Phase 1B Esquimalt Graving Dock Waterlot Dredging Residuals Predictions and Performance

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

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Presentation Overview

- Background
  - Esquimalt Graving Dock (EGD) remediation overview
  - Dredging residuals
- Comparison of residuals predictions and performance
  - Undisturbed residuals
  - Generated residuals
  - Contingency measures
    - Redredging
    - Residuals management placement

Site Description and Background

DND: Department of National Defence
EGD: Esquimalt Graving Dock

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 cubic meters (m^3)
- In-water slope armoring
  - 22,800 m^3
- Residuals management cover placement
  - 45,000 m^3
- Structure demolition and temporary relocations
- Construction June 2013 to March 2014

Phases 1C and 2

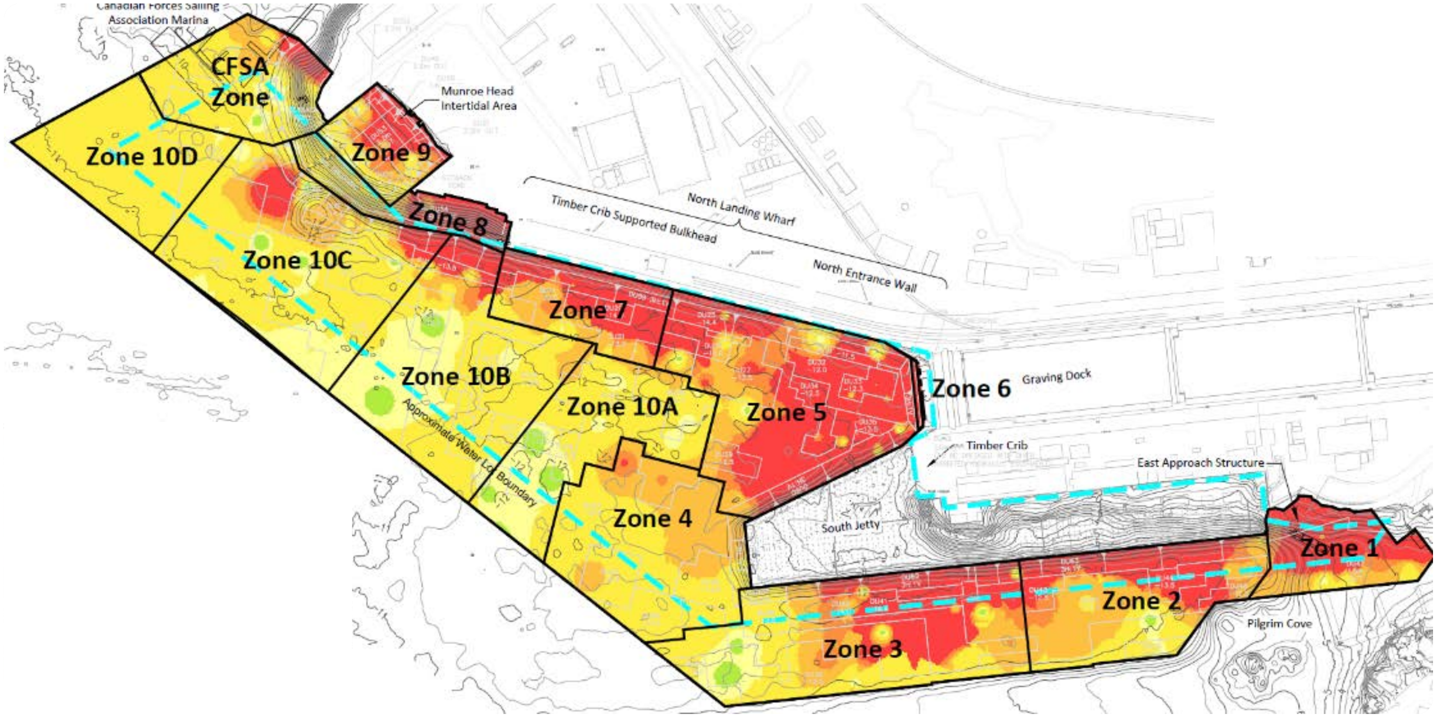
- Phase 1C – Habitat Compensation
  - Offsets impacts of alteration and isolation of under-pier habitat
  - Construction of new intertidal marsh fish habitat
- Phase 2 – Under-Pier Remediation
  - 36,500 m^3 of contaminated sediment removal
  - October 2015 through December 2016

