RMP Special Study Proposal: Dredged Material Management Office (DMMO) Database Enhancements

Summary: In 2018, SFEI began hosting and managing the DMMO database and website (https://www.dmmosfbay.org/). A DMMO Project Team with representatives from the partner agencies USEPA, USACE, SFBRWQCB, and BCDC convene regularly to set priorities and guide the transition from Exa Data to SFEI. Initially, the highest priorities were to assemble the various components of the DMMO information system onto SFEI's servers, maintain the domain registration, make minor updates to the website, upload new data templates into the database, and maintain the technical documentation and procedures. Now that those priorities have been addressed, the DMMO database user community seeks more database functionality and an improved user interface.

This proposed project focuses on improving the DMMO database to make it more accessible by the user community. Enhancements to the database would (1) improve efficiencies and streamline the process of making data available in a timely manner for querying; (2) enable the integration of DMMO data into SFEI's other data visualization tools, such as the Contaminant Data Display and Download tool (cd3.sfei.org), which is the primary data access and visualization tool for the Regional Monitoring Program's long-term dataset; and (3) support DMMO data mining and synthesis efforts.

Estimated Cost: $40,000

Oversight Group: RMP Sediment Workgroup

Proposed by: Cristina Grosso (SFEI)

Proposed Deliverables and Timeline

Deliverable	Due Date
Summarized meeting notes	June 2021
Enhanced database functionality	December 2021
Enhanced access to DMMO data	December 2021

Background

The DMMO database stores testing results for sediment quality and chemical analysis of tissues from bioaccumulation tests for permitted navigational dredging projects in the San Francisco Bay. The database supports the primary goal of the DMMO interagency group to foster a comprehensive and consolidated approach to handling dredged material management issues. The group uses the DMMO data to make suitability determinations for material proposed for disposal or beneficial reuse in and around the San Francisco Bay area.

The DMMO database was developed over ten years ago by Exa Data using Microsoft Access 2007. Currently, new data are uploaded to the Access database and then copied to another format for display on the website. By moving to a more robust database platform such as SQL Server, the process for making testing results accessible on the website could be automated and streamlined. In addition, the DMMO website currently does not provide the ability to map testing results. It is important to update this outdated technology so the DMMO data could be integrated with other relevant datasets and made accessible in online querying and visualization tools that support data synthesis and better decision-making.

Potential opportunities for enhancing the access and integration of DMMO data include synthesizing DMMO data for contamination hot spots in the margins; visualizing DMMO data through CD3; using the database to develop updated beneficial reuse guidelines; improving reporting templates that facilitate data mining; and developing an online tool to compile "Tier 1" track records for projects or project clusters.

Study Objectives and Applicable RMP Management Questions

The study will provide information essential to understanding and analyzing dredged material in the San Francisco Bay. Table 1 shows the objectives of the project and how the information will be used relative to the management questions of the RMP Sediment Workgroup.

Table 1. Study objectives and questions relevant to the Sediment Workgroup management questions.

Management Question	**Study Objective**	**Example Information Application**
1) What are acceptable levels of chemicals in sediment for placement in the Bay, baylands, or restoration	Provide access to dredged material testing data to synthesize with other	The DMMO database can be used to explore options for updating the draft beneficial use sediment screening

projects?	datasets.	guidelines.
2) Are there effects on fish, benthic species, and submerged habitats from dredging or placement of sediment?		Review of toxicity data can help inform appropriate management thresholds for dredge sediment placement and disposal.
3) What are the sources, sinks, pathways, and loadings of sediment and sediment-bound contaminants to and within the Bay and subembayments?		
4) How much sediment is passively reaching tidal marshes and restoration projects and how could the amounts be increased by management actions?		
5) What are the concentrations of suspended sediment in the Estuary and its segments?		

Approach

The DMMO database was developed over ten years ago and uses outdated technology. By making enhancements to the database, it will be easier to integrate the DMMO data into existing data access and visualization tools.

The tasks are described in more detail below.

1. **Coordinate with DMMO Project Team**
   SFEI staff will meet regularly with the DMMO Project Team to ensure the development of the enhancements meet the data tracking and reporting needs of the DMMO's partner agencies.

