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Investigation and Design Considerations for Active Harbors/Recreational Areas with Contaminated Sediments

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Background

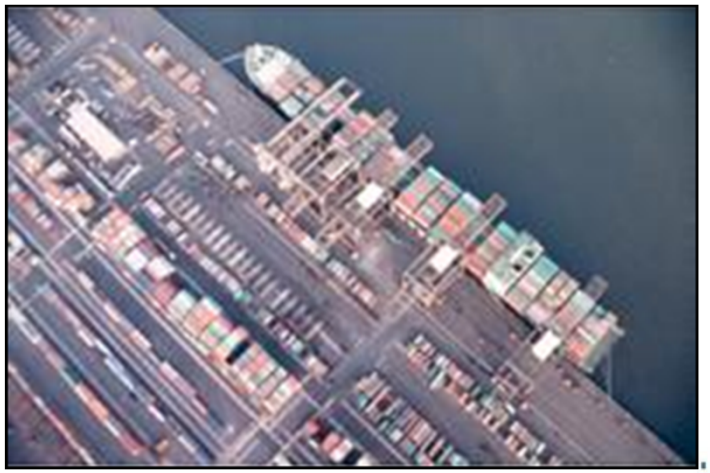
- Sediment contamination is often present in nearshore environments
  - Active harbors/marinas and ports
  - Recreational areas
  - Natural areas
- Reality: nearshore/waterfront areas are of high value economically and ecologically
- Challenge: designing remedies in a manner compatible with current and future uses

Conflict with Sediment Remediation Principles

- #9: Maximize the Effectiveness of Institutional Controls and Recognize their Limitations

  Options:

  - Change or restrict land/waterway uses
  - Develop remedy that respects current (and potential future) uses
  - Hybrid approach



Implementation Challenges

- Balancing the remedy design and cost with the need to:
  - Maintain current and known future uses
  - Allow for expansion of uses in the future
  - Minimize the potential for remedy failure or recontamination
  - Minimize long-term O&M
- Stakeholder concerns
- Long-term liability

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Technical Challenges

- Removal of all contaminated sediments is often challenging and may not be viable or the best option
- Extensive regulatory constraints and requirements to leave material in-place or cap in place
- Environmental review/permitting can be extensive
- Additional testing requirements and special studies:
  - Characterize current and future surface
  - Assess sediment stability, scour potential
  - Evaluate cap feasibility and effectiveness
  - Study sediment transport and recontamination

