Sault Ste. Marie Region Conservation Authority
Ontario Ministry of the Environment
Environment Canada

ST. MARYS RIVER AREA OF CONCERN
Bellevue Marine Park Contaminated Sediments Strategy

Summary presentation made to:

Binational Public Advisory Council

April 29, 2008

Team

- Agencies:
  - Sault Ste. Marie Region Conservation Authority
  - Ontario Ministry of the Environment
  - Environment Canada

- Consultants:
  - Kresin Engineering Corporation
  - Genivar Ontario Inc. (formerly MacViro)
  - Shelby Environmental Services.

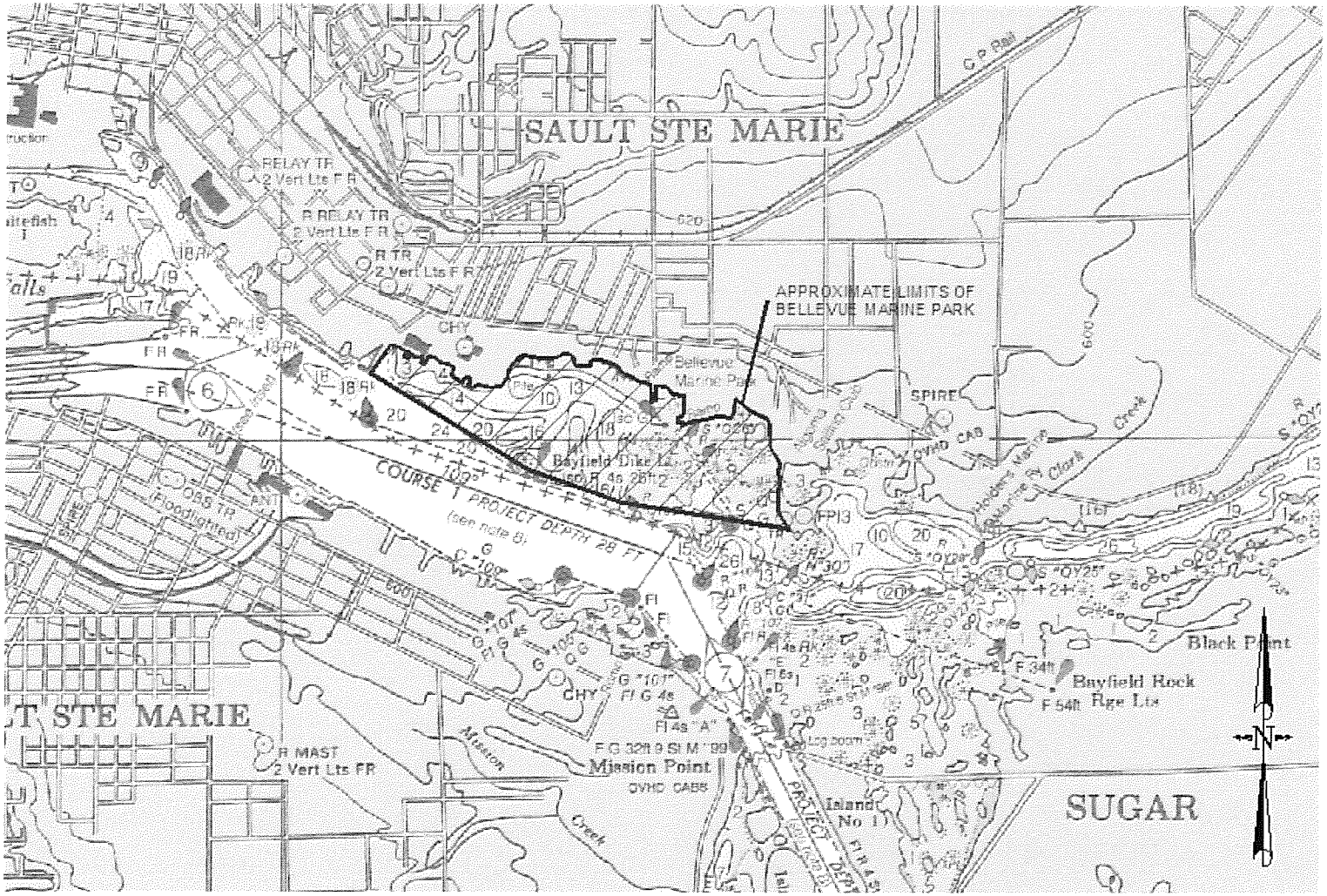
Purpose

- Develop a contaminated sediments management strategy for the Bellevue Marine Park (BMP).
  - Review and amalgamate all sediment quality and other data relevant to the BMP and identify data gaps.
  - Apply the Canada-Ontario Decision-Making Framework for Contaminated Sediments (January, 2005).
  - Document land ownership and zoning in/near the BMP.