2. **Develop DMMO database enhancements**
   Based on input from the DMMO Project Team, SFEI staff will develop and thoroughly test database enhancements. Moving the DMMO database from Microsoft Access 2007 to a more robust database platform such as SQL Server will enable the automation of procedures to make testing results accessible on the DMMO website. These enhancements would also allow the DMMO database to be managed on the same servers and use the same standard protocols as SFEI's Regional Data Center and RMP data.

3. **Develop DMMO data access enhancements**

Based on input from the DMMO Project Team, SFEI staff will develop and thoroughly test data access enhancements by leveraging and integrating DMMO data into existing online visualization tools, such as CD3. Improving the ability to query, map, and download DMMO data will better support DMMO data mining and synthesis efforts.

Budget

The following budget represents estimated costs for this proposed study (Table 2).

Table 2. Proposed Budget.

Expense	Estimated SFEI Hours	Estimated Cost
Task 1: Coordinate with DMMO Project Team	12	$1,680
Task 2: Develop DMMO database enhancements	188	$26,320
Task 3: Develop DMMO data access enhancements	86	$12,000
Subcontracts		$0
Direct Costs		$0
Grand Total	**286**	**$40,000**

Budget Justification
Labor costs include SFEI staff time to coordinate with the DMMO Project Team and develop and test the new database and data access enhancements.

Reporting

Decisions and notes from meetings with the DMMO Project Team will be summarized. The new database and data access enhancements will be released to production.

References

Not Applicable

RMP Special Study Proposal: DMMO San Francisco Bay Floating Percentile Method Update

Summary: The Long-Term Management Strategy for dredged sediment in San Francisco Bay calls for 40% of dredged sediment to be used for beneficial reuse. While this objective is currently being met, the need for additional sediment volume to restore tidal marsh far surpasses the 40%. Concerns that the draft sediment screening guidelines for beneficial reuse were too restrictive resulted in a RMP-led Beneficial Reuse Workshop in September 2019. One of the recommendations from the expert panel was to compare sediment chemistry thresholds currently in use versus those generated using the Floating Percentile Method (FPM). The FPM was developed in 2002 by Avocet Consulting/SAIC, using paired sediment toxicity and chemical analysis data to develop sediment quality guidelines. This proposal seeks to use recent estuarine data reported to the Dredged Materials Management Office (DMMO) and data from the San Francisco Bay Regional Monitoring Program (RMP) to update a regional application of the FPM conducted previously in 2004 for the Sediment Screening Guidelines study and report (Germano & Associates, 2004). This method provides additional weight of evidence for the derivation of thresholds that can be used to determine whether dredged sediment can be used for beneficial reuse purposes. The outcomes of this analysis will be reviewed as an option for updating the draft sediment screening guidelines for beneficial reuse.

Estimated Cost: $34,050

Oversight Group: Sediment Workgroup

Proposed by: Donald Yee, Adam Wong,

Time Sensitive: (yes or no; if yes, why?) No

Proposed Deliverables and Timeline

Deliverable	Due Date (end of)
RMP & DMMO Data compilation	Feb 2021
Data cleanup (sample matching, tox significance)	Mar 2021
FPM runs	Apr 2021
Draft memo/report for Sed WG	May 2021
Final report & website	June 2021
Presentation to Water Board	June 2021

Background

The RMP conducted a workshop on beneficial reuse guidelines in September 2019. External experts reviewed the current guidelines for San Francisco Bay and highlighted areas where improvements could be made, including evaluating the Floating Percentile Method (FPM) to update the sediment screening guidelines (Foley et al., 2020). Currently, the draft sediment guidelines for beneficial reuse (SFBRWQCB, 2000) are based on individual contaminant concentrations, using either ambient concentrations in the Bay or ERL (effects risk low) and ERM (effects risk moderate) thresholds. This approach may be restricting the amount of sediment that is determined as suitable for beneficial reuse purposes, which is urgently needed to restore

marshes around the Bay to make the area more resilient to sea level rise.

The Floating Percentile Method (FPM) was developed by SAIC and Avocet Consulting (SAIC/Avocet, 2002) and used paired sediment toxicity and chemical analytical data to develop sediment quality guidelines for Washington State Department of Ecology. The FPM was also used by the Oregon Department of Environmental Quality Regional Sediment Evaluation Team, for its Freshwater Sediment Workgroup (Michelsen & Anderson, 2011). The method is broadly applicable to scenarios where there is paired toxicity and chemistry data to assess risk. This proposal seeks to use recent estuarine data reported to the Dredged Materials Management Office (DMMO), combined with data from the San Francisco Bay Regional Monitoring Program (RMP) to update a regional application of the FPM conducted previously in 2004 for the Sediment Screening Guidelines study and report (Germano & Associates, 2004). This analysis found that 76% of sediment samples were falsely classified as toxic using the single contaminant threshold approach.

