

# ASSESSMENT AND MANAGEMENT OF MERCURY AND PULP-WASTE CONTAMINATED SEDIMENTS IN THUNDER BAY NORTH HARBOUR, ONTARIO, CANADA

Mark Bassingthwaite, P.Eng., Cole Engineering Group Ltd.

# Project Background

- In 1985, the International Joint Commission identified Areas of Concern (AOCs) across the Great Lakes, where environmental quality has been degraded and beneficial uses of the aquatic ecosystem have been impaired.
- Thunder Bay was identified as one such AOC, and beneficial use impairments were identified related to contaminated sediments. The Remedial Action Plan (RAP) Public Advisory Committee (PAC) has identified a need to address mercury and organic contaminants in the Thunder Bay North Harbour area.

# Site Location



# Enriched Organic Sediment

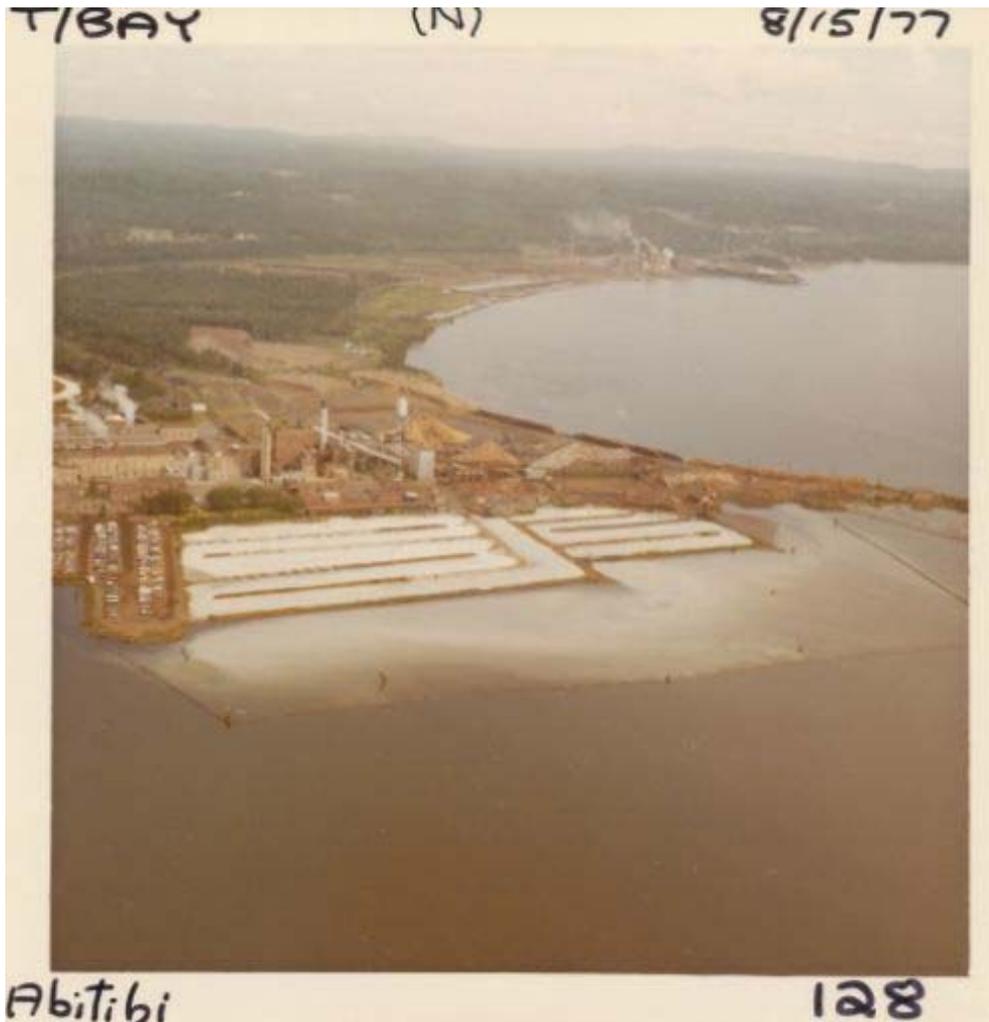
- Enriched Organic Sediment (EOS) is present in the study area and is between 0 and 4 m (12 feet) thick
- The EOS is very soft, fibrous material and varies in composition across the study area
- The EOS has elevated levels of mercury and other contaminants
- Native sediment below the EOS does not show signs of significant contamination