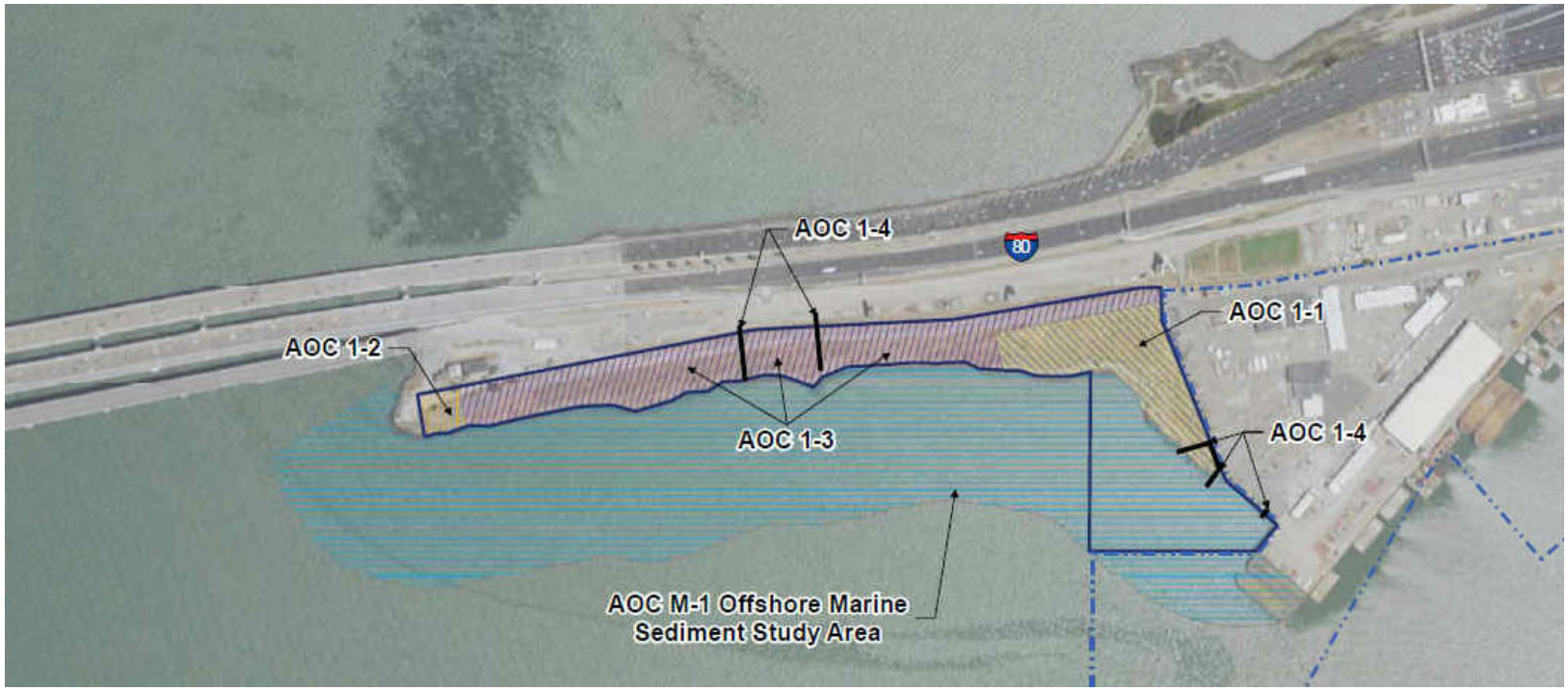
Technical Challenges (cont'd)

- Engineering design consistent with site uses, operations and constraints
- Evaluation of the impact of sea-level rise/ planned improvements for shoreline resiliency
- Implementation and enforcement of institutional controls
- Long-term monitoring, maintenance and reporting

Case Studies

- Restrict waterway use: open space/park
- Design to accommodate land use plans: new ferry landing
- Hybrid approach: existing recreational marina

Example: Open Space/Park



- Future Shoreline Park (AOC M-1): PCB contamination
- Proposed remedy: Institutional Controls only

Proposed Waterway Use Restriction: Institutional Controls (ICs)

- Require landowner to prohibit clamming and harvesting of mussels
- Prohibit collection of shellfish for bait
- Implement by posting warning signs, possibly physical barriers, and landowner enforcement
- Petition State to impose a year-round ban on the harvesting of clams and mussels at the site
- Assume little direct contact with sediments by recreators

