Steering Committee Teleconference Agenda

Wednesday March 11, 2020 10:00 am – 12:00 Noon

Call-in: 415-594-5500
Access Code: 238-626-034#
Online: https://join.me/sfei-conf-cw2
Recommended browser: Chrome

#	Agenda item and desired outcomes	Attachments	Start & Lead
1	**Introductions and Review Agenda** Introduce SC members, establish quorum, and explain goals of the meeting.		10:00 Adam Laputz
2	**Decision: TAC Co-Chairs** The charter calls for the SC to nominate and approve 2 TAC members to serve as chairs each year. The co-chairs "coordinate the TAC's oversight of the technical content and quality of the RMP, co-chair TAC meetings, and help ensure review of all program proposals and technical products. They also provide a communication link between the SC, TAC and Implementing Entity." The TAC has nominated Selina Cole and Melissa Turner to serve as co-chairs. **Desired outcome:** • Approve 2 new TAC co-chairs.		10:05 – 10:20 Adam Laputz

#	Agenda item and desired outcomes	Attachments	Start & Lead
3	**Decision: Proposed nutrients monitoring project to begin May 2020** The USGS Biogeochemistry Group (BGC) has received funding from the Delta Science Program (DSP) to collect high-frequency nutrient data to better understand trends and processes impacting water quality and the foodweb. Funding from the Delta RMP for a May 2020 cruise would ensure that a third set of high-frequency cruise data would be collected before the implementation of Sacramento Regional County Wastewater Treatment Plant's upgrade. The planned upgrade will reduce nitrogen inputs to the Delta as well and alter the predominant form from ammonium to nitrate. **Desired outcome:** ● Decision on whether to fund the proposed study.	(a) Proposal: "High-Resolution Nutrient Monitoring Prior to Major Wastewater Treatment Plant Upgrades" (b) Memo from USGS BGC on status of deliverables for 2018 monitoring study (c) Letter of support from the Delta Science Program (d) Draft summary of TAC meeting from Feb 13, 2020 (e) Draft summary of Nutrients Subcommittee meeting, Jan 15, 2020	10:20 – 11:15 Matt Heberger Tamara Kraus
4	**Decision: Governance Support** The Governance Subcommittee is recommending expanding the role of the TAC Facilitator Dave Ceppos, from the Consensus and Collaboration Program (CCP) at Sacramento State, to provide coordination and facilitation support and governance expertise for Governance Subcommittee activities. **Desired outcome:** • Decision on whether to allocate $15,600 of Delta RMP funds to expand the role of CCP	(a) Memo from the Governance Committee (b) Scope of Work for CCP	11:15 – 11:55 Meredith Howard
5	**Wrap up** • Review action items		11:55 Adam Laputz
	Adjourn		**12:00**

Materials for Agenda Item 3

Title: High Resolution Nutrient Monitoring, May 2020 Survey

Proposed by: USGS Biogeochemistry Group, California Water Science Center
Brian Bergamaschi, bbergama@usgs.gov; Tamara Kraus tkraus@usgs.gov)

Problem Statement/Project Need

While targeted high frequency mapping surveys have been conducted in association with special studies over the last few years, wide-area mapping surveys that collect data across the entire domain of the Delta and Suisun Bay have only been undertaken in May, July and October 2018: those data collection efforts were funded by the Delta Regional Monitoring Program. Results from those three surveys clearly demonstrated that there is informative variability in nutrients across space and time, with seasonal differences driven largely by landscape scale features and hydrologic drivers that have interannual variability. Building on this work, the USGS Biogeochemistry Group will be receiving funding through the Delta Science Program (DSP) to collect, evaluate, and compare high frequency nutrient and other data collected over time to identify trends and processes impacting water quality and the foodweb; those efforts are expected to provide funding to conduct high frequency mapping surveys in July and October 2020, and in May, July, and October 2021. A proposal submitted under the current Proposition 1 call has the potential to fund additional wide-area mapping surveys in 2022, when Regional San's WWTP upgrade is

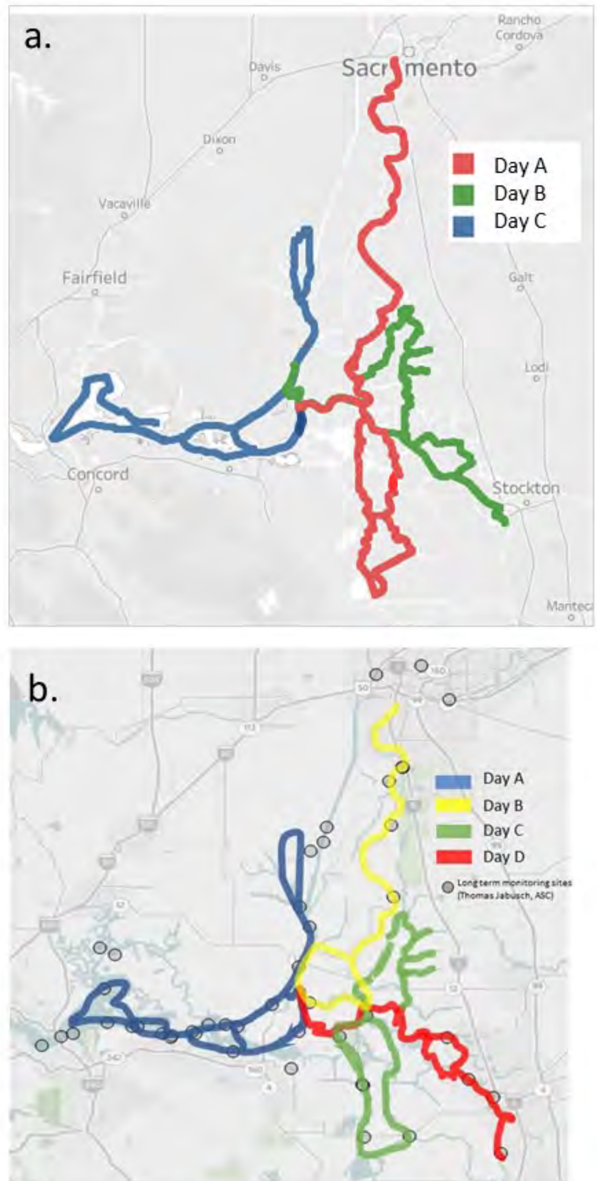

Figure 1. Map of the Delta and Suisun Bay with (a) the route of the boat track from the 2018 Mapping survey that took place over three days, and (b) the proposed mapping survey that will take place over 4 mapping days (see text for details).

expected to be fully operational. Decisions regarding 2020 Prop 1 awards are expected in late March 2020. These surveys will allow comparison with the May, July, and October 2018 dataset collected previously. However, funding for a May 2020 survey has not been identified. Data collection efforts are particularly needed in Spring 2020 prior to the implementation of Regional San's upgrade that is expected to significantly reduce nitrogen inputs to the Delta as well as alter the predominant form of nitrogen the treatment plant discharges from ammonium to nitrate. The upgrade is expected to come online in summer 2021. Funding from the Delta RMP for the May 2020 cruise would ensure that one more set of spring high frequency cruise data would be collected before the treatment plant upgrade takes effect.

Background

The current proposal is to document the variability of nutrients, related water quality parameters, and phytoplankton at high spatial resolution in the Delta in the spring of 2020 *before* the major upgrade to the Sacramento Regional wastewater treatment plant (Regional San WWTP) comes online, scheduled for 2021. The upgrade, known as the EchoWater Project, will have a major impact on nutrient forms and ratios in the Delta. Documenting not only pre-upgrade nutrient conditions but also linkages between nutrients, phytoplankton and other water quality parameters will allow us to track status and trends, identify key inputs, transport pathways, and processes, and also help identify how management actions will impact beneficial uses in the Delta related to nutrients (**Table 1**).

Nutrients play a key role in the Delta ecosystem by regulating the growth of phytoplankton and vegetation. Nutrient concentrations and forms vary seasonally and spatially in response to a number of factors, such as point-source loading, river flows, hydrologic transport, water temperature, turbidity, biological demand, microbial processing, and landscape scale features (e.g., water depth, open water habitats, wetlands) (Richey et al. 2018, Senn et al. in prep). Studies have posited that nutrient forms (e.g., nitrate versus ammonium) and ratios (e.g., nitrate:ammonium, N:P) affect Delta food webs by affecting patterns of phytoplankton productivity and community composition (Dugdale et al. 2007; Glibert et al. 2016; Parker et al. 2012a; Parker et al. 2012b), although there is some controversy whether this theory holds up when other environmental drivers are taken into consideration (e.g. Senn and Novick 2014; Kraus et al. 2017b; Cooke et al. 2018; Stumpner et al. 2020).

A 2016 Delta RMP nutrients workshop summary noted that the existing long-term historical data on ambient nutrient concentrations and effluent loads may allow the evaluation of major trends in relation to known large-scale changes in source-controls (e.g. elimination of point sources for phosphorus; effects of Regional San's planned upgrade) **but not necessarily at the**

finer temporal and spatial scale needed to evaluate impacts of more specific water management actions or non-point source impacts. Further, in order to understand how nutrients impact ecosystem function management outcomes, nutrient data needs to be collected along with other relevant data, such as water quality parameters (temperature, specific conductance, dissolved oxygen, pH, turbidity) and information about phytoplankton abundance and community structure. The USGS California Water Science Center's boat-based mapping system was developed by the Biogeochemistry Group to meet these needs. In the absence of this approach, nutrient and phytoplankton data are collected at limited locations either by collecting discrete water samples and sending them to a laboratory for analysis, and/or by installing in situ sensors that collect high frequency (~15 minute) data at fixed stations (Kraus et al. 2017a; Downing et al. 2017).

