Challenges of Phased Sediment Remediation at Esquimalt Graving Dock – Vancouver Island, BC

Tom Wang, P.E. (Anchor QEA)
Andrew Mylly, B.Sc., EP, PMP (Public Works and Government Services Canada)

May 2, 2012
Presentation Overview

- Site description and background
- Contaminants of concern
- Project phasing and design considerations
  - Operational considerations
  - Sheetpile wall design
  - Open water dredging
  - Infrastructure demolition/temporary relocation
  - Environmental management
  - Construction mitigation/habitat compensation
  - Residuals management
- Project schedule
Site Description and Background

- Esquimalt Graving Dock (EGD) is a federal government-operated multi-user ship repair and maintenance facility.
- Historic activities since 1850’s contributed to sediment contamination; EGD established 1927.
- Contamination located throughout EGD Waterlot and South Jetty underpier.
- South Jetty requires replacement – timeline undetermined.
- EGD is an early action site within Esquimalt Harbour; Department of National Defence responsible for Harbour-wide management.
Site Description and Background

Esquimalt Harbour

EGD

Constance Cove

DND Facilities
Site Description and Background

Remedial objectives

- Prepare for potential governance change
- Reduce financial liabilities and risks as per FCSAP
- Environmental stewardship, policies, due diligence
- Remediate to generic standards - CCME PEL and BC CSR SQC
Site Description and Background

• Harbour-Wide Context
  – DND is the federal custodian
  – Numerous studies conducted, including human health risk assessment
  – Consumption advisory in effect for First Nations and recreational seafood harvest
  – Management plan in development
Site Description and Background

• Remedial Action Plan/Risk Management Plan
  – Remedial Alternatives Developed & Compared
    • Preferred alternative: maximum extent practicable removal, phased approach
    • Long-term risk management for undisturbed residuals
  – Evaluation Criteria
    • Protection of human health
    • Compliance with RAOs
    • Effectiveness (short-term and long-term)
    • Reduction of toxicity, mobility, volume
    • Reduction of liability
    • Technical feasibility and implementability
    • Cost
Site Description and Background

Site Investigations
Site Description and Background

Sediment Sampling Core

EGD Sediment Sample
09-1475-0026 (2000)

SCO9-127

21 July 09
Contaminants of Concern

Legacy contaminants
- Metals, TBT, PAHs, PCBs
Project Phasing

- South Jetty underpier is the highest contaminant concentration area
- Infeasible to remove or cap underpier sediments with South Jetty in place
- Uncertainty in timing of South Jetty replacement and Harbour-wide management plan affects design
  - Supporting potential governance change a priority
  - Prevent recontamination from South Jetty
  - Maintain EGD operations
  - Provide buffer to Harbour-wide contamination and monitoring zone
Project Phasing

• Phase 1 remediation
  – South Jetty sheetpile wall
  – Open water dredging including buffer areas
  – Shoreline stabilization
  – Habitat compensation

• Phase 2 remediation
  – Underpier remediation
  – South Jetty replacement to be integrated under separate capital funding
South Jetty Underpier
Phase 1 Operational Considerations

- Provide operational access to South Jetty underpier areas
- Limit interference with EGD operations during construction
- Accommodate design vessel usage between Phase 1 and 2 remediation
- Mitigate health and safety, and fire protection concerns from sheetpile wall installation
Sheetpile Wall Design

South Jetty Sheetpile Wall Phasing
Sheetpile Wall Design

- **Structural criteria**
  - Design life of 10 years (temporary)
  - Propped cantilever design - top of wall at deck level
  - Extends continuously around jetty perimeter
  - Geotechnical considerations

- **Operational and confined space entry considerations**
  - Vent/light portholes through perimeter wall
  - Small boat access

- **Fire safety considerations**
  - Fire Commission of Canada
  - MOU with DND

- **Design vessel and propwash forces**
Phase 1 Design Vessel Criteria

• Seaspan Hawk Tugboat
  – Twin stern thrusters
  – 50% power
  – 15 m from sheetpile wall
  – All of South Jetty perimeter

• BC Ferries Spirit “S” Class Ferry
  – Single bow thruster
  – 100% power
  – 3 m from sheetpile wall
  – 30 m nearest graving dock mouth
Propwash Modeling

Reference Vector → 2 m/s

Esquimalt Run ID: Sce-4B10

Velocity vectors along x-y plane at z = 54.5 m.
Time (sec) = 0.100000024
Open Water Dredging
Open Water Dredging