Problems with Use Restrictions

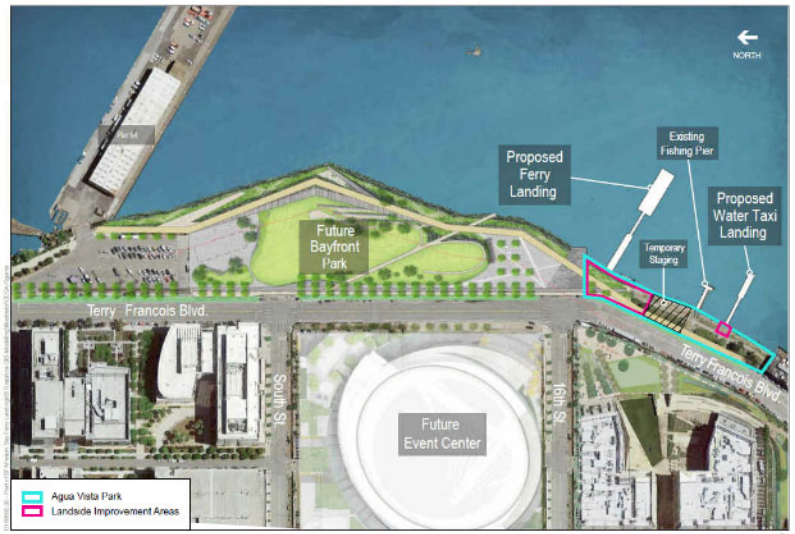
- Not easily enforceable in open access parklands
- Area can be accessed by boat
- State agency (OEHHA) does not impose bans, only issues warnings and advisories
- Beneficial uses remain impaired (conflict with CWA 303d/TMDL)
- Unaddressed pathways: bioaccumulation and higher trophic level risk (fish)—fish movement cannot be managed by ICs
- Assumptions about direct contact may not be realistic

Alternate Option for Remedy

- Limited removal and backfill
  - Removal in areas with highest concentrations
- Warnings still posted, however:
  - Lowers burden on landowner
  - Limits future liability
- Results in:
  - Reduction in direct contact risk for recreators
  - Partially address 303d/TMDL requirements

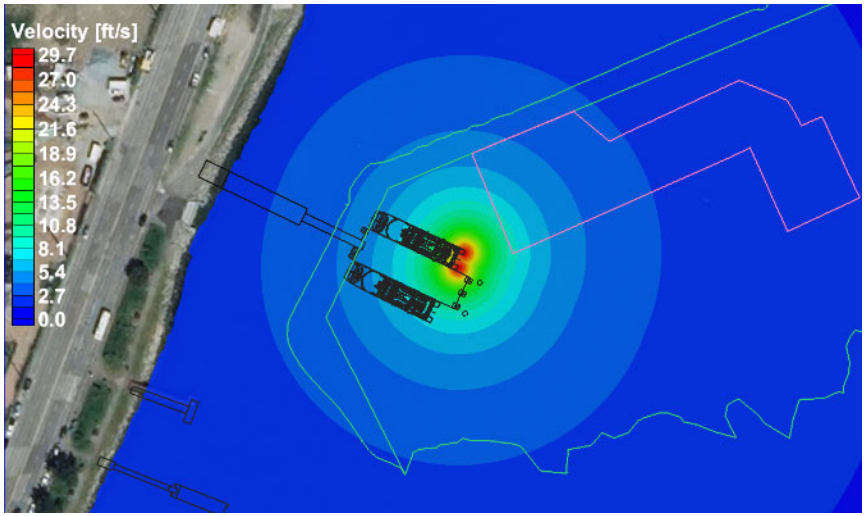
Example: New Ferry Landing

- PAH contamination in portion of new project dredging footprint
- Area will be used by ferries and water taxis
- Remedy: partial dredge and cap with marine mattress



