St. Marys River Area of Concern

Sediment Management Strategy

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ACRONYMS AND ABBREVIATIONS

BUI	beneficial use impairment
PAH	polycyclic aromatic hydrocarbon
RAP	Remedial Action Plan

1 INTRODUCTION

1.1 PURPOSE OF THE STRATEGY

The Sediment Management Strategy for the Canadian section of the St. Marys River Area of Concern provides a plain language summary of the history, current status, and future actions required as related to the management of contaminated sediment in the Area of Concern. This strategy is intended to provide the Area of Concern community with a clear understanding of the sediment assessment process and outline management approaches appropriate for the St. Marys River.

The Stage 1 Remedial Action Plan (RAP) (MOE and DNR 1992) and Stage 2 RAP (EC et al. 2002) reports identified contaminated sediment issues within industrial discharge areas and up to 24 kilometers (km) downstream of the industrial areas. To understand the state of contaminated sediment within the Area of Concern, numerous investigations have been conducted over the last several decades, as documented in the Area of Concern's Conceptual Site Model (Ramboll 2020). These investigations have covered the entire span of the Area of Concern and have revealed that the St. Marys River has five depositional areas in which further assessment was needed to address the contaminated sediments. These areas have been labelled as sediment management sites within the Area of Concern and include the Algoma Boat Slip, the Federal Water Lot, Bellevue Marine Park, East of Bellevue Marine Park and collectively Lake George Channel, Little Lake George and Lake George (Figure 1). Planned and completed actions at these five areas are a subset of the 50 actions described in the Stage 2 RAP report (EC et al. 2002) and the Implementation Annex for the Canadian Waters of the St. Marys River Area of Concern (MECP et al. 2019) (i.e., Actions NPS-1 through -5 and NPSM-5 and -6.

The *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* was used to determine the most suitable management approach to address contaminated sediment at each of the five sediment management sites listed above (Table 1). This Framework is a principal decision-making tool for managing contaminated sediments in the Great Lakes basin and is fundamental to understanding how management decisions are made within Areas of Concern.

1.2 THE ST. MARYS RIVER AREA OF CONCERN

The St. Marys River is a 112 km binational waterway that connects Lake Superior to the North Channel of Lake Huron. In 1987, Canada and the United States designated the St. Marys River as one of 43 Areas of Concern in the Great Lakes basin, and both countries committed to restoring it under *the Canada-U.S. Great Lakes Water Quality Agreement*. "Area of Concern," or AOC, is the term used to identify hotspots in the Great Lakes where the environment has been harmed to the point that it affects the use and enjoyment of that area or the overall health of the lake or river.

The St. Marys River was designated as an Area of Concern due to historical degradation caused by industrial pollution (e.g., wastewater discharges from a former pulp and paper mill and a steel plant), insufficiently treated municipal and private sewage, contaminated stormwater runoff, and habitat alteration. Though the original sources or inputs of pollution to the river have been largely controlled, the long legacy of pollution to the river has left residual effects on fish, habitat, and water and sediment quality.

The Canadian portion of the St. Marys River Area of Concern extends from its head at Gros Cap in Whitefish Bay downstream to St. Joseph Island via Lake George to Quebec Bay in the St. Joseph Channel and downstream to Hay Point on the western shore of St. Joseph Island (Figure 2). As part of the *Canada-U.S. Great Lakes Water Quality Agreement*, Remedial Action Plans[1], or RAPs, were developed for all Areas of Concern to identify and restore environmental impairments. The Agreement was revised in 2012, which reaffirmed the countries' commitment to restoring the Areas of Concern. Key milestones in the Area of Concern's history are listed in Table 2.

1.3 BENEFICIAL USE IMPAIRMENTS

The restoration of an Area of Concern is tracked through successfully removing (or redesignating) the beneficial use impairments (BUIs) identified in the RAP. BUIs are changes to the chemical, physical, or biological integrity of a waterbody in the Great Lakes system sufficient to cause significant environmental degradation. For an Area of Concern to be restored (or delisted), appropriate remedial actions and monitoring activities must be completed, and the identified BUIs must be removed according to established delisting criteria.[2]

In the initial stage of the St. Marys River RAP, in which the most significant environmental challenges were defined and further identified for the Area of Concern, nine BUIs were identified, and one was determined to need further assessment by both the US and Canada. The next stage of the RAP recommended 60 actions to restore the health of the river (Appendix A). Today, six BUIs remain on the Canadian side of the river with four being re-designated to 'not impaired' in recent years (Appendix A).

[1] Remedial Action Plans are three-phase plans that aim to restore Area of Concern, in partnership with federal and provincial/state agencies, conservation authorities, municipalities, Indigenous communities, environmental groups, industry, residents and others (Remedial Action Plan – Bi-National Public Advisory Council (algomau.ca).

[2] Delisting criteria are a set of targets that measure restoration as it relates to recovery and improvement of the individual BUIs. For "impaired" BUIs to be re-designated to "not impaired", the delisting criterion developed specifically for the BUI must be met.

1.4 BENEFICIAL USE IMPAIRMENTS RELATED TO CONTAMINATED SEDIMENT

This Sediment Management Strategy for the St. Marys River Area of Concern describes work conducted to date and planned for the future to help achieve the delisting criteria for those BUIs most closely tied to contaminated sediment, namely

1. Degradation of Benthos
2. Restrictions on Dredging Activities and
3. Fish Tumours or Other Deformities.

Efforts to restore and ultimately redesignate these BUIs have focused on stricter regulatory controls on industrial effluent and identification and cleanup of the most significant historical and ongoing sources of pollution to the river. As detailed in the Conceptual Site Model for the St. Marys River (Ramboll 2020), the following are or were key sources of sediment contamination:

- Algoma Steel Inc. (formerly Essar Steel Algoma and Algoma Inc.) (remediation ongoing)
- St. Marys Paper (formerly Abitibi Paper Company) [decommissioned]
- Municipal wastewater treatment facilities (upgraded)
- Consumers Energy manufactured gas plant (USA) [decommissioned]
- Tannery Bay/Cannelton Industries, Inc. Superfund site (USA) [remediated and decommissioned]
- St. Marys River Federal Water Lot (natural recovery ongoing)
- Non-point/background sources (e.g., storm sewer discharges, urban runoff, atmospheric deposition).

The link between the three BUIs named above (i.e., Degradation of Benthos, Restrictions on Dredging Activities and Fish Tumours or Other Deformities) and contaminated sediment is apparent through their delisting criteria (Appendix A). That is, the delisting criteria for these three BUIs are linked to the management of contaminated sediment in the Area of Concern and are therefore pertinent to this Sediment Management Strategy.

The Degradation of Benthos BUI criteria reference the *Canada-Ontario Decision Making Framework*, which identifies management of contaminated sediment as a key management action in restoring impaired beneficial uses. The criteria also reference three of the five depositional/management sites for which the lines of evidence described in the Framework were applied to determine whether management action is warranted under this Strategy. Restrictions on Dredging Activities BUI criteria reference a Dredging Administrative Controls document, which is a component of this strategy, to provide guidance in the planning and undertaking of dredging activities, and the Fish Tumours or Other Deformities criteria reference fish liver tumour rate caused historically by elevated polycyclic aromatic hydrocarbons (PAHs) in the sediment.

Overall conclusions of the strategy focus on the remaining actions needed for the three BUIs most closely linked to contaminated sediment in the St. Marys River Area of Concern. The rest of the Sediment Management Strategy describes the status of sediment management at the above sites within the St. Marys River Area of Concern (Section 2), approaches for managing contaminated sediments (Section 3), the process by which contaminated sediments are assessed (Section 4), and overall conclusions (Section 5). These analyses were supplemented by several appendices that provide greater detail on factors affecting the Sediment Management Strategy for the St. Marys River Area of Concern.

2 STATUS OF SEDIMENT MANAGEMENT AT SITES WITHIN THE AREA OF CONCERN

For many years, environmental conditions have been studied at five depositional areas within the St. Marys River Area of Concern on the Canadian side of the river. Those five depositional areas are (Figure 1):

- Algoma Boat Slip
- St. Marys River Federal Water Lot
- Bellevue Marine Park
- East of Bellevue Marine Park
- Collectively, Lake George Channel, Little Lake George, and Lake George.

For each of the five areas, this section describes (as applicable) studies conducted to characterize conditions, actions taken to control sources of contamination, sediment management options, monitoring plans and activities, and how the administrative controls may apply. With respect to site characterization, it should be noted that the contaminants present in these five areas do not tend to biomagnify (i.e., increase in tissue concentrations moving up the food chain to fish and wildlife). Consequently, they were not assessed for biomagnification and studies instead focused on sediment chemistry, toxicity and/or benthic community structure.

Pertinent to the entire Area of Concern rather than any single site, Algoma University plans to conduct a fish consumption survey for the entire Area of Concern in 2021 and 2022. The Area of Concern-wide assessment of the Restrictions on Fish Consumption BUI will consider survey responses, as well as concentrations of contaminants in fish and consumption advice issued by the Province of Ontario.

This section is supplemented by more detailed fact sheets for each of the five areas, presented as Appendices B through F. Included with the fact sheets are tables and figures that detail key findings and features for each depositional area. The St. Marys River Area of Concern Dredging and In-water Administrative Controls Guidance Document (ECCC 2021; Appendix G) is relevant to people and entities (proponents) that wish to undertake activities on the Canadian side of the St. Marys River Area of Concern that could disturb sediment, such as dredging, filling, covering, piling, or other activities that result in scouring conditions. It is therefore relevant to all five areas, though in varying ways. The guidance addresses two main types of administrative controls: 1) environmental assessment and planning and 2) regulatory approvals and permitting.

2.1 ALGOMA BOAT SLIP

Site Overview. The Algoma Boat Slip is part of the Algoma Steel Inc. (Algoma Steel) plant. The steel plant and associated property comprise more than 400 hectares of land in Sault Ste. Marie, Ontario. Much of the steel plant and related properties are reclaimed land created through the placement of fill and steel-production waste materials during the initial 75 years of the steel plant's operations, which was founded in 1901. The site has a long history of heavy industrial activities that include the manufacture of coke, iron and steel, power and steam generation, steel rolling and finishing, and transportation. The Algoma Boat Slip, which accommodates commercial-scale shipping from the St. Marys River, is located adjacent to the steel plant. The Algoma Boat Slip contains legacy contamination from historical operations on the site, which is generally related to PAHs associated with coal tar and its distillates. Appendix B provides a fact sheet with further detail about contaminated sediment management at this site.

Characterization. Algoma Boat Slip sediment has been characterized through a series of studies conducted in 2005, 2014, 2018, and 2020. With the exception of Golder's 2020 study (Golder 2021), sediment surveys focused on sediment chemistry relative to sediment quality benchmarks, including Severe Effect Levels and Lowest Effect Levels (https://www.ontario.ca/document/guidelines-identifying-assessing-and-managing-contaminated-sediments-ontario/identification-and-assessment#section-1), as well as Probable Effect Levels (https://ccme.ca/en/resources/sediment), rather than the toxicity, community structure and/or biomagnification lines of evidence specified in the Framework.

The purpose of Golder's 2020 sediment assessment (Golder 2021) was to develop site-specific criteria to determine risk management actions and progress towards restoration. The benthic community line of evidence was excluded from Golder's 2020 assessment because: a) vessel use of this active boat slip mechanically disturbs the sediment to a degree likely to confound the bioassessment; b) past and future dredging would further influence the composition of the benthic community and c) matching the boat slip to comparable reference sites would be extremely difficult. Therefore, Golder's 2020 assessment considered the following lines of evidence:

- Sediment chemistry relative to sediment quality criteria, for purposes of selecting priority constituents of concern
- Sediment toxicity based on survival and growth of chironomids, amphipods, and mayflies
- Concentration-response based on the strength of association between chemistry and toxicity results.

Golder (2021) reported that, of the 14 sampling locations tested, 6 showed negligible effects across all endpoints (survival, growth and biomass) and all species (chironomids, amphipods, and mayflies). Of the remaining 8 locations, 4 showed low effects in one or more endpoint or species, 3 showed moderate effects in a single endpoint-species combination, and one showed moderate effects in two endpoint-species combinations. Golder (2021) recommended the following site-specific benchmarks based on total PAH concentrations: 260 micrograms per gram (µg/g) dry weight as a low-effect concentration and 340 µg/g dry weight as a moderate-effect concentration. Future reports will use these site-specific criteria to evaluate the need for further dredging and to determine whether additional investigation and/or remedial actions are needed.

Source Control. Algoma Steel has implemented several source control measures at the plant (EC et al. 2002; AMEC 2004), which include:

- Upgrades to the wastewater treatment plant between 1997 and 1999, which reduced phenol, ammonia, cyanide, oil and grease, and suspended solids concentrations in wastewater and optimized water re-use by up to 90%.
- Upgrades and refurbishment activities on all three coke oven batteries since 2016 to control air emissions of particulate matter and PAHs (namely benzo(a)pyrene), resulting in significant reductions in emissions from those processes. Installation of a blast furnace contact water recirculation facility in 1998 reduced ammonia and cyanide discharges.
- Installation of a coal tar collection system in 1990 to address contaminated groundwater migration to the river.

Sediment Management and Monitoring. Environmental (remedial) dredging is the management approach adopted to date for the Algoma Boat Slip. Algoma Steel dredged a total of nearly 30,000 cubic meters (m^3) of sediment from the boat slip in 1995, 2006, 2017, and 2019. While early dredging events focused on maintaining shipping access, those undertaken since 2017 have targeted the removal of contaminated sediments from the boat slip. The dredging conducted in 2019 focused on the northern end of the slip, where previous sediment assessments had identified elevated concentrations of PAHs.

In 2019, Algoma Steel entered into a risk-based environmental management agreement with the Ministry of Environment, Conservation and Parks. This agreement is called the Legacy Environmental Action Plan and includes identifying, assessing, managing, and mitigating offsite adverse environmental effects caused by legacy environmental contamination. Remediating the boat slip sediment is being conducted as part of the Legacy Environmental Action Plan, and in the future Algoma is expected to issue a long-term monitoring plan to comply with the Legacy Environmental Action Plan.

Administrative Controls

There are several ways in which the Dredging and In-water Administrative Controls guidance (ECCC 2021; Appendix G) may apply to the Algoma Boat Slip, such as:

- Future navigational dredging and transport of dredged materials, including potential re-exposure of contaminated sediment
- In-water construction that includes installation or removal of infrastructure that penetrates into the subsurface sediment.

2.2 ST. MARYS RIVER FEDERAL WATER LOT

Site Overview. St. Marys River Federal Water Lot is a portion of Sault Ste. Marie Harbour that is owned by Transport Canada. Comprised of 245 hectares on the Ontario side of the St. Marys River, it extends along 9 km of shoreline. The major industrial activities that have impacted the Water Lot include historical operations at Algoma Steel and the former St. Marys Paper plant as well as vessel traffic and hydroelectric power generation (Golder 2008). Appendix C provides a fact sheet with further detail about contaminated sediment management at this site.

Characterization. Since 2007, Transport Canada has commissioned several studies to determine whether management action is required. Consistent with the Framework and as detailed in Section 2, four lines of evidence were considered in the evaluation of contaminated sediment at the Water Lot. The chemistry line of evidence was assessed by measuring contaminants of concern in the surface sediment layer (the biologically active zone) and comparing them to sediment quality guidelines. For the community structure line of evidence, the types of invertebrate organisms present and their abundance were compared to those observed at local and regional reference stations. Laboratory experiments (or bioassays) were conducted to assess toxicity on four species of benthic invertebrates and fish, and assess their responses to exposure to site sediment compared to responses to exposures to reference sediment and/or control sediment. No studies were conducted for the biomagnification potential line of evidence because the concentrations of bioaccumulative contaminants in Water Lot sediment are generally low and similar to those at reference sites. Studies were conducted in 2008, 2009, 2010, 2011, and 2018.

Sediment Management and Monitoring. The outcome of those studies was a recommendation to adopt monitored natural recovery as a management approach and continue monitoring every five years at nine stations. The next round of monitoring is planned for 2023, with the goal of determining whether sediment chemistry and toxicity are improving, stable, or worsening. If dredging is contemplated in the future, characterization of deeper sediment will be considered

Administrative Controls

There are several ways in which the Dredging and In-water Administrative Controls guidance (ECCC 2021; Appendix G) may apply to the Water Lot, such as:

- Filling, straightening, changing, or diverting an existing channel of the river, creek, stream, watercourse, or wetland associated with the river
- Removal or transport of dredged materials
- Dredging that does not meet the criteria and specific terms and conditions for construction under the Minor Works Order
- In-water construction that includes installation or removal of infrastructure that penetrates into the subsurface sediment.

2.3 BELLEVUE MARINE PARK

Site Overview. Bellevue Marine Park is a major depositional area located along the Sault Ste. Marie, Ontario, waterfront, immediately downstream of historical and current industrial inputs to the river. The Stage 1 and Stage 2 RAP reports, issued in 1992 and 2002 respectively, described accumulation of wood fibres and elevated concentrations of petroleum hydrocarbons, PAHs, metals and oil and grease that had originated upstream and deposited at Bellevue Marine Park.

Characterization. As described in Appendix D, a considerable amount of scientific information was used to assess sediment quality and benthic community health in the area stemming from studies conducted from 2002 to 2016. This research was done as part of the overall process of assessing the degradation of benthos BUI for the Canadian section of the St. Marys River Area of Concern. Sediment samples were collected from 13 stations within Bellevue Marine Park to support the evaluation of sediment contaminant concentrations, benthic invertebrate community structure, and sediment toxicity.

Consistent with the Contaminated Sediment Management Framework (Section 2), three lines of evidence were considered in the evaluation of contaminated sediment. No studies were conducted for the biomagnification potential line of evidence because there were no biomagnifying contaminants identified in Bellevue Marine Park. The weight of evidence indicates that benthos were not adversely affected. The application of the Framework indicated no further actions were needed for Bellevue Marine Park due to the absence of benthic impairment and toxicity.

Because some of the deeply buried sediments have elevated concentrations of contaminants, sediment stability was also evaluated by Krishnappan (2021) based on a sediment transport model, sediment grain size profiles, and sediment videography. The model used information on sediment erodibility and on water flow conditions to predict whether and under what conditions sediments in Bellevue Marine Park will erode. Sediment erodibility was estimated based on video imaging work, sediment grab sample analysis, and *in situ* erosion flume experiments. The modelling results indicate that, under a range of flow conditions including ice cover, contaminated sediment deposits along the edges of the river are stable at sediment depths greater than approximately 5 centimeters (cm) (Krishnappan 2021). Biberhofer (2011) evaluated whether vessel traffic is likely to disturb sediment and concluded it is not for the following reasons. Large vessel traffic is limited to the navigation channel and has speed limits managed by the seaway control. An island and ridge complex protect the central portion of Bellevue Marine Park from ship wake. Additionally, the shallow, soft sediments in this area are protected by substantial plant cover.

Sediment Management and Monitoring: No further action.

Administrative Controls. For Bellevue Marine Park, activities most likely to trigger permitting requirements under that the St. Marys River Area of Concern In-water Administrative Controls Guidance Document include:

- Filling to enhance the shoreline of the park
- Dredging projects for private boat access to support the marina
- Building, constructing, dredging, filling, or removal of aquatic vegetation on the shorelands or on Crown land under water
- Construction of bridges or culverts
- In-water construction that includes installation or removal of infrastructure that penetrates into the subsurface sediment.

2.4 EAST OF BELLEVUE MARINE PARK

Site Overview. East of Bellevue Marine Park (i.e., the Topsail Island area) is the second major depositional area located along the Sault Ste. Marie, Ontario waterfront, downstream of industrial inputs to the river.

Characterization. As described in Appendix E, a considerable amount of scientific information was used to assess sediment quality and benthic community health in the area stemming from investigation conducted in 2008, 2009, 2010, 2016, and 2018. This research was done as part of the overall process of assessing the Degradation of Benthos BUI. Samples were collected from 22 stations within East of Bellevue Marine Park to support the evaluation of sediment contaminant concentrations, benthic invertebrate community structure, and sediment toxicity.

The weight of evidence indicates that toxicity persists in East of Bellevue Marine Park sediment, though the benthic communities were similar to those from upstream and regional reference locations that were not subject to the same industrial inputs. In such cases, the Framework requires evaluation of potential causes of toxicity. That evaluation considered correlations between toxicological response, sediment chemistry and tissue chemistry, as well as whole-sediment toxicity identification evaluation. PAHs and/or petroleum hydrocarbons, as well as poor water quality in laboratory test vessels, were identified as likely most responsible for or contributing to toxicity. The outcome for East of Bellevue Marine Park was no further actions needed, with the evaluation of the causes of toxicity completed and the Framework's stipulation that field surveys take precedence over laboratory toxicity tests.

Because some of the deeply buried sediments have elevated concentrations of contaminants, sediment stability was also evaluated by Krishnappan (2021) using a flow model and by M.R. Wright and Associates Co., Ltd. (MRW) using geotechnical analyses (MRW 2012). These two methods showed that the buried sediments are stable and sediments at depths greater than 5 cm are unlikely to be disturbed even under high flow conditions. Sediment cores collected from East of Bellevue Marine Park in 2018 indicate that the sediment concentrations from 5–15 cm do not significantly differ from the concentrations from 0–10 on which the *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* framework decision was made. This indicates that the unlikely theoretical loss of the top 5 cm does not pose an environmental risk. In reality some of the top 5 cm and additional incoming new material may indeed stay in place as deposition and consolidation occurs. Further, sediment cores collected from East of Bellevue Marine Park in 2018 show higher concentrations of contaminants at depths of 5–10 cm than at depths of 0–5 cm. This apparent vertical stratification also indicate that sediments have been stable in the past and likely will to continue to be stable in the future unless there is a significant change to the system.

Sediment Management and Monitoring: No further action.

Administrative Controls. The studies described above recommended administrative controls for management of deeper sediment and contaminants at depth. For East of Bellevue Marine Park, activities most likely to trigger permitting requirements under the St. Marys River Area of Concern In-water Administrative Controls Guidance Document include:

- Filling to enhance the shoreline of the park
- Dredging projects for private boat access to support the marina
- Building, constructing, dredging, filling, or removal of aquatic vegetation on the shorelands or on Crown land under water
- Construction of bridges or culverts
- In-water construction that includes installation or removal of infrastructure that penetrates into the subsurface sediment.

2.5 LAKE GEORGE CHANNEL, LITTLE LAKE GEORGE, AND LAKE GEORGE

Site Overview. Lake George Channel, Little Lake George and Lake George are depositional areas downstream of Sault Ste. Marie, Ontario.

Characterization. As described in Appendix F, a considerable amount of scientific information was used to assess sediment quality and benthic community health in the area stemming from investigation conducted in 2002, 2005, 2006, 2008, 2009, 2010, and 2016. As with Bellevue Marine Park and East of Bellevue Marine Park, this research supported the assessment of the Degradation of Benthos BUI for the Area of Concern. Samples were collected from 23 stations to support the evaluation of sediment contaminant concentrations, benthic invertebrate community structure, and sediment toxicity.

The benthic communities were equivalent to reference at all but three stations, with no significant decrease in taxon richness and reduced average abundance compared to reference. Strong evidence of altered communities was observed at a single station in Lake George Channel (station 170 in 2009); because concentrations of contaminants are generally low at that station, the apparent alteration in the community likely reflected factors other than contaminated sediment. Although the benthic community was possibly different from reference at two Lake George Channel stations, toxicity was not observed at either location. Toxicity was observed in 9 of the 23 stations. Consistent with Framework requirements, the potential cause(s) of toxicity were evaluated using the same methods described above for East of Bellevue Marine Park. PAHs and/or petroleum hydrocarbons again were identified as likely most responsible for toxicity. At eight of the nine stations, laboratory toxicity results contradicted those of field survey results that showed no adverse affects on the benthos. Because the Framework stipulates that field surveys take precedence over laboratory toxicity tests, management actions were not required at any station based on the most recent data.