Key Project Objectives

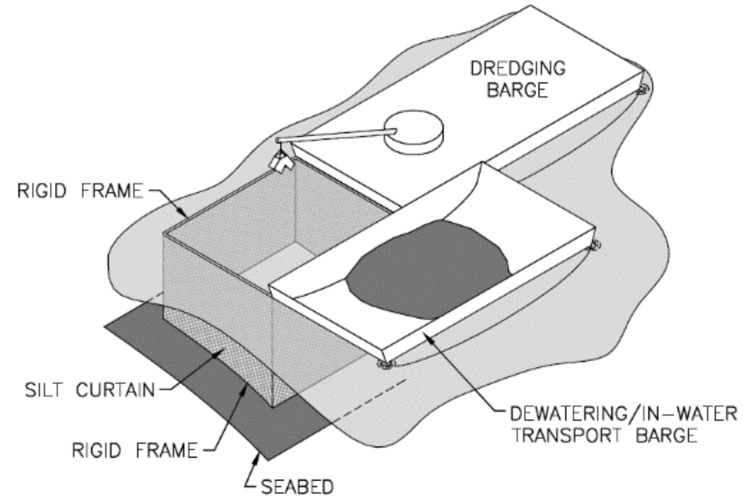
- Remove maximum contamination practicable
  - Reduce federal financial liability and establish baseline
  - Reduce risks to human health and the environment
  - Meet federal and provincial standards
- Schedule
  - Minimize disturbance to operations
- Ensure high level of certainty in project outcome

