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Randle Reef Sediment Remediation Project – Hamilton Harbour Ontario FCS 2008 National Workshop – Vancouver

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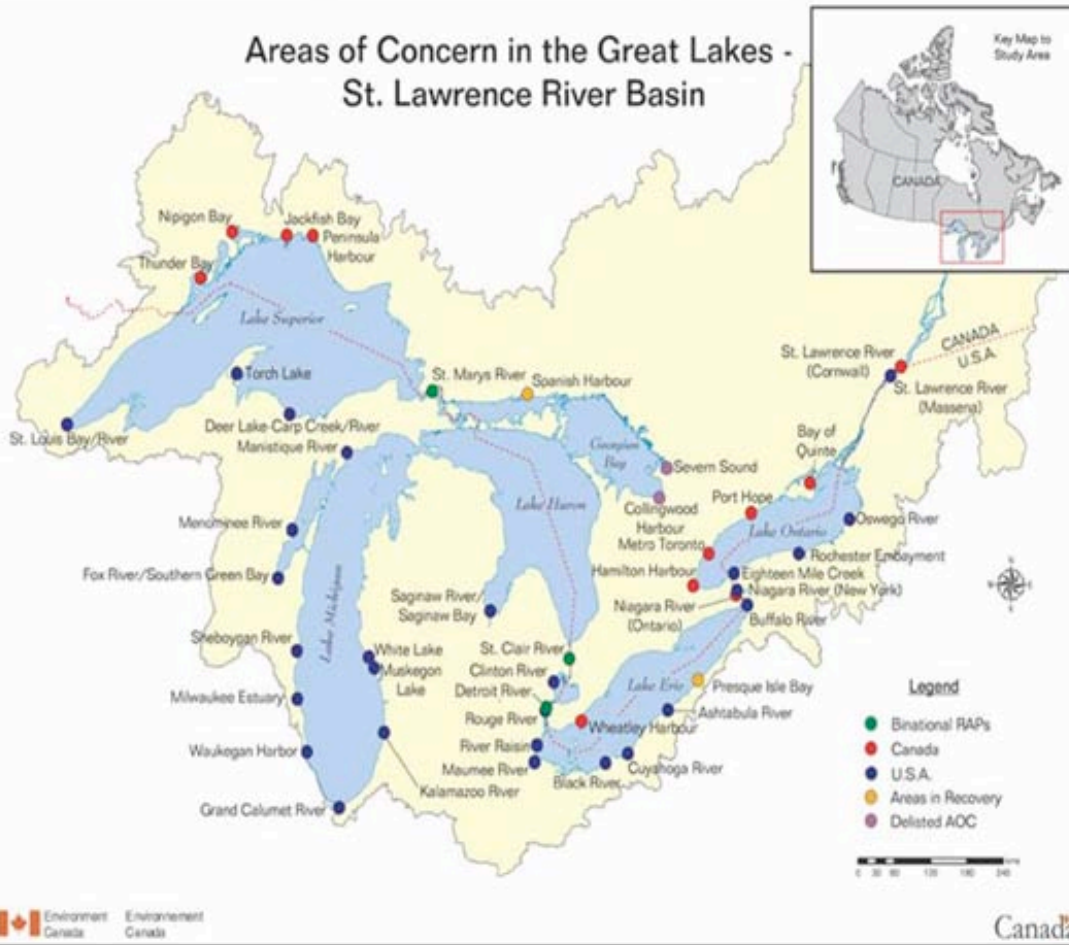
April 30 2008



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Environment Canada's role in Managing Great Lakes Contaminated Sediment

Areas of Concern in the Great Lakes - St. Lawrence River Basin



GREAT LAKES WATER QUALITY AGREEMENT

- **GLWQA is a joint Canadian - U.S. agreement first signed in 1972**
- **Annex 7 governs dredging (1978)**
- **Annex 14 governs contaminated sediment (1987)**
- **To identify the nature and extent of sediment contamination in the Great Lakes**
- **To develop methods to evaluate the impact of sediment contamination on the ecosystem.**
- **To develop Sediment Management Options**

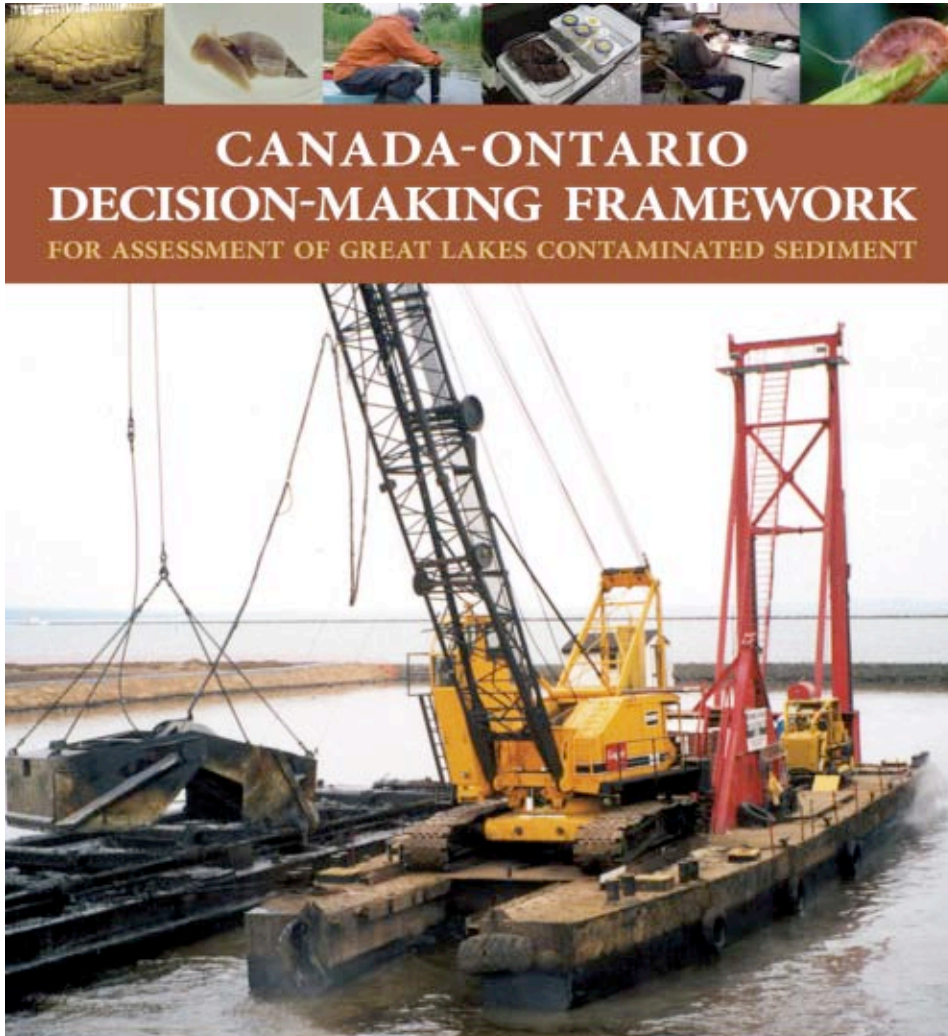


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COA Sediment Assessment Decision Making Framework



CANADA-ONTARIO DECISION-MAKING FRAMEWORK FOR ASSESSMENT OF GREAT LAKES CONTAMINATED SEDIMENT

OVERVIEW

- Need for consensus on conduct of scientific assessments of contaminated sediments
- Need for a framework that is consistent, transparent, scientifically rigorous, technically defensible, understandable by laypersons
- Acknowledges and fits with existing guidance/criteria and clearly articulates decision rules and outcomes based on science.
- Extensive review within EC nation wide, internationally (US, Spain & Australia) and scientific journal peer review (i.e. SETAC)

Randle Reef Sediment Remediation Project

Project Overview

- Approximately 630,000 m³ of contaminated sediment
- Historic operation of coal gasification plant and current Steel Operations
- Average total PAHs concentration in Priority Area near 5,000 ppm with peaks over 67,000 ppm.