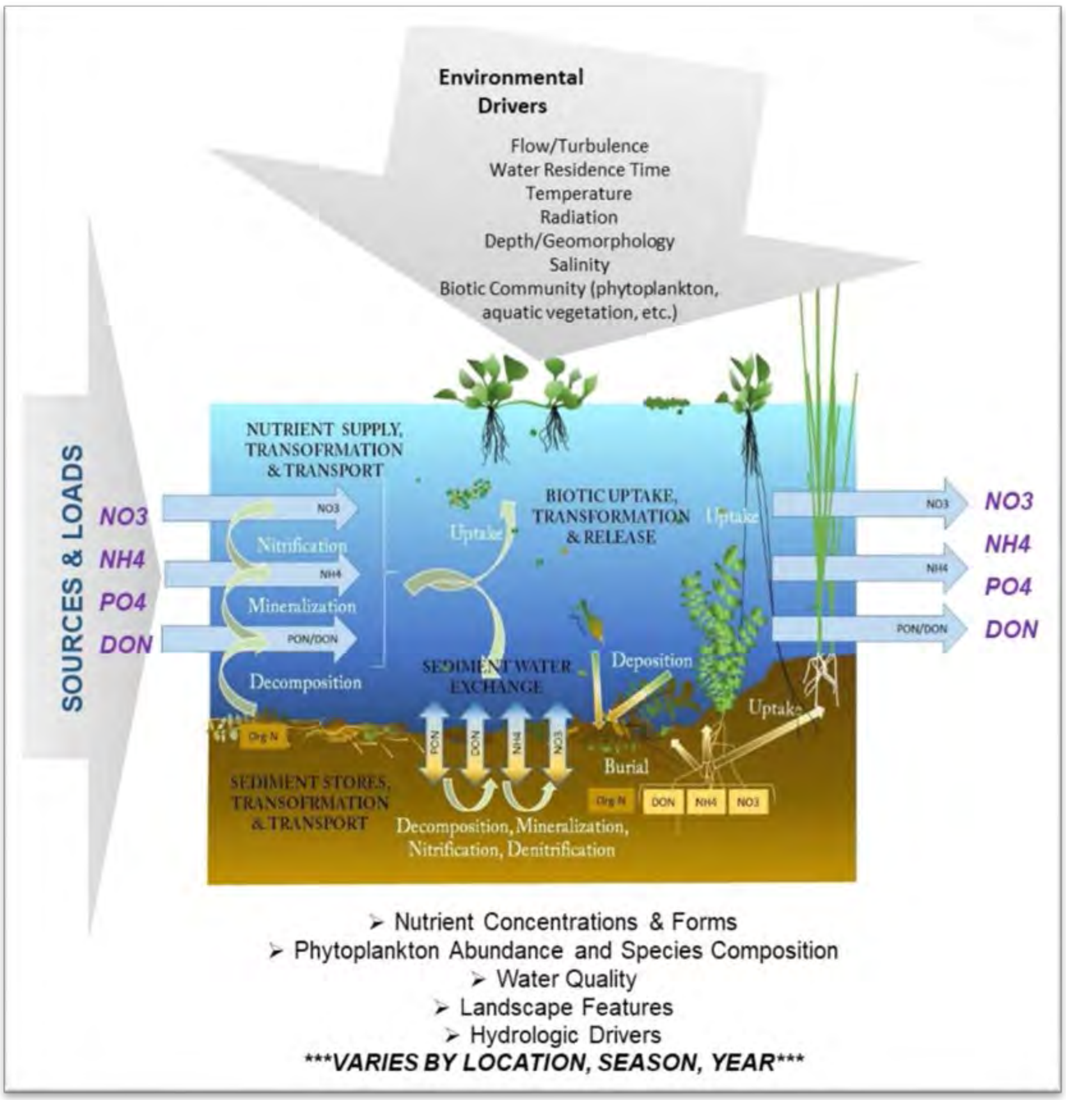

Figure 2. Conceptual model showing how nutrient concentrations and forms are altered due to multiple processes, and how they interact with phytoplankton, aquatic vegetation, and sediment as water transits the Delta.

Study Goal

The main goal of this study it to collect spatially rich nutrient, water quality and phytoplankton data across the Delta and Suisun Bay in spring 2020 to ensure the region's stakeholder and management community has sufficient information to assess the role nutrients play in the Delta, with a focus on effects on phytoplankton abundance and community composition and while simultaneously collecting other key water quality data. This information will enable analysis of nutrient-related effects before and after the large change in nutrient inputs to the Delta pursuant to Regional San's WWTP upgrade. Funding for this work will ensure a more complete data set is collected prior to the large change in nutrient inputs to the Delta associated with Regional San's WWTP upgrade in 2021.

Study Approach/Information Gathered

The concept, methods, cruise tracks, and products of this effort will follow previous work conducted under the project "Cross-Delta Monitoring Using High-Frequency Tools" funded by the Delta RMP in FY17-18, which allowed the USGS to collect high resolution nutrient, water quality and phytoplankton data across the Delta in May, July, and October of 2018. Brian Bergamaschi presented provisional results from the study at the Feb 22, 2019 Steering Committee meeting. Data visualizations of those surveys are available online and other products including an interpretive report is forthcoming (**please see information regarding the status of those products provided in a separate document**).

The USGS's boat-based mapping survey approach uses unique capabilities to collect high resolution data sets by using existing instruments (e.g., multiparameter sondes, optical sensors for nitrate and phytoplankton species) and newly developed instruments (e.g., flow through ammonium analyzer), which are an integrated into an on-board flow-through system and data integration platform that can be operated at high speeds (~25 mph), permitt ng simultaneous and rapid collection of high-quality measurements over large regions, within the context of a single tide (**Table 2**). This approach was further refined in 2018 under the project funded by the Delta RMP which supported three Delta wide surveys: May, July and October. In addition, in 2019 the Biogeochemistry group developed data processing workflows, batch data processing routines, GIS-based products and data visualization tools that allow these data to be more rapidly and effectively made available to cooperators, managers, and the public. These new approaches also facility access to, interpretation of, and understanding of these data.

In addition to the in situ high resolution data collection, during each cruise date discrete samples are collected at approximately 30 locations across the Delta and analyzed for nitrate, ammonium, phosphate, total dissolved nitrogen, dissolved organic carbon, chlorophyll-a, phaeophytin, phytoplankton enumeration, and picocyanobacterial direct counts (**Table 3**). These data are used to validate instrument performance and add additional parameters to the data set that are not collected in situ.

Additional method details can be found at the end of this document.

Study Boundaries

The study covers a wide portion of the Delta and Suisun Bay, extending between Sacramento, Stockton, Clifton Court, and the Martinez Bridge. **Figure 1** shows the specific path the boat takes overs over the three (Figure 1a) or four (Figure 1b) consecutive days of mapping that comprises a single wide-area survey, and **Figure 3** shows the channel area for which data are contoured. For future surveys we have made slight modifications to the boat tracks compared to the 2018 surveys to allow some additional coverage, as well as to reduce the length of a single mapping day. Over a four-day survey, (i) one day covers the north-south axis of the Delta from the Sacramento River north of Freeport to the Rio Vista then back to the Sacramento River via Georgiana Slough (ii) one day covers Old and Middle Rivers down to Clifton Court where water enters the Harvey Banks export and also the North and South Forks of the Mokelumne River (iii) one day covers the east-west axis of the Delta from the Sacramento River at Rio Vista to the San Joaquin River at Stockton, including Disappointment Slough, and (iii) one day covers the northern and western Delta from the northern reaches of the Cache Slough Complex to Grizzly, Honker and Suisun Bays. Data is collected at high speed to minimize to the extent to which tidal currents, changes in river flows, and variability in inputs obscure nutrient and phytoplankton distributions and linkages.

Applicable RMP Management Questions

The information gathered will provide important information to help stakeholders engaged in the Delta Nutrient Research Plan to determine whether nutrient concentrations cause or contribute to water quality problems and to evaluate how nutrient conditions respond to current and future management actions. Simultaneous collection of phytoplankton abundance and community composition using an in situ fluorometer (BBE Fluorprobe) along with other water quality parameters (temperature, specific conductance, DO, pH) will allow researchers to investigate linkages between nutrients and the health of the foodweb, while taking into account other ecosystem drivers. The objectives of the project and how the information will be used relative to the RMP's high-level management questions are summarized in **Table 1**. In addition, examples of some of the main findings gleaned from the 2018 High Resolution mapping campaigns are listed below.

Key Findings from the 2018 High Resolution Mapping Surveys

- Water Year 2018 (WY2018), a high flow water year, was characterized by low concentrations of chlorophyll acrossthe majority of the Delta (Figure 3).
- The 2018 mapping surveys showed that in addition to well recognized nutrient inputs to the Sacramento and San Joaquin Rivers from WWTPs and agriculture, inputs to Suisun Bay were also apparent (Figure 3).
- Nutrient concentrations in the North and South forks of the Mokelumne river were much higher in July and October compared to May (Figure 3); this difference results from the status of the Delta Cross Channel which was closed in May but open in July and October, allowing nutrient rich water from the Sacramento area to enter this region and potentially support higher rates of phytoplankton productivity (Figure 2).
- Although there did not appear to be notable point source nutrient sources within the Delta, we can not rule out the role of non-point source releases such as fluxes from the benthos or decomposition of detrital material. These internal sources may become more apparent after anthropogenic inputs to the system are reduced due to Regiona San's WWTP upgrade.
- The 2018 study showed that nutrient concentrations and losses during transit through the Delta are predominantly controlled by hydrodynamic processes through their effects on transport, mixing and water residence time. At the broadest scale, the distribution of nutrients across the Delta was controlled by the location of major nutrient sources and the transport pathways to the Bay and to the South Delta export facilities. Clear gradients were found along major hydrologic flow paths, with the location of the gradients shaped by the local hydrodynamic interaction between tidal currents and local channel geometries, which together affected the extent of mixing. As a consequence, nutrient concentrations and distributions varied seasonally in relation to river discharge and pumping.
- Dissolved inorganic nitrogen concentrations and distributions were strongly affected by water residence times, with extensive losses associated with areas of limited exchange and concomitantly long water residence times. As a consequence, features such as dead-end sloughs and the northern CSC exhibited very low DIN concentrations and strong gradients in concentration in all seasons, elevating in concentration with proximity to nearby tidal channels (Figure 3). These persistent gradients signify that such sloughs and similar areas are a constant sink for DIN in the Delta
- In the Western Delta near the confluence region, nutrient concentrations were notably lower in July compared to May and October, a trend that did not show up when data for the entire study domain was examined. These lower concentrations appear to be related to high rates of nutrient drawdown due to uptake by biota. Similarly, low nutrient concentrations in the northern reaches of Grizzly Bay are associated with high chlorophyll concentrations and elevated DO and pH, strongly indicating nutrient depletion by phytoplankton (Figure 3). These and other data

indicate that phytoplankton blooms can significantly deplete DIN concentrations over their spatial extent and affect concentrations in surrounding areas.

