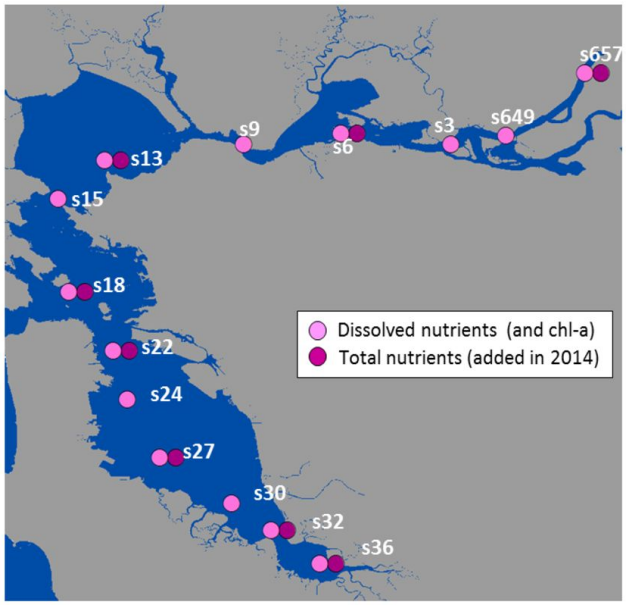
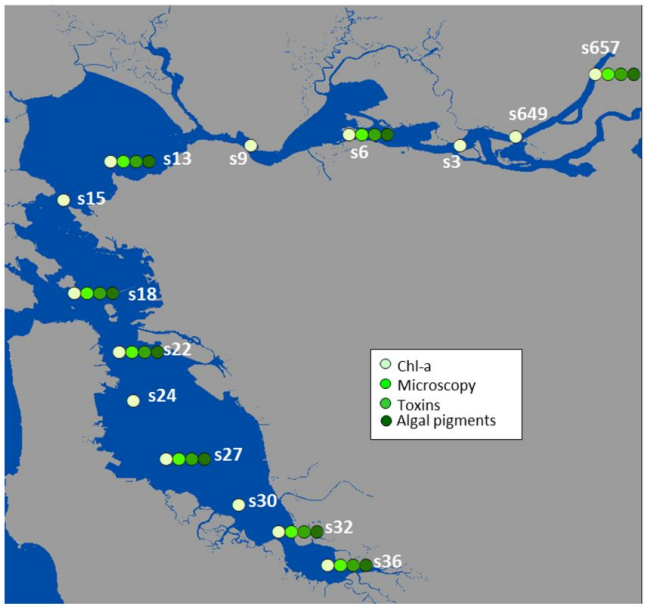
Nutrient Management Strategy Proposals for RMP Funding

C.1 Ship-based sampling and sample analysis
FY17 Estimated NMS Cost = $153,000
Collaborators: USGS, UCSC, SFEI

Ship-based samples will be collected and analyzed for a range of nutrient-related parameters. This data is essential for basic condition assessment, model calibration, and improved understanding of nutrient behavior and nutrient-related effects in the Bay. Ship-based discrete samples will be collected by USGS aboard the R/V Peterson on ~12 full-bay cruises and an additional ~12 South Bay cruises.





Costs covered by NMS

- Nutrient analyses (USGS national lab)
- Analysis of integrated toxin samples (SPATT), discrete toxin samples, and algal pigments (at UCSC)
- Basic data QA/QC and basic reporting
- Additional staff support on cruises to support the collection of NMS-related samples: inorganic nutrients, total nutrients, microscopy, algal pigments, and particulate algal toxins; spatially integrated toxin samples (SPATT)

Costs covered by USGS as part of their core program

- Collection of samples for chlorophyll and ancillary data (e.g., suspended particulate matter, dissolved oxygen, salinity)
- Vertical profiles for multiple parameters
- Underway flowthrough data collection (salinity, T, chl-a fluorescence, turbidity/optical backscatter)
- Program management, scientific oversight
- Data management for USGS parameters plus inorganic nutrients