Project Components

- Construct a 7.5 hectare Engineered Containment Facility (ECF) over the most highly contaminated sediment (130,000 m³ *insitu*)
- Using a combination of hydraulic and mechanical dredging remove 500,000 m³ and place within ECF
- Use a double sheet pile wall – inner environmental and outer structural as ECF perimeter
- Dewater sediment using physical and chemical processes
- Cap ECF and construct a Port Facility and open green space



Project Advisory Group (PAG) Selected Remediation Option in 2002

- **PAG Multi-stakeholder group: (17 organizations)**
 - local community associations, federal/provincial government agencies, City of Hamilton, City of Burlington, Hamilton Conservation Authority, Hamilton Port Authority, Stelco Inc., Local 1005 of the United Steel Workers of America, Bay Area Restoration Council, Great Lakes United, Clean Air Hamilton, consultants
- **Options to manage contaminated sediment included:**
 - dredging followed by treatment (thermal biological chemical) and or disposal/reuse or
 - dredging and in-situ containment
- ***In situ* Containment was selected by PAG for the following reasons:**
 - Whole harbour solution
 - Partnership potential
 - Lower technological risk
 - Accelerates the process for delisting contaminated sediment impairment
 - Cost-effectiveness



RANDLE REEF (RR) CONTAMINATION

RR Largest PAH Site in the Great Lakes

- RR second largest site in Canada
- Sydney Tar Ponds #1

Remediation Project equivalent to:

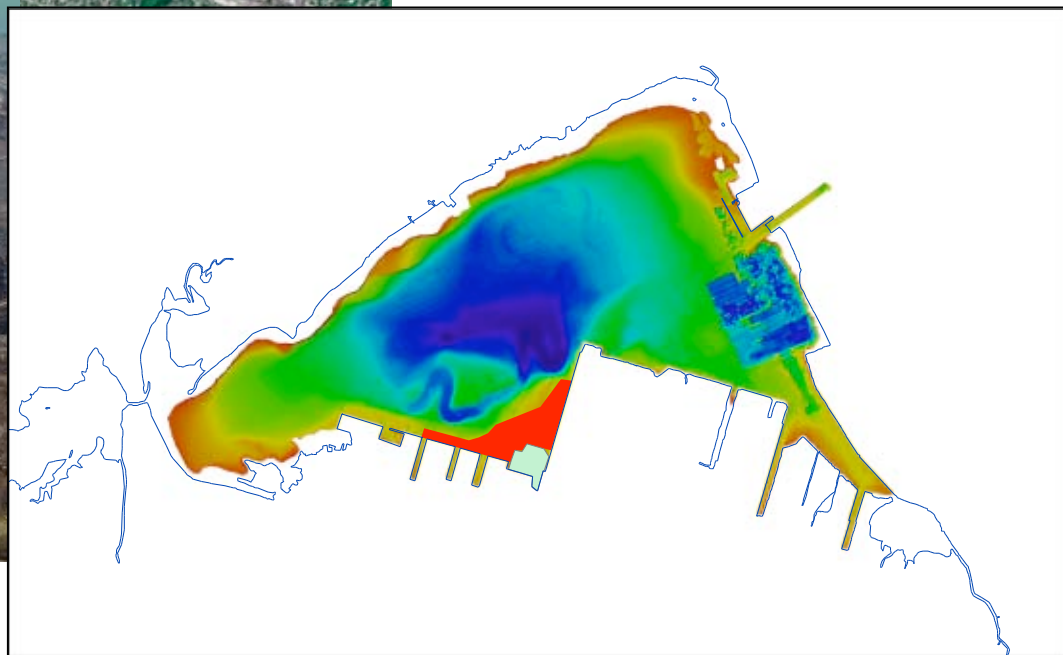
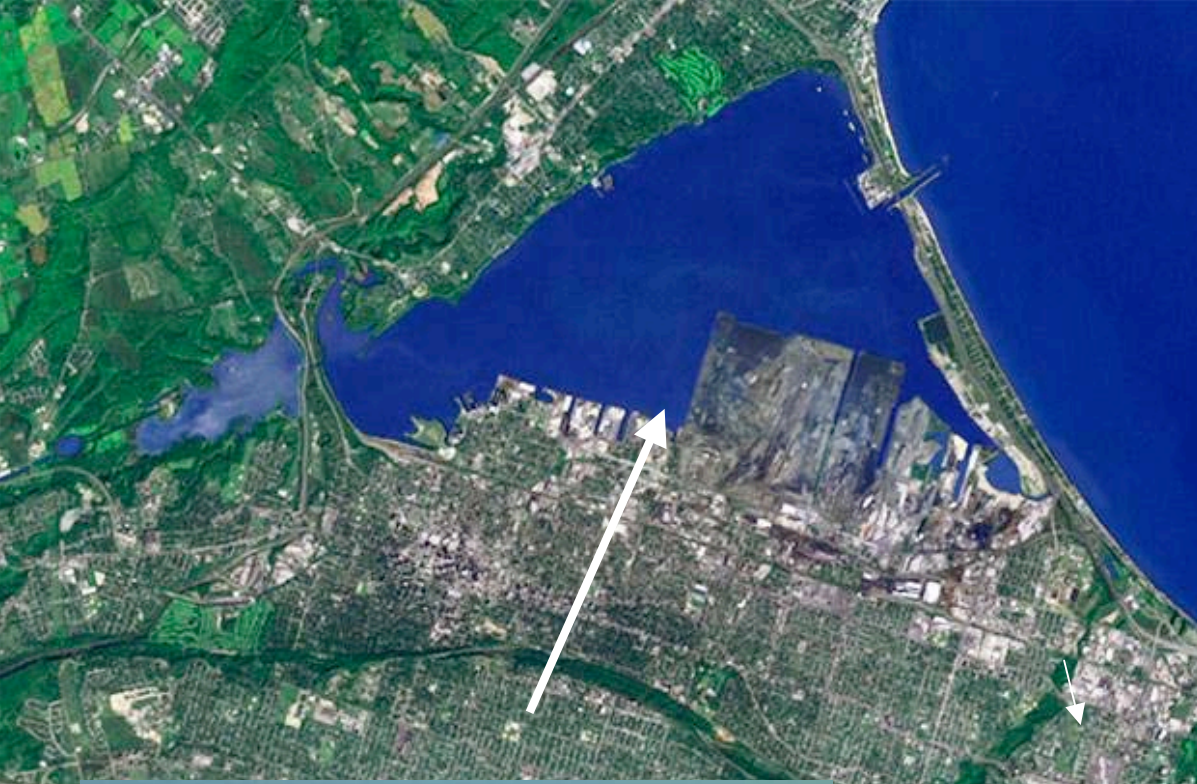
- 40 dump truck loads (338 tonnes of PAHs)
- Filling a professional sporting arena 3 times over (630,000 cubic metres)