Between 2002 and 2012, the Regional Monitoring Program for Water Quality in San Francisco Bay has conducted annual sediment sampling at randomized sites distributed in the subtidal Bay, with concurrent chemical analysis and sediment toxicity. Since 2012, RMP has not regularly conducted toxicity testing of surface sediment samples, but the 2002 to 2012 data collected can provide a useful refinement and update to the prior FPM analysis of SF Bay data. The data from RMP studies primarily includes surface sediment (0-5 cm depth) composited and subsampled for chemical analysis and toxicity testing, so there is generally a 1:1 correspondence between samples with both types of analyses.

Another source of recent and potentially ongoing data is the chemical analysis and toxicity testing performed by dredging projects to assess contaminant risks and decide appropriate disposal or reuse options for dredged sediment. Attempts have been made to modernize their reporting by inclusion in a queryable database for the DMMO in SF Bay. That database was released for public access in 2019, and nearly all of the data present in its initial release were collected from projects occurring between 1998 and 2016, with new projects continuing to be added. Thus it would be expected that a majority of data in the DMMO database were obtained after the 2004 application of FPM to SF Bay. Pairing the sediment chemistry and toxicity data from the DMMO database is difficult because metadata do not exist for all samples. This may limit the number of samples that can be used in the analysis, but the sample size should be large enough to evaluate the usefulness of the method.

Study Objectives and Applicable RMP Management Questions

The study will provide information essential to understanding the toxicity risks posed to resident biota by known pollutants of concern. The objectives of the project and how the information will be used are shown in Table 1 relative to the RMP Sediment Workgroup management questions.

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

Management Question	Study Objective	Example Information Application
1. What are acceptable levels of chemicals in sediment for placement in the Bay, baylands, or restoration projects?	Determine risks associated with chemical concentrations in sediment	Output of this effort is a probability distribution for toxicity associated with chemical pollutants

2. Are there effects on fish, benthic species, and submerged habitats from dredging or placement of sediment?	Estimate effects thresholds based on regional tox testing for relevant species	Revise or provide weight of evidence for sediment beneficial reuse concentration limits for various chemicals
3. What are the sources, sinks, pathways and loadings of sediment and sediment bound contaminants to and within the Bay and subembayments?	Not applicable	Bay RMP & DMMO data provide some insight, but this is not an objective of this study
4. How much sediment is passively reaching tidal marshes and restoration projects and how could those amounts be increased by management actions?	Not applicable	
5. What are the concentrations of suspended sediment in the Estuary and its segments?	Not applicable	

Approach

For Bay RMP data, paired toxicity and chemistry data will be collated from the period 2002-2012, which includes the entire period during which the RMP sampled Bay sediment using a randomized spatial allocation scheme. This data will either be considered on its own, or compiled and analyzed with the database used for the prior Sediment Screening Guidelines analysis (Germano & Associates, 2004), depending on the sufficiency of new data spanning a range of toxicity. For example, if all newer concentration data were far lower than past concentrations, and all showed no toxicity, the new data would provide little additional elucidation of toxicity thresholds.

Chemistry and toxicity data reported for the DMMO database will also be collated for use in the FPM analysis. Past attempts to use the DMMO database (Yee & Wong, 2019) have illustrated some challenges, such as the difficulty in matching samples analyzed for different chemicals or subjected to different types of tests. Samples within a site may be composited or not, from different depths, or sub-areas within a site. Thus the exact correspondence between samples collected at a given site and date may not be as clear cut as for RMP samples. After DMMO data are collated, we will identify sets with ambiguous linkages between chemistry and toxicity data, and will engage with stakeholders for alternative matching criteria that will be “imperfect” but sufficiently similar to attempt the analysis. Whether or not such “imperfect” matches are needed will depend in large part on the characteristics and counts of the available pairwise matching data.

Some other clean-up of the data may also be needed. For example, a positive/negative determination of significant toxic effect is required for each toxicity test, and may not always be clearly summarized in the database. These cases will require re-derivation or summarization from raw test results based on the published method. In such cases, we would consult toxicologist(s) (from the reporting party if possible, or SFEI staff if needed) to summarize results appropriately for use in the FPM method.