- Project area: 106,400 m$^2$
- Dredging thickness: 0.5 to 3.0 m
- Dredge volumes
  - Phase 1: 144,600 m$^3$
- Dredge elevations
  - Maximum depth: -14.4 m chart datum
  - Intertidal dredging/excavation
- Dredging limitations
  - Structural considerations
  - Geotechnical stability
# Statistical Level of Confidence for Phase 1 Dredging

<table>
<thead>
<tr>
<th>Removal Scenario</th>
<th>Removal Volume, m³</th>
<th>Confidence Level</th>
<th>Phase 1B Cost*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminated Neatline (no OD)</td>
<td>71,250</td>
<td>50%</td>
<td>$25,123,000</td>
</tr>
<tr>
<td>Contaminated Neatline + 0.3 m OD</td>
<td>98,444</td>
<td>70%</td>
<td>$30,826,000</td>
</tr>
<tr>
<td>Contaminated Neatline + 0.5 m OD</td>
<td>116,573</td>
<td>85%</td>
<td>$34,626,000</td>
</tr>
<tr>
<td>Dredge Prism Design (no OD)</td>
<td>117,336</td>
<td>90%</td>
<td>$36,206,000</td>
</tr>
<tr>
<td><strong>Dredge Prism Design + 0.3 m OD</strong></td>
<td><strong>144,600</strong></td>
<td><strong>94%</strong></td>
<td><strong>$41,911,000</strong></td>
</tr>
<tr>
<td>Dredge Prism Design + 0.5 m OD</td>
<td>162,658</td>
<td>99%</td>
<td>$45,713,000</td>
</tr>
</tbody>
</table>

* Does not include non-remedial construction costs
Remediation Zones to Reduce Potential for Recontamination and Operational Impacts
Dredged Material Disposal Classification

- Sediment disposal suitability impacted by Na & Cl
- Cost estimate assumes all material disposed as IL+
- Volume breakdown, excluding Na & Cl suitability

<table>
<thead>
<tr>
<th>Material Classification</th>
<th>Percent of Dredged Material</th>
<th>Volume, m³</th>
<th>Probable Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>RL+</td>
<td>34%</td>
<td>48,200</td>
<td>$90/tonne</td>
</tr>
<tr>
<td>IL+</td>
<td>66%</td>
<td>96,400</td>
<td>$120/tonne</td>
</tr>
</tbody>
</table>
Environmental Management and Approvals

- CEAA screening
- DFO Section 35(2) Habitat Authorization
- Archaeological overview assessment
- Habitat compensation
  - Habitat equivalency analysis
  - Evaluation of six conceptual designs/sites
- First Nations communications
- Public communications
- Construction environmental monitoring program
- Navigable Waters Protection Act (NWPA) approval
- Local/municipal construction permit
Construction Mitigation and Habitat Compensation

- Work within fisheries windows
- Containment of dredge area
  - Silt curtain
- Water quality monitoring
- Water tight barge (if required)
- Marine mammal monitoring
- Osprey nest
  - Relocation or monitoring
- Mitigation during pile driving
  - “Ramp up” approach
  - Acoustic monitoring
- Habitat compensation
  - Temporary loss under South Jetty prior to Phase 2
Water Quality

- Dredging and barge dewatering
  - Baseline turbidity
  - DRET results indicate most areas acceptable for barge dewatering with containment
- DREDGE modeling
  - Containment during dredging required
- Turbidity monitoring
Off-Site Sediment Offloading and Handling

PHOTO 1: OFFLOADING OPERATIONAL CONTROLS

PHOTO 2: OFFLOADING OPERATIONAL CONTROLS
Residuals Management

- Probable scenario: 4-10 cm thick
- Dredge cleanup pass if required, based on post-dredge sampling
- Placement of 30 cm clean sand
- Sediment mixing occurs 40 cm deep
- Top 40 cm average concentration
  - Combines sand cover and residuals
Residuals Management

Pre-dredge Condition

Post-dredge Condition with Residual Layer

Condition After Sand Placement

Post Remediation Condition After Mixing

1. Dredged material
2. Design Depth
3. Surface After Sand Placement
   - Clean Sand Layer (30 cm)
   - Propwash Mixing Zone (40 cm)

- 10 cm grab
- 50 cm composite core
- Residual Layer
Confirmation Sampling Decision Framework

• Post-dredge sampling
  – Top 10 cm – residual measurement
  – Top 50 cm – missed inventory
  – Possible 0.5 m cleanup pass, if necessary

• Long-term monitoring
  – Baseline following cover placement – top 10 cm
  – Assess potential recontamination
  – Risk management monitoring of remaining contaminants
• Phase 2 – To be determined
Questions?

Design Team
Public Works and Government Services Canada
Anchor QEA
Golder Associates
Klohn Crippen Berger