The assessments of sediment stability discussed above for Bellevue Marine Park and East of Bellevue Marine Park also were conducted within Lake George Channel, and led to the same conclusion that sediments at depths greater than 5 cm are generally stable and not susceptible to disturbance.

Sediment Management and Monitoring: No further action

Administrative Controls. The studies described above recommended administrative controls for management of deeper sediment and contaminants at depth. For Lake George Channel, Little Lake George and Lake George, activities most likely to trigger permitting requirements under the St. Marys River Area of Concern Dredging and In-water Administrative Controls Guidance Document include:

- Filling to enhance the shoreline of the park

- Dredging projects for private boat access to support the marina
- Building, constructing, dredging, filling, or removal of aquatic vegetation on the shorelands or on Crown land under water
- Construction of bridges or culverts
- In-water construction that includes installation or removal of infrastructure that penetrates into the subsurface sediment.

3 APPROACHES TO MANAGING CONTAMINATED SEDIMENT WITHIN THE ST. MARYS RIVER AREA OF CONCERN

Under the Canada-U.S. Great Lakes Water Quality Agreement and the *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* (Framework), management of contaminated sediment is identified as a key management action in restoring impaired beneficial uses to not impaired. Interstate Technology Regulatory Council (ITRC 2014) and U.S. Environmental Protection Agency (USEPA 2005) offer detailed guidance on methods for managing contaminated sediments. The following overview is largely drawn from those documents. Selection and implementation of sediment management approaches can be straightforward for small and simple sites, but many contaminated sediment sites—including those in the St. Marys River Area of Concern—are challenging from a technical and risk-management perspective. Sediment management options that have been selected for the sediment management sites in the St. Marys River Area of Concern include monitored natural recovery and removal (dredging and excavation), discussed in Section 3.1 and 3.2 below. Administrative controls and long-term monitoring are additional tools employed, often in concert with the above methods; these are discussed in Sections 3.3 and 3.4, respectively.

Other management options such as treatment in place (or *in situ*) and capping were not selected for any of the five areas discussed in this report but could be implemented in the future as part of adaptive management (if required). They are briefly summarized in Section 3.5 below.

3.1 MONITORED NATURAL RECOVERY

Monitored natural recovery is a sediment management method that uses ongoing naturally occurring processes to contain, destroy or reduce concentrations, bioavailability, or toxicity of contaminants in sediment. Burial, binding, and degradation are examples of such processes (USEPA 2005). Successful monitored natural recovery reduces contaminants of pollutants in sediment to acceptable levels within a reasonable timeframe. Because some natural processes may not reduce overall risks, successful implementation of monitored natural recovery requires identification of processes that contribute to risk reduction. Natural processes that reduce toxicity through transformation or reduce bioavailability through increased sorption tend to be more permanent than natural burial. However, because few sediment contaminants are readily transformed or destroyed, burial is a commonly accepted sediment management approach.

The following site conditions are particularly well suited to monitored natural recovery:

- The original source of pollution has been controlled

- Future shoreline and in-water uses and structures are compatible with natural recovery
- Natural recovery processes have a reasonable degree of certainty to continue at rates that will achieve desired results within an acceptable timeframe
- Human exposure is low or can be managed through administrative controls
- The sediment bed is reasonably stable and likely to remain so
- Sediment is either cohesive, well-armoured, or otherwise resistant to resuspension
- Contaminant concentrations in biota and in the biologically active zone of sediment are trending towards risk-based goals
- Contaminants biodegrade or transform to less toxic forms
- Contaminant concentrations are low and cover diffuse areas
- Contaminants tend not to bioaccumulate.

The most notable advantages of monitored natural recovery are its low implementation cost and its non-invasive nature. Implementation costs are largely tied to monitoring, administrative controls, and public engagement. Because there is no physical disruption to the biological community, monitored natural recovery can be particularly beneficial in wetlands or other sensitive habitats. Key limitations of monitored natural recovery are that it leaves contaminants in place and risk reduction may occur at a slower pace as compared to more active remedies.

The effectiveness of monitored natural recovery depends on adequate control of contributing sources of contamination. Compared to other management options, monitored natural recovery is minimally invasive and therefore tends to have a lower carbon footprint, be less expensive, and be less disruptive to the existing natural and human communities.

3.2 REMOVAL

Removal of contaminated sediments can be conducted by dredging (while the sediment is under water) or excavation (after water has been diverted or drained and sediment exposed). Both methods typically require transportation of the dredged material to a location where it is treated and/or disposed; they also frequently include treatment of the water from dewatered sediment before it can be discharged to a receiving water body. Though navigational dredging has been practiced for centuries, environmental dredging is a fairly recent development. While removal is particularly effective for source control (mass removal of hot spots), it does not always reduce risks posed by contaminated sediment due to resuspension and residual contamination.

The following site conditions are particularly conducive to dredging or excavation:

- Suitable disposal site with sufficient capacity is available and nearby
- Space is available for staging and handling dredged material (de-watering, water treatment etc.)
- Shorelines and infrastructure can accommodate removal needs, such as maneuvering and accessing barges
- Water depth can accommodate equipment but not so great as to be infeasible; or excavation in the dry is feasible
- Long-term risk reduction resulting from sediment removal outweighs the risks and time to recover from sediment and habitat disturbance
- Water diversion is practical, or current velocity is low or can be controlled, in order to reduce resuspension and downstream transport of contamination during dredging
- Contaminated sediment overlies clean(er) sediment so that over-dredging is feasible
- Sediment contains limited debris (e.g., logs, boulders, scrap material) or such debris can be removed before dredging or excavation
- High contaminant concentrations cover discrete areas of sediment
- Contaminants are highly correlated with sediment grain size (to facilitate segregation and reduce disposal costs).

The two primary methods of dredging are mechanical and hydraulic dredging. Mechanical dredging removes sediment by capturing the sediment and then lifting it to the water surface. Mechanical dredges usually consist of a bucket equipped with a cutting or grabbing edge, a crane or other means of lowering and retrieving the bucket, and a means of transporting the dredged material from the dredging site to a handling and processing or disposal facility (i.e., usually a barge). Mechanical dredging equipment may be operated from shore or set up on a barge equipped with an anchoring system.

Hydraulic dredging removes sediment by cutting into and agitating sediment with a rotating cutterhead, auger or equivalent, to fluidize it and then pumping the sediment-water slurry via a pipeline to a handling location, where it is dewatered.

3.3 ADMINISTRATIVE CONTROLS

Most sediment management projects include administrative controls as a means of ensuring that the remediated sediment will not be disturbed, at least until long-term monitoring indicates that the expected risk reduction has been achieved. Examples of administrative controls include permitting requirements for in-water activities with the potential to disturb sediments, fish consumption advisories, fishing bans, controls on vessels' drafts, anchoring, and wakes. Structural maintenance agreements are legal mechanisms used with some remedies. Remedies that include monitored natural recovery frequently require permitting requirements for in-water activities, as well as fish consumption advisories to limit human exposure during the recovery period. Administrative controls often require guidance, public education programs, and posting of warning signs. The 2021 guidance on administrative controls for the St. Marys River is provided as Appendix G.

For administrative controls to be effective, it is necessary to identify the legal authority with capability and willingness to implement and monitor, enforce, and report on the status of the administrative control. Administrative controls generally protect the remedy and/or humans, but rarely do they protect ecological receptors. That is, administrative controls can limit where people fish, but they cannot limit where the fish themselves swim and feed.

3.4 MONITORING

Monitoring refers to the collection and analysis of repeated observations or measurements to evaluate progress toward meeting a management objective (USEPA 2004). Regardless of the sediment management option selected, monitoring data are usually collected before, during and after sediment remediation to evaluate remedy effectiveness and ensure that timely steps can be taken to address conditions when outcomes are not as planned. Effective monitoring requires collection of chemical, physical and/or biological data over a sufficient period of time and frequency to determine status and trends over time for a particular environmental characteristic, relative to specific targets.

All sediment management options described in this section require monitoring at various stages. After the site is fully characterized and before remediation is initiated, baseline monitoring is conducted to provide a basis for comparison during and after remediation. Construction monitoring is conducted during remedy implementation to determine whether the remedy achieves the design criteria, such as cap thickness, dredging depth, turbidity limits, sedimentation rates, water quality criteria. Post-remediation monitoring, sometimes referred to as long-term monitoring, begins after the remedy has been implemented and continues until the remedy has achieved the established goals. Such monitoring may involve collecting sediment samples for chemical analysis (including cores), surveying bathymetry (water depth), conducting high-resolution acoustic surveys and sediment profile imaging, and benthic infaunal surveys. In all cases, site-specific monitoring plans are critical to judging performance. Typically, monitoring plans define interim and final measures of effectiveness and the data required to evaluate conditions relative to each type of measure.

Example measures of sediment remedy effectiveness include:

- <u>Short-term remedy performance</u> (e.g., have the sediment cleanup goals been achieved? was the cap placed as intended?

- Long-term remedy performance (e.g., have the sediment cleanup levels been reached and maintained for five or more years? has the cap withstood significant erosion?)
- Short-term risk reduction (e.g., do the data demonstrate or at least suggest a reduction in fish tissue levels, a decrease in benthic toxicity, or an increase in species diversity or other community indices after five years?)
- Long-term risk reduction (e.g., have the remediation goals in fish tissue been reached or has ecological recover been accomplished?).

A broad range of monitoring tools are available and are typically selected based on the overall goals of the remedy, as well as many site-specific considerations. Examples of physical measurements are sediment geophysical properties, water column turbidity and total suspended solids, bathymetry, sediment types and bedforms, cap depth and settlement, and sediment grainsize and depth of bioturbation and oxidation. Examples of chemical measurements methods are concentrations of chemicals in surface and subsurface sediment, water column chemistry, concentrations of dissolved chemicals at the sediment-water interface, and chemical flux using seepage meters. Examples of biological measurements are benthic community structure, sediment toxicity, concentrations of chemicals in biological tissue, and caged fish or invertebrate studies.

3.5 SEDIMENT MANAGEMENT OPTIONS NOT APPLICABLE TO THE ST. MARYS RIVER AREA OF CONCERN

Alternative sediment management options not selected for the contaminated sediment sites within the St. Marys River Area of Concern are enhanced monitored nature recovery, *in situ* treatment, and capping. Rationale for not selecting these options differ across sites within the Area of Concern, but generally relate to hydrological conditions, susceptibility to erosion, and/or potential for these options to interfere with current uses. In the interest of completeness, each is briefly summarized in this section.

Enhanced monitored natural recovery can be an effective option in cases where monitored natural recovery appears to be the most suitable management option except that natural processes do not occur quickly enough to reduce risks within an acceptable timeframe. Enhanced monitored natural recovery accelerates the recovery process by adding a thin layer of clean sediment or amendments. In contrast with traditional caps, enhanced monitored natural recovery is not intended to isolate the underlying contamination; as such, the added layer may be only a few centimeters in thickness. Enhanced monitored natural recovery can be implemented at MNR sites as part of adaptive management.

Treatment in place, or *in situ* treatment, involves applying or mixing material (referred to as amendments) into sediments, where the material used reduces bioavailability, toxicity, or mobility of contaminants in the sediment. Such treatments may be mixed with the existing sediment either passively through bioturbation[3] or actively using mechanical methods. *In situ* treatment technologies can help reduce risks in environmentally sensitive habitats, such as wetlands, where sediment removal or capping could be harmful. Few *in situ* technologies have been proven in the field. Areas susceptible to erosion or disturbance are poor candidates for *in situ* treatment due to the likelihood of migration of amendment material away from the targeted sediment. Such was the case when a chemical injection system was developed as part of a pilot test to treat contaminated sediment in the St. Marys River in the 1990s.

Capping is the process of covering contaminated sediment with clean sand, sediment or other material that remains in place over the long-term. Caps are designed to achieve one or more of the following objectives: a) stabilization to prevent resuspension and transport of contaminants; b) isolation to reduce migration and release of contaminants; and/or c) protection of benthic community by reducing their exposure to contaminants. Depending upon the remedial objectives, the cap may include geotextiles to aid in layer separation or geotechnical stability, amendments to enhance protectiveness, or additional layers to improve cap integrity or habitat quality.

A form of capping, similar to enhanced monitored natural recovery, may be used after dredging (referred to as "backfill") to help manage residual contamination.

Advantages of capping are that it can quickly reduce contaminant exposures and, compared to removal, requires less infrastructure and material handling, dewatering, treatment, and disposal. Capping is also conducted in areas where dredging is not permitted because of possible damage to infrastructure.

The main limitation of capping is that the contaminated sediment remains in the aquatic environment, so that if the cap is seriously damaged, contaminants may be exposed. The cap material required to prevent erosion may not provide the preferred habitat for the benthic community.

[3] Bioturbation is the movement of sediment particles and pore water by organisms living within the sediment, as they move, feed, and excrete. Bioturbation results in changes in sediment stratigraphy, chemical profiles, rates of chemical reactions, sediment-water exchange, and sediment physical properties (e.g., grain size, porosity, permeability [Shull 2009]).

4 OVERVIEW OF SEDIMENT ASSESSMENT APPROACH

In 2007, Environment and Climate Change Canada and Ontario Ministry of Environment, Conservation and Parks jointly issued the *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* (Framework; EC and MOE 2007) that provides a consistent decision-making process for assessing and managing contaminated sediments within Great Lakes Areas of Concern. Because the Framework is the principal decision-making tool for managing contaminated sediments in Areas of Concern, including the St. Marys River Area of Concern, understanding it is fundamental to understanding how management decisions are made at this, and other Canadian and Bi-national Areas of Concern.

The Framework encourages structured evaluation of effects of pollutants on sediment-dwelling and aquatic organisms as well as potential for pollution to accumulate in the food chain (or biomagnify). The Framework uses four guiding principles:

1. Remediation (or cleanup) decisions should rely exclusively on sediment chemistry data only when either: a) costs of further investigation outweigh costs of cleanup and stakeholder agree that action is warranted, or b) the site is subject to regulatory action.
2. If neither of the situations listed in the first principle applies, cleanup decisions are to be primarily based on biology, rather than chemistry.
3. If lines of evidence, such as laboratory toxicity tests and community structure surveys, yield contradictory conclusions, findings from properly conducted field surveys take precedence over other lines of evidence.
4. If a cleanup action will cause more environmental harm than good, it should not be implemented.

The four guiding principles listed above drive the design of sediment assessment under the Framework to include site-specific evaluations using four lines of evidence: sediment chemistry, toxicity, benthic community structure, and biomagnification potential. Though the Framework is generally applied to surface sediments (i.e., those in the biologically active zone inhabited by sediment-dwelling organisms or benthos), the Framework also considers whether deeper sediments may be uncovered in the future. Therefore, sediment stability is an additional consideration under the Framework.

The four lines of evidence, plus sediment stability to examine deeper sediments, address different aspects of contaminated sediment assessment and management. For example, toxicity testing is typically needed (though not always sufficient) to determine the cause(s) of impairment, while chemistry data from deeper sediment can inform whether a significant risk would be posed if buried sediment are disturbed in the future. It is not uncommon to observe conflicting outcomes for the different lines of evidence at a given location. The Framework provides clear guidance on the actions that are required under such circumstances.

Sampling and analysis to characterize the four lines of evidence plus sediment stability requires specialized methods, which are briefly summarized in Appendix H. Detailed guidance on the specifics of sediment sampling is provided by the Canadian Council of Ministers of the Environment (CCME) (2016). Consequently, the work that is done within Areas of Concern, including the St. Marys River, is tied to nation-wide approaches.

Over the last 20 years various entities, such as the Federal and Provincial governments and responsible parties, have applied the sampling and analytical methods described above at many locations in the St. Marys River Area of Concern (Appendix I).

5 CONCLUSIONS AND SEDIMENT MANAGEMENT APPROACHES

Over the course of more than two decades, public and private entities have extensively studied five depositional areas of the St. Marys River Area of Concern, where contaminants are present in sediments at high concentrations. Summarized below are the current status and conclusions for Algoma Boat Slip, the Federal Water Lot, Bellevue Marine Park, East of Bellevue Marine Park and collectively Lake George Channel, Little Lake George and Lake George. Actions taken and underway in these five areas represent a subset of the 50 actions described in the Stage 2 RAP Implementation Annex for the Canadian Waters of the St. Marys River Area of Concern (i.e., Actions NPS-1 through -5 and NPSM-5 and -6). Management approach, status, and further actions for the five areas are summarized below.

5.1 ALGOMA BOAT SLIP

Management approach: Environmental dredging.

Status: Verification sampling and assessment are underway to establish risk-based targets and to determine if dredging completed to date has met those targets.

Future Actions: Depending on the results of the status assessment, either management is complete or further dredging and verification sampling are required.

Sediments in the Algoma Boat Slip are predominantly contaminated with petroleum hydrocarbons and PAHs. Dredging performed in 1995 and 2006 was for purposes of maintaining shipping access. Dredging performed in 2017 and 2019 was for purposes of removing contaminated sediments. Dredging operations were guided by sediment chemistry testing that was conducted in 2005, 2014, 2018, and 2020. Sediment sampling and characterization conducted in 2020, in contrast, included both chemistry and toxicity lines of evidence.

In 2019, Algoma Steel entered into a risk-based environmental management agreement with the Ministry of Environment, Conservation and Parks. This agreement is called the Legacy Environmental Action Plan. It provides the basis for and approach to identifying, assessing, managing, and mitigating offsite adverse environmental effects caused by legacy environmental contamination and it includes the rehabilitation of the boat slip.

5.2 ST. MARYS RIVER FEDERAL WATER LOT

Management approach: Monitored natural recovery, plus recommend administrative controls for in-water work.

Status: Ongoing.

Future actions: The next round of long-term monitoring will be completed in 2023, with continued monitoring every five years thereafter; adaptive management will be considered in the future if monitored natural recovery is deemed ineffective.

Transport Canada's 245-hectare Water Lot has been impacted by industrial activities at the Algoma Steel Plant and the former St. Marys pulp and paper plant, as well as by vessel traffic and hydroelectric power generation. Multiple studies conducted from 2008 through 2018 addressed the four lines of evidence considered under the Framework. The outcome of those studies is a recommendation to continue monitoring every five years at nine stations, with the next round of monitoring planned for 2023. If dredging is contemplated in the future, characterization of deeper sediment will be considered. The St. Marys River Area of Concern In-water Administrative Controls Guidance Document will help prevent disturbance of buried sediments through management of certain activities within the Water Lot, such as removal or transport of dredged material and in-water construction of infrastructure.

5.3 BELLEVUE MARINE PARK

Management approach: No action required; recommend administrative controls for in-water work.

Status: Complete.

Future actions: None, other than abide by administrative controls for in-water work.

A major depositional area for sediments is located adjacent to the City of Sault Ste. Marie's Bellevue Marine Park and immediately downstream of historical and current industrial inputs to the river. As described in the Stage 1 and Stage 2 RAP reports, wood fibres and sediments contaminated with petroleum hydrocarbons, PAHs, metals and oil and grease were historically released from upstream sources and accumulated adjacent to Bellevue Marine Park. Investigations conducted between 2002 and 2016 supported the evaluation of sediment chemistry, benthic community structure, and sediment toxicity at 13 stations adjacent to Bellevue Marine Park, consistent with the Framework. The weight of evidence from those studies indicates that because benthos is not adversely affected, no further actions are needed at this location. The St. Marys River Area of Concern In-water Administrative Controls will help prevent disturbance of buried contaminated sediments through management of certain activities within Bellevue Marine Park, such as filling to enhance the park's shoreline and dredging projects for private boat access.

5.4 EAST OF BELLEVUE MARINE PARK (TOPSAIL ISLAND AREA)

Management approach: No action required; recommend administrative controls for in-water work.

Status: Complete.

Future actions: None, other than abide by administrative controls for in-water work.

Downstream of Bellevue Marine Park is a second major depositional area, referred to as East of Bellevue Marine Park. Investigations aligned with the Framework have been conducted at 22 stations within East of Bellevue Marine Park in 2008, 2009, 2010, 2016, and 2018. Although toxicity persists at some stations, benthic communities are similar to those from upstream and regional reference locations. No further actions are needed, in that potential causes of toxicity have been evaluated and the Framework specifies that field surveys take precedence over laboratory toxicity tests. In-water Administrative controls will help minimize disturbance of buried contaminated sediments through management of certain in-water activities.

5.5 LAKE GEORGE CHANNEL, LITTLE LAKE GEORGE, AND LAKE GEORGE

Management approach: No action required, but administrative controls for in-water work within Lake George Channel recommended.

Status: Complete.

Future actions: None, other than abide by administrative controls for in-water work.

Depositional areas of sediment are located within Lake George Channel, Little Lake George, and Lake George. Investigations at 23 stations in these areas were conducted in 2002, 2005, 2006, 2008, 2009, 2010, and 2016. At many stations, outcomes of different lines of evidence yielded conflicting conclusions. The benthic communities are equivalent to reference at all but three stations. At the three stations where some community structure alteration was observed, concentrations of contaminants were low or toxicity was not observed; consequently, the observed alteration in community structure at those three stations appears unrelated to contaminated sediment. Toxicity was observed at nine stations, only one of which also had altered community structure. Consistent with Framework requirements, the potential cause(s) of toxicity were evaluated. Because the Framework specifies that field surveys take precedence over laboratory toxicity tests, management actions are not required at any station based on the most recent data. In-water Administrative controls will help to minimize disturbance of buried contaminated sediments through management of certain in-water activities.

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TABLES

Table 1. Sediment Management Approaches for the St. Marys River Area of Concern

Sediment Management Site	Management Approach*
Algoma boat slip	Environmental (remedial) dredging
Federal water lot	Monitored natural recovery
Bellevue Marine Park	No action required
East Bellevue Marine Park	No action required
Lake George Channel, Little Lake George and Lake George	No action required

* Administrative controls for dredging and in-water works recommended for entire AOC.