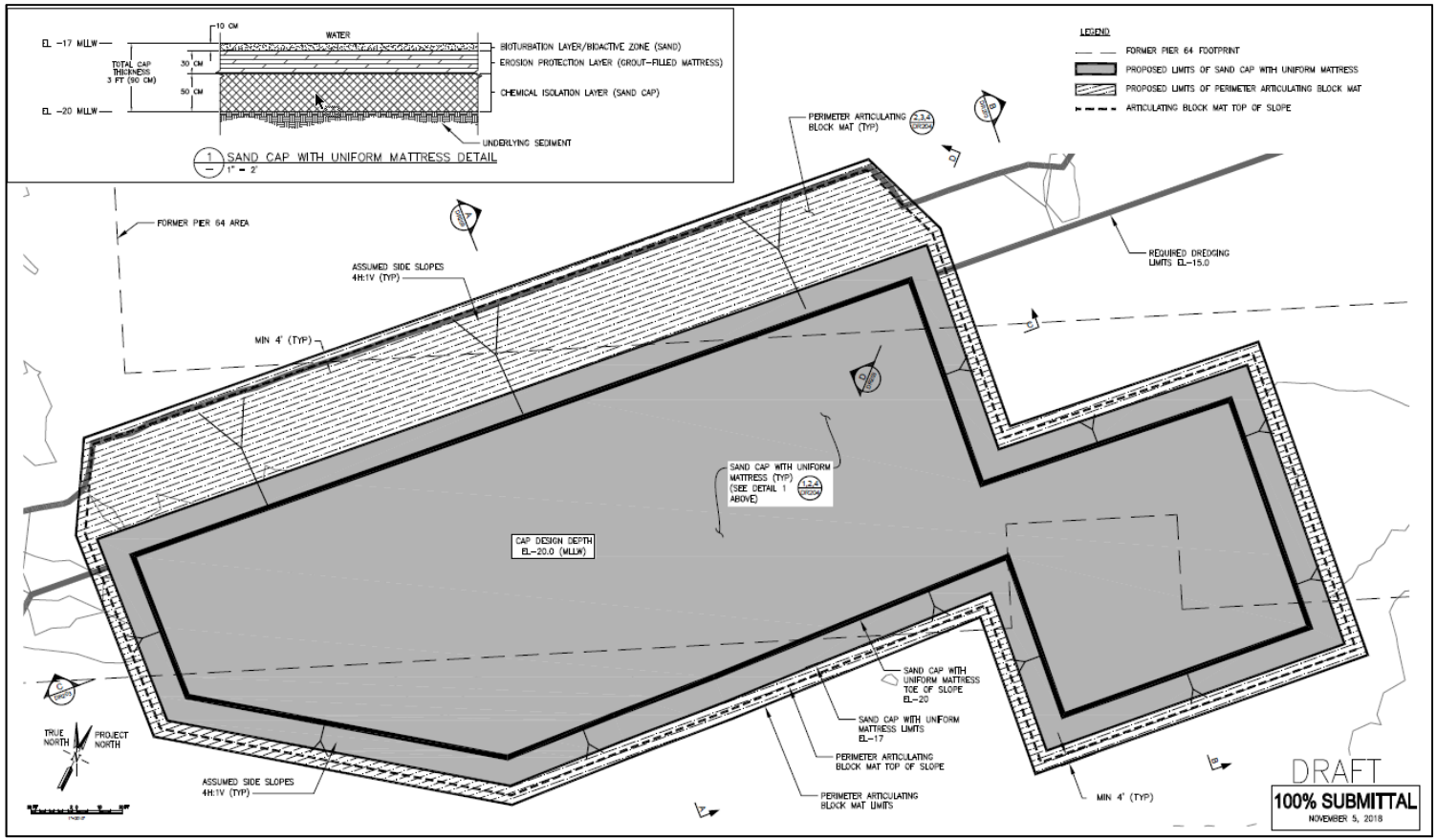
Technical Challenges

- Characterize "z-layer" and data to estimate post-remedy surface PAHs
- Analyze breakthrough (Palermo algorithm)
- Model scour/erosion and sediment transport
- Dredge to depths to:
  - Accommodate project design
  - Accommodate cap
  - Address vessel scour
  - Allow for future maintenance dredging
  - Provide a habitat layer for benthic recolonization



Findings

- A 2 ft sand cap isolation layer is expected to reliably contain underlying PAH contamination for more than 100 years
- Vessel traffic (worst-case jet boat applying 100% power while moored) generates a sustained bottom velocity of 13 feet/second
  - A 12-in thick marine mattress or articulating block mat is a viable option for scour protection
- A bioturbation layer thickness of 10 cm (3.9 in.) was a reasonable estimate