- As demonstrated in Figures 3-5, these wide area high resolution mapping surveys provide detailed spatial and temporal data sets that allow us to identify and quantify differences in nutrients and phytoplankton over time for specific subregions of the Delta as well as between dates. Examination of specific regions revealed that while phytoplankton parameters remained relatively stable across season (e.g. Western Delta phytoplankton abundance and species composition; Figure 5), nutrient parameters showed large variability (e.g. Western Delta nutrient concentrations Figure 4). This suggests that there is not always a strong linkage between these nutrient concentrations and phytoplankton, and that other drivers that can moderate these linkages need to be accounted for.
- While longer residence time areas typically had low DIN concentrations, in contrast phosphate concentrations were elevated in those areas (e.g., North Delta, Dead end sloughs). This suggests that phosphate is imported and accumulated in these areas, and that sources of phosphate exceed its demand.
- Examination of data along specific flow paths allows identification of specific processes that occur as water transits the Delta. As an example, increases in nitrate concentrations with travel downstream of Regional San's effluent discharges in the Sacramento River reflect nitrification of wastewater derived ammonium, with values increasing 2-3 µM over a 10 mile stretch.
- Because 2018 was a relatively unproductive year with chlorophyll concentrations rarely exceeding 10 µg/L (Figure 3), comparing data collected during this high water year with a low water year should provide information about interactions between hydrology, nutrient gradients, and phytoplankton production.
- Data from this study will provide baseline data against which to evaluate future changes to the Detla.

Timeline for Data Collection and Deliverables

- Data collection will occur in **Spring 2020** – likely late May.
- Data will be processed as described in the detailed methods section by **November 2020**.
- Data will be made available within 6 months following collection via the online dashboard (https://tableau.usgs.gov/#/views/DRMP_2018_v1_4/Contents?:iid=1), and within 1-year via Science Base (https://www.sciencebase.gov/catalog/).
- High level findings will be reported to the Delta RMP upon their request. Stakeholders will also be invited to annual workshops held by the Delta Science Program as part of the 2020-2022 USGS study they are funding.
- A report comparing data collected in May 2018 to May 2020 will be submitted by **June 2021.**

Budget

- The total amount requested from the Delta RMP is **$85,000.**
- The USGS will provide an additional **$12,000** in Cooperative Matching funds associated with labor and travel expenses.

This work will leverage efforts funded by the 2-year Delta Science Program under a 2-year $720,000 agreement for the USGS to conduct two mapping surveys later in 2020 (July, October) and three in 2021 (May, July, October). Additional mapping surveys may be funded into 2022 under a recently submitted Proposition 1 proposal. This work leverages funds provided to the USGS by the Delta RMP FY17-18 ($195,000) along with USGS matching dollar and other internal support dollars (~$75,000) to conduct, analyze and report on the May, July and October 2018 surveys.

Table 1. Study objectives and questions relevant to RMP management questions.

Management Question & Assessment Question	Study Objective	Example Information Application
Status & Trends **Q1. How do concentrations of nutrients (and nutrient-associated parameters) vary spatially and temporally?** **b. How are ambient levels and trends affected by variability in climate, hydrology, and ecology?**	Collect spatially rich, multiparameter data across a large area of the Delta in Spring 2020: these data will be compared to analogous survey's conducted on other dates. Survey's conducted during different seasons and water years will enable assessment of how climate, hydrology and biology impacts nutrients, phytoplankton and other parameters.	Baseline data on current conditions to evaluate changes over time and after major wastewater upgrades. Data collected during different water year types (i.e. high and low flows) can capture differences related to hydrology. Alterations to water flow paths and water inputs due to directed flow actions (e.g., Salinity Control Gates, N. Delta Flow Actions) can be related to nutrient and phytoplankton gradients.
Sources, Pathways, Loadings, and Processes **Q1. Which sources, pathways, and processes contribute most to observed levels of nutrients?** **SPLP 1.F. What are the types and sources of nutrient sinks within the Delta?**	Provide data and associated maps of nutrient concentrations and forms, phytoplankton abundance and species composition, and other water quality parameters (Temp, SpCond, DO, pH) to identify nutrient inputs and key areas of nutrient transformation, removal and release.	These data allow us to identify key regions of nutrient inputs to the Delta, as well as regions that support internal sources and sinks. Sharp gradients in nutrient concentrations indicate hotspots of nutrient transformation within the Delta. Identifying what attributes (e.g., flow, water residence time, wetland area, aquatic vegetation) support these process will provide insights into effective management actions.
Forecasting Scenarios **Q1. How will ambient water quality conditions respond to potential or planned future source control actions, restoration projects, and water resource management changes?**	Data collected by this study can be used by modelers and planners to forecast future conditions. Identifying current linkages between environmental drivers (flow, temperatures), landscape scale features (channel morphology, wetlands), nutrients and phytoplankton is the basis for predicting how the Delta will respond to management actions.	Evaluate changes to nutrient-related process in the Delta pre- and post-upgrade

Table 2. *Measurements made continuously onboard during high speed mapping surveys.*

Measurement/Instrument	Information Provided
Time **Garmin16X-HVS GPS receiver**	Timestamp of record
Position Garmin16X-HVS GPS receiver	Latitude and Longitude of record
Salinity/Conductivity YSI EXO 2; Seabird model 45 Thermosalinograph	Affects both abiotic and biotic processes; indicator of water source
Temperature YSI EXO 2; Seabird model 45 Thermosalinograph	Indicator of water source; affects both abiotic and biotic processes
Turbidity YSI EXO 2: WetLabs transmissometer (676 nm)	Provides information about total particulate concentrations; insight into water source, river mixing and the light field.
pH YSI EXO 2	Higher pH indicates photosynthesis, lower pH indicates decomposition or WWTP inflow; affects biogeochemical reactions
Dissolved Oxygen YSI EXO 2	Reflects balance between oxygen production during photosynthesis and consumption during respiration; availability affects biogeochemical reactions
Chlorophyll fluorescence YSI EXO 2 Total Algae probe; WetLabs WETStar Chlorophyll-a fluorometer	Proxy for algal biomass and primary production
DOM Fluorescence WetLabs WETStar cDOM fluorometer; YSI EXO 2 FDOM probe	Proxy for dissolved organic carbon concentration; information about carbon production and consumption; tracer of water source
Optical Nitrate Seabird Scientific SUNA V2	Information about nitrate concentrations and nutrient supply to the food web; differences allow us to estimate production and consumption; full spectral data can be mined to determine if a wastewater or other contaminant signal is detectable and quantifiable
Ammonium Timberline TL-2800	Information about ammonium concentrations and nutrient supply to the food web; tracer of SRWTP effluent; differences allow us to estimate production and consumption
Phytoplankton Taxa BBE Fluoroprobe	Measurement of blue-greens algae/cyanobateria, diatoms, green algae, cryptophytes; provides information about total chlorophyll concentration and relative contribution of each class; information about quality of the phytoplankton pool (beneficial versus harmful species, food quality); tracer of water source

Table 3. *Laboratory analyses and number of samples to be collected as part of the May 2020 survey, including sample duplicates and blanks.*

Analyte	Approximate sample number
Nitrate	160
Ammonium	160
Phosphate	160
Total Dissolved Nitrogen	36
Total Dissolved Organic Carbon	36
Chlorophyll/phaeophytin total (>0.7 uM) and large (>5 uM)	33
Picocyano direct counts	18
Phytoplankton enumerations	18
Picocyanobacterial counts	18