Table 2. Milestones in the History of the St. Marys River Area of Concern[1]

Year	Milestone
1987	St. Marys River was identified as an Area of Concern (AOC) under the Canada-U.S. Great Lakes Water Quality Agreement.
1988	The Bi-National Public Advisory Council (BPAC) was formed – a stakeholder group with members from Canada and the United States that represents a variety of interests around the river.
1991	The commissioning of a main filtration plant for wastewater discharged from Algoma Steel Inc.* that led to improved wastewater quality.
1992	The first stage of the RAP for St. Marys River was completed. Federal and provincial government agencies worked with BPAC to identify specific environmental issues in the St. Marys River.
1995	St. Marys Paper Ltd. installed an activated sludge secondary treatment facility that led to improved wastewater quality.
1997	The St. Marys River Fisheries Task Group was established by the Great Lakes Fishery Commission to coordinate fisheries assessment among Canadian and U.S. agencies.
1997-1999	Algoma Steel Inc.* invests heavily in new water technology to reduce phenol concentrations in waste-water and optimize water re-use by up to 90% (e.g., new biological treatment facility to treat Cokemaking wastewater, new direct casting facility, toxicity control system on the Bar and Strip process effluent, and water recirculation system on Ironmaking Blast Furnace water facilities).
2002	In partnership with the BPAC, the RAP Team completed the Stage 2 Report which recommended remedial actions to address the environmental challenges within the AOC.
2003	The City of Sault Ste. Marie (ON) constructed a sanitary sewer overflow tank at Bellevue Park to address infiltration and high-flow events.
2006	Sault Ste. Marie's (ON) East End Wastewater Treatment Plant was upgraded to secondary treatment using the first Biological Nutrient Removal system in Ontario, which uses organic material instead of chemicals to reduce contaminants in wastewater.
2007	Clean-up of the Tannery Bay Great Lakes Legacy Act site is completed, helping to remove mercury and chromium from the river sediment.
2009	Sault Ste. Marie (ON) launched an investigative study to identify ways to improve stormwater runoff and minimize the input of contaminants to the river.
2010	The Sugar Island Monitoring Work Group released the last of three reports that confirmed episodes of floating solids and bacteria (E. coli) were due to natural causes and stormwater outfalls on both sides of the river.
2010	Clean-up at Consumers Energy Manufactured Gas Plant site as part of the Great Lakes Legacy Act and 26,000 cubic yards of contaminated sediment is removed.
2011	The City establishes a stormwater master plan and policy to improve the quality and quantity of stormwater runoff around the community to minimize the input of contaminants to the river.
2013	The RAP Implementation Annex is completed, which outlines the priority actions going forward to complete the AOC's restoration.
2013-2015	Water quality study by Algoma University on physical and chemical parameters show aesthetics and eutrophication/algae are not impaired (ON).
2015	City of Sault Ste. Marie (ON) established new *Storm Water Management Master Plan and Guidelines*.
2011-2016	Beach closings BUI assessment show water quality and state of public beaches along the river are comparable to outside the AOC, and are not impaired (ON).
2017	Little Rapids Restoration Project completed! Re-established flow to the rapids for the first time in more than 50 years.
2018	The Sault Ste. Marie (MI) combined sewer system is separated.
2020	The Conceptual Site Model (CSM) for the St. Marys River Contaminated Sediments is updated.

[1] Source: http://bpac.algomau.ca/?page_id=2913

FIGURES

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Depositional Areas within the St Marys River Area of Concern
St. Marys River
Ontario, Canada

FIGURE
1

DRAFTED BY: JLB | DATE: 3/15/2021 | PROJECT: 1690020398

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integral consulting inc. RAMBOLL	**Area of Concern** St. Marys River Ontario, Canada	FIGURE **2**
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APPENDIX A
DE-LISTING CRITERIA FOR BENEFICIAL USE IMPAIRMENTS IN THE ST. MARYS RIVER AREA OF CONCERN (EXCERPTED FROM THE ST. MARS RIVER IMPLEMENTATION ANNEX)

Appendix A. Summary of Beneficial Use Impairments and Delisting Criteria for the St. Marys River Area of Concern (excerpted from St. Marys River RAP Implementation Annex)

Table 1. Summary of the BUI status within the St. Marys River AOC.

	Beneficial Use Impairment (BUI)	Status
1.	**Restrictions on Fish and Wildlife Consumption** [specific to fish only; those for wildlife NI]	I
2.	**Tainting of Fish and Wildlife Flavour**	NI
3.	**Degradation of Fish and Wildlife Populations** [specific to fish populations only; those for wildlife RFA but change to NI recommended]	I
4.	**Fish Tumours and Other Deformities**	I
5.	**Bird and Animal Deformities or Reproductive Problems**	NI
6.	**Degradation of Benthos**	I
7.	**Restrictions on Dredging Activities**	I
8.	**Eutrophication or Undesirable Algae** [*change to NI recommended]	I*
9.	**Restrictions on Drinking Water Consumption or Taste and Odour Problems**	NI
10.	**Beach Closures** [*change to NI recommended]	I*
11.	**Degradation of Aesthetics** [*change to NI recommended]	I*
12.	**Added Cost to Agriculture and Industry**	NI
13.	**Degradation of Phytoplankton and Zooplankton**	NI
14.	**Loss of Fish and Wildlife Habitat** [specific to fish habitat only; those for wildlife RFA but change to NI recommended]	I

I = Impaired; RFA = Requires Further Assessment; NI = Not Impaired

Table 2. Stage 2 RAP Report's Recommended Remedial Actions and Monitoring for the Restoration of Beneficial Uses

Stage 2 RAP Remedial Actions and Monitoring Activities	
REMEDIAL ACTIONS	
Point Source:	
Action PS-1:	Virtual elimination of all persistent and bioaccumulative contaminants from industrial and municipal discharge.
Action PS-2:	Reduce stormwater infiltration at East End Wastewater Treatment Plant (EEWWTP).
Action PS-3:	Upgrade EEWWTP to secondary treatment.
Action PS-4:	Relocate discharge pipe at EEWWTP to deeper, faster moving water.
Action PS-5:	Contaminant source control in stormwater discharge systems should be addressed by source control, air quality control, and pollution prevention education.
Action PS-6:	Continue with Canadian and U.S. regulatory programs for industrial dischargers.
Action PS-7:	Encourage major point source dischargers to continue process improvements.
Action PS-8:	Continue work on combined sewer overflows in Sault Ste. Marie, Michigan.
Action PS-9:	Algoma Steel to limit discharges from its de-kish operation.
Non-Point Source:	
Action NPS-1:	Development of a multi-agency sediment management program for the river to address immediate remedial options and implement actions for contaminated sediments. [Broken into 10 subsections, see pages 53-55 of the Stage 2 RAP report].
Action NPS-2:	Further characterize several high priority areas (i.e. adjacent to Algoma Slag Dump, portion of Little Lake George Channel downstream of EEWWTP, and the Algoma Slip).
Action NPS-3:	Completion of the St. Marys River contaminated sediment zones evaluation including chemistry analysis and benthic community assessment (needed for Action NPS-1).
Action NPS-4:	Identification and control of contaminants from the Algoma Slag Dump, including stabilization of shoreline and nearshore sediments. [Broken into 2 subsections, see pages 55-56 of the Stage 2 RAP report].

Action NPS-5:	Evaluation of Algoma Slip sediment and implementation of cleanup.
Action NPS-6:	Control of agricultural and other non-point sources of pollution. [Broken into 5 subsections, see pages 56-57 of the Stage 2 RAP report].
Action NPS-7:	Remediation for contaminated terrestrial and aquatic disposal sites (if through Action NPSM-9 there are found to be any).
Action NPS-8:	Plan and implement appropriate remediation, protection, and enforcement actions to remove any potential public health risks identified by Action NPSM-10.
Flora and Fauna:	
Action FF-1:	Bar River habitat project including recovery of the walleye habitat and spawning stock.
Action FF-2:	Watershed Development Plan for Bennett and West Davignon Creeks. [Broken into 23 subsections, see pages 68-71 of the Stage 2 RAP report].
Action FF-3:	Watershed Development Plan for the East Davignon and Fort Creeks.
Action FF-4:	Sedimentation reduction in the Munuscong River/Bay.
Action FF-5:	Characterization/Feasibility Study for waste removal in Mission Creek.
Action FF-6:	Remediation of rapids habitat and associated wetlands. [Broken into 8 subsections, see pages 71-73 of the Stage 2 RAP report].
Action FF-7:	Develop a 10 Year Fisheries Assessment Program for the river and develop assessment of mortality rates for walleye, pike, and yellow perch.
Action FF-8:	Continued support for Sea Lamprey control efforts.
Action FF-9:	Stabilize shoreline of the Algoma Slag Dump to provide habitat for plant growth to soften and stabilize the landscape.
MONITORING ACTIONS	
Point Source:	
Action PSM-1:	Long-term water monitoring at the Cannelton Industries site.
Action PSM-2:	The Sault Ste. Marie, Michigan air quality monitoring project.
Action PSM-3:	Ambient water monitoring in the St. Marys River.
Action PSM-4:	The Sault Ste. Marie, Ontario air quality monitoring project.
Action PSM-5:	Monitoring for particulate emissions at Algoma's de-kish operation.
Action PSM-6:	Monitoring receiving water at St. Marys Paper.
Action PSM-7:	Monitoring system for urban stormwater.
Action PSM-8:	Examine short-term variability and monthly ranges of contaminant discharges from wastewater treatment plants.
Non-Point Source:	
Action NPSM-1:	Monitor EEWWTP and identify upstream sources to determine concentrations and loadings of persistent contaminants exceeding guidelines in Lake George Channel sediments.
Action NPSM-2:	Aerial monitoring of Cannelton Industries site.

Action NPSM-3:	Biological monitoring at the Cannelton Industries site to ensure protection of the ecological food chain.
Action NPSM-4:	Task team monitoring recommendations. [Broken into 4 subsections, see page 58 of the Stage 2 RAP report].
Action NPSM-5:	Re-sampling of river sediments to obtain trend information.
Action NPSM-6:	Benthic, toxicity, and sediment chemistry studies at Bellevue Marine Park.
Action NPSM-7:	Assess potential health risks resulting from floating contaminated masses.
Action NPSM-8:	Monitor non-point sources of pollution in the AOC. (Incidences of algal blooms were believed caused by excessive nutrients from EEWWTP and septic bed leakage in Echo Bay).
Action NPSM-9:	Identify terrestrial and aquatic disposal sites transferring contaminants into waterways.
Action NPSM-10:	Assess health risks to communities and individuals taking their water from the "down-river" regions of the St. Marys River.
Action NPSM-11:	Assess the potential hazards associated with spills from shipping vessels.
Action NPSM-12:	Identify locations within the AOC that are associated with elevated levels of human health disorders.
Flora and Fauna:	
Action FFM-1:	Identify the causes of fish tumours and other deformities that originate within the AOC.
Action FFM-2:	The marsh monitoring program – established to provide baseline information on marsh birds and amphibian populations and their habitat.
Action FFM-3:	The fish harvest survey.
Action FFM-4:	The fish contaminant monitoring programs.
Action FFM-5:	Canadian Wildlife Service surveys of the Common and Black Tern populations.
Action FFM-6:	Analysis of contaminant levels in bird eggs.
Action FFM-7:	Monitoring of population changes due to habitat enhancement.
Action FFM-8:	Reproductive assessment of Gulls and Terns.
Action FFM-9:	Evaluate influence of water levels and flows on spawning and production.
Action FFM-10:	Determine minimum water levels and flow rates necessary for spawning.
Action FFM-11:	Monitoring water quantity.

Table 3: Beneficial Use Impairments Linked to Contaminated Sediment Management Strategy via Their Delisting Criteria

Beneficial Use Impairment (BUI)	Delisting Criteria

Degradation of Benthos (i.e., invertebrates that inhabit the sediment)	*This BUI will no longer be impaired when:*
	• *Assessments of St. Marys River sediment using multiple lines of evidence (sediment chemistry, benthic community alteration, toxicity, and biomagnification potential) conclude negligible environmental risk[1] requiring no further management action, as demonstrated under the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment.*
	• *And for these specific sites, the following criteria need to be met:*
	  ○ *The contaminated sediment in the <u>Algoma Boat Slip</u> is: i) assessed, ii) removed through dredging (down to native material/point of refusal), and iii) reported upon post-cleanup. This shall be done in a manner consistent with the Legacy Environmental Action Plan (LEAP) agreement between Algoma Steel and the Province of Ontario, which requires source track-down investigations and a recourse should contaminants redeposit at elevated concentrations; and*
	  ○ *Assessments using multiple lines of evidence (sediment chemistry, benthic community alteration, toxicity, and biomagnification potential) on the area east of <u>Bellevue Marine Park</u> and the <u>"Transport Canada Water Lot"</u> conclude negligible environmental risk[1] requiring no further management action, as demonstrated under the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment. If there is environmental risk requiring management actions, evidence of successful implementation of management action – as indicated by improving trends over three monitoring cycles and as determined through expert technical review – will be required for BUI re-designation.*

Restriction on Dredging Activities	*This BUI will no longer be impaired when administrative controls and other regulatory procedures are in place within the Area of Concern that provide guidance and oversight for dredging proponents and permitting agencies in the planning and undertaking of dredging activities, including mitigating measures to reduce negative impacts. Such guidance will be made clear in a multi-agency Dredging Administrative Controls document that will be part of a broader sediment management plan for the Area of Concern.*
Fish Tumours or Other Deformities	*This BUI will no longer be impaired when liver tumour prevalence rate within fish (sucker family) must be less than 5%, based on a survey encompassing a diverse age range.*

[1] The use of the term "Negligible Environmental Risk" is in reference to the *Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment* and is in context to what is described therein. Its use is explained in more detail under sections 6.0 and 7.0.

APPENDIX B
SEDIMENT QUALITY ASSESSMENT OF ST. MARYS RIVER: ALGOMA BOAT SLIP

Sediment Quality Assessment of St. Marys River:

Algoma Boat Slip

Summary

The objective of this fact sheet is to provide a clear and concise description of the work that has been completed to date related to the environmental characterization, dredging and post-dredge sediment characterization for the Algoma Boat Slip, as well as next steps for evaluating and managing contaminated sediments within the boat slip.

Algoma Boat Slip, located adjacent to the Algoma Steel Plant, is both a sink and source of sediments predominantly contaminated with petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) and certain metals. Beginning in 1990 and continuing to the present, several source control measures have been implemented to manage the contaminated sediments, including but not limited to, dredging approximately 30,000 cubic meters (m^3) of sediment from the boat slip. The most recent dredging event in 2019 was followed by a survey to ascertain whether further dredging is warranted. In the fall of 2020, Algoma Steel hired Golder Associates to review the 2019 post-dredge sediment chemistry to determine the need for further dredging. Based on their assessment, Golder prepared a sediment chemistry and toxicity sampling program which was carried out in November 2020. The resultant report (Golder 2021) recommends site-specific benchmarks based on concentrations of total PAHs in sediment that will be used to evaluate the potential need for further investigation and/or remedial actions.

Introduction

Algoma Steel is an active steel manufacturing facility, which together with associated property, comprises more than 400 hectares (ha) of land in Sault Ste. Marie, ON. The Algoma Boat Slip, which accommodates commercial-scale shipping from St. Marys River, is located adjacent to the plant and the material storage and reprocessing site (**Figure 1**). Much of the steel plant and related property are reclaimed lands that were created through the placement of fill and steel-production waste materials during the initial 75 years of the mill's operations. The site has a long history of heavy industrial activities, including the manufacture of coke, iron and steel, power and steam generation, steel rolling and finishing, and transportation.

Groundwater discharges from the Algoma Steel property to surface drainages, which mixes with surface water flow and is discharged to the northern part of the boat slip, and then to the St Marys River. Some groundwater discharge also likely occurs directly to the boat slip and to the river. The combination of discharges of groundwater and/or non-aqueous phase liquid contamination (e.g., petroleum) via the ditch and creek channels to the boat slip and St. Marys River, is likely the main transport pathway for mobile legacy environmental contamination at the site.

Algoma Steel has implemented several source control measures (ECCC et al. 2002, AMEC 2004), as follows:

- A coal tar collection system was installed in 1990 to address contaminated groundwater migration to the river.
- The wastewater treatment plant was upgraded between 1997 and 1999, which reduced phenol, ammonia, cyanide, oil and grease, and suspended solids concentrations in wastewater and optimized water re-use by up to 90%.
- A blast furnace contact water recirculation facility installed in 1998 reduced ammonia and cyanide discharges.
- Since 2016, all three coke oven batteries have been upgraded and refurbished to control air emissions of particulate matter and PAHs (namely benzo(a)pyrene), resulting in significant reductions in air emissions from those processes.

In addition to the above source control measures, Algoma Steel has dredged a total of nearly 30,000 m^3 of sediment from the boat slip in 1995, 2006, 2017, and 2019. While early dredging events focused on maintaining shipping access, those undertaken from 2017 forward have focused on removing contaminated sediments from the boat slip. The initial objective of dredging was to remove all contaminated material down to native material. The 2019 dredging focused on the northern end of the slip, where the 2017 dredging had left some material behind, and previous sediment assessments had identified elevated concentrations of PAHs.

The pursuit of dredging contaminated sediment from the boat slip – including the assessment and reporting on conditions pre- and post-dredging - – is consistent with the remedial and monitoring actions recommended under the Stage 2 Remedial Action Plan report (ECCC et al. 2002) as well as the LEAP agreement signed between the Ontario Ministry of Environment, Conservation and Parks and Algoma. The LEAP agreement outlines general objectives for clean up and identifies the boat slip as one area of focus.

Tables 1 and 2 summarize available sediment chemistry results collected after the 2019 dredging. **Table 1** presents data on concentrations of metals, while **Table 2** presents data on concentrations of PAHs and petroleum hydrocarbons. **Figure 2** illustrates the spatial distribution of PAHs in boat slip sediment as of 2020.

Assessment Summary

The dredging operations described above were guided by a series of studies conducted in 2005, 2014, 2018 and 2020 to characterize sediment contamination before and after dredging. With the exception of Golder's 2020-21 study (discussed below), all sediment surveys focused on sediment chemistry relative to sediment quality benchmarks, including Severe Effect Levels (SEL) and Lowest Effect Levels (LEL) (MECP 2008), as well as Probable Effect Levels (PEL; CCME 2014). Golder's 2020-2021 study will inform the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment (Framework; EC and MOE 2008) relative to the beneficial use impairment of degradation of benthos. Contaminated sediments in the boat slip also influence the Fish Tumours and Other Deformities beneficial use impairment, in that elevated concentrations of PAHs in sediment are believed to be the cause of liver tumours in fish caught within the Area of Concern. An ECCC assessment of fish tumours in the Area of Concern showed improvement in that beneficial use impairment, with the tumour rate dropping from 10.7% in 2009 sampled fish to 6% in 2015. ECCC is planning a repeat survey as early as 2021 to determine current fish tumour rates.

Totten Sims Hubicki Associates (TSH) collected sediment samples from the boat slip in 2005 (TSH 2006) prior to the dredging operations in 2006. Ten surface sediment samples and ten core samples were collected and analyzed for bacteria, leachate quality, loss on ignition, PAHs, total petroleum hydrocarbons (TPH), oil and grease, and total organic carbon (TOC). Many of the samples collected from the boat slip had a slight to moderate petroleum hydrocarbon odor and/or visible black particles (likely coal). PAHs were detected in all surface and subsurface sediment samples at concentrations greater than the LEL. In one surface sediment sample and three subsurface samples, concentrations of PAHs also exceeded the SEL. When compared with concentrations in sediment samples collected from the boat slip in 2000, average total PAH concentrations decreased from 499 mg/kg in 2000 to 289 mg/kg in 2005. Maximum total PAH concentrations decreased from 2,347 mg/kg in 2000 to 1,571 mg/kg in 2005.

To document changes in sediment concentrations over time, Pinchin Ltd. (Pinchin 2015) sampled sediment from the boat slip in 2014 and analyzed sediment samples for the same parameters that were analyzed in 2000 and 2005. For the 2014 survey, Pinchin collected 16 surface sediment samples and 24 core samples and retained AquaTox Testing & Consulting Inc. (AquaTox) to evaluate the results relative to the pre-dredge 2005 concentrations. AquaTox found that, while PAH impacts were most notable, some elevated concentrations of TPH, total metals, and oil and grease also were observed. In addition, AquaTox found that concentrations of PAHs in sediment increased after 2005. For sample locations that were duplicated between 2005 and 2014, the 2014 samples had average total PAH concentrations approximately 30% higher than those sampled in 2005. Across all samples, average total PAH concentrations were 90% higher in 2014 than in 2005.

In 2018, following Algoma Steel's 2017 dredging of 10,900 m^3 of contaminated sediment from the boat slip, Pinchin again evaluated changes in sediment quality relative to previous assessments (Pinchin 2018). For the 2018 survey, Pinchin collected 18 surface sediment samples and 29 sediment core samples; all samples were collected from the same locations as samples collected during the 2014 survey and analyzed for the same parameters. Pinchin again contracted AquaTox to interpret the sediment chemistry results. AquaTox (2018) found that total metal concentrations in sediment collected from the boat slip in 2018 were consistent with concentrations in 2014. Manganese was the only metal that exceeded the sediment SEL in some samples; none of the samples had metal concentrations that exceeded the PEL (AquaTox 2018). In contrast, average concentrations of PAHs exceeded the SEL in 2018, including fluorene, phenanthrene, anthracene, fluoranthene, pyrene, and chrysene. These same PAHs exceeded the SEL in 2014. Despite dredging in 2017, concentrations of total PAHs did not decline between 2014 and 2018.

Following Algoma Steel's 2019 removal of an additional 4,638 m^3 of contaminated sediment from the boat slip, two distinct sediment assessments were undertaken: one by Pinchin conducted in late 2019 to early 2020 and a second conducted by Golder in late 2020 to early 2021. Pinchin's study paralleled their previous work but used a larger number (60) of sediment cores, compared to their earlier surveys. Average concentrations of several metals exceeded the LEL, while the maximum concentration of lead exceeded the PEL and the maximum concentrations of iron and manganese exceeded the SEL. Overall, average total metal concentrations were unchanged relative to those measured in 2014 and 2018. Concentrations of metals in deeper sediments were very similar to those near the sediment surface. Average concentrations of all individual PAHs exceeded LELs, and most also exceeded the PEL, SEL or both. The same is true for maximum concentrations of PAHs. Exceedances of benchmarks for petroleum hydrocarbons also were widespread. In contrast with metals, however, concentrations of all individual PAHs decreased substantially relative to those measured in 2018, as reflected by an 84% decrease in average PAH concentrations. Also in contrast with the results for metals, deeper sediment tended to have considerably lower concentrations of PAHs compared to surface sediment. Similarly, when petroleum hydrocarbon results were considered over time, 2019 sampling results were considerably lower than historical results.

The purpose of Golder's 2020 sediment assessment (Golder 2021) was to develop site-specific criteria to determine risk management actions and progress towards restoration. The benthic community line of evidence was excluded from Golder's 2020 assessment because: a) vessel use of this active boat slip mechanically disturbs the sediment to a degree likely to confound the bioassessment; b) past and future dredging would further influence the composition of the benthic community and c) matching the boat slip to comparable reference sites would be extremely difficult. Therefore, Golder's 2020 assessment considered the following lines of evidence:

- Sediment chemistry relative to sediment quality criteria, for purposes of selecting priority constituents of concern
- Sediment toxicity based on survival and growth of chironomids, amphipods, and mayflies
- Concentration-response based on the strength of association between chemistry and toxicity results

Golder (2021) reported that, of the 14 sampling locations tested, 6 showed negligible effects across all endpoints (survival, growth and biomass) and all species (chironomids, amphipods, and mayflies). Of the remaining 8 locations, 4 showed low effects in one or more endpoint or species, 3 showed moderate effects in a single endpoint-species combination, and one showed moderate effects in two endpoint-species combinations. Golder (2021) recommended the following site-specific benchmarks based on total PAH concentrations: 260 micrograms per gram (μg/g) dry weight as a low-effect concentration and 340 μg/g dry weight as a moderate-effect concentration. Future reports will use these site-specific criteria to evaluate the potential need for further dredging and to determine whether additional investigation and/or remedial actions are needed.

Conclusion

The elevated sediment chemistry results reported by Pinchin (2018) and AquaTox (2018) indicated that further dredging was warranted; therefore, subsequent dredging was undertaken in 2019. Based on verification sediment chemistry samples collected in 2019 after the dredging was complete, Pinchin (2020) and AquaTox (2020) reported an 84% decrease in average concentrations of total PAHs as well as a substantial decline in petroleum hydrocarbon concentrations. Average metal concentrations measured in the boat slip were unchanged relative to those measured in 2014 and 2018. Pinchin (2020) and AquaTox (2020) conclude that:

> "[a]lthough sediment within the Boat Slip still contains a significant amount of PAHs, the extent of contamination was much less than measured in previous sampling years…these data suggest that while the total PAH concentrations are still high, the most recent dredging effort carried out in 2019 had a notable and significant impact on contaminant load reduction with the Boat Slip."

