Delta RMP Nutrient Symposium Program

September 27, 2022

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DRMP Nutrient Symposium Program | September 27, 2022

Goals and Objectives of the Symposium

- Inform upcoming Delta RMP long-term nutrient planning efforts.
- Inform Delta RMP stakeholders on recent nutrient activities in the Delta including an assessment of data gaps and an evaluation of management questions.
- Improve understanding of management activities associated with water quality problems identified in the Delta Nutrient Research Plan.

8:00 to Lunch Coffee and Pastries

8:20 to 8:30 **Welcome / Introduction** by Steering Committee Co-Chairs, Debbie Webster (Central Valley Clean Water Association) and Meredith Howard (Central Valley Regional Water Quality Control Board)

8:30 to 9:50 Looking Back: A Review of Delta RMP-Funded Nutrient Projects

This session will begin with an overview of nutrient management in the Delta and the introduction to the Delta Nutrient Research Plan, which has been identified by the Delta RMP as an important roadmap for prioritizing nutrient research including a summary of how nutrient problems in the Delta impact various stakeholders. Presenters will review projects associated with nutrients and phytoplankton that the Delta RMP has partially or fully funded.

8:30 to 8:40 Opening Remarks by Adam Laputz (Central Valley Regional Water Quality Control Board)

8:40 to 9:10 The Delta Nutrient Research Plan – A Roadmap for Nutrient Research in the Sacramento-San Joaquin Delta (Tom Grovhoug, Larry Walker and Associates)

This presentation will provide an overview of the purpose, goals, and content of the 2018 Delta Nutrient Research Plan (DNRP). The history of development of the DNRP by the Central Valley Water Board will be described, including the organizational and collaborative processes used, including the use of expert panels to define problems and assess the state-of-science in those problem areas and the active engagement with stakeholders throughout the development of the plan. The presentation will include a description of the key elements of the DNRP, including important management questions to be addressed, the identification of monitoring, research and modeling needs to address those questions, a prioritization methodology and the resulting list of prioritized studies, research and modeling efforts. The presentation is intended to provide a forum for understanding the DNRP

and how it can be leveraged in planning future studies within the Delta Regional Monitoring Program (DRMP) and to foster collaboration with other programs.

Delta Nutrient Research Plan:
https://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/delta_nutrient_research_plan/2018_0802_dnrp_final.pdf

9:10 to 9:40 Overview of Delta RMP Studies (Tim Mussen, Regional San)

Main findings from completed Delta RMP nutrient reports, including nutrient status and trends, modeling to identify data gaps in nutrient monitoring, and chlorophyll-a sensor and sample analysis intercomparison. Program reports are available at https://deltarmp.org/documents/

9:40 to 9:50 Questions and Discussion

9:50 to 10:00 BREAK

10:00 to 12:35 Status and Trends in Nutrient Studies

This session will focus on the evaluation of how changes in nutrient concentrations affect the Delta, potential implication of management activities on HABs, and evaluation of data gaps. The focus will be on nutrient special studies currently underway by the Delta RMP and other agencies.

10:00 to 10:05 Opening Remarks (Janis Cooke, Central Valley Regional Water Quality Control Board)

10:05 to 10:30 Filling in the Blanks: Nutrient Data Gaps and Special Studies in the Delta (Dylan Stern, Delta Stewardship Council)

A Delta Science Program perspective on the progress that has been made to address nutrient data gaps and management questions identified in the Delta Nutrient Research Plan and the Science Action Agenda, including special studies funded by the Delta Stewardship Council.

2017-2021 Science Action Agenda:
https://scienceactionagenda.deltacouncil.ca.gov/pdf/2021-01-14-science-action-plan.pdf

2017-2021 Science Action Agenda Progress Summary:
https://scienceactionagenda.deltacouncil.ca.gov/pdf/SAA-Progress-Summary.pdf

2022-2026 Science Action Agenda: https://scienceactionagenda.deltacouncil.ca.gov/pdf/2022-2026-science-action-agenda.pdf

Delta Science Program Research Funding: https://deltacouncil.ca.gov/delta-science-program/research-funding-and-fellowships

10:30 to 11:05

Sacramento River Nutrient Studies (Lisa Thompson, Regional San)

Review of the Delta RMP's Sacramento River Nutrient Change Study, an experiment investigating potential ecological effects due to a temporary halt in nutrient loading from Regional San's Sacramento Regional Wastewater Treatment Plant.