The BMP

- An embayment located along the northern shoreline of the St. Marys River.
- Extends from:
  - Purvis Marine dock in the west; and,
  - Top Sail Island in the east.
- Lies north of Bayfield Dike.
- Estimated area of 1 km^2.

The BMP



KRESIN
Engineering Corporation

The BMP

- First major depositional zone in the St. Marys River downstream of the industrial sources in Sault Ste. Marie.
- One study estimated approximately 2.2 million cubic metres of sediment have been deposited within the BMP.
- Identified as being moderately impaired in a 2004 Environment Canada review.

The Process

- Review background information – interim report on data gaps.
- Summarize physical and chemical characteristics of BMP sediments and water quality (incl. exposure pathways).
- Apply the decision-making framework for contaminated sediments.
- Identify potentially affected land and water lots.
- Present Conclusions and Recommendations.

Background Information

- Reports reviewed (in addition to Stage 1 and 2 Remedial Action Plan reports and 2004 Remedial Action Plan review report):
  - Milani, D. and L.C. Grapentine. 2006. The Application of BEAST Sediment Quality Guidelines to the St. Marys River Area of Concern.
  - Golder Associates Inc. 2004. "Synthesis of Sediment and Biological Investigations in the St. Marys River Area of Concern."
  - Kilgour, B.W., W.B. Morton and P.B. Kauss. 2001. Sediment and Benthic Invertebrate Community Assessment of the BMP Area in the St. Marys River.
  - Arthur, A. and P.B. Kauss. 2000. Sediment and Benthic Community Assessment of the St. Marys River.
  - Bedard, D. and S. Petro. 1997. Laboratory Sediment Bioassay Report on St. Marys River Sediments 1992 and 1995.
  - Kauss, P. 1996. Preliminary St. Marys River Sediment Survey Data.
  - Hesselberg. R.J. and Y. Hamdy. 1987. Current and Historical Contamination of Sediment in the St. Marys River.

Background Information

- Selected Conclusions from reports reviewed:
  - Soft and loose sediments near easterly limits of the BMP may limit remedial options.
  - Pulp fibre deposits throughout.
  - Methane flux observed inhibits oil degradation.
  - Foreign material within sediment:
    - Wood chips/fibres (largest proportion).
    - Charcoal.
    - Soot.
    - Iron and copper plates.
    - Coke.

Background Information

- Selected Conclusions from reports reviewed:
  - Gases escaping from anoxic layers may be toxic to sediment dwelling invertebrates.
  - Observations identify physical characteristics of the sediment in addition to the presence of contaminants as concerns.
  - Disturbance of sediments should be avoided unless part of major clean-up.

Background Information

- Selected Conclusions from reports reviewed:
  - PAHs and TOC concentrations are among the more important variables affecting benthic invertebrate communities.
  - Sediment TPH concentrations also linked to observed toxicity.
  - Moderately elevated concentrations of contaminants are likely acting together to cause toxicity (eg. PAHs and TPHs).

PAH - Polycyclic Aromatic Hydrocarbons
TOC - Total Organic Carbon
TPH - Total Petroleum Hydrocarbons

Characteristics of Sediment

- Physical Characteristics:
  - Layered substrate, total sediment depths range from 0.6m to 3.3m.
  - Surficial deposits consist of fine silty material, organic matter and vegetation.
  - Silty sediments overlay deeper pulp fibres and wood chips.
  - Contains oil globules and gases.

Characteristics of Sediment

- Physical Characteristics (cont'd):
  - Ranges from silty-sand to very fine silty-clay.
  - Highest percentage of fines in the AOC.
  - Various sized sediments closer to the shoreline.
  - Relatively unstable due to decomposing wood fibres and gases.

Characteristics of Sediment

- Chemical Characteristics:
  - Petroleum hydrocarbons.
    - Highest TPH concentrations in AOC (2006).
    - TPH – on average higher in 2001 than in 1995.
  - Metals:
    - Concentrations exceed PSQG-LEL and SEL.
  - PAHs:
    - Exceed PSQG-LEL at locations in BMP.

PSQG - Provincial Sediment Quality Guidelines

LEL - Lowest Effect Level

SEL - Severe Effect Level

Characteristics of Sediment

- Chemical Characteristics:
  - TOC and TKN:
    - Elevated in BMP.
    - Correlations observed between concentrations of TOC and TKN and concentrations of TPH and PAH.
  - Chemicals that Bioaccumulate:
    - Mercury, PCBs, lead detected above PSQG-LEL.
  - Other Contaminants:
    - Arsenic, cyanide, methane, others.

