REPORT

Conceptual Sediment Management Plan for the Kingston Inner Harbour

Transport Canada and Parks Canada Waterlot, Kingston, Ontario

Submitted to:

Public Services and Procurement Canada

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1783886-014-R-Rev1

4 August 2021

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Executive Summary

This conceptual Sediment Management Plan (SMP) for the Kingston Inner Harbour (KIH; the Site) provides an analysis of the scientific issues, estimates of indicative liability costs, alternatives evaluation, and a recommended approach for sediment management within the aquatic portions of the harbour. The conceptual SMP is based on the approach outlined in the report "Recommended Remedial Option for the Kingston Inner Harbour" (Golder 2019) and provides a summary of results from previous investigations, the identified contaminants of concern (COC), affected media, quantity and quality of materials to be treated/managed, an assessment of sediment stability, and the recommended sediment management approach.

Project Context

Kingston Harbour is adjacent to the City of Kingston, at the eastern end of Lake Ontario. The entire Kingston Harbour is approximately 765 hectares (ha) in size and includes an Inner and Outer Harbour. The Kingston Inner Harbour is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Highway 401 to the north and includes a 5 km length of the Great Cataraqui River. The Inner Harbour is further divided into northern and southern sections by the Great Cataraqui Park. The sediment management area within KIH is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Belle Island/Cataraqui Park to the north and includes an approximate 1.7 km length of the Great Cataraqui River. Jurisdiction of most of the southern section of the Inner Harbour (i.e., south of Belle Island and Cataraqui Park) is held by Transport Canada. Parks Canada is the manager of harbour sediments in the portion of the Inner Harbour immediately south of Belle Park Fairways (southwest of Belle Island) and in the portion of the Inner Harbour north of Belle Island. A small percentage of the southern half of KIH is managed by other parties, including the City of Kingston, and the Department of National Defense.

Since 2010, multiple field studies and desktop evaluations have been conducted in KIH to characterize the spatial extent and magnitude of contamination, including assessment of the risks of contaminants to humans and aquatic and semi-aquatic life. Investigations have followed the Canada-Ontario Decision-Making Framework for assessment of Great Lakes Contaminated Sediment, which uses an ecosystem approach to sediment assessment; this framework is intended to standardize the decision-making process while also being flexible enough to account for site-specific considerations. The Federal Contaminated Sites Action Plan (FCSAP) Expert Support departments (Health Canada, Environment and Climate Change Canada, Fisheries and Oceans Canada), which provide advice regarding the technical competency of environmental investigations, have peer reviewed these studies and evaluations at milestone reporting stages.

Project Outcomes

A conceptual remedial options analysis (CROA) was completed in 2017, which integrated multiple scientific and logistical factors that influence the risk management decisions for KIH. Management units were identified to customize candidate management options to specific portions of the water lot and the overall Site-wide intensity of physical intervention was categorized into high, moderate, and low levels. Multiple risk management strategies and technologies were identified, including both conventional intrusive options (e.g., capping, dredging) and lower intrusion options (e.g., thin-layer capping with active layers, monitored natural recovery). Consideration was given to balancing many factors, such as chemical risk reduction, feasibility, cost, habitat modification, the potential presence of cultural/archaeological resources or artifacts, and disruption to existing and future water uses. Water lot boundaries were also used in the division of management units for larger jurisdictional areas; however, for some management units it was necessary to overlap jurisdictional boundaries in cases where similar contaminant profiles, ecological risk profiles, and/or site uses spanned jurisdictional areas. A preferred conceptual design for sediment management with a moderate level of intervention that balanced several competing risk management objectives was recommended.

General agreement on the recommended approach to sediment and risk management has been received from both the contractual authority (Public Services and Procurement Canada) and site custodian agencies (Transport Canada and Parks Canada). The recommended approach, which is the central focus of this report, provides the following:

- Golder's professional judgement regarding the trade-offs among several competing considerations for sediment management.
- Specification of recommended design elements specific to each management unit, used in preliminary costing estimates and for partitioning of environmental liability among multiple water lot jurisdictions.
- Conceptual plans and costing (preliminary Class C estimate; +/- 30%).

Path Forward

Harbour-wide management has been recommended as part of this conceptual SMP, which includes work on lots managed by parties other than Transport Canada and Parks Canada. Agreement from the other parties will be pursued; however, if the other parties are not interested or are unable to join the project, the management strategy may be refined to remove work recommended for their properties. This conceptual sediment management plan addresses those alternative options.

Stakeholder Engagement and Indigenous Consultation will be completed to seek feedback on risk management objectives and design considerations; the latter include level of contaminant mass reduction, protection of habitats, interaction with recreational opportunities, business operations and plans for adjacent lands, shoreline character, and offsets from infrastructure and other valued harbour components. As such, this conceptual SMP may be updated and modified as the project continues to develop.

List of Abbreviations

Abbreviation	Definition
BMP	Best Management Plan
CAD	Canadian dollars
CDF	Confined disposal facility
CEM	Conceptual exposure model
CEPA	Canadian Environmental Protection Act
CNWA	Canadian Navigable Waters Act
COC	Contaminant of concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
COSSARO	Committee on the Status of Species at Risk in Ontario
CRCA	Cataraqui Region Conservation Authority
CROA	Conceptual Remedial Options Analysis
DFO	Fisheries and Oceans Canada
DIA	Detailed Impact Assessment
ECCC	Environment and Climate Change Canada
EMP	Environmental Management Plan
FCSAP	Federal Contaminated Sites Action Plan
GOST	Guidance and Orientation for the Selection of Technologies
HAAD	Harmful alteration, disruption, or destruction
HCCL	HCCL Coastal & River Engineering
IAA	Impact Assessment Act
KIH	Kingston Inner Harbour
LEL	Lowest Effect Level
MBCA	Migratory Bird Convention Act
MDMER	Metal and Diamond Mining Effluent Regulation
MECP	Ontario Ministry of Environment, Conservation, and Parks
MNRF	Ontario Ministry of Natural Resources and Forestry
NTU	Nephelometric Turbidity Unit
OEPA	Ontario Environmental Protection Act
OMOE	Ontario Ministry of Environment (now MECP)
OWRA	Ontario Water Resources Act

Abbreviation	Definition
PAH	Polycyclic aromatic hydrocarbon
PC-N	Parks Canada North management unit
PC-W	Parks Canada West management unit
PCB	Polychlorinated biphenyl
PEL	Probable Effects Level
POD	Point of Discharge
PSPC	Public Services and Procurement Canada
PWGSC	Public Works and Government Services Canada
SAR	Species at Risk
SARA	Species at Risk Act
SARO	Species at Risk in Ontario
SOW	Statement of Work
S/S	Stabilization and Solidification
TBT	Tributyltin
TC-1	Transport Canada management unit #1
TC-2A	Transport Canada management unit #2a
TC-2B	Transport Canada management unit #2b
TC-3A	Transport Canada management unit #3a
TC-3B	Transport Canada management unit #3b
TC-4	Transport Canada management unit #4
TC-5	Transport Canada management unit #5
TC-AB	Transport Canada Anglin Bay management unit
TC-OM	Transport Canada Orchard Marsh management unit
TC-RC	Transport Canada Rowing Club management unit
TCLP	Toxicity Characteristic Leaching Procedure
TEC	Threshold Effects Concentration
UNESCO	United Nations Educational, Scientific, and Cultural Organization
WQG	Water Quality Guideline
ZVI-PRB	Zero Valent Iron Permeable Reactive Barrier

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1.0 INTRODUCTION

This conceptual Sediment Management Plan (SMP) for the Kingston Inner Harbour (KIH; the Site) provides an analysis of the scientific issues, estimates of indicative liability costs, an alternatives evaluation, and a recommended approach for sediment management within the aquatic portions of the harbour. This report was completed by Golder Associates Ltd. (Golder) at the request of request of Public Services and Procurement Canada (PSPC) in response to the statement of work (SOW) received from PSPC on 30 June 2020. The work was completed following acceptance of Golder's proposal dated 17 July 2020, in accordance with the rates, terms, and conditions outlined in the Public Works and Government Services Canada (PWGSC) Task Authorization No. EQ447-180276/009/TOR dated 5 March 2018.

The conceptual SMP is based on the recommended approach outlined in the report "Recommended Remedial Option for the Kingston Inner Harbour" (Golder 2019) and provides a summary of results from previous investigations including identified contaminants of concern (COC), affected media, quantity and quality of materials to be treated/managed, sediment stability, and the recommended sediment management approach. The recommended approach, which is the central focus of this report, provides the following:

- Golder's professional judgement regarding the trade-offs among several competing considerations for sediment management.
- Specification of design elements specific to each management unit, used in preliminary costing estimates and for partitioning of environmental liability among multiple water lot jurisdictions.
- Conceptual plans and costing (preliminary Class C estimate, +/- 30%) (Appendix A and B).

General agreement on the recommended approach to sediment and risk management has been received from both the contractual authority (PSPC) and site custodian agencies (Transport Canada and Parks Canada). Harbour-wide management has been recommended as part of this conceptual SMP, which includes work on lots managed by parties other than Transport Canada and Parks Canada. Agreement from the other parties will be pursued; however, if the other parties are not interested or are unable to join the project, the management strategy may be refined to remove work recommended for their properties. This sediment management plan addresses those alternative options.

Stakeholder Engagement and Indigenous Consultation will be completed to seek feedback on risk management objectives and design considerations; the latter include level of contaminant mass reduction, protection of habitats, interaction with recreational opportunities, business operations and plans for adjacent lands, shoreline character, and offsets from infrastructure and other valued harbour components. As such, the sediment management strategy may be updated and modified as the project continues to develop.

2.0 PROJECT DESCRIPTION

Kingston Harbour is adjacent to the City of Kingston, at the eastern end of Lake Ontario. The entire Kingston Harbour is approximately 765 hectares (ha) in size and includes an Inner and Outer Harbour. The Kingston Inner Harbour (KIH; the Site) is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Highway 401 to the north and includes a 5 km length of the Great Cataraqui River. The Inner Harbour is further divided into northern and southern sections by the Great Cataraqui Park. The sediment management area within KIH is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Belle Island/Cataraqui Park to the north and includes an approximate 1.7 km length of the Great Cataraqui River.

Jurisdiction of most of the southern section of the Inner Harbour (i.e., south of Belle Island and Cataraqui Park) (Figure 1) is held by Transport Canada. Parks Canada is the manager of harbour sediments in the portion of the Inner Harbour immediately south of Belle Park Fairways (southwest of Belle Island) and in the portion of the Inner Harbour north of Belle Island. A small percentage of the southern half of KIH is managed by other parties, including a square water lot managed by the City of Kingston adjacent the former Woolen Mill, a triangular portion of water lot adjacent to the Orchard Street Marsh (jurisdiction for this lot is being determined), small areas of foreshore near the Kingston marina managed by the City of Kingston, and a Military Reserve in the southeastern corner of KIH managed by the Department of National Defense (Figure 1).

Since 2010, multiple field studies and desktop evaluations have been conducted in KIH to characterize the spatial extent and magnitude of contamination, including assessment of the risks of contaminants to humans and aquatic life (Golder 2016). Investigations have followed the Canada-Ontario Decision-Making Framework for assessment of Great Lakes Contaminated Sediment (Chapman 2008), which uses an ecosystem approach to sediment assessment; this framework is intended to standardize the decision-making process while also being flexible enough to account for site-specific considerations. The Federal Contaminated Sites Action Plan (FCSAP) Expert Support departments (Health Canada, Environment and Climate Change Canada, Fisheries and Oceans Canada), which provide advice regarding the technical competency of environmental investigations, have peer reviewed these studies and evaluations at milestone reporting stages.

A conceptual remedial options analysis (CROA) was completed in 2017 (Golder 2017a), which integrated multiple scientific and logistical factors that influence the risk management decisions for KIH. Management units were identified to customize candidate management options to specific portions of the water lot (Figure 2) and the overall Site-wide intensity of physical intervention was categorized into high, moderate, and low levels. Consideration was given to balancing many factors, such as chemical risk reduction, feasibility, cost, habitat modification, the potential presence of cultural/archaeological resources or artifacts, and disruption to existing and future water uses. Water lot boundaries were also used in the division of management units for larger jurisdictional areas; however, for some management units it was necessary to overlap jurisdictional boundaries in cases where similar contaminant profiles, ecological risk profiles, and/or site uses spanned jurisdictional areas. A preferred conceptual design for sediment management with a moderate level of intervention that balanced several competing risk management objectives was recommended.

Multiple risk management strategies and technologies were identified, including both conventional intrusive options (e.g., capping, dredging) and lower intrusion options (e.g., thin-layer capping with active layers, monitored natural recovery). The lower intrusion options were intended to provide a balance between chemical risk reduction (and associated long-term environmental liability) and the short- to medium-term consequences for ecological functions (e.g., sensitive habitats and presence of listed species).

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LEGEND

- FEDERAL WATER LOT BOUNDARY
- KINGSTON MUNICIPAL PARK
- FEDERAL PARK

0 200 400

1:9,000 METERS

REFERENCE(S)
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CLIENT
PWGSC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SPATIAL DOMAIN OF KIH STUDY AREA AND WATER LOT BOUNDARIES

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	SS
PREPARED	JP
REVIEWED	SS
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
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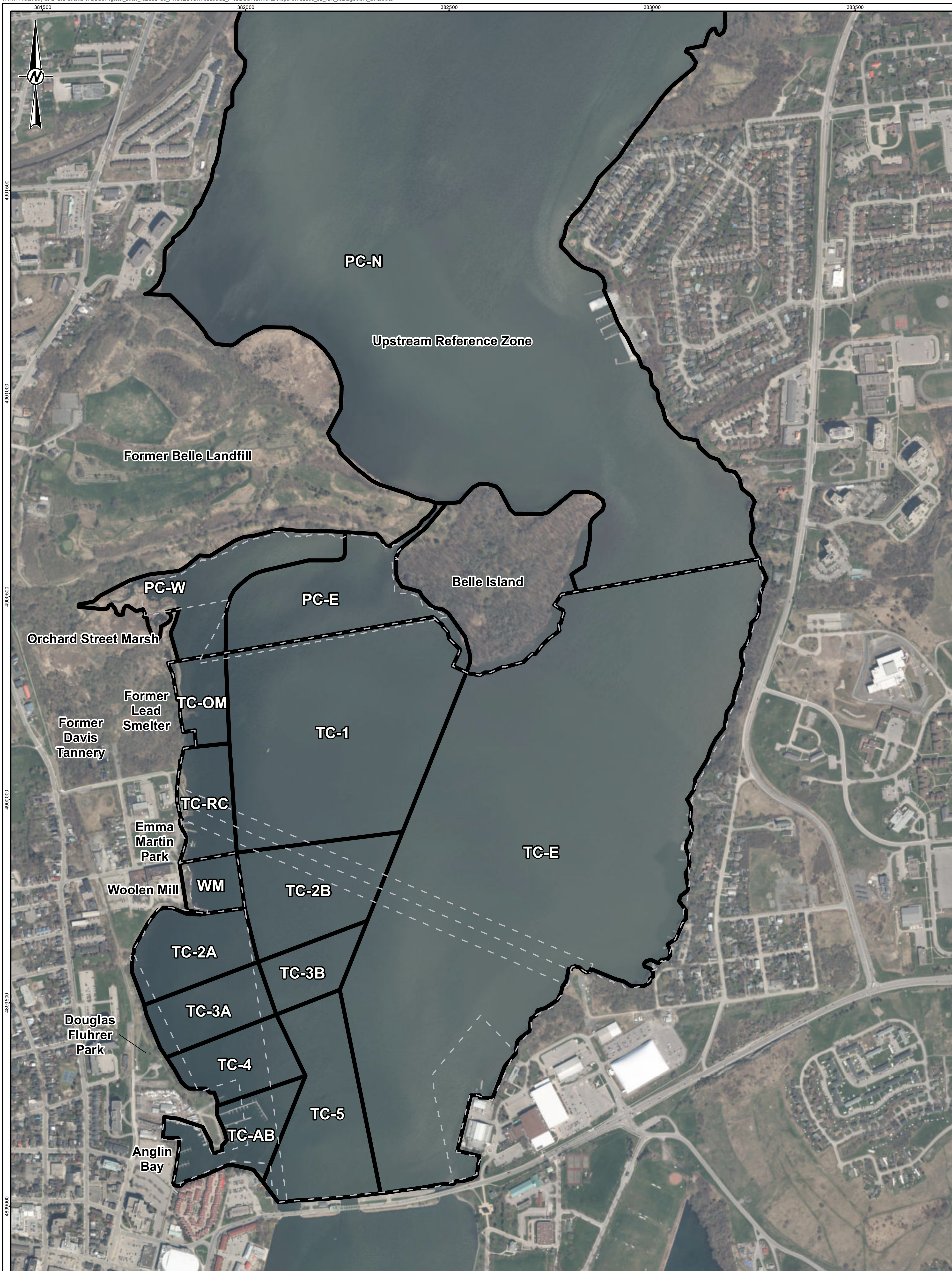

LEGEND

FEDERAL WATER LOT BOUNDARY

MANAGEMENT UNIT

0 200 400

1:9,000 METERS

REFERENCES

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CLIENT
PWGSC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SPATIAL DOMAIN OF KIH STUDY AREA AND MANAGEMENT UNITS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-12-10
DESIGNED	SS
PREPARED	JP
REVIEWED	SS
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
1783886	7000	0	2

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In 2019, Golder prepared a Recommended Remedial Options report (Golder 2019) to document the professional judgement and assumptions used to balance competing considerations for sediment management; the recommended design included specification of some design elements (e.g., shoreline revetment) and provided preliminary costs for sediment management. Conceptual designs and costs developed at this stage have since been refined in preparation of the conceptual SMP and to set the stage for Stakeholder Engagement and Indigenous Consultation and to provide a basis for future design and tender documents.

3.0 REGULATORY CONSIDERATIONS

This section discusses regulatory requirements and guidelines that could influence the development of the SMP for the KIH water lot. Federal and provincial regulations and sediment quality guidelines and criteria are presented herein that may be applicable to the sediment management plan.

The water lot is mainly under federal jurisdiction (i.e., most of the wetted area, with the exception of the portions managed by the City of Kingston and a private party), and therefore provincial or municipal statues would not apply to the submerged sediments in the federally managed water lot. However, the management plan includes some shoreline areas under provincial jurisdiction, where federal, provincial, and municipal statues may apply (see Section 3.2).

3.1 Federal Jurisdiction

3.1.1 Fisheries Act

The purpose of the *Fisheries Act* (Canada 1985) is to maintain healthy, sustainable, and productive Canadian fisheries through the prevention of pollution and the protection of fish and their habitat. All projects undertaking in-water or near-water work must comply with the provisions of the *Fisheries Act*.

All projects where work is being proposed that cannot avoid impacts to fish or fish habitat require a Fisheries and Oceans Canada (DFO) project review (DFO 2019). If it is determined through the DFO review process that the project will result in death of fish or harmful alteration, disruption or destruction (HADD) of fish habitat, an authorization is required under the *Fisheries Act*. This includes projects that have the potential to obstruct fish passage or affect flows.

Proponents of projects requiring a *Fisheries Act* Authorization are required to also submit a Habitat Offsetting Plan, which provides details of how the death of fish and/or HADD of fish habitat will be offset; the plan also outlines associated costs and monitoring commitments. Proponents also have a duty to notify DFO of any unforeseen activities during the project that cause harm to fish or fish habitat, and outline the steps taken to address them.

The main concerns for fisheries resources and fish habitat are: 1) the dispersion of sediments and contaminants during dredging operations; 2) limitation to access to shoreline habitats within the study area during project works; 3) destruction or alteration of habitats that provide resources or refuge for fish species.

3.1.2 Species at Risk Act

At a federal level, species at risk (SAR) designations for species occurring in Canada are initially determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). If approved by the federal Minister of the Environment, species are added to the federal List of Wildlife Species at Risk (Canada 2002). Species that are included on Schedule 1 of the *Species at Risk Act* (SARA) as endangered or threatened are afforded protection of critical habitat on federal lands under the Act. On private or provincially managed lands, only migratory birds and aquatic species listed as endangered, threatened, or extirpated are protected under SARA, and critical habitat protection on non-federal lands is afforded only to aquatic species, unless ordered by the Governor in Council. Several federally listed species are found within the study area (Appendix C, Table C-1), with the SAR turtle species anticipated to be of largest concern to interest groups.

3.1.3 Migratory Birds Convention Act, 1994

The federal *Migratory Birds Convention Act, 1994* (MBCA) protects migratory birds, their eggs and nests. It is unlawful to disturb or destroy the nest of a migratory bird protected under the MBCA, even incidentally. There are no permits available to exempt development activities. Environment and Climate Change Canada (ECCC), the federal government department responsible for enforcing the Act, advises that proponents schedule activities outside of the migratory bird nesting season to avoid incidental take. Sections 5.1(1) and (2) prohibit the deposition of substance that are or can become harmful to migratory birds. Although the MBCA does not directly contain specific provisions for permits or authorizations of the deposition of such substances, mitigation measures are anticipated to protect the shoreline bird habitats and nests during construction.

3.1.4 Canadian Navigable Waters Act

The *Canadian Navigable Waters Act* (CNWA) regulates works that may result in permanent or temporary navigational interference within navigable Canadian waters. Given that the Cataraqui River is listed as a navigable waterway in the Schedule to the Act and the potential for interference with navigation by sediment management activities, an assessment and approval will be required by Transport Canada. Other requirements under the CNWA include submittal of an Application for Approval for review and approval by Transport Canada.

During construction activity, the Contractor will be required to maintain open communication lines with vessels including all construction vessels, commercial vessels, public vessels, and local harbourmaster. No water use restrictions are expected to be required pre- or post-construction.

3.1.5 Impact Assessment Act

On 28 August 2019, the *Impact Assessment Act* (IAA) 2019, the *Canadian Energy Regulator Act*, and the *Navigation Protection Act* came into force. The *Impact Assessment Act* creates the new Impact Assessment Agency of Canada and repeals the *Canadian Environmental Assessment Act* (CEAA) 2012.

The IAA sets out requirements in relation to projects on federal lands or outside Canada (Sections 81 to 91). Before taking action or making a decision that would enable a project to proceed, authorities must determine whether the project is likely to cause significant adverse environmental effects. If the project is likely to cause significant adverse environmental effects, the project is not permitted to proceed unless those effects are determined by the Governor in Council to be justified in the circumstances. The *Designated Classes of Projects Order* sets out classes of the most common, routine, and straightforward projects that cause only insignificant effects or no potential for adverse environmental effects (Section 88). A project would not be exempt under the Ministerial Order if the project:

- may cause a change to a water body
- may cause change to a migratory bird or its nest (*Migratory Bird Convention Act*, 1994)
- may cause change to a wildlife species under Schedule 1 of the *Species at Risk Act*, or its residence or critical habitat
- requires a permit or other authorization under the *Fisheries Act*, the *Canadian Navigable Waters Act*, or the *Canada Wildlife Act* (e.g., Wildlife Area Regulations) or
- involves the removal of or damage to any structure, site or resource that is of historical, archeological, paleontological or architectural significance

Parks Canada's Impact Assessment Directive (IAA 2019) outlines Parks Canada's policy framework to ensure compliance with legal regimes for impact assessment and indicates the circumstances in which impact assessment will be undertaken, the general principles that will be respected, the processes and procedures that must be followed, and the associated responsibilities and accountabilities.

3.1.6 Historic Canals Regulation

According to the Historic Canals Regulations, no person shall dredge, fill or dredge and fill in a historic canal, except in accordance with a permit issued by Parks Canada. A permit will be required for project works as KIH (Cataraqui River) forms a portion of the Rideau Canal National Historic Site of Canada and UNESCO World Heritage Site.

3.1.7 Parks Canada Act

The Parks Canada Act (1998), administered by Environment and Climate Change Canada, was created to ensure that Canada's national parks, historic sites, and regulated heritage areas are protected for present and future generations. Under this act, all work completed in water within historic canals are under authority of Parks Canada Agency.

3.2 Provincial Jurisdiction

Generally, Provincial legislation is not applicable to projects undertaken on federal land or waterlots. However, consideration of and general alignment with provincial requirements should be considered for the duration of the project. Works undertaken on non-federal lands (i.e., private or municipal) would be subject to provincial legislation and may include the following.

3.2.1 Ontario Endangered Species Act, 2007

SAR designations for species in Ontario are initially determined by the Committee on the Status of Species at Risk in Ontario (COSSARO). If approved by the provincial Minister of Natural Resources, species are added to the *Endangered Species Act, 2007* (ESA).