The collated and cleaned-up data will then be run through the FPM analyses as described in the documentation and spreadsheet routines provided for the Oregon RSET Program (Michelsen & Anderson 2011). As time allows, the analyses may be re-run using different subsets of the San

Francisco Bay Data (e.g., RMP & DMMO combined, RMP or DMMO independently, different year ranges, with or without imperfect DMMO matches) to examine the robustness of the derived thresholds to the specific training data sets used.

Budget

The following budget represents estimated costs for this proposed special study (Table 2). Efforts and costs can be scaled back by reducing the effort spent in trying to clean up data that do not clearly match. This project could also be timed to follow the proposed DMMO database improvements project.

Table 2. Proposed Budget.

Expense	Estimated Hours	Estimated Cost
Labor		
Staff data compilation & analysis	110	12,375
Stakeholder/data provider consultation (dataset cleanup)	20	2,250
Staff toxicologist consultation	12	1,500
Technical memo staff	25	2,875
Technical memo Sr Sci	24	4,675
Sr Management review	8	1,735
Report finalization	8	1,640
Presentation to stakeholders	35	7,000
Grand Total		$34,050

Reporting

The primary output of this effort would be a website page similar to that provided for Dredged Material Testing Thresholds for San Francisco Bay Area Sediments:

https://www.sfei.org/projects/dmmo-ambient-sediment-conditions

A short technical memo/report and associated supplemental material, describing the methods, analyses performed, and the cleaned-up dataset used for the analyses, would be provided on the web page.

Another important by-product of this effort (and future efforts using the DMMO data) may be to establish and better enforce guidelines for data provided to the database, to better avoid ambiguities in the linkage between different types of data obtained for dredging projects.

The results of this analysis will also be communicated at a Technical Review Committee meeting, as well as to the San Francisco Bay Regional Water Quality Control Board to inform their decision to revise the current sediment screening guidelines for beneficial reuse.

References

Foley, M.; Christian, E.; Goeden, B.; Ross, B. 2020. Expert review of the sediment screening guidelines for the beneficial reuse of dredged material in San Francisco Bay. SFEI Contribution No. 978. San Francisco Estuary Institute: Richmond, CA.

Germano & Associates, 2004. An Evaluation of Existing Sediment Screening Guidelines for Wetland Creation/Beneficial Reuse of Dredged Material in the San Francisco Bay Area Along with a Proposed Approach for Alternative Guideline Development. Funded by the California State Coastal Conservancy in cooperation with the Port of Oakland. February, 2004.

Michelsen,Teresa, Michael R. Anderson. 2011. Description and Use of the RSET Floating Percentile Method Spreadsheets. Prepared by Avocet Consulting, for the Oregon Department of Environmental Quality Regional Sediment Evaluation Team. March 4, 2011

SAIC/Avocet. 2002. Draft Report. Development of freshwater sediment quality values for use in Washington State, Phase I Task 6: Final Report. September 2002. Publication Number 02-09-050. Prepared for Washington Department of Ecology, Sediment Management Unit. Prepared by Science Applications International Corporation and Avocet Consulting.

SFBRWQCB. 2000. Beneficial reuse of dredged materials: sediment screening and testing guidelines. San Francisco Bay Regional Water Quality Control Board Draft Staff Report, 35 pp.

Yee, D. Wong, A. 2019. Evaluation of PCB Concentrations, Masses, and Movement from Dredged Areas in San Francisco Bay. SFEI Contribution No. 938. San Francisco Estuary Institute, Richmond, CA.

South Bay shallows sediment flux study

(SMMS category: Flux on shoals and into wetlands)

J. Lacy, USGS Pacific Coastal and Marine Science Center

Description

Salt marshes provide critical habitat as well as coastal protection. One of the key sediment management questions for San Francisco Bay is whether adequate sediment is available for marshes to keep up with sea-level rise, and how sediment availability varies spatially. We propose to investigate the influence of tides, waves, and water levels on sediment supply to a marsh. We will measure suspended-sediment concentration (SSC) and the magnitude and direction of suspended sediment flux (SSF) in the shallows of South Bay, as well as SSF into a marsh through a tidal creek. The study site will feature a marsh with a wave-exposed edge that is not leveed, with large wind fetch, and fine grain size in the mudflats. We propose a site on the eastern shore of South Bay, between the San Mateo and Dumbarton Bridges, a region with vulnerable infrastructure and active marsh restoration. Site selection would take into account plans of the WRMP, the South Bay Salt Ponds restoration project, and other potential synergistic RMP studies (e.g. K. Thorne, D.Roberts).