Remedial Dredge Design

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



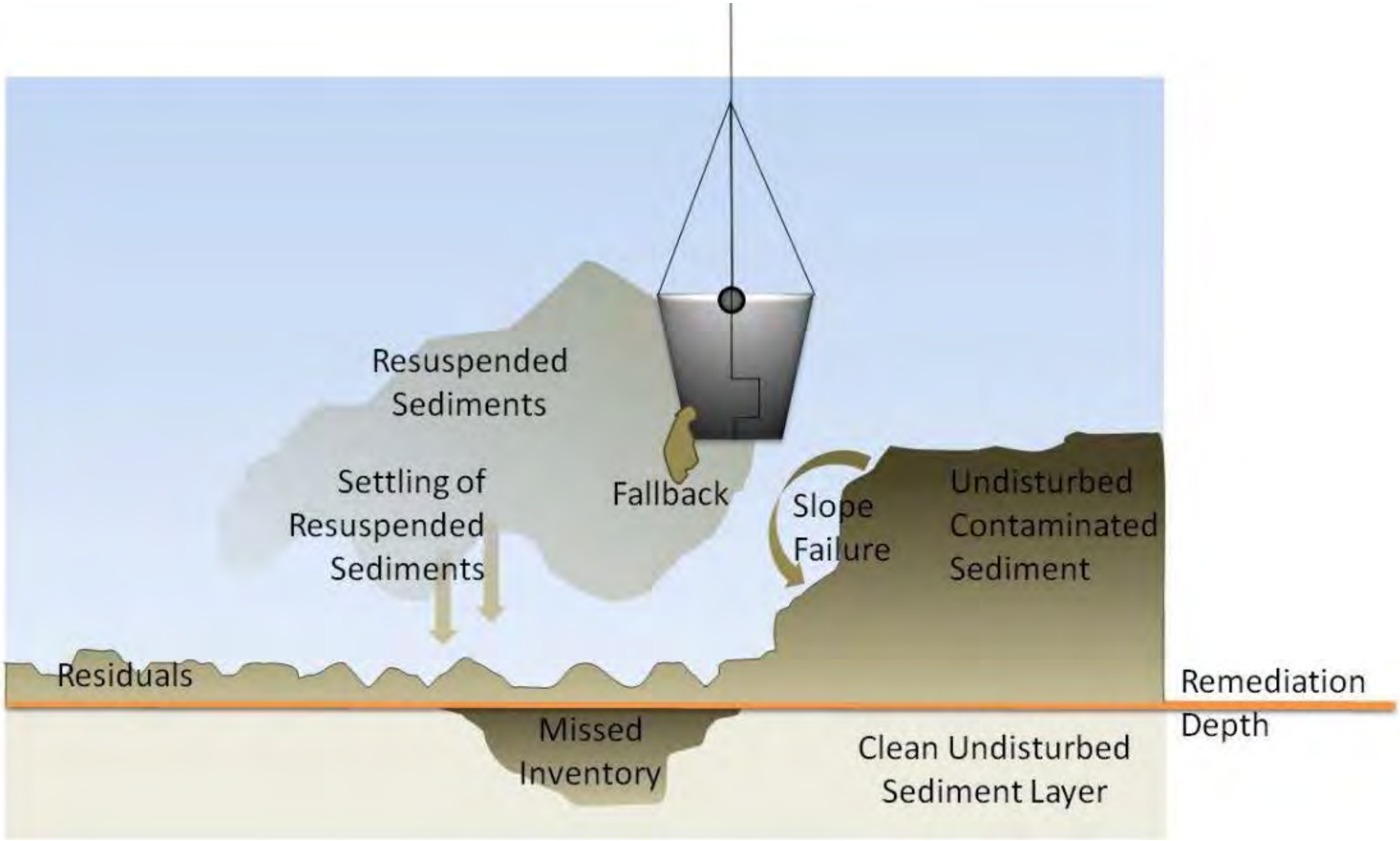
Silt Curtain



Dredging Residuals Conceptual Model and Design Predictions

- Undisturbed and generated residuals

Dredging Residuals Defined



Undisturbed residuals =
missed inventory

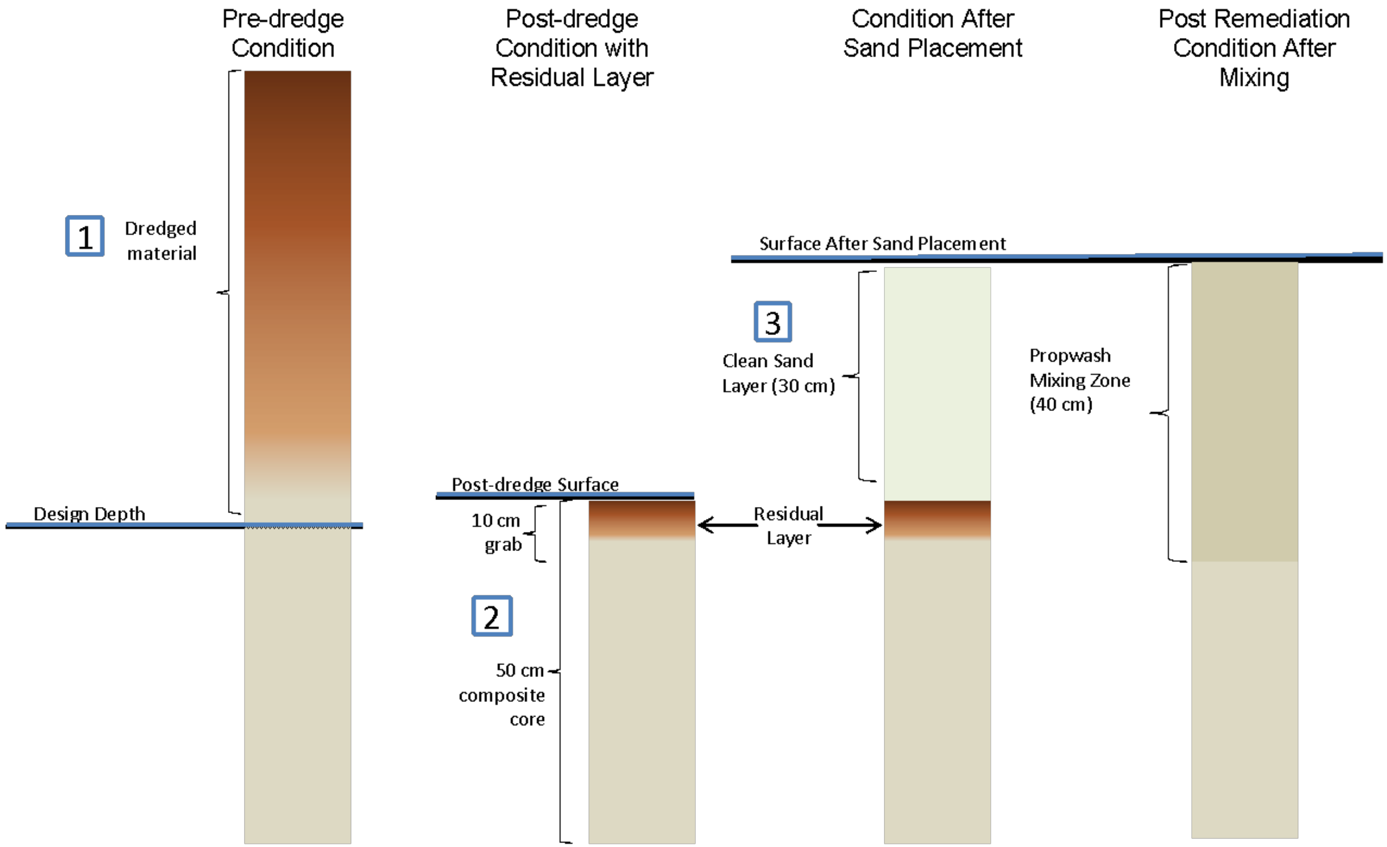
Generated residuals =
resuspended resettled, fallback, slope failure

Prediction of Undisturbed Residuals With Geostatistical Modeling

Removal Scenario	Removal Volume (m^3)	Confidence Level
Contaminated Neatline (no OD)	71,250	50%
Contaminated Neatline +0.3 m OD	98,444	70%
Contaminated Neatline +0.5 m OD	116,573	85%
Dredge Prism Design (no OD)	117,336	90%
Dredge Prism Design +0.3 m OD*	149,630	94%
Dredge Prism Design +0.5 m OD	162,658	99%