Subsection 9(1) of the ESA prohibits the killing, harming, or harassing of species identified as "endangered"' or "threatened" in the schedules to the Act. Subsection 10(1) (a) of the ESA states that *"No person shall damage or destroy the habitat of a species that is listed on the Species at Risk in Ontario List as an endangered or threatened species"*. As of 30 June 2008, the Species at Risk Ontario (SARO) List is contained in Ontario Regulation (O. Reg.) 230/08.

The ESA also provides general habitat protection to all species listed as threatened or endangered under the Act. Species-specific habitat protection is only afforded to those species for which a habitat regulation has been prepared and passed into law as a regulation of the ESA. The ESA has a permitting process to allow alterations to protected species or their habitats. In addition, the ESA allows for a registration approach for projects meeting specific conditions. Several provincially listed species are found within the study area and mitigation measures applicable for their protection are provided in Appendix C.

These ESA permitting requirements would only strictly apply to the parcels under provincial jurisdiction. However, because management of the shoreline areas is complex, particularly in the southeastern portions of KIH, the habitat protection measures may need to be aligned between the provincial and federal requirements.

3.2.2 Ontario Environmental Protection Act 1990

The Ministry of the Environment, Conservation and Parks (MECP) is responsible for oversight and implementation of Ontario's primary pollution prevention act, the *Ontario Environmental Protection Act* (OEPA). OEPA is aimed at preventing pollution to the natural environment that has potential to cause adverse effects. Remedial orders are applied through the OEPA, whereby any discharge or contaminant that may affect ecological or human health, or cause environmental damage, the owner must repair the damage and prevent reoccurrence. Application of the OEPA and the following *Ontario Water Resources Act* are often applied interchangeably. Again, the provincial requirements under OEPA would need to be aligned with the federal environmental requirements that apply to the majority of KIH.

3.2.3 Ontario Water Resources Act 1990

The *Ontario Water Resources Act* (OWRA) regulates the quality of water (i.e., ground or surface water) and deems water to be impaired for any discharge or material that may cause injury or interfere with any living organisms that are exposed to the water, soils/sediments, and living organisms in contact with the contaminated water. The administration and enforcement of OWRA is under the jurisdiction of the MECP in Ontario.

3.2.4 Ontario Contaminated Sites Regulation (O. Reg. 163) 1990

Regulated by the MECP, the Ontario Contaminated Sites Regulation describes the requirements for assessing the environmental condition of a site, and clean up of brown fields sites under the Environmental Protection Act and associate provisions in the OWRA and others.

3.2.5 Ontario Heritage Act 1990

The Ontario Heritage Act is concerned with heritage conservation within Ontario and serves to give municipalities and the provincial government powers to conserve Ontario's heritage. The Act has provisions for conservation of heritage at the individual property level, as a heritage district or through easements. The Act is administered by the Ministry of Tourism, Culture and Sport (MTCS). It is primarily focused on protecting heritage properties and archaeological sites. A permit issued by MTCS may be required for works within KIH areas under provincial jurisdiction.

3.2.6 Provincial Policy Statement

The Provincial Policy Statement (PPS) was issued under Section 3 of the *Planning Act* (MMAH 2014) and governs development on non-federal lands within the Province that is subject to the policies of the *Planning Act*. The natural heritage policies of the PPS indicate that development and site alteration shall not be permitted in:

- Significant wetlands in Ecoregions 5E, 6E and 7E.
- Significant coastal wetlands.

As portions of the study area are considered provincially significant wetlands, discussions relating to works within those wetlands must occur with the responsible authority. In the case of non-federally managed parcels, the Ontario Ministry of Natural Resources and Forestry (MNRF) should be engaged to discuss intrusions into these wetlands.

3.2.7 City of Kingston

The City of Kingston has prepared an Official Plan (Kingston 2019), which is in accordance with the PPS. As it relates to natural heritage features, the Official Plan identifies Provincially Significant Wetland and Riparian Corridor within the study area associated with the Cataraqui River and the shoreline (Schedule 7-A). The shoreline wetlands are identified as Environmental Protection Area, while the parks and shoreline are identified as Open Space on Schedule 3-A. The forested portion of the study area is identified as Significant Woodlands (Schedule 8-A). Together, these features form part of the City's Natural Heritage System. Development within or adjacent to the Natural Heritage System requires a municipal Environmental Impact Assessment (EIA) be prepared, and that no negative impacts to the system will result from the proposed project.

The City of Kingston Official Plan also includes the "Ribbon of Life" policy that is protective of a 30 m naturalized buffer along waterfronts and includes a 30 m setback for construction activities from the highwater mark. Specific activities that are required to occur within the 30 m buffer would require an exemption permit. The official plan also sets out water quality improvement policies, dock and shoreline stabilization policies, and environmental protection areas (including rivers and riparian corridors).

3.2.8 Cataraqui Region Conservation Authority

The Cataraqui Region Conservation Authority (CRCA) is the governing body which regulates flood potential and natural heritage features in the Cataraqui River watershed. The CRCA maintains wetland mapping in conjunction with the City of Kingston and the Ontario MNRF. The CRCA assigns Natural Heritage and Natural Hazard related boundaries as defined under the PPS. Development within regulated areas is governed by Regulation 148/06 *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* (Ontario Legislative Assembly 2006). Regulation 148/06 was derived under the authority of Ontario Regulation 97/04 (Ontario Legislative Assembly 2004) and is specific to the CRCA.

Under Ontario Regulation 97/04 a regulation may:

a) Restrict and regulate the use of water in or from rivers, streams, inland lakes, ponds, wetlands and natural or artificially constructed depressions in rivers or streams.

b) Prohibit, regulate or require the permission of the authority to straighten, change, divert, or interfere in any way with the existing channel of a river, creek, stream or watercourse, or change or interfere in any way with a wetland.

c) Prohibit, regulate or require the permission of the authority for development if, in the opinion of the authority, the control of flooding, erosion, dynamic beaches, or pollution, or the conservation of land may be affected by the development.

Although development, which would include disturbance associated with the project, is not necessarily restricted within the CRCA regulated area, it designates an area which triggers the need for a permit and, in most cases, an accompanying environmental study. Based on CRCA mapping, a regulatory limit (approximately 15 to 50 m buffer) has been applied around the majority of the harbour area.

3.3 Sediment Quality Guidelines

Because the Site is primarily under federal jurisdiction, the screening of sediment chemistry data emphasized the Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the protection of aquatic life (CCME 2011). These guidelines were supplemented by the Ontario Ministry of the Environment (OMOE, now MECP) Provincial Sediment Quality Guidelines (PSQG) for the protection and management of aquatic sediment (OMOE 2008; Persaud et al. 1993). The PSQGs contain two sets of guidelines reflecting different levels of protection. The lower sediment values (Lowest Effect Level; LEL) represent concentrations that can be tolerated by most sediment-dwelling organisms, whereas the higher guideline values (Severe Effects Level; SEL) represent concentrations likely to affect the health of sediment-dwelling organisms. Similar levels of protection (as expressed in the guideline narratives) are represented by the CCME interim sediment quality guideline (ISQG) and probable effects level (PEL).

Additional sediment quality guidelines from other jurisdictions were used to: (1) provide further context in characterizing chemical hazard for COC that exceeded the applicable CCME and PSQG guidelines; or (2) fill gaps when CCME and PSQG guidelines were lacking. Metals (including arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc), total polycyclic aromatic hydrocarbons (PAHs; including benzo(a)pyrene and phenanthrene), and polychlorinated biphenyls (PCBs), which were identified as COC in surface and subsurface sediments at the Site during the Preliminary Quantitative Risk Assessment (PQRA; Golder 2011), were compared to consensus-based sediment quality guidelines recommended by MacDonald et al. (2000) for freshwater ecosystems. MacDonald et al. (2000) considered a variety of existing sources of co-occurrence-based sediment guidelines in North America, including the PSQG and multiple guidelines from the National Oceanic and Atmospheric Administration (NOAA; Long and MacDonald 1998). MacDonald et al. (2000) established a Threshold Effect Concentration (TEC; below which adverse effects are not expected to occur) and a Probable Effect Concentration (PEC; above which adverse effects are expected to occur more often than not) which were used as a supplemental screen for data from this study. In addition, where applicable, the Effect Range–Median (ER–M; established by Long and MacDonald [1998]) was included.

3.4 Human Health-Based Guidelines

Sediment quality guidelines for the protection of human health are currently not available from federal or provincial jurisdictions. Therefore, the surficial sediment data were compared to CCME Canadian soil quality guidelines for the protection of environmental and human health (CCME 1999, including updates to 2015; CCME 2011). The lower of the soil ingestion or direct contact human health guidelines for residential/parkland land use and fine-grained surface soils was used for screening purposes. For carcinogens, the soil guideline based on a cancer risk of 1 in 100,000 was selected. If a pathway-specific CCME soil guideline was not available, the generic CCME soil guideline was used.

In the absence of a CCME soil guideline, screening values were obtained from the OMOE (2011) Soil Components for Table 3 full depth, non-potable water scenario. The soil contact value for fine to medium textured soil and residential/parkland land use was selected.

3.5 Federal Risk Assessment Frameworks

There are two key federal documents used to assess risks to wildlife (i.e., fish, birds, and mammals), sediment-dwelling animals (i.e., invertebrates), and human receptors from contaminated sites: the Canada-Ontario Framework (EC and OMOE 2008) and the FCSAP Aquatic Sites Guidance (Chapman 2011; FCSAP 2019a). Both the Canada-Ontario Framework and the FCSAP Aquatic Sites Guidance provide a step-by-step process for assessing the risks posed by contaminated sediments to the environment as well as to human receptors. Four key lines of evidence (i.e., sediment chemistry, toxicity to benthic invertebrates, benthic community structure, and the potential for biomagnification) are often identified and assessed to determine sediment management practices best suited to each site.

The Canada-Ontario Framework and the FCSAP Aquatic Sites Guidance are presented in Figure 3, below. An additional complication is that some parts of KIH, specifically those associated with marinas, boat launches, and shipyard areas, qualify as working harbours. Therefore, the Guidance for Assessing and Managing Aquatic Contaminated Sites in Working Harbours (FCSAP 2019b) is applicable to management of KIH; such guidance includes refinements to FCSAP (2019a) in terms of applicable guidelines and use of reference sediment.

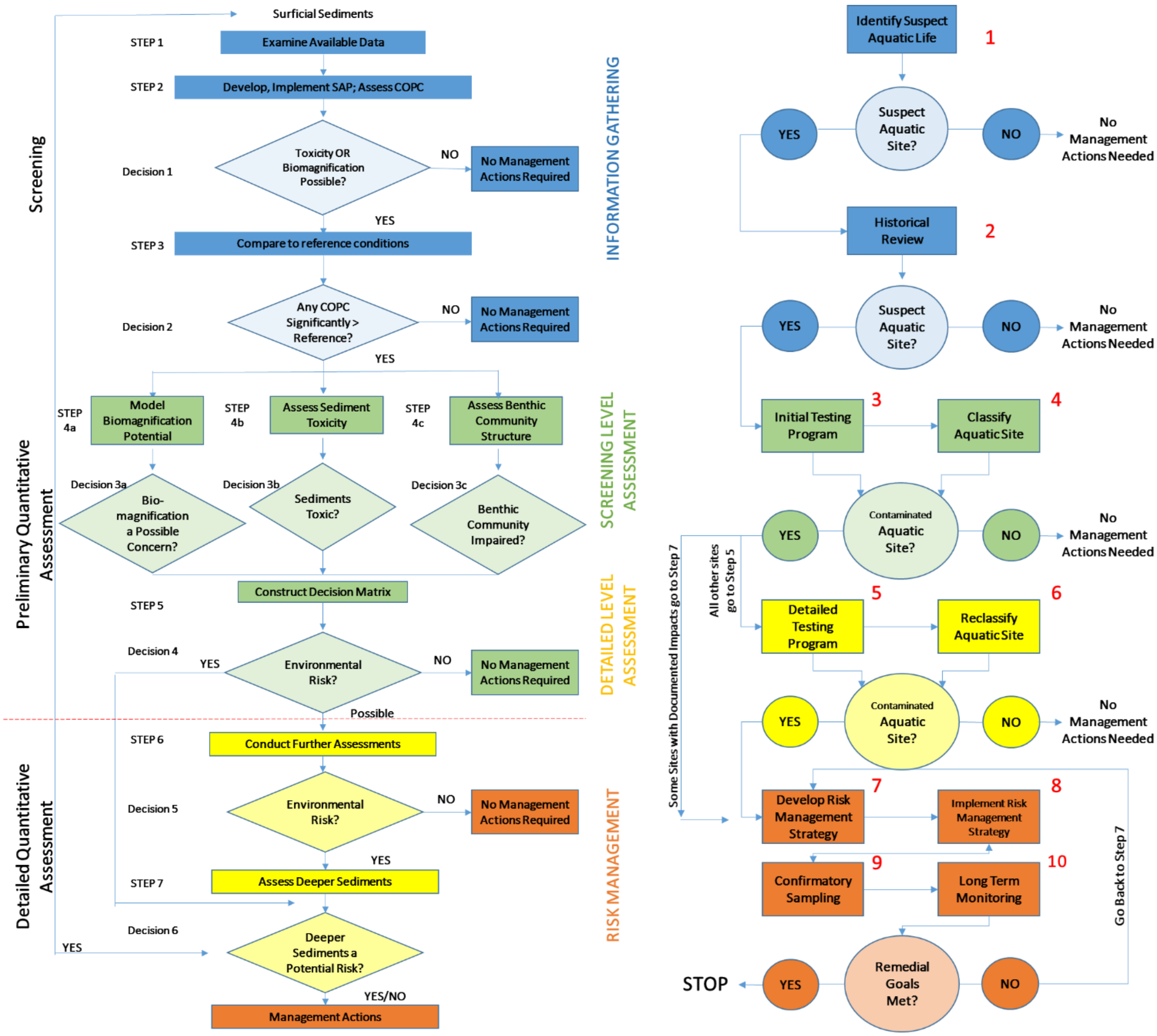

Figure 3: Canada-Ontario Framework (left) and FCSAP Aquatic Sites Guidance (right) Flow Charts

Although the approaches used by the Canada-Ontario Framework and the FCSAP Aquatic Sites Guidance are similar, there are some differences in the procedural details and the use of supporting assessment tools (i.e., FCSAP Aquatic Sites Classification System; CSMWG 2009). Based on discussions with PSPC, the Canada-Ontario Framework was the primary document used to complete the risk assessment and management activities for KIH, including the problem formulation, preliminary risk assessment, detailed risk assessment, and conceptual remedial options analysis.

3.6 Timing Windows

Physical interventions have potential to result in a significant short-term alteration of biological resources; it is important to identify sensitive habitats and ecological functions for which habitat disruption may be discouraged altogether or avoided through the application of timing windows (i.e., restricted activity periods; Table 1). Based on the desktop records review and SAR screening for the KIH water lot conducted for this report (Appendix C, Table C-1), suitable habitat was identified for fourteen SAR species within the study area. These SAR, identified as having moderate or high potential to be present in the study area, include species listed federally (under the SARA) and/or provincially (under the ESA) as endangered, threatened or special concern, and are listed below:

- Turtles—Blanding's turtle (*Emydoidea blandingii*), Northern map turtle (*Graptemys geographica*), Snapping turtle (*Chelydra serpentina*), Eastern musk turtle (*Sternotherus odoratus*), Midland painted turtle (*Chrysemys picta*)
- Snakes—Eastern ribbonsnake (*Thamnophis sauritus sauritus*), Milksnake (*Lampropeltis triangulum*)
- Birds—Bald eagle (*Haliaeetus leucocephalus*), Eastern wood-pewee (*Contopus virens*), Red-headed woodpecker (*Melanerpes erythrocephalus*)
- Bats—Little brown myotis (*Myotis lucifugus*), Tri-colored bat (*Perimyotis subflavus*), Northern myotis (*Myotis septentrionalis*)
- Butterflies—Monarch (*Danaus plexippus*)

These species are not expected to be impacted by the management activities on-site, with the exception of the listed turtles. Restricted activity periods for the sensitive species with moderate potential to occur on the Site and mitigation measures are presented in Table 1. Additional mitigation measures will be established as planning progresses.

No federally listed fish SAR are known to be located within the study area (DFO 2020). Bowfin (2011) indicated potential for some aquatic SAR to occur as transients within the Cataraqui River through migration from Lake Ontario (including the provincially endangered American eel (*Anguilla rostrata*)); however, the habitat requirements for the species were not met within the study area. As such, these species were considered unlikely to use the Site habitats extensively, particularly as more suitable habitats exist both upstream and downstream of the study area. Aquatic SAR were ranked as having low potential to occur within the KIH water lot (Appendix C, Table C-1). A summary of the fish community present in KIH is presented in Appendix C, Table C-2.

In addition to the species identified above, other endangered and threatened species and species of concern listed either provincially or federally have been identified in the vicinity of KIH. These include numerous additional birds (e.g., king rail [endangered], loggerhead shrike [endangered], Henslow’s sparrow [endangered], least bittern [threatened], black tern [special concern], common nighthawk [threatened], chimney swift [threatened], short-eared owl [special concern]). No threatened or endangered mammals other than bats have been identified in the vicinity of the Site. These additional organisms were identified in RMC-ESG (2014) as part of their review of local biological resources, which included input from the MNRF records of natural resources, and documentation from local naturalists. The list of SAR species is currently being re-evaluated and will be updated in the Detailed Impact Assessment for the project.

Table 1: Restricted Activity Periods and Recommended Mitigation Measures for Species at Risk and Fish Communities within the KIH Study Area

Major Taxa	Location of Suitable Habitat in the Study Area	Restricted Activity Period(a)	Recommended Mitigation Measures
Fish Community	Warmwater fish community exists within the water lot. No federally listed fish SAR were found with records in the Study Area. Provincially listed fish SAR may occur as transients within the Cataraqui River through migration from Lake Ontario, although habitat suitability was ranked as low.	15 March – 15 July	Schedule in- and near-water work to take place after 15 July and to be completed prior to 15 March within a given year. Isolate the work area and complete a fish rescue prior to work being undertaken. Conduct turbidity monitoring throughout construction. Apply erosion and sediment control, spill management, and working in-water best management practices.
SAR Turtles—Blanding's turtle, Northern map turtle, Snapping turtle, Eastern musk turtle, Midland painted turtle	These species are known to be present in the Cataraqui River. Map turtles are known to concentrate in the small bay at the north end of Douglas Fluhrer Park where abundant basking structures are present. Snapping turtles are also known to nest on shore at this location. No concentrations of the other turtle species are known within the study area.	Mid-September through March (Over-wintering) Late May through early July (Nesting)	Turtles will typically leave an area where disturbance is occurring. If possible, avoid in-water work during the over-wintering period, when turtles are less mobile. Install exclusion fencing around terrestrial work areas prior to 1 April to stop turtles from nesting, and maintain until end of July. Additional mitigation measures would be required for work outside recommended periods.
SAR Snakes—Eastern ribbonsnake, milksnake	Suitable habitat for Eastern ribbonsnake is present in the study area in areas with dense shoreline vegetation. Suitable habitat for milksnake is present throughout the terrestrial habitats in the study area.	October through March (Hibernating) April through September (Active)	Conduct searches for wildlife prior to any removal of terrestrial vegetation. If soil disturbance is required during the hibernation period, a Wildlife Encounter Protocol should be developed to identify appropriate actions in case hibernating snakes are uncovered.
SAR birds—Bald eagle, Eastern wood-pewee, Red-headed woodpecker	Suitable nesting habitat includes wooded areas. Bald eagle prefers to nest in super-canopy trees, whereas red-headed woodpecker prefers forest edges or scattered trees in parkland. Eastern wood-pewee may nest in a variety of wooded habitats.	1 April – 31 August (Nesting)	Avoid removal of terrestrial vegetation during the nesting period. If removal of terrestrial vegetation is necessary during the nesting period, a qualified biologist must conduct a search for active nests within 24 hours of the proposed clearing activity. If an active nest is located, it must be buffered and the area left uncleared until the nest is no longer active.

Major Taxa	Location of Suitable Habitat in the Study Area	Restricted Activity Period(a)	Recommended Mitigation Measures
SAR bats- Little brown myotis, Tri-colored bat, Northern myotis	Roosting habitat may occur in wooded areas, individual trees, or man-made structures within the study area. No hibernation habitat has been identified in the study area.	Early April through start of September (Roosting)	Only for non-federal lands (not applicable to federal water lots) Avoid clearing trees. If tree clearing is required, each tree must be assessed by a qualified biologist for potential to support bat roosting. If potential roosting habitat is identified, the trees must be assessed through targeted surveys to determine presence/absence of SAR bats. If presence is found, additional mitigations and permitting may be required.
Monarch butterfly	Adults of this species may be found wherever flowering plants are present, and may roost in forested habitats. Eggs and larvae are found on milkweed plants (*Asclepias* spp.) which are most often found in open or semi-open habitats.	May through October (Active) May through September (Eggs / Larvae Development)	Avoid clearing areas containing milkweed plants during May and September, if possible.

(a) Restricted Activity Period: Period of time where work should be avoided to protect sensitive species life history events (i.e., reproductive periods, hatching, over wintering) or sensitive life stages (i.e., larval, egg, juvenile development).

In addition to endangered and threatened species and species of special concern, there may also be species of high cultural value within the study area. For example, eel and sturgeon have been identified in the vicinity of the Site (e.g., near Lasalle Causeway), and these species have importance for First Nations uses. These species will be considered in the Detailed Impact Assessment for the project.

4.0 ENVIRONMENTAL CONSIDERATIONS

4.1 Environmental Management Plan

During intrusive physical work (e.g., dredging, capping, or construction), an Environmental Management Plan (EMP) will be required to provide a framework for the management of potential environmental effects during the project through the implementation of protection measures. The EMP is meant to provide site-specific details on how the mitigation measures identified in the Detailed Impact Assessment, the environmental specifications in the design tender package, and associated permit conditions will be met once a contractor is retained. These specifications cannot yet be developed as they require input from the detailed design stage.

Specifically, the EMP will identify:

- Regulatory requirements, such as those outlined in Section 3.0, that apply during the implementation of the sediment management activities.
- Roles and responsibilities of the project team (e.g., PSPC, environmental and construction monitors, the prime contractors and their subcontractors).
- Best Management Practices (BMPs), and other established protocols that will be implemented during various phases of sediment management.
- Measurable environmental protection requirements, including environmental mitigation measures and monitoring that are to be undertaken during the project.
- Environmental incident reporting protocols in the event an environmental incident occurs during implementation of the project.

The EMP will address how project effects and mitigation measures identified in the Detailed Impact Assessment (as required by the *Impact Assessment Act)*, as well as those identified through subsequent Stakeholder Engagement and Indigenous Consultation, and engineering design, and permit conditions will be met in the implementation of the project. The EMP will allow for a process of continuous improvement through adaptive management if additional effects are identified as intrusive works progress.

In the event of a discrepancy between the EMP and the provisions of any legislation, regulations, or municipal bylaws, the more stringent provisions resulting in the higher protection of the environment, the lower discharge of contaminants, and the higher degree of environmental protection and safety will prevail.

4.2 Water Quality Management

Water quality in and adjacent to KIH may be temporarily impacted by sediment management activities. The primary effects expected from intrusive management efforts (e.g., dredging, dewatering of dredged material, in-water transport of dredged material and debris, placement of substrate in-fill, placement of engineered cap) is the potential increase in total suspended solids and subsequent release of contaminants from re-suspension of contaminated sediments. This risk may be mitigated using environmental controls, such as turbidity curtains and environmental monitoring of sediment and water quality. Mitigation measures for the project will be established as part of the Detailed Impact Assessment and design process.

There are presently no specific regulations pertaining to discharge from dredging projects, nor are there provincial discharge standards applicable to the point of discharge from a dredging project. The specific parameters and points of compliance are generally determined by agreement at the project level through the process of environmental review and consultation with the responsible regulatory agencies such to meet the general provisions of the environmental statutes[1]. Regulatory compliance is typically evaluated at the point at which an operator no longer exercises control over a discharge, often called the “end of pipe”[2]. In a dredging operation, there is no pipe terminus and control ends at the point at which turbidity is no longer managed. Accordingly, the functional equivalent to end of pipe is the edge of the turbidity curtain for the dredging and at the point of discharge (POD)[3] for the dewatering barge and the treatment system, if applicable.

Site-specific benchmarks may be developed for select parameters. The objectives of the development and application of these benchmarks are two-fold:

- Lethal conditions (to fish) do not exist at the POD or the immediately surrounding work zone. This is often operationally defined by Environment and Climate Change Canada as 96 h LC50 ≥100%. The potential for acute lethality may also be evaluated against the proposed benchmarks.
- Chronic sub-lethal conditions (to fish) do not exist outside the work zone, most commonly defined as 100 m away from the point of discharge (also called the assessment point). Ambient water quality guidelines (WQGs; protective against chronic toxicity) or the proposed benchmark divided by 10, depending on how the benchmark is derived, would be used to screen water quality data from the edge of the work zone.