Golder's (2020-21) sediment assessment, also conducted after the 2019 dredging, supported the development of site-specific benchmarks based on concentrations of total PAHs in sediment--260 μg/g dry weight as a low-effect concentration and 340 μg/g dry weight as a moderate-effect concentration—that will be used to evaluate the need for further investigation and/or remedial actions.

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Table 1. Comparison of 2019 Sediment Results for Metals to Environmental Quality Guideline Values (source: AquaTox 2020)

Parameter	RDL	Sediment				Average	Minimum	Maximum	% Extent to Which Average Exceeds the EQG (%)	
		CCME		MOE						
		ISQG	PEL	LEL	SEL				LEL	SEL
Total Metals (Sediment)		(µg/g dry wt.)								
Aluminum	50	--	--	--	--	14450	3900	30800	--	--
Antimony	0.8	--	--	--	--	ND	ND	9.2	--	--
Arsenic	1	5.9	17.0	6	33	5	2	11	0	0
Boron	5	--	--	--	--	8	ND	17	--	--
Barium	2	--	--	--	--	111	23	238	--	--
Beryllium	0.5	--	--	--	--	0.6	ND	1.0	--	--
Cadmium	0.5	0.6	3.5	0.6	10	ND	ND	ND	0	0
Chromium	2	37.3	90.0	26	110	40	15	67	54	0
Cobalt	0.5	--	--	--	--	9.3	3.4	18.2	--	--
Copper	1	35.7	197	16	110	31	13	60	94	0
Iron	500	--	--	20000	40000	28712	13000	44500	44	0
Lead	1	35	91.3	31	250	18	5	101	0	0
Manganese	5	--	--	460	1100	728	298	1520	58	0
Molybdenum	0.5	--	--	--	--	1.2	0.25	4.1	--	--
Nickel	1	--	--	16	75	24	8	44	50	0
Phosphorus	5	--	--	600	2000	478	214	661	0	0
Selenium	0.8	--	--	--	--	ND	ND	0.8	--	--
Silver	0.4	--	--	--	--	ND	ND	ND	--	--
Thallium	0.4	--	--	--	--	ND	ND	ND	--	--
Uranium	0.5	--	--	--	--	1.2	ND	2.2	--	--
Vanadium	1	--	--	--	--	42	16	76	--	--
Zinc	5	123	315	120	820	91	30	168	0	0
Other Parameters										
Total Organic Carbon (%)	0.30	--	--	1	10	1.7	0.3	6.8	70	0
Loss On Ignition (LOI) (%)	0.01	--	--	--	--	5.1	1.7	23.7	--	--

RDL = Reported Detection Limit
CCME = Canadian Council of Ministers of the Environment - Sediment quality guidelines for the protection of aquatic life - freshwater (CCME, 2014).
MOE = Ministry of the Environment - Guidelines for identifying, assessing and managing contaminated sediments in Ontario: An integrated approach (MOE, 2008; Table 1).
ISQG = Interim Sediment Quality Guideline; Indicates the concentration below which instances of adverse biological effects are rarely observed.
SEL = Severe Effect Level; Indicates a heavy level of contamination expected to be detrimental to the majority of sediment-dwelling organisms.
PEL = Probable Effect Level; Indicates the concentration above which instances of adverse biological effects are frequently observed.
LEL = Lowest Effect Level; Indicates a clean to marginally polluted level of contamination tolerated by the majority of sediment-dwelling organisms.
Note: Sample R1C1 was not excluded from values presented in this table because measured concentrations were not high for metals (as they were for PAHs and PHCs).

Equals or exceeds the SEL (MOE, 2008; Table 1).
Equals or exceeds the PEL; CCME - Sediment quality guidelines for the protection of aquatic life - freshwater (CCME, 2014).
Equals or exceeds the LEL (MOE, 2008; Table 1).

Table 2. Comparison of 2019 Sediment Results for PAHs with Environmental Quality Guideline Values (Source: AquaTox 2020)

Parameter	RDL	Sediment						Soil*	Average	Minimum	Maximum	Maximum (R1C1 included)	Average % Above SEL
		CCME		MOE				EPA					
		ISQG	PEL	LEL	SEL: µg/g TOC Min 0.31%	SEL: µg/g TOC Max 6.84%	SEL: µg/g TOC Ave 1.67%	Full Depth Background (Industrial)					
Polycyclic Aromatic Hydrocarbons (PAHs)						(µg/g dry wt.)							
2-and 1 methyl Naphthalene	0.50	0.02	0.20	--	--	--	--	NA	3.0	ND	22	1400	--
Naphthalene	0.50	0.04	0.39	--	--	--	--	NA	12.4	ND	200	8800	--
Acenaphthylene	0.50	0.01	0.13	--	--	--	--	NA	1.1	ND	15	980	--
Acenaphthene	0.50	0.01	0.09	--	--	--	--	NA	5.4	ND	38	1100	--
Fluorene	0.50	0.02	0.14	0.19	0.50	10.94	2.67	NA	6.1	ND	49	1500	128
Phenanthrene	0.50	0.04	0.52	0.56	2.95	65.0	15.9	NA	27.4	ND	200	5700	72
Anthracene	0.50	0.05	0.25	0.22	1.15	25.3	6.18	NA	8.5	ND	97	1600	38
Fluoranthene	0.50	0.11	2.36	0.75	3.16	69.8	17.0	NA	23.3	ND	130	3200	37
Pyrene	0.50	0.06	0.88	0.49	2.64	58.1	14.2	NA	16.3	ND	93	2500	15
Benz(a)anthracene	0.50	0.03	0.39	0.32	4.59	101	24.7	NA	6.0	ND	29	620	0
Chrysene	0.50	0.06	0.86	0.34	1.43	31.5	7.68	NA	5.1	ND	26	590	0
Benzo(b)fluoranthrene	0.50	--	--	--	--	--	--	0.47	4.5	ND	24	580	--
Benzo(k)fluoranthrene	0.50	--	--	0.24	4.15	91.7	22.4	NA	2.1	ND	10	190	0
Benzo(a)pyrene	0.50	0.03	0.78	0.37	4.46	98.5	24.1	NA	3.2	ND	16	470	0
Indeno(1,2,3-cd)pyrene	0.50	--	--	0.20	0.99	21.9	5.34	NA	1.3	ND	6.2	210	0
Dibenz(a,h)anthracene	0.50	0.01	0.14	0.06	0.40	8.9	2.17	NA	0.3	ND	1.2	39	0
Benzo(g,h,i)perylene	0.50	--	--	0.17	0.99	21.9	5.34	NA	1.4	ND	7.4	230	0
Total PAH's**	0.3	--	--	4	31	684	167	NA	125		793	28309	0
Petroleum Hydrocarbons F1 – F4 (with PHCs)						(µg/g dry wt.)							
Benzene	0.02	--	--	--		--		0.02	2.3	ND	33	820	--
Toluene	0.05	--	--	--		--		0.2	0.6	ND	3.0	310	--
Ethylbenzene	0.05	--	--	--		--		0.05	0.2	ND	0.95	36	--
Xylene mixture	0.05	--	--	--		--		0.05	0.4	ND	2.2	190	--
F1 (C6 – C10)	5	--	--	--		--		--	8.6	ND	43	2000	--
F1 (C6 – C10) minus BTEX	5	--	--	--		--		25	4.9	ND	31	640	--
F2 (C10 – C16)	10	--	--	--		--		10	59.3	ND	290	29000	--
F2 (C10 – C16) minus Naphthalene	10	--	--	--		--		10	47.4	ND	230	20000	--
F3 (C16 – C34)	50	--	--	--		--		240	452	ND	2100	48000	--
F3 (C16 – C34) minus PAHs	50	--	--	--		--		240	366	ND	2000	35000	--
F4 (C34 – C50)	50	--	--	--		--		120	35.3	ND	260	900	--
Oil and grease (a/v) in soil	250	--	--	--		--		--	1010	ND	16000	2500	--
Oil and grease (mineral) in soil	250	--	--	--		--		--	537	ND	5100	93000	--
Oil and grease (total)	250	--	--	--		--		--	1506	ND	21000	95000	

* Full Depth Background Site Condition Standards for Soils are shown for comparison purposes only.
** Excludes 2-and 1-methyl Napthalene, and replaces Benzo[b]fluorine with Benzo(b)fluoranthrene.
RDL = Reported Detection Limit; TOC = Total Organic Carbon (measured); NA = Not Applicable; ND = Not Detectable; a/v = Animal and Vegetable
CCME = Canadian Council of Ministers of the Environment - Sediment quality guidelines for the protection of aquatic life - freshwater (CCME, 2014).
MOE = Ministry of the Environment - Guidelines for identifying, assessing and managing contaminated sediments in Ontario: An integrated approach (MOE Table 2b, 2008).
EPA = Environmental Protection Act; Soil, ground water and sediment standards for use under Part XV.1 (MOE Table 1, 2011).
ISQG = Interim Sediment Quality Guideline; Indicates the concentration below which instances of adverse biological effects are rarely observed.
PEL = Probable Effect Level; Indicates the concentration above which instances of adverse biological effects are frequently observed.
LEL = Lowest Effect Level; Indicates a clean to marginally polluted level of contamination tolerated by the majority of sediment-dwelling organisms.
SEL = Severe Effect Level; Indicates a heavy level of contamination expected to be detrimental to the majority of sediment-dwelling organisms.

Equals or exceeds SEL for Average TOC.
Equals or exceeds sediment PEL or Full Depth Background Site Condition Standards for Soils.
Equals or exceeds the LEL where available.

Figure 1. Location of Algoma Boat Slip (Source: Golder 2020b)

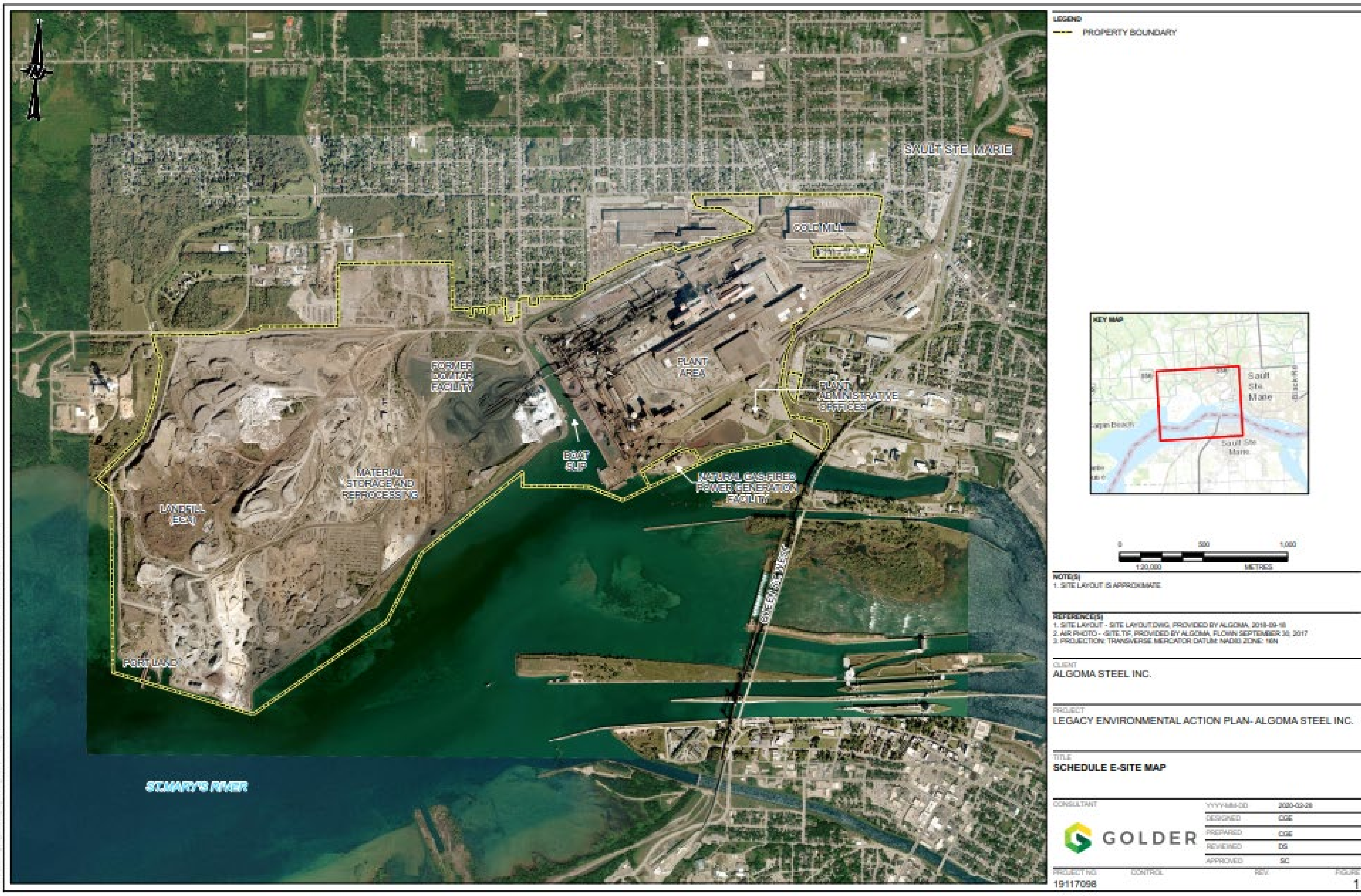
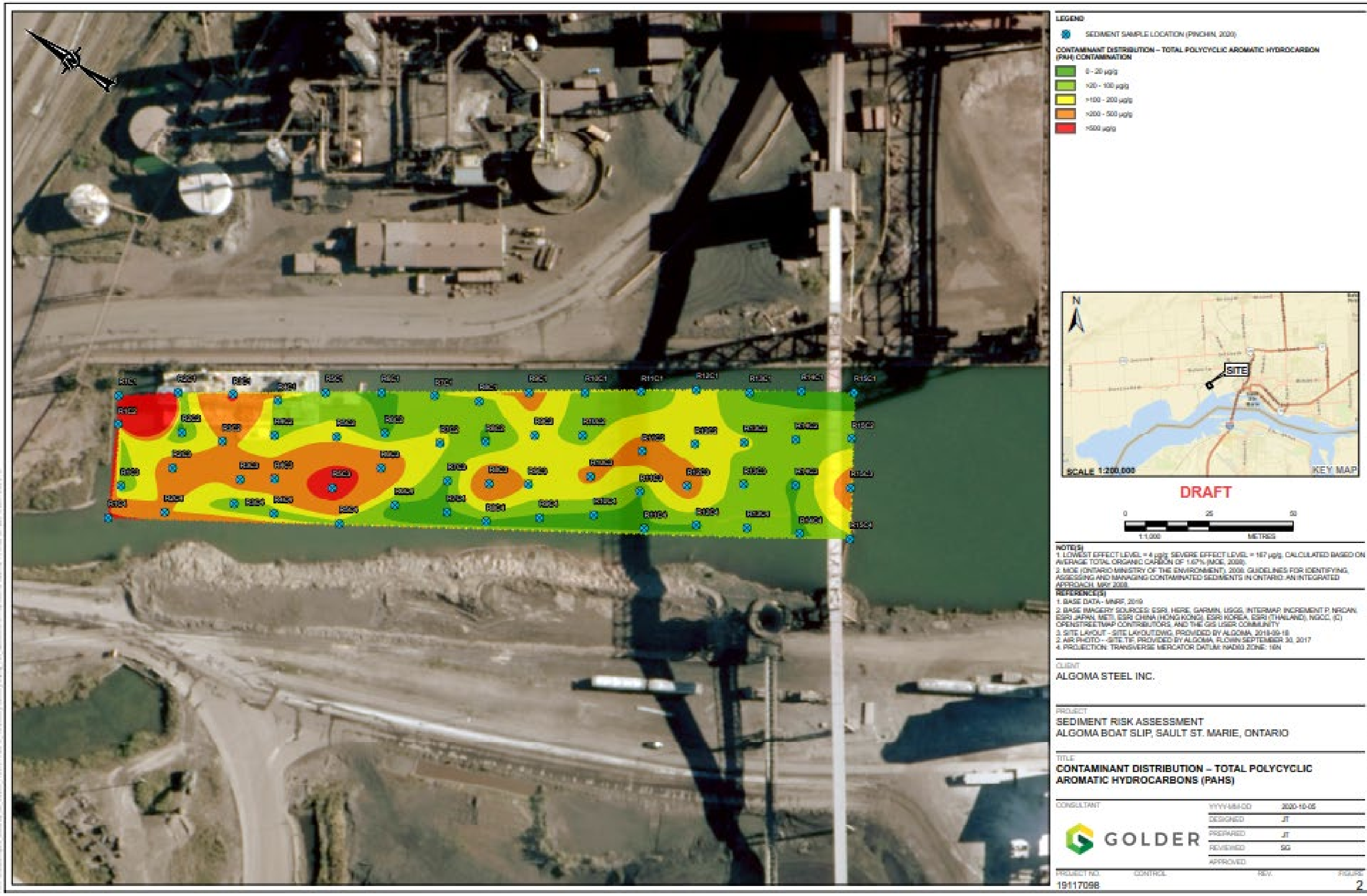


Figure 2. Distribution of PAHs in Boat Slip Sediment (Source: Golder 2020b)



APPENDIX C
SEDIMENT QUALITY ASSESSMENT OF ST. MARYS RIVER: ST. MARYS RIVER FEDERAL WATER LOT

Sediment Quality Assessment of St. Marys River:

St. Marys River Federal Water Lot

Summary

The objective of this summary is to describe the work completed to date related to the environmental characterization, contaminated sediment assessment, and outcomes for the St. Marys River Federal Water Lot (Federal Water Lot). The Federal Water Lot is a portion of Sault Ste. Marie Harbour owned by Transport Canada, and comprises of 245 hectares on the Ontario side of the St. Marys River, extending along 9 km of shoreline from Old Vessel Point to Church Street (**Figure 1**). Part of the Federal Water Lot near Purvis Marine (former government wharf) was dredged for navigational purposes in 1995. The major industrial activities that have impacted the Federal Water Lot include historical operations at Algoma Steel and the former St. Marys Paper plant, as well as vessel traffic and hydroelectric power generation (Golder 2008). Since 2007, Transport Canada has completed a number of studies to support implementation of the *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* (Framework) (ECCC and MECP 2008) at the site to assess whether management action is required. The outcome of those studies is a recommendation to continue monitoring at nine stations, with the next round of monitoring planned for 2023. If dredging is contemplated in the future, characterization of deeper sediment will be considered.

Introduction

To assist with decisions regarding future risk management actions at the Federal Water Lot, Transport Canada assessed contaminated sediments in the area following the Framework through a multi-step process, and arriving at an assessment outcome. Results were evaluated using the following lines of evidence specified in the Framework:

Sediment Contamination. Contaminants of concern are measured in the surficial sediment layer and compared to low and high sediment quality guidelines.

Benthic Invertebrate Community Structure. The macroinvertebrate composition (types of organisms present and their abundance) are compared to those found at local and/or regional reference stations.

Sediment Toxicity. Laboratory bioassays are conducted using four benthic invertebrates but also included other test organisms (e.g., *Daphnia*, freshwater mussel, fish). Toxicological responses are compared to those from local and regional reference sediment and/or control sediment.

Biomagnification Potential. This line of evidence is assessed in areas where contaminants known to biomagnify are present. Given the low concentration of of biomagnifiable contaminants identified for the Federal Water Lot (similar to reference sites), this line of evidence is not applicable.

The Framework is an ecosystem approach that considers potential effects on the benthos due to contaminated sediment. The Framework was applied using results from the individual lines of evidence for the stations throughout the Federal Water Lot. The process involves a series of steps and decisions points that lead to the development of a decision matrix, which is presented in **Table 1**.

Results

As summarized by SNC-Lavalin (2019), early steps of the Framework were carried out by Golder Associates Ltd (Golder; 2007) and Aqua Terre (2009), yielding a screening level assessment that evaluated sediment chemistry data against sediment quality guidelines. Biomagnification potential was assessed through a preliminary quantitative human health and ecological evaluation, concluding that all biomagnification pathways pose negligible risk to humans and wildlife. Sediment toxicity was evaluated through toxicity testing conducted in 2008, 2009, and 2010. No strong correlations could be identified between sediment chemistry and toxicological responses, and a remedial action objective for specific contaminants could not be derived. Benthic community studies were conducted in 2008 and 2009, with varied results by sampling station. Results of associated studies are summarized in this section, while the weight of evidence decision matrix prepared by SNC-Lavalin is presented below in the conclusions section of this fact sheet (Table 1).

In 2008, Public Works and Government Services Canada (PWGSC) retained GolderGolder on behalf of Transport Canada (property owner) to complete the first screening steps of the Framework. Metals and PAHs were detected in sediment at concentrations exceeding the Canadian Council of Ministers of the Environment's (CCME 2014) Interim Sediment Quality Guidelines and Lowest Effect Levels (LELs). Golder identified benthic invertebrates as the primary receptor of potential concern. Golder (2008) concluded that the chemicals of potential concern posed a potential risk to ecological receptors and recommended further assessment of Water Lot sediment.

In 2009, PWGSC retained Aqua Terre Solutions Inc. (Aqua Terre 2009) on behalf of Transport Canada to: 1) develop an assessment strategy to address data gaps; 2) investigate sediment quality per the Framework; and 3) draw a conclusion regarding the risk to human health and the environment and recommend methods for risk management. The study concluded that management action would likely be required at the site and, before identifying management actions, recommended additional investigation related to bioaccumulation in fish, rates of fish consumption by area residents (which is also an identified need), and cause(s) of sediment toxicity and benthos alterations.

In 2010, PWGSC retained SNC-Lavalin on behalf of Transport Canada to conduct a detailed quantitative risk assessment of sediment to support the development of a contaminated sediment management strategy (SNC-Lavalin 2010). Considering the previous work conducted and undertaking an independent assessment, SNC-Lavalin assessed metals, PAHs, dioxins and furans, and oil and grease. SNC-Lavalin ruled out further consideration of methylmercury, dioxins, and furans because concentrations in sediment were consistent with reference areas and concentrations in fish tissue were less than those likely to harm people or wildlife that consume those fish.[1]

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[1] Environment and Climate Change Canada (ECCC) and Ontario Ministry of Environment, Conservation and Parks (MECP) are planning a fish consumption survey to determine fish consumption rates by area residents within the Area of Concern (AOC), and ECCC/MECP can share the results with Transport Canada to consider for its own needs. Specifically, Algoma University will be conducting a community fish consumption survey in 2021-22 to ask area residents and Indigenous communities what species of AOC-caught first do they eat, how often and how much. Given its proximity to popular fishing areas, this AOC survey will capture anglers fishing in and near the Federal Water Lot. The survey responses will feed into the AOC-wide assessment of the Restrictions on Fish Consumption

SNC-Lavalin (2010) identified three sites (S-10, S-15, and S-16) requiring further investigation to determine if management action is warranted due to potential or significant toxicological effects, plus possible benthic community alteration. Of the other sites evaluated, no further action was required at four sites (S-4, S-7, S-12, and S-18). Benthos alteration at six sites (S-1, S-6, S-8, S-9, S-13, and S-17) was attributed to physical factors. Sediment toxicity testing suggested no toxic effects at these six sites.