We studied the effects of changes in nutrient loading resulting from a scheduled 48-hour wastewater hold at the Sacramento Regional Wastewater Treatment Plant (100% reduction in nitrogen loading from the plant). The hold created a parcel of "without-wastewater" river water approximately 20 miles (32 km) long. We observed the effects of short-term changes in nutrient loading in water with wastewater (9/10/19) and without wastewater (9/11/19 and 9/12/19) in the Sacramento River and three downstream channels: Georgiana Slough, the North Fork Mokelumne River, and the South Fork Mokelumne River. Flow and transport modeling suggested that the proportions of water from three different sources, Sacramento River, Sacramento Regional Wastewater Treatment Plant, and Mokelumne River, varied among the channels. High resolution boat-based monitoring of water quality showed that a well-defined without-wastewater treatment, as indicated by changes in the concentrations of ammonium, nitrate, and dissolved inorganic nitrogen, was produced in the Sacramento River, Georgiana Slough, and North Fork Mokelumne River, while the pattern in the South Fork Mokelumne River was less distinct due to variable contributions from the Sacramento River and Mokelumne River. Similarly, in the discrete water samples collected in each channel, concentrations of various forms of nitrogen decreased in without-wastewater conditions. Across the study area, fluorescent chlorophyll fluorescence did not show a clear increase or decrease in association with the decrease in wastewater nutrient loading. Chlorophyll fluorescence attributed to diatoms decreased in association with the decrease in wastewater nutrient loading from 9/10/19 to 9/11/19, but only in the North Fork Mokelumne River. Chlorophyll fluorescence attributed to blue-green algae showed a slight decrease from 9/10/19 to 9/12/19 across the study area. Although not part of our experimental design, turbidity decreased and light availability increased on 9/11/19, starting upstream of the Sacramento Regional Wastewater Treatment Plant, and not associated with the wastewater hold. Phytoplankton primary productivity increased across the days of the study, indicated by higher carbon fixation (following an acclimation period of one day) and lower δ^{13}C-particulate organic carbon (consistent with higher fractionation by the Rubisco enzyme with higher rates of carbon fixation). Because water clarity can impact phytoplankton communities, changes in turbidity likely confounded effects resulting from changes in nutrient concentrations with the wastewater hold. Future nutrient-related studies could include the potential effects of longer-term, but smaller, nutrient loading reductions resulting from the upgrade to biological nutrient removal at the Sacramento Regional Wastewater Treatment Plant (65% reduction in nitrogen

loading from the plant), as well as other reductions in nutrient loading to the Delta that may occur in future.

A river-scale Lagrangian experiment examining controls on phytoplankton dynamics in the presence and absence of treated wastewater effluent high in ammonium - Kraus - 2017 - Limnology and Oceanography - Wiley Online Library (https://aslopubs.onlinelibrary.wiley.com/doi/10.1002/lno.10497)

11:05 to 11:55 Nutrients, Phytoplankton, and Harmful Algal Bloom Research by the U.S. Geological Survey (Tamara Kraus & Keith Bouma-Gregson, U.S. Geological Survey California Water Science Center)

The mission of the U.S. Geological Survey (USGS) California Water Science Center (CAWSC) is to provide reliable, impartial, foundational data and scientific analysis to address water issues facing California by conducting monitoring and investigative studies in partnership with Federal, State, and local agencies to assist them in managing California's water resources. As such, researchers at the CAWSC work with the Delta Regional Monitoring Program (RMP) to address key data gaps related to nutrient status and trends and impacts on phytoplankton and water quality.