We propose to collect data at three stations, one in the subtidal shallows (1 to 1.5 m MLLW), the second in intertidal shallows within 50 m of the marsh edge, and the third in a primary tidal creek in the marsh. At all stations we will measure currents, water level, and SSC; at the shallows stations we will also measure salinity, temperature, and wave properties. Turbidity (measured by optical backscatter sensors) will be calibrated to SSC measured in water samples collected in-situ. We will collect bed sediment samples (three per station) and analyze the surficial centimeter of sediment for bulk density and grain size distribution.

A full two-year effort ($142k) would include seven months of data collection (Jan-Aug) in 2021 at all three stations. We will analyze seasonal (contrasting the effects of storm waves, storm surge, and sparser marsh vegetation of winter to the daily sea breeze and denser vegetation of summer) as well as spring-neap variation, which was very important in China Camp marsh tidal creeks (Lacy et al., ESPL, 2018). All data collection would occur in 2021, with data analysis and writing extending into 2022. Results would connect sediment dynamics in the shallows to marsh sediment delivery. Interpretation of these results would benefit from colocation with accretion measurements (K.Thorne proposal) and/or comparison with additional shallows data (D. Roberts proposal). USGS will provide all instruments for the study and will fund salary for J. Lacy and partial salary for field technicians. We plan to couple this study with measurements of wave attenuation in the marsh (funded by USGS), which would provide much-needed information to support local coastal managers interested in implementing nature-based solutions. Coupling the two studies will increase the cost effectiveness of each one.

A one-year effort ($50k) would focus on only a 10-week winter deployment at the two shallows stations and data analysis. An intermediate option ($99k, two years) includes 10-week deployments in winter and summer at just the two shallows stations.

Budget

Expense	Estimated Cost (Option 1 – low cost effort)	Estimated Cost (Option 2 – intermediate cost effort)	Estimated Cost (Option 3 – full effort)
Task 1: Deployment field expenses	$10,000	$20,000	$32,200
Task 2: Laboratory analyses	$1,540	$3,100	$4,620
Task 3: Presentation to the Sediment Workgroup	$1,000	$1,000	$1,000
Task 4: Salary: data processing and analysis	$12,600	$25,100	$40,200
Subcontracts UC Berkeley grad student (Lukas WinklerPrins, part time)	$25,000	$50,000	$60,000
Subcontract: Permitted biologist to facilitate marsh access			$4,660
Estimated cost includes direct and indirect			
Grand Total	**$50,140**	**$99,200**	**$142,680**

Deliverables and Timeline

Deliverable	Due Date
Full ($142k) or intermediate ($98k) two-year option	
Data release	December 2021
Report (draft paper) on factors governing SSC and SSF in shallows and tidal creek	December 2022
One-year ($50k) option	
Data release	September 2021
Report (draft paper) on factors governing SSC and SSF in shallows, winter only	December 2021

Marsh Elevation Dynamics Across San Francisco Bay Estuary

K. Thorne, USGS Western Ecological Research Center

Description

Precise measures of sediment elevation and deposition in tidal marshes of San Francisco Bay (SFB) estuary are necessary to quantify the role of marshes as sediment sinks and determine long-term rates of elevation change. These data are particularly relevant in the context of ongoing management actions and sea-level rise and provide valuable insights into the processes that govern marsh evolution. The deep rod Surface Elevation Table-Marker Horizon (rSET-MH) method is a nondestructive approach to establish a standardized monitoring methodology to determine mm-scale changes in marsh elevation. Data from rSET-MH fill a critical data gap and can be paired with other spatial data and numerical modeling of sediment transport and deposition. When the SET is attached to a bench rod, it provides a constant reference plane in space from which the distance to the sediment surface can be measured. Repeated measurements of elevation can be made with high precision because the spatial orientation of the SET remains constant for each sampling periods and is relative to a fixed subsurface datum. Marker Horizons (MH) are used in conjunction with the rSET to measure surface vertical accretion. rSET-MH data is paired with local water and salinity instruments at the marsh sites to develop important relationships between water quality, flooding, and sediment accretion. These relationships can be linked to bay-wide measurements. This monitoring approach is being implemented in Chesapeake Bay and the Louisiana Delta to inform subsidence reversal, numerical modeling, sediment and water quality management, and restoration activities. Here, our objective is to understand marsh elevation change and the biogeomorphic processes that control marsh accretion in SFB by using a standardized approach (rSET-MH) and meta-analysis.