In 2011, SNC-Lavalin refined the assessment of S-10, S-15, and S-16 to laterally delineate contamination in surface sediments and evaluate relationships between analytes and observed toxicity. SNC-Lavalin (2011) concluded that S-10 and S-15/S-16 can be addressed through in-place management involving a sediment monitoring program with samples collected from at least three sampling locations within each station. This approach is similar to monitored natural recovery. They advised that, before any proposed future dredging is initiated, additional assessment should be conducted to evaluate potential effects resulting from the exposure of deeper sediments.[2]

In 2018, SNC-Lavalin sampled nine locations, collecting 31 samples and six duplicates, all of which were analyzed for bulk sediment chemistry and 16 of which also were tested for toxicity. In addition, six reference samples were analyzed for bulk sediment chemistry and two were tested for toxicity. This study's design reflected the conclusions of the previous assessments and targeted the following objectives:

- Delineate the lateral extent of sediment exhibiting significant overall toxicity at Station S-10;
- Confirm that conditions are not deteriorating at Stations S-15 and S-16; and
- Confirm that conditions at Stations S-1, S-6, S-8, S-9, S-13, and S-17 have not worsened relative to historical findings.

Near Station S-10, three of four stations tested showed negligible overall toxicity, and one suggested significant overall toxicity. The authors concluded that "based on the relatively small area affected, the absence of definitive evidence of benthic community structure impairment, the low percentage of sediment samples exhibiting significant toxic effects (two samples out of 14 tested; or 14%) and given that a wide range of [chemicals of potential concern] were tested for toxicity, station S-10 could be satisfactorily addressed through in-place management.

Near Stations S-15/S-16, all sediment samples collected in 2018 exhibited negligible overall toxicity. Among these were five locations that had previously indicated potential toxicity and six that previously had bulk chemistry (primarily PAH) concentrations greater than the effect range high concentrations. The authors concluded that sediments in the vicinity of Stations S-15/S-16 also can be satisfactorily addressed through in-place management.

Confirmatory sediment chemistry monitoring at select other stations yielded variable results. Concentrations of PAHs in sediment have increased since 2008 at Stations S-8 and S-9. At the remaining four stations (S-1, S-6, S-13, and S-17), conditions have either remained the same or improved slightly since 2008. With respect to concentrations of metals, sediment quality has deteriorated at stations S-6,

beneficial use impairment, which will also examine contaminant levels in AOC-caught fish and the associated consumption advice issued by the Province of Ontario.

[2] See the 2021In-Water Works Administrative Controls Guidance Document, which applies to the entire AOC.

S-9, S-13, and S-17 since 2008. The authors concluded that these stations can be satisfactorily addressed through in-place management.

Conclusion

The overall outcome of the studies summarized above is that continued monitoring is necessary at nine stations, every five years. The next round of monitoring at the Federal Water Lot will be conducted in 2023 to evaluate whether conditions are stable, improving or worsening based on bulk chemistry and toxicity testing. At that point, the frequency of future monitoring will be reassessed; if conditions are improving, monitoring may be less frequent. Finally, if dredging is contemplated in the future, characterization of deeper sediment will be considered. Transport Canada, as the property owner, will follow measures to ensure environmental protection.

References

Aqua Terre. 2009. Contaminated Sediment Management Strategy – Phase 2 (PQRA) Sault Ste. Marie Harbour Sault Ste. Marie, Ontario. Prepared by Aqua Terre Solutions Inc for Public Works and Government Services Canada/Transport Canada. March 31.

Canadian Council of Ministers of the Environment (CCME). 2014. Sediment quality guidelines for the protection of aquatic life. Freshwater. www.st-ts.ccme.ca/en/index.html

Environment Canada (EC) and Ministry of Environment (MOE). 2008. Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment.

ECCC, USEPA, MECP, and EGLE. 2002. The St. Marys River Area of Concern, Remedial Strategies for Ecosystem Restoration. Remedial Action Plan Stage 2 Report. Environment Canada, U.S. Environmental Protection Agency, Ontario Ministry of Environment, Conservation

Golder. 2008. Transport Canada Water Lot, St. Marys River, Sault Ste. Marie. Screening Steps 1-3 for Managing Sediment Contamination. Prepared by Golder Associates Ltd for Public Works and Government Services Canada. March.

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SNC-Lavalin. 2019. Update to Step 6 and Decision 5 of the Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment – Sediment Quality Evaluation, Transport Canada, Sault Ste. Marie Harbour. Prepared by SNC-Lavalin Environment and Geoscience. March 29

Table 1. Decision matrix for weight of evidence categorization for Federal Water Lot stations based on 2018 update (Source: adapted from SNC-Lavalin 2019)

Station	Bulk Chemistry[1]	Toxicity Endpoint[2]	Overall Toxicity[3]	Benthos Alteration[4]	Possible Reason for Benthos Alteration	Biomagnification Potential[5]	Overall Assessment[6]
Transport Canada Sault Ste. Marie Harbour Site							
S-1	▣	□	□	▣ in 2008	High current velocity near St. Marys Falls	□	Scenario 8: Determine reason for benthos alteration.[7]
S-4	▣	□	□	□ in 2008	Not Available	□	Scenario 2: No further actions required.
S-6	■	□	□	▣ in 2008	Coarse substrate	□	Scenario 8: Determine reason for benthos alteration.**Error! Bookmark not defined.**
S-7	■	□	□	□ in 2008	Not Available	□	Scenario 2: No further actions required.
S-8	▣	▣ Toxicological Effect (to 1 endpoint)	□	▣ in 2008	High current velocity near St. Marys Falls	□	Scenario 8: Determine reason for benthos alteration.**Error! Bookmark not defined.**
S-9	■	□	□	▣ in 2008	High current velocity near St. Marys Falls	□	Scenario 8: Determine reason for benthos alteration.**Error! Bookmark not defined.**
S-10	■	■ ▣ in 2008 (4 endpoints); ▣ in 2009 (2 endpoints); ▣ in 2010 (4 endpoints); ■ ▣ in 2018 (4 endpoints)	■ in 2008; ▣ in 2009; ■ in 2018.	▣ in 2008; ▣ in 2009	Possible scouring from ships' bow thrusters	□	Scenario 15: Management action required.
S-12	■	□	□	▣ in 2008; □ in 2009	Possible scouring from ships' bow thrusters; Area reportedly dredged in 2008	□	Scenario 2: No further actions required.**Error! Bookmark not defined.**,[8]

Table 1. Decision matrix for weight of evidence categorization for Federal Water Lot stations based on 2018 update (Source: adapted from SNC-Lavalin 2019)

Station	Bulk Chemistry[1]	Toxicity Endpoint[2]	Overall Toxicity[3]	Benthos Alteration[4]	Possible Reason for Benthos Alteration	Biomagnification Potential[5]	Overall Assessment[6]
S-13	◘	☐	☐	◘ in 2008	Coarse substrate; Possible scouring from ships' bow thrusters	☐	Scenario 8: Determine reason for benthos alteration.**Error! Bookmark not defined.**
S-15	■	◘ in 2008 (4 endpoints); ◘ in 2009 (2 endpoints); ◘ 2010 (4 endpoints); - ☐ 2018 (4 endpoints)	◘ in 2008; ☐ in 2009; ☐ in 2018	◘ in 2008; ☐ in 2009	Area reportedly dredged in 2008	☐	Scenario 2: No further actions required.**Error! Bookmark not defined.**[,]**Error! Bookmark not defined.**[,9, and 10]
S-16	■	◘ in 2008 (4 endpoints); ◘ in 2009 (2 endpoints); ◘ 2010 (4 endpoints); - ☐ 2018 (4 endpoints)	◘ in 2008; ☐ in 2009; ☐ in 2018	◘ in 2008; ☐ in 2009	Area reportedly dredged in 2008	☐	Scenario 2: No further actions required.**Error! Bookmark not defined.**[,]**Error! Bookmark not defined.**[,]**Error! Bookmark not defined.**[, and] **Error! Bookmark not defined.**
S-17	◘	☐	☐	◘ in 2008	Possible scouring from ships' bow thrusters; Area reportedly dredged in 2008	☐	Scenario 8: Determine reason for benthos alteration.**Error! Bookmark not defined.**
S-18	■	☐	☐	☐ in 2008	Area reportedly dredged in 2008	☐	Scenario 2: No further actions required.
Reference Stations[11]							
S-19	◘	N/A	N/A	N/A	N/A	N/A	N/A

Table 1. Decision matrix for weight of evidence categorization for Federal Water Lot stations based on 2018 update (Source: adapted from SNC-Lavalin 2019)

Station	Bulk Chemistry[1]	Toxicity Endpoint[2]	Overall Toxicity[3]	Benthos Alteration[4]	Possible Reason for Benthos Alteration	Biomagnification Potential[5]	Overall Assessment[6]
S-20	▣	N/A	N/A	N/A	N/A	N/A	N/A
S-21	▣	N/A	N/A	N/A	N/A	N/A	N/A
S-22	☐	N/A	N/A	N/A	N/A	N/A	N/A
S-23	▣	N/A	N/A	N/A	N/A	N/A	N/A
S-24	▣	N/A	N/A	N/A	N/A	N/A	N/A
S-198	☐	N/A	N/A	N/A	N/A	N/A	N/A

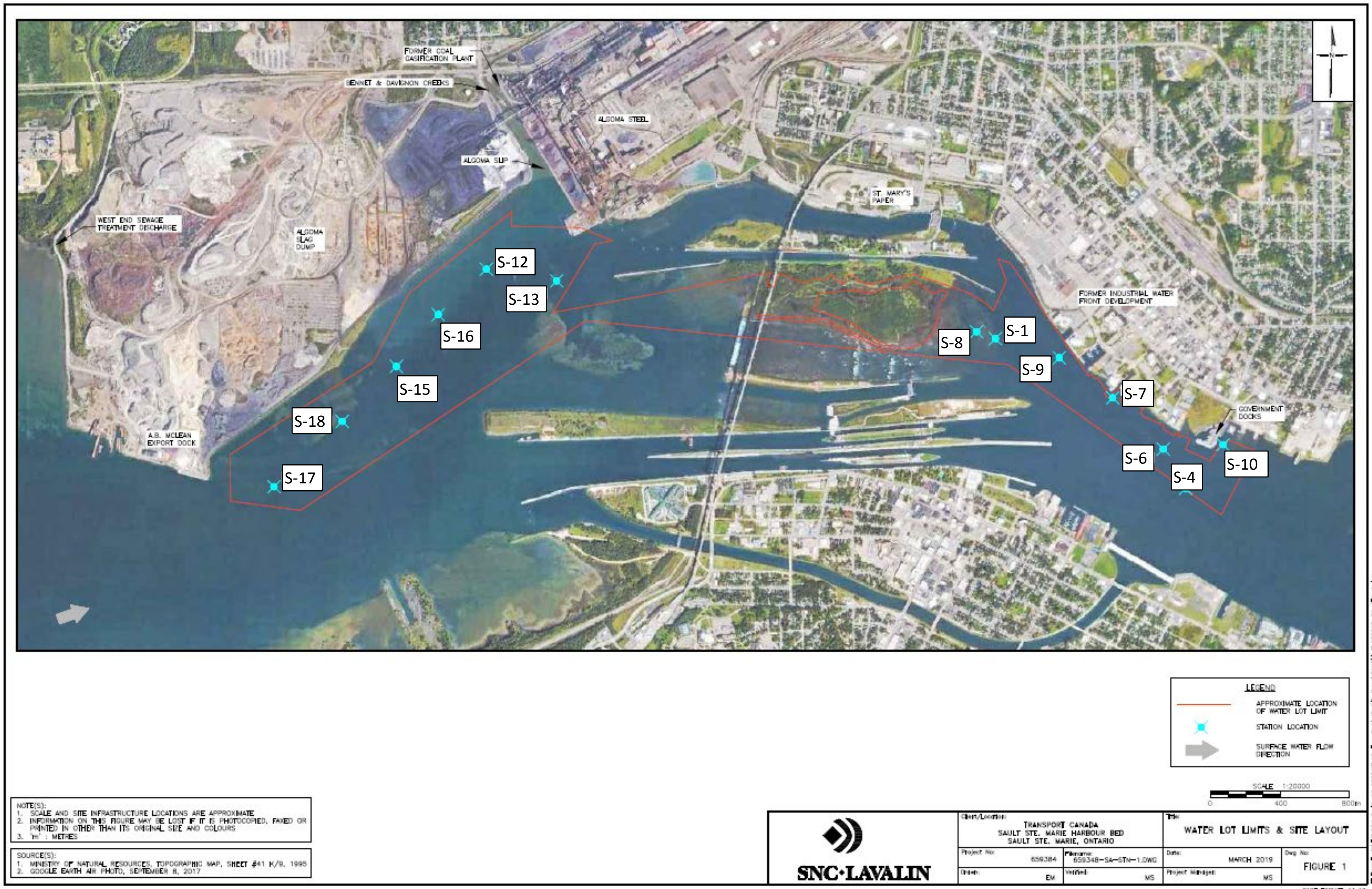
Note: Descriptions of weight of evidence categorizations are based on Figure 2 (Ordinal Ranking for WOE Categorizations for Chemistry, Toxicity, Benthos and Biomagnification Potential) as presented in Framework (COA, 2008).

Bulk Chemistry: ■ adverse effects likely; ▣ adverse effects may or may not occur; ☐ adverse effects unlikely
Toxicity Endpoint: ■ major; ▣ minor; ☐ negligible
Overall Toxicity: ■ significant; ▣ potential; ☐ negligible
Benthos Alteration: ■ different/very different from reference stations; ▣ possibly different from reference stations; ☐ equivalent to reference stations
Overall Assessment: ■ significant adverse effects; ▣ potential adverse effects; ☐ no significant adverse effects

[1] Bulk sediment chemistry based on a comparison of analyzed concentrations of COPC to effects range low and effects range high concentrations
[2] Toxicity endpoints evaluated to determine if major (>50% reduction), minor (>20% reduction) or negligible (≤20% reduction) toxicological effects relative to reference samples.
[3] Overall toxicity evaluated to determine if significant (multiple tests/endpoints exhibit major toxicological effects), potential (multiple tests/endpoints exhibit minor effects and/or one test/endpoint exhibit major effect) or negligible (minor toxicological effects in no more than one endpoint) effects relative to reference samples
[4] Benthos alteration evaluated by determining if site benthic populations are "very different", "different", "possibly different" or "equivalent" to reference area populations.
[5] Biomagnification potential evaluated through a HHERA (Step 4a) and fish tissue analyses and comparison to reference area fish tissue concentrations (Step 6) to determine if biomagnification potential is "significant", "possible" or "negligible".
[6] Overall assessment scenarios based on Figure 2 (Decision Matrix for WOE Categorization) as presented in the Framework (COA, 2008).
[7] Benthos alteration is not a suitable line of evidence in sampling area based on possible physical factor(s) affecting alteration of the benthic community.
[8] Overall assessment is based on 2009 evaluation that benthic community is equivalent to reference area benthic communities.
[9] Assessment of overall toxicity is based on batch corrected sediment toxicity testing results for tests conducted in 2008 and 2009.

[10] The sediment samples collected at station S-15/S-16 during 2018 program all identified with negligible overall toxicity were considered representative of sediment quality of the overall area at station S-15/S-16 even though some of these samples were collected short distance away from the planned locations.
[11] Some lines of evidence are not applicable to reference area sampling locations because evaluation involves a comparison to reference conditions

Figure 1. St. Marys River Federal Water Lot Layout (Source: SNC-Lavalin 2019)



APPENDIX D
SEDIMENT QUALITY ASSESSMENT OF ST. MARYS RIVER: BELLEVUE MARINE PARK

Sediment Quality Assessment of St. Marys River:

Bellevue Marine Park

Summary

Bellevue Marine Park (BMP) is a major depositional area located along the Sault Ste. Marie, Ontario, waterfront. A considerable amount of scientific information was used to assess sediment quality and benthic community health in the area stemming from studies conducted from 2002 to 2016. This was done as part of the overall process of assessing the Degradation of Benthos beneficial use impairment for the Canadian section of the St. Marys River Area of Concern. Studies included the evaluation of sediment contaminant concentrations, benthic invertebrate community structure, and sediment toxicity at BMP. There are no biomagnifying substances identified in BMP sediment. This document presents a consolidation of those findings to inform decision-making for this area. Evidence indicates that the benthos are not adversely affected in BMP. The application of the *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* (Framework) indicates *no further actions needed* for BMP due to the absence of benthic impairment and toxicity.

Introduction

Bellevue Marine Park is the first major depositional area along the Sault Ste. Marie waterfront located downstream of industrial inputs to the river (former and current sources) (**Figure 1**). Historically, accumulation of wood fibres and elevated levels of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), metals and oils and grease from upstream sources were documented in this area in the Stage 1 and Stage 2 Remedial Action Plan reports, released in 1992 and 2002, respectively. From 2002-2016, BMP was investigated on three occasions (2002, 2006, and 2016) with 13 stations sampled in total (**Figure 1**). The information used in determining the assessment outcome for BMP was amalgamated from various documents (listed below).

To arrive at the assessment outcome for BMP, stations were evaluated using the following lines of evidence specified in the Framework:

Sediment Contamination. Contaminants of concern are measured in the surficial sediment layer. Concentrations are compared to the Ontario Provincial Sediment Quality Guidelines (SQGs) and/or to reference conditions. The SQG Lowest Effect Level (LEL) is the level of contamination that can be tolerated by the majority of benthos and the Severe Effect Level (SEL) is the level above which adverse effects are likely to occur in the majority of benthos.

Benthic Invertebrate Community Structure. The macroinvertebrate composition (types of organisms present and their abundance) are compared to those found at local and/or regional reference stations.

Sediment Toxicity. Laboratory bioassays are conducted using four benthic invertebrates but also included other test organisms (e.g., *Daphnia*, freshwater mussel, fish). Toxicological responses are compared to those from local and regional reference sediment and/or control sediment.

Biomagnification Potential. This line of evidence is assessed in areas where contaminants known to biomagnify are present. Given the absence of biomagnifiable contaminants identified for BMP, this line of evidence is not applicable.

The Framework is an ecosystem approach that considers potential effects on the benthos due to contaminated sediment. The assessment parameters for each line of evidence are listed in **Table 1**. The Framework was applied using results from the individual lines of evidence for the 13 BMP stations. The process involves a series of steps and decisions points that lead to the development of a decision matrix, which is presented in **Table 2**.

Framework Results (Table 2)

1. The assessment shows that metal concentrations at all BMP stations are above the LEL and reference concentrations, but are below the SEL. Total PAHs (sum of 16 parent compounds) are above the LEL at 7 of the 13 stations (range: 5-46 µg tPAHs/g) and reference concentrations but are well below the SEL. Total petroleum hydrocarbon concentrations at 9 of the 13 BMP stations are above those at reference locations.
2. The benthic communities of BMP are not deemed impaired with no significant decrease in taxon richness and reduced average abundance compared to reference.
3. Toxicity is noted at two stations in 2002 (6986, 6991), but subsequent sampling in 2006 and 2016 found none. An investigation into the potential cause(s) of toxicity occurred, which included the examination of correlations between toxicological response and sediment (suite of contaminants) and tissue contaminant concentrations (PAHs, metals), as well as whole-sediment toxicity identification evaluation. This identified PAHs and/or petroleum hydrocarbons as the contaminants most likely responsible for toxicity.
4. The latest sampling efforts show no adverse effects, leading to the outcome no further actions needed.

Overall Conclusion (Table 3)

The latest sampling efforts show no toxicity or adverse effects on the benthos at any station. Based on all scientific evidence and supporting investigative work, the outcome for Bellevue Marine Park is no further actions needed.

Documents used in the evaluation of Belleview Marine Park

EC/OMOE (Environment Canada/ Ontario Ministry of the Environment). 2008. Canada-Ontario decision-making framework for assessment of Great Lakes contaminated sediment. Prepared by P. Chapman with the COA Sediment Task Group on behalf of Environment Canada and the Ontario Ministry of the Environment. March 2008. ISBN 978-0-662-46147-0.

Milani D, Grapentine LC. 2006. The application of BEAST sediment quality guidelines to the St. Marys River area of concern. Environment Canada, Burlington, Ontario. NWRI Contribution No. 06-415.

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Milani D, Grapentine LC. 2012. Benthic Conditions in the St. Marys River from 2009 to 2010 and an overview from 2002 to 2010. Environment Canada, Burlington, Ontario. WSTD Contribution No. 12-093

Parrott JL, Bartlett AJ, Gillis PL, Frank RA. 2018. Fish and invertebrate long-term exposure to St. Marys River sediments. Environment and Climate Change Canada, Burlington, Ontario, Canada.

Ramboll. 2020. Conceptual site model and recommendations, St, Marys River sediments Revision 7. November 6, 2020.

Table 1. Assessment parameters for Bellevue Marine Park.

<table>
<tr><th rowspan="2">Year Sampled</th><th rowspan="2">No. Stations</th><th rowspan="2">Sediment Contaminants</th><th colspan="2">Toxicity</th><th rowspan="2">Benthic Community Structure</th><th rowspan="2">Biomagnification Potential</th></tr>
<tr><th>Test Species</th><th>Endpoints</th></tr>
<tr><td>2002</td><td>6</td><td>PAHs, petroleum hydrocarbons, metals</td><td rowspan="2">Hyalella azteca
Chironomus riparius
Hexagenia spp.
Tubifex tubifex</td><td rowspan="2">Survival, growth
Survival, growth
Survival, growth
Adult survival, reproduction</td><td rowspan="2">Macro-invertebrate community density and composition</td><td rowspan="3">N/A</td></tr>
<tr><td>2006</td><td>7</td><td>PAHs, petroleum hydrocarbons, oil and grease, PCBs, metals</td></tr>
<tr><td>2016</td><td>2[a]</td><td>PAHs (parent and alkylated), PCBs, metals</td><td>Hyalella azteca
Daphnia magna
Pimephales promelas
Lampsilis siliquoidea</td><td>Survival, growth, reproduction
Survival, growth, reproduction
Survival, hatch[b], length, deformities
Survival, burial ability</td><td>N/A</td></tr>
</table>

[a] Stations were previously sampled in 2002.
[b] Includes hatchability, hatch success, and time to hatch.
N/A = not assessed.

Table 2. Decision matrix for weight of evidence categorization for 13 Bellevue Marine Park stations sampled 2002-2016. For stations sampled on multiple occasions, the assessment for the most recent year is bolded

Station	Year Sampled	Sediment Chemistry	Toxicity	Benthos Alteration	Assessment[a]
6981	2002	▣	☐	☐	No further actions needed.
6983	2002	▣	☐	☐	No further actions needed.
6984	2002	▣	☐	☐	No further actions needed.
6986	2002	▣	■	☐	Determine reasons for sediment toxicity
	2006	▣	☐	☐	**No further actions needed**
6991	2002	▣	■	☐	Determine reasons for sediment toxicity
	2006	▣	☐	☐	No further actions needed
	2016	▣	☐	N/A	**No further actions needed**
6992	2002	▣	☐	☐	No further actions needed
	2006	▣	☐	☐	No further actions needed
	2016	▣	☐	N/A	**No further actions needed**
EC70	2006	▣	☐	☐	No further actions needed
M219	2006	▣	☐	☐	No further actions needed
M221	2006	▣	☐	☐	No further actions needed
M223	2006	▣	☐	☐	No further actions needed
M224	2006	▣	☐	☐	No further actions needed
M225	2006	▣	☐	☐	No further actions needed
M226	2006	▣	☐	☐	No further actions needed

■ Adverse effects likely /Major or significant adverse effects
▣ Adverse effects may or may not occur/Minor or potential adverse effects
☐ Adverse effects unlikely/Negligible or no significant adverse effects

[a] Reason(s) for toxicity was investigated.
N/A = not assessed.