Because the Sacramento-San Joaquin Delta (Delta) is a tidally influenced, hydrologically complex system with multiple habitats (deep channels, shallow open water habitats, wetlands), information about flow, water quality, nutrients and phytoplankton need to be collected at the appropriate temporal and spatial scales. The USGS meets these needs by collecting data at high temporal resolution (fixed stations) and at high spatial resolution (boat-based mapping surveys) to provide information about spatio-temporal patterns and trends and to identify sources and drivers of nutrients and phytoplankton. Furthermore, because multiple factors affect nutrient cycling and phytoplankton, the USGS strives to collect a broad suite of flow, water quality (temperature, specific conductance, turbidity, pH, dissolved oxygen), nutrient (nitrogen, phosphorus, and carbon) and phytoplankton (abundance, community composition) data simultaneously.

Nutrient inputs in the Delta from point source and non-point sources are primary controls of nutrients in the Delta, but results of studies conducted during the last few years have demonstrated that water residence time, phytoplankton uptake, and landscape-scale features are key factors determining nutrient concentrations, forms, and gradients. We will present results of these USGS studies, particularly in relation to Regional San's recent wastewater treatment plant upgrade.

While multiple factors impact phytoplankton production in the Delta, nutrients are a requirement for phytoplankton growth and can affect which types of algae thrive. Which phytoplankton taxa grow, and how much, influence the rest of the aquatic food web. Phytoplankton blooms can be beneficial (Beneficial Algal Blooms, BABs) or harmful (Harmful Algal Blooms, HABs). Production by BABs is rapidly consumed by grazers and fuels zooplankton and fish production. Alternatively, HAB formation can negatively affect drinking water quality, public health, and ecosystem health.

In the Delta, HABs are formed by cyanobacteria (cyanoHABs). While cyanoHABs have been documented since 1999, cyanotoxins produced by cyanoHABs are not

routinely monitored in the Delta. The USGS HABs studies were implemented to create a routine cyanotoxin monitoring dataset in the Delta. Adding cyanotoxins and phytoplankton analyses to pre-existing USGS water quality monitoring stations provides opportunities to study the relationships between nutrients, cyanotoxins, and the phytoplankton community. We will present the results of cyanotoxin concentrations at 6 stations in the Delta beginning in October 2020, and during Delta-wide mapping campaigns conducted in May, July, and August of 2020 and 2021. These studies are filling data gaps regarding linkages between environmental conditions, cyanoHAB diversity, cyanoHAB abundance, and cyanotoxin concentrations. Results can be used to model cyanobacterial risk in different regions of the Delta, inform targeted experiments, and guide the development of broader cyanotoxin monitoring in the Delta.

Data gaps addressed by USGS HABs studies:

- 1. Where, when, and under what conditions do cyanobacteria blooms occur in the Delta over a range of habitats (particularly near natural and restored wetlands, drinking water intakes, and recreational areas)?
- 2. How do physical, chemical, and biological factors affect phytoplankton abundance and growth, including nutrients, phytoplankton growth and species composition, microbial processes related to nutrient release, biological controls of phytoplankton (e.g., grazing), and physical factors, including hydrology, turbidity, turbulence, irradiance, and temperature?
- 3. How do previous light and nutrient conditions affect nutrient uptake by phytoplankton?
- 4. What range in harmful algal toxins occur across different Delta habitats, particularly in natural and restored wetlands, drinking water intakes, and recreational areas?
- 7. How do nutrients and other drivers control the growth rate, maximum biomass, and toxin production of HABs?
- 19. Do predictive relationships exist between cyanobacteria (bloom occurrence and toxin concentrations) and readily available data (e.g., nitrogen forms, chlorophyll, and other pigments) from continuous sensors or other sources?