# Enriched Organic Sediment

- Test Pit Videos – TP 1-1 and TP 7-3

# Historic Aerial Photos



*Thunder Bay North Harbour - 1977*

# Historic Aerial Photos

*Thunder Bay North Harbour - 1989*

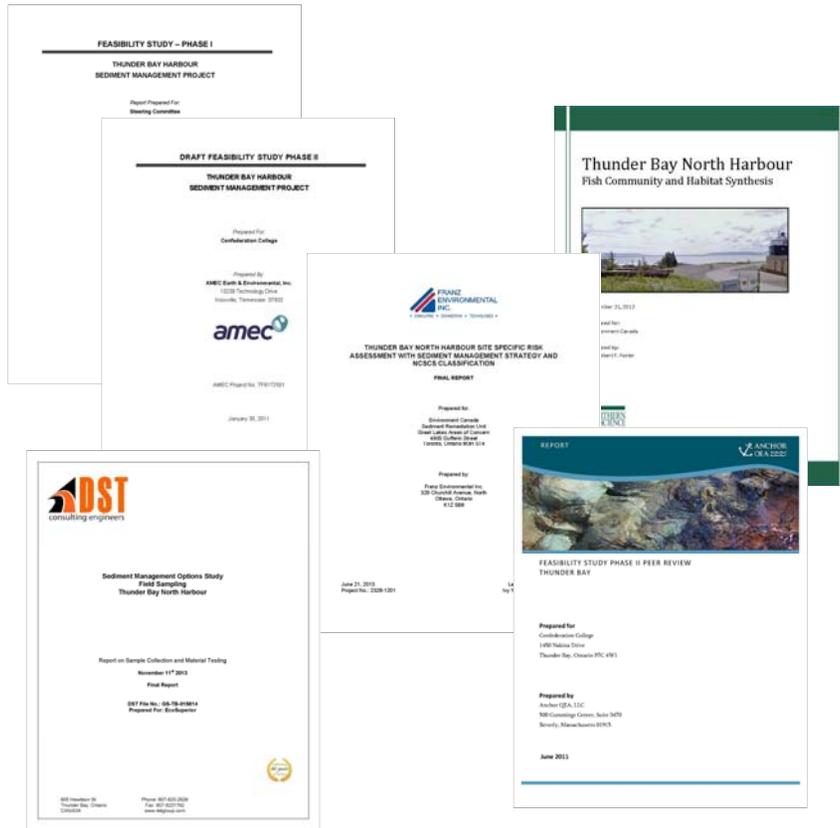


# Historic Aerial Photos



*Thunder Bay North Harbour - 2008*

# Purpose of Study



- Over the years, numerous studies have been conducted by a variety of consultants and researchers on behalf of different stakeholders. The objectives of these studies have generally been to characterize the Enriched Organic Sediment (EOS) and assess potential methods to address contaminants in the area, in support of removing the beneficial use impairment related to the sediment and ultimately delisting the Thunder Bay Area of Concern.
- The purpose of the current project is to bring the analysis phase to a conclusion and to make concrete recommendations to move forward with a Sediment Management Option (SMO).

# Remedial Action Objective

- The Remedial Action Objective is to bring the average concentration of mercury within the study area to at or below local background concentrations.
- This will result in decreased risk from contaminants.