Table 3. Outcome for Bellevue Marine Park.

Bellevue Marine Park		
Years sampled	2002, 2006, 2016	
Total number of stations	13	
Scenario	Assessment[a]	Outcome
a) management actions required	0	0
b) determine reason(s) for toxicity	2[b]	0
c) determine reason(s) for benthos alteration	0	0
d) no further actions needed	11	13

[a] Summarized from Table 2 based on most recent sampling year for each station.
[b] Reason(s) for toxicity were investigated and the latest sampling efforts show no toxicity (or benthos alteration); therefore, no further action is recommended for these stations.

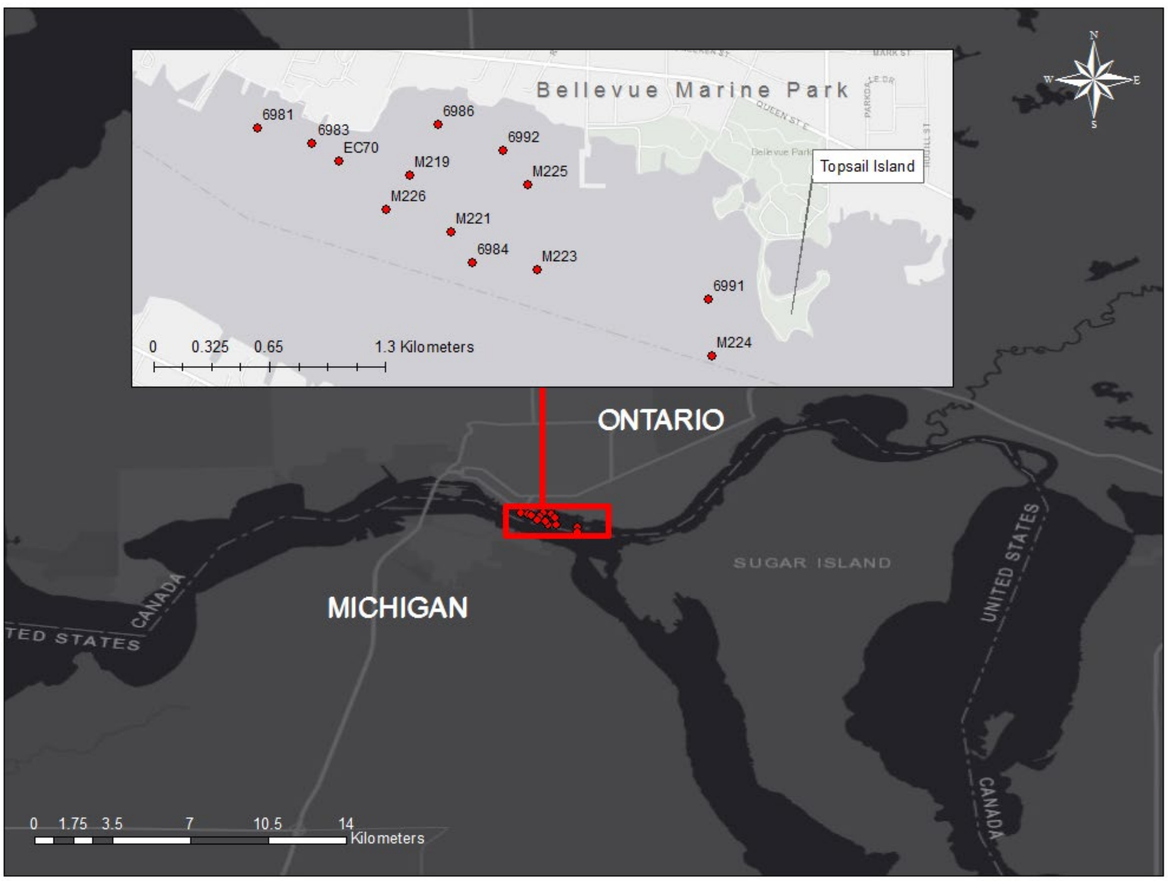

Figure 1. Sampling station locations in the St. Marys River at Bellevue Marine Park, 2002-2016.

APPENDIX E
SEDIMENT QUALITY ASSESSMENT OF ST. MARYS RIVER: EAST OF BELLEVUE MARINE PARK

Sediment Quality Assessment of St. Marys River Depositional Zones:

East Bellevue Marine Park

Summary

East Bellevue Marine Park (EBMP) is a major depositional area located along the Sault Ste. Marie, Ontario, waterfront. A considerable amount of scientific information was used to assess sediment quality and benthic community health in the area stemming from studies conducted from 2008 to 2018. This was done as part of the overall process of assessing the Degradation of Benthos beneficial use impairment for the Canadian section of the St. Marys River Area of Concern. Studies included the evaluation of sediment contaminant concentrations, benthic invertebrate community structure, and sediment toxicity at EBMP. There are no biomagnifying substances identified in EBMP sediment. This document presents a consolidation of those findings to inform decision-making for this area. The evidence indicates that while laboratory toxicity persists in EBMP, the resident benthos are not adversely affected. The application of the *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* (Framework) led to the outcome *determine the reasons for sediment toxicity* or *no further actions needed*. Investigation into the cause(s) of toxicity indicate that PAHs and/or petroleum hydrocarbons are the contaminants most likely responsible but poor water quality in laboratory tests may have been a confounding factor in the latest sampling effort. Based on all scientific evidence and supporting investigative work, the recommended decision for EBMP is *no further actions needed*.

Introduction

East Bellevue Marine Park (EBMP) is the second major depositional area located along the Sault Ste. Marie waterfront downstream of industrial inputs to the river (former and current sources). Historically, accumulation of wood fibres and elevated levels of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), metals and oils and grease from upstream sources were documented in the river in the Stage 1 and Stage 2 Remedial Action Plan reports, released in 1992 and 2002, respectively. From 2008-2018, EBMP was investigated on five occasions (2008, 2009, 2010, 2016, and 2018) with 22 stations sampled in total (**Figure 1**). The information used in determining the assessment outcome for EBMP was amalgamated from various documents (listed below).

To arrive at the assessment outcome for EBMP, stations were evaluated using the following lines of evidence specified in the Framework:

Sediment Contamination. Contaminants of concern are measured in the surficial sediment layer. Concentrations are compared to the Ontario Provincial Sediment Quality Guidelines (SQGs) and/or to reference conditions. The SQG Lowest Effect Level (LEL) is the level of contamination that can be tolerated by the majority of benthos and the Severe Effect Level (SEL) is the level above which adverse effects are likely to occur in the majority of benthos.

Benthic Invertebrate Community Structure. The macroinvertebrate composition (types of organisms present and their abundance) are compared to those found at local and/or regional reference stations.

Sediment Toxicity. Laboratory bioassays are conducted using four benthic invertebrates but also included other test organisms (e.g., *Daphnia*, freshwater mussel, fish). Toxicological responses are compared to those from local and regional reference sediment and/or control sediment.

Biomagnification Potential. This line of evidence is assessed in areas where contaminants known to biomagnify are present. Given the absence of biomagnifiable contaminants identified for EBMP, this line of evidence is not applicable.

The Framework is an ecosystem approach that considers potential effects on the benthos due to contaminated sediment. The assessment parameters for each line of evidence are listed in **Table 1**. The Framework was applied using results from the individual lines of evidence for the 22 EBMP stations. The process involves a series of steps and decisions points that lead to the development of a decision matrix, which is presented in **Table 2**.

Framework Results (Table 2)

1. The assessment shows that metal concentrations at most EBMP stations are above the LEL and reference concentrations, but are below the SEL except for one station in 2008. Total PAHs (sum of 16 parent compounds) are above the LEL at all stations (range: 11-52 µg tPAHs/g) and reference concentrations but are well below the SEL. Total petroleum hydrocarbon concentrations at all EBMP stations except one in 2018 are above those at reference locations.
2. The benthic communities of EBMP are not deemed impaired based on the latest sampling effort, with no significant decrease in taxon richness and reduced average abundance compared to reference.
3. Toxicity is persistent in the area, with 68% percent of stations in EBMP affected (15 of 22 stations). An investigation into the potential cause(s) of toxicity for the St. Marys River occurred, which included the examination of correlations between toxicological response and sediment (suite of contaminants) and tissue contaminant concentrations (PAHs, metals) as well as whole-sediment toxicity identification evaluation. This identified PAHs and/or petroleum hydrocarbons, as well as poor water quality in laboratory test vessels, as likely most responsible for or contributing to, toxicity.
4. Management actions are not required at any station based on the most recent data. Management action is indicated in 2008 at 4 stations, but not in subsequent sampling where the benthos is not deemed impaired at these stations.
5. The assessment, based on the most recent sampling, is determine the reason(s) for sediment toxicity or no further actions needed. However, the reason(s) for toxicity has been investigated, and laboratory toxicity results contradict those of field survey results, which shows no adverse affects on the benthos. The Framework stipulates that field surveys take precedence over laboratory toxicity tests.

Overall Conclusions (Table 3)

While toxicity persists in East Bellevue Marine Park, the benthic communities are similar to those from upstream and regional reference locations that are not subject to the same industrial inputs. Based on all scientific evidence and supporting investigative work, the outcome for East Bellevue Marine Park is no further actions needed.

Regarding deeper sediment and contaminants at depth, administrative controls are recommended. An expanded *St. Marys River Area of Concern Dredging and In-water Administrative Controls Guidance Document* (developed July 2016, updated February 2021) has been developed to provide information to proponents on the required approval, permitting and planning process pertaining to dredging and in-water activities in Canadian waters of the St. Marys River (including EMBP area). This is also tied to the Restrictions on Dredging Activities beneficial use impairment for the AOC.

Documents used in the evaluation of East Bellevue Marine Park

Bartlett, AJ, Brown L, Hedges A, Milani D. 2019. St. Mary's River: Toxicity assessment of sediments collected in 2018 using reproduction tests with *Hyalella azteca*. Final report of methods and results. Water Science and Technology Directorate, Environment and Climate Change Canada, Burlington, Ontario, Canada.

EC/OMOE (Environment Canada/ Ontario Ministry of the Environment). 2008. Canada-Ontario decision-making framework for assessment of Great Lakes contaminated sediment. Prepared by P. Chapman with the COA Sediment Task Group on behalf of Environment Canada and the Ontario Ministry of the Environment. March 2008. ISBN 978-0-662-46147-0.

Milani D, Grapentine LC. 2006. The application of BEAST sediment quality guidelines to the St. Marys River area of concern. Environment Canada, Burlington, Ontario. NWRI Contribution No. 06-415.

Milani D, Grapentine LC. 2009. Biological Assessment of Sediment Collected from the St. Marys River in 2006: Application of the Sediment Decision-Making Framework. Environment Canada, Burlington, Ontario. WSTD 09-513.

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Milani D, Grapentine LC. 2018. Assessment of benthic community composition in the St. Marys River, East of Bellevue Marine Park 2008-2010 using revised models. Technical Memorandum. April 16, 2018. 36 pp.

Milani D, Grapentine LC. 2019. Combined results of 2018 assessments of contaminated sediment from the St. Marys River, East of Bellevue Marine Park. August 2, 2019. 10 pp.

Milani D, Grapentine LC, Parrott JL. 2020. Toxicity of St. Marys River (Ontario, Canada) sediment from different depth ranges to benthic invertebrates and fathead minnow: Assessment of natural recovery. *Submitted to Journal.*

Parrott JL, Bartlett AJ, Gillis PL, Frank RA. 2018. Fish and Invertebrate Long-term Exposure to St. Marys River Sediments. Water Science and Technology Directorate, Environment and Climate Change Canada, Burlington, Ontario, Canada.

Parrott JL, Milani D. 2020. Fish long-term exposure to St. Mary's River sediments collected in 2018: Comparing depths of sediment collection. Water Science and Technology Directorate, Environment and Climate Change Canada, Burlington, Ontario, Canada.

Ramboll. 2020. Conceptual site model and recommendations, St, Marys River sediments Revision 7. November 6, 2020.

Table 1. Assessment parameters for East Bellevue Marine Park.

<table>
<tr><th rowspan="2">Year Sampled</th><th rowspan="2">No. Stations</th><th rowspan="2">Sediment Contaminants</th><th colspan="2">Toxicity</th><th rowspan="2">Benthic Community Structure</th><th rowspan="2">Biomagnification Potential</th></tr>
<tr><th>Test Species</th><th>Endpoints</th></tr>
<tr><td>2008</td><td>11</td><td>PAHs, petroleum hydrocarbons, oil and grease, PCBs, metals</td><td rowspan="3">Hyalella azteca
Chironomus riparius
Hexagenia spp.
Tubifex tubifex</td><td rowspan="3">Survival, growth
Survival, growth
Survival, growth
Adult survival, reproduction</td><td rowspan="3">Macro-invertebrate community density and composition</td><td rowspan="5">N/A</td></tr>
<tr><td>2009</td><td>8</td><td rowspan="2">PAHs (parent and alkylated), petroleum hydrocarbons PCBs, metals</td></tr>
<tr><td>2010</td><td>3</td></tr>
<tr><td>2016</td><td>4[a]</td><td>PAHs (parent and alkylated), PCBs, metals</td><td>Hyalella azteca
Daphnia magna
Pimephales promelas
Lampsilis siliquoidea</td><td>Survival, growth, reproduction
Survival, growth, reproduction
Survival, hatch[b], length, deformities
Survival, burial ability</td><td>N/A</td></tr>
<tr><td>2018</td><td>8[a]</td><td>PAHs (parent and alkylated), petroleum hydrocarbons, oil and grease, metals</td><td>Hyalella azteca
Chironomus riparius
Hexagenia spp.
Tubifex tubifex
Pimephales promelas</td><td>Survival, growth, reproduction
Survival, growth
Survival, growth
Adult survival, reproduction
Survival, hatch[b], length, deformities</td><td>Macro-invertebrate community density and composition</td></tr>
</table>

[a] Stations were previously sampled.
[b] Includes hatchability, hatch success, and time to hatch.
N/A = not assessed.

Table 2. Decision matrix for weight of evidence categorization for 22 East Belleview Marine Park stations sampled 2008-2018. For stations sampled on multiple occasions, the assessment for the most recent year is bolded.

Station	Year Sampled	Sediment Chemistry	Overall Toxicity	Benthos Alteration	Assessment[a]
CS6	2008	▣	▣	☐	Determine reason(s) for sediment toxicity
	2018	▣	▣	☐	**Determine reason(s) for sediment toxicity**
CS7	2008	▣	▣	☐	Determine reason(s) for sediment toxicity
CS8	2008	▣	▣	☐	Determine reason(s) for sediment toxicity
CS9	2008	▣	▣	☐	Determine reason(s) for sediment toxicity
CS10	2008	▣	▣	☐	Determine reason(s) for sediment toxicity
CS11	2008	▣	☐	☐	No further actions needed
CS12	2008	■	☐	☐	No further actions needed
EC15	2008	▣	☐	☐	No further actions needed
EC16	2008	▣	■	☐	Determine reason(s) for sediment toxicity
EC26	2008	▣	■	▣	Management actions required
	2016	▣	☐	N/A	No further actions needed
	2018	▣	☐	☐	**No further actions needed**
EC64	2008	▣	■	▣	Management actions required
	2016	▣	☐	N/A	No further actions needed
	2018	▣	■	☐	**Determine reason(s) for sediment toxicity**
EC30	2009	▣	■	☐	Determine reason(s) for sediment toxicity
EC31	2009	▣	■	☐	Determine reason(s) for sediment toxicity
	2016	▣	☐	N/A	No further actions needed
	2018	▣	■	☐	**Determine reason(s) for sediment toxicity**
EC32	2009	▣	■	☐	Determine reason(s) for sediment toxicity
EC33	2009	▣	■	☐	Determine reason(s) for sediment toxicity
EC34	2009	▣	■	☐	Determine reason(s) for sediment toxicity
	2018	▣	■	☐	**Determine reason(s) for sediment toxicity**
EC35	2009	▣	■	☐	Determine reason(s) for sediment toxicity
	2016	▣	☐	☐	No further actions needed
	2018	▣	■	☐	**Determine reason(s) for sediment toxicity**
EC36	2009	▣	☐	☐	No further actions needed
EC37	2009	▣	☐	☐	No further actions needed
EC52	2010	▣	▣	▣	Management actions required
	2018	▣	☐	☐	**No further actions needed**
EC53	2010	▣	▣	☐	Determine reason(s) for sediment toxicity
EC54	2010	▣	▣	▣	Management actions required
	2018	▣	■	☐	**Determine reason(s) for sediment toxicity**

■ Significant/Major adverse effects
▣ Potential/Minor adverse effects
☐ No significant/Negligible adverse effects

[a] Reason(s) for toxicity were investigated.
N/A = not assessed.

Table 3. Outcome for East Bellevue Marine Park.

East Bellevue Marine Park

Years sampled	2008, 2009, 2010, 2016, 2018	
Total number of stations	22	
Scenario	Assessment[a]	Outcome
a) management actions required	0	0
b) determine reason(s) for toxicity	16[b]	0
c) determine reason(s) for benthos alteration	0	0
d) no further actions needed	6	22

[a] Summarized from Table 2 based on most recent sampling year for each station.

[b] Reason(s) for toxicity were investigated and laboratory toxicity contradicts field survey results that show no adverse effects on the benthos; therefore, no further action is recommended for these stations.

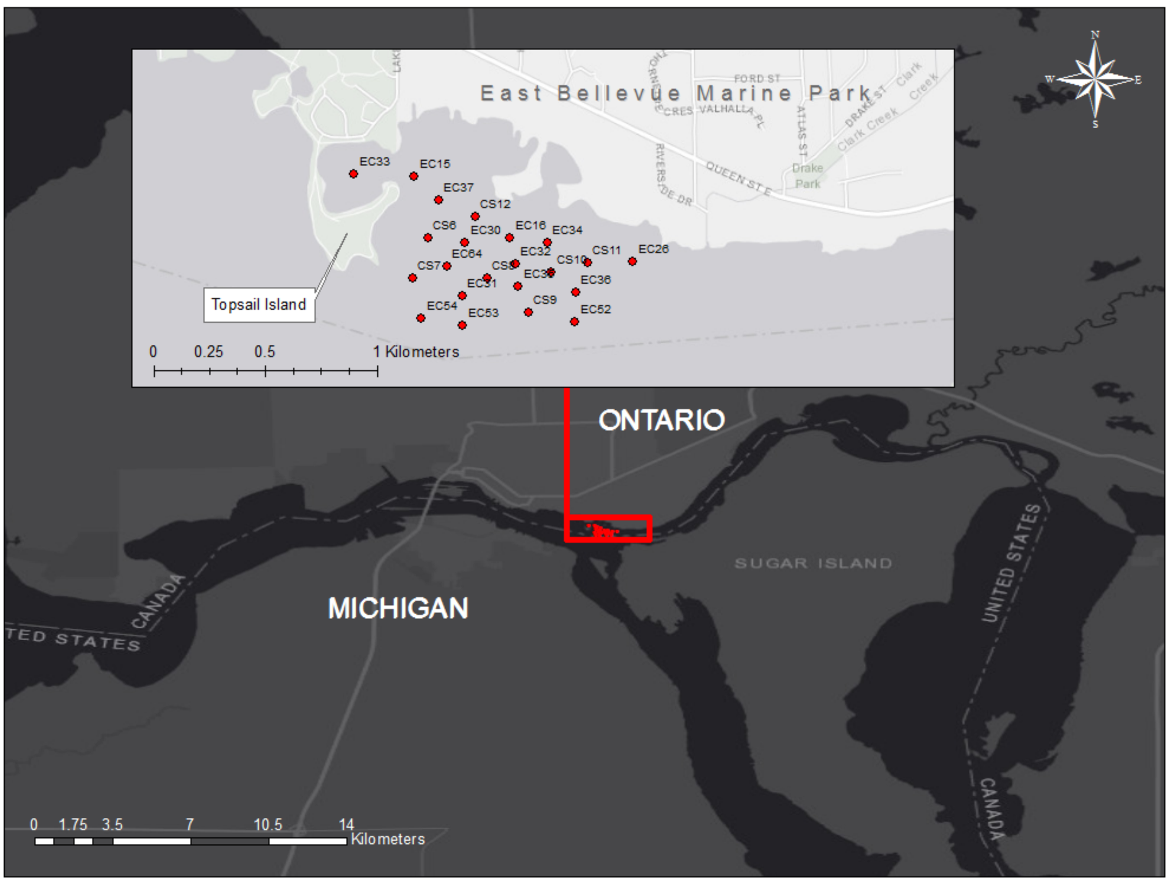

Figure 1. Sampling station locations in the St. Marys River at East Bellevue Marine Park, 2008-2018.

APPENDIX F
SEDIMENT QUALITY ASSESSMENT OF ST. MARYS RIVER: LAKE GEORGE CHANNEL, LITTLE LAKE GEORGE, AND LAKE GEORGE

Sediment Quality Assessment of St. Marys River Depositional Zones:

Lake George Channel, Little Lake George, Lake George

Summary

Lake George Channel (LGC), Little Lake George (LLG) and Lake George (LG) comprise depositional areas within the St. Marys River Area of Concern, located downstream of the Sault Ste. Marie, Ontario, waterfront. A considerable amount of scientific information was used to assess sediment quality and benthic community health in the area stemming from studies conducted from 2002 to 2016. This was done as part of the overall process of assessing the Degradation of Benthos beneficial use impairment for the Canadian section of the Area of Concern. Studies included the evaluation of sediment contaminant concentrations, benthic invertebrate community structure, and sediment toxicity. There are no biomagnifying substances identified in the sediment. This document presents a consolidation of those findings to inform decision-making for these areas. Some stations show toxicity, but in almost all cases, there is no coinciding effects on the resident benthos at these stations. Benthic communities are mostly equivalent to reference with few exceptions. The application of the *Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment* (Framework) leads to no management actions required for all stations. Based on these results, the technical team recommends no further actions for LGC, LLG and LG.

Introduction

Lake George Channel (LGC), Little Lake George (LLG) and Lake George (LG) comprise depositional areas within the St. Marys River Area of Concern that are downstream of industrial inputs (former and current sources). Historically, accumulation of wood fibres and elevated levels of petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), metals, and oils and grease from upstream sources were documented in the St. Marys River in the Stage 1 and Stage 2 Remedial Action Plan reports, released in 1992 and 2002 respectively. From 2002-2016, LGC, LLG and LG were investigated on 7 occasions (2002, 2005, 2006, 2008, 2009, 2010, and 2016) with 23 stations sampled in total (**Figure 1**). The information used in determining the assessment outcome for LGC, LLG and LG was amalgamated from various documents (listed below).

To arrive at the assessment outcome for LGC, LLG and LG, stations were evaluated using the following lines of evidence specified in the Framework:

Sediment Contamination. Contaminants of concern are measured in the surficial sediment layer. Concentrations are compared to the Ontario Provincial Sediment Quality Guidelines (SQGs) and/or to reference conditions. The SQG Lowest Effect Level (LEL) is the level of contamination that can be tolerated by the majority of benthos and the Severe Effect Level (SEL) is the level above which adverse effects are likely to occur in the majority of benthos.