Notes:
* Selected design criteria
m: meter m^3: cubic meter   OD: overdredge

Prediction of Generated Residuals with Mass Balance Approach

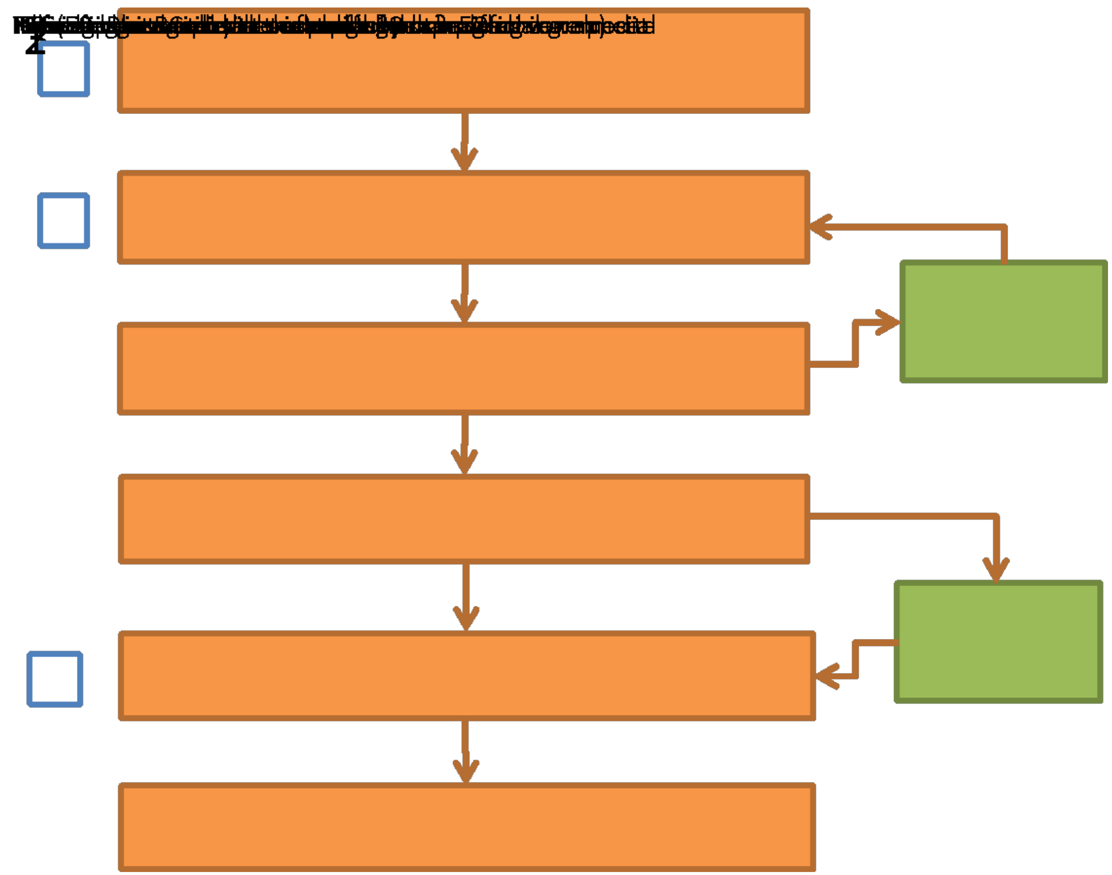


2% to 9% loss of dredge material

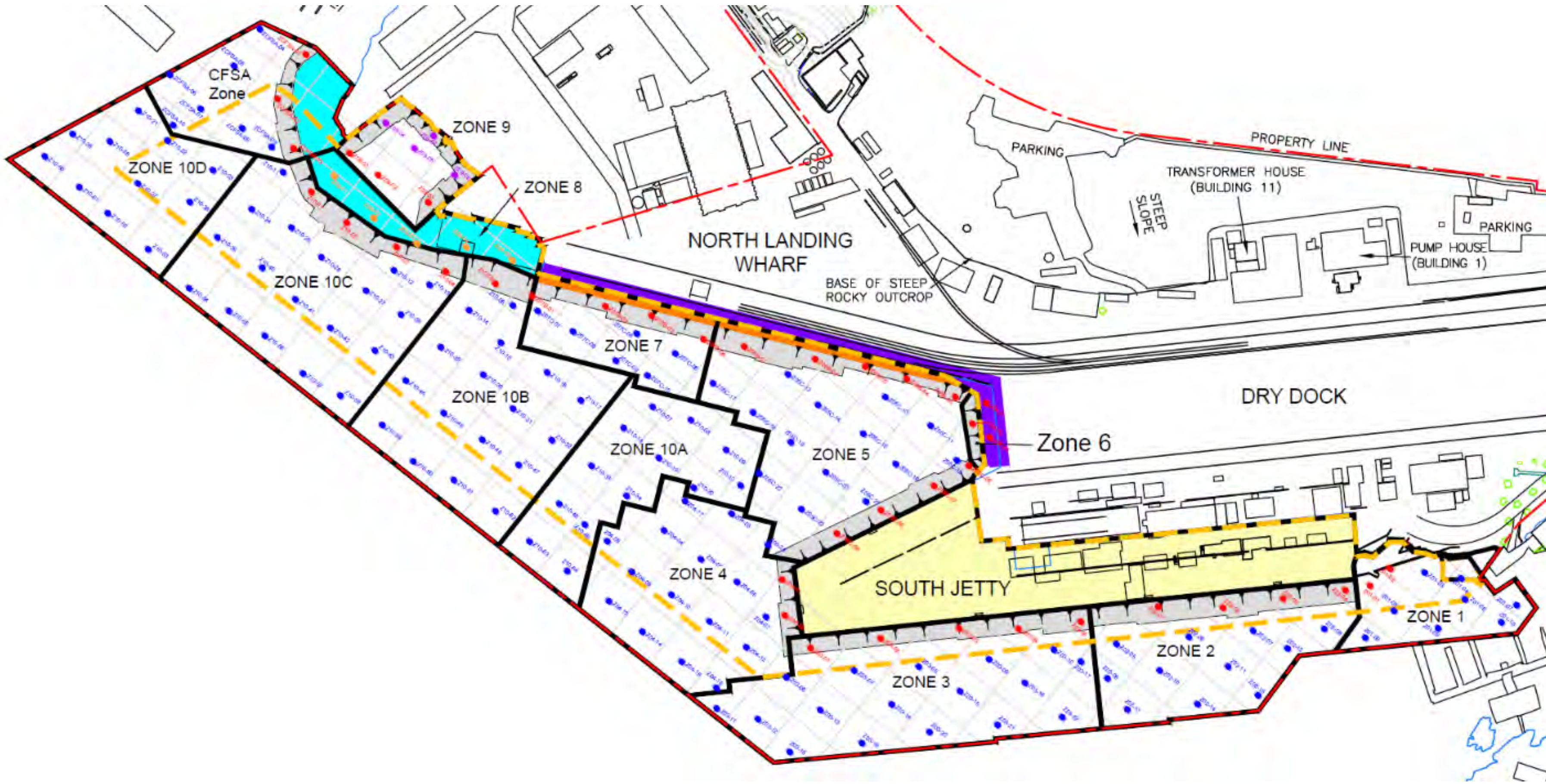
Residuals management placement and mixing