# Study Process

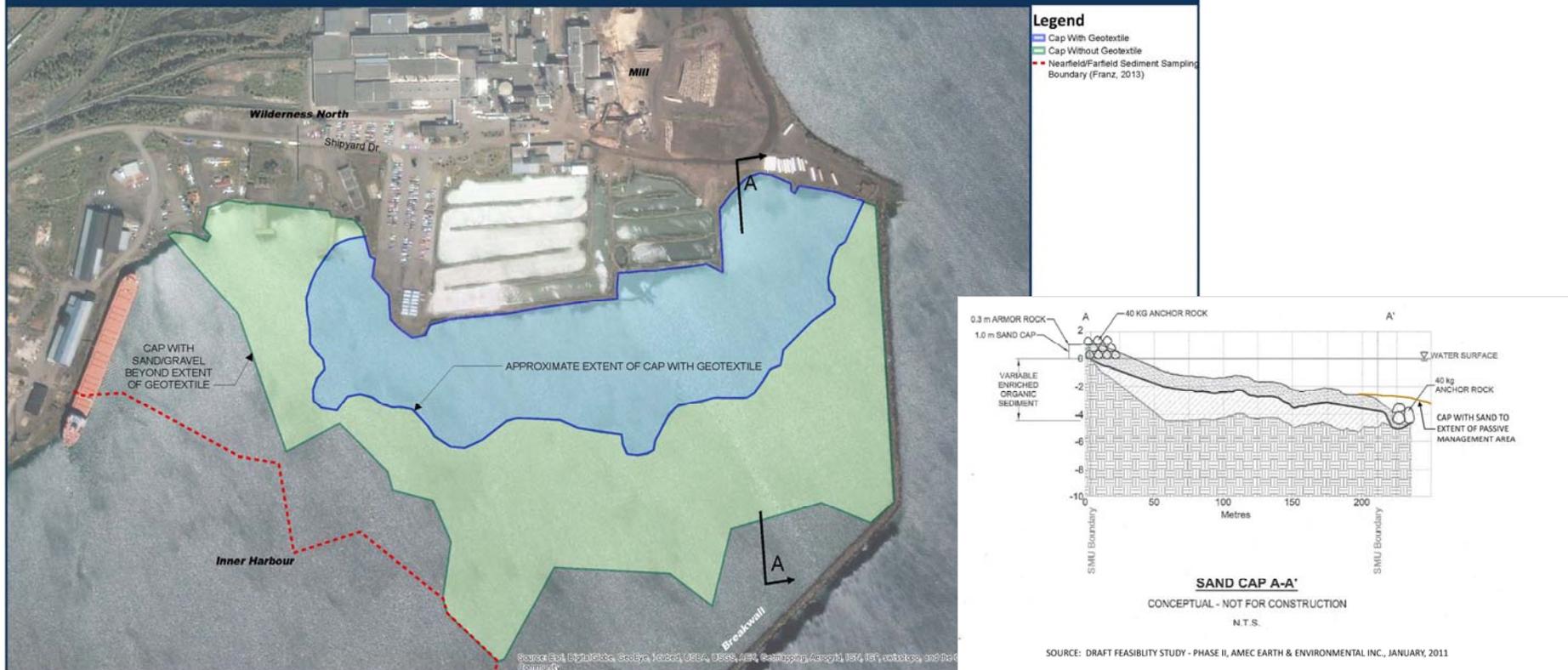
- The process being followed to recommend an SMO is:
  - Review of feasible technologies and background information
  - Define a set of viable SMOs
  - Develop evaluation criteria and levels of importance (weights)
  - Score each SMO for each of the parameters
  - Assemble total scores for each SMO and establish ranking
- The result of the study is a recommendation from a technical perspective only
- Further consultation will be undertaken and an option for implementation will be determined

# Sediment Management Options

- Using information from previous reports, a review of available technologies and the experience of the Study Team, options were generated for evaluation:
  - Capping
  - Excavation and upland disposal
  - Dredging and upland disposal
  - Dredging and disposal in a new Confined Disposal Facility (CDF)
  - Dredging and disposal in a new CDF using the adjacent lagoons
  - Dredging and disposal in the existing Misson Bay CDF

# Capping

## Capping | Sediment Management Options and Recommendations



- The Enriched Organic Sediment (EOS) would remain in place.
- A 1 m thick cap made of sand would be placed over the EOS.
- Geotextile would be used to support the cap where EOS is thick.