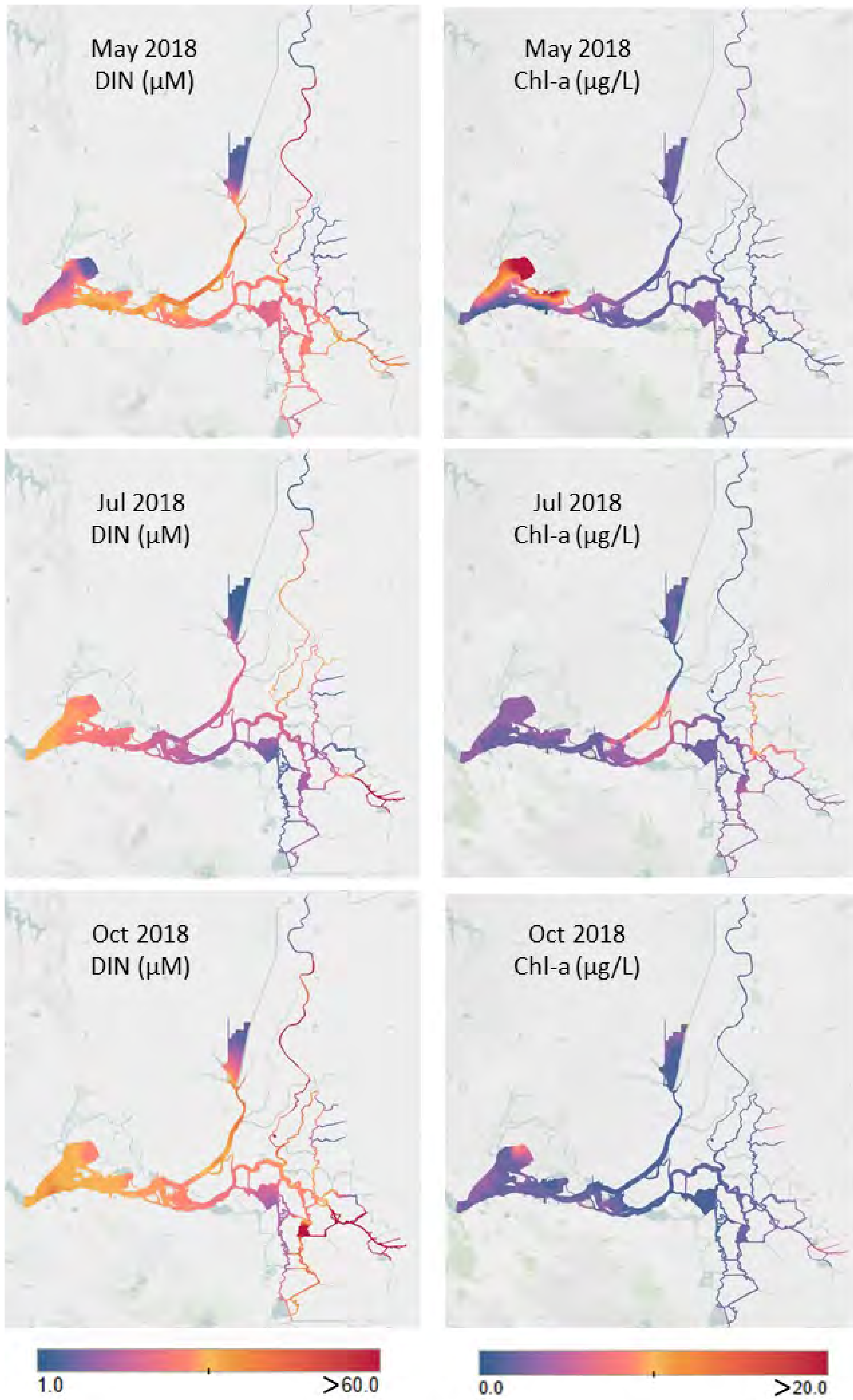

Figure 3. Contour maps generated from the high resolution surveys conducted in May, July and October 2018. The left panels show the distribution of dissolved inorganic nitrogen (DIN), the sum of nitrate and ammonium. The right panels show the distribution of chlorophyll-a concentration (Chl-a), a reflection of phytoplankton abundance.

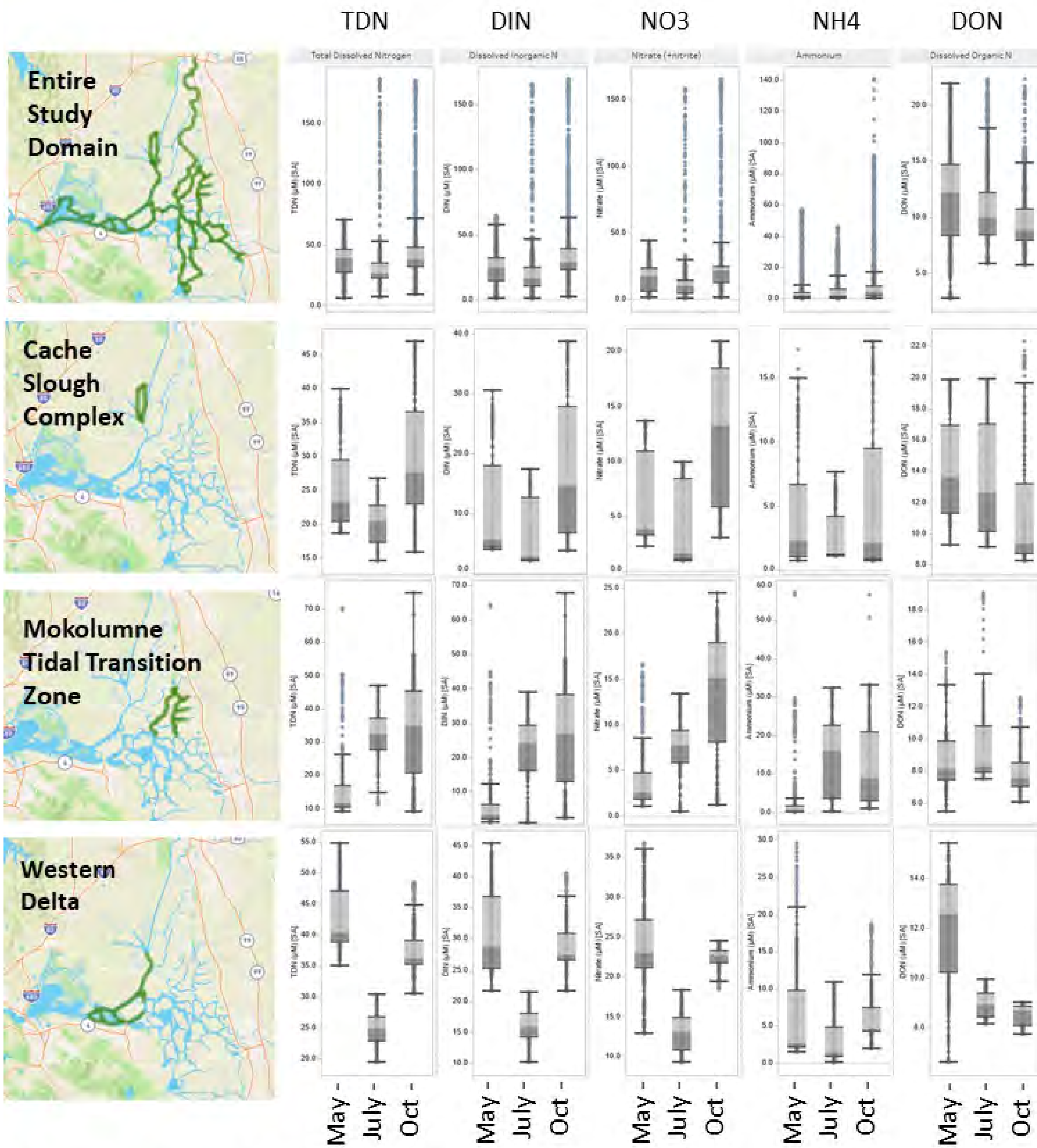

Figure 4. Box plots for different nutrient parameters associated with different regions of the Delta during the May, July and October 2018 high resolution mapping surveys. Green lines on the maps on the left indicate the specific data used to generated the box plots in each row. Differences across both space and time highlight the need to collect additional data sets to understand interactions between nutrients, phytoplankton, hydrology, environmental drives, landscape attributes, and management decision.

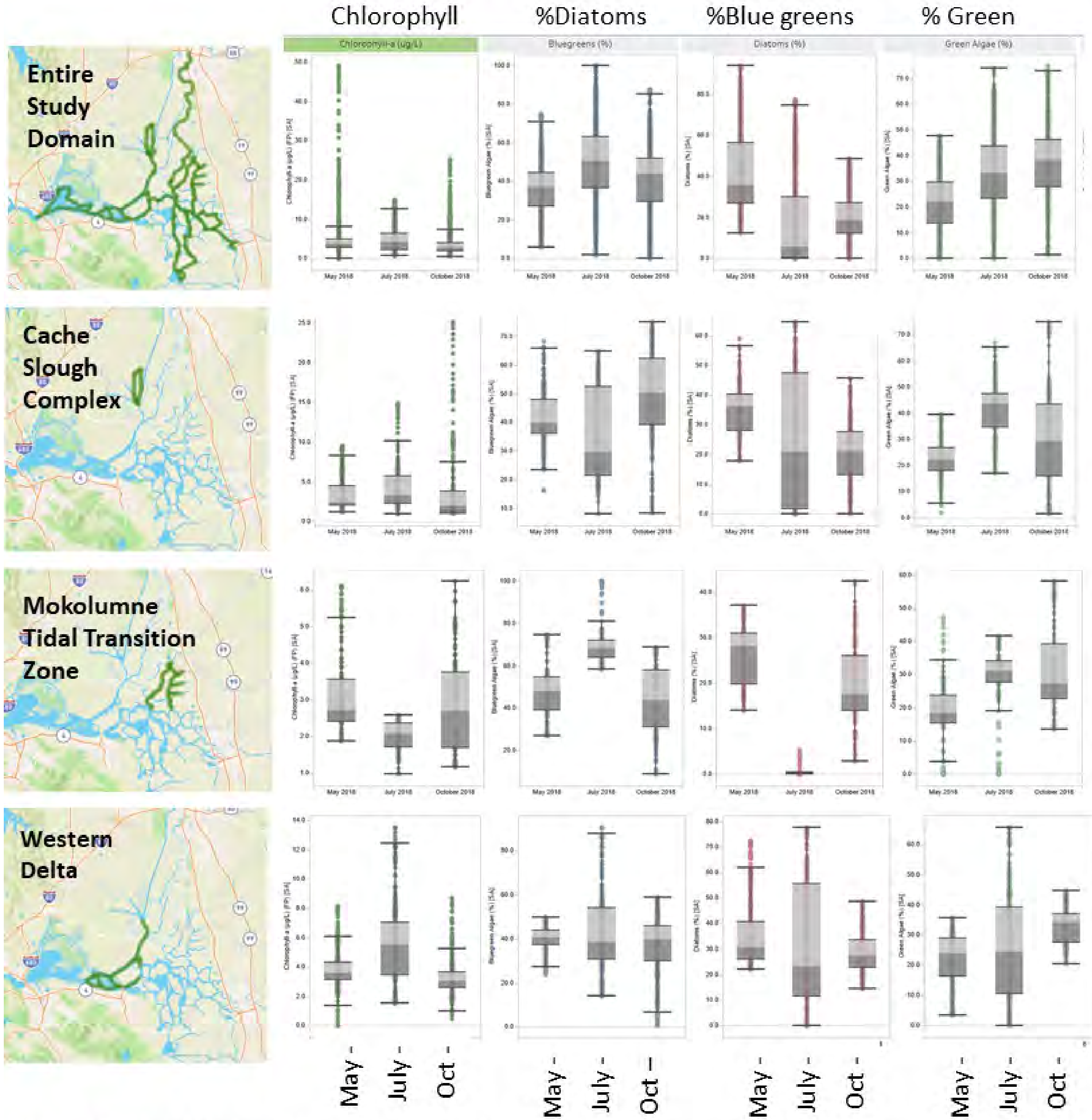

Figure 5. Box plots for different phytoplankton parameters associated with different regions of the Delta during the May, July and October 2018 high resolution mapping surveys. Green lines on the maps on the left indicate the specific data used to generated the box plots in each row. Differences across both space and time highlight the need to collect additional data sets to understand interactions between nutrients, phytoplankton, hydrology, environmental drives, landscape attributes, and management decision.

