# Investigation and Design Considerations for Active Harbors with Contaminated Sediments

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**Background/Objectives.** The presence of contaminated sediments creates a management challenge for active harbors and marinas. Several sites in San Francisco Bay, including a recreational marina and a ferry landing, are currently in various stages of investigation, design, environmental review and project permitting. The challenges are technical in terms of site investigation, project design, and regulatory approvals, but also create long-term operational controls and management, monitoring and maintenance.

**Approach/Activities.** Four topic areas will be discussed: site characterization, engineering evaluations and design, environmental review and agency permitting, and long-term management and maintenance considerations. The site characterization approach at an active harbor needs to include the typical data quality objectives to define the area of remediation (dredging capping, or other) but also included the collection of data to assess the feasibility of dredging to remove all contaminated sediment vs placement of a cap and additional data needed to evaluate and design the cap (e.g., post-cap z layer for breakthrough analysis and other important parameters such as upwelling velocity and geotechnical data). Additional data and evaluations are necessary to assess factors that include long-term stability, wave and vessel scour potential, recontamination potential, and dredge residuals among others.

As part of the remedial alternatives evaluation, there may be a need to consider reconfiguration of the harbor or berths (e.g., berth depth, location, etc.) and/or changes in uses and usage patterns to minimize operational impacts to the cap and facilitate future maintenance and long-term effectiveness of the remedy. Special considerations during environmental review and permitting include impacts of the quantity and types of fill, habitat alterations, and related mitigation requirements. Long-term performance monitoring and maintenance needs to ensure stability and integrity of the remedy (e.g., protection of a cap) as well as the ability to cost-effectively operate within the harbor. An important post operational challenge is how to effectively conduct future maintenance dredging of the harbor without impacting the sediment cap.

**Results/Lessons Learned.** The presentation will review the approach and results of evaluations described above for two harbors: (1) a recreational marina where the configuration and usage of the marina were redesigned along with a plan for dredging and capping, and (2) a newly planned ferry landing where scour analysis, chemical breakthrough, sediment transport and recontamination potential were assessed to address long term stability and performance of a cap over a portion of the project dredge footprint.