPD-quinone and N,N'-diphenylguanidine (DPG) were highest. Tire related chemicals were detected in wet season open Bay samples (collected ~1 week after storm) at concentrations indicating significant dilution, though both compounds were detected. Overall, urban runoff showed higher concentrations, with declines spatially and temporally away from stormwater sites and storm events for these two contaminants.

Ezra Miller continued the presentation with a discussion of new toxicity information on tires. Within the literature, there is a growing body of toxicity evidence for tire particles and tire-related contaminants based on exposure levels at environmentally relevant concentrations, which result in observed negative health outcomes. Ezra briefly reviewed some toxicology basics related to dose-reponse to add needed context to the toxicology updates. Although LC50s are not PNECs, they are still important to consider as they indicate potential population effects for a single species. When there is no PNEC or chronic toxicity data, a default assessment factor of 10 or 100 is applied to the LC50 to provide a protective threshold. In addition, stormwater exposure occurs in repeat pulses, and toxicity depends on exposure duration, making it difficult to understand the toxicokinetics and toxicodynamics of tire contaminants like 6PPD-quinone. The concentrations of tire related contaminants in the Bay (presented by Alicia) are helpful in identifying whether steelhead trout in the Bay could experience sublethal exposure and toxicity conditions. Toxicity evidence is building for tire wear due to exposure levels at environmentally relevant concentrations, resulting in negative health outcomes. In addition, runoff tends to be a complicated mixture of different contaminants, which could lead to an altered toxicity of co-exposed contaminants.

The five-year plan for the RMP tires strategy serves as a short-term supplement to the RMP's current MYPs for the ECWG, MPWG, and SPLWG. Over the next five years, this strategy will seek to answer priority questions and inform relevant management policies and decisions with a draft due sometime this year. The timeline of the plan is centered around upcoming management decisions including the DTSC Safer Consumer Products Program Workplan, the OPC tires sector pollution prevention strategy, and the US EPA Trash Free Waters Program - tires workplan. Currently, the focus is on tire chemicals in SF Bay, reflecting the prior year's stakeholder feedback to limit study of tire particles. The draft five-year special studies plan will include continued monitoring of known chemical groups in the wet season as well as identification of new chemicals for monitoring in the coming years. These studies, along with relevant literature, will aid in advancing scientific information to management agencies.

Several meeting participants noted a need for continued work on the interactions between tire related chemicals and particles in conjunction with the tire chemicals entering environmental matrices. It may be appropriate to reevaluate the initial guidance to focus exclusively on tire chemicals without considering the particles themselves. Tom Mumley noted a cause for concern for tire-related chemicals, spotlighting the importance to understand the potential problem clearly in the Bay. Ed Kolodziej identified an important data gap in understanding the separation of chemicals from the particle, with surface degeneration an important factor; improved understanding will provide information needed to effectively tackle this issue.

14. Summary of Proposed ECWG Studies for 2023

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 in the next agenda item. The focus of discussion was on seven high-priority proposals, with a brief review of three special study proposals relevant to ECWG from other RMP WGs including SPLWG, MPWG, and PCBWG.

The proposal for the second year of the stormwater CECs monitoring strategy continues to develop a novel, long-term stormwater monitoring approach to effectively address CECs. The updated approach would expand the focus beyond particles (most relevant to legacy contaminants) to include dissolved contaminants, consider diverse sources and physicochemical properties, monitor contaminants with ongoing use, and simplify monitoring questions relative to those designed for legacy contaminants. The two major elements of this strategy focus on development of an approach for prioritizing CECs for stormwater monitoring and updated CEC-specific sampling methodology for stormwater including integration of modeling and relevant stakeholder needs.

The CECs in Stormwater: PFAS proposal was presented next, an application of the stormwater CECs monitoring strategy. This study focuses on PFAS, a priority CEC, to establish an important foundation for monitoring and modeling with the resulting design advancing the estimation of the annual load of PFAS entering the Bay via stormwater. This approach would examine available PFAS knowledge to develop a conceptual model and examine prior data to help inform monitoring design. This study would also serve as an important pilot of remote sampling methods for stormwater.