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Method details following approaches developed for the 2018 Surveys

Underway water sampling and onboard analyses

Surveys were conducted using the USGS R/V Mary Landsteiner three times in 2018, each on three successive days: May 15, 16, and 17; July 24, 25, and 26; and October 17, 18, and 19. On each day data were collected during daylight hours beginning at approximately 07:30 am. For analysis, sample water was continuously pumped onto the boat while underway at speeds up to 30 mph (13 m/s) using a pick-up tube mounted at a fixed depth of ~1 m below the surface, routed through a screen to remove large debris and into a pressure-compensated manifold that maintained system pressure at a proscribed level irrespective of boat speed (Downing et al. 2016). A 2-stage debubbler was used to remove bubbles that can interfere with optical measurements. Sample water was split into separate flow paths for each analytical flow path, with constant flow rates maintained by metering the discharge line, except for the flow path serving the open split interface, which was metered on the feed line. Flows were continuously monitored using a sight gauge for each flow path. Onboard analyses are summarized in **Table 2.**

The manifold delivered water to the following flowpaths: (1) A flow-through system consisting of a thermosalinograph that recorded temperature and conductance (Sea-Bird Scientific SB45 (TSG), Belluve, WA); fluorometers that measured fluorescence of chlorophyll-a (fCHLA) and fluorescence of dissolved organic matter (fDOM, WETLabs WETstar (WS), Philomath, OR); a beam transmissometer that recorded transmittance and attenuation (WETLabs model C-Star transmissometer (CStar), Philomath, OR), a nitrate (NO3) analyzer (SUNA V2; Sea-Bird Scientific, Bellevue, WA). (2) A flow chamber for a multiparameter water quality sonde (YSI EXO2; Xylem Inc. (EXO), Rye Brook, New York) equipped with sensors to measure temperature, specific conductance (SpC), turbidity, pH, dissolved oxygen (DO), fDOM and fCHLA. (3) A fluorometer designed to measure different algal classes (FluoroProbe III (FP); BBE Moldaenke, Kiel, Germany). (4) An open-split interface at atmospheric pressure that served water filtered through a 0.45 micron high-capacity in-line groundwater sampling capsule filter (PALL Corporation, Port Washington, New York) to the on-board ammonium (NH4) analyzer.

The NH4 analyzer was a continuous flow, gas diffusion/conductivity-based (Carlson 1986) analyzer for ammonium (NH4) analysis (TL-2800; Timberline Instruments, Boulder, CO) that was modified for field operation and continuous data collection by the manufacturer. Modifications included installation in a ruggedized housing, addition of an automated line switching valve, addition of a heating unit to maintain the instrument at a constant above-ambient temperature, and changes to the software. Full standard curves were run at the beginning and end of each day and partial curves run throughout the day each time the boat stopped to sample. While underway, the analyzer was run in continuous mode with frequent periodic introduction of standard and blank solutions. The NH4 analyzer was connected to a stand-alone computer and collected data through its native software.

All instrumentation was cleaned, and calibrations were checked prior to each use following the manufacturer's recommendation or as described below. Data for most instruments was recorded at 1 second frequency on a single data logger (CR6, Campbell Scientific, Logan, Utah, United States) together with a timestamp and boat position obtained from a high-resolution global positioning system receiver (16X-HVS, Garmin, Olathe, Kansas). The FluoroProbe logged data internally and to the host software. All data were displayed in real time, so scientists on board could respond when they observed changes relevant to study objectives, or if issues with flow or instrument performance were noted.

Discrete water sampling and laboratory analysis

Discrete water samples were collected either underway or – in the case of more extensive sample requirements – while stopped on station (**Table 2**). Discrete samples were collected while underway either using a fifth flow path on the sampling manifold or using a separate system with a separate pick-up tube mounted adjacent to the main sampling pick-up and pumping sample through a 0.45-micron filter into a sample bottle. Samples were collected while underway approximately every 2 miles, principally for determination of ortho-phosphate (PO4). At designated sampling stations samples for determination of NH4, NO3, dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) concentrations were collected using this system.

Additionally, unfiltered samples were collected at designated locations (~10 per day) from 1 m depth using a submersible pump for analysis of chlorophyll-a (Chl-a), pheophytin, phycocyanin, allophycocyanin, and phycoerythrin. Samples for picocyanobacteria counts and phytoplankton enumeration were fixed immediately with formaldehyde (1 mL) and Lugol's iodine solution (4 mL), respectively.

All samples were stored on ice in the dark during transit to the laboratory where they were stored at 2°C. Dissolved organic carbon samples were preserved to <2 pH with high-purity sulphuric acid the day following collection and stored at 2°C. Samples for pigment analysis were filtered within 24 hour of collection and immediately frozen (-90°C). Total Chl-a samples were filtered through a 0.7 µm nominal pore size glass fiber filter (Advantec MFS, Inc, Dublin, CA). Chlorophyll-a associated with the larger sized cell fraction were filtered through a 5 µm nominal pore size 25 mm polycarbonate filter (General Electric Healthcare, Chicago, IL). Samples for phycocyanin, allophycocyanin, and phycoerythrin pigment analysis were filtered a 0.3 µm nominal pore size glass fiber filter (Advantec MFS, Inc, Dublin, CA). Frozen Chl-a samples and chilled nutrient samples were shipped to the USGS National Water Quality Laboratory (Denver, CO). Frozen filters for analysis of phycocyanin, allophycocyanin, and phycoerythrin were shipped to BSA Environmental Services, Inc. (Beachwood, OH) as were preserved picocyanobacteria and phytoplankton enumeration samples.

Concentrations of nutrients were determined colorimetrically using an automated-segmented flow analyzer. Concentrations of nitrogen as nitrite (NO2-N) and as nitrate plus nitrite (NO3-N + NO2-N) were determined by colorimetric analysis (Fishman 1993; Patton and Kryskalla 2011), ammonium as nitrogen (NH4-N) was determined by colorimetric analysis after reaction with salicylate-hypochlorite (Fishman 1993), and total dissolved nitrogen (TDN) was determined by alkaline persulfate digestion . Orthophosphate as phosphorous (PO4-P; also referred to as soluble reactive phosphate) was determined by colorimetric analysis after reaction with NH4 molybdate and reduction with ascorbic acid (Patton and Truitt 1992). Chlorophyll-a and phaeophytin: Chlorophyll-a and phaeophytin concentrations were determined according to EPA Method 445.0 (Arar and Collins 1997) using the sonication extraction techniques described by Jeffrey and others (1997). Dissolved organic carbon concentrations were measured using a total organic carbon analyzer (TOC-VCSH, Shimadzu Scientific Instruments, Columbia, Maryland) using high-temperature catalytic combustion according to a modified version of USEPA method 415.3 from (Potter and Wimsatt 2005).

Phycocyanin, Allophycocyanin, and Phycoerythrin: Phycocyanin, allophycocyanin, and phycoerythrin were determined by azolectin-CHAPS buffer extraction as described by Zimba (2012) and modified from Bennett and Bogorad (1973) at BSA Environmental Services. Phytoplankton Enumeration: Phytoplankton enumeration was completed in accordance with the American Public Health Association (APHA) Standard Method 10200 (2012). Picocyanobacteria Direct Counts: Picocyanobacteria were enumerated via epifluorescence microscopy as described by Murrell and Lores (2004). Phycoerythrin-containing cells (PE) and phycocyanin-containing cells (PC) were counted separately and then summed to obtain total picocyanobacteria densities for cells sized between 0.2 and 2.0 microns.

Data Processing

Data from onboard continuous instruments not directly logged to the flow-through data collection system were merged based on timestamp to the nearest second. All data directly logged to the flow-through data collection system was processed using pandas software library in Python to remove periods of compromised data (e.g. flow blockages, bubbles), apply instrument corrections and unit conversions, and filtered by applying a centered 20 second median filter to the time series. Onboard nitrate data was processed to remove the salinity-dependent interference of bromide and DOM using the Sakamoto et al. (2009) method (as implemented in the Seabird UCI software). Final NO3 values were obtained by regressing instrument response against NO3 concentrations obtained from laboratory measurement of discrete samples collected through the course of the day. Individual sample results with more than three standard deviations from the regression were judged to be outliers and removed from the regression. No more than one outlier was removed from any day. Ammonium data was processed by first correcting the voltage output of the instrument for baseline drift based on the instrument response during periodic measurements of OFW ($n \geq 10$) and then using a regression model of the voltage response to standard concentration. A regression coefficient of >0.97 R^2 or better was judged to be acceptable. The NH4 data timestamp was corrected to account for the time lag associated with the microfluidic processing prior to integration with other data sources.

Dissolved inorganic nitrogen (DIN) concentration was calculated as the sum of NO3, NO2 and NH4 – both for the continuous data and the discrete sample data. Laboratory DON concentration was calculated by subtracting NH4, NO3 and NO2 data from the TDN data, i.e. DON = TDN – DIN. Continuous DOC and DON concentrations were developed by regressing onboard fDOM data against the DOC and DON concentrations measured in discrete samples. Data exceeding 3 times the standard deviation of the residuals was judged to be an outlier and not included in the model. Total dissolved nitrogen (TDN) was calculated as the sum of DIN ($NO3 + NH4$) and DON.

Data was spatially aligned (SA) to a common spatial framework to facilitate comparisons between dates and to minimize the effects of differential data density on the spatial interpolation calculations by assigning median-filtered data by proximity to a centerline vector comprising points located at the centerline of all channels navigated, spaced at approximately 150 m intervals. Interpolated water quality maps were created from the spatially aligned data using ArcGIS Spline with Barriers tool (Terzopoulos 1988). The raster output was smoothed with the Focal Statistics tool, and interpolated values were extracted to the spatially aligned points to create continuous spatially aligned data across the mapping domain.

Quality Assurance/Quality Control

Sampling will follow USGS quality assurance protocols for blanks and duplicates. Additional quality-control checks will be implemented to assess whether data quality objectives are being met. Quality control data will be inspected by the project chief as it becomes available during the course of the project. If any data indicates that quality objectives are not being met, staff will consult with the lab to determine if the failure is most likely due to field or laboratory procedures/methods. If it is determined that field methods are the likely cause, the project chief will work with the sampling personnel to ensure that field protocols are being followed and if any additional protocols specific to the project need to be implemented. If it is determined that laboratory procedures are the likely cause then the project chief will work with NWQL laboratory personnel to ensure that proper procedures are being implemented. Any changes to field or laboratory procedures will be documented. Details can be found in the QAAP associated with the 2018 mapping surveys.

