Esquimalt Graving Dock Waterlot Remediation Mega-Site (Phase 1B): Design, Contracting, and Construction Challenges

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Presentation Overview

- Esquimalt Graving Dock (EGD) site description and background
- Phase 1B description and objectives
- Challenges
  - Remedial design
  - Construction tendering
  - Construction implementation
- Project performance
Site Description and Background

Esquimalt Harbour

Constance Cove

EGD

DND Facilities

DND - Department of National Defence
EGD - Esquimalt Graving Dock
Site Description and Background (cont.)
Site Description and Background (cont.)
Active Shipyard/Graving Dock Facility

- More than 50 vessel calls per year
Phase 1A – Under-Pier Erosion Protection System

- Sheetpile wall prevents resuspension and transport of contaminated under-jetty sediment into Phase 1B area
- Constructed November 2012 to April 2013
Phase 1A – Under-Pier Erosion Protection System (cont.)
Phase 1B – Open-Water Dredging

- Dredging and disposal
  - 145,600 m$^3$
- In-water slope armouring
  - 22,800 m$^3$
- Residuals management cover placement
  - 45,000 m$^3$
- Structure demolition and temporary relocations
- Construction June 2013 to March 2014
Phase 1B – Open-Water Dredging (cont.)
Phases 1C and 2

• Phase 1C – Habitat compensation
  - Offsets impacts of alteration and isolation of under-pier habitat
  - Construction of new intertidal marsh fish habitat

• Phase 2 – Under-pier remediation
  - 40,000 m³ of contaminated sediment removal
  - To be conducted within 10 years in coordination with jetty redevelopment projects
Key Phase 1B Objectives

- Remove maximum contamination practicable
  - Reduce Government of Canada financial liability
  - Establish baseline conditions for future operations
  - Meet federal and provincial standards
  - Reduce risks to human health and the environment
  - Achieve Federal Contaminated Sites Action Plan objectives
Key Phase 1B Objectives (cont.)

• Schedule
  - Minimize disturbance to operations
  - Complete by March 2014

• Ensure high level of certainty in project outcome
  - Conservative, practical, and constructible design
  - Proven technologies
  - Qualified contractors
Design Challenges

• Development of remedial dredge prism
• Dredge residuals management
• Construction sequencing and operations needs
• Water quality criteria and best management practices (BMPs)
• Geotechnical and structural restrictions
• Balancing use of performance vs. prescriptive specifications
• Risk-based contingency
Development of Remedial Dredge Prism

- Dredge design considerations

Legacy contaminants (metals, tributyl tin [TBT], polycyclic aromatic hydrocarbons [PAHs], and polychlorinated biphenyls [PCBs])
# Development of Remedial Dredge Prism (cont.)

- Dredge design considerations

<table>
<thead>
<tr>
<th>Removal Scenario</th>
<th>Removal Volume, m³</th>
<th>Confidence Level</th>
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</thead>
<tbody>
<tr>
<td>Contaminated Neatline (no OD)</td>
<td>71,250</td>
<td>50%</td>
</tr>
<tr>
<td>Contaminated Neatline + 0.3 m OD</td>
<td>98,444</td>
<td>70%</td>
</tr>
<tr>
<td>Contaminated Neatline + 0.5 m OD</td>
<td>116,573</td>
<td>85%</td>
</tr>
<tr>
<td>Dredge Prism Design (no OD)</td>
<td>117,336</td>
<td>90%</td>
</tr>
<tr>
<td><strong>Dredge Prism Design + 0.3 m OD</strong>*</td>
<td><strong>149,630</strong></td>
<td><strong>94%</strong></td>
</tr>
<tr>
<td>Dredge Prism Design + 0.5 m OD</td>
<td>162,658</td>
<td>99%</td>
</tr>
</tbody>
</table>

* Selected design criteria
Residuals Management at EGD

- Confirmation testing for contingency redredging
- Placement of residuals management cover material

**Residuals Management Flowchart**

1. Remove dredged material to depth specified in remedial plan.
2. Collect confirmatory samples (50 cm composite core and 10 cm surficial grab)
   - Is missed inventory detected based on 50 cm composite samples?
     - NO
     - DO concentrations in the surface and mixing zone meet the remedial goals?
       - YES
         - Sand Placement
       - NO
3. Residuals Successfully Managed

Refine data

Continue dredging in specific area

Contingent cleanup pass

Sand Placement

YES

NO
Residuals Management at EGD (cont.)

- **Pre-dredge Condition**
  - Dredged material
  - Design Depth

- **Post-dredge Condition with Residual Layer**
  - 10 cm grab
  - Post-dredge Surface
  - Residual Layer

- **Condition After Sand Placement**
  - Clean Sand Layer (30 cm)
  - Surface After Sand Placement

- **Post Remediation Condition After Mixing**
  - Propwash Mixing Zone (40 cm)
  - Residual Layer

- **Other Notes**
  - 50 cm composite core
  - 50 cm
  - 10 cm
Confirmatory Sampling

- Residuals management strategy included in design
  - Contingency actions during construction
Construction Sequencing

- Construction sequencing to remove “hotter” contamination areas first
- Operational considerations
Water Quality Monitoring

- Intensive water quality monitoring as part of comprehensive environmental monitoring program
  - Field turbidity monitoring
  - Assess total suspended solids from dredging
  - Allow faster responsiveness in the field
  - Laboratory analysis to confirm field results
Silt Curtain
Integrating Geotechnical and Structural Restrictions

- Work adjacent to existing structures
  - Requirements for dredging setback and offsets
Integrating Geotechnical and Structural Restrictions (cont.)