PAH-contaminated sediment

- PAH concentrations up to 67,000 ppm (PAH cleanup level 100 ppm) & elevated concentrations of metals
- Polycyclic aromatic hydrocarbons (PAHs) are linked to cancer
- PAHs suspected of causing developmental & reproductive deformities in fish and wildlife



A SPILL IN SLOW MOTION



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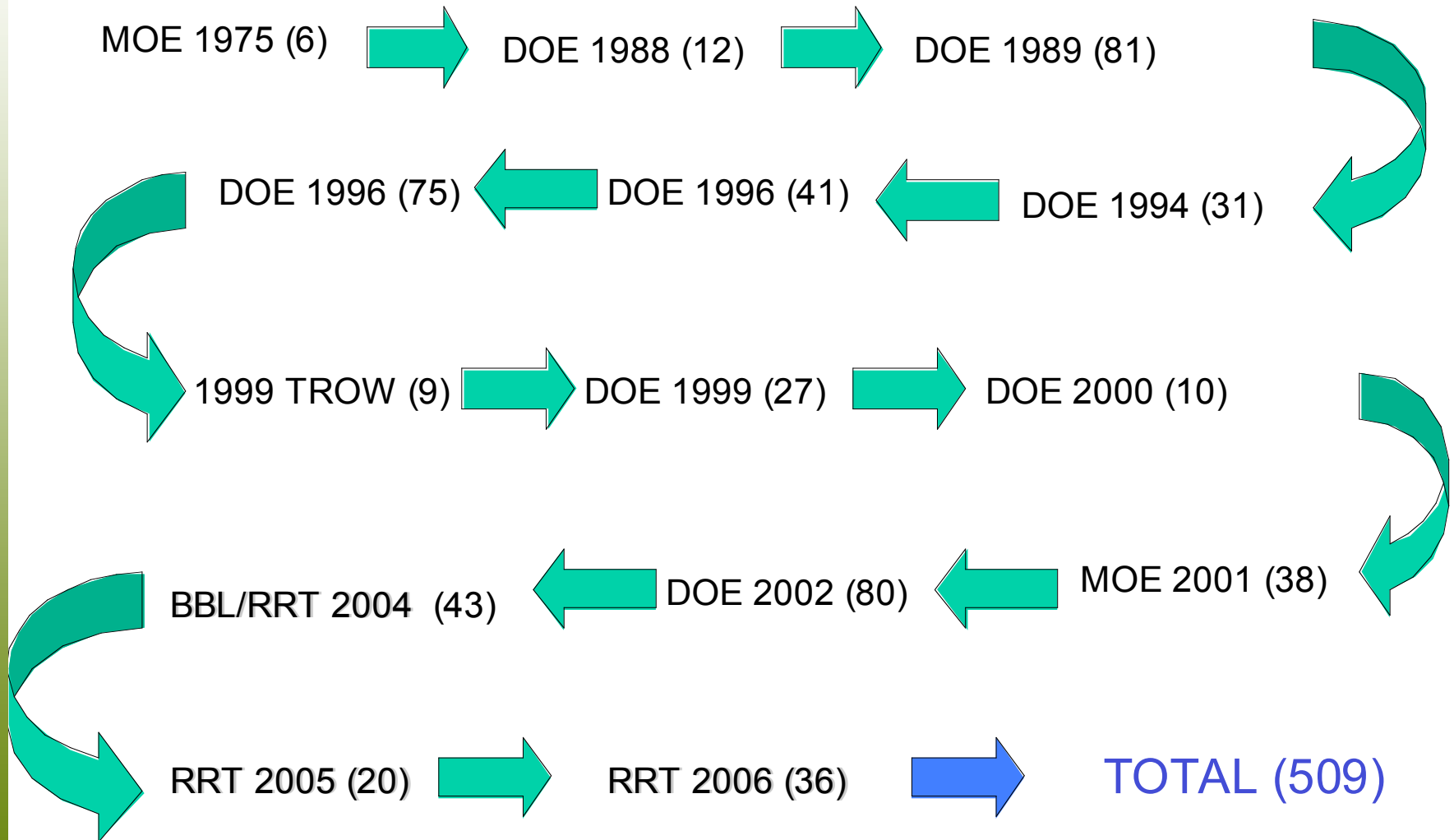
An aerial photograph showing a large industrial facility, likely a port or refinery, situated along a body of water. The facility features numerous large, dark, conical piles of sediment or waste material. A large ship is docked at a pier on the right side of the image. The background shows a cityscape with buildings and greenery.

RANDLE REEF SEDIMENT REMEDIATION PROJECT

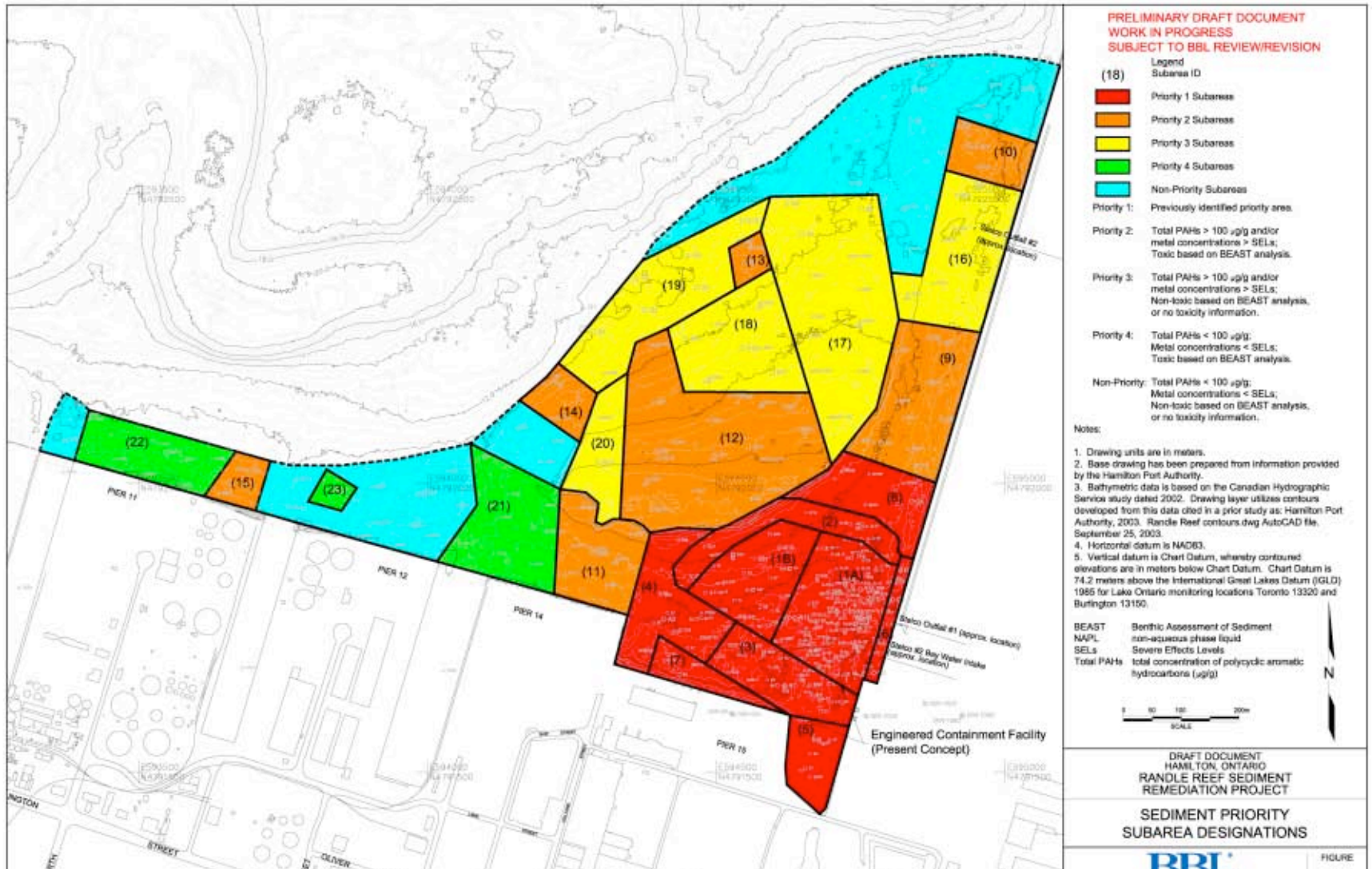
Project Objective:

To diminish the extent to which highly concentrated PAH's can move into the water column or across the bottom of the harbour, and constitute a source of continuing contamination within the local ecosystem.

Randle Reef – Chemistry



Sub-area Priorities



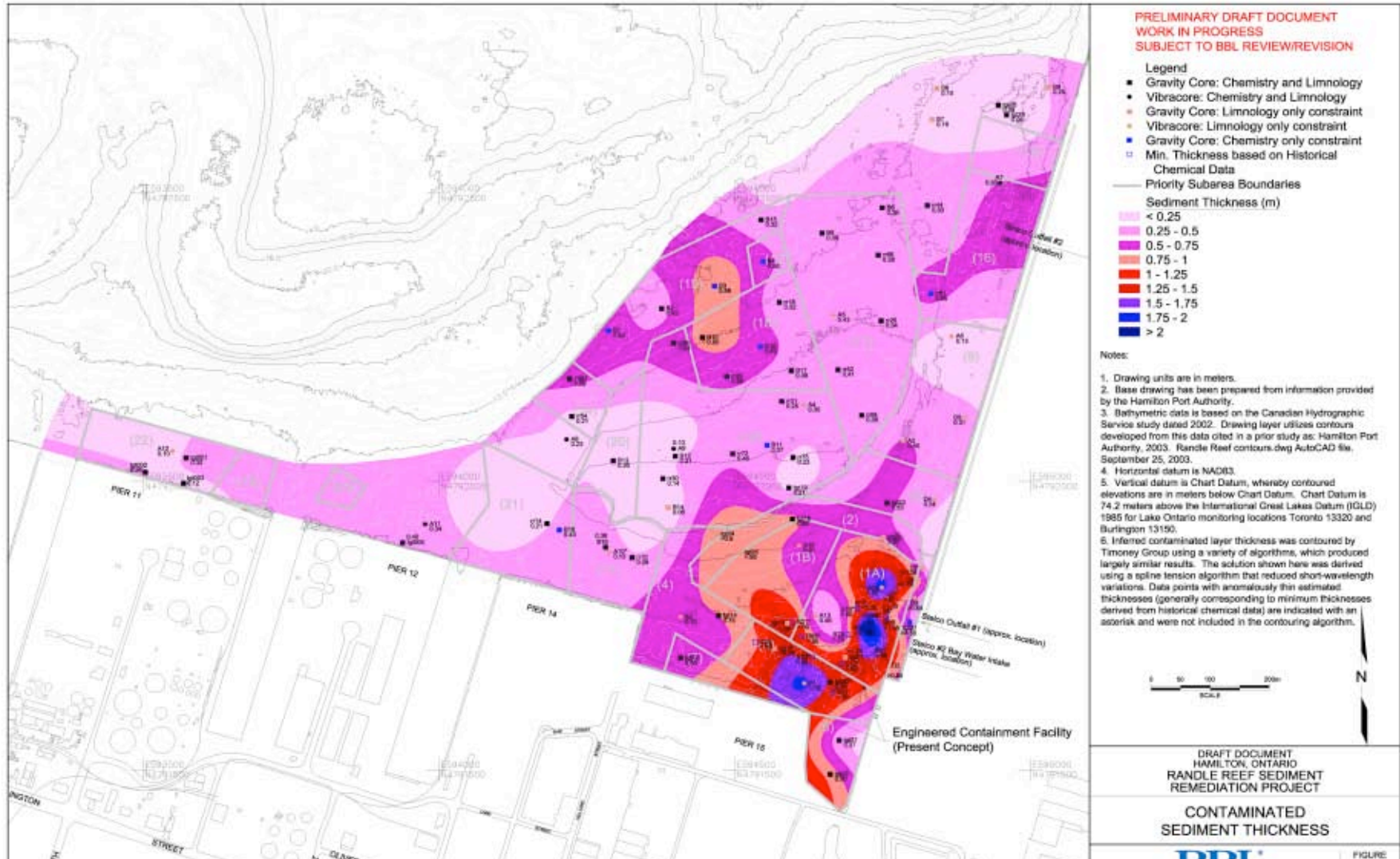
Preliminary PAH Mass Distribution

DRAFT –
Subject to
Revision

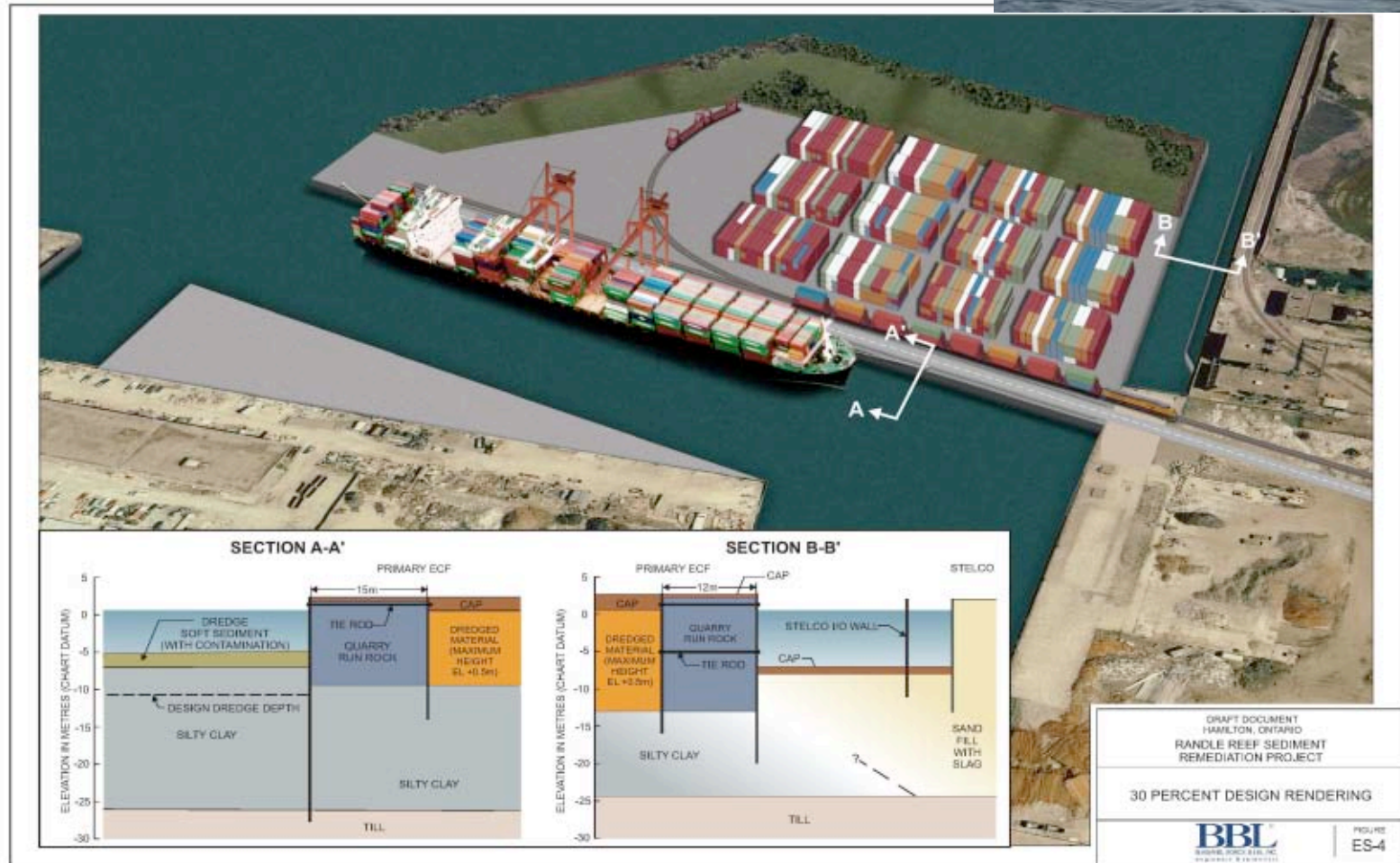
Subarea	Priority Designation	Preferred Weighted-Average Mass PAHs (kg)	Percentage Mass PAHs (%)	Cummulative Mass PAHs (%)
1A	1	205304	45.8	45.8
1B	1	74905	16.7	62.5
2	1	4159	0.9	63.4
3	1	110248	24.6	88.0
4	1	3969	0.9	88.8
5	1	1841	0.4	89.3
6	1	4334	1.0	90.2
7	1	1544	0.3	90.6
8	1 (139,000 m3)	3722	0.8	91.4
9	2	19190	4.3	95.7
10	2	504	0.1	95.8
11	2	609	0.1	95.9
12	2	2583	0.6	96.5
13	2	257	0.1	96.6
14	2	73	0.0	96.6
15	2 (316,000 m3)	87	0.0	96.6
16	3	5291	1.2	97.8
17	3	6226	1.4	99.2
18	3	1893	0.4	99.6
19	3	1596	0.4	99.9
20	3 (534,000 m3)	122	0.0	100.0
21	4	114	0.0	100.0