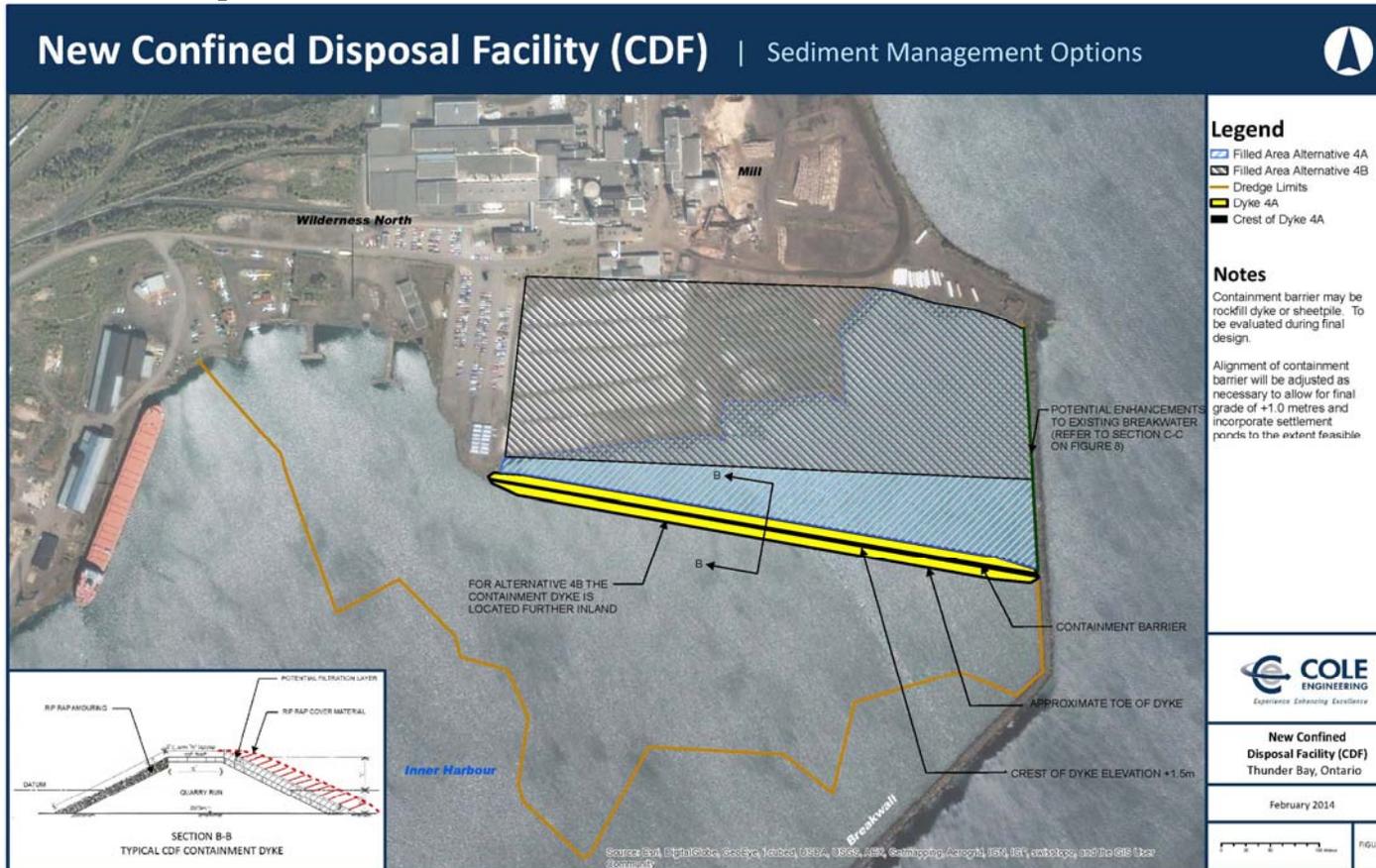
# Disposal Options

- If the Enriched Organic Sediment (EOS) is removed from the North Harbour, it must be disposed of properly.
- Options for disposal of the EOS include:
  - Disposal at a landfill site
  - Disposal at a new confined disposal facility (CDF)
  - Disposal at the existing Mission Bay CDF