- Graving dock sill
Integrating Geotechnical and Structural Restrictions (cont.)
Performance-Based vs. Prescriptive-Based Specifications

- Performance-based specifications
  - Achieving required dredge prism
  - Environmental compliance
    - Silt curtain usage
    - Water quality
  - Placement of in-water slope armour and backfill material
  - Transport and disposal
Performance-Based vs. Prescriptive-Based Specifications (cont.)

- Prescriptive-based specifications
  - Operational considerations
  - Construction sequencing
    - Fisheries and Oceans Canada (DFO) work windows
  - Work near structurally sensitive areas
  - Quality control
    - Surveying
    - Reporting
  - Transport and disposal
Risk Management Contingency Budget

- Identify key construction risks and potential consequences
- Identify controls and risk response strategy
- Calculate risk allowance
  - Based on likelihood, impact, and response
- Calculate Risk Management Contingency
- Update during course of project
Construction Tendering Challenges

- Limited pool of potentially qualified contractors
  - Develop Invitation To Tender qualification criteria
    - Contaminated sediment dredging > 40,000 m³
    - In-water slope armoring
    - Silt curtains and projects requiring Environmental Management Plans
    - Active marine site
    - Land transport and landfill disposal > 20,000 m³
  - Contracting strategy
    - Single Design-Bid-Build contract
    - Public tender
  - Balance cost competitiveness vs. risk
Key Pre-Construction Challenges

• Pre-construction submittal requirements
  - Landfill disposal and offload facility permits
  - Construction work plan
  - Environmental protection plan
  - Quality control plan

• Public communication and outreach

• Design team responsibilities
  - Construction Quality Assurance Plan
  - Environmental Management Implementation Plan
  - Confirmatory Sediment Sampling Plan
Key Construction Challenges

- Construction impacts on EGD operations
  - Operations takes precedence over construction
  - Booking schedule changes
  - Limited on-site staging area
  - DND facility coordination

- Contractor schedule changes

- Residual management cover placement after dredging is complete
Key Construction Challenges (cont.)

- Contractor experience with large-scale sediment remediation
  - Achieve tight design tolerances
  - Offload facility production rate
  - Diver-assisted hydraulic dredging
  - Dewatering
Key Construction Challenges (cont.)

- Remove maximum contamination practicable
  - Unanticipated subsurface conditions

- Rock buttress material encountered above design dredge elevation
- Debris encountered in hydraulic dredge area
- Bedrock encountered above design dredge elevation
- Hard material (debris) and glacial till encountered above design dredge elevation
- Timber piles encountered in dredge prism
- Re-design of backfill pads
Key Construction Challenges (cont.)

- Remove maximum contamination practicable
  - Missed inventory and residuals contingency dredging
Project Performance

- Work completed on schedule in March 2014
- Maximum contaminant removal - 145,600 m³
- Confirmatory results
Project Performance (cont.)

- Predicted post-cover mixed concentration
Project Performance (cont.)

**Esquimalt Graving Dock - Phase 1B - Open Water Remediation**

Dredging Progress by Volume

- **Cumm. Planned Volume**
- **Cumm. Actual Barge Volume**
- **Cumm. Actual Trucked Volume**
- **Cumm. Actual Survey Volume (Monthly)**

**Note:** A total of 145,548 cubic metres of dredged material (payable and non-payable volume) has been removed from the EGD Work Site to date.

- 149,630 Cubic Metres Design Volume and Schedule for Completion
- 136,162 Cubic Metres Adjusted Payable Volume for Required Dredging and Contingency Re-Dredging Work Completed to Date

**Week of**

- 5/20/13
- 6/9/13
- 6/17/13
- 7/1/13
- 7/7/13
- 8/2/13
- 8/12/13
- 9/9/13
- 9/2/13
- 10/21/13
- 11/18/13
- 12/16/13
- 1/10/14
- 1/21/14
- 2/24/14
- 3/10/14
- 4/7/14

**Cumulative Totals (m³)**

- 0
- 20,000
- 40,000
- 60,000
- 80,000
- 100,000
- 120,000
- 140,000
- 160,000

**Completion of dredging activities (based on initial schedule)**

**Completion of dredging activities (based on current schedule)**

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Lessons Learned

- Develop specifications to address risk and minimize claim potential
  - Allow contractor flexibility in means and methods
  - Be prescriptive where operational needs govern
- Plan for dredge residuals with sequencing, BMPs, and contingency actions
- Incorporate risk-based contingency into project cost estimate
- Select qualified contractor using criteria that balance cost-competitiveness and risk
Lessons Learned (cont.)

- On-site construction management staff reinforce objectives of the cleanup
  - Slower pace of work
  - Techniques to manage more precise dredge cuts
  - Maximize removal of contamination

- Minimize impact to operations
  - Regular communication with contractor is essential
  - Full-time construction inspection improves coordination
  - Adaptive management approach is critical
Questions?

Photograph courtesy of Heath Moffatt