Benthic Invertebrate Community Structure. The macroinvertebrate composition (types of organisms present and their abundance) are compared to those found at local and/or regional reference stations.

Sediment Toxicity. Laboratory bioassays are conducted using four benthic invertebrates but also included other test organisms (e.g., *Daphnia*, freshwater mussel, fish). Toxicological responses are compared to those from local and regional reference sediment and/or control sediment.

Biomagnification Potential. This line of evidence is assessed in areas where contaminants known to biomagnify are present. Given the absence of biomagnifiable contaminants identified for LGC, LLG, and LG, this line of evidence is not applicable.

The Framework is an ecosystem approach that considers potential effects on the benthos due to contaminated sediment. The assessment parameters for each line of evidence are listed in **Table 1**. The Framework was applied using results from the individual lines of evidence for the 23 LGC, LLG and LG stations. The process involves a series of steps and decisions points that lead to the development of a decision matrix, which is presented in **Table 2**.

Framework Results (Table 2)

1. The assessment shows that metal concentrations at most stations are above the LEL and reference concentrations, but are below the SEL except for one LLG station in 2002 (station 6902). Total PAHs (sum of 16 parent compounds) are above reference concentrations at all stations and above the LEL at all stations sampled from 2008-2016 except one in LGC (station 170) (range: 0.6-39 µg tPAHs/g). All stations have total PAHs well below the SEL. Total petroleum hydrocarbon concentrations are above those at reference locations at all stations except three located in lower to mid LGC (stations 170, EC22 and EC25). Average concentrations of solvent extractables, measured in 2005, are above the concentrations measured at the reference station, except for station 248 in lower LG.
2. The benthic communities are equivalent to reference at most stations (87%) with no significant decrease in taxon richness and reduced average abundance compared to reference. There is no strong evidence of altered communities except at LGC station 170 (2009); however, this could be a result of other factors as sediment contaminant concentrations are low at this station. The benthic community is *possibly different* from reference at two LGC stations (EC38 (2009) and EC49 (2010)) but there is no concurrence with toxicity at these stations.
3. Toxicity is noted in parts of the study area, with 39% of stations affected (9 of 23 stations. based on latest sampling year for repeated stations). An investigation into the potential cause(s) of toxicity for the St. Marys River occurred, which included the examination of correlations between toxicological response and sediment (suite of contaminants) and tissue contaminant concentrations (PAHs, metals) as well as whole-sediment toxicity identification evaluation. This identified PAHs and/or petroleum hydrocarbons, as likely most responsible for toxicity. At 8 of the 9 stations, laboratory toxicity results contradict those of field survey results, which shows no adverse affects on the benthos. The Framework stipulates that field surveys take precedence over laboratory toxicity tests.
4. Management actions are not required at any station based on the most recent data.

Overall Conclusions (Table 3)

While toxicity is evident at some stations from tests conducted in the laboratory, the field surveys show no evidence of benthic alteration in almost all cases. Most benthic communities are similar to those from upstream locations in the river that are not subjected to the same industrial inputs, and similar to those from reference locations in the Great Lakes. Management actions are not required at any station. At the stations requiring further toxicity investigative work, the toxicity results contradict those from the field surveys that show no adverse effects on the benthos and the reasons for toxicity have been investigated. There is no strong evidence of altered benthic communities except at one station where alteration may be due to other factors as sediment contamination is low. At the two stations showing possibly different communities, surrounding stations show no adverse effects on the benthos. As a result, no further work is recommended for the benthic community structure line of evidence. Based on all scientific evidence and supporting investigative work, the outcome for Lake George Channel, Little Lake George and Lake George is no further actions needed.

Documents used in the evaluation of LGC, LLG and LG

EC/OMOE (Environment Canada/ Ontario Ministry of the Environment). 2008. Canada-Ontario decision-making framework for assessment of Great Lakes contaminated sediment. Prepared by P. Chapman with the COA Sediment Task Group on behalf of Environment Canada and the Ontario Ministry of the Environment. March 2008. ISBN 978-0-662-46147-0.

George, T. 2006. Preliminary results of the 2005 Lake George/Little Lake George recovery study – sediment and water chemistry. Memorandum. Ministry of the Environment, Etobicoke, Ontario. Oct 26, 2006. 37 pp.

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Milani D, Grapentine LC. 2012. St. Marys River assessment. Benthic Conditions in the St. Marys River from 2009 to 2010 and an Overview from 2002 to 2010. WSTD Contribution No. 12-093.

Milani D, Grapentine LC. 2018. Assessment of benthic community composition in the St. Marys River, East of Bellevue Marine Park 2008-2010 using revised models. Technical Memorandum. April 16, 2018. 36 pp.

Milani D. 2021. Assessment of Lake George Channel benthic community using revised models: 2008-2010 stations (power point file).

OMOE. 2010. Laboratory sediment toxicity report on Lake George and Little Lake George – St. Marys River Area of Concern 2005. Technical Memorandum. Ontario Ministry of the Environment, Etobicoke, Ontario. 33 pp.

Parrott JL, Bartlett AJ, Gillis PL, Frank RA. 2018. Fish and Invertebrate Long-term Exposure to St. Marys River Sediments. Water Science and Technology Directorate, Environment and Climate Change Canada, Burlington, Ontario, Canada.

Ramboll. 2020. Conceptual site model and recommendations, St, Marys River sediments Revision 7. November 6, 2020.

Table 1. Assessment parameters for Lake George Channel, Little Lake George and Lake George.

Year Sampled	No. Stations	Sediment Contaminants	Toxicity: Test Species	Toxicity: Endpoints	Benthic Community Structure	Biomagnification Potential
2002	7	PAHs, petroleum hydrocarbons, metals	*Hyalella azteca* *Chironomus riparius* *Hexagenia* spp. *Tubifex tubifex*	Survival, growth Survival, growth Survival, growth Adult survival, reproduction	Macro-invertebrate community density and composition	N/A
2005	4	PAHs, petroleum hydrocarbons, solvent extractables, metals	*Hyalella azteca* *Chironomus tentans* *Hexagenia* spp.	Survival, growth Survival, growth Survival, growth		
2006	3[a]	PAHs, petroleum hydrocarbons, oil and grease, PCBs, metals	*Hyalella azteca* *Chironomus riparius* *Hexagenia* spp. *Tubifex tubifex*	Survival, growth Survival, growth Survival, growth Adult survival, reproduction		
2008	4					
2009	4[b]	PAHs (parent and alkyl), petroleum hydrocarbons, oil and grease, PCBs, metals				
2010	5					
2016	3[c]	PAHs (parent and alkyl), PCBs, metals	*Hyalella azteca* *Daphnia magna* *Pimephales promelas* *Lampsilis siliquoidea*	Survival, growth, reproduction Survival, growth, reproduction Survival, hatch[d], length, weight, deformities Survival, burial ability	N/A	

[a] 1 new and 2 previously sampled stations
[b] 2 new and 2 previously sampled stations
[c] previously sampled stations
[d] Includes hatchability, hatch success, and time to hatch
N/A = not assessed

Table 2. Decision matrix for weight of evidence categorization for 23 Lake George Channel (LGC), Little Lake George (LLG), and Lake George (LG) stations sampled 2002-2016. Stations are ordered upstream to downstream. For stations sampled on multiple occasions, the assessment for the most recent year is bolded.

Station	Year Sampled	Location	Sediment Chemistry	Overall Toxicity	Benthos Alteration	Assessment[a]
EC22	2008	LGC	◘	□	□	No further actions needed
170	2002	LGC	◘	◘	◘	Management action required
	2006	LGC	□	◘	◘	Determine reason(s) for sediment toxicity and benthos alteration
	2009	LGC	□	N/A	■	**Determine reason(s) for sediment toxicity and benthos alteration**
172	2002	LGC	◘	□	□	No further actions needed
175	2002	LGC	◘	◘	□	Determine reason(s) for sediment toxicity
EC25	2008	LGC	◘	□	□	No further actions needed
176	2002	LGC	◘	◘	□	Determine reason(s) for sediment toxicity
EC46	2006	LGC	◘	■	□	Determine reason(s) for sediment toxicity
	2016	LGC	◘	□	N/A	**No further actions needed**
EC29	2008	LGC	◘	◘	□	Determine reason(s) for sediment toxicity
EC38	2009	LGC	◘	□	◘	Determine reason(s) for benthos alteration
EC47	2010	LGC	◘	■	□	Determine reason(s) for sediment toxicity
DBCR1	2008	LGC	◘	◘	□	Determine reason(s) for sediment toxicity
6900	2002	LGC	◘	□	□	No further actions needed
EC48	2010	LGC	◘	■	□	Determine reason(s) for sediment toxicity
	2016	LGC	◘	□	N/A	**No further actions needed**
EC39	2009	LGC	◘	◘	□	Determine reason(s) for sediment toxicity
EC49	2010	LGC	◘	□	◘	Determine reason(s) for benthos alteration
EC50	2010	LGC	◘	□	□	No further actions needed
EC51	2010	LGC	◘	□	□	No further actions needed
	2016	LGC	◘	□	N/A	**No further actions needed**
6901	2002	LLG	◘	□	□	No further actions needed
	2006	LLG	◘	□	□	No further actions needed
	2009	LLG	◘	□	□	**No further actions needed**
0087	2005	LLG	□	□	□	No further actions needed
6902	2002	LLG	■	□	□	No further actions needed
0231	2005	LG	□	◘	□	Determine reason(s) for sediment toxicity
0249	2005	LG	◘	◘	□	Determine reason(s) for sediment toxicity
0248	2005	LG	□	□	□	No further actions needed

■ Significant/Major adverse effects
◘ Potential/Minor adverse effects
□ No significant/Negligible adverse effects

[a] Reason(s) for toxicity was investigated.
N/A = not assessed.

Table 3. Outcome for Lake George Channel, Little Lake George and Lake George.

Lake George Channel, Little Lake George and Lake George		
Years sampled	2002, 2005, 2006, 2008, 2009, 2010, 2016	
Total number of stations	23	
Scenario	Assessment[a]	Outcome
a) management actions required	0	0
b) determine reason(s) for toxicity	8[b]	0
c) determine reason(s) for benthos alteration	2[c]	0
d) determine reason(s) for toxicity and benthos alteration	1[d]	0
e) no further actions needed	12	23

[a] Summarized from Table 2 based on most recent sampling year for each station.
[b] Reason(s) for toxicity were investigated and laboratory toxicity contradicts field survey results that show no adverse effects on the benthos; therefore, no further action is recommended for these stations.
[c] There is no strong evidence of adverse effects on the benthos and surrounding stations show no effects; therefore, no further actions are recommended for these stations.
[d] Possibly altered benthos and toxicity may be due to other factors as sediment contaminant is low; therefore, no further action is recommended for this station.

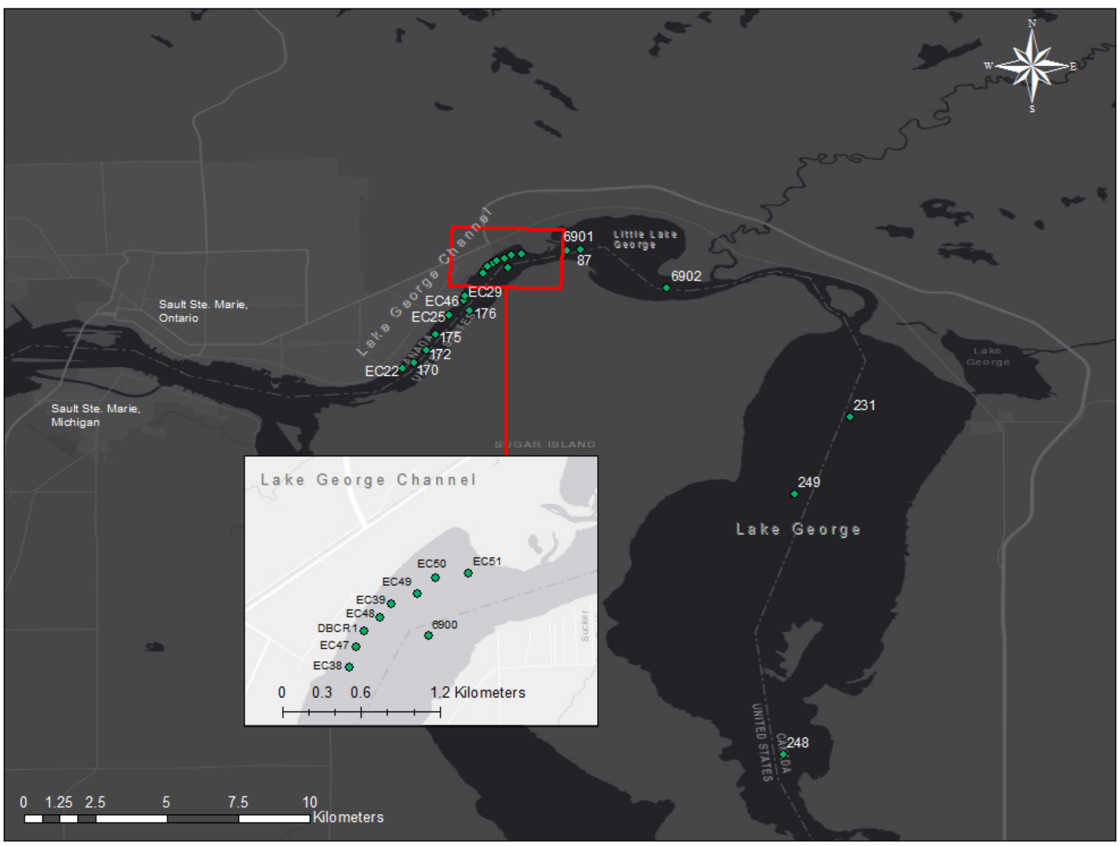


Figure 1. Sampling station locations in Lake George Channel, Little Lake George and Lake George, 2002-2016.

APPENDIX G
2021 ST. MARYS RIVER AREA OF CONCERN IN-WATER ADMINISTRATIVE CONTROLS GUIDANCE DOCUMENT

St. Marys River Area of Concern Dredging and In-water Administrative Controls Guidance Document

June 2021

Table of Contents

This Protocol Guidance document does not substitute for local, provincial and federal laws and regulations that apply to dredging and in-water work. This is only a summary. Project proponents are advised to contact the relevant authorities, and to review and abide by the appropriate legislation.

This Protocol Guidance document follows the outline of the one developed for the Cornwall Sediment Strategy in 2003 (French, 2003).

Why are we focused on dredging and other in-water activities in the St. Marys River?

The St. Marys River is a 112 km waterway bordering Canada and the United States. The river is the outflow of Lake Superior to Lake Huron, and is an important shipping channel within the Great Lakes – St. Lawrence Seaway. The St. Marys River is an Area of Concern (AOC) identified in the Canada-U.S. Great Lakes Water Quality Agreement. An AOC is a location that has experienced significant environmental degradation and impaired beneficial use. Canada and the United States have committed to developing and implementing a remedial action plan to address environmental degradation through a collaborative, scientific, and ecosystem-based approach.

One of the environmental issues in the St. Marys River AOC is contaminated sediment in the river resulting from past pollution. Contaminants of concern include petroleum hydrocarbons, polycyclic aromatic hydrocarbons, oils, grease, and trace metals. Although studies have shown that the contaminants are covered with layers of cleaner sediment, it is important that proponents of projects with in-water activities that could potentially disturb or expose deeper sediments to consider potential environmental impacts, follow best management practices, and obtain appropriate regulatory permits and approvals as needed. In-water activities which could pose a risk include but are not limited to: dredging, dock wall/wharf replacement, pile driving and trenching.

This document provides information to proponents considering in-water activities in Canadian waters of the St. Marys River, and encourages coordination and cooperation among the different authorities and government agencies that have a responsibility in the approval, permitting and planning process.

Levels of contaminants vary with location within the St. Marys River AOC. As a result, the restrictions on certain in-water activities, and the conditions under which they may be carried out, will also vary with location. In some cases, contaminant levels may result in the denial of an application if appropriate mitigation measures cannot be implemented.

What is the St. Marys River Guidance Document for Dredging and In-water Activities?

The *St. Marys River Dredging and In-water Administrative Controls document* is a tool that provides guidance to proponents considering projects such as dredging, dock wall/wharf replacement or other in-water activities that risk disturbing buried sediments. This document is also a tool for the agencies involved in the permitting process. Administrative controls for these activities fall into two broad categories:

a) Environmental assessment and planning
b) Regulatory approvals and permitting

The environmental assessment and planning processes are comprehensive exercises involving several agencies. These processes are used to forecast, assess and mitigate potential impacts of in-water activities, and to fulfill legislative and mandate requirements.

Permit approvals processes (for example, work and building permits) tend to involve a less comprehensive review and approval process, typically a single agency, and have limited scope and review.

Both types of administrative controls have the potential to play key roles in minimizing the disturbance of sediments within the St. Marys River AOC when in-water activities are being planned and implemented.

Objectives

The objectives of the St. Marys River Dredging and In-water Administrative Controls are:

- to outline the administrative approach on in-water activities to minimize the disturbance, exposure or resuspension of contaminated sediment;
- to establish principles that will guide decisions;
- to summarize the roles and responsibilities of the proponent and agencies involved;
- to provide guidance for proponents submitting in-water project applications for required permits; and
- to summarize agency mandates and to promote a common review process for regulatory activities that have the potential to disturb contaminated sediment.

For proponents considering in-water activities

This guidance document provides information to proponents considering in-water activities on the Canadian side of the St. Marys River AOC [see Figure 1]. It outlines the considerations that government agencies will take into account while evaluating in-water activities that could disturb sediment; such as dredging, filling, covering, piling, or scouring. It provides information on the type of activities that require approval, outlines the review process for applications, identifies the authorities/agencies to contact, and articulates the principles of sound decision-making.

Applicants who submit a proposal should be aware that each of the applicable regulatory agencies must provide approval before they begin.

There may be cases in which one agency may approve an application while another declines in which case the activity would be unable to proceed (i.e. another agency may decline the proposal).

Regulatory agencies may also solicit input from others on an application. MECP may solicit input from ECCC based upon their joint work on the Great Lakes Areas of Concern and because of contaminated sediment experience residing with ECCC.

Geographic scope of the Protocol

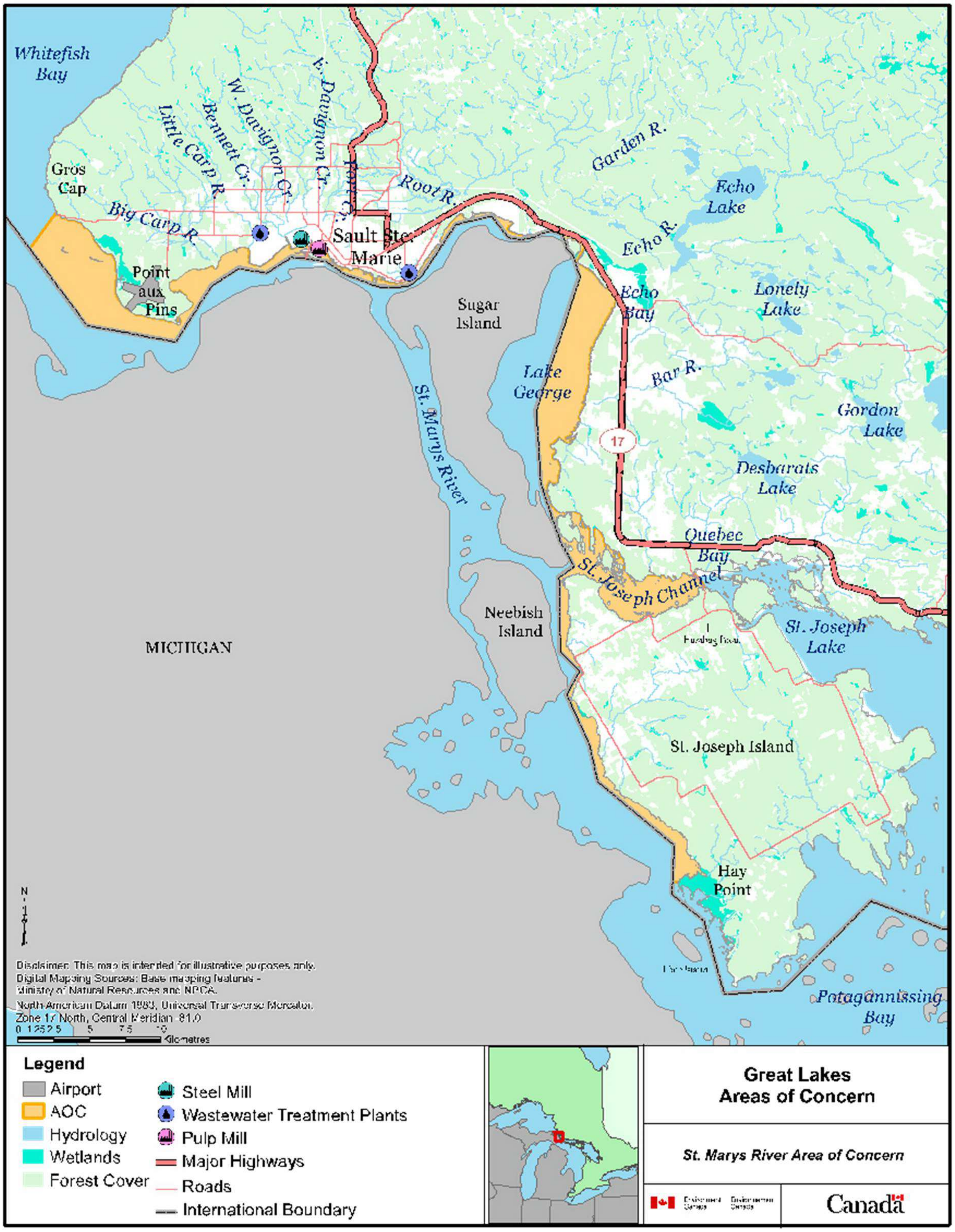


Figure 1: St. Marys River Area of Concern

What are some examples of approvals that need to be obtained?

The approvals required will vary depending on the location and type of activity proposed. Table 1 provides examples, but the list is not exhaustive and additional activities may require a permit or approval. It is the responsibility of the proponent to contact the appropriate authorities. See Appendix B for additional information on applicable legislation.

Table 1: Examples of in-water activities and potential permit or approval requirements

Activity	Submissions/Approvals	Agency	Legislation
Development or placing or dumping of fill or the straightening, changing, diverting or interfering with the existing channel of a river, creek, stream or watercourse or interference with a wetland.	Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation Permit	Sault Ste. Marie Region Conservation Authority	Ontario Regulation 176/06, *Conservation Authorities Act*
Removal and transport of dredged materials (contaminated or not) to the appropriate disposal site(s).	Waste Generator Registration Number, Environmental Compliance Approval	MECP	Regulation 347, General Waste Management, *Environmental Protection Act*
Collection, treatment, and discharge of contaminated water and sewage	Section 53 Environmental Compliance Approval	MECP	*Ontario Water Resources Act*
Taking of water greater than 50,000 litres/day.	Permit to Take Water	MECP	*Ontario Water Resources Act*
Visit the DFO Projects Near Waters website (https://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html), which provides an overview of the DFO review process, aquatic SAR mapping, Codes of Practice, and the Measures to protect fish and fish habitat. This guidance is available to help proponents determine if a DFO regulatory review is required	-Authorization under Fisheries Act s. 34.4(2)(b) and 35(2)(b), with or without SARA conditions; -SARA permit under Species At Risk Act s.73; or -Letter of Advice	Fisheries & Oceans Canada	*Fisheries Act & Species at Risk Act*
Dredging that does not meet the criteria and specific terms and conditions for construction under the *Minor Works Order*, or works that risk a substantial interference with navigation. An in water work that is not considered a minor work will likely require that an application for approval be submitted.	Must submit a *Notice to the Minister* and *Notice of Works* that details project and likely interferences with shipping and boating activities.	Transport Canada	*Canadian Navigable WatersAct*
Dredging project that may have an impact to species at risk and their habitat (see Appendix D).	Approval	MECP	*Endangered Species Act*
Building, constructing, dredging, filling, or removal of aquatic vegetation on shorelands or on Crown land under water.	Work Permit	MNRF	*Public Lands Act*
Dams, channelization (including dredging, diverting or enclosing a channel), diversions, bridges and culverts	Work Permit and/or Approval	MNRF	*Lakes and Rivers Improvement Act*

What is the process to obtain approval for dredging and other in-water activities?