[1] In low-contamination environments, Parks Canada, DFO, and MECP typically apply the CCME guidelines for total particulate matter of 25 mg/L (8 NTU) for short term exposures, and 5 mg/L (2 NTU) for long term exposures. Where contamination is higher, this default requires evaluation for protectiveness of the environment and human health.

[2] This reasonable operational concept is adapted from the *Metal and Diamond Mining Effluent Regulation* (MDMER), a regulation made pursuant to the *Fisheries Act*. Although the dredging project is obviously not a metal mine and the regulations do therefore not apply, the definition of a discharge point contained in the MDMER is a contemporary workable definition for the present purpose and one intended to have conformity with the parent legislation, the *Fisheries Act*.

[3] The MDMER defines a discharge point as being the point at which the operator ceases to have control over the effluent. This definition provides a workable parallel to prevailing environmental statutes and enables an assessment of ecological risks within the context of federal and provincial regulatory requirements. Parks Canada has commonly interpreted the discharge point to equate to within 5 m of a turbidity curtain for environmental dredging applications. The same would be applied for barge water drainage into the dredging area.

5.0 SITE CHARACTERIZATION

5.1 Summary of Site Investigations

Numerous environmental investigations have been undertaken in the KIH water lot over the last decade. RMC-ESG prepared several chapters following the Canada-Ontario Decision-Making Framework, beginning with a synthesis of historical sources, and carrying through various levels of risk assessment toward an options analysis for site management (RMC 2014). Concurrent with their efforts, additional investigations were conducted on behalf of PSPC on both the Transport Canada and Parks Canada properties; these investigations included supplemental sediment quality assessments, data gap assessments, source evaluations, coring studies, and targeted technical research in the field of aquatic health assessment (e.g., toxicity reference value derivation, evaluation of causes of bottom fish deformities).

On behalf of Transport Canada and Parks Canada, the following studies pertaining to the KIH water lot were completed to support the development of the KIH sediment management project. These studies represent a systematic application of Canada-Ontario Decision-Making Framework for Contaminated Sediments across the entire KIH, beginning with site assessment and risk assessment, and progressing through multiple steps of risk management, resulting in findings of relevance to the conceptual SMP:

- Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.
- Golder. 2012. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421- 0039. 31 March 2012.
- Golder. 2016. Kingston Inner Harbour—Risk Assessment Refinement and Synthesis. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1416134-004-R-Rev0. 17 August 2016.
- Golder. 2017a. Kingston Inner Harbour—Conceptual Remedial Options Analysis. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1661792-001-R-Rev1. 17 August 2017.
- Golder. 2017b. Kingston Inner Harbour—Preliminary Sediment Transport Study. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1661792-002-R-Rev0. 16 March 2017.
- Golder. 2019. Recommended Remedial Option for the Kingston Inner Harbour. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1783886-003-R-RevA. 24 January 2019.
- SNC Lavalin. 2019. Inner Harbour Sediment Stability Study – Kingston Inner Harbour Transport Canada and Parks Canada Water Lot Kingston, Ontario. Preliminary Report.

6.0 CONCEPTUAL SITE MODEL

6.1 Upland Sources of Contamination

The shoreline and bed sediments of KIH reflect historical influence of numerous sources of contaminants, most of which have been curtailed through source control measures, as discussed below. The main COC that pose a risk to environmental health include:

- Inorganic metals (particularly chromium, lead, arsenic, copper, and zinc)—These contaminants are associated primarily with historical industrial activities along the western shoreline of KIH, such as the Davis Tannery, Frontenac Lead Smelter, and the Woolen Mill, although other urban sources including storm water discharges have contributed to contamination. Source control actions and targeted sediment removals have occurred along the western shoreline, but legacy contamination remains in the water lot (MacLatchy 2013, pers. comm.). Elevated concentrations of copper relative to other areas of KIH were observed in the northern portion of Anglin Bay. Copper is a common constituent of antifouling paints used on boat hulls. Concentrations observed may be related to current and/or historical ship building and vessel maintenance activities in the area.
- Mercury—This contaminant, which is present in organism tissues mainly in the organic form (methylmercury), is associated with discharges from industries, including historical contamination from the vicinity of the Woolen Mill.
- Nutrients—The entire Lower Cataraqui River, including the Upstream Reference Zone, contains elevated nutrient conditions, and therefore some sediment chemistry parameters (e.g., organic carbon, nitrogen, and phosphorus) are elevated. KIH is a eutrophic environment, and strong gradients in nutrient status do not exist due to high regional background inputs relative to local sources.
- Organotins—The spatial profiling of tributyltin (TBT) in 2010 and 2011 (Golder 2011; 2012) indicated that exceedances of screening criteria for TBT were only observed within portions of Anglin Bay, and not in remaining areas of KIH. This is expected due to the close association of TBT contamination with the historical usage of TBT as an antifoulant. Although TBT is now a restricted substance in antifouling paints, residual contamination of harbours can occur in areas of extensive ship moorage, particularly where scraping or blasting of ship hulls is conducted near open water.
- Polychlorinated biphenyls—Contamination of sediments by PCBs have been documented in the Parks Canada water lot of KIH, associated with leachate from the former Belle Landfill. Golder (2011) provides a review of pathways for this portion of the harbour, focussing on pathways to the Parks Canada zone. Recent sediment quality assessments have documented widespread sediment PCB contamination (Golder 2012, 2014), and the pattern over much of KIH is consistent with landfill leachate as the primary source. Two former demolition/scrap yard properties may have also contributed to the PCBs found in the KIH sediment (MacLatchy 2013, pers. comm.). Historical poor PCB handling practices may have led to the discharge of PCBs through the storm sewer system from the Kingscourt outfall and in the vicinity of Douglas Fluhrer Park.
- Polycyclic aromatic hydrocarbons—Sediment PAH concentrations observed within KIH in the vicinity of Anglin Bay and the Douglas Fluhrer Park area are likely the result of historical contamination from a former rail yard and coal gasification plant (Golder 2013a). Although the overall contribution of PAHs from the rail yard area is unknown, the spatial extent of contamination, PAH composition and type of industrial activity all suggest that rail yard activities played a significant role in contaminating the adjacent water lots of KIH. Within Anglin Bay, migration of PAHs from the large deposits of weathered coal tar historically transported

via storm sewers are expected to be responsible for the PAH concentrations found in nearby sediments. These historical contributions are expected to represent the bulk of the observed PAH contamination, with ongoing sources (i.e., storm water discharges, vessel traffic, hydrocarbon spills) representing only a minor component.

6.2 Pathways

Exposure pathways for human and ecological receptors, which are routes by which receptors may be exposed to COC in environmental media, were assessed for the KIH water lot and documented in the KIH Risk Assessment Refinement and Synthesis Report (Golder 2016). Only those pathways related to use of the water lot were considered. Exposure and contribution from upland, terrestrial areas were not considered because these are not part of the Site. For ecological receptors that may be exposed to both upland and riparian areas (e.g., herbivorous birds and mammals), representative species were assessed under the conservative and simplified assumption that exposures within the federal water lots (alone) reflected their overall exposure profile. A conceptual model illustrating the exposure pathways retained for the risk assessment is presented in Figure 4.

For aquatic receptors, operable exposure pathways include:

- Direct contact with COC in sediment
- Dietary exposure to COC through bioaccumulation in food items

For wildlife receptors, operable exposure pathways include:

- Direct exposure to COC in sediment via incidental ingestion of sediment through foraging
- Direct exposure to COC in surface water via drinking water
- Dietary exposure to COC through bioaccumulation in food items

For human health, operable exposure pathways retained for the recreational wader/swimmer/fisher receptors include:

- Incidental ingestion of COC in suspended sediment while wading
- Dermal contact with COC in bedded sediment and surface water while wading
- Incidental ingestion of COC in surface water and associated suspended sediment while swimming/fishing
- Dermal contact with COC in surface water while swimming/fishing
- Ingestion of bioaccumulative COC in recreationally caught and consumed fish (i.e., bottom and sportfish).

Ingestion of suspended sediment while swimming typically contributes a minor fraction the overall exposure dose, particularly when incidental ingestion of sediment via hand to mouth contact is also considered. Exposure to COCs dissolved in surface water is also a relatively minor pathway relative to tissue and sediment-associated sources.

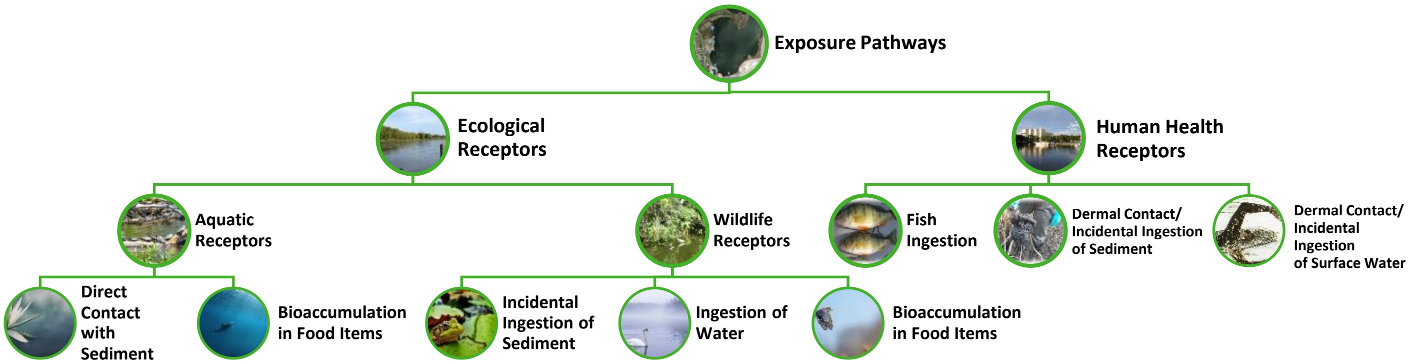

Figure 4: Exposure Pathways Retained for the KIH Project Risk Assessment

Although there is a fish consumption advisory in place for Cataraqui River (Belle Island Area) for Black Crappie (*Pomoxis nigromaculatus*), Brown Bullhead (*Ameiurus nebulosus*), Bluegill (*Lepomis macrochirus*), Common Carp (*Cyprinus carpio*), Largemouth Bass (*Micropterus salmoides*), Northern Pike (*Esox lucius*), Pumpkinseed (*Lepomis gibbosus*), Walleye (*Sander vitreus*), White Sucker (*Catostomus commersonii*) and Yellow Perch (*Perca flavescens*) (MECP 2019), recreational fishing in KIH remains common practice. Therefore, fish ingestion was included as an operable exposure pathway in the HHRA.

Dermal contact with sediment while swimming and fishing was considered an inoperable exposure pathway. Dermal contact with suspended sediment in the water is considered negligible for recreational fishers and swimmers as it would not adhere to the skin for a prolonged period. Dermal contact with sediment while swimming is expected to be much lower than during wading. Similarly, dermal contact with sediment while fishing was considered negligible compared to dermal contact while wading, primarily due to low degree of skin contact with contaminated media.

Although the contamination at the Site is mainly associated with sediments and does not readily penetrate skin, people may contact surface water during wading or swimming activity. Therefore, dermal contact with surface water was included in the assessment of wading and ingestion of and dermal contact with surface water was included in the assessment of swimming. Inhalation of outdoor air was not considered an operable pathway as sediments are submerged underwater, and partitioning of COC from sediment to air is limited.

6.3 Human and Ecological Risk

Results of the aquatic, wildlife, and human health risk assessments under the KIH Risk Assessment Refinement and Synthesis Report (Golder 2016) are presented in Figure 5. Because the receptors have different uncertainties and varying receptor-specific factors for consideration by different stakeholders and Indigenous communities, a synthesis of the results across all receptors (invertebrates, fish, birds, mammals, human health) was not attempted.

The results indicate several key findings of relevance to site management (n.b., receptors were only assessed in those management units where they are likely to be present based on presence of suitable habitat):

- Significant ecological risks, ranging from low to moderate in magnitude, were identified in the Parks Canada water lot, particularly in the areas adjacent to Orchard Street Marsh and the unnamed creek that enters KIH. Although few indications of harm were documented for the benthic community, moderate risks to bottom fish (elevated risk of deformities primarily from PCB contamination), birds (elevated risks to omnivorous birds such as mallards and marsh wrens due to chromium contamination), and mammals (PCB risk to resident mink) were all identified for the areas close to the shoreline (i.e., management units PC-W and TC-OM).
- Significant ecological risks, ranging from low to high in magnitude, were also identified for the southeastern portion of KIH including Anglin Bay and vicinity. However, the risk pathways were different for this area, with high risks for the benthic community and moderate risks for bottom fish identified from exposure to PAHs.
- Some areas in KIH were identified to have low overall risks relative to adjacent management units (e.g., TC-1, which covers a large area of the Transport Canada water lot, but yields negligible to low risk outcomes for all receptors). This helps to prioritize management on areas with multiple elevated risk levels. Achievement of negligible risks for all receptors, COC, and management units was found to be impractical due to the high volume of sediments with low risk.
- Multiple drivers for elevated risks were identified, with PAHs, PCBs, and chromium driving the highest ecological risks, and PAHs, PCBs, and mercury driving the human health risks. The contaminant distributions for these COC are often coincident (e.g., PC-W contains among the highest concentrations of these substances). However, in some portions of KIH, the concentration distributions do not align; for example, PAH and PCB concentration distributions in the central portion of the harbour are different.
- Human health risks above acceptable levels were identified for multiple constituents, yielding moderate risk for the sediment exposure pathway (i.e., dermal contact from scenarios entailing recreation within the nearshore sediments) and low risk for the fish consumption pathway. The constituents driving these risks are primarily carcinogenic PAHs for the sediment exposure pathway, but mercury and PCBs drive risks for the fish consumption pathway. These constituents have different concentration distribution patterns across KIH.
- Although risks to herptiles could not be quantified or categorized with the same level of confidence as other receptors, the areas with suitable habitat for these organisms (i.e., management units PC-E, PC-W, and TC-OM) already have significant ecological risks (i.e., moderate risks) identified for other organisms. As such, risk management or sediment management to address other risk pathways will contribute to the management of herptile populations. An added consideration is that physical intervention in the wetland areas of KIH, while of benefit for reducing risks for some pathways, will have potentially significant consequence for the habitat of amphibians and reptiles.

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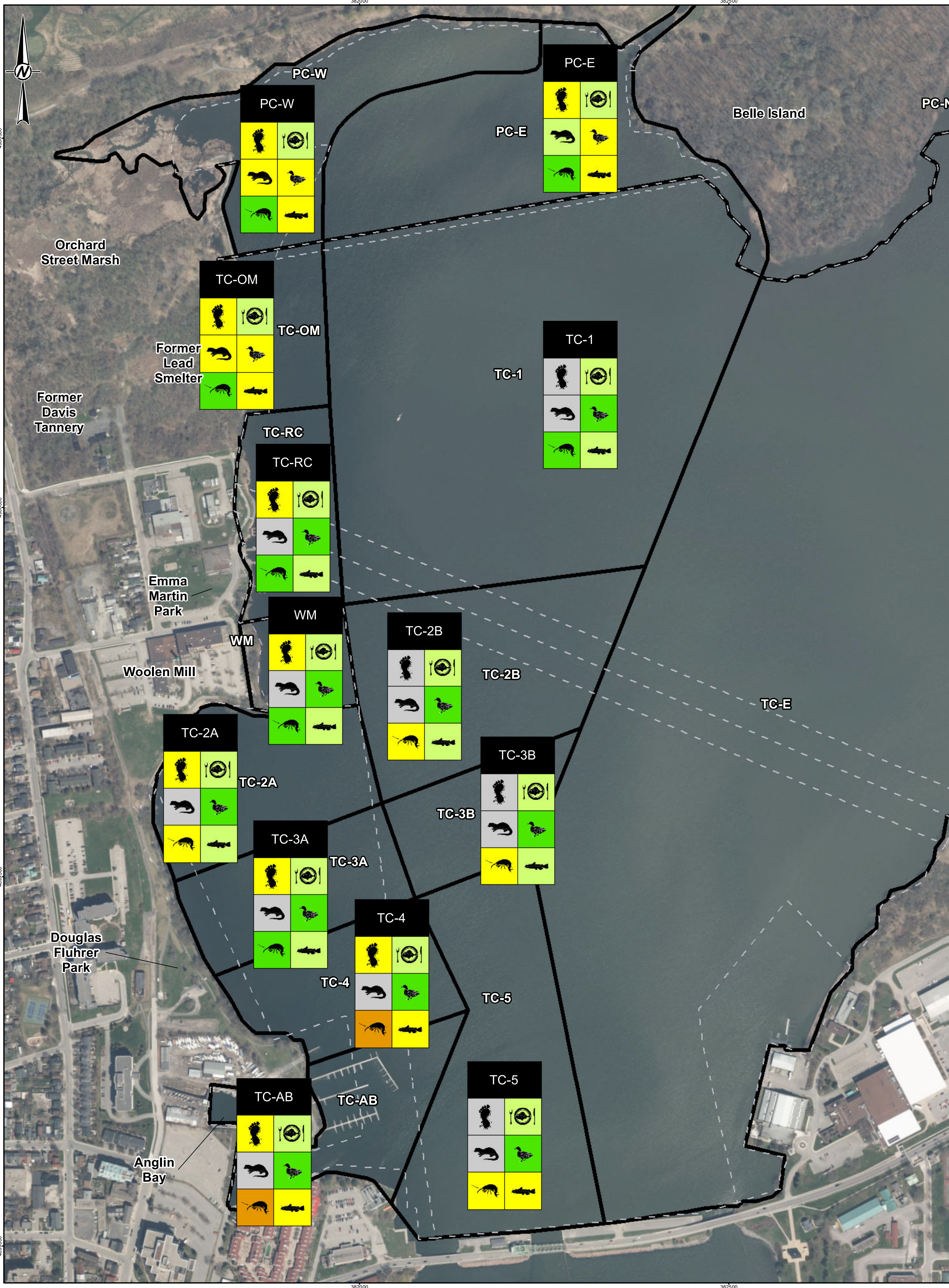

LEGEND

FEDERAL WATER LOT BOUNDARY

MANAGEMENT UNIT

RISK

NOT APPLICABLE

NEGLIGIBLE RISK

LOW RISK

MODERATE RISK

HIGH RISK

Legend

HUMANS (SEDIMENT CONTACT) | HUMANS (FISH INGESTION)

AQUATIC MAMMALS | INSECTIVOROUS BIRDS

BENTHIC INVERTEBRATES | BOTTOM FISH

0 100 200

1:5,000 METERS

NOTE(S)

1. SAMPLES COLLECTED PRIOR TO THE 2005 REMEDIAL DREDGING NEAR THE KINGSTON ROWING CLUB ARE NOT INCLUDED.
2. NA – MANAGEMENT UNIT NOT ASSESSED FOR ENDPOINT.
3. EFFECTS TO BENTHIC COMMUNITIES – NEGLIGIBLE RISK, MODERATE RISK, HIGH RISK.

REFERENCE(S)

1. IMAGERY COPYRIGHT © 20180508 ESRI AND ITS LICENSORS. SOURCE: CITY OF KINGSTON. USED UNDER LICENSE, ALL RIGHTS RESERVED.
2. INSET BASE OBTAINED FROM ESRI CANADA.
2. PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PWGSC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SUMMARY OF RISKS TO HUMAN HEALTH, AND AQUATIC AND WILDLIFE RECEPTORS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-12-10
DESIGNED	SS
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APPROVED	GL

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6.4 Sediment Transport Process

In 2017, a sediment transport study was undertaken by Golder (2017b) that examined hydrology, bathymetry/topography, geology, wind and wave action, vessel-related sediment disturbance, presence of aquatic vegetation, and potential for bioturbation. These processes were examined in relation to the distribution of contaminants within the sediments to conceptually model the physical processes governing transport and fate. It was determined that a complex sediment transport regime exists within the KIH water lot. Distributions of contaminated sediments within the harbour were influenced by a clockwise gyre in the north and east portion of the KIH water lot. The trajectory of the suspended sediments carried by the Cataraqui River is influenced by the La Salle Causeway, with some discharges to Lake Ontario and the remaining sediment redirected toward Anglin Bay (Golder 2017b). This model is supported by the presence of high concentrations of contaminants from historical sources at or near the surface of sediments. The study concluded that the La Salle Causeway is acting as a partial sediment trap during transport, and the dominant source of sediments to KIH is a combination of fine-grained sediments delivered via Cataraqui River flows and resuspension of localized bed sediments through wave/wind, current, and contributions from local stormwater flows (Golder 2017b).

SNC Lavalin (2020) completed a sediment stability study in 2019 within KIH to gain a better understanding of the hydraulic circulation dynamics in KIH and sediment dynamics in the areas of concern. Water velocities within the KIH basin were assessed as low, with no strong circulation pattern. Suspended sediment loads and turbidity were also assessed as low in magnitude, and peak turbidity was observed during wind-induced wave action originating from southeasterly winds. Water levels within the KIH basin were shown to align with fluctuations in water levels within Lake Ontario (SNC 2020).

As observed in previous studies, very low sedimentation rates were confirmed, with the northern portion of the water lot (PC-W and TC-1) having slightly higher rates (SNC 2020). Erodibility experiments showed low near bottom water velocities, reaching critical water velocity for resuspension under easterly or southeasterly wind conditions. The hydraulic influence on water velocities and subsequent sediment resuspension from the Cataraqui River is very limited. Overall, KIH was classified as a quiescent environment which promotes sediment settling with the presence of aquatic plants that have a stabilizing effect on the fine organic sediments. Risk associated with large sediment resuspension events were determined to be unlikely due to the low mean water velocities and extensive macrophyte bed coverage.

6.5 Potential Sources of Recontamination

Most contaminants in the water lot are from historical contamination, both within the water lot and in adjacent upland and/or riparian areas. Managed sediments have potential to be contaminated through primary sources (i.e., storm water drainage) or secondary sources (i.e., resuspension and migration of contaminated sediments from adjacent areas). Implications to the sediment management project were identified for the following sources of recontamination:

- Sediment resuspension due to wind and wave action—as concluded in Golder 2017b and SNC 2020, strong winds can generate localized currents that cause lateral sediment transport within the water lot, with the dominant currents produced from the south and southwest. However, large sediment resuspension events are unlikely due to the low mean water velocities and extensive macrophyte bed coverage that has the potential to lower water velocities and hold sediment in place.

- Propeller Action—propeller scour from vessel movements within the water lot may resuspend and transport materials within the harbour, although most vessel traffic is limited to the vicinity of La Salle Causeway and Anglin Bay. In those areas, sediments are primarily silts and the water depth is shallow (i.e., <1.5 m). Vessel speeds and wakes are restricted for the remainder of the water lot; sediment resuspension from propeller action and vessel traffic is not expected to contribute to resuspension in areas outside of the navigation routes (Golder 2017b).
- Bioturbation—surface sediments with the harbour are susceptible to re-suspension through bioturbation to a maximum depth of 0.15 m. The potential for sediment re-suspension by bioturbation would occur predominantly in the summer and early fall (Golder 2017b).

7.0 SEDIMENT MANAGEMENT UNITS

KIH is a large and complex area of sediment contamination, with different contamination profiles found in different portions of the harbour, and a variety of riparian and habitat conditions. Management units for KIH were originally developed to identify data gaps in sediment chemistry, toxicity, and benthic invertebrate community structure prior to the implementation of the PQRA field program conducted by Golder (2011). Although those management units were appropriate for their intended purpose, it was necessary to revise and update these management units for the risk refinement and sediment management planning. These management units, as depicted in Figure 2, reflect several considerations for management:

- Knowledge of sediment quality in KIH, particularly for the southern half of the study area, including local investigations by both Parks Canada and Transport Canada between 2014 and 2016 to refine the sediment chemistry profile, including coring in the vicinity of Anglin Bay.
- Aggregation of areas with similar contaminant profiles and/or effects (e.g., toxicity results or benthic community patterns).
- Specification of nearshore areas with increased potential for wading or other human recreational use, and for which habitat considerations (e.g., riparian zone management) play a significant role in sediment management options evaluation.
- Aggregation of areas with similar ecological and riparian features, to provide a linkage to wildlife exposures and to highlight areas with ecological sensitivity.
- Identification of zones with a spatial scale that is relevant to home ranges of wildlife that have high site fidelity, and spatial scale appropriate for preliminary sediment management options evaluation.

Expert Support comments on draft risk assessment deliverables emphasized the need to consider risk outcomes that are clearly linked to subunits of KIH, particularly for wildlife (mammals/birds) and fish. Mobile receptors that cross management unit boundaries require a refined assessment of the home ranges and habitat preferences of these organisms. The risk refinement deliverable explicitly addressed the spatial scale of exposures; the home ranges of each receptor type (including human uses) were linked to these management units.