(1) Monitor existing NB network: A rSET-MH monitoring network (4 rSET-MHs per marsh, n=16) was deployed in San Pablo Bay-Suisun Bay at San Pablo Bay NWR (2013), Petaluma marsh (2016), Suisun Marsh (2016), Browns Island (2016) and is being monitored by USGS WERC (funding ended in 2019). We propose continued quarterly monitoring for 1-year of the rSET-MH, water level loggers, and salinity sensors. As recommended by the WRMP, we propose to survey the rSET-MHs into a unified geodetic framework with differential levelling to achieve mm accuracy of receiver elevation, which is needed to monitor sediment elevations and relative sea level rise (RSLR).

(2) Establish a Central/South Bay network: We propose to deploy a long-term rSET-MH monitoring network in Central/South SFB to compliment the NB efforts. An extensive marsh inventory was done in 2018 and five distinct regions were identified to deploy the network south of the San Mateo-Hayward Bridge (intermediate-cost option). We will select a representative marsh within each of the five areas and deploy 20 long-term monitoring stations (4 rSET-MH per marsh). Selection of the sites will be based on access permissions, endangered species restrictions, WRMP recommendations, and the desire to co-locate with other proposed RMP studies (e.g., J. Lacy and D. Roberts) to link measurements when possible. Monitoring will be done quarterly. As recommended by the WRMP, we propose also to survey the rSET-MHs into a unified geodetic framework with differential levelling to achieve mm accuracy of receiver elevation.

(3) Analysis of biogeomorphic trends: We propose to analyze the existing NB rSET-MH data with ongoing turbidity and SSC monitoring, water quality, tides, and storm information to quantify sediment accretion trends and assess the relative importance of environmental drivers for marsh accretion (intermediate-cost option). In an expanded effort, we propose to deploy supplemental MH plots (15-20) at each marsh site to improve the spatial characterization of sediment deposition relative to the upland and bay edges, channels, and vegetation.

Budget

Task	***Estimated Costs***	**Estimated Total Cost (Option 1) NB focus: 1 year of monitoring + leveling**	**Estimated Total Cost (Option 1.5) NB focus: 1 year of monitoring + leveling + meta analysis**	**Estimated Total Cost (Option 2) CB-SB focus: rSET network establishment + leveling + 1 year of monitoring**
Monitor existing San Pablo Bay-Suisun Bay rSET-MH, water level, and water salinity. 1 year with measurements done quarterly.	*$30,000*	$30,000	$30,000	
San Pablo Bay- Suisun rSET Leveling into geodetic framework (WRMP recommended)	*$24,000*	$24,000	$24,000	
Meta-analysis of biogeomorphic landscape properties for San Pablo Bay- Suisun with existing data	*$76,300*		$76,300	
Establish Central Bay-South Bay rSET-MH network.	*$90,000*			$90,000
Monitor newly established Central Bay-South Bay rSET-MH, water level, and water salinity. 1 year with measurements done quarterly.	*$50,000*			$50,000
Central Bay-South Bay rSET leveling into geodetic framework (WRMP recommended)	*$62,150*			$62,150
Presentation to RMP Sediment Workgroup	*$1,000*	$1,000	$1,000	$1,000
Grand Total		**$55,000**	**$131,300**	**$203,150**

Deliverables and Timeline

Deliverable	Due Date
Document summarizing rSET-MH sediment marsh data for North Bay	January 2022
Document summarizing rSET-MH sediment marsh data for South Bay	January 2022
Summarized results of rSET levelled elevations relative to NAVD88 and local tidal datums	January 2022
Summarized results and synthesis of North Bay rSET-MH data with other biogeomorphic data parameters	January 2022
Presentation to the RMP Sediment Workgroup	May 2022

Continuous Suspended Sediment Monitoring on the Eastern Shoal of South San Francisco Bay

D. Roberts, SFEI (Nutrient Management Strategy)

Description

Understanding sediment dynamics in estuaries requires measuring time-varying suspended sediment concentrations (SSC) at sub-tidal time scales. Continuous turbidity measurements from moored sensors can be calibrated to SSC to enable high-frequency estimates of water column sediment concentrations. By leveraging existing and ongoing turbidity measurements from a network of monitoring stations managed by the San Francisco Bay Nutrient Management Strategy (NMS; Figures 1 and 2), estimates of historic and on-going SSC concentrations at sites across South and Lower South San Francisco Bay (SB and LSB respectively) can be achieved at relatively low cost. Note that Figure 1 shows eight of the nine existing NMS stations. The ninth station, on the eastern shoal of SB, is shown in Figure 2. The NMS has tentative plans to move the Newark and Mowry stations (Figure 1) to the sites shown by blue stars in Figure 2.