Relevant Links:

Delta Boat-Based Mapping Survey Dashboard SFBD_Data_Portal (usgs.gov) (associated data can be found at https://www.sciencebase.gov/catalog/item/5f284f1782cef313ed9df50e)

Stumpner E.B., J. Yin, M. Heberger, J. Wu, A. Wong, and Saraceno, J.F. 2022. **San Francisco Estuary Chlorophyll Sensor and Sample Analysis Intercomparison**. SFEI Contribution Number 977. Richmond, California: San Francisco Estuary Institute. Chl Intercomparison Report_USGS_approval_121521.pdf (deltarmp.org)

Kraus, T.E.C., Bergamaschi, B.A., and Downing, B.D., 2017, **An introduction to high-frequency nutrient and biogeochemical monitoring for the Sacramento–San Joaquin Delta, northern California**: U.S. Geological Survey Scientific Investigations Report 2017–5071, 41 p., https://doi.org/10.3133/sir2015071.

Downing, B.D., Bergamaschi, B.A., and Kraus, T.E.C., 2017, **Synthesis of data from high-frequency nutrient and associated biogeochemical monitoring for the Sacramento–San Joaquin Delta, northern California:** U.S. Geological Survey

Scientific Investigations Report 2017–5066, 28 p., https://doi.org/10.3133/sir20175066.

Bergamaschi, B.A., Downing, B.D., Kraus, T.E.C., and Pellerin, B.A., 2017, **Designing a high-frequency nutrient and biogeochemical monitoring network for the Sacramento–San Joaquin Delta, northern California**: U.S. Geological Survey Scientific Investigations Report 2017–5058, 40 p., https://doi.org/10.3133/sir20175058.

11:55 to 12:20 **Expanding the Spatial and Seasonal Research on Delta Cyanobacterial Harmful Algal Blooms (Ellen Preece, Robertson-Bryan, Inc)**

Presentation of recent studies that focus on the distribution of cyanotoxins and cyanobacteria cells in water, shellfish, and sediment throughout the Delta.

Cyanobacteria harmful algal blooms (CHABs) have become a persistent seasonal phenomena throughout much of the Sacramento-San Joaquin Delta (Delta) since they were first documented in 1999. To date, much of the monitoring for CHABs and associated cyanotoxins has occurred at select fixed monitoring stations and via State CHAB response data. Numerous knowledge gaps remain regarding the spatial and temporal extent of CHABs and cyanotoxins throughout the Delta. The goal of this presentation is to synthesize three ongoing CHAB research projects that are collecting data outside of the fixed monitoring stations to elucidate factors that may influence the distribution of Delta CHABs. Although these studies are not complete, several findings have emerged. First, areas of the southern and central Delta routinely have the highest toxin concentrations and the greatest amount of overwintering *Microcystis* seedstock. Overwintering vegetative *Microcystis* colonies remain photosynthetically active and reenter the water column when environmental factors provide favorable growth conditions or through passive wind-induce resuspension. Second, there are locations with severe, predictable, blooms that are observable in many Delta waterways by mid to late summer. Toxins persist in shellfish in all months but are highest from July through November. By April, there is little *Microcystis* seedstock remaining in some areas of the Delta, suggesting that *Microcystis* at these locations are likely seeded from other upstream locations in the Delta. Continuing to research the spatial and seasonal occurrence of CHABs will be important for tracking how blooms may evolve in response to climate change and to inform managers where to target future mitigation efforts. It will be particularly important to focus research and management efforts in areas of the Delta that experience the most severe CHABs.

12:20 to 12:35 Questions and Discussion

12:35 to 1:20 LUNCH PROVIDED

1:20 to 3:10 Predicting the Future – Nutrient Modeling

This session will provide an update on current nutrient modeling efforts in the Delta including work partially funded by the Delta RMP and future work planned. Discussion of how modeling can be used to assess the effectiveness

of nutrient management. Identification of modeling limitations and potential areas where additional data can help inform / update existing models. Review of existing tools to predict changes in nutrients and discussion of data gaps. Discussion of integration with other important factors, such as HAB, diatom, or macrophyte growth, and their potential for informing nutrient management programs.