Where possible, water lot boundaries were also used in the division of management units to reflect different jurisdictions (e.g., Transport Canada versus Parks Canada; federal management versus City of Kingston). This provided logical divisions between larger jurisdictional areas, such as the Parks Canada and Transport Canada-managed portions of KIH and the City of Kingston-managed area adjacent to the Woolen Mill. However, for some management units it was necessary to overlap jurisdictional boundaries because of the considerations provided above. For example, for shoreline management units in the southern portion of KIH where the City of Kingston jurisdiction is small relative to the portion managed by Transport Canada, contaminant profiles, ecological/riparian features, and human recreational use span jurisdictional boundaries. As such, some of these management units include waterlots managed by both the City of Kingston and Transport Canada. Sediment management in these areas would therefore likely require participation from both parties.

8.0 POTENTIAL SEDIMENT MANAGEMENT TECHNOLOGIES

In 2018, Golder conducted a review of candidate sediment management technologies applicable to sediment contamination that would meet the sediment management objectives (Section 9.0) for the Site and address Site constraints. Initial assessments included identification of available technologies, and the potential applicability of these technologies to the Site, using the federal Guidance and Orientation for the Selection of Technologies (GOST) tool. The GOST analysis provided preliminary indications of applicable sediment management technologies, assuming conditions of no time constraints, preference for in situ treatment, and no preference between control or reduction treatment.

Due to the broad extent of low-level contamination at the Site and physical and practical constraints, the intrusive management options considered for the Site will be used in conjunction with passive options including risk management in place. The management options therefore addressed the water lot areas with the highest priorities for active intervention based on risk to aquatic, wildlife, or human health risks, rather than meeting conservative numerical standards across the Site.

8.1 Conventional Approaches

Conventional strategies and technologies considered as candidates to meet the sediment management objectives included:

- **Dredging**—Removes contaminated sediment to reduce risks to human health and the environment. Removal is particularly effective for source control (mass removal of hot spots) but potentially less effective for overall risk reduction because of resuspension and residual contamination (ITRC 2014). This strategy is favourable for portions of KIH due to the low gradient shoreline in most areas (with the exception of areas with supporting sheet pile or rip-rap retaining walls), relatively uniform grain size, and absence of obstacles such as permanent piers; however, in some areas, dredging may undermine the geotechnical stability of retaining walls.
- **Capping**—This strategy is useful for stabilizing sediment to prevent resuspension, diluting exposures, and isolating contaminated sediments from receptors. The thickness and composition of the cap can vary depending on the contaminants ability to migrate through sediment due to the upwelling of groundwater, the stability of the underlying sediment to support the cap and prevent consolidation, and the depth of which sediment is mixed either naturally (i.e., through wave action or by benthic invertebrates [bioturbation]) or through physical disturbances (i.e., boat wakes or propeller wash) (Palermo 1998; ITRC 2014). For shallow areas in KIH, capping alone is not a feasible option, particularly given the shallow water depths across most of the western KIH.
- **Dredging and Capping**—A combination of the above two strategies is a potential management strategy for areas where dredging or capping alone is not possible. Capping becomes a feasible option when used in combination with selective dredging, particularly for areas for which contamination at depth is a concern.
- **Monitored Natural Recovery**—Natural recovery is a sediment management strategy that relies on natural processes to contain, remove, or reduce the bioavailability of contaminants and protects the environment and receptors from unacceptable exposures (NRC 1997). This management approach depends on natural processes to decrease chemical contaminants in sediment to acceptable levels within a reasonable time frame and can only be possible once source control of the contaminant has been achieved (ESTCP 2009).

This process may be enhanced through the addition of a thin cap or carbon amendment (ITRC 2014). Given the persistence of metals, PAHs, and PCBs in KIH, monitored natural recovery is not a viable option for all areas of KIH. However, some areas for which risks to human or ecological health are low, and for which gradual burial of contaminated sediments is ongoing, monitored natural recovery may be appropriate.

- **Institutional/Engineering Controls**—Risks to human health may be mitigated through institutional controls (i.e., limiting fish consumption through fishing advisories) or through engineering controls (i.e., fencing or boardwalks that reduce the potential for sediment exposure). Although these controls may mitigate against the contaminants ability to affect people, they do not reduce the concentrations of contaminants, do not reduce ecological risks, and are more appropriately used in addition to one of the above mitigation measures, or in areas where mitigation is not possible or recommended. Such controls become more important for areas that are not recommended for physical management due to aversion to habitat alteration. With engineering controls, it is possible to implement shoreline designs (such as shoreline revetments) that either encourage or discourage specific human uses such as wading or swimming, thus influencing the degree of exposure.
- **No Action**—For areas where contaminant concentrations are low and with negligible risks to human health or the environment, no intrusive actions are required.

8.2 Lower Intrusion Techniques

Higher costs (financial and short-term environmental) are often associated with the isolation or removal of contaminated sediment, as well as uncertainty regarding the implementation success (e.g., imperfect delineation, dredge residuals). Recent advances in design and implementation are available for less intrusive methods for sediment management. With advantages in terms of habitat conservation, economic costs, carbon balance, and environmental management of dredge spoils and residuals, these techniques achieve a lower degree of contaminant removal or sequestration relative to conventional dredging and capping options. These methods were considered in conjunction with conventional dredging and capping options to provide a customized design suited to the features of each management unit.

These innovative sediment management techniques are summarized into the following general categories:

- Thin-layer capping
- Sediment amendments
- Managed wetlands
- Passive uptake devices

Further detail on the implementation of lower intrusion techniques in the recommended sediment management option is provided in Section 13.1.

9.0 SEDIMENT MANAGEMENT OBJECTIVES

The sediment management objectives were developed based on our understanding of the project goals of the site custodians and PSPC, and the FCSAP decision-making process for Risk Management.[4] The primary sediment management objective is to balance passive and intrusive management techniques to be protective of human health and the environment by:

- Removal or reduction of contamination
- Preservation of sensitive habitats, particularly where contamination risks are marginal
- Modifying or limiting site use by receptors
- Interception or removal of the exposure pathways

The interactions among these four factors are impacted by the effectiveness and implications of methods for adjacent management units. Multiple constraints (ecological, economic, socio-political, logistical) exist for each of the methods; these influence the ease of application and preference for each method. Differences in existing land use, development plans, riparian habitat conditions, infrastructure, and other Indigenous and stakeholder preferences must be taken into consideration along with contaminant risk reduction.

9.1 Level of Intervention Categories

The sediment management objectives were evaluated broadly (i.e., site wide, at a conceptual level) to categorize the management units based on the level of intervention required. The categories ranged from high intervention (e.g., dredging of contaminated sediments, shoreline revetments, physical barriers), where substantial intrusive management is required, to low intervention (e.g., management in place, small and focussed sediment removals, preservation of riparian corridors), where judicious intervention is preferred (Table 2).

[4] http://www.federalcontaminatedsites.gc.ca/default.asp?lang=En&n=B4AC7C22-1&offset=3&toc=show#X-2012091011445732

Table 2: Summary of Sediment Management Intervention Categories

Intervention Level	Approach	Additional Considerations
High Intervention	▪ Sediment management options emphasize contaminant-based risk pathways ▪ Focused on the removal of constituents contributing to moderate and high risks ▪ Approaches assume that the benefits of contaminant removal or isolation (i.e., chemical risk reduction) offset the disruption to existing natural resources and infrastructure	Emphasis on long term reduction of liability associated with contamination.
Moderate Intervention	▪ Sediment management options seek to find an intermediate approach that will minimize disruption to significant "social and ecological areas" [5] ▪ Addresses the most heavily contaminated areas to reduce human and ecological risks associated with contaminant exposure ▪ Additional consideration given to the impacts of the restoration activities of the adjacent land use and ecological features	Further consideration is given to the weight of the impacts associated with the sediment management options (i.e., increased potential for environmental harm) versus risk of not implementing the sediment management options (i.e., leave contaminants in place).[a, b]
Low Intervention	▪ Adopts a cautious approach to physical intervention, adopting intrusive measures only where the chemical risk reduction is great, and with high weighting assigned to social, economic, and environmental attributes ▪ Solutions often emphasize either risk management (i.e., monitored natural recovery or institutional controls) or localized (targeted) removals of sediments focussing on areas of greatest concern	Greater emphasis is placed on short-term conditions, seeking not to disturb conditions that would require an extended recovery period to reach a desirable state.
No Intervention	▪ Reliance on maintenance of existing habitat features without disruption. This approach is required where critical habitat requirements negate the feasibility of removing contaminant mass, or where the net benefits of contaminant removals or containment are outweighed by environmental costs.	Areas of "no action" have been identified at a broad scale (e.g., Western KIH management units) based on negligible priority designations (Section 9.2) but localized areas within the remaining units may be assigned a "no action" designation at detailed design stage following input from ongoing detailed impact assessment.

(a) USEPA 1998

(b) Chapman 2008

[5] Social and ecological areas include: areas of ecologically significant habitat to be designated for protection; areas with geotechnical issues (sheet pile walls, etc.); high uses areas; and, areas with potential for future shoreline redevelopment (brownfields, etc.).

9.2 Priority Rankings for Risk Management

Determination of overall priority for risk management of a management unit relied on various considerations, as summarized below:

- Degree of overlap of risk determinations for separate pathways, particularly for those indicative of moderate to high risk based on the findings presented in the 2016 KIH Risk Refinement and Synthesis
- Degree of overlap of multiple stressors, both within and among exposure pathways
- Non-quantifiable risk pathways
- Cost-efficiency and mass removal
- Level of uncertainty
- Professional judgement

Assignment of an overall priority ranking for risk management in each of the management units was completed, with rationale for rankings provided in Table 3. Table 3 includes the individual risk characterization outcomes for each receptor and management unit, the specific contaminants yielding non-negligible risks for each management unit, and other substances documented to be elevated in the management unit. The determination of the degree of importance for risk management is summarized in the "Overall Priority for Risk Management" (purple shaded cells) column.

- **Negligible**—These areas have conclusively been demonstrated, following the Canada-Ontario Decision-Making Framework, to be acceptable without need for physical management or requirement for additional studies or monitoring.
- **Low**—These areas have some indications of risk, but not to a degree warranting physical management. Such areas are strong candidates for monitored natural recovery, or at most, spot management.
- **Moderate**—These areas have multiple indications of risk, including at least one receptor group at "moderate" magnitude or greater. However, risk estimates have higher uncertainty, lower magnitude of contamination, and/or reduced evidence of harm relative to "High" category. Some could be partitioned into smaller parcels.
- **High**—These areas have multiple indications of risk, including at least one receptor group at "moderate" magnitude or greater. In addition, these areas have greater average exposure conditions and are adjacent to source areas of contamination, yielding higher benefit:cost ratio relative to "Moderate" category.
- **Very High**—These areas multiple indications of risks to at least "moderate" magnitude or greater. Such areas contain the highest concentrations of COC (often co-located). Should be a focus for physical management.

Management units identified as negligible were not carried forward in the evaluation of conceptual sediment management options (Section 10).

Table 3: Integrated Results of the Aquatic, Wildlife and Human Health Risk Assessments and Site Constraints for Risk Management

<table>
<tr><th rowspan="2">Unit</th><th colspan="4">Ecological Receptors</th><th colspan="2">Human Health</th><th>Overall Priority for Risk Management</th><th>Contaminant(s) Driving Significant Ecological Risk Designations</th><th>Other COC Elevated in Management Unit</th><th colspan="4">Site Constraints Overview</th></tr>
<tr><th>Effects to Benthic Community</th><th>Effects to Fish Health</th><th>Effects to Birds</th><th>Effects to Mammals</th><th>Risks from Sediment Exposure</th><th>Risks from Fish Ingestion*</th><th></th><th></th><th></th><th colspan="2">Ecological Sensitivity Rating</th><th>Structural/Shoreline Uses / Water Lot Uses</th><th>Additional Considerations</th></tr>
<tr><td>PC-N</td><td>Negligible Risk</td><td>Negligible Risk</td><td>Negligible Risk</td><td>Negligible Risk</td><td>NA</td><td rowspan="7">Low Risk</td><td>Negligible</td><td>None</td><td>—</td><td>N/A</td><td>Varied—this is the upstream reference area north of Belle Island</td><td>Varied—ecologically sensitive area on north side of Belle Park; mostly residential on east and west banks of Cataraqui River</td><td>There are a few localized areas (individual stations) that exhibit elevated chemistry, but these are either anomalies or insufficient to influence KIH management.</td></tr>
<tr><td>TC-E</td><td>Negligible Risk</td><td>Negligible Risk</td><td>Negligible Risk</td><td>Negligible Risk</td><td>NA</td><td>Negligible</td><td>None</td><td>—</td><td>N/A</td><td>Varied—this is the eastern half of KIH, where risks are negligible to low</td><td>Varied—riparian corridor along most of eastern shoreline.</td><td>Weight of evidence is that the entire eastern half of Lower KIH can be excluded from physical intervention.</td></tr>
<tr><td>PC-E</td><td>Negligible Risk</td><td rowspan="3">Moderate Risk</td><td>Moderate Risk</td><td>Low Risk</td><td rowspan="3">Moderate Risk</td><td>Moderate</td><td>PAHs, PCBs, chromium (birds)</td><td>antimony</td><td>High</td><td>Shallow water, macrophyte beds.</td><td>Water lot includes portion of "Ecological Protection Area" adjacent to Belle Island.</td><td>First Nations conservation/management agreement for Belle Island.</td></tr>
<tr><td>PC-W</td><td>Negligible Risk</td><td>Moderate Risk</td><td>Moderate Risk</td><td>Very High</td><td>PAHs, PCBs, chromium (birds)</td><td>antimony, lead, zinc</td><td>Very High</td><td>Orchard Street Marsh wetland, shallow water, macrophyte beds; presence of multiple listed species of concern. Presence of herptiles adjacent to marsh, plus bird species suited to this habitat.</td><td>The wetland area has no defined shoreline (cattail marsh). Surrounding shoreline is loose rip-rap with soil and some vegetation.</td><td>The sediment management strategy will need to strike a compromise between chemical risk and habitat alteration. The southern shoreline of Belle landfill is more amenable to intrusive management relative to Orchard Street Marsh. Dredging south of the golf course could open preferential pathways for landfill seeps. Storm sewer flows could remobilize contaminants associated with soils in Orchard Street Marsh.</td></tr>
<tr><td>TC-OM</td><td>Negligible Risk</td><td>Moderate Risk</td><td>Moderate Risk</td><td>Moderate</td><td>Chromium (birds)</td><td>—</td><td>High</td><td>Shallow water, macrophyte beds</td><td>Upland area designated as parkland.</td><td>Appear to have lower COC concentrations, although PAH and PCB data coverage is incomplete. Sensitive shoreline areas may need to be maintained for habitat value.</td></tr>
<tr><td>TC-1</td><td>Negligible Risk</td><td rowspan="2">Low to Moderate Risk</td><td rowspan="2">Low Risk</td><td rowspan="2">NA</td><td>NA</td><td>Low</td><td>None</td><td>PCB, chromium, antimony, lead, mercury, silver</td><td>Moderate</td><td>Shallow water, macrophyte beds</td><td>Central harbour portion; therefore, no significant obstacles to physical management.</td><td>Due to the shallow water depth in this area, dredging may be required to allow barge access to shoreline areas through this unit.</td></tr>
<tr><td>TC-RC</td><td>Negligible Risk</td><td>Moderate Risk</td><td>High</td><td>PAHs</td><td>antimony, arsenic, lead, mercury, silver, PCB</td><td>Moderate</td><td>Shallow water, macrophyte beds</td><td>-Sheet pile wall around Emma Martin Park boat launch
-Public boat launch currently too shallow for use
-Kingston Rowing Club docks and water access</td><td>Existing structures provide obstacles for access to sediments. Engineered shoreline provides options for creative solutions to isolate sediments and modify shoreline. City of Kingston endorsed dredging to increase water depth and reduce macrophytes, provided shoreline appears natural (MacLatchy 2013, pers. comm.).

Presence of water/sewage force mains here—will need to confirm the depth of utilities with plans.</td></tr>
</table>

Unit	Ecological Receptors				Human Health		Overall Priority for Risk Management	Contaminant(s) Driving Significant Ecological Risk Designations	Other COC Elevated in Management Unit	Site Constraints Overview			
	Effects to Benthic Community	Effects to Fish Health	Effects to Birds	Effects to Mammals	Risks from Sediment Exposure	Risks from Fish Ingestion*				Ecological Sensitivity Rating		Structural/Shoreline Uses / Water Lot Uses	Additional Considerations
WM	**Negligible Risk**						**Moderate—High**	PAHs	arsenic, chromium, lead, mercury, silver, zinc, PCB	**Low-Moderate**	Riparian zone is artificial relative to adjacent shoreline	Woolen Mill - City Managed Water Lot	Potential for vessel hulls (Moore 1995). Engineered shoreline provides options for creative solutions to isolate sediments and modify shoreline.
TC-2B	**Moderate Risk**		**Negligible Risk**		**NA**		**Low**	Metals (lead, silver)	PCB, antimony	**Moderate**	Shallow water, macrophyte beds	Open water area	Potential for vessel hulls (archaeology value)
TC-2A	**Moderate Risk**	**Low to Moderate Risk**			**Moderate Risk**		**Moderate**	PAHs	arsenic, mercury, silver	**Moderate-High**	Shallow water, macrophyte beds, shoreline turtle nesting sites on logs	Stone landscaped retaining wall along waterfront at Molly Brant Point	The ribs of two hulls can be seen above the water surface. Hulls may be protected under the Ontario Heritage Act (Moore 1995). Evidence of herptile use (turtles).
TC-3A	**Negligible Risk**						**Low**	PCBs, PAHs	mercury (shoreline)	**Moderate**	Shallow water, macrophyte beds, upland turtle nesting sites	Shoreline trail area	Potential for vessel hulls
TC-3B	**Moderate Risk**		**Negligible Risk**		**NA**		**Low**	PCBs	PAH	**Low-Moderate**	Open-water area	Open water area	Potential for vessel hulls
TC-4	**High Risk**						**Moderate**	PAHs, PCBs	mercury (shoreline), lead, silver	**Moderate**	Shallow water, macrophyte beds, upland turtle nesting sites	Shoreline trail area	The ribs of two hulls can be seen above the water surface. Hulls may be protected under the Ontario Heritage Act (Moore 1995).
TC-AB	**High Risk**	**Moderate Risk**	**Negligible Risk**		**Moderate Risk**		**High**	PAHs, PCBs, Cu	antimony	**Low**	Marina and industrial embayment; highly engineered shoreline	-Structural sheet pile retaining wall around north side of bay -Kingston Marina docks and boat launch	Geotechnical considerations for access to nearshore sediments. Marina structures provide barriers to sediment access. Logistical issues working in and around industrial embayment.
TC-5	**Moderate Risk**				**NA**		**Low—Moderate**	PAHs, PCBs	antimony	**Low**	Open-water area; high vessel traffic	Provides access to/from Kingston Marina and navigation channel	Potential for vessel hulls

Notes:

* Risks determined based on the fish consumption advisory being in place

NA—Management unit not assessed for endpoint, due to lack of viable pathway or low concentrations of COC

Ecological receptor endpoint categories—Negligible Risk, Moderate Risk, High Risk

Human Health endpoint categories— Negligible Risk, Low Risk, Moderate Risk, High Risk

10.0 CONCEPTUAL SEDIMENT MANAGEMENT OPTIONS

Prior to developing an engineering-based or detailed sediment management plan, it was necessary to conduct a broad (i.e., conceptual) evaluation of the ecological and human health risks across the KIH management units (i.e., the CROA). Considerations for each management unit with potential to influence the selection of the final remedy for the Site included:

- **Habitat Considerations**—The ecological sensitivity of the habitat in the water lot units and was aligned with the Canada-Ontario Decision-Making Framework guidance (Chapman 2008) for areas where physical management was considered as a sediment management option. Primary concerns were for the protection of turtle habitat and ecological features within the western shoreline and the wetland zone within management unit PC-W.
- **Shoreline Configuration**—The presence of structures or shoreline works were identified that either constrained or provided opportunities for creative sediment management solutions. Although the vast majority of KIH is open water, the shorelines are used for a variety of activities, and require maintenance of physical works.
- **Lot Management**—Lot management within KIH is complex and the jurisdiction of each management unit was taken into consideration. The vast majority of the KIH study area falls under the management and jurisdiction of the federal government. There are, however, some parcels of water and sediment that fall under separate jurisdiction, requiring liaison among affected parties to achieve a mutually satisfactory sediment management design.
- **Urban Development Planning**—The City of Kingston development plan for the North King's Town district has direct relevance to the sediment management planning for KIH, particularly as the City of Kingston Official Plan (2019; under which the North King's Town Secondary Plan is being prepared) contains information relevant to the development or alteration of waterfront lands. Section 2.8.3 of the draft Official Plan deals with the protection of waterfront areas, and references a goal of protecting a 30-metre "Ribbon of Life" zone along waterfronts where practical.
- **Archaeological**—A total of 14 wrecks have been identified in KIH, with ten of these near Douglas Fluhrer Park (Tocher Heyblom Design Inc. 2014), that may be considered part of Kingston's cultural heritage resources and may be protected under the *Ontario Heritage Act* (Moore 1995). Additional archaeological artifacts may also be present in the harbour, either from its use by the French in 1675 to 1758 during their occupation of Fort Frontenac, or from First Nations traditional uses. To this end, RMC-ESG (2014) documents that four archaeologically sensitive areas along the shorelines of the Great Cataraqui River have been identified (Archaeological Services Inc. 2008), including two pre-contact Indigenous sites (one on Belle Island and one at the Kingston Outer Station located on the western shore immediately south of the Great Cataraqui Marsh). Two historical Euro-Canadian areas have also been identified on the western and eastern shores at the mouth of the Great Cataraqui River, including an archaeologically sensitive area along the southwestern shore of KIH near the Inner City Core and Anglin Bay (RMC-ESG 2014). The fourth archaeologically sensitive area is on the eastern shore and therefore unlikely to be influenced by sediment management activities. The City of Kingston Archaeological Master Plan (Archaeological Services Inc. 2008) identifies the entire shoreline on both sides of the river as having potential for pre-contact archaeological significance.

Additional considerations included identifying:

- Contiguous areas of contamination that may influence the practicality and economies of scale for a dredging program.
- Sediment management options that eliminate or reduce contaminant-based hazards (particularly where multiple risk pathways or constituents can be reduced simultaneously) but also those that align well with urban redevelopment, recreation, and aesthetic values.
- Upland fate/transport linkages to which upgradient sources of contamination have been controlled.

As such, a conceptual plan was developed to facilitate discussion and consultation with the federal custodians. The three levels of intervention (High, Moderate, Low) were provided as a means of bounding the range of intrusion levels required to effectively manage the sediment contamination.

10.1 High Intervention Overview

The high intervention sediment management options for KIH include the removal of all moderate- and high-risk sediments in 13 of the 15 management units. Additional dredging of lower risk threshold sediments was recommended under the high intervention scenario in management units where the removal of sediment PAHs above the low-risk threshold for fish deformities would also reduce the management unit or harbour wide averages of secondary COC. For some management units, the dredge volumes under this scenario may be scaled down with further delineation. A description for the high intervention scenario for each management unit is presented in Table 4, while the total surface area that would be physically managed is illustrated in Figure 6.

10.2 Moderate Intervention Overview

The moderate intervention sediment management options for KIH include the removal of moderate- and high-risk sediments in 8 of the 15 management units. Where possible, engineering controls to discourage water lot usage or monitored natural recovery have been recommended in lieu of dredging moderate- to high-risk sediments in sensitive and highly valued habitats. For some management units, the dredge volumes indicated under this scenario in Table 4 may be scaled down with further delineation. A description for the moderate intervention scenario for each management unit is presented in Table 4, while the total surface area that would be physically managed is illustrated in Figure 6.

10.3 Low Intervention Overview

The low intervention sediment management options for KIH include the removal of only the highest-risk sediments, and a reliance on more passive sediment management strategies, such as monitored natural recovery or engineering controls in 7 of the 15 management units. A description for the low intervention scenario for each management unit is presented in Table 4, while the total surface area that would be physically managed is illustrated in Figure 6.