Sediment dynamics in San Francisco Bay are driven by the interplay between inflow watershed loading, tidal currents, and wind waves. Existing watershed gauges can be used to estimate inflow loads. Tidal currents, or at least the magnitude of these currents, are somewhat easily inferred from existing field data and hydrodynamic models. However, long-term wave effects have mostly been inferred from wind speed; the lack of direct measurement is an impediment to understanding and modeling sediment fluxes in shallow areas. NMS stations could be supplemented with high-frequency pressure sensors to quantify wave height and period in parallel with the turbidity/SSC signal. Continuous and spatially-distributed measurements of water-column SSC and wave characteristics are essential to sediment transport model calibration and validation. These data would also serve as valuable background data for parallel observational studies in SB, including the SB sediment flux studies proposed by J. Lacy (USGS). All data associated with this study will be processed, quality assured, and shared via a publicly accessible web portal.

Potential options for leveraging NMS moored sensor stations for efficient and low-cost expansion of sediment monitoring in San Francisco are described below. Cost estimates for one year of monitoring are included in Table 1.

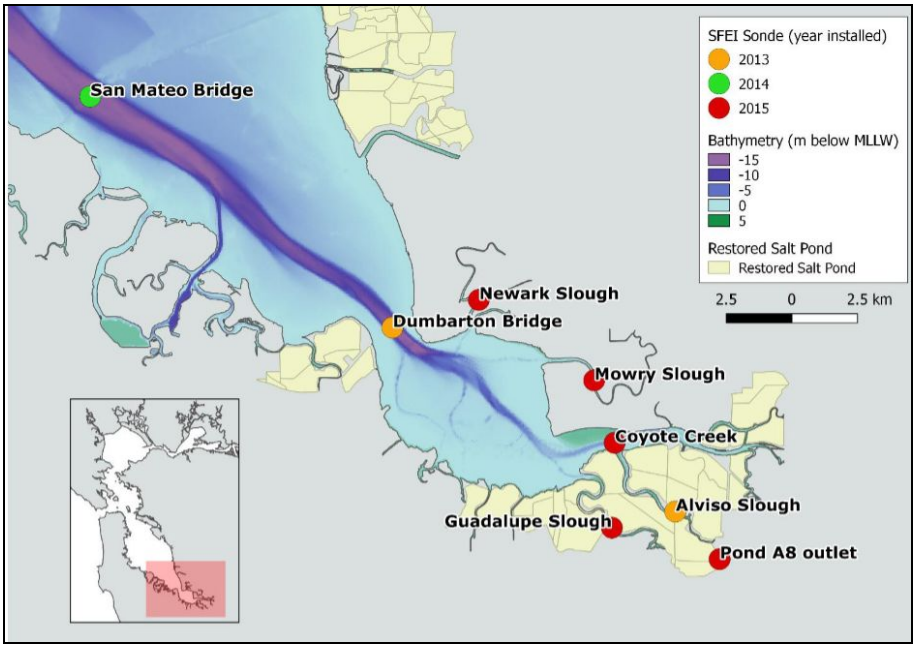

Figure 1 - Eight of nine nutrient management strategy monitoring stations in South and Lower South San Francisco Bay.