1:20 to 1:25 Opening Remarks (Melissa Turner, DRMP Program Manager)

1:25 to 1:55 SFEI Delta-Suisun Biogeochemical Model (David Senn, San Francisco Estuatry Institute-Aquatic Science Center (SFEI-ASC))

Quantitative, mechanistic understanding of nutrient cycling and nutrient-related ecosystem responses are needed to help inform on-going adaptive management and future management decisions in the Delta and San Francisco Bay. Given the physical and biogeochemical complexities of the northern San Francisco Estuary (nSFE), numerical models which are capable of simulating coupled hydrodynamics and biogeochemistry will be important tools in supporting science-based decision making. Work has been underway over the past several years developing the San Francisco Estuary Biogeochemical Model (SFE-BGCM), a 3-D coupled hydrodynamic-biogeochemical model capable of simulating nutrient transport, nutrient cycling, and ecosystem responses (e.g., phytoplankton production). Initial work focused on model development, sensitivity analysis, and model calibration. This presentation will provide an overview of the SFE-BGCM including modeling limitations and upcoming work in applying the model to extract mechanistic insight and exploring factors or conditions under which phytoplankton production may increase or decrease.

Delta-Suisun Biogeochemical Model: Calibration and Validation (WY2016, WY2011): https://deltarmp.org/Documents/2021_SFEI_DeltaSuisun_BiogeochemModel_WY2016_and_WY2011_DraftFinal_shareSep30_RevisedTitlePage.pdf

Bergamaschi, B.A., Downing, B.D., Kraus, T.E.C., and Pellerin, B.A. 2017. Designing a high-frequency nutrient and biogeochemical monitoring network for the Sacramento–San Joaquin Delta, northern California. U.S. Geological Survey Scientific Investigations Report 2017–5058. https://doi.org/10.3133/sir20175058.

Downing, B.D., Bergamaschi, B.A., and Kraus, T.E.C. 2017. Synthesis of data from high-frequency nutrient and associated biogeochemical monitoring for the Sacramento–San Joaquin Delta, northern California. U.S. Geological Survey Scientific Investigations Report 2017–5066. https://doi.org/10.3133/sir20175066

Kraus, T.E.C., Bergamaschi, B.A., and Downing, B.D. 2017. An introduction to high-frequency nutrient and biogeochemical monitoring for the Sacramento–San Joaquin Delta, northern California. U.S. Geological Survey Scientific Investigations Report 2017–5071. https://doi.org/10.3133/sir20175071.

Delta-Suisun Biogeochemical Model: Calibration and Validation (WY2016, WY2011). SFEI Contribution #1056. [this is the final/Dec 2021 version of the report to DRMP] SFEI 2021

Sacramento-San Joaquin River Delta and Suisun Bay Hydrodynamic Model: Water Year 2016. SFEI Contribution #964. SFEI 2019

1:55 to 2:25 SPARROW Model of Nutrients in California Streams (Joe Domagalski, U.S. Geological Survey California Water Science Center)

SPARROW (SPAtially Referenced Regression On Watershed attributes) models were developed by the U.S. Geological Survey National Water Quality Assessment Program to understand and predict concentrations, loads, and most probable sources of nutrients in unmonitored stream reaches of large watersheds. The model works by producing a most probable flux of nutrients from one small part of the watershed to the next based on known sources such as atmospheric deposition, wastewater discharge locations and average annual loads, fertilizer use, and land-use types, along with geological attributes (soil types for example) and biogeochemical reactions that affect concentration change along the flow paths. Co-locating water-quality monitoring locations with flow monitoring stations that are near potential sources is necessary to calibrate the SPARROW models. The hydrological framework used for SPARROW modeling in California is the USGS National Hydrography Dataset (NHD), with modeled discharges based on the Unit Runoff Method. Locations and amounts of stream diversions were added to the NHD framework to improve model calibrations. Two SPARROW models have been developed for California. The first model used hydrologic conditions centered on the base year 2002, and a newer model used hydrologic conditions centered on the base year 2012. All nutrient source data, land cover, and other temporally variable watershed parameters such as climate are averaged or detrended to represent the base year. Both models used 30 prior years of climate and streamflow data to simulate average annual discharges. Although both models produced similar results, the 2012 model was an improvement over 2002 in that a better representation of stream diversions was obtained. At any location throughout the model domains, average loads of total nitrogen (TN) or total phosphorus (TP) and the proportion of each source contributing to the load were calculated. Principal sources of TN in the 2012 model were atmospheric deposition, grasslands, fertilizer and livestock manure, urban land, and wastewater discharges. Principal sources of TP in the 2012 model include geological sources, grazing lands, fertilizer and manure, urban land, and wastewater discharge. In the lower Sacramento River downstream of the Sacramento Wastewater Treatment Plant discharge point, SPARROW predicts that 14.5 percent of the TN load and 26.9 percent of the TP load originates from wastewater sources. The largest predicted sources of TN from upstream locations are fertilizer and livestock manure and atmospheric deposition. SPARROW output can be used to produce heat maps of the larger watershed showing total delivered loads of nutrients and their specific sources.