Table 4: Summary of Sediment Management Options by Management Unit and Overall Degree of Intervention

Unit	Jurisdiction	Overall Priority for Risk Management	Contaminant(s) Targeted for Intervention	Other COC Elevated in Management Unit	Primary Sediment Management Options					Summary of Intervention
					Dredging	Capping	Monitored Natural Recovery	Institutional/ Engineering Controls	No Action	
PC-W	Parks Canada Potentially Private or Municipal Party	Very High	PAHs, PCBs, Cr (birds)	Sb, Pb, Zn	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PAHs, PCBs, and chromium above low-risk thresholds for fish and birds. This would reduce the harbour wide average of these concentrations, but would remove marsh habitat for listed species and impact habitat for herptiles.
					☑	☐	☑	☑	☐	**Moderate Intervention:** Dredging areas of the management unit with concentrations of PAHs, PCBs, and chromium above moderate-risk thresholds for fish and birds, with the exception of the marsh area, which would be maintained to protect habitat features. Human health risks from exposure to sediment may be controlled by engineering controls, such as a boardwalk or fencing.
					☑	☐	☑	☑	☐	**Low Intervention:** Dredging areas of the management unit with contiguous concentrations of PAHs, PCBs, and chromium above moderate- to high-risk thresholds for fish and birds, with the exception of the marsh area, which would be maintained to protect habitat features. Human health risks from exposure to sediment may be controlled by engineering controls, such as a boardwalk or fencing.
TC-RC	Transport Canada	High	PAHs	Sb, As, Pb, Hg, Ag, PCB	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PAHs above low- risk thresholds for fish deformities. This would also reduce the harbour wide average concentrations of arsenic, mercury, PCBs, and silver. In the case of mercury and PCBs, these actions would reduce human health risks for consumption of fish.
					☑	☐	☑	☑	☐	**Moderate Intervention:** Dredging all areas of the management unit with concentrations of PAHs above moderate-risk thresholds for fish deformities. This would also reduce the harbour wide average of arsenic, mercury, PCBs, and silver concentrations. In the case of mercury and PCBs, these actions would reduce human health risks for consumption of fish, but with lower effectiveness relative to high-intervention. Shoreline could be engineered to minimize human contact with sediments or isolate contaminated sediments.
					☑	☐	☑	☑	☐	**Low Intervention:** Dredging areas of the management unit with concentrations of PAHs above high-risk thresholds for fish deformities. Additional dredging would be required to remove sediment with elevated concentrations of arsenic, mercury, PCBs, and silver not co-located with PAHs. Shoreline could be engineered to minimize human contact with sediments or isolate contaminated sediments.
TC-AB	Transport Canada City of Kingston Department of National Defense	High	PAHs, PCBs, Cu	Sb	☑	☑	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PAHs, PCBs above low-risk thresholds for fish deformities, and copper concentrations with the potential to cause toxicity to benthic invertebrates. PAH contaminated areas would be dredged to depth of clean material (2-3 m) and then capped with clean fill. This would assist in reducing the harbour-wide averages of these substances.
					☑	☑	☐	☐	☐	**Moderate Intervention:** Dredging all areas of the management unit with concentrations of PAHs, PCBs above moderate-risk thresholds for fish deformities, and copper concentrations with the potential to cause toxicity to benthic invertebrates. PAH contaminated areas would be dredged to a depth of 1 m below current mudline (where residual contamination may exist) and then capped with clean fill. This would assist in reducing the harbour-wide averages of these substances, but leave some areas with elevated contamination at depth.
					☑	☑	☑	☐	☐	**Low Intervention:** Dredging all areas of the management unit with concentrations of PAHs, PCBs above high-risk thresholds for fish deformities, and copper concentrations with the potential to cause toxicity to benthic invertebrates. Localized hotspots of surface contamination may be dredged prior to cap placement to achieve navigational draft, but such would be limited in extent.
WM	City of Kingston	Moderate—High	PAHs	As, Cr, Pb, Hg, Ag, Zn, PCB	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PAHs above low-risk thresholds for fish deformities. This would also reduce the harbour wide average of arsenic, chromium, lead, mercury, and PCB concentrations.
					☑	☐	☐	☑	☐	**Moderate Intervention:** Dredging all areas of the management unit with concentrations of PAHs above moderate-risk thresholds for fish deformities. This would also reduce the harbour wide average of arsenic, chromium, lead, mercury, and PCB concentrations. Shoreline could be engineered to minimize human contact with sediments or isolate contaminated sediments.
					☑	☐	☐	☑	☐	**Low Intervention:** Dredging areas of the management unit with concentrations of PAHs above high-risk thresholds for fish deformities. Additional dredging would be required to remove sediment with elevated concentrations of arsenic and mercury not co-located with PAHs. Shoreline could be engineered to minimize human contact with sediments or isolate contaminated sediments.

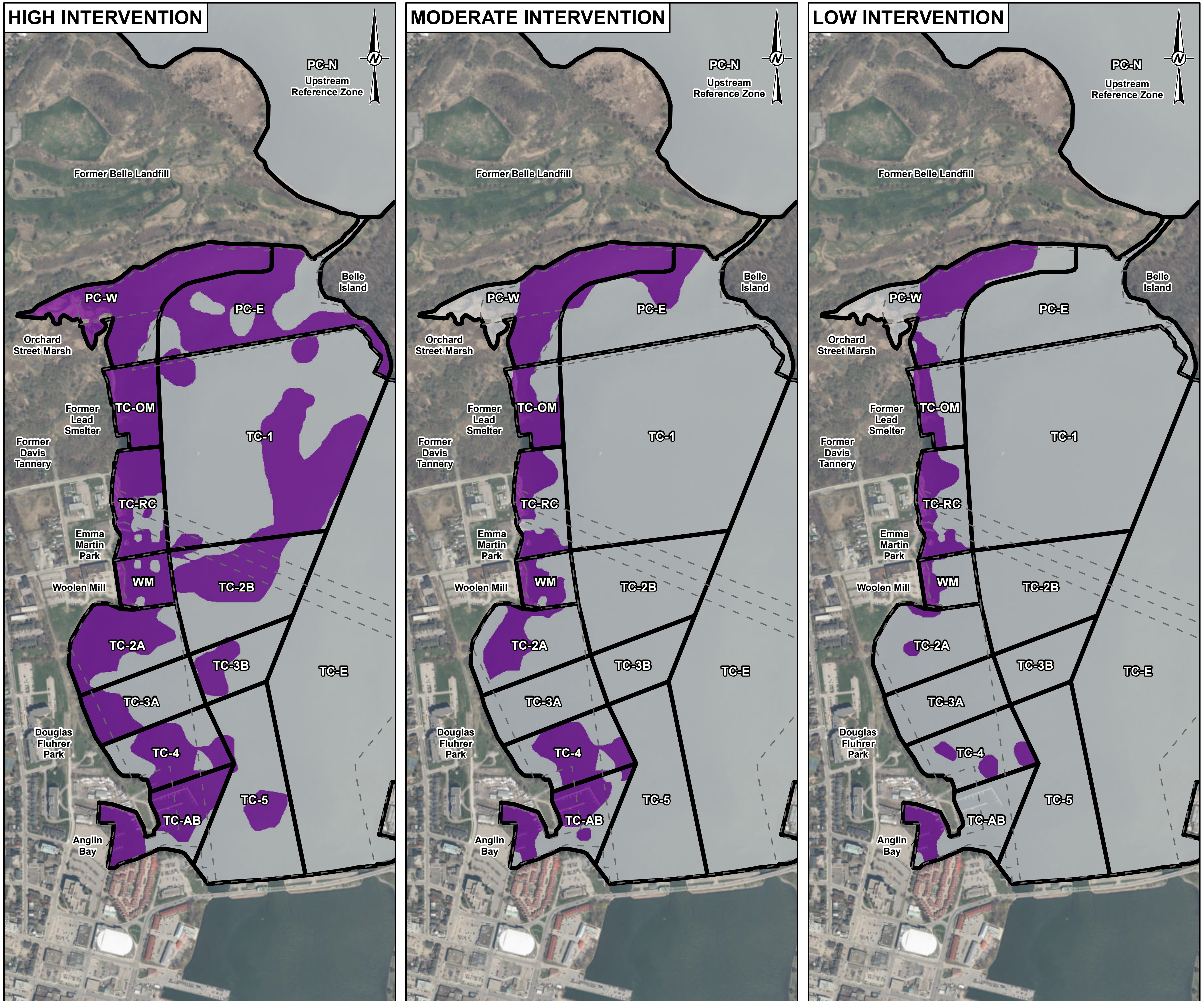
Unit	Jurisdiction	Overall Priority for Risk Management	Contaminant(s) Targeted for Intervention	Other COC Elevated in Management Unit	Primary Sediment Management Options: Dredging	Capping	Monitored Natural Recovery	Institutional/ Engineering Controls	No Action	Summary of Intervention
PC-E	Parks Canada	**Moderate**	PAHs, PCBs, Cr (birds)	Sb	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PAHs above low-risk thresholds. This would also reduce the harbour wide average of chromium and antimony concentrations.
					☑	☐	☑	☐	☐	**Moderate Intervention:** Dredging all areas of the management unit with concentrations of PAHs above moderate-risk thresholds for fish deformities.
					☐	☐	☑	☐	☐	**Low Intervention:** Concentrations of chromium and PCBs pose a lower risk to mammals and birds, whereas the elevated PAHs in this unit pose a moderate risk to fish for fish deformities. Natural recovery in this area may be a feasible option given the benefits of management measures in neighbouring units.
TC-OM	Transport Canada	**Moderate**	Cr (birds)	—	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit would reduce the harbour wide average of chromium and may remove localized elevations of PAHs and PCBs.
					☑	☐	☑	☐	☐	**Moderate Intervention:** Dredging would be focused on areas with the highest concentrations of chromium posing the greatest risk to wildlife. The remaining areas of this management unit may be suited to monitored natural recovery provided that the scale of management measures in adjacent management units is sufficient (i.e., potential redistribution of chromium, PAHs, and PCBs is reduced). The present-day concentrations of PCBs and PAHs appear to be lower than adjacent management units.
					☑	☐	☑	☐	☐	**Low Intervention:** Dredging focused mainly on nearshore areas posing the greatest risk to wildlife. The remaining areas of this management unit may be suited to monitored natural recovery provided that the scale of management measures in adjacent management units is sufficient. The dredging would emphasize chromium contamination given that concentrations of PAHs and PCBs are lower than adjacent management units.
TC-2A	Transport Canada City of Kingston	**Moderate**	PAHs	As (localized), Hg, Ag	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with elevated mercury concentrations. This would also remove all areas with concentrations of PAHs above low- and moderate-risk thresholds for fish deformities, remove mass of silver and arsenic, and reduce the harbour-wide average concentration of mercury.
					☑	☐	☑	☑	☐	**Moderate Intervention:** Dredging all areas of the management unit with elevated mercury concentrations colocated with elevated PAHs, silver, and arsenic from the unit. Shoreline could be engineered to minimize human contact with sediments in order to maintain a 30-m ribbon of life.
					☑	☐	☑	☐	☐	**Low Intervention:** Dredging areas of the management unit with concentrations of PAHs above moderate-risk thresholds. Lower concentrations of PAHs or those adjacent to the shoreline areas would be managed in place.
TC-4	Transport Canada City of Kingston	**Moderate**	PAHs, PCBs	Hg (shoreline), Pb, Ag	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with elevated mercury concentrations, and areas with concentrations of PCBs and PAHs above moderate- risk thresholds for fish deformities.
					☑	☐	☑	☑	☐	**Moderate Intervention:** Dredging all areas of the management unit with concentrations of PCBs and PAHs above moderate risk threshold for fish deformities, leaving shoreline sediment with elevated mercury in place. Shoreline could be engineered to minimize human contact with sediments in order to maintain a 30-m ribbon of life.
					☑	☐	☑	☐	☐	**Low Intervention:** Dredging areas of the management unit with concentrations of PCBs and PAHs above high-risk thresholds for fish deformities. Remainder to be managed in place.
TC-5	Transport Canada Department of National Defense	**Low—Moderate**	PAHs, PCBs	Sb	☑	☐	☐	☐	☐	**High Intervention:** Dredging areas of the management unit with concentrations of PAHs above the moderate-risk threshold for fish deformities.
					☐	☐	☑	☐	☐	**Moderate Intervention:** Natural recovery in this area may be possible given management measures in neighbouring units.
					☐	☐	☐	☐	☑	**Low Intervention:** No action.

Unit	Jurisdiction	Overall Priority for Risk Management	Contaminant(s) Targeted for Intervention	Other COC Elevated in Management Unit	Primary Sediment Management Options					Summary of Intervention
					Dredging	Capping	Monitored Natural Recovery	Institutional/ Engineering Controls	No Action	
TC-1	Transport Canada	**Low**	PCB	Cr (widespread), Sb (spotty), Pb (widespread), Hg, Ag, PAH	☑	☐	☑	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PCBs and PAHs above moderate-risk threshold for fish deformities. Low sample density in this area indicates a possible over assumption of the degree to which sediment above the moderate risk PCB threshold exists in this management unit.
					☐	☐	☑	☐	☐	**Moderate Intervention:** Natural recovery in this area may be possible given management measures in neighbouring units. Low sample density in this area indicates a possible over assumption of the degree to which sediment above the moderate risk PCB threshold exists in this management unit.
					☐	☐	☐	☐	☑	**Low Intervention:** No action.
TC-2B	Transport Canada City of Kingston	**Low**	PCBs	PAH	☑	☐	☑	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PCBs and PAHs above moderate-risk threshold for fish deformities.
					☐	☐	☑	☐	☐	**Moderate Intervention:** Natural recovery in this area may be possible given management measures in neighbouring units. Low sample density in this area indicates a possible over assumption of the degree to which sediment above the moderate risk PCB threshold exists in this management unit.
					☐	☐	☐	☐	☑	**Low Intervention:** No action.
TC-3A	Transport Canada City of Kingston	**Low**	PCBs, PAHs	Hg (shoreline)	☑	☐	☐	☑	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PCBs and PAHs above moderate-risk threshold for fish deformities, leaving shoreline sediment with elevated mercury in place. Shoreline could be engineered to minimize human contact with sediments in order to maintain a 30-m ribbon of life.
					☐	☐	☑	☐	☐	**Moderate Intervention:** Natural recovery in this area may be possible given management measures in neighbouring units.
					☐	☐	☐	☐	☑	**Low Intervention:** No action.
TC-3B	Transport Canada	**Low**	PCBs	PAH	☑	☐	☐	☐	☐	**High Intervention:** Dredging all areas of the management unit with concentrations of PCBs above moderate-risk threshold for fish deformities.
					☐	☐	☑	☐	☐	**Moderate Intervention:** Natural recovery in this area may be possible given management measures in neighbouring units.
					☐	☐	☐	☐	☑	**Low Intervention:** No action.

Notes:

For the purposes of evaluating risks to cause fish deformities, the following thresholds for PAHs and PCBs have been adopted from previous works (CLAW 2013; Golder 2013a, 2016):

- Low Risk - 4 mg/kg PAH, 0.3 mg/kg PCB
- Moderate Risk - 8 mg/kg PAH, 0.5 mg/kg PCB
- High Risk - 15 mg/kg PAH, 0.3 mg/kg PCB



LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- APPROXIMATE AREA REQUIRING PHYSICAL INTERVENTION
- UNDISTURBED AREA

0 200 400

1:10,000 METRES

REFERENCE(S)

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CLIENT

PWGSC

PROJECT

KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE

OVERVIEW OF HIGH, MODERATE AND LOW INTERVENTION FOR KINGSTON INNER HARBOUR

CONSULTANT

GOLDER

YYYY-MM-DD	2020-12-10
DESIGNED	SS
PREPARED	JP
REVIEWED	SS
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
1783886	7000	0	6

11.0 SELECTION OF THE RECOMMENDED SEDIMENT MANAGEMENT OPTION

The recommended sediment management option is based on integration of the scientific findings, a preliminary assessment of constraints, and anticipated Indigenous and stakeholder concerns. The following outcomes are elements of the recommended sediment management option presented in Section 12:

- **Primary Sediment Management Strategy**—The primary physical sediment management strategy for KIH will be dredging, with off-site disposal of contaminated material. There are some areas near Anglin Bay and the Orchard Street Marsh for which a thin-layer (0.3 m) cover with activated carbon (referred to herein as a thin-layer cap) may be appropriate, such as management units TC-AB, TC-2A, TC-4, and PC-W. Within Anglin Bay, a thicker (0.7 m) sand cap, followed by a thin-layer cap with activated carbon is proposed.
- **Level of Intervention**—Management in place (monitored natural recovery) will be a significant component of the recommended sediment management strategy, considering the magnitude of risk and the anticipated preferences of stakeholders and Indigenous communities. This considers the cost and high short-term environmental disturbance associated with a large dredging program. Focused physical management will be in areas that have the least degree of environmental disturbance but a high degree of contaminant removal, particularly where multiple contaminants and/or receptors can receive reduced contaminant-related risk where dredging is performed.
- **Shoreline Modification**—Areas for shoreline excavations were identified based on consideration of habitat sensitivity, risk reduction, anticipated preferences of stakeholders and Indigenous communities, and other factors specific to each shoreline segment. Avoidance of nearshore areas has several other advantages in terms of cost, practicality, and alignment with the site constraints. To achieve an adequate degree of protection of public health and the environment, some shoreline areas will require physical management due to the proximity of some contaminant hotspots near shorelines and the need to remove sufficient contaminant mass to reduce risks.
- **Management Unit Priorities**—Management units categorized with a minimum rating of moderate priority for risk management were the emphasis of physical intervention (Golder 2016). The risks in PC-N and TC-E were demonstrated to be negligible and it was recommended in Golder (2017) that management units TC-1, TC-2B, TC-3A, TC-3B, and TC-5 be excluded from dredging and instead considered for monitored natural recovery, given that the estimated degree of contaminant reduction per unit area is low relative to other management units. As a result, some risk tolerance for ecological endpoints (e.g., fish deformities and modest benthic invertebrate community alterations) would be required for these management units. Dredging of sediments in these management units would be expensive and difficult to remove, has low environment benefit per unit cost relative to other areas, and would yield significant short-term environmental alteration, including disruption of dense macrophyte beds used by fish.

12.0 DEVELOPMENT OF THE CONCEPTUAL SEDIMENT MANAGEMENT PLAN

Golder has prepared a conceptual SMP that describes an overall level of intervention that is intermediate between the low and moderate intervention levels identified in the CROA (Table 4; Golder 2017), reflecting assumptions regarding the practicality, cost, proportional risk reduction, site constraints, and expected Indigenous and stakeholder input. The objective of the conceptual SMP is to estimate the overall level of effort that would be required for a practical and cost-effective sediment management design. This document presents the recommended sediment management option (presented as the “recommended remedial option” in Golder 2019) that acknowledges several of the key sediment management concerns from a practical, logistical, and Indigenous and stakeholder perspective, with emphasis placed on management units of greatest priority for physical intervention.

The development of the recommended remedial option (Golder 2019) entailed application of multiple approaches to risk management in conjunction with dredging, building from:

- The various levels of intervention for each management unit presented in the conceptual sediment management options (Section 10).
- The general considerations summarized in Section 11.
- The local conditions of habitat, shoreline and infrastructure configuration, and development plans associated with each management unit depicted in Figure 7.
- An evaluation of costs and benefits of candidate management alternatives.

The design options that were advanced include a combination of dredging, conventional capping, thin-layer activated carbon capping, engineered shoreline features, and monitored natural recovery. Continued discussions regarding the scenarios presented are anticipated during further consultation.

Recommended sediment management actions for each management unit are summarized in Table 5. The sediment management actions were based on professional judgement, risk assessment findings, and several of the applicable constraints. Often a mixture of sediment management techniques for each KIH management unit was recommended and carried forward through the conceptual SMP, although Stakeholder Engagement and Indigenous Consultation is required to refine the design.

Cost estimates for the conceptual SMP are presented in Appendix A (Moffatt and Nichol 2020a) for each management unit. The following subsections provide a narrative for each management unit, including key assumptions that guided the sediment management action for each unit.

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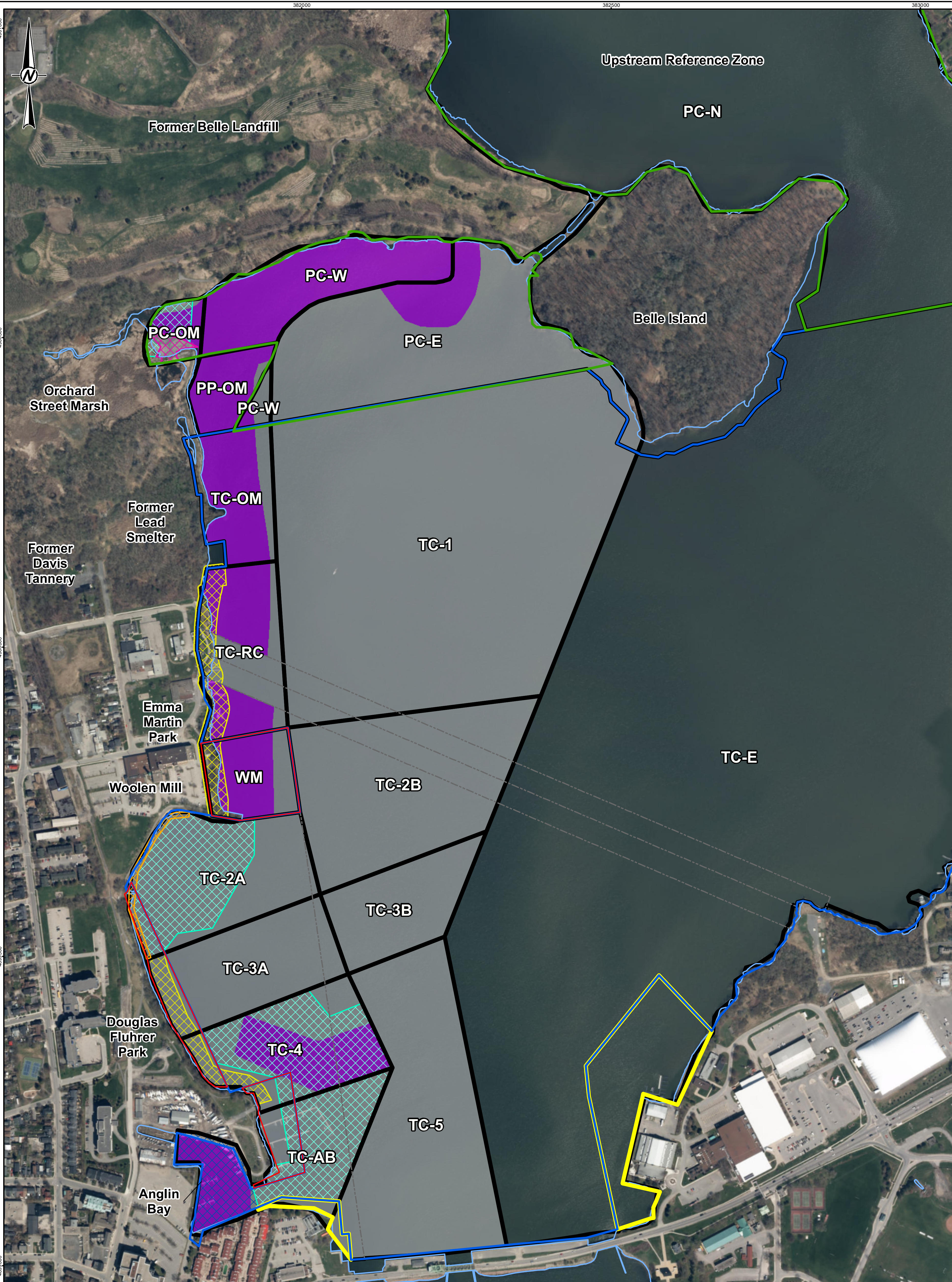

LEGEND

- MANAGEMENT UNIT
- CITY OF KINGSTON JURISDICTION
- PARKS CANADA JURISDICTION
- DEPARTMENT OF NATIONAL DEFENCE JURISDICTION
- TRANSPORT CANADA JURISDICTION
- FEDERAL WATER LOT
- WATERBODY
- WATERCOURSE

MANAGEMENT TECHNIQUE

- CAP (CONVENTIONAL WITH ACTIVATED CARBON)
- THIN CAP WITH ACTIVATED CARBON
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (BOARDWALK)
- HABITAT MOSAIC (WETLAND REMEDIATION)

INTERVENTION TECHNIQUE

- DREDGED SURFACE SEDIMENT
- MONITORED NATURAL RECOVERY

0 150 300

1:6,000 METERS

REFERENCES

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3. PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PWGSC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SEDIMENT MANAGEMENT PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	SS
PREPARED	JP
REVIEWED	SS
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
1783886	7000	0	7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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12.1 PC-W Rationale

Because the Parks Canada West (PC-W) management unit includes both federal and non-federal management areas, sharing of costs and liability, as negotiated amongst the property managers, would benefit and facilitate the sediment management in this area. The PC-W management unit requires dredging to address several risk pathways and includes the highest concentrations of several constituents of interest as well as those that drive the highest environmental risks (i.e., PAHs, PCBs, and chromium). Furthermore, the current distribution of environmental risks across the PC-W unit introduces potential for PC-W sediments to be a source for sediment contamination in other areas as surface sediments are remobilized and transported over time (Golder 2017b). As such, the following sediment management actions have been identified for PC-W:

- Dredging 5.2 ha of surface sediment, emphasizing hotspots of chromium and/or organic contamination.
- Placement of 0.4 ha of a thin-layer sand cap and activated carbon placement over the central wetland area.
- Selective management of remaining portions (0.2 ha) of the wetland, entailing phased removals of localized pockets of sediments, with replanting to enhance recovery of wetland plant species.
- Confirmation that upland soil contamination has been appropriately managed through erosion protection measures—this activity would be required only if the sediment management plan was coordinated with an upland brownfield development, to ensure that upland activities (considered as an off-site environmental protection measure, and not included in the cost estimates for sediment management) do not create a pathway for migration of contaminants to the water lot.