Data Quality Objectives

Laboratory measurements will be made at the USGS national water quality laboratory. Underway instruments are calibrated prior to use and are accurate to <2% of the full scale value. Uncertainty due to analytical errors in underway instrumentation is included in the replication inherent in high frequency sampling, and is reported together with natural variation as standard deviation across averaging periods. Underway instrument performance will be validated against laboratory values and the uncertainty published in the report. The cumulative uncertainty will be estimated in quadrature or using Monte Carlo simulations over the domain of the uncertainty of the individual measurements. This cumulative uncertainty will be used to assess the statistical significance of spatial variation with a defined threshold of $p < 0.001$. Details can be found in the QAAP associated with the 2018 mapping surveys.

Status of project reports for the RMP-funded investigation entitled: *"Assessing spatial variability of nutrients and related water quality constituents in the Delta at the landscape scale: 2018 High frequency mapping campaigns"*

USGS Biogeochemistry Group (*contacts: Brian Bergamaschi, bbergama@usgs.gov; Tamara Kraus tkraus@usgs.gov*)

The reporting we envision for the RMP-funded mapping project comprises four separate elements. A description of the elements and the status of each is below.

1) **Science Base Data Release.**
This product is a full description of the data generation methods and a machine-readable version of the mapping data, available to interested parties at https://www.sciencebase.gov/catalog/ when the publication process is complete.

   STATUS: This product is complete and has been released to production for web release.

2) **Web-based data exploration portal**
We view this as the central product from this project. The product is a publicly-accessible web-based interface to the complete data that allows users to explore and visualize the data in various ways. We believe this is the central product for the project because the richness of the data cannot be fully conveyed in a short written report, and the data are useful for answering questions not motivating the current project.

   STATUS: This product is complete in draft form and was posted on the web this past summer for RMP review. It is available at

   https://tableau.usgs.gov/#/views/DRMP_2018_v1_4/Contents?:iid=1. Screen shots showing some of the available functionality are on the following pages.

   In addition, we have also prepared a separate product to present the phytoplankton enumeration data that was made possible by additional funding from SFCWA as a supplement to the RMP-funded project. STATUS: This product is available at https://tableau.usgs.gov/#/views/PhytoplanktonEnumerationDataV3_2/BVbysite?:iid=3. Screen shots showing functionality are included in the following pages.

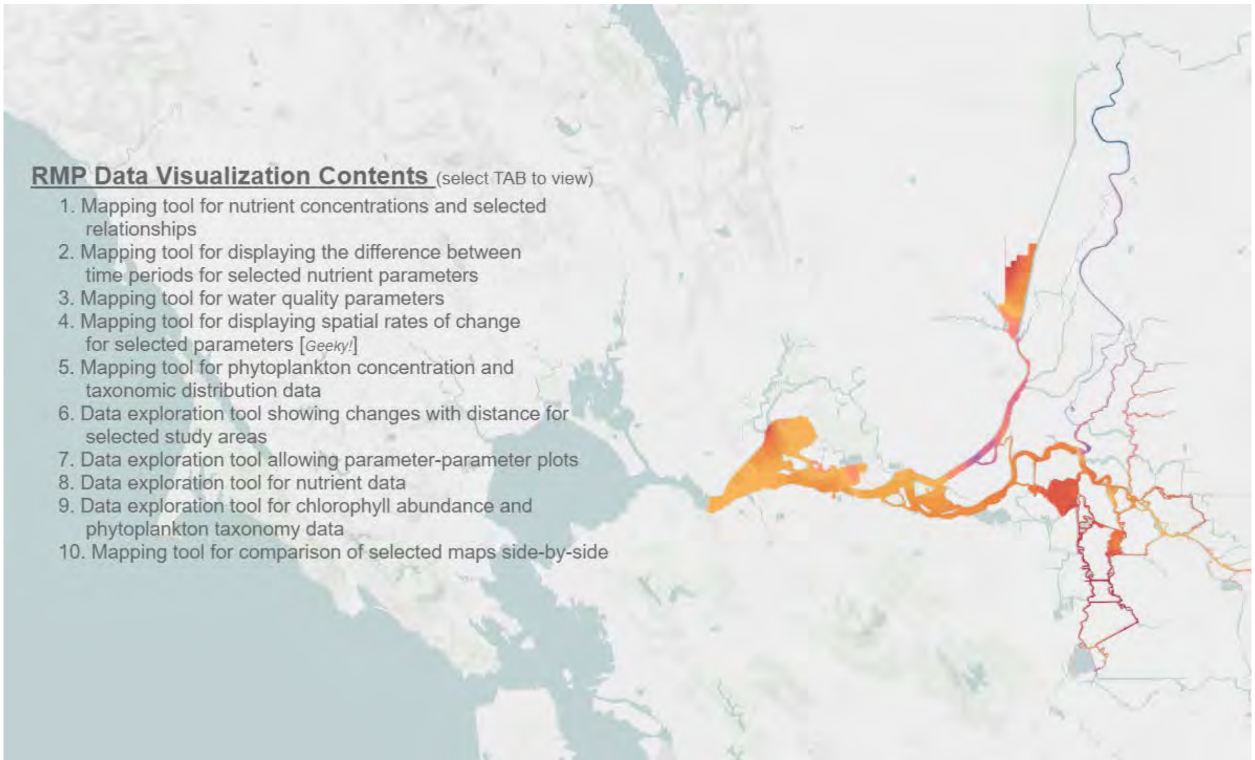
3) **Open File Report.**
   This product is a printable pdf form of the mapping products available through the web page.

   STATUS: This product is complete and has been released to the USGS Enterprise Publishing Network for production. When published, it will be available for download as a pdf at https://pubs.er.usgs.gov/.

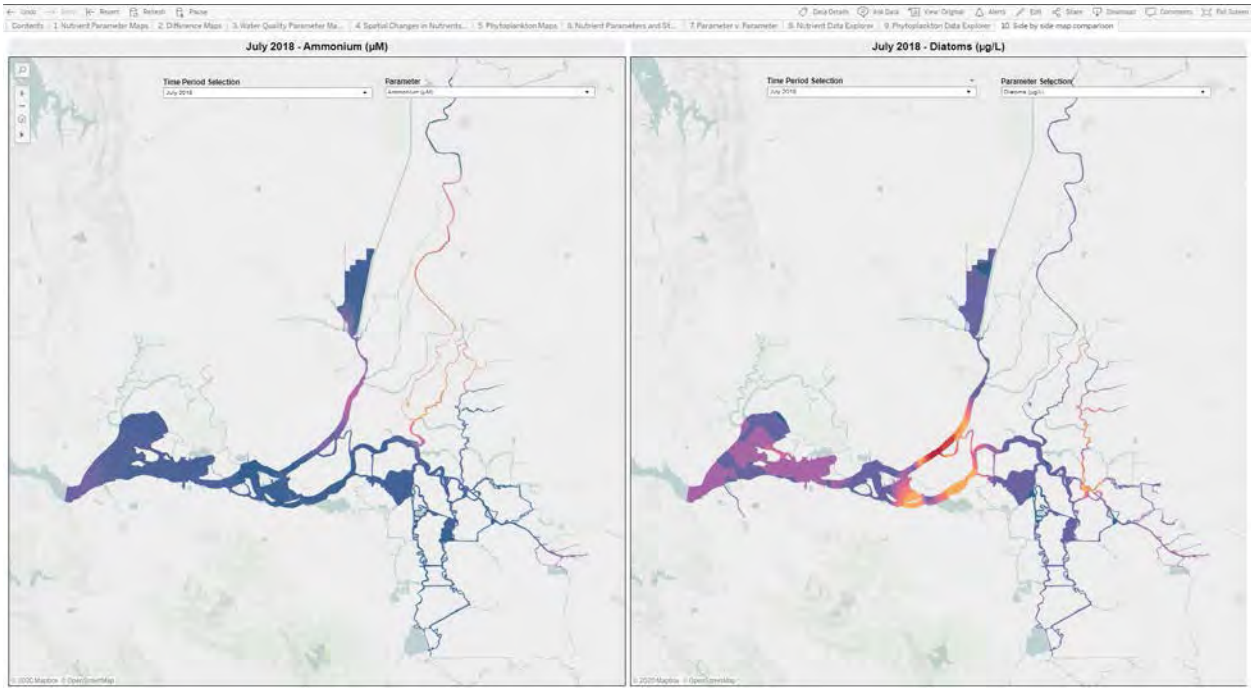
4) **Scientific Investigations Report**
   This product is a descriptive report describing the findings of the study, as discussed in the project proposal.

   STATUS: This product is in draft and will be provided to RMP for review as soon as possible, with a target of March 1, 2020. Once published, it will be available for download as a pdf at https://pubs.er.usgs.gov/.