2:25 to 2:55 Modeling Delta water quality using coupled hydrodynamic and biogeochemical models (Zhenlin Zhang, Department of Water Resources)

An unstructured-grid hydrodynamic model, SCHIM (Semi-implicit Cross-scale Hydroscience Integrated System Model) is coupled with a water quality model,

CoSiNE (Carbon, Silicate, Nitrogen Ecosystem) to model the biogeochemical cycling processes in the Delta System. This study is built on extensive existing modeling effort to model flow, water level, nutrients, phytoplankton, and submerged aquatic vegetations using the same modeling platform in the bay-delta region. In setting up the model, a significant amount of observed environmental data was used to drive and validate the model. The biogeochemical model simulates nutrient cycling, phytoplankton dynamics, zooplankton grazing, and sediment nutrient fluxes. Clam grazing on phytoplankton was modeled using spatially interpolated clam grazing rates from observed data by multiple monitoring efforts. Such coupled models provide a mechanistic approach to synthesize the extensive water quality data observed in the system and a tool to establish causal linkages between environmental factors and water quality issues.

2:55 to 3:10 Questions and Discussion

3:10 to 3:20 BREAK

3:20 to 4:35 Nutrient Monitoring Collaborations and Partnerships

Updates from other monitoring programs in the Delta including short-term and long-term goals of those programs. Discussion focused on how the Delta RMP can develop partnerships and how collaboration can foster data sharing and maximizing resources.

3:20 to 3:25 Introduction (Delta RMP Steering Committee Co-Chairs, Debbie Webster (Central Valley Clean Water Association) and Meredith Howard (Central Valley Regional Water Quality Control Board)

3:25 to 3:45 USGS Nutrient Monitoring Program (Brian Bergamaschi, U.S. Geological Survey)

This presentation will provide an overview of the USGS nutrient research group vision, highlight collaborations currently funded, and explore what is key in having good collaboration between programs. The presentation will highlight how existing USGS tools have been developed to share data with collaborators and where current collaborations are focused to ensure consistency in data collection amongst programs.

3:45 to 4:05 Department of Water Resources Municipal Water Quality Investigations (MWQI), Interagency Ecological Program (IEP) and Environmental Monitoring Program (EMP) (Ted Flynn, Department of Water Resources & Leslie Palencia, Technical Consultant)

The presentation will provide an overview of short-term and long-term goals of nutrient monitoring and research conducted by the Interagency Ecological Program (IEP), Environmental Monitoring Program (EMP), and Municipal Water Quality

Investigation (MWQI) Program including how partnerships and collaborations can foster data sharing and effective use of resources.

The Interagency Ecological Program (IEP) consists of nine member agencies (three State and six federal) along with several key partners. The IEP works to improve the ecological understanding of the San Francisco Estuary while collecting data required for the management of the State Water Project (SWP) and the Central Valley Project (CVP). IEP's core monitoring activities focus on compliance with State and Federal Endangered Species Acts and State Water Rights Decisions (e.g., D-1641). IEP participates in science through collaborative monitoring, research, and synthesis efforts focusing on aspects of the aquatic ecosystem in the San Francisco Estuary.