Key assumptions and constraints for the proposed sediment management design in PC-W included:

- A small setback in the detailed dredge design (i.e., strip of non-dredged sediment between Belle Island and KIH) may be required adjacent to the northern Parks Canada shoreline to avoid disruption of the leachate management system for the former Belle Landfill. As an interim guideline, the City has proposed a 10-metre exclusion zone for excavation from top of bank along the south shore of Belle Park (MacLatchy 2018, pers. comm.).
- Management of PC-W sediments would require clear mitigation measures and an impact analysis to ensure that Species at Risk, cultural and archeological considerations, and sensitive ecological features are not harmed as part of sediment management work, as well as meeting permit requirements. These investigations could reduce the areas and/or volumes of sediment proposed for active intervention.
- Monitored natural recovery would only be considered at the eastern margins of the management unit, subject to detailed delineation during dredge design.

Since development of the Recommended Remedial Option for KIH (Golder 2019), Parks Canada has provided new property survey information that updates our understanding of the jurisdiction of areas in the previously defined PC-W management unit. Specifically, a large portion of the interior wetland habitats along the western edge of the PC-W water lot, previously identified as being managed by Parks Canada, have now been reassigned to the City of Kingston. Due to the complexity in management of wetland habitats, it is recommended that the City of Kingston address sediment management in the interior portion of the wetland as a separate project.

Additionally, jurisdiction for a waterlot area that extends in to the PC-W management unit is pending confirmation.. As such, the PC-W management unit has now been subdivided into three management sub-units to reflect these changes (shown on Figure 7):

- PC-W sub-unit—open water property managed by Parks Canada (a subset of the water lot previously defined as PC-W)
- PC-OM sub-unit —Orchard Street March area managed by Parks Canada
- PP-OM sub-unit—open water area, jurisdiction pending confirmation

The revised sub-unit boundaries and nomenclature were not included in the Recommended Remedial Option for the Kingston Inner Harbour (Golder 2019), but are included herein to advance the sediment management plans for this portion of the Site. It is recognized that, although a unified and collaborative sediment management plan for all three sub-units is preferred, the legal and regulatory requirements for the non-federal portions would differ from the areas managed by Parks Canada.

The variety of alternatives considered were carefully balanced among contaminant risk removal, maintenance of sensitive habitat features, and alignment with both current and future recreational uses of KIH. For costing purposes, it was assumed that a relatively intrusive physical intervention in these areas may be required, recognizing that more nuanced and cautious sediment management activities may ultimately be adopted. This assumption was made to provide a reasonable upper bound to predicted costs, which are strongly dependent on sediment excavation and disposal. Final sediment management options for this area will take into consideration that people may practice recreational sports such as kayaking, canoeing, and paddling, and that these activities may result in direct sediment contact. The management option must also consider the need to maintain a 10-m management buffer to avoid disruption of the leachate management system for the former Belle Landfill, following recommendations made by the City of Kingston (MacLatchy 2018, pers. comm.). In these shallow areas, detailed design will consider the slopes and sediment substrate that is appropriate to maintain recreational use, protect against slumping and erosion, and reduce exposure from direct contact.

Due to the more complex management of these sub-units, interaction with upland development plans, and the additional complexity involved with management of higher value habitats (such as presence of SAR, potential additional offsetting requirements, Indigenous and stakeholder concerns, etc.) there may be a need to sequence management activities in these sub-units separately from those in the remainder of KIH. As such, additional mobilization/demobilization, environmental controls, and monitoring have been integrated into the cost estimates provided for these management sub-units.

In the event that one or more of these management sub-units are not managed using intrusive methods for an extended period following management of neighbouring management units, the risk of recontamination through natural sediment remobilization and transport is low due to the low mean water velocities and extensive macrophyte bed coverage in these areas (SNC 2020). However, future management action (e.g., dredging, dewatering of dredged material, in-water transport of dredged material and debris, placement of substrate in-fill, placement of engineered cap) within these management sub-units will likely lead to the resuspension of contaminated sediment having a higher potential for recontamination of previously capped or dredged areas. This risk may be mitigated using environmental controls, such as turbidity curtains and environmental monitoring of sediment and water quality. Re-application of cap material may be required in areas immediately adjacent to the newer managed areas in the event dredge residuals are observed during environmental monitoring.

Table 5: Prioritization and Identification of Primary Sediment Management Options (Management Units Sorted in Reducing Degree of Priority for Active Management)

Unit	Jurisdiction(s) within Management Unit	Overall Priority for Risk Management	Contaminant(s) Targeted for Intervention	Other COC Elevated in Management Unit	Primary Management Options						Summary of Sediment Management Actions
					Dredging	Monitored Natural Recovery	Institutional/ Engineering Controls	Conventional Sand Capping	Thin-Layer Capping	Other Low-Intrusion Method	
PC-W	Parks Canada Potentially Private or Municipal Party	**Very High**	**PAHs, PCBs, Cr (birds)**	Sb, Pb, Zn	☑	☑	☑	—	☑	☑	Includes sediment removal through dredging in the open water portion of the management unit. In the western portion of the management unit, a variety of alternatives were considered to carefully balanced among contaminant risk removal, maintenance of sensitive habitat features, and alignment with recreational uses of KIH. For costing purposes, it was assumed that a relatively intrusive physical intervention in these areas may be required, recognizing that more nuanced and cautious management approach may ultimately be adopted.
TC-RC	Transport Canada	**High**	**PAHs**	Sb, As, Pb, Hg, Ag, PCB	☑	☑	☑	—	—	—	Includes the use of dredging and shoreline engineering, which provides an opportunity for both chemical risk reduction and improved shoreline benefits; the character of the shoreline could be designed to accommodate the desired combination of functional, and aesthetic values, and could deepen the navigational draft for small vessels as a beneficial use
TC-AB	**Transport Canada** **City of Kingston** **Department of National Defense**	**High**	**PAHs,** PCBs, Cu	Sb	☑	☑	—	☑	☑	—	The use of dredging and various cap types in TC-AB is focussed primarily on reducing the level of PAH exposure associated with historical sources. There is high probability that significant PAH mass removal could be achieved within the interior portion of TC-AB. Uncertainty remains with respect to the distribution of PAHs in the outer portions of the management unit; detailed delineation combined with consideration of other Indigenous and stakeholder objectives could result in substantial modification to the ultimate management design for the latter.
WM	**City of Kingston**	**Moderate—High**	**PAHs**	As, Cr, Pb, Hg, Ag, Zn, PCB	☑	minor	☑	—	—	—	The use of dredging and shoreline engineering provides an opportunity for both chemical risk reduction and improved shoreline benefits; the character of the shoreline could be designed to accommodate the desired combination of functional, and aesthetic values
PC-E	**Parks Canada**	**Moderate**	**PAHs**, PCBs, Cr (birds)	Sb	☑	☑	—	—	—	—	Includes the use of selective dredging, with monitored natural recovery for remaining water lot areas. The greatest uncertainty is with respect to the volume of removals required following detailed delineation
TC-OM	**Transport Canada**	**Moderate**	**Cr (birds)**	—	☑	minor	—	—	—	☑	Most of management unit has been flagged for active management, but this estimate may be reduced with respect to the spatial extent of intrusion and the types of nearshore works that could be complementary to the overall sediment management plan. Although we have assumed a conservatively high volume of affected sediments for costing purposes, the Stakeholder Engagement and Indigenous Consultation should consider potential synergy of lower intrusion approaches with broader planning objectives in KIH.
TC-2A	**Transport Canada** **City of Kingston**	**Moderate**	**PAHs**	As (localized), Hg, Ag	—	☑	☑	☑	☑	—	Physical intervention recommended to address elevated sediment contamination, but spatial extent is constrained by habitat and other water lot characteristics, requiring caution in the level and intensity of intrusive works. Rather than apply intrusive methods such as dredging, less intrusive measures including thin-layer capping and the use of institutional/engineering controls to prevent human health risks are planned.
TC-4	**Transport Canada** **City of Kingston**	**Moderate**	**PAHs, PCBs**	Hg (shoreline), Pb, Ag	☑	minor	☑	☑	☑	—	A hybrid of actions including focussed dredging, partial placement of thin-layer caps, and shoreline revetment is planned. It is foreseeable that the ultimate configuration of these techniques would require customization following detailed delineation, but the footprint for intrusive management would be more likely to decrease than to expand.

Unit	Jurisdiction(s) within Management Unit	Overall Priority for Risk Management	Contaminant(s) Targeted for Intervention	Other COC Elevated in Management Unit	Primary Management Options						Summary of Sediment Management Actions
					Dredging	Monitored Natural Recovery	Institutional/ Engineering Controls	Conventional Sand Capping	Thin-Layer Capping	Other Low-Intrusion Method	
TC-5	**Transport Canada** **Department of National Defense**	**Low—Moderate**	**PAHs**, PCBs	Sb	—	☑	—	—	—	—	Sediment management would be limited to monitored natural recovery for this management unit. The areas of elevated PAH contamination would be difficult and expensive to delineate, and physical intrusion in this zone would confer low net benefit relative to areas closer to shore
TC-1	**Transport Canada**	**Low**	PCB	Cr (widespread), Sb (intermittent), Pb (widespread), Hg, Ag, PAH	—	☑	—	—	—	—	Sediment management would be limited to monitored natural recovery for this management unit. Although there are some moderate elevations of PCBs, the contaminant distribution is uncertain and would not likely yield a high mass removal per unit of dredging effort
TC-2B	**Transport Canada** **City of Kingston**	**Low**	PCBs	PAH	—	☑	—	—	—	—	Sediment management would be limited to monitored natural recovery for this management unit. Although there are some moderate elevations of PCBs, the distribution is uncertain and would not likely yield a high mass removal per unit of dredging effort
TC-3A	**Transport Canada** **City of Kingston**	**Low**	**PCBs**, PAHs	Hg (shoreline)	—	☑	☑	—	—	—	No substantive physical intervention is required. A shoreline revetment has been included for costing purposes and to match the options for shoreline to the north and south (adjacent Douglas Fluhrer Park), as an incomplete shoreline revetment may funnel people into this management unit, and allow access to neighbouring management units increasing the potential for exposure.
TC-3B	**Transport Canada**	**Low**	**PCBs**	PAH	—	☑	—	—	—	—	Sediment management would be limited to monitored natural recovery for this management unit. Although there are some moderate elevations of PCBs, the distribution is uncertain and would not likely yield a high mass removal per unit of dredging effort
PC-N	**Parks Canada**	**Negligible**	**None**	—	—	—	—	—	—	—	No action required—sediments are considering local reference conditions
TC-E	**Transport Canada** **Department of National Defense**	**Negligible**	**None**	—	—	—	—	—	—	—	No action required—sediments were evaluated in screening level risk assessment stage and determined to be suitable for in place management

12.2 TC-RC Rationale

High concentrations of PAHs were observed within the Transport Canada Rowing Club (TC-RC) management unit, especially along the shoreline. TC-RC exhibits hot spots for several other COC indicative of historical industrial sources. The sediments are within relatively confined areas where multiple constituents overlapped, and as such, TC-RC would benefit from the efficiency of simultaneous mass reduction for multiple constituents.

The sediment management actions planned for TC-RC include the following combination of approaches:

- Dredging 2.1 ha of contaminated sediments.
- Placement of 0.9 ha of a thin-layer sand cap along the shoreline revetment (see below).
- Shoreline revetment (generally consistent with existing shoreline character) to provide a physical barrier to exposure along a length of 300 m × 10 m wide, over an area of 0.3 ha.
- Monitored natural recovery for the Transport Canada water lots associated with the utilities corridor across KIH.

Key assumptions and constraints for the proposed management in TC-RC included:

- Detailed delineation sampling in the utilities corridor will confirm that sediment chemistry remains less contaminated relative to other parts of TC-RC.
- The revetment structures will be compatible with both the City's Master Plan for shoreline development and with regulatory requirements (permitting) for habitat alteration.
- The implementation of the shoreline revetment will not interfere with adjacent upland remediation techniques ongoing in Emma Martin Park (e.g., historical arsenic and other metals contamination that required management of contaminated groundwater moving through the soil toward KIH). The technology in place for this purpose is an underground Zero Valent Iron Permeable Reactive Barrier (ZVI-PRB), which filters and cleans the groundwater near the water table.
- Disruptions in shoreline uses, including existing boat docks, will be accommodated within the construction designs, or even enhanced long-term through engineering.

In summary, the use of dredging and shoreline engineering approaches provide an opportunity for both chemical risk reduction and improved shoreline benefits; the character of the shoreline could be designed to accommodate the desired combination of functional, and aesthetic values, and could deepen the navigational draft for small vessels as a beneficial use.

12.3 TC-AB Rationale

The highest concentrations of PAH contamination were observed to variable degrees within the Transport Canada Anglin Bay (TC-AB) management unit, resulting in moderate to high environmental risk determinations for benthic invertebrates, fish, and humans.

The sediment management actions planned for TC-AB include the following combination of approaches:

- Dredging 1.3 ha of contaminated sediments over most of the interior portion of the management unit (i.e., enclosed portion of Anglin Bay).
- Replacement of the above sediments with a multi-layer engineered cap consisting of a moderate thickness (0.7 m) sand layer overlain by a thinner activated carbon cap layer (0.3 m).
- Placement of 2.7 ha of a thin-layer sand cap and activated carbon over most outer portions of the management unit.
- Monitored natural recovery for some sediments underneath marina structures that cannot be accessed without significant disruption.

Key assumptions and constraints for the proposed management activities in TC-AB included:

- Ship mooring infrastructure and geotechnical constraints were determined to be the primary constraints to the dredging activities, and would limit the proximity of dredging to the margins of the management unit and/or necessitate slopes to dredge cuts that reduce the volumes of sediment that can be safely excavated.
- Existing bathymetry within the enclosed portion of Anglin Bay would be satisfactory for long-term operation of the bay as both a recreational and industrial port.
- Removal of the uppermost one metre of contaminated sediment was determined sufficient for costing purposes. Gross contamination (i.e., free product concentrations of non-aqueous phase liquid) would not be prevalent at the new sediment surface prior to cap placement. Given the heterogeneity of the PAH contamination, additional volumes of removal may be necessary and/or consideration of additional cap design elements to limit upward migration of PAH contamination.
- An activated carbon cap was assumed to be used for the outer portion of TC-AB, due to the patchiness of PAH contamination; more detailed delineation could result in a smaller area requiring placement of activated carbon.

In summary, the recommendation of dredging and various cap types in TC-AB is focussed primarily on reducing the level of PAH exposure associated with historical sources, and potential improvements for PCB and copper contamination may also be realized. PAH mass removal will emphasize the interior portion of TC-AB where concentrations are most frequently elevated. The distribution of PAHs in the outer portions of the management unit remains uncertain; detailed delineation combined with consideration of other Indigenous and stakeholder objectives could result in changes to the sediment management plan for either the inner or outer portions of the TC-AB area.

12.4 WM Rationale

The Woolen Mill (WM) management unit is currently wholly managed by the City of Kingston and exhibits locally high elevated concentrations of PAHs and concentrations of several other COC (e.g., PCBs, mercury, and arsenic). These COC are indicative of historical industrial sources, especially along the shoreline. Multiple constituents were noted to be co-occurring, yielding high efficiency (benefit per unit of effort) mass reduction in these areas that would also reduce harbour-wide average exposure for multiple constituents. Accordingly, the sediment management actions planned for WM include the following combination of approaches:

- Dredging 1.4 ha of contaminated sediments.
- Placement of a thin-layer sand-cap over 0.45 ha, associated with the shoreline revetment (discussed below).
- Construction of a shoreline revetment (generally consistent with existing shoreline character) of a 0.15 ha area as a physical barrier to exposure, and linked as appropriate to redevelopment plans in adjacent water lots.
- Monitored natural recovery for the sediments at the eastern margin of the water lot, where concentrations are expected to be lower than in nearshore areas.

Key assumptions and constraints for the proposed sediment management plan in WM included:

- Cost estimates were calculated without consideration of liability, and without any requirement for cost-sharing among multiple responsible parties or recognition of efficiencies that may occur from conducting works in this area concurrently with management activities in neighbouring MUs.
- The revetment structures are compatible with both the City's Master Plan for shoreline development and with regulatory requirements (permitting) for habitat alteration.
- The implementation of the shoreline revetment will not interfere with adjacent upland remediation techniques applied in Emma Martin Park, as discussed previously for TC-RC.

In summary, the use of dredging and shoreline engineering approaches provide an opportunity for both chemical risk reduction and improved shoreline benefits; the character of the shoreline could be designed to accommodate the desired combination of functional and aesthetic values.

12.5 PC-E Rationale

The Parks Canada East (PC-E) management unit contains moderate levels of chemical contamination for several COC, although these levels are lower than observed in PC-W. Much of the management unit contains sediments within acceptable ecological and human health risk levels.

The sediment management plan for PC-E includes the following combination of approaches:

- Dredging 1.2 ha of contaminated sediments over the portion of the management unit that is closest to PC-W, both in terms of physical proximity and sediment contamination profile.
- Monitored natural recovery for the sediments at the eastern margin of the water lot, where concentrations are expected to be lower than in nearshore areas.

Key assumptions and constraints for the proposed management plan in PC-E included:

- The broad gradient in sediment contamination described in Golder (2016) and Golder (2017) will be confirmed prior to development of a detailed dredge design. Areas near the boundary between PC-W and the western portion of PC-E should be included in the detailed delineation prior to dredging. Identification of areas of elevated PAH contamination are the priority for discerning which areas require physical removals.
- A buffer zone of non-dredged sediment may be required adjacent to the northern Parks Canada shoreline to avoid disruption of the leachate management system for the former Belle Landfill.

In summary, the use of selective dredging, with no-action for remaining water lot areas was recommended for PC-E. The greatest uncertainty was with respect to the volume of removals required following detailed delineation.

12.6 TC-OM Rationale

Moderate risks to wildlife from chromium are the main driver for sediment management within the Transport Canada Orchard Street Marsh (TC-OM) management unit. A significant portion of TC-OM has been identified as recommended for intrusive management. Part of this recommendation comes from the identification of shared concentrations of elevated sediment chromium near the northwestern shoreline.

Most of the management unit (2.2 ha out of 2.6 ha) has been flagged for intrusive management, but this estimate may be reduced through Stakeholder Engagement and Indigenous Consultation and detailed delineation, as concentrations (and risks to aquatic life) of PAHs and PCBs are lower in the TC-OM management unit relative to the adjacent management units to the north and south.

As detailed in Appendix A, the primary sediment management technique proposed for TC-OM is dredging, without requirement for placement of an engineered cover. Portions of the conventional dredging footprint could be replaced with one or more of the following strategies:

- Spot removals—Given the lower degree of contamination relative to other management units, the scale of dredging could be reduced, such that removals are focussed on the conditions of higher chromium, PAHs, and/or PCBs, rather than for a larger contiguous block of sediment. This approach would rely on the results of a detailed delineation program.
- Shoreline redevelopment—The adjacent brownfield areas have been considered for property redevelopment, and the design plans convey shoreline alterations that would be connected to proposed high density residential development, including recreational linkages to waterfront (City of Kingston 2018). Any shoreline modifications that physically isolate sediments (e.g., placement of revetments or covers) would convey chemical risk reductions, even if they are not strictly necessary for sediment risk management.

Substantial flexibility is shown with respect to the spatial extent of intrusive management and the types of nearshore works that could be complementary to the overall sediment management plan for TC-OM. A high volume of affected sediments was costed, although the Stakeholder Engagement and Indigenous Consultation should consider potential synergy of lower intrusion approaches with broader planning objectives in KIH.

12.7 TC-2A Rationale

The Transport Canada Unit 2A (TC-2A) management unit has environmental risks driven primarily by PAHs, with localized elevation of arsenic, mercury, and silver that appear to be related to the nearby Emma Martin Park sources to the north. Due to the habitat values of the area, including the presence of turtle nesting sites, and presence of shipwreck hulls, intrusive dredging for this management unit was not recommended. Maintenance of the dense macrophyte community is an example of an ecological feature in the nearshore areas that may be valued by Indigenous communities and other stakeholders.

Accordingly, the management activities planned for TC-2A include the following combination of approaches:

- Thin-layer of sand capping of contaminated sediments, incorporating an activated carbon amendment to reduce PAH exposure in 2.4 ha; thin-layer caps would be placed judiciously in near-shore areas to limit the degree of habitat disruption.
- Development of a 3 m wide by 100 m boardwalk to provide an institutional/engineering control against potential human health risks, while still offering aesthetic, ecological, and recreational value.

Key assumptions and constraints for the proposed management plan in TC-2A included:

- The near-shoreline zone was maintained unaltered for protection of existing habitat values, and boardwalk features or structures would be designed to preserve these features.
- Connectivity of the boardwalk and other recreational paths is compatible with the industrial park (management units WM and TC-RC to the north).
- Approximately half of the TC-2A management unit area would require a thin-layer cap with activated carbon, given the possible need for exclusions of specific areas on the basis on archaeological sites or maintenance of macrophyte beds.

The management actions were recommended to address elevated sediment contamination in TC-2A while limiting the intensity of physical intervention. The boardwalk feature in this area would replace the existing walking path with an elevated platform to provide turtles open access to nesting areas on the west side of the boardwalk, and reduce the potential for human contact with harbour sediments to the east and nesting areas to the west of the boardwalk. The existing rock wall and asphalt path would be also removed and graded to a gentle slope, and subsequently vegetated to provide turtles easier access to nesting areas.

12.8 TC-4 Rationale

PCB contamination within the Transport Canada Unit 4 (TC-4) management unit is heterogeneous but contributes to harbour-wide bioaccumulation in fish. PAH contamination in TC-4 also appears more widespread and higher in magnitude than in TC-2A or TC-3A.

The recommended sediment management approach for TC-4 is to apply the following combination of approaches:

- Dredging 1.9 ha of TC-4 sediment to address areas of maximum PCB and PAH contamination.
- To limit the areal extent of dredging, application of 3.3 ha of thin-layer sand cap with activated carbon (both on the dredge cut zone and the non-dredged areas), where water depth will accommodate.
- Placement of 0.4 ha of thin-layer sand cap and construction of a 100 m shoreline revetment (generally consistent with existing shoreline character) to manage shoreline contaminants through physical isolation.

Key assumptions and constraints for the proposed sediment management plan in TC-4 include:

- Placement of a thin-layer cap to accommodate bathymetric constraints; placement of cap could be abandoned in areas where water depths are too shallow to permit placement.
- The broad gradient in sediment contamination described in Golder (2016) and Golder (2017) will be confirmed in the detailed delineation during detailed dredge design.

A hybrid approach was recommended that focussed on dredging and partial placement of thin-layer caps, although some degree of customization following detailed delineation may be necessary. The footprint for intrusive management will likely decrease rather than expand at the design stage.

12.9 Remaining Management Units

Monitored natural recovery is the primary management method proposed for the remaining management units listed in Table 5 and depicted in Figure 7. For these areas, physical intrusion would reduce chemical exposures to several ecological receptors, including mobile receptors such as sportfish that integrate their exposure over wide areas. However, the magnitude of risk reduction, relative to the costs of management measures and other constraints (short term habitat destruction, navigational depth, etc.) result in a much lower priority for active management:

- Transport Canada Unit 1 and 2B—Some moderate magnitude elevations of PCB concentrations in sediment were observed but the distribution was heterogeneous and unlikely to provide high mass removal per unit of dredging effort.
- Transport Canada Unit 3A—The majority of this unit will be monitored for natural recovery, as physical management of the elevated areas of PAH contamination was determined to be difficult and expensive. Intrusive management activities planned for this management unit includes the placement of 0.4 ha of sand cap in conjunction with construction of shoreline revetment (generally consistent with existing shoreline character) for a length of 100 m to physically isolate contaminants in this area.
- Transport Canada Unit 3B—Although there are some moderate magnitude elevations of PCB concentrations in sediment, the distribution is uncertain and would not likely yield a high mass removal per unit of dredging effort. No intrusive management actions are planed for this unit.
- Transport Canada Unit 5—The limited areas of elevated PAH contamination would be difficult and expensive to delineate, and management of this management unit would confer low net benefit relative to areas closer to shore. No intrusive management actions are planned for this unit at this time.