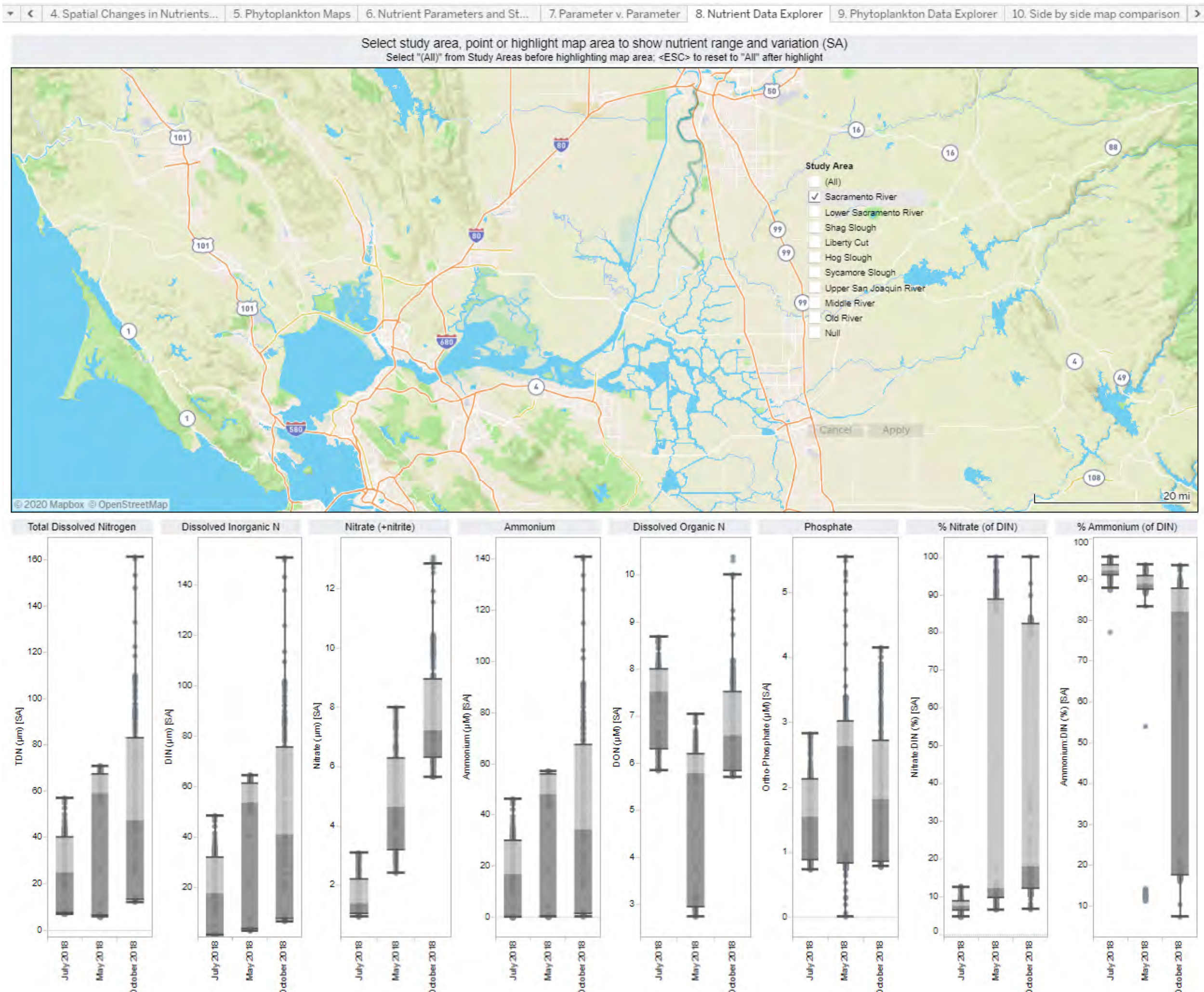
Example figures from the above products are shown below.



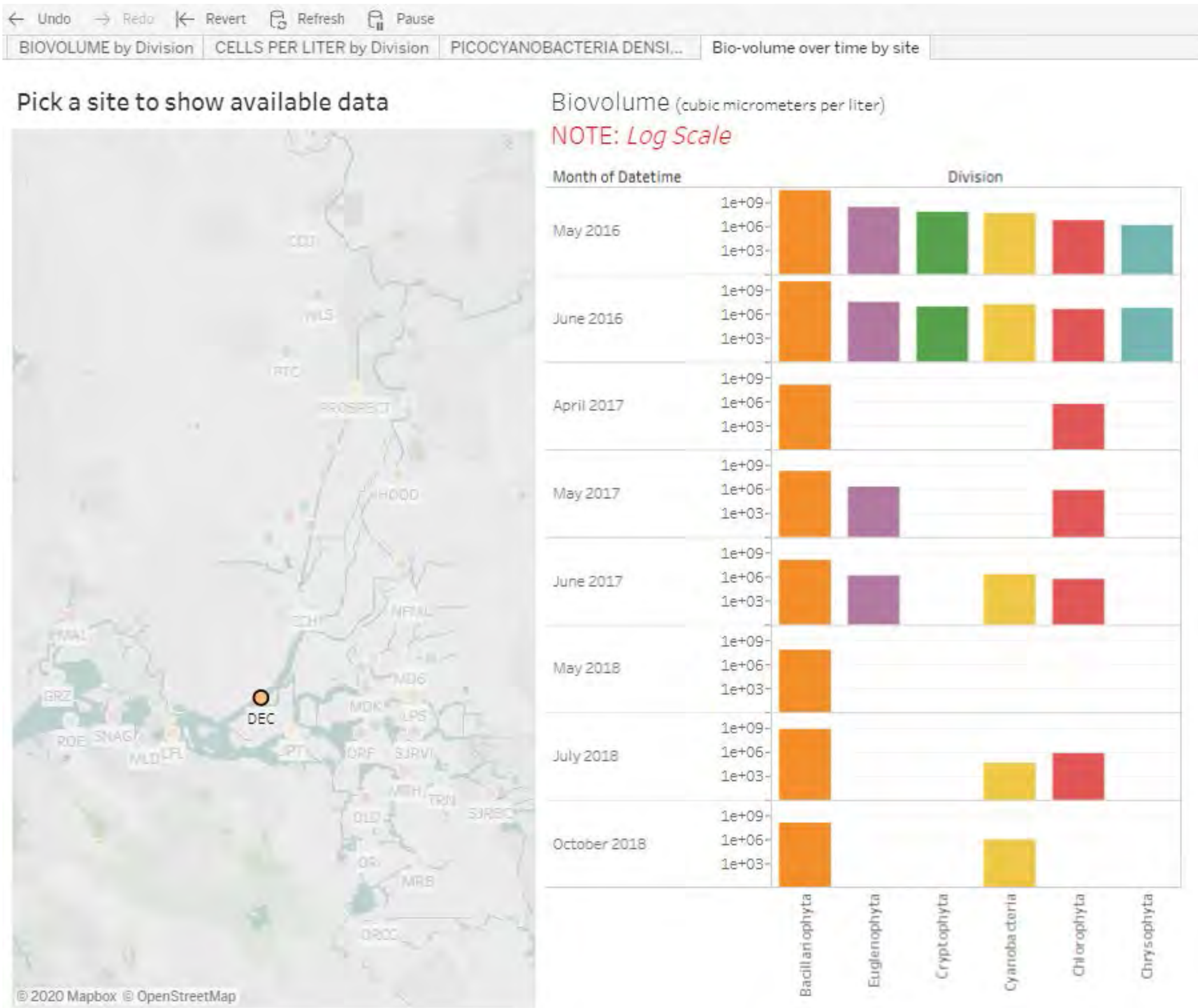
Contents page from online RMP Mapping Survey Data Explorer listing currently available tools.
https://tableau.usgs.gov/#/views/DRMP_2018_v1_4/Contents?:iid=1



Screen shot for online RMP Mapping Survey Data Explorer. Functionality is to select "Time Period' and Parameter' to map for comparison of adjacent maps. Maps shown are for July, 2018, with the parameters ammonium on the left and diatom abundance on the right. Note many other exploration tools are available at the different tabs.
https://tableau.usgs.gov/#/views/DRMP_2018_v1_4/Contents?:iid=1



Screen shot for online RMP Mapping Survey Data Explorer. Exploration functionality it to select 'Study Area' from list or highlight region from map to show statistical distribution of data within the selected area. Note many other exploration tools are available at the different tabs. https://tableau.usgs.gov/#/views/DRMP_2018_v1_4/Contents?iid=1



Screen shot for Phytoplankton Explorer Tool. Map shows all points for which data is available. Pick a station from the map and it shows the biovolume by division for all available days when samples were collected. Note additional functionality in different tabs.
https://tableau.usgs.gov/#/views/PhytoplanktonEnumerationDataV3_2/BVbysite?:iid=3

980 NINTH STREET, SUITE 1500
SACRAMENTO, CALIFORNIA 95814
HTTP://DELTACOUNCIL.CA.GOV
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DELTA STEWARDSHIP COUNCIL
A California State Agency

February 28, 2020

Matthew Heberger
Delta Regional Monitoring Program
San Francisco Estuary Institute - Aquatic Science Center

Letter of Support – Delta RMP Special Study: High Resolution Nutrient Monitoring Prior to Major Wastewater Treatment Plant Upgrades

This letter is to express support for the current USGS proposal to Delta RMP to fund a high-frequency nutrient mapping cruise in May 2020. The proposed work is highly complementary to work that the Delta Science Program intends to fund. The proposal also supports a shared goal between the Delta RMP and the Delta Science Program to advance our understanding of drivers and trends in water quality in the Delta.

The Delta Science Program's mission is to provide the best possible unbiased scientific information to inform water and environmental decision-making in the Delta. One of the ways we carry our mission out is by funding critical science investigations that inform management. A particularly important aspect of management right now is in the area of water quality and nutrients because of the impending upgrades to the Sacramento Regional County Sanitation District (Regional San) Wastewater Treatment Plan. This is a complex and controversial topic in the Delta. The Delta Science Program intends to fund a proposal from the USGS to collect, evaluate, and compare high frequency nutrient and other data collected over two years to identify trends and processes impacting water quality (nutrients in particular) and the food web. This contract has been initiated and will enable high frequency mapping surveys in July and October 2020, and in May, July and October 2021. However, the contract is not likely to be in place prior to May 2020, a particularly important time period prior to the Regional San upgrade. This contract is one aspect of a suite of studies that began in 2017 and collectively aims to document some of the environmental baseline before the Regional San wastewater treatment plant upgrade takes place, and the resulting ecological changes. We call this collection of related studies 'Operation Baseline.' In total, the Delta Science Program is investing $2.5 million in Operation Baseline studies, which include previous high frequency cruises (that were in addition to Delta RMP-funded cruises) and funding novel approaches to document how changes to nutrient inputs may affect the food web. The Delta Science Program is particularly interested in promoting this work because it is responsive to the science needs identified in the Delta Nutrient Research Plan, in addition to the 2017-2021 Science Action Agenda.

High frequency mapping is not only a new and exciting water quality monitoring approach, but it actually provides data to describe the fleeting nutrient dynamics in our system. The data is so valuable because it captures nutrients at fine temporal and spatial scales required to describe nutrient processes. This information will, in ways not possible by fixed station monitoring alone, allow the Delta science community to track nutrient dynamics in the Delta, calibrate and validate predictive models, and inform nutrient management actions. A web-based data exploration portal funded by Delta RMP and currently in progress will enable quick access, visualization, and facilitate synthesis of this new data.