The IEP Science Strategy (PDF) outlines 5-year science priorities and management challenges and serves as a subject-matter guide for our management-relevant compliance science (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=185011&inline).

The IEP Annual Work Plan (PDF) is a summary of the work our 9 member agencies plan to conduct in the coming year as part of its cooperative mandate in the Bay-Delta (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=196010&inline).

Brief descriptions of the work plan elements can be found in the IEP Factsheets (https://iep.ca.gov/Public-Engagement/Summaries-At-a-Glance).

An annual work plan schedule and Communications Plan (PDF) are used by the IEP Coordinators Team and IEP Science Management Team to craft routine monitoring programs (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=185007&inline).

The Department of Water Resources (DWR) conducts water quality monitoring and assessment through four program components: Environmental Monitoring Program (EMP), Municipal Water Quality Investigation (MWQI) Program, Bryte Chemical Laboratory (Bryte Lab) and Quality Assurance/Quality Control (QA/QC) Program. The EMP is a joint effort by DWR and the United States Bureau of Reclamation (USBR) to characterize the aquatic environment of the Sacramento-San Joaquin Delta, Suisun, and San Pablo Bays. With assistance from the California Department of Water Resources (CDFW), each month EMP scientists visit up to 28 (24 fixed and 4 floating) stations to sample water quality and biological communities (phytoplankton, zooplankton, and benthic invertebrates). EMP also services and maintains a network of 15 continuous water quality stations that provide data in real time through the California Data Exchange Network (CDEC). The data collected and analyzed by EMP scientists is essential for the effective management of water resources in the estuary and assures that the objectives mandated by SWRCB in the permits issued to DWR and UBSR are met. The standards include minimum Delta outflows, limits to Delta water exports by the SWP and the CVP, and maximum allowable salinity levels in the Delta. Since 1975, these efforts have established an irreplaceable ecological record in the San Francisco estuary that has been used in dozens of peer-review scientific articles and technical reports. IEP's monitoring efforts and makes its data openly and freely available to the public.

The Municipal Water Quality Investigations Program (MWQI) is part of the Division of Environmental Services within the Department of Water Resources (DWR). The MWQI Program mission is to support the effective and efficient use of the State

Water Project (SWP) as a municipal water supply source through monitoring, forecasting, and reporting; provide early warning of changing conditions in source water quality used for municipal purposes; provide data and knowledge based support for operational decision-making on the SWP; conduct scientific studies of drinking water importance; and provide scientific support to DWR, the State Water Project Contractors, and other governmental entities. Studies include long-term discrete monitoring, real time monitoring (modeling/forecasting), science support studies, emergency response, and technical and scientific support.

Environmental Monitoring Program: https://iep.ca.gov/Science-Synthesis-Service/Monitoring-Programs/EMP

DWR Water Quality Monitoring & Assessment: https://water.ca.gov/Programs/Integrated-Science-and-Engineering/Water-Quality-Monitoring-And-Assessment

Real Time Data and Forecasting (RTDF) Report: https://rtdf.info/

The 2022 workplan can also be found on the website. https://rtdf.info/public_docs/WorkPlans/MWQP_Jan-Dec2021_Workplan_Final.pdf

4:05 to 4:25 San Francisco Regional Monitoring Program (San Francisco Bay RMP) (Tom Mumley, San Francisco Bay Regional Water Quality Control Board)

Overview of the San Francisco Bay Regional Monitoring Program (SF Bay RMP) and Nutrient Management Strategy including identification of key opportunities for more collaborations with Delta interests from both a scientific and management perspective.

https://sfbaynutrients.sfei.org/

San Francisco Bay Nutrient Management Strategy: Work Plan for Assessment Framework Development 2020-2024 https://drive.google.com/file/d/1zBjWb9mlzkWK7jGGaB5HIsy3khsukCzX/view

4:25 to 4:35 Questions and Discussion

4:35 to 4:55 Final Opportunity for Questions

4:55 to 5:00 Closing Remarks