In addition to the above management units, the Transport Canada East (TC-E; eastern portions of KIH) sediments, and the entirety of Parks Canada North (PC-N; upstream reference) had previously been confidently excluded from consideration of intrusive management (Golder 2012, 2016, 2017). The sediment management plan for these areas remains a “no action” recommendation based on the negligible risks identified for those areas.

13.0 DESIGN STEPS AND ASSUMPTIONS

The following sections outline the design steps and assumptions considered by Moffatt and Nichol in the development of concept development plans for the conceptual SMP. Additional information is provided in Appendix A, and design drawings are provided in Appendix B. The sediment management techniques within each management unit vary based on the levels of contamination and the desired treatment goals. Options proposed range from dredging and off-site disposal, conventional capping with sand, thin capping with activated carbon addition, engineering controls using sand capping and rock shoreline revetment installation, engineering controls with boardwalk construction to limit public access into the water, and wetland management.

13.1 Engineering Design Considerations

13.1.1 Mechanical Dredging

It has been assumed that mechanical dredging would be performed using a closed clamshell environmental bucket inside of a turbidity control curtain. However, dredging methods may be adjusted to address site conditions and logistical challenges. It is assumed that the Contractor will determine the dredging method based upon past experience, available equipment, site limitations, and best management practices. In general, for costing and design purposes it is assumed that:

- Average dredging depth is 1 m.
- Debris removal, transportation, and disposal will occur at an MECP licensed disposal facility.
- Sediments are characterized for disposal at an MECP licensed disposal facility.
- Dewatering of the dredged sediment will potentially occur.

During dredging, in order to reduce the potential for the mobilization and transport of dredged sediments, it is assumed that:

- The dredge will control the penetration depth of the bucket to:
  - minimize the total number of passes needed to dredge the required sediment volume
  - minimize the loss of sediment due to extrusion through the bucket's vents openings or hinge area
- The dredge will control the rate of descent of the bucket to maximize the vertical cut of the clamshell bucket while not penetrating the sediment beyond the vertical dimension of the open bucket (i.e., overfilling the bucket).
- The closed clamshell environmental bucket will be lifted slowly through the water at a rate of 2 feet per second or less to reduce induced turbidity.
- The dredged material will be deliberately placed into the barge to prevent spillage of material overboard.
- The discharge (i.e., overflow) of water from the barge into which dredged material is placed will be prohibited.

The barges will be transported to a dewatering location (either a temporary dock barge or anchored within the turbidity curtain at an approved place) where the material would be allowed to settle, and the free-standing water will be decanted by pumping the water (i.e., supernatant) from the loaded barges into water holding (decant) barges that allow for additional settlement, treatment, and eventual discharge to the receiving environment once water quality is acceptable.

13.1.2 Stabilization and Solidification

Following dewatering of dredged materials, the dewatered dredged material will be treated using a stabilization and solidification process to facilitate trucking of the material in the event sufficient space is not available for dewatering. Stabilization and solidification (S/S) is a soil remediation process by which contaminants are rendered immobile through reactions with additives or processes. During this process, also called immobilization, fixation, or encapsulation, contaminants may be chemically bound or encapsulated into a matrix. Stabilization is the general term for a process that transforms contaminants into a less mobile or toxic form, while solidification is a more specific process that treats material to increase its solidity and structural integrity. Solidification does not remove nor degrade contaminants but prevents their transport by eliminating or significantly hindering their mobility. Stabilization and solidification as a process accomplishes one or more of the following:

- Improves handling and physical characteristics of sediment
- Decreases surface area of the sediment mass through which transfer/contaminant leakage can occur
- Limits solubility of hazardous constituents in the waste

13.1.3 Backfilling and Capping

A conventional cap entails covering contaminated sediment, which remains in place, with clean material that may or may not include geotextiles, liners, and other permeable or impermeable materials in multiple layers. The thin-layer capping option is a modification of the conventional capping tool, and operates on the general principle that reduction of risk can be accommodated even when the cover is thin and contamination is not 100% contained. Capping of sediment with sand will be used for seven of the nine management units (all except TC-OM and PC-E, which will not require engineered covers). The sand cap will be 30 cm thick over the area, except for Anglin Bay where the sand cap would be multi-layered, consisting of 70 cm of sand overlain by 30 cm of sand containing activated carbon. Method for placement will determined by the Contractor, but will likely involve placement of the cap using a clamshell bucket to remove the sand from a material barge and lowering it to the bottom, or by hydraulically pumping the sand out of a barge or land-based containment box and spreading it with a discharge end configured to reduce velocity. The spreading could be performed through use of baffle plates, upturned ends, and/or wider end sections. Alternatively, the sand may be pumped into a floating box with a grated bottom or through a grate to allow sand to "rain down" to the bottom.

A thin sand cap offers some (limited) potential for assisting the natural recovery of some areas for which there are low-to-moderate risks where contamination is heterogeneous, and in areas where it would be extremely difficult to reliably delineate hotspots for dredging. Furthermore, the potential spatial extent of these areas is large for substances such as PAHs and PCBs, rendering a dredging-based solution costly and with high short-term impact to the ecological communities. Use of a simple sand cap would provide reduction in harbour-wide average concentrations without requiring physical removal. A thin sand cap will be used for the three management units TC-2A, TC-4 and TC-AB, along with placement of activated carbon to treat the sediment. Management units TC-4 and TC-AB also incorporate dredging prior to the cap and activated carbon placement.

Activated carbon (and other carbonaceous amendments such as coal and coke breeze) have been used in pilot- and full-scale applications for in situ sediment remediation, and are attractive amendments because of their strong sorbent properties (i.e., often 10 to 100 times greater than absorption to organic carbon alone) (US EPA 2013). This amendment has been demonstrated to be effective in sorbing PAHs, PCBs, and dioxins/furans, making them less bioavailable (Ghosh et al. 2011; Patmont et al. 2015). The resulting adsorption is strong enough to lower the pollutant's bioavailability and mobility significantly, limiting its release from sediment into the water and uptake into organisms (Abel and Akkanen 2018).

The activated carbon will be spread over the entire designated area and the sand cap will be 0.3 m thick. Placement of the activated carbon can be accomplished using several different methods. It can be spread out over the bottom as a thin layer, spread out and then "tilled" into the bottom to mix with the existing sediment, placed between two geotextile layers to create a mat that is placed onto the bottom, mixed with the sand cap, or placed as a layer within the sand cap. Equipment such as clamshell buckets, submerged diffusers, energy dissipaters, submerged discharge points, and tremies (specialized underwater pipes, typically used for pouring concrete) can be used to apply amendments evenly to a required thickness.

The material quantity necessary for activated carbon varies by delivery method. Bulk placement typically is incorporated at a rate of 5 to 10 percent activated carbon dry weight to the top 10 cm of sediment which is approximately 5 kg/m^2 (1 lb/ft^2). Laboratory studies indicate that a one centimeter thick layer of activated carbon or other carbon material beneath a sand cap can effectively mitigate contaminant flux of PCBs from sediment (USEPA 2013). Placement equipment such as a clamshell bucket or backhoe will be used to place the material.

13.1.4 Boardwalks

Development of a boardwalk to effectively form an institutional/engineering control against potential human health risks, while still offering aesthetic, ecological, and recreational value will be included as part of the sediment management plan. Management unit TC-2A will include installation of a timber boardwalk to provide a means for people to walk along the shoreline. This boardwalk will replace the existing walking path with an elevated platform to provide turtles open access to nesting areas on the west side of the boardwalk, as well as reduce the potential for human contact with harbour sediments to the east and nesting areas to the west of the boardwalk.

13.1.5 Shoreline Revetment

A shoreline revetment will be placed on top of the sand cap for management units TC-RC, WM, TC-3A and TC-4. The revetment structures will be designed to be compatible with both the City's Master Plan for shoreline development and with regulatory requirements (permitting) for habitat alteration. This revetment will perform a similar function to a conventional cap, coupled with limiting exposure of shoreline users to harbour sediments. For planning and costing purposes, it is assumed the revetment will be along the shoreline and be constructed of rock having a median mass of 20 kg and will be 1 m thick and 10 m wide sloping into the water; however, the intent is that the final revetment design will provide a balance between providing physical isolation from the KIH sediments, geotechnical integrity and erosion control, and maintaining a natural looking shoreline. Sand material will be first placed on the bottom to provide a smooth surface for constructing the revetment. A geotextile will be placed on top of the smooth sand surface, followed by the rock. The sand, geotextile and rock will be delivered to the site overland via truck haul or over water via barge. In these areas, the detailed revetment design will consider the slopes and sediment substrate that is appropriate to maintain recreational use and ecological function, protect against slumping and erosion, and reduce exposure from direct contact, all while maintaining shoreline aethestics compatible with the City's Master Plan.

13.1.6 Wetland Management

The wetland management component of the conceptual SMP is likely to be shaped further through Stakeholder Engagement and Indigenous Consultation, along with input from the DIA. The methods proposed for wetland management include recognition of sensitive habitats where intrusive methods could be minimized; where intrusive management is required, the methods would entail a combination of small-scale conventional dredging, conventional and thin-layer capping, and replanting. The specific areas recommended for each method will depend on the habitat values assigned to different portions of the PC-OM management sub-unit (e.g., presence of rare or endangered species, maintenance of habitat for recolonization of disturbed areas, alignment with other shoreline design features (e.g., proximity to boardwalk), and other factors. Depending on access and the contractor's selected methodology, the sand cap may be placed via hydraulically pumping out of a barge or land-based containment box and spreading with a discharge end configured to reduce velocity. Following cap placement, the vegetation would be planted using a suitable mix of native plant species.

13.1.7 Habitat Compensation

Habitat compensation will likely be required for portions of the intrusive management footprint based on HADD of fish habitat under Section 36 of the *Fisheries Act*, resulting from the temporary loss and alteration of existing habitat (i.e., marsh habitats, macrophyte beds, changes to sediments) due to dredging and backfilling, or potential permanent loss from shoreline revetments. The total loss of habitat or required compensation is currently undefined, and will depend on the refinement of the conceptual SMP following Stakeholder Engagement and Indigenous Consultation, and discussions with regulatory agencies.

14.0 SCHEDULE

The next steps for the sediment management plan, including detailed design of the intrusive works, depend on factors outside the scientific and engineering components used to develop the conceptual SMP, such as:

- Funding status—alignment with federal financial cycles, post cost-sharing with non-federal lot managers within and adjacent to KIH.
- Partnerships—schedule for activities conducted around the Orchard Street Marsh area would depend on coordination with brownfield redevelopment, City of Kingston Master Plan development (e.g., recreational corridors), or other synergies with management of the shoreline areas.
- Timelines for the synthesis of input from stakeholders and Indigenous communities (e.g., Consultation on impact assessment and offsetting).
- Permit approvals required for project works.

Approximate dates for the project milestones are listed below, assuming reasonable schedule factors and no major delays. Due to the volume of sediments targeted for removal, dredging is scheduled to take place over 2-3 years, with early emphasis placed on the areas of greatest risk reduction (i.e., northwest shoreline and Emma Martin Park). Project milestones include:

- Planning/Pre-Implementation, including biological and archaeological inventories, Stakeholder Engagement and Indigenous Consultation, partnership agreements, Detailed Impact Assessment, detailed design, and permitting—2020 to 2025
- Implementation of Physical Works—2025 to 2027 (assuming efficiencies in scheduling/conducting management activities concurrently)
- Post-Implementation Monitoring—2027 to 2030
- Long-Term Monitoring for Monitoring Natural Recovery Zones—2030 to 2040

The 2–3 years for implementation is based upon the estimated rate of dredging/backfilling, assuming that each management unit and activity is undertaken sequentially. Should multiple activities (i.e., dredging and backfilling) and/or management in multiple management units be conducted concurrently, the schedule would then be reduced.

15.0 NUMERICAL SEDIMENT MANAGEMENT CRITERIA

To inform management decisions and evaluate overall reductions of risk resulting from the conceptual SMP, risk-based numerical sediment management criteria were derived. As discussed in Section 11.0, some residual risk tolerance for ecological endpoints (e.g., fish deformities and modest benthic invertebrate community alterations) is required for areas where:

- sediments would be expensive and/or difficult to physically manage;
- physical management was determined to be of limited efficiency or effectiveness; or
- physical management would yield significant short-term environmental alteration (e.g., disruption of dense macrophyte beds used for fish foraging).

Therefore, the numerical sediment management criteria were derived to achieve the following set of protection goals: no unacceptable risks to humans (i.e., hazard quotients less than 0.2 for non-carcinogenic substances and incremental lifetime cancer risks less than 0.00001 for carcinogenic substances); an overall level of risk not greater than “low” for mammals, birds, amphibians, and fish; and an overall level of risk not greater than “moderate” for benthic invertebrates.

Based on the methods and results of the Risk Assessment Refinement and Synthesis (Golder 2016), numerical sediment management criteria were derived for those combinations of substances, receptor groups, and management units with risk levels that exceeded the stated protection goals. These include total PAHs in TC-4 and TC-AB for benthic invertebrates, total PAHs and total PCBs in all management units (excluding PC-N and TC-E) for fish, and total PCBs and chromium in PC-W, PC-E, and/or TC-OM for wildlife (includes birds, mammals, and by extension, herptiles). For the remaining combinations of substances, receptor groups, and management units, risk levels under existing conditions (i.e., before implementation of the SMP) are acceptable based on the stated protection goals and results of the Risk Assessment Refinement and Synthesis. As a result, it was not considered necessary to derive numerical sediment management criteria for those substances, receptor groups, and management unit combinations.

Although potentially unacceptable risks were identified in the Risk Refinement and Synthesis for human receptors from dermal contact with PAHs in sediment, engineering controls will be implemented as part of the SMP to reduce exposure. These controls include the construction of boardwalks and shoreline revetments to limit human exposure to harbour sediments. Potentially unacceptable risks were also identified for human receptors from dietary exposure to PCBs and mercury from the ingestion of fish caught in KIH, using tissue consumption estimates similar to those outlined in the 2017–2018 Guide to Eating Ontario Fish. However, potential risks were categorized as “low” and implementation of the SMP throughout KIH is expected to reduce the weighted average concentrations of these substances by focussing on hot spots. In addition, maintenance of fish consumption advisories specific to these substances (i.e., largemouth bass, northern pike and walleye for mercury, and black crappie, bluegill sunfish, brown bullhead, common carp, largemouth bass, northern pike, walleye, and white sucker for PCBs), will limit exposure through dietary uptake. As a result of the reductions in exposure and because the fish consumption advisory will remain in place due to the Site being a working harbour, it was not considered necessary to derive numerical sediment management criteria for the protection of human health.

The numerical sediment management criteria derived for each management unit (or group of management units depending on the receptor) are provided in Table 6. For benthic invertebrates, criteria were set equal to the upper range of established sediment quality criteria categorized as having the potential for moderate risk to benthic invertebrates in the Risk Refinement and Synthesis. This approach also considered the results of the integrated benthic community weight of evidence assessments in the PQRA and DQRA for KIH (Golder 2011, 2012) and the sediment chemistry and toxicity assessment conducted in the Parks Canada water lot in 2012 (Golder 2013b).

Although concentrations of several metals exceeded generic sediment quality criteria and were categorized as having the potential for moderate risk to benthic invertebrates, the distribution of sites with benthic community impairment and/or toxicological impairment suggested the relationship between metals concentrations and observed biological responses was weak (Golder 2016). In contrast, localized sediment toxicity to benthic invertebrates was observed in sediments with elevated PAH concentrations, and toxicity identification evaluations conducted in the DQRA (Golder 2012) confirmed PAHs as a plausible causal agent. Therefore, a numerical sediment management criterion for the protection of benthic invertebrates was only derived for total PAHs and was set equal to 22.8 mg/kg, which is the upper range of the probable effects concentration (PEC; MacDonald et al. 2000) documented for PAHs in the Risk Refinement and Synthesis.

Although samples with total PAH concentrations less than 22.8 mg/kg were identified as having likely or potential adverse effects to the benthic community at some stations in the PQRA and DQRA, a clear relationship between sediment PAH concentrations and biological effects could not be established. Furthermore, ecologically meaningful benthic community impairment and/or toxicological impairment were found to be negligible or low at total PAH concentrations higher than the sediment management criterion selected (i.e., at an average total PAH concentration of 37.7 mg/kg in TC-RC [Golder 2016] and at 24.9 mg/kg in station 2012-F in the Parks Canada water lot [Golder 2013b]). Although some potential for benthic community impairment or toxicity exists below this concentration, the magnitude and probability of ecologically meaningful alteration is not sufficiently high to warrant physical intervention. Given the observed heterogeneous distribution of PAHs within management units and prevalence of benthic invertebrate communities throughout KIH, it is recommended that the numerical sediment management criteria for benthic invertebrates be considered applicable to all management units in KIH that are subject to physical intervention in the conceptual SMP, and not just those previously identified as having greater than moderate risks.

Table 6: Numerical Sediment Management Criteria

Management Unit	Total PAHs	Total PCBs	Chromium
Benthic Invertebrates			
All management units	22.8	—	—
Fish Health			
PC-W	8	1.0	—
PC-E			
TC-OM			
TC-1	8	1.0	—
TC-RC			
WM	8	1.0	—
TC-2B			
TC-2A			
TC-3A			
TC-3B			
TC-4	8	1.0	—
TC-5			
TC-AB			
Wildlife			
PC-E	—	—	Marsh Wren: 250
PC-W	—	Mink: 0.92	Mallard: 2500 Marsh Wren: 250
TC-OM			

Notes:
— = not calculated because acceptable risk level under existing conditions (see Risk Refinement and Synthesis)
Concentrations presented in mg/kg dry weight

For fish health, numerical sediment management criteria were set equal to benchmarks derived in the Risk Refinement and Synthesis to be protective against increases in deformity rates in bottom-dwelling fish. These include the 8 mg/kg total PAH concentration benchmark categorized as having moderate risk of increased deformity incidence and the 1.0 mg/kg total PCB concentration benchmark categorized as having high risk of increased deformity incidence. These benchmarks meet the overall protection goal of a level of risk not greater than “low” for fish health because the incidence of external deformities and/or liver lesions has an unknown correspondence to biological endpoints that are commonly used to evaluate ecological health (i.e., survival, growth, reproduction, and development). Furthermore, the PCB benchmarks developed in the fish deformity evaluation are highly conservative, as they were developed based on empirical associations between sediment PCB concentrations and deformity incidence. The strength of evidence was much stronger for PAHs as a causative agent, based on a known mechanism of action and the conclusions of several independent researchers cited in the literature review. As such, the PCB criterion in Table 6 was based on high magnitude responses, recognizing that PCBs likely contributed little if any response to the deformity profile compiled from the literature.

For wildlife, numerical sediment management criteria were back-calculated using the food chain model (and associated input parameters) used in the Risk Refinement and Synthesis to derive sediment concentrations that result in low risk as defined in the Risk Refinement and Synthesis (i.e., hazard quotients below 1.0 using the lower-bound toxicity reference values derived by Golder (2012) for chromium and total PCBs). In the Risk Refinement and Synthesis, risks to wildlife receptors were negligible or low for all receptors with the exception of exposure of mink to total PCBs in PC-W and TC-OM, exposure of mallard to chromium in PC-W and TC-OM, and exposure of marsh wren to chromium in PC-E, PC-W, and TC-OM.

The numerical sediment management criteria were derived to be protective of those combinations of substances, receptor groups, and management units with risk levels that exceeded the stated protection goals, and use different statistics to represent exposure concentrations, depending on the receptor. These statistics include the mean (average), 75th percentile, or 90th percentile concentrations across one or more management units, as follows:

- Benthic Community—For benthic invertebrates, organisms require protection at the community level. Given that home ranges of invertebrates are small and the relationship between PAH concentrations and biological or toxicological responses were not always clear (e.g., TC-RC had the highest average management unit concentrations, though no effects to the benthic community or toxicity were observed), the average PAH concentration within a management unit is considered an appropriate measure of exposure.
- Fish—For fish, organisms require protection at the population level. For most fish species, the existing risk level is considered low, with accumulations of contaminants into fish tissue remaining at or below concentration thresholds protective against survival, growth, reproduction, and developmental effects. However, bottom fish are an exception, showing evidence from both field and literature evaluations that elevated PAH concentrations can lead to an increased risk of health impairment due to increased prevalence of external and liver lesions. While a clearer concentration-response may exist for bottom fish as compared to benthic invertebrates, the deformity threshold is a non-standard ecological risk endpoint affecting only some individuals within a population, potentially due to habitat preferences at the individual level. As such, the 75th percentile is considered an appropriate measure of exposure for bottom fish to account for the possibility that some fish within each area may preferentially use habitats that have higher than average sediment concentrations.
- Wildlife—For wildlife receptors, organisms require protection at the population level at minimum, and require protection at the individual level for listed species (if present). As such, the 90th percentile is considered an appropriate measure of exposure for wildlife to avoid potential underestimation of exposure, such would occur if receptors forage over more contaminated portions of the exposure unit.

As a result, the following numerical sediment management criteria were selected and should be implemented as follows:

- **Total PAHs (benthic community)**: The numerical sediment management criterion derived for the protection of the benthic community (i.e., 22.8 mg/kg) is protective against risks exceeding moderate magnitude. This criterion should not be applied at specific locations, but within each management unit. Localized areas of sediment contamination may exceed 22.8 mg/kg total PAH provided that the average concentrations do not exceed the sediment management criterion protective of benthic communities.
- **Total PAHs (fish health)**: The numerical sediment management criterion derived for the protection of fish health (i.e., 8 mg/kg) is protective of potential impacts to fish health. This criterion should not be applied at specific locations or in small areas, but rather across large contiguous areas of water lot, commensurate with the foraging ranges of bottom fish, as indicated in Table 6. Localized areas of sediment contamination may exceed 8 mg/kg total PAH provided that the 75th percentile concentrations do not exceed the sediment management criterion protective of fish health.
- **Total PCBs (mink)**: The numerical sediment management criterion derived for the protection of mink (0.92 mg/kg) is protective of sensitive piscivorous mammals. This criterion should only be applied within management units or groups of management units that provide suitable habitat for piscivorous mammals (i.e., within PC-E and within PC-W and TC-OM). Localized areas of sediment contamination may exceed 0.92 mg/kg total PCBs provided that the 90th percentile concentrations do not exceed the sediment management criterion protective of sensitive piscivorous mammals.
- **Chromium (marsh wren)**: The numerical sediment management criterion derived for the protection of marsh wren (250 mg/kg) is protective of sensitive herbivorous birds that inhabit marsh areas. This criterion should only be applied within management units that provide suitable habitat for these receptors (i.e., within PC-E, PC-W, and TC-OM). Localized areas of sediment contamination may exceed 250 mg/kg chromium provided that the 90th percentile concentrations do not exceed the sediment management criterion protective of sensitive herbivorous birds that inhabit marsh areas.
- **Chromium (mallard)**: The numerical sediment management criterion derived for the protection of mallard (2,500 mg/kg) is protective of avian receptors both inside and outside marsh areas within KIH. This criterion should be applied across the large contiguous areas that provide suitable habitat for these receptors, where current sediment chromium concentrations exceed acceptable risk thresholds (i.e., within PC-W and TC-OM). Localized areas of sediment contamination may exceed 2,500 mg/kg chromium provided that the 90th percentile concentrations do not exceed the benchmark for protection of avian receptors.

16.0 RESIDUAL RISKS

As described in Section 15, not all contaminated sediments that exceed the “negligible” risk category in the Risk Refinement and Synthesis (Golder 2016) are planned for removal in the conceptual SMP. Therefore, a degree of residual risk is assumed in the successful completion of the project to the specifications shown in Figure 7.

To evaluate the predicted overall reductions in risk associated with implementation of the conceptual SMP, post-implementation sediment concentrations were calculated for each management unit (or group of management units depending on the receptor being assessed) and used to evaluate residual risks relative to those estimated under existing conditions (i.e., as presented in the Risk Refinement and Synthesis). Residual risks under post-implementation conditions were evaluated using the methods, assumptions, and models used in the Risk Refinement and Synthesis.

To calculate post-implementation sediment concentrations, inverse-distance weighted (IDW) concentrations (a spatial averaging technique presented in the Risk Refinement and Synthesis) were calculated assuming that material used to cover dredged/capped areas will be less than CCME PELs, as is typically required for backfill material for such applications. To evaluate residual risks under the post-implementation scenario, exposure point concentrations (EPCs) were calculated using post-implementation IDW sediment concentrations. The statistic used to estimate exposure (i.e., the EPC) varied depending on the receptor being evaluated (i.e., average concentrations were used to assess residual risks to the benthic community, 75th percentile concentrations were used to assess residual risks to fish health, and 90th percentile concentrations were used to assess residual risks to wildlife receptors), consistent with the approach used in the Risk Refinement and Synthesis.