The following proposal was the second year of ethoxylated surfactants analysis in multiple matrices, aimed at filling the data gaps in ethoxylated surfactant analyses described in the presentation by Lee Ferguson. Based on prior screening data, this second year will focus on wastewater with influent, effluent, and upstream sampling at one facility, and only effluent from two facilities, using the expanded analytical method under development.

PFAS and non-targeted analysis of marine mammal tissues, the first of a two year study, was showcased next. This study aims to inform S&T study design by determining if it is appropriate to add marine mammals while monitoring PFAS, a contaminant of high priority. In addition, improved analytical methods, particularly for non-targeted analysis, are likely to provide new insights into the presence of CECs in marine mammal tissues. This would be a two year pilot study with collection of tissues from the Marine Mammal Center. Two different labs have been identified to examine liver and serum as well as blubber, to get a complete understanding of the fate of CECs.

Several meeting participants had questions regarding this proposal, with Lee Ferguson inquiring on the current capabilities of examining serum for fluorinated compounds. Bernie Crimmins

discussed the method and its capability to effectively examine serum. Miriam Diamond mentioned if it would be possible to use archived samples if this study is not approved this year, though Rebecca noted the use of archived samples is not yet certain due to the need to review collection and storage materials and available sample masses. Tom Mumley suggested expanding the analysis to include other contaminants, especially for status and trends monitoring. Rebecca noted that the use of non-targeted techniques would allow identification of a broad range of contaminants; expansion of the study for more targeted contaminant monitoring could be considered, though it may be difficult to obtain sufficient mass of certain samples. Jay Davis underlined the importance of the non-targeted component to allow for CEC screening at the top of the food web.

The next study was the first year of a two-year study examining tire contaminants in Bay water during the wet season. Initial samples have indicated the presence of the tire contaminant 6PPD-quinone in Bay water, with further results needed to classify the contaminant under the tiered risk-based framework. In addition, these findings can help evaluate the pilot wet season monitoring effort. The study would examine eight near-field stations and 4-5 open Bay stations, leveraging S&T monitoring. Anne Cooper Doherty was interested in learning more about the analyte list, with Ed Kolodziej responding that there are roughly six tire related chemicals in the method and several CECs considered typical in stormwater.

The proposal on mining NTA data for additional targets for future study aims to leverage existing NTA datasets to elucidate new study ideas. This would also include in depth review of literature and database information on sources and toxicity of at least 40 contaminants.

PFAS in archived sport fish was the final proposal presented, with an aim to fill data gaps relevant to human health concerns, especially of disadvantaged communities, and provide more data for trends analysis. This study could also serve to inform S&T study design. Several different fish will be examined from archives in 2009, 2014, and 2019 from sites all across the Bay to better understand PFAS sport fish contamination in the Bay.

15. Discussion of Recommended Studies for 2023 - General Q&A, Prioritization

Melissa Foley introduced the item by reviewing the process for prioritization and recommendation of special study proposals. She also noted the overall planning budget for the special studies to prioritize for the TRC and overall scope of the budget within the RMP. Meeting attendees asked any remaining questions while proposal PIs were still in attendance. The discussion focused on three of the high priority studies previously presented.

CECs in Stormwater: PFAS
Heather Stapleton commented on potential sources of PFAS to stormwater from construction and other urban PFAS. She recommended expanding monitoring to include diPAPs and fluorotelomer alcohols. Dan Villeneuve thought the proposal should be marked as time sensitive and urgent due to its use in understanding sampler needs for similar studies. Lee Ferguson expressed concern with the use of AOF, indicating efforts so far using the method have not been

fruitful; instead, he recommended a focus on the TOP method. Rebecca noted AOF in stormwater is a pilot for understanding PFAS method and comparison to wastewater. Miriam indicated further support of the TOP method, particularly as PFAS polymers are not quantified via targeted methods. Derek suggested characterizing trifluoroacetic acid.

PFAS and non-targeted analysis of marine mammal tissue
Derek Muir supported use of both Bernie's and Eunha's lab for non-targeted analysis of marine mammal samples. He also noted it would be useful to compare these measurements to those of PFAS in wastewater. Tom Mumley would like to further consider the addition of other analytes to this study.

Tire and roadway contaminants in wet season Bay water
A meeting participant inquired about potential synergy with the stormwater strategy, including identification of sampling methods and locations. Kelly Moran noted this would be an ideal scenario, and that this study is designed to leverage the Bay S&T pilot study design. Tom Mumley reiterated that he did not want to rule out potential consideration of particles.