Development of Residuals Management Approach

- Confirmational sampling
- Contingency redredging
- Residuals management cover (RMC)



Confirmation Sampling Grid

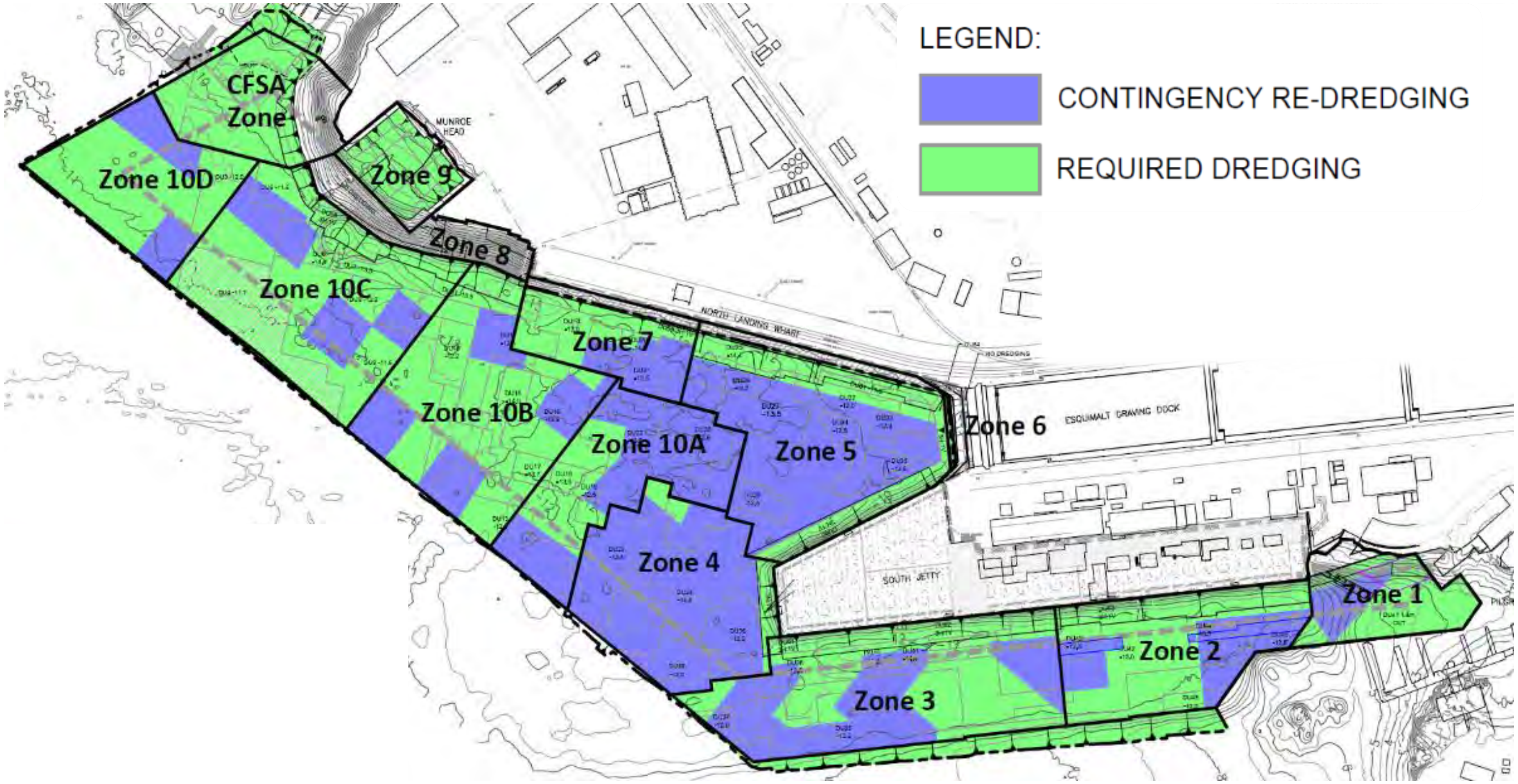


Project Performance for Residuals

- Predicted versus actual
  - Undisturbed residuals
  - Generated residuals
- Effectiveness of residuals management