Characteristics of Sediment

- Sediment Toxicity
  - Toxicity observed in 5 of 6 samples collected in 2002.
  - Varying degrees and extents of toxicity identified in other studies.
  - TPH, PAH and sediment characteristics thought to be causes, among others.
  - Further study required to specifically identify cause of toxicity.

Characteristics of Sediment

- Benthic Communities
  - Based on 2002 data (2006):
    - No strong evidence of benthic community impairment was observed (compared to reference site).
    - 4 of 6 sample locations in the BMP characterized as equivalent to reference site.
  - In 2004, it was noted that previous studies identified impairment of benthic communities in the BMP.
  - In 2001, improvement in benthic communities was identified (since 1985).

Water Quality and Exposure Pathways

- Water Quality
  - Considering parameters analyzed for in 2002, water quality throughout the AOC appeared homogeneous.
  - Samples from the Algoma Slip were most dissimilar.
- Exposure Pathways
  - Limited specific information in studies reviewed.
  - Ingestion of contaminated sediment.
  - Uptake through absorbing epithelia (e.g. fish gills).

Decision-Making Framework

- Developed through the C-O Agreement respecting the Great Lakes Basin.
- Process to determine when contaminants become pollution (characterized by adverse biological effects).
- Based on ecological risk assessment principles.
- Does not include assessment of human health risk.
- Nine step process with 8 decision points.

Decision-Making Framework

- Key Guidance Rules:
  - Sediment chemistry data not to be used alone.
  - Remediation decisions based primarily on biology, not chemistry.
  - Reliance on field studies over laboratory tests.
  - If an alternative remediation strategy will cause more harm than leaving contaminants in-place, it should not be implemented.

Decision-Making Framework

- Decision Points and responses:
  1. Is toxicity or biomagnification possible?
     - Yes to both – proceed.
  2. Are COPC significantly > reference site?
     - Yes – proceed.
  3. Is biomagnification a potential concern?
     - Yes.
  4. Are sediments toxic?
     - Yes.
  5. Are benthic community assessments appropriate, possible and completed?
     - Yes to all.

Decision-Making Framework

- Decision Points and responses:
  6. Do sediments pose an environmental risk?
     - Involves the application of a weight of evidence (WOE) decision matrix.
     - Least weight to sediment chemistry data and most weight to benthic community data.

     - Yes – proceed.

Decision-Making Framework

Decision Matrix for Weight of Evidence (WOE) Categorization					
Sample Location	**Sediment Chemistry**	**Toxicity**	**Benthos Alteration**	**Biomagnification Potential**	**Assessment**
6981	■	○	■	■	Determine reason(s) for benthos alteration **and** fully assess risk of biomagnification.
6983	●	○	○	■	Fully assess risk of biomagnification.
6984	■	○	■	■	Determine reason(s) for benthos alteration **and** fully assess risk of biomagnification.
6986	●	●	○	■	Determine reason(s) for sediment toxicity **and** fully assess risk of biomagnification.
6991	●	●	○	■	Determine reason(s) for sediment toxicity **and** fully assess risk of biomagnification.
6992	●	○	○	■	Fully assess risk of biomagnification.
BMP Site Overall	●	■	○	■	Determine reason(s) for sediment toxicity **and** fully assess risk of biomagnification.
● - major effect, ■ - minor effect, ○ - negligible effect					

Decision-Making Framework

- Decision Points and responses:

7. Does an environmental risk exist?
   - With reference to the WOE decision matrix – additional information is required to respond to Decision Point 7.

8. Should deeper sediments be assessed?
   - Available information suggests they are impacted.
   - Additional confirmatory data required to respond to Decision Point 8.

Conclusions

- Sediment toxicity in the BMP has been documented.
- The specific cause of the toxicity is unclear in the information reviewed.
- Appropriate and pristine reference sites are required.
- Additional information required to finalize a management strategy for BMP sediments.

Recommendations

- Address data gaps – including Toxicity Identification Evaluations (TIE).
- Specific recommendations for the design of monitoring programs.
- Further develop the understanding of exposure pathways.
- Apply consistent guidelines for each study.

Recommendations

- A detailed assessment (similar to Kilgour and Morton, 2001) should be designed and carried out.
- An assessment of the risk to human health is required.
- Undertake the studies/assessments identified following the WOE assessment.

Thank you for your time and attention.

Questions – Discussion