Every proponent must follow these steps for any in-water activity in the St. Marys River:

Step 1

Contact the Sault Ste. Marie Region Conservation Authority (SSMRCA) – to determine if the proposed activity is within or will affect the St. Marys River watershed the proponent should contact the SSMRCA. Initial discussions with the SSMRCA will help to determine the feasibility of the proposed activity and permitting requirements from the applicable regulators. Note that if the project falls outside of the SSMRCA jurisdiction, then the MNRF should be the first point of contact.

> All property owners and proponents of activities must obtain the appropriate permits and authorizations, and should apply best management practices when doing work in or near the St. Marys River.

Step 2

Complete and submit applications to appropriate agencies – the number of permits to be obtained will depend on the size, location and duration of the project and the requirements of each individual agency. Become familiar with the decision-making process (see Appendix A) and be prepared to modify the project if necessary. Sediment sampling need to be completed and included in the application in order to determine the presence/absence of contamination and answer the questions in the decision-making process. Complete the permit application(s), include any additional requirements or conditions, and submit to the appropriate agencies. These may include:

- Sault Ste. Marie Region Conservation Authority
- Ministry of Environment, Conservation and Parks
- Fisheries and Oceans Canada
- Ministry of Natural Resources and Forestry
- Transport Canada

Step 3

Application Review – each agency will review the application in accordance with their own regulatory requirements and may discuss it with other authorities/agencies. Each agency involved should provide the other agencies with copies of their comments/permits (project specific).

Step 4

Notification to Proponent of Decision – each agency will contact the proponent with a decision to approve or deny the proposed work.

> The proponent cannot start the project without the appropriate permits and authorizations.

Step 5

Monitoring Compliance – proponents are responsible for ensuring that the project meets all terms and conditions of approval throughout the construction and post-construction phases. Any agency may visit the project site to ensure compliance.

What should a proponent consider before submitting an application?

- The proponent is responsible for submitting all necessary applications, that the required information for each application is provided (including documentation of sediment chemistry at surface and at depth if project involves the disturbance of sediment) and that all approvals are obtained before any work commences. There may be costs associated with submission of these applications.
- Failure to obtain the correct permits prior to the work could be a violation of one or more of the above noted Acts, which can result in fines or a term of imprisonment, and the proponent may be required to restore/rehabilitate the disturbed area and/or to remove unapproved structures.
- Be aware that permits usually include conditions, such as the time of year when the work can be done.
- A change in location may help avoid areas with contaminated sediment. Certain types of construction or dredging techniques, and the use of certain materials, may help alleviate problems in dealing with contaminated sediment. Contact a qualified professional to discuss ways of reducing your impacts on the St. Marys River.
- Projects that cannot be relocated or redesigned and may potentially disturb sediments must have a plan that indicates how contaminated sediment will be handled, removed and disposed of in a safe and environmentally protective manner.
- Preventing disturbance is critical when planning an in-water activity. The application should include how the proponent will ensure that there will be as little disturbance, exposure or re-suspension of sediments as possible.
- Be prepared. When an unforeseen spill or escape of contaminated materials occur, the impacts must be monitored and appropriate actions taken to mitigate further re-suspension of contaminated sediment. Application(s) may require you to outline what measures will be taken, including materials and equipment on site, to deal with these types of situations. Failure to show due diligence may result in fines or other penalties.
- The proponent of any activity is responsible for worker safety and all costs associated with the project. Examples of potential costs include (but are not limited to) application fees, engineering reports, and the removal, handling and disposing of contaminated sediment.

What guides an agency's decision?

Each agency will review their required application according to that agencies' mandate and legislative authority and may discuss the proposed activity with other parties.

All activities may also be assessed using the Decision Making Process outlined in Appendix A which looks at projects based on potential for Relocation, Redesign and Remediation. If the proponent disagrees with the decision or any of the conditions of approval they should contact the appropriate agency(ies) to consider their options in accordance with the provisions of the applicable legislation as noted in the decision.

Where can I obtain more information?

For more information on specific applications, please contact the appropriate agency:

Sault Ste. Marie Region Conservation Authority
1100 Fifth Line East
Sault Ste. Marie, Ontario P6A 6J8
(705) 946-8530
Email: nature@ssmrca.ca
Web: https://ssmrca.ca/permits/

Ministry of Natural Resources and Forestry
64 Church Street
Sault Ste. Marie, Ontario P6A 3H3
(705) 949-1231
For inquiries relating to work permits:
1-855-613-4256
Email: mnr.rasc@ontario.ca

Ministry of the Environment and Conservation and Parks
Sault Ste. Marie Area Office
70 Foster Drive, Suite 110
Sault Ste. Marie, Ontario P6A 6V4
(705) 942-6354
Email: MECPSaultSteMarie@ontario.ca

Fisheries and Oceans Canada
Fish and Fish Habitat Protection Program867 Lakeshore Road
Burlington, Ontario L7S 1A1
1-855-852-8320
Email: FisheriesProtection@dfo-mpo.gc.ca
Web: www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html

Transport Canada
Navigation Protection Program
100 S Front Street, 1st Floor
Sarnia, Ontario N7T 2M4
(519) 383-1863
Email: NPPONT-PPNONT@tc.gc.ca
Web: www.tc.gc.ca/eng/programs-621.html

For agencies involved in the permitting process:

One of the objectives of this document is to support a coordinated approach by agencies with regulatory responsibility for dredging and other in-water activities in the St. Marys River.

Table 2: Agency Roles and Responsibilities

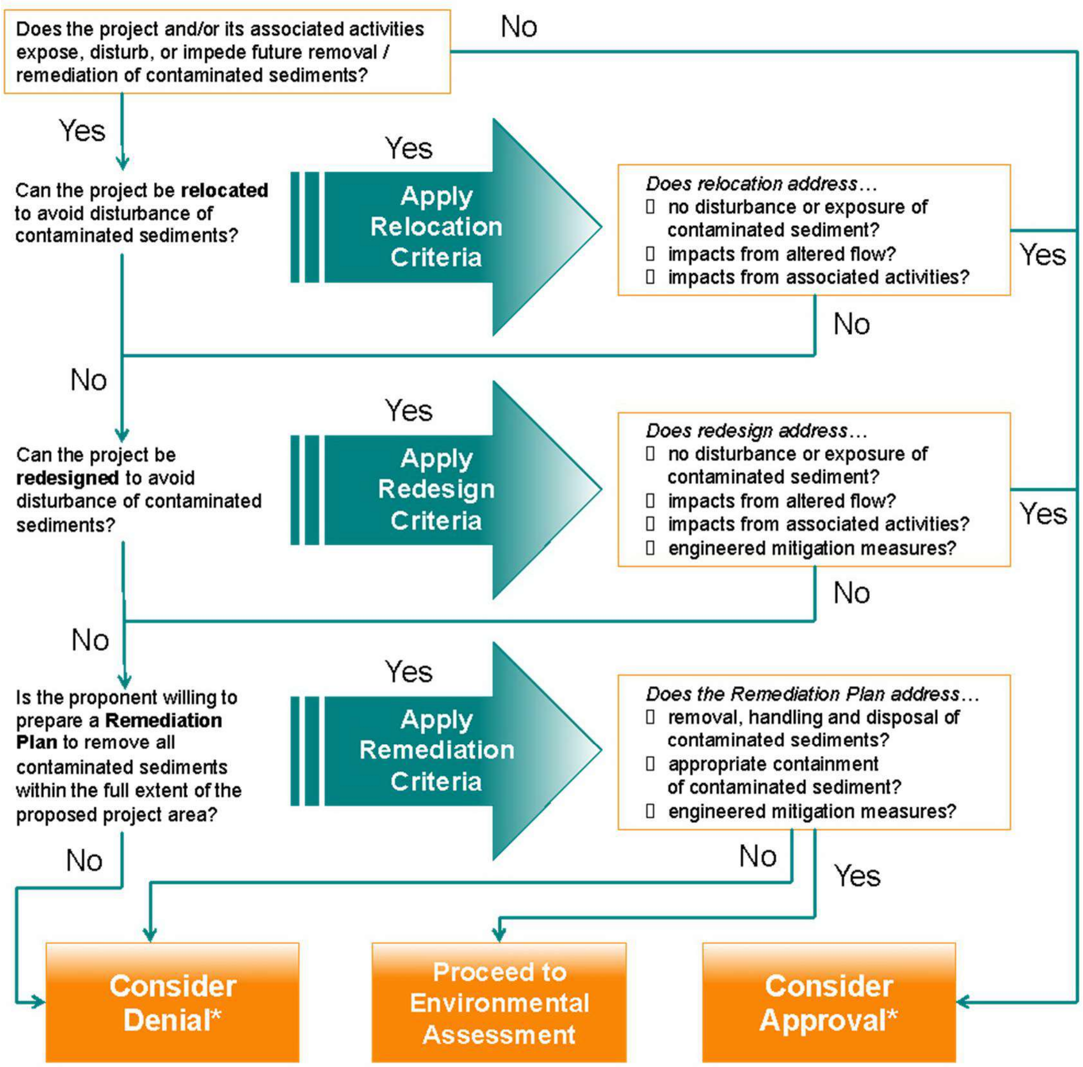
	SSMRCA	MECP*	DFO	MNRF	TC**
Coordinate Process					
• Participates in the implementation of a coordinated application review process by all parties	✓	✓	✓	✓	
• Participates in meetings and discussions as required	✓	✓	✓	✓	✓
Notification/Circulation					
• Refers proponents to appropriate agencies	✓	✓	✓	✓	
• Provides guidance document to assist proponents throughout the process	✓	✓	✓	✓	
• Notifies appropriate agencies when applications are received (project specific)	✓	✓	✓	✓	
• Responds to requests for information in a timely manner	✓	✓	✓	✓	✓
Review Application					
• Reviews application and provides input in accordance with jurisdiction	✓	✓	✓	✓	✓
• Provides scientific information and technical data with respect to the impact of activities on contaminated sediment		✓			
• Reports to other agencies on findings of its review and recommendations before making a decision on approval.	✓	✓	✓	✓	
• Provides notice of final decision to the parties and to the proponent.	✓	✓	✓	✓	✓
Monitoring – Activities					
• Monitors compliance of activity with conditions of approval, if applicable	✓	✓	✓	✓	✓

* MECP may solicit input from ECCC based upon their joint work on the Great Lakes Areas of Concern and because of contaminated sediment experience residing with ECCC.

** Navigable Waters Protection

Appendix A: Decision Making Process

The "Decision Making Process" [1] outlined below summarizes the process for reviewing of all in-water project applications on the Canadian side of the St. Marys River Area of Concern involving the participating agencies.



*Pending consideration of all applicable legislation

[1] Adapted from the "Decision Making Process" flow chart in the Cornwall Sediment Strategy – Administrative Controls Protocol (2005) found at: https://www.rrca.on.ca/view.php?id=40

Appendix B: Applicable legislation as it relates to dredging and in-water activities

The provincial ***Conservation Authorities Act*** and the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Ontario Regulation 176/06 (Sault Ste. Marie Region Conservation Authority) requires approval of any activities that may result in development such as the construction of buildings habitable or non-habitable, site alterations (filling, excavating) shoreline alteration (dredging, shorewalls, decks, groynes), interference with a wetland or a watercourse (bridges, culverts).

The provincial ***Public Lands Act*** (Ministry of Natural Resources & Forestry) provides that no person shall dredge or fill shorelands or work on Crown land without a work permit. "Shorelands" are defined as lands covered or seasonally inundated by the water of a lake, river, stream or pond and may include private, municipal or Crown lands. It is important to note that the MNRF plays a permitting and approvals role when enforcing timing restrictions for in-water work. This is to prevent fisheries from suffering and means that NO in-water work can occur during spawning and incubation periods for fish. For more information on MNRF's in-water work timing window guidelines visit: www.ontario.ca/document/water-work-timing-window-guidelines

The provincial ***Lakes and Rivers Improvement Act*** (MNRF) requires a work permit and/or approval for dams, channelizations (including dredging, diverting, enclosing a channel), diversions, bridges and culverts. There is a two-phase approval process. The first phase involves location approval and is subject to an ecological review. Once the location is approved, the proponent must provide the MNRF with plans and specification drawings that have been approved by an engineer. Copies of the work permit application form are available at Service Ontario Centres.

The provincial ***Environmental Protection Act*** (Ministry of the Environment, Conservation and Parks) requires a generator registration number if the dredged sediment is classified as a waste. Additional requirements may apply, depending on the waste classification. For information on how to classify dredged material visit: www.ontario.ca/document/registration-guidance-manual-generators-liquid-industrial-and-hazardous-waste

The provincial ***Ontario Water Resources Act*** (MECP) provides approval for the collection, treatment and discharge of water and sewage (https://www.ontario.ca/document/guide-applying-environmental-compliance-approval-0) . The Act also requires a Permit to Take Water for any water takings greater than 50,000 litres per day. For more information and to download application forms visit: www.ontario.ca/environment-and-energy/permits-take-water

The provincial ***Endangered Species Act*** (MECP) requires a permit to move species at risk individuals and/or encroach on their habitat. These permits are required for all activities proposed within existing or potential species at risk habitat. Under the Act, the MNRF can grant different types of permits or other authorizations with conditions that are aimed at protecting and recovering species at risk. There are five types of permits issued under the Act including (1) health and safety, (2) protection and recovery, (3) social or economic benefit to Ontario, (4) Aboriginal, and (5) overall benefit. For more information on getting a permit/authorization visit: www.ontario.ca/environment-and-energy/how-get-endangered-species-act-permit-or-authorization

The federal **Canadian Navigable Waters Act**(Transport Canada) has a *Minor Works Order* that allows for in-water works to be implemented if they meet established criteria and specific terms and conditions for construction. Proponents are responsible for assessing their own proposed project to ensure it meets the criteria and that all legal requirements set out in the Minor Works Order are met. Works meeting the assessment criteria are classed as "designated works" under the Act, and may proceed as long as they comply with the legal requirements. Otherwise, proponents must provide a "Notice to the Minister (of Transport)" and "Notice of Works" that details the work and identifies likely interferences with shipping and boating activities, and a decision to approve or deny the project will be made. Applications are to be submitted through an external submission site (https://npp-submissions-demandes-ppn.tc.canada.ca/auth/login-connexion?ret=%2F) which also includes a tool that can be used to assist in the determination of CNWA applicability (which can be found at the following link: https://npp-submissions-demandes-ppn.tc.canada.ca/projectreview-outildexamenduprojet).

For more information visit: www.tc.gc.ca/eng/programs-621.html

The federal ***Fisheries Act*** includes a prohibition against the death of fish (section 34.4(1)) and the harmful alteration, disruption, and destruction (HADD) to fish and fish habitat (section 35(1)), unless authorized by the Minister of Fisheries and Oceans. To protect fish and fish habitat, efforts should be made to avoid, mitigate and/or offset harm. Projects in or near water must also comply with the pollution prevention provisions of the *Fisheries Act,* and with the federal ***Species at Risk Act*** (DFO).Consult DFO's website (www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html), specifically the section "Projects Near Water".

Appendix C: Federally Regulated Species at Risk that may be impacted within the St. Marys River AOC

- Deepwater sculpin (Great Lakes – Upper St. Lawrence populations) has been assessed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). It is listed under the federal Species at Risk Act (SARA) and was afforded protection under SARA as of December 2007. They are found in lake habitats within the AOC.
- Upper Great Lakes Kiyi has been identified as a Special Concern by COSEWIC. It was listed and afforded protection under SARA as of 2007. Additional protection is afforded through the Fisheries Act. They are found in lake habitats within the AOC.
- Lake Sturgeon (Great Lakes - Upper St. Lawrence populations) is currently being considered for listing under SARA. Currently, protection is afforded through the federal Fisheries Act. If listed under the SARA, it will be afforded additional protection. They are found in lake habitats within the AOC.
- Northern Brook Lamprey (Great Lakes - Upper St. Lawrence populations) has been identified as Special Concern by COSEWIC. It is listed under SARA and was afforded protection under SARA as of March 2009. Additional protection is afforded through the Fisheries Act. They are found in riverine and lake habitats within the AOC.
- Redside Dace is listed as Endangered under SARA as of 2017. Additional protection is afforded through the Fisheries Act. They are found in the Two Tree River watershed.
- Silver Lamprey (Great Lakes – Upper St. Lawrence populations) is identified as Special Concern by COSEWIC. It was listed and afforded protection under SARA in 2019. Additional protection is afforded through the Fisheries Act. They are found in lake and riverine habitats within the AOC.

Appendix D: Provincially Regulated Species at Risk that may be impacted within the St. Marys River AOC

- Lake Sturgeon is listed as threatened in the Great Lakes-Upper St. Lawrence River population. They are found in the river within the AOC.
- Redside Dace is listed as endangered under the Endangered Species Act. They are found in the Two Tree River watershed.
- Northern Brook Lamprey (Great Lakes - Upper St. Lawrence populations) has been identified as Special Concern
- Silver Lamprey (Great Lakes – Upper St. Lawrence populations) has been identified as Special Concern.

APPENDIX H
SUMMARY OF SEDIMENT SAMPLING AND ANALYSIS METHODS

Appendix H. Summary of Sediment Sampling and Analysis Methods

Sampling to support application of the Framework generally targets areas of depositional, fine-grained sediments. The number of samples and the locations sampled are decided based on the goal of mapping the extent of contamination, both horizontally and with depth. Samples collected from reference areas provide a basis for comparison to the area of contaminated sediment and to differentiate contamination derived from non-point sources from that derived from the site.

To evaluate the four lines of evidence, sediment is collected from the biologically active zone (generally the upper 10 cm of sediment) using sampling tools that range from manual hand tools, hand augers and push tubes (which can be used where water depth is wadable) to indirect mechanical samplers that must be used in deeper waters or waters that cannot be waded safely. Photographs of representative sediment sampling tools are provided below.

Several tools are available for collecting the invertebrate samples used to evaluate community structure. The choice of sampling method is dictated by site-specific conditions, such as whether the area tends to accumulate sediment (depositional) or lose sediment (erosional). Sediment sampling devices such as those listed above often are used to collect both sediment and benthic organisms together, and then the sample is sieved, before invertebrates are fixed, preserved, or hand-picked. Alternatively, dip-nets, kick-nets, Surber or Hess, or Hester-Dendy samplers may be used to collect invertebrates living within the water column, rather than in the sediment.


Hand auger


Ekman Sampler

To characterize sediment stability and potential risks in the event that buried sediments are disturbed, subsurface sediment samples are typically collected using core samplers. Cores can also be used to develop sediment erosion profiles and concentration profiles as evidence of natural burial and how prone the sediment is to erosion (i.e., sediment stability). A variety of tools other than cores exist for evaluating sediment stability.

After sediment samples have been retrieved, samples may be processed to remove stones, twigs or other debris, homogenized, transferred to laboratory pre-cleaned sample containers, labeled, preserved if required by the specified method, sealed, and shipped to: a) an analytical laboratory for chemical and physical characterization; b) a taxonomy laboratory for community structure characterization; or c) a toxicity testing laboratory.

Analytical laboratories follow specific approved methods to prepare and analyze samples, in order to ensure the quality and reliability of the reported results (e.g., CCME 2016b).

Taxonomy laboratories evaluate invertebrate community structure based on the number of different invertebrate taxa counted in a given sample. Using the results of the taxonomic identification, various measures of community structure are calculated, such as biomass, diversity, dominance, and prevalence of pollution intolerant taxa.

Toxicity testing laboratories conduct short-term and long-term studies to determine whether exposure of test organisms to contaminants in test media causes an adverse effect (such as decreased survival, growth, or reproduction) in those organisms (Canada 2010). Toxicity tests are usually conducted using field-collected samples, though exposure concentrations can be manipulated through spiking or dilution in order to achieve a desired range of exposure concentrations. Many standardized methods of sediment toxicity testing exist (e.g., Biological test methods publications - Canada.ca and as listed in Table 2 of Canada 2010). The general process for testing involves preparing samples and distributing them among multiple test containers, adding the prescribed number and type of test organism, monitoring those organisms over the prescribed test duration, and recording key metrics (e.g., survival, growth, reproduction, emergence) for each test container over time. By simultaneously testing control sediments and sediments collected from the site and reference areas, it may be possible to discern differences in toxicity as a function of source/location and concentrations of different contaminants.

APPENDIX I
TIMELINE OF SAMPLING ACTIVITIES IN THE ST. MARYS RIVER AREA OF CONCERN

Year	Sampling Activities in the St. Marys River Area of Concern
2000	sediment chemistry in Algoma Boat Slip
2002	sediment chemistry, community structure, and toxicity in Lake George Channel, Little Lake George, Lake George, and Bellevue Marine Park
2005	sediment chemistry in Algoma Boat Slip, Lake George Channel, Little Lake George, Lake George, East of Bellevue Marine Park and Bellevue Marine Park, as well as community structure and toxicity in Little Lake George and Lake George
2006	sediment chemistry in Algoma Boat Slip, Lake George Channel, Little Lake George, Lake George, East of Bellevue Marine Park and Bellevue Marine Park 2007: sediment cores for chemistry in Bellevue Marine Park, East of Bellevue Marine Park, and Lake George Channel
2008	sediment chemistry in the Water Lot; sediment chemistry, community structure, and toxicity in East of Bellevue Marine Park
2009	sediment chemistry in the Water Lot; sediment chemistry, community structure, and toxicity in East of Bellevue Marine Park and Lake George Channel
2010	sampling and monitoring program conducted along Algoma Slag Dump shoreline, including sediment and groundwater monitoring, acute toxicity testing; sampling for chemistry, community structure and toxicity in the Water Lot; sediment chemistry, community structure, and toxicity in East of Bellevue Marine Park and Lake George Channel; sediment chemistry throughout Area of Concern
2011	sediment chemistry and benthic invertebrate community structure in Bennett Creek Diversion; post-dredge sediment chemistry at Consumers Energy Former Manufactured Gas Plan (Michigan); sampling for sediment chemistry and toxicity in the Water Lot
2014	sediment chemistry in Algoma Boat Slip
2016	sediment toxicity throughout the Area of Concern
2018	sediment chemistry in Algoma Boat Slip; sediment cores for chemistry, community structure and sediment toxicity in East of Bellevue Marine Park; sediment chemistry, community structure and toxicity in the Water Lot
2019	site-wide groundwater monitoring throughout Algoma and surface and subsurface sediment chemistry in Algoma Boat Slip
2020	sediment chemistry and toxicity in Algoma Boat Slip sediment
2021	sediment chemistry in Algoma Boat Slip
Ongoing	shallow groundwater monitoring along perimeter of Algoma Slag Dump and municipal wastewater effluent monitoring