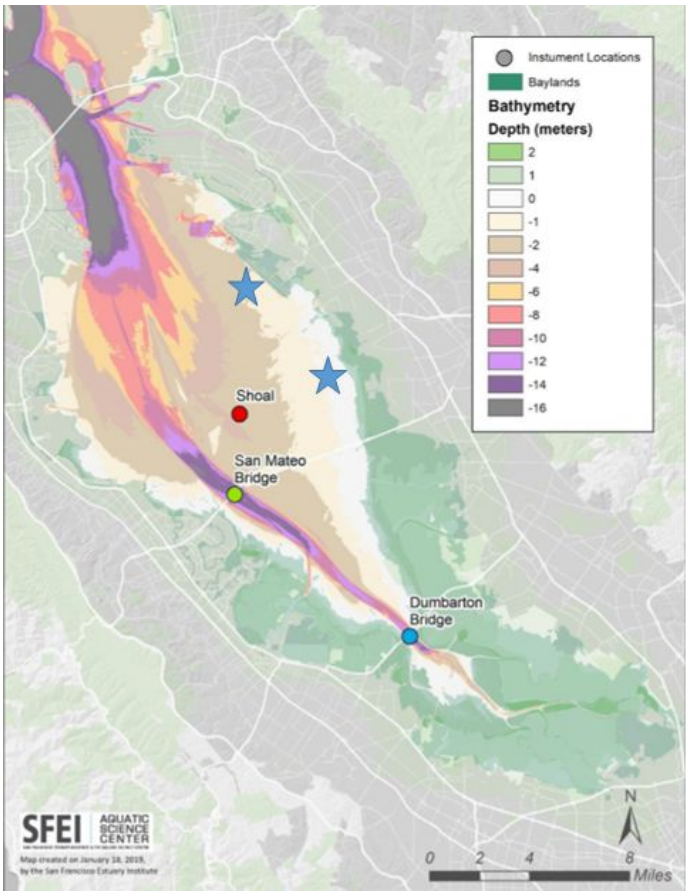

Figure 2 - NMS South Bay monitoring sites. Proposed new sites are shown as blue stars.

Lowest-Cost Effort (Option 1)*:* Near-surface water samples could be collected at any four of the nine NMS moored sensor sites selected with input from representatives of the Sediment WG and the Wetlands RMP, and modeling community. These samples would be analyzed for suspended sediment concentration (SSC) and particle size distribution (PSD). Processing and quality control of turbidity data is already performed as part of NMS monitoring efforts. The processed turbidity signal from the time of the sample would be calibrated to SSC. Variability in PSD associated with SSC levels could be explored (if needed).

Next-Level Effort (Option 2)*:* In addition to the turbidity-to-SSC calibration summarized above, high-frequency, bursting pressure sensors could be deployed at the proposed shoal stations shown as blue stars in Figure 2. These low-profile, reliable sensors would supplement the continuous SSC estimates with continuous data on wave height and period. Sensors would require static mounting within ~1-2 meters of the surface (wave pressure signal attenuates with depth). Sensors would be serviced (cleaning, batteries, data offload) during standard monthly NMS station servicing. Data would be processed in parallel to the turbidity data. Deployment-specific and on-going/long-term files of processed/quality controlled data would be maintained.

Budget

Expense	**Estimated Cost (Option 1 - low cost effort)**	**Estimated Cost (Option 2 - full effort)**
Task 1 - Project coordination	$10,800	$13,500
Task 2 - Suspended sediment sample collection and processing; SSC concentration and PSD	$9,600	$9,600
Task 3 - Calibration of sensor turbidity data to SSC samples; basic technical report	$6,750	$6,750
Task 4 - Initial pressure sensor deployment		$1,620
Task 5 - Wave data processing		$5,400
Task 6 - Maintaining web portal with up-to-date data	$10,000	$10,000
Task 7 - Presentation and reporting to RMP	$5,000	$5,000
Direct Costs		
16 Hz RBR pressure sensor and mounting hardware		$7,100
Miscellaneous deployment hardware		$1,200
Grand Total	**$42,150**	**$60,170**

Timeline and Deliverables

Task/Deliverable	Date
Begin monthly SSC sampling	Mar 2021
Deploy wave sensors	Mar 2021
Monthly updates to curated wave height/period data set	Mar 2021 - Mar 2022
Curated SSC sample dataset	Apr 2022
Technical report, including turbidity-to-SSC calibration	Apr 2022
Curated high-frequency SSC dataset from turbidity data	Apr 2022
Presentation to RMP	May 2022

Expected Outcomes/Value-Add

Continuous estimates of water-column suspended sediment concentrations are essential to sediment transport model calibration and to guiding pointed field studies. In addition to filling spatial gaps in our overall understanding of San Francisco Bay sediment dynamics, these data would indirectly support understanding of SB biogeochemical processes; the effect of SSC on light conditions is understood to be an essential process in controlling SB phytoplankton growth.