Undisturbed Residuals

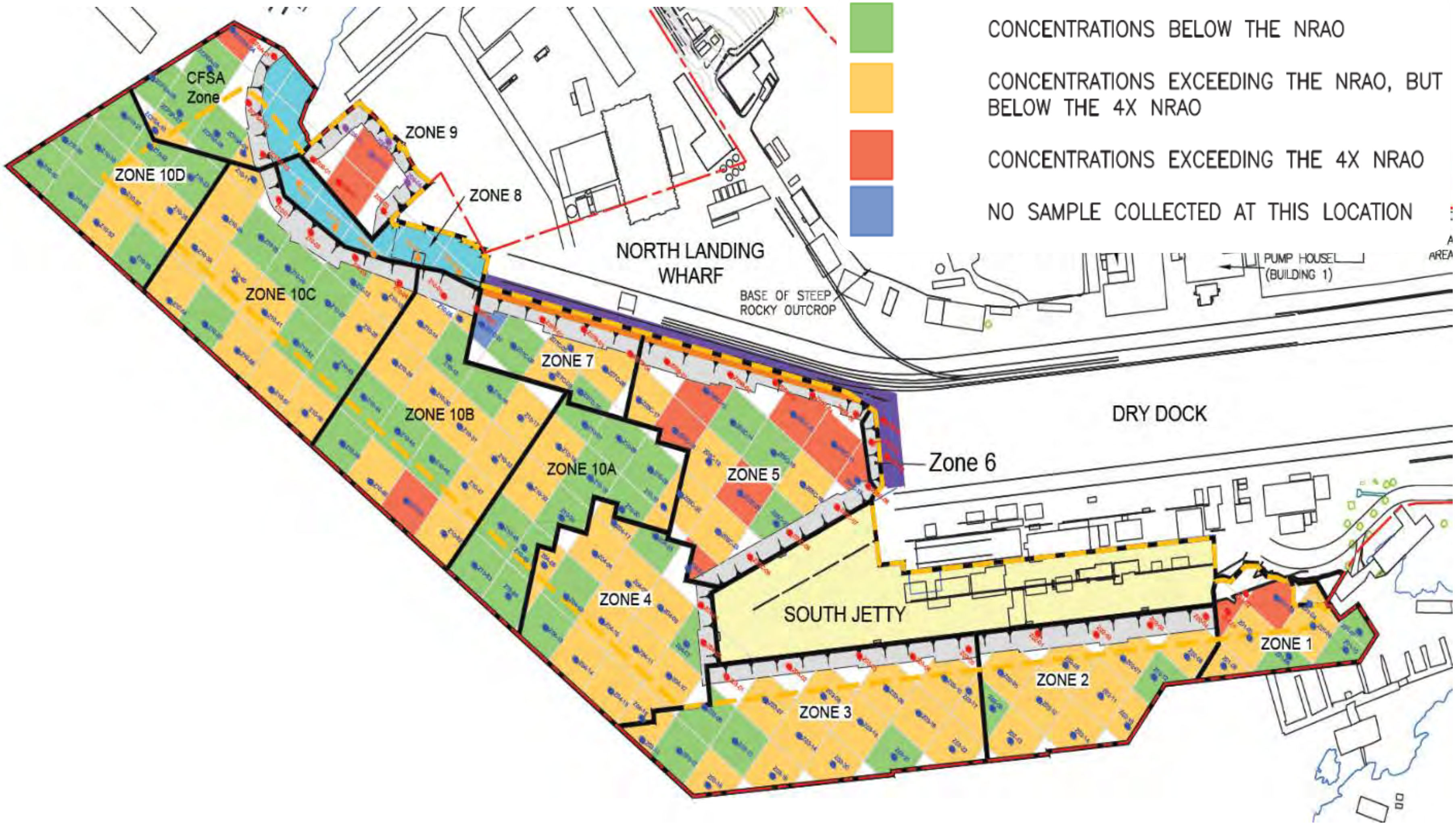
- 41% redredging
  - 31% due to undisturbed residuals
  - 10% due to high levels of generated residuals



Undisturbed Residuals More than Predicted

- Reviewed potential reasons for greater undisturbed residuals
  - Contaminant depth
  - Contaminant concentration
  - Distance from design cores
  - Bathymetric elevation
  - Contaminant of concern driver
- Most likely due to local variation in historical dredging elevations encountered
  - Higher density post-dredge sampling