16. Closed Session - Decision: Recommendations for 2023 Special Studies Funding

Karin North led the closed door discussion. Following extensive discussion, studies were prioritized. The resulting recommendations are shown in the following prioritization tables:

Study Name	Budget	Modified Budget	Priority	Comments
Stormwater monitoring strategy for CECs (year 2 of 2)	$55,000		1	
Ethoxylated surfactants in ambient water, margin sediment, wastewater, Part 2 (year 2 of 2)	$30,000		2	
Tire and roadway contaminants in wet season Bay water (year 1 of 2)	$40,000		3	

Mining nontargeted analysis data for additional targets for future study	$45,000		4	Potential for add-on to follow up on specific contaminants that are observed. Possible limited pro bono work from Lee to try to update the NTA table. Should not lose sight that there are likely other things out there (other than PFAS) that we may need to monitor.
CECs in stormwater: PFAS	$180,000		5	EPA 1633 focused on AFFF; potential to add other PFAS to the study (dipaps and fluorotelomer alcohols)? TOP method would capture these compounds. Dipaps specifically could give info about pathways. Maybe don't do AOF and focus on TOP due to interpretation challenges with AOF (reason to include is because it is a pilot and SWRCB want to look at a broader suite of methods). AOF helpful to compare pathway to wastewater (included in BACWA study). Add GCMS for TFA and TFRA? Use sampling pilot to look at other CECs, particularly for blanks and recovery ($35-40k for additional CEC pilot)? Use savings from not doing AOF to test additional CECs with the remote samplers. Add tire contaminants to pilot. Also potentially add other stormwater contaminants - metals (copper, nickel, zinc) as a useful indicator. Further dialogue to discuss the design and depth of conceptual model development.
PFAS and nontargeted analysis of marine mammal tissues (year 1 of 2)	$115,500		6	Additional contaminants? Non-targeted analysis important for identifying other CECs to include in S&T monitoring. Could blubber analysis be done on GCGC high-res?
PFAS in archived sport fish	$72,500		7	PFAS is part of future S&T work; archive samples may be less useful for EJ communities than future analysis.
Total	$538,000	$0		

17. 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 and recommendations. The proposals for continued activity on two year studies were prioritized

because they are ongoing. The proposal to monitor chemical tire contaminants during the wet season was the next priority because it is time sensitive. The NTA data mining proposal was next because it is relatively low cost and high impact. The proposal on stormwater (with revisions) was a high priority but was placed further down on the list because the Water Board assumed it could be funded via a variety of mechanisms (including the RMP). Additional feedback will be obtained during the SPLWG meeting. Proposals on marine mammals and sport fish were essentially a tie; monitoring marine mammals was of interest because these are top predators, while an examination of PFAS in archived sport fish was of interest due to the intersection with environmental justice.

Adjourn

About the RMP

<u>RMP ORIGIN AND PURPOSE</u>

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.

<u>RMP PLANNING</u>

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.

<u>PURPOSE OF THIS DOCUMENT</u>

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

Governance Structure for the
Regional Monitoring Program for Water Quality in San Francisco Bay

Figure 1. Collaboration and adaptation in the RMP is achieved through the engagement of stakeholders and scientists in frequent committee and workgroup meetings.

The Steering Committee consists of representatives from discharger groups (wastewater, stormwater, dredging, industrial) and regulatory agencies (Regional Water Board and U.S. Army Corps of Engineers). The Steering Committee determines the overall budget and allocation of program funds, tracks progress, and provides direction to the Program from a manager's perspective.

Oversight of the technical content and quality of the RMP is provided by the **Technical Review Committee** (TRC), which provides recommendations to the Steering Committee.

Workgroups report to the TRC and address the main technical subject areas covered by the RMP. The Nutrient Technical Workgroup was established as part of the committee structure of a separate effort—the Nutrient Management Strategy—and makes recommendations to the RMP committees on the use of the RMP funds that support nutrient studies. The workgroups consist of regional scientists and regulators and invited scientists recognized as authorities in the field. The workgroups directly guide planning and implementation of special studies.

RMP strategy teams constitute one more layer of planning activity. These stakeholder groups meet as needed to develop long-term RMP study plans for addressing high priority topics.