# Disposal at Landfill

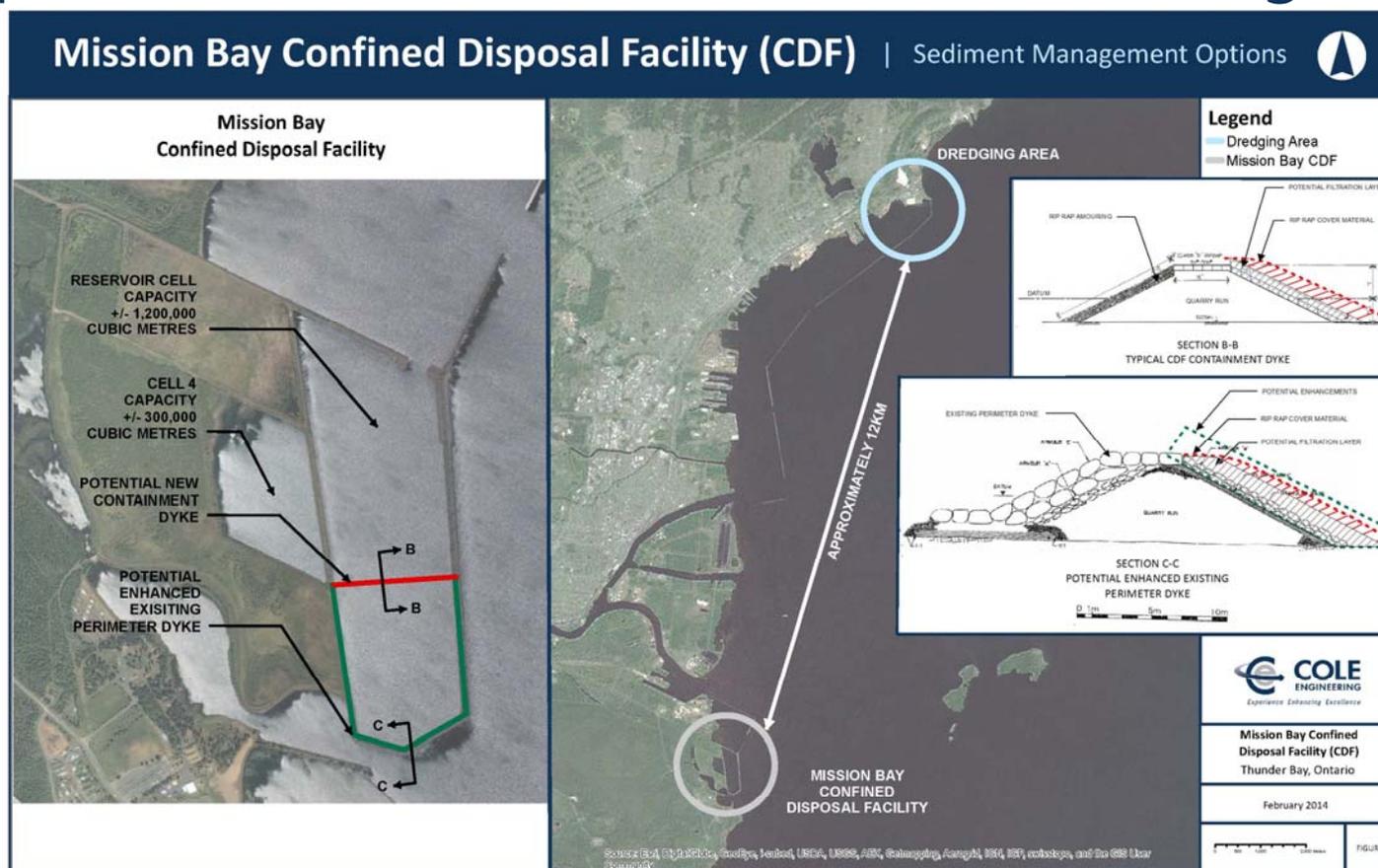
- In order for the Enriched Organic Sediment (EOS) to be disposed of at a landfill site, it must be dewatered to be classified as a solid waste.
- The dewatering process may require management of the water removed from the EOS. If required, after treatment, this water could be discharged to the City's sanitary sewer system.
- Dewatered EOS would be trucked to an approved landfill.

# Disposal at a New CDF



- A new Confined Disposal Facility (CDF) would be constructed. To reduce the footprint of the new CDF, it could utilize the existing adjacent lagoons. Enriched Organic Sediment (EOS) within the footprint of the new CDF would remain in place.
- EOS outside the new CDF would be dredged and placed in the new CDF.
- After several years of consolidation, the new CDF would be capped. The new CDF could ultimately be used as parkland, recreational space or marina uses.

# Disposal at the Mission Bay CDF



- Dredged Enriched Organic Sediment (EOS) would be placed in the existing Mission Bay Confined Disposal Facility (CDF), owned by the Port Authority.
- Enhancements to the existing CDF may be required to contain contaminants in the EOS.
- After several years of consolidation, the EOS would be capped.