22	4	29	0.0	100.0
23	4 (580,000 m3)	5	0.0	100.0



Preliminary Contaminated Thickness Layer



30 % Design Rendering



□□□□



Engineering Design Tasks

- Geotechnical
- Structural
- Dredging & Dewatering
- Groundwater
- Air
- Capping
- Stelco Channel
- Hydraulics
- Landscape

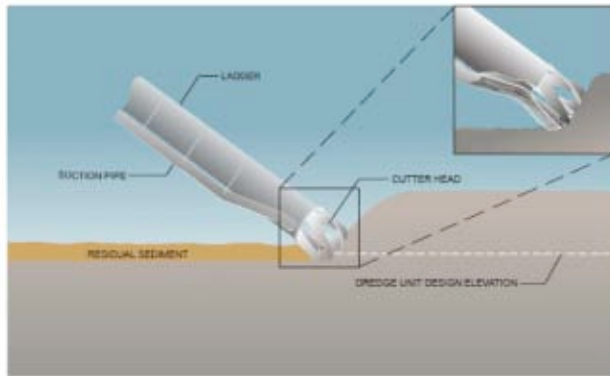


Treatability Studies

- **Flocculation Jar Test** – Determine the most effective coagulant/flocculant
- **Column Settling Test (CST)** – Simulate settling using preferred polymer
- **Column Media Filtration Test** – Determine the most effective filtration media
- **Batch Media Adsorption Test** - Determine adsorption capacity (K_d) of filtration media
- **Thin Column Leach Test (TCLT)** - Models sediment leaching in a ECF by groundwater and rain water
- **Dredge Elutriate Test (DRET)** - Simulates chemical release at the point of dredging
- **Pore Water Extraction** - Measure pore water chemical conc. in equilibrium with sediment