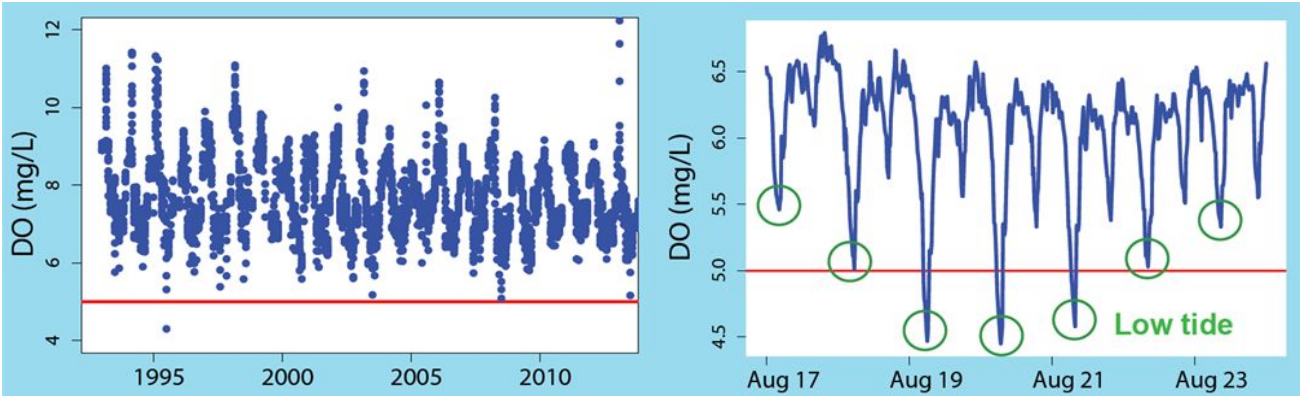
- Ship maintenance, fuel, crew, etc.

Deliverables
Nutrient and chl-a data will be made publicly available through USGS's website. Results will also be summarized in the NMS Annual Report. Data will be used for many NMS aspects (model calibration, condition assessment, assessment framework development).

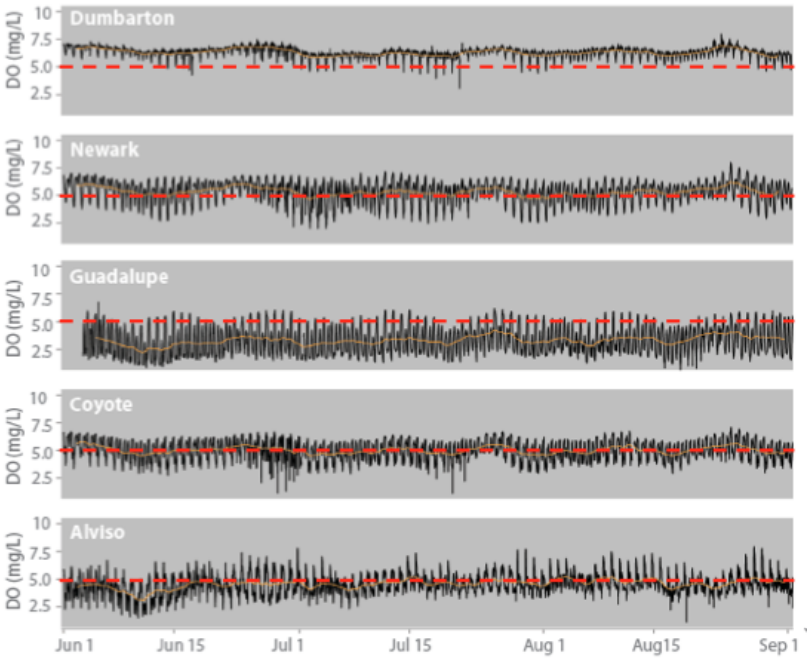
Budget Justification
Nutrient analyses for 300 station-date samples ($40,000; ammonium, nitrate + nitrite, reactive phosphorous, dissolved silicate; total N and P measured at a subset of sites samples); Taxonomy on ~200 samples for phytoplankton community composition and biovolume ($45k); toxin and algal pigment measurements ($55k); Additional staff support for field work ($20k).