In conclusion, since the Delta Science Program cannot complete the contract with USGS in time to fund the May 2020 high frequency cruise, we strongly support USGS's special study proposal submitted recently to the Delta RMP. We look forward to collaborating with you and this research group to inform policy-makers and decision-makers about this exciting work.

Sincerely,

JOHN C. CALLAWAY
Delta Lead Scientist
Delta Stewardship Council

Materials for Agenda Item 4

Memorandum

Date: February 28, 2020
To: Delta Regional Monitoring Program Steering Committee
From: Delta RMP Governance Subcommittee
Subject: Services to Support Delta RMP Governance Subcommittee

Recent conditions in Delta Regional Monitoring Program (RMP) management have highlighted the need to review and potentially revise several aspects of RMP governance. These conditions include but are not limited to:

- The need for improved procedures to manage the hierarchy and communication between various committees and workgroups under the RMP; and
- The potential need for long-range governance agreements between RMP parties.

These issues were identified at the August 2019 Steering Committee meeting, and in response, the Steering Committee (SC) formed the Governance Subcommittee (Subcommittee) to develop solutions and options to address these issues. The Subcommittee began meetings in October 2019 and identified immediate needs to help alleviate some of the identified issues in the short-term, which included hiring a neutral facilitator for the RMP Technical Advisory Committee (TAC) meetings and setting up the TAC similar to the SC by nominating 2 TAC Co-Chairs (1 from the regulated and 1 from the regulatory entities). In November 2019, Sacramento Regional County Sanitation District (Regional San) volunteered to temporarily fund the Consensus and Collaboration Program (CCP) at Sacramento State (Dave Ceppos) to begin facilitation of up to 2 TAC meetings and 3 Subcommittee meetings on a trial basis. Task Order 3 to Regional San's existing contract with CCP was executed on January 7, 2020.

On the issue of potential long-range governance agreements, the Subcommittee has discussed their inherent time restrictions, the complexity of work involved, and the extensive expertise of Dave Ceppos (CCP) on governance. In this context, the Subcommittee has asked the CCP to prepare a draft scope of work for enhanced facilitation and consultant support and governance expertise for Subcommittee activities.

Attached is Sacramento State's proposed scope for this support. The scope has targeted an initial set of interviews with Subcommittee members, followed by a sequence of five Subcommittee meetings during which the Subcommittee and the facilitator will prepare a comprehensive set of governance recommendations and materials for the RMP Steering Committee to consider in the near future.

Through subsequent discussions, Regional San has determined it has the capacity in their existing agreement with Sacramento State to fund this request, provided that this contracted amount is also shown as an in-kind contribution by Regional San to the RMP with a commensurate reduction of $15,628.99 in Regional San's annual financial contribution to the RMP. The Subcommittee is requesting the Delta RMP Steering Committee approve the allocation of RMP funds for these services.

Contract 90000185 - TASK ORDER No. 3, Amendment 1
Facilitation, Engagement and Governance Support to the Delta Regional Monitoring Program (RMP)

Contract 90000185 *– Regional San and SASD On-Call Meeting Facilitation and Strategic Consulting Services* ***Task Order No.3, Amendment 1***
For services December 1, 2019 -June 30, 2020.

The following represents amended services to be provided by the Sacramento State, Consensus and Collaboration Program (CCP) under current Task 3 of Task Order No. 3. These amended services are described as per the request and direction of the RMP Steering Committee Co-Chairs, and all members of the RMP Governance Subcommittee. Support to the Governance Subcommittee was already estimated to be 12 hours total in the original Task 3. That estimate was for attendance of up to three (3) Subcommittee meetings with a presumed duration of 4 hours / meeting. This task amendment presents hours in addition to the hours already contracted for between Regional San / SASD and Sacramento State. It assumes two additional Subcommittee meetings for a total of five (5) meetings and associated services described below.

Amended Task 3: Support RMP Subcommittee Meetings - Governance Subcommittee

Subtask A – Interview Governance Subcommittee Members

In addition to existing documentation of Governance Subcommittee discussions and RMP Steering Committee direction to the Subcommittee, CCP will conduct brief confidential discussions with each Governance Subcommittee member to better understand and then propose (based on said discussions) a set of prioritized and sequential items the Subcommittee should address over a target period of five (5) meetings.

Subtask A Deliverables

- *Interview conclusions*
- *Workplan / Calendar for Subcommittee meetings*

Subtask B – Plan, Attend, Facilitate and Memorialize Governance Subcommittee Meetings

To provide each Subcommittee member enhanced opportunity to speak freely and not assume dual roles of interest representatives and meeting facilitator, CCP will support the Subcommittee as the neutral facilitator. Similarly, CCP will prepare (through input collected before, during and after Subcommittee meetings) proposed and final meeting agendas, meeting materials (when warranted) and brief meeting summaries. Services will include:

- Agenda Development

- Tracking and preparing meeting materials
- Intermittent conversations with Subcommittee members to prepare for and debrief from Subcommittee meetings.
- Preparing brief Subcommittee Meeting Summaries

Subtask B Deliverables

- *Meeting Agendas*
- *Meeting materials (as warranted)*
- *Governance Subcommittee Meeting Summaries (including documentation of standing action items, action items completed, decisions made, decisions pending, and similar)*

<u>Subtask C – Prepare Governance Documents</u>

The Governance Subcommittee has identified (in recent phone discussions with CCP) that in addition to the RMP Charter, other documents and governance methods might be warranted to enhance RMP efficacy. Subtask A above is intended to better define what these documents and methods might be. Therefore, while CCP cannot specify the exact documents, nor sequence in which these might be enhanced (i.e. existing documents to be revised) or created (i.e. new documents to be prepared), this task provides an overall estimate of time to support such efforts within the proposed 5-meeting sequence.

Subtask C Deliverables

- *To Be Determined as an outcome of Subtask A*

<u>Subtask D – Coordinate Governance Subcommittee Activities</u>

CCP administrative staff will provide coordination support for all Governance Subcommittee activities including scheduling meetings, communication of materials, tracking status of action items (if warranted) and similar.

Subtask D Deliverables

- *Meeting calendaring*
- *Email communication of meeting materials and meeting updates*
- *Action Item tracking sheet (if warranted)*

<u>Subtask E – Task Management</u>
CCP financial staff and the project manager will prepare monthly reports, invoicing, budgetary oversight and similar in support of this task

Subtask E Deliverables

- *Monthly reports*
- *Invoices*
- *Project management correspondence (if warranted)*

Cost Estimate

The cost estimate for the additional services described herein is based on rates negotiated in 2018 between Regional San / SASD and Sacramento State. Exhibit A presents Sacramento State's proposed amended budget for this additional effort. The additional budget is $15,628.99. The following presents assumptions used to develop this cost estimate.

General Process Assumptions

- Governance Subcommittee meetings are expected to be held in person in the Sacramento region for a duration up to 4 hours (including meeting travel and setup / breakdown)
- Mediator/Facilitator duties and hours may be moved between various tasks at CSUS, based on focus areas and project need, subject to regular review by client.
- Hours identified in each task will be permitted to be applied to other tasks, as needed within this agreement.
- An Indirect Cost Rate of 5% will be assessed on all personnel costs and direct expenses.
- Conditions causing assumptions described in this Project Scope to be exceeded will be communicated to client on an as needed basis. Persistent conditions causing these assumptions to be exceeded—or if new/expanded tasks are requested--may necessitate a modification or amendment to the scope and/or budget.
- Meeting facility arrangements, logistics support, photocopying and printing of meeting materials and the taking and creating of meeting minutes will continue to be handled as they have been on this project to date.
- Communication of agenda, notes, etc., will be accomplished electronically.
- Conference call services in support of this project will be arranged from within the Client's (or another stakeholder's) telecommunications system, unless otherwise discussed and accommodated.
- Monitoring, uploading of information and management of any Web-based preparations of tools for meetings and groups will be handled by client or other stakeholder staff.

EXHIBIT A

Task Order No.3, Amendment 1

Delta Regional Monitoring Program

Governance Subcommittee Enhanced Support

Task Descriptions / Labor Resource	Mng. Senior Mediator	Admin Support / Clerical	Admin Support / Contract and Financial Mngmnt.		Total Hours by Task	Hrs x rate	Summary
Billing Rates	**$195**	**$48**	**$57**				
Task A - Interview Subcommittee Members							
Interviews	6				6	$1,170	
Prepare and update Subcommittee Workplan	6				6	$1,170	
					0	$0	
Subtotal Task A	12	0	0	0	12		$ 2,340
Task B - Support Subcommittee Meetings (5)							
Attend 2 Meetings (in addition to 3 already scoped)	8				8	$1,560	
Prepare 5 Meeting Agendas	8				8	$1,560	
Communicate with Subcommittee Members	15				15	$2,925	
Prepare Meeting Summaries	10				10	$1,950	
Prepare Meeting materials	5				5	$975	
					0	$0	
Subtotal Task B	46	0	0	0	46		$ 8,970
Task C - Prepare Governance Documents							
Prepare Charter revisions and other TBD documents	12				12	$2,340	
					0	$0	
Subtotal Task C	12	0	0	0	12		$ 2,340
Task D - Coordinate Subcommittee Activities							
		20			20	$960	
					0	$0	
					0	$0	
Subtotal Task D	0	20	0	0	20		$ 960
Task E - Project Management							
Budgetary oversight, fiscal record-keeping			4		4	$228	
					0	$0	
					0	$0	
Subtotal Task 8	0	0	4	0	4		$ 228
Total Professional Services	**70**	**20**	**4**	**0**	**94**		**$ 14,838**
						Extended	
<u>Other Direct Costs (ODC)</u>		**<u>UOM</u>**	**<u>Qty</u>**	**<u>Unit Rate</u>**		**Value**	
Photocopying b/w		lot	300	$ 0.06		$ 18.00	
Travel Coordination:							
Mileage (private vehicle), current rates		mile	50	$ 0.575		$ 28.75	
Subtotal Other Direct Costs							**$ 46.75**
Indirect Cost 5%							**$ 744.24**
ESTIMATED BUDGET							**$ 15,628.99**