Generated Residuals



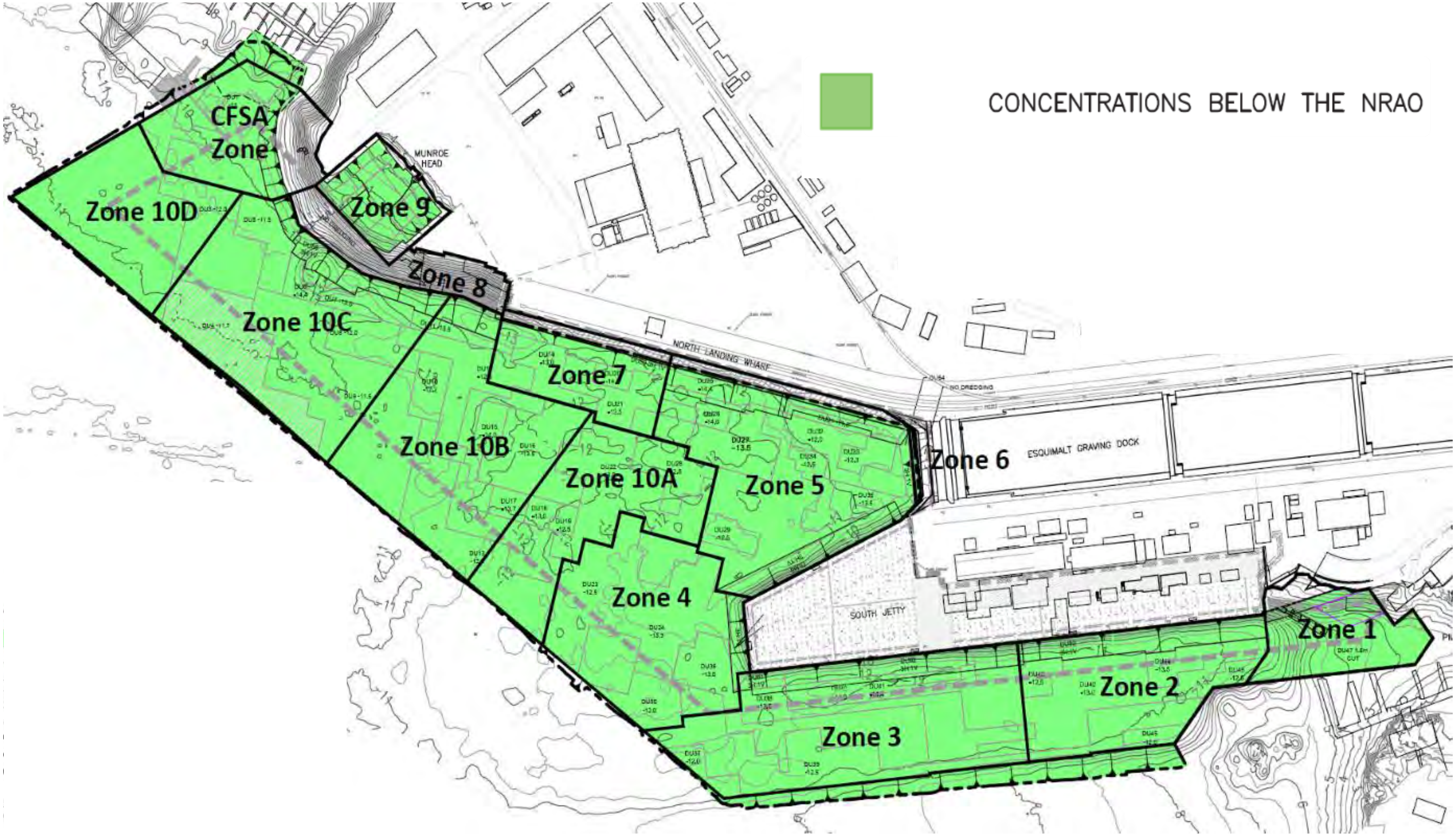
Measured Generated Residuals

Measured Surface Sediment Concentrations Following Dredging (mg/kg)									
Item	tPAH	tPCB	As	Cd	Cu	Pb	Hg	Zn	Average
Average Concentration	3.25	0.29	15.2	1.4	87	55	1.0	136	--
Method 1: Linear Interpolation	11.5%	4.9%	4.6%	5.6%	9.7%	3.2%	6.1%	7.5%	6.6%
Method 2: Contaminant Concentration	6.7%	4.0%	3.9%	4.4%	5.4%	3.3%	4.2%	4.8%	4.6%

Notes:
As: arsenic Cd: cadmium Cu: copper Hg: mercury mg/kg: milligrams per kilogram Pb: lead
tPAH: total polycyclic aromatic hydrocarbon tPCB: total polychlorinated biphenyl Zn: zinc

- Predicted percent loss between 2% and 9%, with best estimate of 5%

Residuals Management Cover



Residuals Management Cover Effectiveness

Analysis of Surface Sediment Concentrations Following RMC Placement (mg/kg)									
Item	tPAH	tPCB	As	Cd	Cu	Pb	Hg	Zn	Average
Percent Residuals Resuspension and Resettling during RMC Placement	17%	4.7%	0%	7.3%	15%	0.6%	2.5%	14%	2.5%
Percent Increase in Concentration from Year 0 to Year 1	26%	4.7%	16%	-7.1%	11%	5.3%	13%	2.6%	9.0%

Notes:
As: arsenic Cd: cadmium Cu: copper Hg: mercury mg/kg: milligrams per kilogram Pb: lead
tPAH: total polycyclic aromatic hydrocarbon tPCB: total polychlorinated biphenyl Zn: zinc