# Evaluation Criteria

- The evaluation of options considered the following criteria:
  - Environmental effectiveness and permanence
  - Short term impacts
  - Implementability
  - Community support
  - Land use benefits
  - Sustainability
  - Cost

# Evaluation Criteria and Weights

- With concurrence of the Stakeholder Committee, the evaluation of options considered the following weighted criteria:

Criterion	Verbal Weighting	Numeric Weighting	Relative Numeric Weighting	Adjusted Numeric Weighting	Adjusted Numeric Weighting
Environmental Effectiveness and Permanence	Critical	100	0.22	100	0.25
Short Term Impacts	Moderately Important	50	0.11	50	0.13
Implementability	Important	75	0.17	75	0.19
Community Support (NOT SCORED)	Moderately Important	50	0.11	0	0
Land Use Benefits	Moderately Important	50	0.11	50	0.13
Sustainability	Minimally Important	25	0.06	25	0.063
Cost	Critical	100	0.22	100	0.25
Total		450	1	400	1

- Note that for the purposes of the initial evaluation, the numeric weighting of Community Support was adjusted to zero, and therefore other weights were increased proportionally

# Results of Evaluation

- Using the weighted criteria, the Study Team performed a comparative analysis and ranking of the Sediment Management Options (SMOs). The analysis was completed by scoring each of the SMOs individually against each one of the evaluation criteria and then using a numeral technique to establish a total relative score for each SMO.
- The highest scoring SMO is considered the recommended SMO from a technical perspective.

Rank	SMO	Score	Net Present Value (NPV) Cost Range (\$ million)
1	Dredging and Disposal at Mission Bay Confined Disposal Facility (CDF)	0.722	\$40 to \$50
2	Dredging and Disposal at New CDF	0.666	\$50 to \$60
3	Dredging and Disposal at New CDF using adjacent lagoons	0.636	\$50 to \$60
4	Capping	0.570	\$30 to \$40
5	Dredging and Disposal at Landfill	0.548	> \$90
6	Excavation and Disposal at Landfill	0.531	> \$90

# Recommended SMO

- The recommended SMO is to dredge the Enriched Organic Sediments (EOS) and dispose of it off-site at the Mission Bay Confined Disposal Facility.
- The reasons SMO ranks the highest are as follows:
  - It ranks second in cost as it has the second lowest cost of the SMOs considered;
  - It ranks as high as the highest of any of the other SMOs for the following parameters:
    - Prevent human health risks from fish ingestion;
    - Minimize ecological risks;
    - Durability and monitoring & maintenance requirements;
    - Un-mitigatable environmental impacts (during construction);
    - Constructability;
    - Effectiveness in verification modeling;
    - Technology reliability;
    - Implementation uncertainty;
    - Depletion of local aggregate resources;
    - Open water inside breakwater; and,
    - Regulatory requirements.

# Recommended SMO

- A more detailed cost estimate has been prepared for the recommended SMO
- The total net present value cost in 2014 dollars is \$44.7 million. This cost includes a 20% recommended contingency (primarily to address additional details that are currently unknown and variations in quantities and/or unit prices used in the estimate). The cost also includes allowances for permitting, procurement, engineering, project administration, and construction management.
- As the project will not commence construction until 2017 and is to be constructed over 3 years, inflationary costs have been calculated assuming a 3% annual inflation rate. For the purposes of this calculation it has been assumed that 100% of the project cost will experience inflation between 2014 and tender in 2017. In addition, 40% of the project value will experience inflation during construction between the tender and completion of construction. Including these inflationary costs, the project cost rises to \$50.6 million at time of tender in 2017.

# Next Steps

- The Study Team will consult with the Public, Aboriginal groups, Public Advisory Committee (PAC) and other stakeholders regarding the recommended option.
- Further consultations with, and input from, the public, PAC, Aboriginal groups and other stakeholders will be used to finalize an option for implementation.
- The table below presents proposed upcoming major milestones related to the project. Scheduling is subject to funding.

<b>Milestone</b>	<b>Potential Timeline</b>
Consultation Regarding Recommended SMO and Selection of Preferred SMO	Complete by End of 2014
Design and Permitting Land Acquisition	Initiate at Start of 2015
Tender	January 2017 to March 2017
Construction	Spring 2017 to End of 2019
Project Verification and Close-out	March 2020