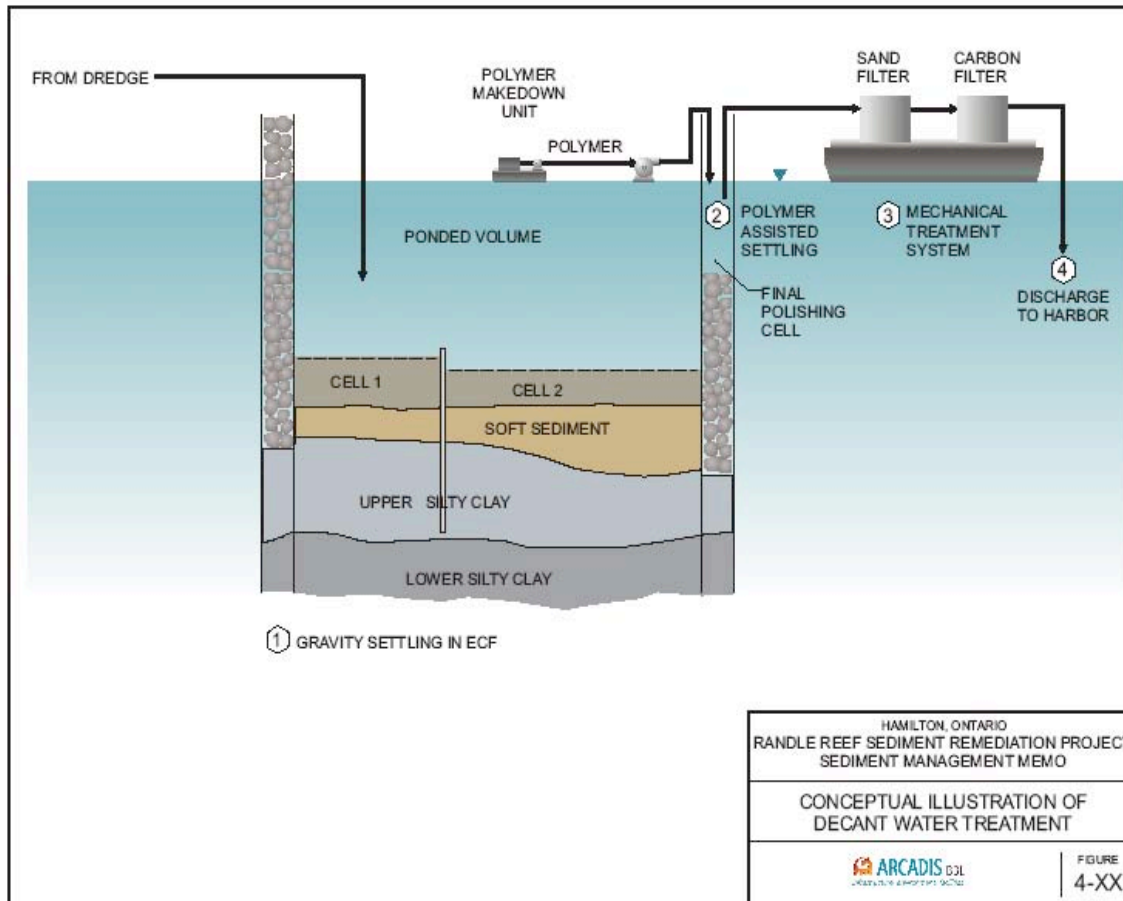
Cutter Suction Hydraulic Dredge



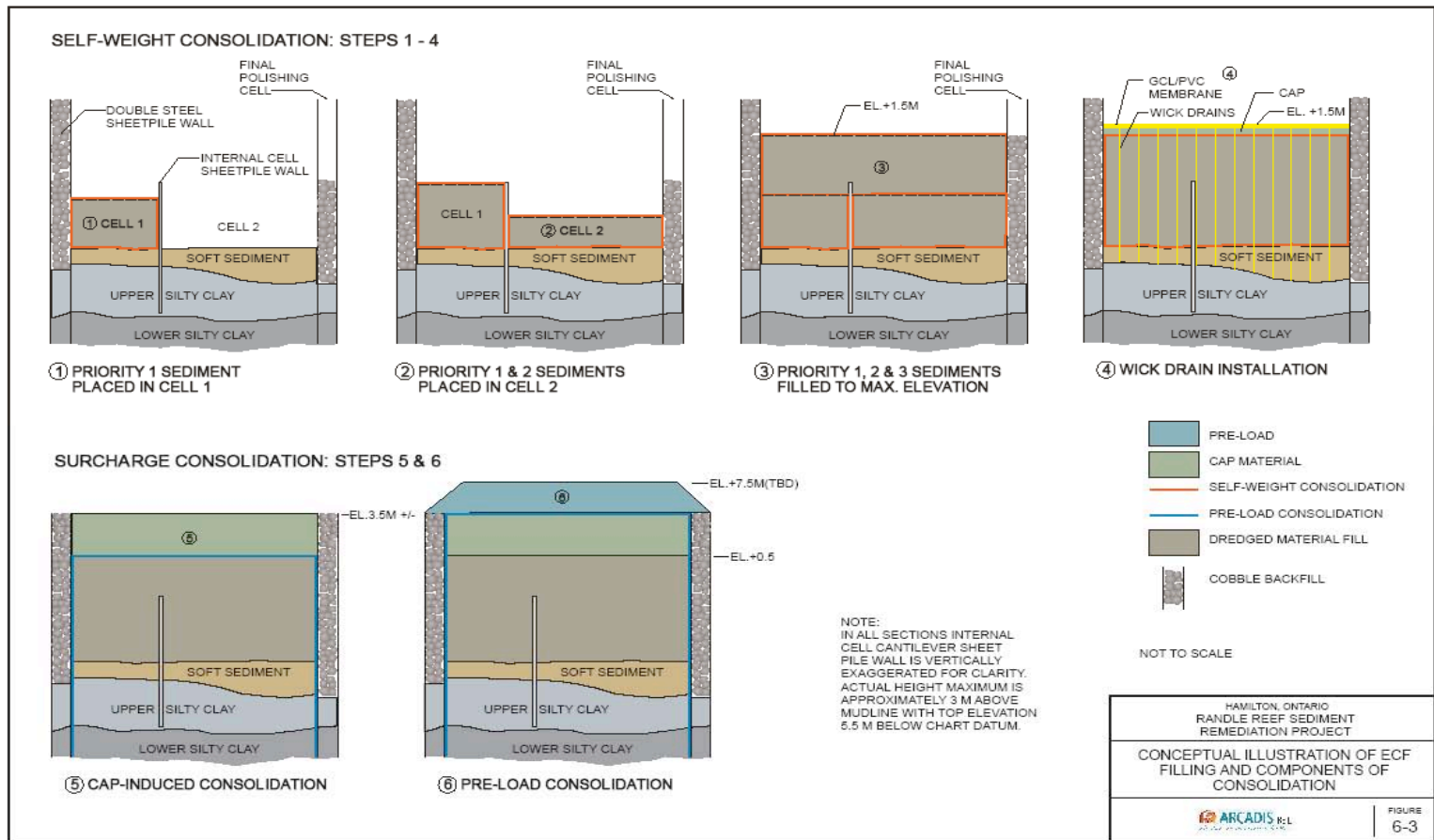
REMEDIATION DIVISION
RANGLE REEF SEDIMENT
REMEDICATION PROJECT
CONCEPTUAL ILLUSTRATION OF HYDRAULIC
DREDGING AND RESIDUAL SEDIMENT
ARCADIS
FIGURE
3-2