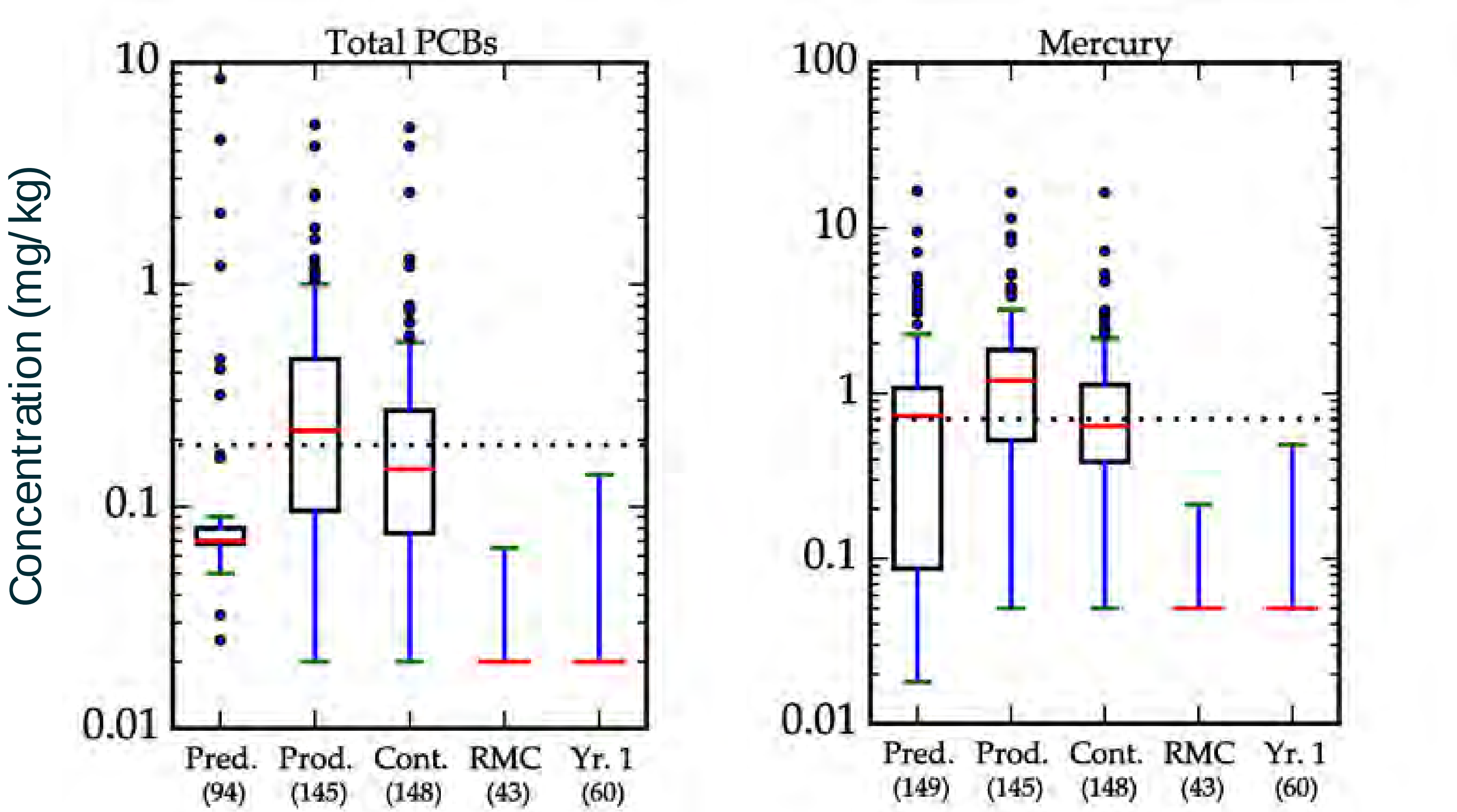
- Based on imported sand material, post-dredge surface sediment, and post-sand placement concentrations

Residuals Management Cover Compared to Redredging

Comparison of Surface Sediment Concentrations Before and After Contingency Residuals Management Actions (mg/kg)									
Item	tPAH	tPCB	As	Cd	Cu	Pb	Hg	Zn	Average
Contingency Redredging									
Percent Reduction in Concentration	69%	57%	38%	7%	58%	65%	65%	45%	50%
Residuals Management Cover									
Percent Reduction in Concentration	98%	86%	71%	86%	80%	95%	92%	64%	84%

Notes:
As: arsenic Cd: cadmium Cu: copper Hg: mercury mg/kg: milligrams per kilogram Pb: lead
tPAH: total polycyclic aromatic hydrocarbon tPCB: total polychlorinated biphenyl Zn: zinc

Overview of Concentrations During Project Phases



Note: mg/kg: milligrams per kilogram

Conclusions

- Benefit of geostatistical tools, such as contaminated neatline and confidence level analysis, for remediation dredge design
  - Density of design-level sampling and post-dredge sampling
- Contingencies for missed inventory and residuals redredging key to schedule and budget
- 2 to 9% loss is generally appropriate for mechanical dredging
- RMC placement reduces surface sediment concentrations more effectively than redredging

Questions

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