C.3 Open-Bay and slough moored sensors: data analysis/interpretation and maintenance
FY17 Estimated NMS Cost = $342,000
Collaborators: SFEI, USGS-Sac, UC Berkeley

While San Francisco Bay is generally not known to be either eutrophic (primary production > 300 g C m^{-2} y^{-1}) or hypoxic (dissolved oxygen < 2 mg L^{-1}), a substantial portion of our knowledge of SFB biogeochemistry comes from a long-term dataset collected in the Bay's main channel. Over the past ~2 decades, dissolved oxygen rarely dipped below 5 mg L^{-1} during biweekly to monthly surveys at stations in South and Lower South Bay (below left). More recently, though, high-frequency moored *in situ* sensors at the Dumbarton Bridge have shown that dissolved oxygen concentrations frequently drop to levels not typically observed in the long time series. For example, dissolved oxygen repeatedly dipped near or below 5 mg L^{-1} in August 2013 during the lower low tide several days in a row (below, right). The DO signal was strongly coupled to the tides at multiple frequencies (semidiurnal: two highs and two lows per day; fortnightly: two spring tides and two neap tides per lunar month), with lowest DO observed around the spring tide on August 20, 2013. Since dissolved oxygen decreases on ebbing tides, we hypothesized that lower dissolved oxygen waters were being advected from margin habitats, including the extensive network of sloughs and creeks in Lower South Bay (SFEI 2015a).



We began testing this hypothesis in Spring/Summer 2015 by installing a network of moored sensors in margin areas of Lower South Bay, measuring dissolved oxygen and a range of other parameters (e.g., salinity, T, turbidity, chl-a fluorescence). Observations over Summer 2015 confirmed that DO frequently fell below 5 mg L^{-1} at multiple sites. The data also indicated that condition varied substantially among the sites, and that DO concentration was strongly influenced by the tides. In addition, DO-related condition at individual sites appears prone to large differences between years, based on comparisons of summer 2012 and 2015 data in Alviso Slough (SFEI 2015a).



Dissolved oxygen concentrations at a subset high-frequency moored sensors sites in Lower South Bay.

FY17 work will focus on the following:

- Complete Year 3 of open bay stations (San Mateo, Dumbarton Bridges) and Alviso Slough.
- Complete Year 1 of slough/creek deployments, and extend through a second summer/fall/winter.
- Data analysis, and quantitative mechanistic interpretations to identify factors contributing to observed conditions.
- Sensor network maintenance.
- Data management and QA/QC.

Deliverables:

- Mid-fiscal year (Dec 2016) update to inform FY18 priorities;
- Summary of major observations in the NMS FY17 Annual Report (e.g., SFEI 2015b), and technical report(s) included as appendices to the annual report describing:
    - Spatial/temporal variability in LSB/South Bay/open Bay and slough water quality (DO, chl, etc.)
    - Mechanistic interpretations, including physical forcings (including exchange between pond ← → sloughs ← → Bay)
    - Initial inferences related to the potential influence of anthropogenic nutrients on DO conditions at specific sites or in LSB margins more broadly, and the potential role of exchange with salt ponds on DO, phytoplankton biomass, and nutrient budgets in LSB.

Budget Justification: 2 staff (0.8 FTE, 0.65 FTE; $233,000) for field work, data management, data analysis, interpretation, and report preparation. Field support and additional technical support (including boat, fuel, field technicians; USGS, $80k); equipment/supplies ($30k, replacement sensors, maintenance).