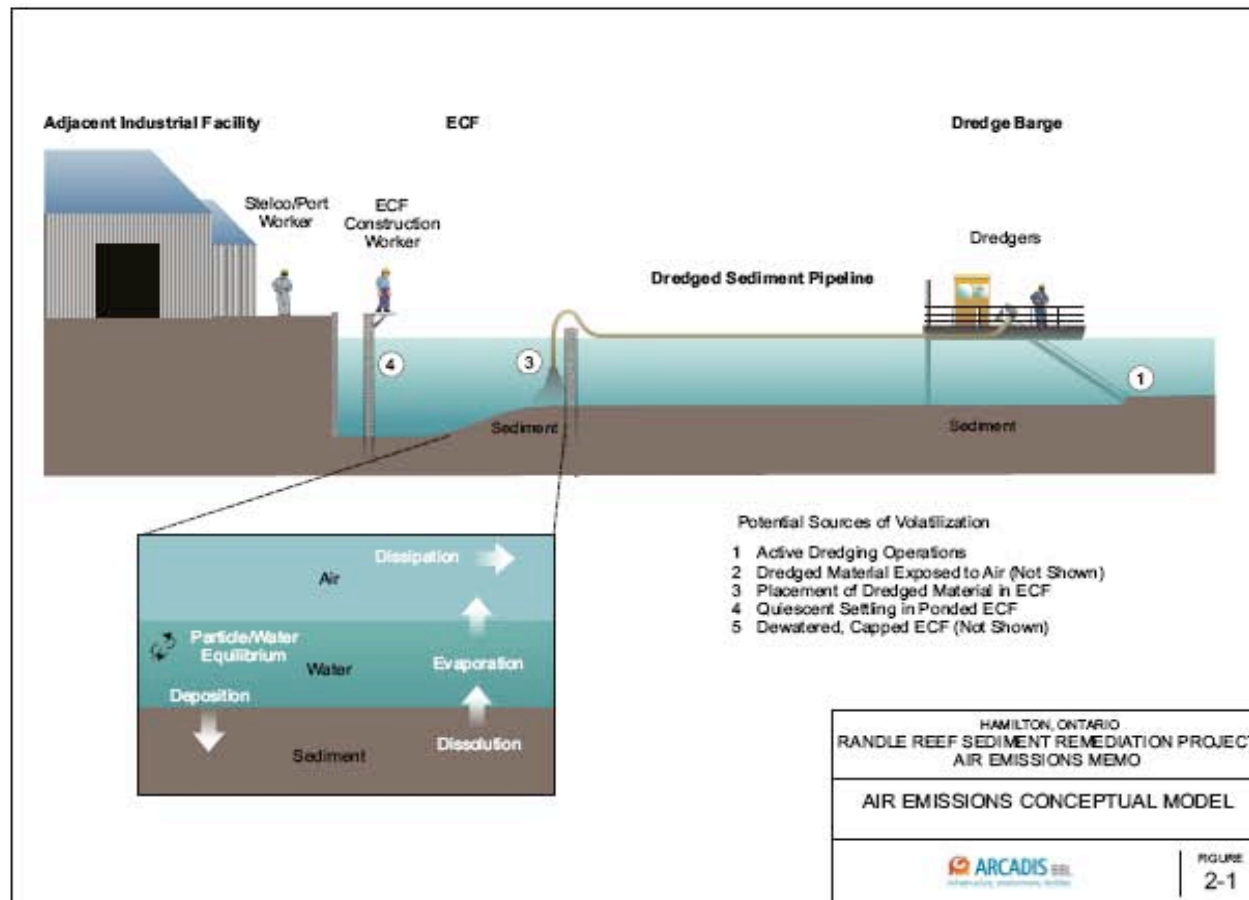
Conceptual Design of Water Treatment



Conceptual Illustration of ECF Filling and Components of Consolidation



Conceptual VOC Emission Scenario



HAMILTON, ONTARIO
 RANDLE REEF SEDIMENT REMEDIATION PROJECT
 AIR EMISSIONS MEMO

AIR EMISSIONS CONCEPTUAL MODEL

ARCADIS EBL
ADVANCING SUSTAINABILITY TOGETHER

FIGURE
 2-1





Benefits Assessment Study completed by York University's Schulich School of Business in 2007

- **Economic**
 - \$126M linked to sediment cleanup and \$900M linked to all harbour restoration initiatives.
 - Increases capacity for international trade (deep draft vessels)
 - Increases property values
 - Increases growth and redevelopment
- **Environmental**
 - Removes 340 tonnes of PAHs and associated environmental and health risks
 - Allows harbour delisting from list of Areas of Concern in 2015
- **Social**
 - Helps to change negative public image to positive one
 - Increased recreation and harbour use



8 Studies to Assess the Clean-up

- Baseline studies (prior to remediation) have been conducted 2005, 2006, 2007 and some planned in 2008.
- To be compared with studies undertaken during remediation, and post-remediation studies conducted again in 5,10 and 15 and 20 years.

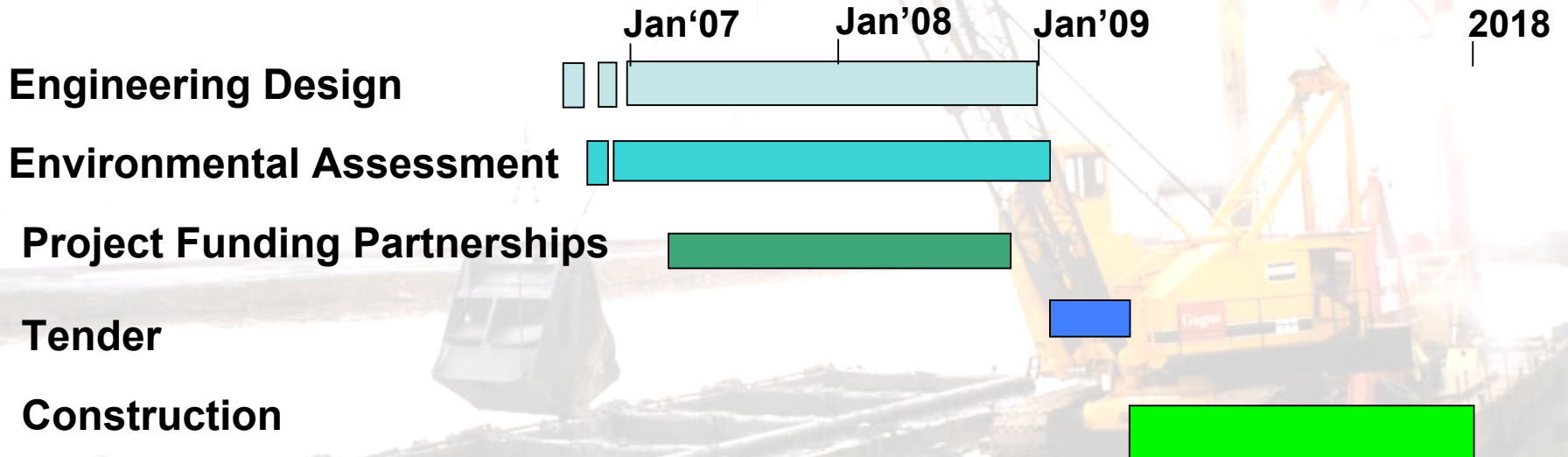
Multiple endpoints should help indicate the effectiveness of PAH/metal-contaminated sediment removal.