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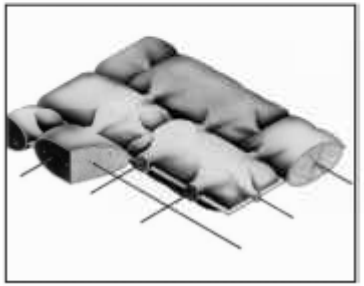
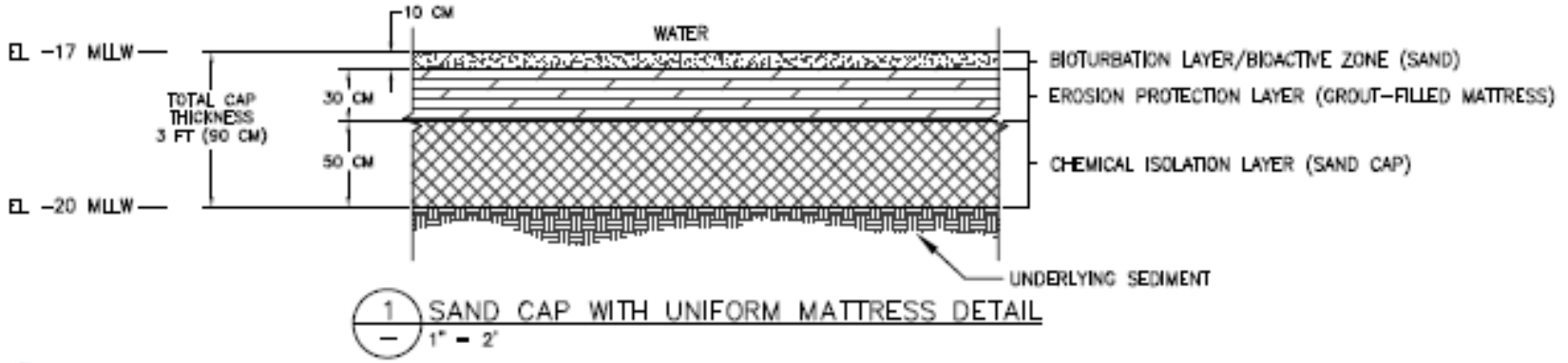


ARTICULATING BLOCK MAT



Example: Recreational Marina

- Contaminated sediment extends to >20 ft below MLLW in some areas
- NAPL is present in a limited area
- Less contamination in northern berths
- Marina requires maintenance dredging to remain operational

- Fuel dock within the Marina is an important concession and continued use as marina/recreational area is desirable
- Remediation of the entire marina is technically challenging and costly
- Remediation will have impacts on local community (noise, odor, etc.) and force temporary closure and relocation of vessels

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"Hybrid" Approach Being Considered

- Goals
  - Minimal to no net decrease in slips, retain the fuel dock
  - Address NAPL area
  - Provide recreational opportunities while minimizing impacts of remediation on local community
- Potential solution
  - Dredge portion of marina and place a cap over residual contamination where necessary to support current uses
  - Remediate NAPL area and develop cleanup plan for southern berth area to support alternate recreational use, increase public access, and provide restoration opportunity
    - e.g., habitat area, water taxi, kayak/paddleboard launch
  - Renovate adjacent marina
    - Expand adjacent marina to create additional slips
    - Install fuel tanks and move fuel dock to adjacent marina

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Advantages (and disadvantages) of Hybrid Approach

- Addresses technical challenges
  - Less dredge and disposal
  - Less complicated cap
  - Reduced long-term O&M, risks
  - Less construction impacts on local community
- Reduces project costs
- Maintains or expands overall use opportunities

Main disadvantages
- Additional CEQA, permitting
- Extends project timeline
- Leaves more contamination in place

Important Considerations

- Design data collection to enable evaluation of all approaches being considered
- Collect data for cap and scour modeling
- Mitigation may be required for temporary disturbance, fill, shading, etc.
- Stakeholder involvement
- Development requirements for future maintenance dredging to protect remedy (e.g., cap)

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