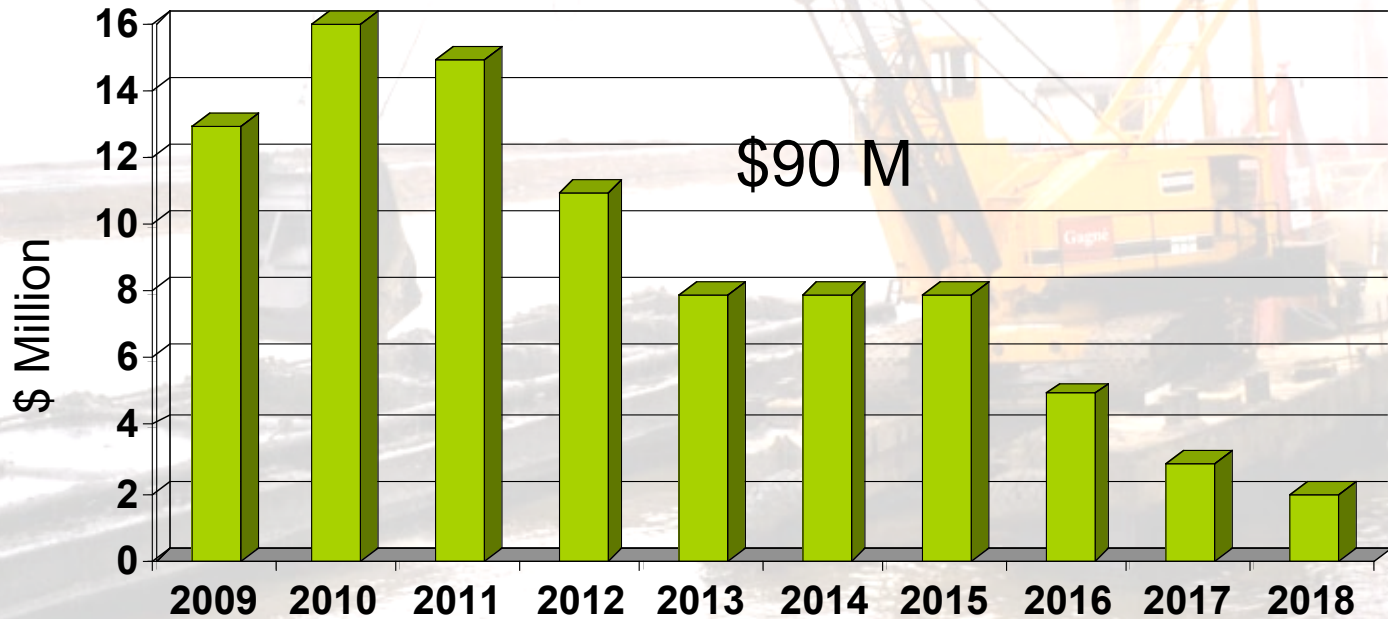
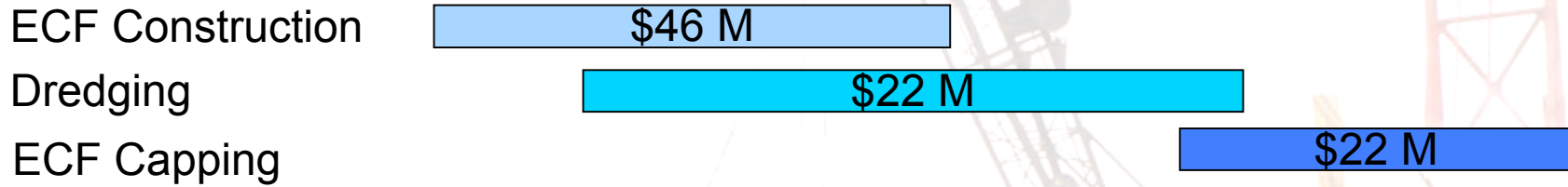
Assessing the Effectiveness of the Randle Reef Clean-up

-  PAH concentrations & profiles in suspended sediments.
-  Sediment toxicity & benthic invertebrate community structure.
-  Toxicity Identification & Evaluation (TIE).
-  Haemocytic leukemia in caged bivalves.
-  Larval & embryo deformities in fish exposed to PAHs.
-  Genetic & reproductive endpoints for caged fish and second generation inherited effects.
-  Wild fish health endpoints.
-  Tumours & external abnormalities in wild fish.
-  Georeferenced Database.

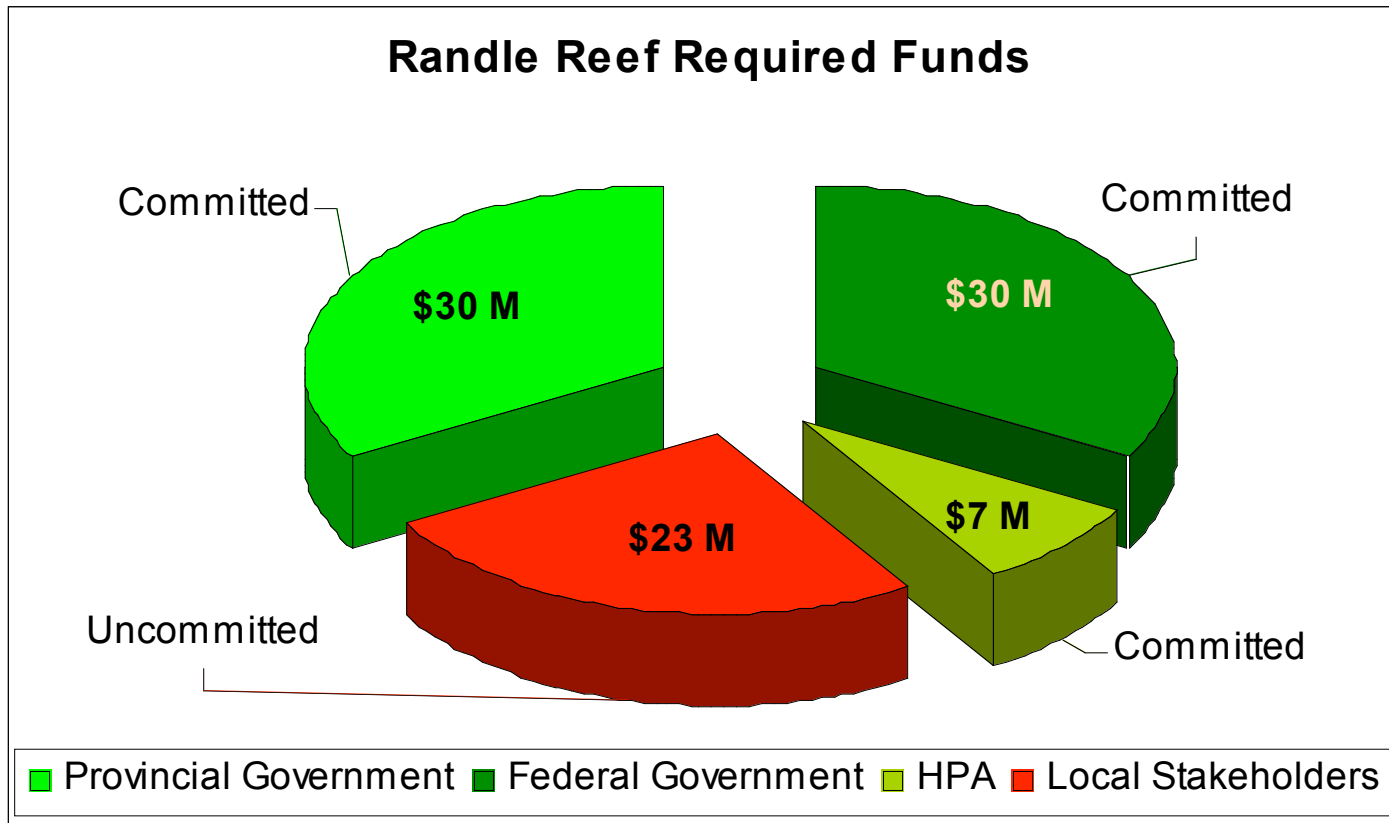
WHERE ARE WE?



Construction and Cost Schedule



Randle Reef Required Funds





Thank you.

Questions?

Acknowledgements:

Bill Fitzgerald	- HPA
Erin Hartman	- EC
Anne Borgmann	- EC
Cherlene Vieira	- MOE
Ron Hewitt	- PWGSC