As discussed in Section 15, although potentially unacceptable risks were identified in the Risk Refinement and Synthesis for human receptors from dermal contact with PAHs in sediment and dietary exposure to mercury and PCBs from the ingestion of fish caught in KIH, administrative and engineering controls will be implemented as part of the SMP to reduce exposure. These controls include the construction of boardwalks and shoreline revetment to limit human exposure to harbour sediments as well as the maintenance of fish consumption advisories to limit exposure to COC through dietary uptake. Additionally, implementation of the SMP throughout KIH is expected to reduce the weighted average concentrations of these substances by focussing on hot spots. As a result, it was not considered necessary to evaluate residual risks for the protection of human health.

16.1 Benthic Community

For the assessment of residual risks to the benthic community, average post-implementation sediment concentrations were calculated and categorized based on exceedances of increasing sediment quality guideline (SQG) thresholds, consistent with the numerical sediment management criterion developed in Section 15 and the category definitions provided in Figure 12 in the Risk Refinement and Synthesis (modified to reflect the information presented in Section 15). As described previously, although concentrations of several metals exceeded sediment quality criteria protective of the benthic community, the results of the Risk Refinement and Synthesis found that the distribution of sites with benthic community impairment and/or toxicological impairment suggested the relationship between metals concentrations and observed biological responses was either weak or non-existent. In contrast, localized sediment toxicity to benthic invertebrates was observed in sediments with elevated PAH concentrations, and toxicity identification evaluations confirmed PAHs as a plausible causal agent. Therefore, the assessment of residual risks to the benthic community was based on the average post-implementation sediment concentrations for total PAHs and is presented for those management units subject to physical intervention in the

SMP. The average post-implementation sediment concentrations and their categorization based on SQG thresholds is provided in Table 7. To permit comparison to existing conditions, average pre-implementation sediment concentrations are also presented and categorized.

Table 7: Assessment of Residual Risks to the Benthic Community based on Total PAH Concentrations

Management Unit	Average Total PAH Sediment Concentrations	
	Pre-Implementation	Post-Implementation
PC-E	5.97	5.02
PC-W	20.4	5.23
TC-OM	4.68	3.87
TC-RC	37.7*	4.39
WM	16.1	5.17
TC-2A	5.15	3.69
TC-3A	5.16	4.84
TC-4	11.3	4.11
TC-AB	8.59	4.73

Notes:

Concentrations presented in mg/kg dry weight

Colour categories based on the SQG thresholds provided in Figure 12 in the Risk Refinement and Synthesis (Golder 2016) but modified to reflect the numerical sediment management criterion developed in Section 15 to be protective of moderate risks to benthic communities

Negligible Risk	(dark green)	Less than the SQG threshold provided in Figure 12 of the Risk Refinement and Synthesis determined to be protective of negligible risks to the benthic community (total PAHs < 4 mg/kg)
Low Risk	(light green)	Less than the SQG threshold provided in Figure 12 of the Risk Refinement and Synthesis determined to be protective of low risks to the benthic community (total PAHs < 10 mg/kg)
Moderate Risk	(yellow)	Less than the numerical sediment management criterion derived in Section 15 to be protective of moderate risks to the benthic community (total PAHs < 22.8 mg/kg)
High Risk	(orange)	Greater than the numerical sediment management criterion derived in Section 15 to be protective of moderate risks to the benthic community (total PAHs > 22.8 mg/kg)

* While the average PAH sediment concentrations were higher in this waterlot, impacts to the benthic community or toxicity were not observed; therefore, the risk to benthic invertebrates was considered low in the Risk Refinement and Synthesis (Golder 2016)

Because sediment toxicity and benthic community data are not available under the future post-implementation scenario, the weight of evidence categorization for overall benthic community effects could not be reproduced with high precision to evaluate residual risks to the benthic community upon completion of the SMP. Instead, the results of the categorization of average post-implementation sediment concentrations were extrapolated to make predictions about the residual risks to the benthic community for each management unit subject to physical intervention. For those management units subject to monitored natural recovery, residual risks are expected to improve over time. Based on the results presented in Table 7, residual risks to the benthic community are predicted to be negligible to low with implementation of the SMP, and therefore meet the overall protection goal of achieving a level of risk not greater than "moderate" for benthic invertebrates.

16.2 Fish Health

For the assessment of residual risks to fish health, 75th percentile post-implementation sediment concentrations were calculated and categorized based on exceedances of the benchmarks derived in the Risk Refinement and Synthesis as being protective of bottom fish deformities, which were modified to reflect the numerical sediment management criteria determined in Section 15 to be protective of low magnitude risks to fish health.

Post-implementation sediment concentrations were calculated for all substances and groups of management units predicted to have greater than negligible effects to fish health in the Risk Refinement and Synthesis (i.e., for total PAHs and total PCBs in all groups of management units). The 75th percentile post-implementation sediment concentrations and their categorization based on the benchmarks protective of fish health are provided in Table 8. To permit comparison to existing conditions, 75th percentile pre-implementation sediment concentrations are also presented and categorized.

Table 8: Assessment of Residual Risks to Fish Health

Habitat Area (Management Units)	75th Percentile Pre-Implementation Sediment Concentrations		75th Percentile Post-Implementation Sediment Concentrations	
	Total PAHs	Total PCBs	Total PAHs	Total PCBs
North (PC-E, PC-W, TC-OM)	12.7	0.36	4.75	0.30
North Central (TC-1, TC-RC)	4.52	0.63	4.00	0.58
South Central (WM, TC-2A, TC-2B, TC-3A, TC-3B)	5.23	0.62	4.18	0.61
South (TC-4, TC-5, TC-AB)	10.5	0.39	6.55	0.30

Notes:

Concentrations presented in mg/kg dry weight

Management units grouped into zones commensurate with the foraging ranges of bottom fish

Negligible Risk	Less than the low-risk benchmarks derived in the Risk Refinement and Synthesis (total PAHs = 4 mg/kg; total PCBs = 0.3 mg/kg)
Low Risk	Less than the numerical sediment management criteria derived in Section 15 to be protective of low risks to fish health (total PAHs = 8 mg/kg; total PCBs = 1 mg/kg)
Moderate Risk	Exceeds the numerical sediment management criteria derived in Section 15 to be protective of low risks to fish health (total PAHs = 8 mg/kg; total PCBs = 1 mg/kg)

Based on the results shown in Table 8, the assessment of residual risks to fish health following implementation of the SMP is summarized below:

- For the north area (i.e., management units PC-E, PC-W, TC-OM), residual risks to fish health from total PAHs are predicted to decrease from moderate to low following implementation of the SMP.
- For the north central and south central areas (i.e., TC-1, TC-RC, WM, TC-2A, TC-2B, TC-3A, TC-3B), residual risks to fish health are predicted to decrease but remain low following implementation of the SMP.
- For the south area (i.e., management units TC-4, TC-5, TC-AB), residual risks to fish health from total PAHs are predicted to decrease from moderate to low following implementation of the SMP.

16.3 Wildlife

For the assessment of residual risks to wildlife, 90th percentile post-implementation sediment concentrations were used to calculate residual risks using the food chain model (and associated input parameters) used in the Risk Refinement and Synthesis. Post-implementation sediment concentrations and residual risks were calculated for those substances and groups of management units (based on receptor foraging ranges) predicted to have greater than negligible effects in the Risk Refinement and Synthesis. The 90th percentile post-implementation sediment concentrations are provided in Table 9 and the calculated hazard quotients (HQs) and categorization of residual risks are presented in Table 10. The categories used to categorize potential risks were updated from those used in the Risk Refinement and Synthesis to reflect the overly conservative approach used in calculating HQs using toxicological reference values (TRVs) developed using United States Environmental Protection Agency (US EPA) Eco-SSLs. As described in the Risk Refinement and Synthesis, the US EPA specifically warns that that Eco-SSLs are "not designed to be used as cleanup levels" but rather to identify COC. As a result, Golder (2012) developed mammalian and avian TRVs for total PCBs and chromium using the guidance and principles recommended by Environment Canada. As a result, HQs greater than 1.0 using the Eco-SSLs but less than 1.0 using Golder (2012) lower bound TRVs have been re-categorized as having the potential for very low risk to wildlife, and HQs greater than 1.0 using Golder (2012) lower bound TRVs but less than 1.0 using Golder (2012) upper bound TRVs have been re-categorized as having the potential for low risk to wildlife. To permit comparison to existing conditions, pre-implementation HQs are also presented and categorized in Table 10.

Based on the results shown in Table 10, the assessment of residual risks to wildlife following implementation of the SMP is summarized below:

- For mammals, residual risks to mink from PCBs decrease from low to negligible, whereas residual risks to muskrat from chromium remain very low (with reduced HQ values) in PC-E and TC-OM, and decrease to negligible in PC-W.
- For birds, residual risks to mallard from chromium decrease from very low/low to negligible, whereas residual risks to marsh wren decrease from very low to negligible for total PCBs, and remain very low for risks from lead. For chromium, residual risks decrease from low to very low in PC-W but remain low in PC-E and TC-OM (with reduced HQ values).

Table 9: 90th Percentile Post-Implementation Sediment Concentrations

<table>
<tr><th rowspan="2">Management Unit</th><th>Mink</th><th>Muskrat</th><th>Mallard</th><th colspan="3">Marsh Wren</th></tr>
<tr><th>Total PCBs</th><th>Chromium</th><th>Chromium</th><th>Total PCBs</th><th>Chromium</th><th>Lead</th></tr>
<tr><td>PC-E</td><td>—</td><td>1052</td><td>1052</td><td>—</td><td>1052</td><td>124</td></tr>
<tr><td>PC-W</td><td rowspan="2">0.3</td><td>90</td><td rowspan="2">875</td><td>0.3</td><td>90</td><td>91</td></tr>
<tr><td>TC-OM</td><td>960</td><td>—</td><td>960</td><td>130</td></tr>
<tr><td>TC-RC</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">1141</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">—</td></tr>
<tr><td>TC-1</td></tr>
</table>

Notes:

Concentrations presented in mg/kg dry weight

— Suitable habitat for receptor not present or negligible risks (i.e., HQ < 1.0) under existing conditions (Risk Refinement and Synthesis)

Table 10: Assessment of Residual Risks to Wildlife, Using Hazard Quotients

<table>
<tr><th rowspan="3">Management Unit</th><th colspan="6">Pre-Implementation Hazard Quotients</th><th colspan="6">Post-Implementation Hazard Quotients</th></tr>
<tr><th>Mink</th><th>Muskrat</th><th>Mallard</th><th colspan="3">Marsh Wren</th><th>Mink</th><th>Muskrat</th><th>Mallard</th><th colspan="3">Marsh Wren</th></tr>
<tr><th>Total PCBs</th><th>Chromium</th><th>Chromium</th><th>Total PCBs</th><th>Chromium</th><th>Lead</th><th>Total PCBs</th><th>Chromium</th><th>Chromium</th><th>Total PCBs</th><th>Chromium</th><th>Lead</th></tr>
<tr><td>PC-E</td><td>—</td><td>1.8</td><td>1.0</td><td>—</td><td>3.4</td><td>1.1</td><td>—</td><td>1.6</td><td><1.0</td><td>—</td><td>3.0</td><td>1.1</td></tr>
<tr><td>PC-W</td><td rowspan="2">1.2</td><td>5.6</td><td rowspan="2">2.2</td><td>1.3</td><td>14.5</td><td>1.6</td><td rowspan="2"><1.0</td><td><1.0</td><td rowspan="2"><1.0</td><td><1.0</td><td>1.1</td><td>1.0</td></tr>
<tr><td>TC-OM</td><td>2.2</td><td>—</td><td>4.5</td><td>1.2</td><td>1.6</td><td>—</td><td>2.8</td><td>1.1</td></tr>
<tr><td>TC-RC</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">1.0</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2"><1.0</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">—</td></tr>
<tr><td>TC-1</td></tr>
</table>

Notes:

— Suitable habitat for receptor not present or negligible risks (i.e., HQ < 1.0) under existing conditions (Risk Refinement and Synthesis)

Negligible Risk	All HQ values below 1.0 using screening level TRVs
Very Low Risk	HQ values above 1.0 using screening level TRVs but less than 1.0 using Golder (2012) lower bound TRVs; exceedance of screening level TRV shown as value in cell
Low Risk	HQ values above 1.0 using Golder (2012) lower bound TRVs but less than 1.0 using Golder (2012) upper bound TRVs; exceedance of Golder lower bound TRVs shown as value in cell
Moderate to High Risk	HQ values above 1.0 using Golder (2012) upper bound TRVs

16.4 Summary of Residual Risks

A summary of the results of the assessment of residual risks to ecological receptors is presented in Table 11. As shown in the table, it is predicted that the protection goals listed in Section 15 will be met with full implementation of the SMP (i.e., an overall level of risk not greater than “moderate” will be achieved for benthic invertebrates and an overall level of risk not greater than “low” will be achieved for fish health, birds, and mammals). A description of residual risks predicted under full and partial implementation of the SMP is provided below the table.

Table 11: Summary of Residual Risks to Ecological Receptors from Sediment in KIH

<table>
<tr><th rowspan="2">Management Unit</th><th colspan="4">Ecological Receptors</th></tr>
<tr><th>Effects to Benthic Community</th><th>Effects to Fish Health</th><th>Effects to Birds</th><th>Effects to Mammals</th></tr>
<tr><td>PC-N*</td><td>Negligible</td><td>Negligible</td><td>Negligible</td><td>Negligible</td></tr>
<tr><td>TC-E*</td><td>Negligible</td><td>Negligible</td><td>Negligible</td><td>Negligible</td></tr>
<tr><td>PC-E</td><td>Negligible</td><td rowspan="3">Low</td><td>Low</td><td>Very Low</td></tr>
<tr><td>PC-W</td><td>Negligible</td><td>Very Low</td><td>Negligible</td></tr>
<tr><td>TC-OM</td><td>Negligible</td><td>Low</td><td>Very Low</td></tr>
<tr><td>TC-1*</td><td>Negligible</td><td rowspan="2">Low</td><td rowspan="2">Negligible</td><td rowspan="10">N/A</td></tr>
<tr><td>TC-RC</td><td>Negligible</td></tr>
<tr><td>WM</td><td>Negligible</td><td rowspan="5">Low</td><td rowspan="3">Negligible</td></tr>
<tr><td>TC-2B*</td><td>Moderate</td></tr>
<tr><td>TC-2A</td><td>Negligible</td></tr>
<tr><td>TC-3A*</td><td>Negligible</td><td rowspan="3">Negligible</td></tr>
<tr><td>TC-3B*</td><td>Moderate</td></tr>
<tr><td>TC-4</td><td>Low</td><td rowspan="3">Low</td></tr>
<tr><td>TC-AB</td><td>Low</td><td rowspan="2">Negligible</td></tr>
<tr><td>TC-5*</td><td>Moderate</td></tr>
</table>

Notes:

N/A = not applicable; management unit not assessed for endpoint

* Monitored natural recovery is the primary management method proposed for these management units

Negligible Risk

Very Low Risk

Low Risk

Moderate

16.4.1 Full Implementation

Full implementation of the SMP is predicted to meet the overall protection goals for KIH (i.e., no unacceptable risks to humans; an overall level of risk not greater than “low” for mammals, birds, amphibians and fish; and an overall level of risk not greater than “moderate” for benthic invertebrates). If all management units are addressed per the SMP, residual environmental liabilities would be restricted to the following:

- **Benthos**—No substantial alterations to the abundance or diversity of the benthic invertebrate community are anticipated for the areas identified for “monitored natural recovery” in Figure 7 (i.e., grey shaded areas), although small pockets of contaminated sediments will remain. Based on the distributions of chemical stressors, and the observed relationships to sediment toxicity and biology information (Golder 2016), residual risks in these areas would be minor, and not significant at the broader community level (i.e., no meaningful effects in terms of food resources for resident fish species).

- **Fish**—The areas identified for “monitored natural recovery” in Figure 7 will not result in unacceptable residual risks to fish for endpoints related to survival, growth, reproduction, or normal development. Fish communities will remain healthy and consistent with other conditions in the lower Cataraqui River, subject to habitat constraints. However, the residual concentrations of PAHs in some management units would potentially cause elevated frequency of bottom fish deformities. The SMP addresses surface PAH concentrations expected to cause high incremental rates of lesions in Brown Bullhead, but some increases in lesion prevalence could remain for weighted average PAH concentrations above 4 mg/kg total PAH. We have not recommended intrusive management of sediments to that level, in part due to the practical constraints to this degree of sediment removal, and in part due to the presence of elevated PAHs in adjacent parts of Kingston Harbour, particularly in the Outer Harbour (western shoreline) where legacy contamination of PAHs affected a large portion of the shoreline.

- **Wildlife**—The targeted removal of contaminated sediments along the shoreline areas of KIH will result in elimination of significant risk pathways for PCBs and chromium to most species. The residual risks for birds and mammals (predicted to be low or very low; e.g., potential adverse sublethal effects including effects to reproduction, growth, development, etc.) would be limited to animals with small home ranges that reside mainly within wetland habitats of PC-W that are not excavated or capped. For species that use wetland habitats but are wide ranging (i.e., those that also use neighbouring wetland habitats in the Great Cataraqui Marsh), residual risks are not expected to be significant even if large portions of the wetland are retained without intrusive management. The “thin cap” and “habitat mosaic” options currently specified for these wetland areas (Figure 7) may be adjusted through input from the Detailed Impact Assessment and Stakeholder Engagement and Indigenous Consultation, while balancing chemical risk and habitat alteration.

- **Humans**—The SMP will address significant risk pathways for most recreational users, either through physical removals (or isolation) of contaminated nearshore sediments, or through meaningful reductions in weighted average fish concentrations for substances that are strongly bioaccumulative (i.e., mercury and PCBs). Fish consumption advisories for mercury and PCBs will be maintained, as harbour wide concentrations of these substances will not be reduced to background levels and unlimited consumption of fish is not a viable management objective. Long term continued reductions in average fish tissue concentrations through the combination of source control, targeted intrusive management in areas of greatest sediment contamination, and natural recovery through burial and mixing with cleaner sediments may be possible.

The implementation of the SMP will result in a long-term steady improvement of conditions throughout the entire western half of KIH for all above receptor groups. Recirculation of sediments via resuspension and settling will occur, although the rate of lateral sediment mixing will be restricted due to the overall low energy environment and sediment transport dynamics of KIH. The removal of the most heavily contaminated sediments is anticipated to result in positive effects to adjacent sediments flagged for monitored natural recovery areas within the next decade.

16.4.2 Partial Implementation

Some uncertainty remains as to whether the SMP will be applied consistently across the harbour, due to the complex management and jurisdiction model of KIH. Sharing of costs and liability, as negotiated amongst the property managers, would be a beneficial step forward to the overall management of KIH. The following provides an overview of potential residual liabilities in scenarios where the SMP may not be applied consistently. This is not intended to be an exhaustive list of scenarios and outcomes, but rather provided a qualitative assessment of potential outcomes from partial implementation of the SMP.

16.4.2.1 WM – City of Kingston

The Woolen Mill management unit (WM) is the largest area of sediment not under federal jurisdiction. Clear links to upland contaminant sources were identified, particularly with respect to arsenic, mercury, and antimony. Although the City of Kingston has installed an underground Zero Valent Iron Permeable Reactive Barrier (or ZVI-PRB) Wall, to filter and clean the groundwater, residual sediment contamination remains. Contamination may be migrating from adjacent Management units (TC-RC in particular, but also the northern tip of TC-2A). Mercury contamination is also evident throughout WM, TC-RC, and water lots to the south (TC-2A, TC-3A, and TC-4) where it appears that sediment mercury contamination has been redistributed from the Emma Martin Park source area.

If sediment management is not conducted for the Woollen Mill management unit, additional risks relative to those discussed for the “full implementation scenario” will remain. The risks to benthic invertebrates and fish will remain similar to the full implementation scenario, because the arsenic, mercury, and antimony concentrations are not expected to cause significant responses to benthic community endpoints. For wildlife, the risks will be slightly greater than under full implementation, but the difference will not be large because the habitat adjacent to Emma Martin Park is not well suited to shoreline birds and mammals (i.e., commercial/industrial use) and because the concentrations of chromium and PCBs are lower here than in some other management units. Risks to human health would be elevated primarily through the mercury contributions to KIH fish; as such, the rate of reduction of harbour-wide fish concentrations would be slowed if the WM water lot is not actively managed to reduce exposure. Risks to humans through the direct contact pathway (i.e., wading, swimming) would also persist, although these risks could be reduced through relatively inexpensive engineering controls (e.g., fencing to prohibit human access to shallow sediments).

16.4.2.2 PC-W – Jurisdiction Pending Portion (PP-OM)

The second largest area that has potential to not be under federal jurisdiction (pending confirmation) includes the PC-W sub-management area PP-OM adjacent to the Orchard Street Marsh. Sediment in this management sub-unit contains some of the highest chromium concentrations and elevated PAHs associated with Davis Tannery historical industrial activities. If active management to reduce exposures is not conducted for this management sub-unit, additional risks relative to those discussed for the “full implementation scenario” will remain. The risks to benthic invertebrates and fish will remain similar to the full implementation scenario, because the chromium concentrations are not expected to cause significant responses to benthic community endpoints. For wildlife, the risks will be greater than under full implementation, but residual risks for birds and mammals would be limited to animals with small home ranges that reside mainly within wetland habitats of PC-W. Risks to human health would be similar to full implementation, as the concentrations of PAHs are generally lower in this area and do not contribute to the fish ingestion pathway. Risks to humans through the direct contact pathway (i.e., wading, swimming) would also persist, although these risks could be reduced through relatively inexpensive engineering controls (e.g., fencing to prohibit human access to shallow sediments).

16.4.2.3 TC-2A, TC-3A, TC-4, TC-AB –City of Kingston (Douglas Fluhrer Park Shoreline)

The sediment management strategies recommended for the shoreline areas of Douglas Fluhrer Park include a boardwalk within TC-2A, and shoreline revetment (generally consistent with existing shoreline character) within TC-3A, TC-4, and TC-AB. Shoreline works for these areas fall partially or entirely within areas under the City of Kingston jurisdiction. Sediment in these areas contain elevated concentrations of PAHs associated with the historic railyard activities, as well as localized elevated concentrations of PCBs, arsenic, and mercury. Some intrusive management actions in these areas are recommended to address elevated sediment contamination, but the extent and type of these interventions are constrained by habitat and other water lot characteristics requiring caution, particularly in areas with higher ecological or archaeological value. Rather than apply intrusive methods such as dredging of large areas, less intrusive measures including dredging of localized hotspots, thin-layer capping, and the use of institutional/engineering controls to prevent human health risks are planned.

If sediment management is not conducted within shoreline areas, it is expected that most of the contamination within these management units will be addressed through sediment management activities planned within Transport Canada’s jurisdiction. However, the sediments along the shoreline would remain contaminated, and mixing of those shoreline sediments with cleaner sediments from the central water lot would require very long period (i.e., decades) to occur. Although it can be inferred that elevated concentration of PAHs, PCBs, and metals exist within shoreline areas, sampling has emphasized the federal water lots, and the details of the Douglas Fluhrer Park nearshore contamination (both vertical and lateral delineation) are not presently known.

Based on our current understanding of the sediment chemical composition within these areas, risks to receptors would be affected as follows (under the scenario of shoreline exclusion):

- Benthic invertebrates and fish—residual risks would remain similar to the full implementation scenario, mainly due to the small relative contribution of the shoreline areas to the total habitat area. The residual PCB, arsenic, and mercury, concentrations are not expected to cause significant responses to benthic community endpoints, due to the lower sensitivity of these organisms to these COCs, and the hotspots of elevated PAHs will be primarily managed under Transport Canada’s jurisdiction.
- Wildlife—For wildlife, the risks will be slightly greater than under full implementation, due to the use of shoreline areas for foraging by several species of wildlife. However, the magnitude of the difference will not be large because the habitat adjacent to Douglas Fluhrer Park is less well suited to shoreline birds and mammals relative to areas further north, and the management units encompass wide areas of shallow water habitat where wildlife would dilute their exposure. Furthermore, the concentrations of chromium and PCBs are relatively low in these shoreline areas of southern KIH relative to other management units.

- Humans—Risks to humans through the direct contact pathway (i.e., wading, swimming) would persist, and the implications for residual risk would be highest for this exposure pathway because human contact with sediment is greatest within nearshore areas. It is difficult to quantify the numerical effect on human health risk from dermal contact under a scenario where shoreline contaminated areas were left unmanaged, but qualitatively it is expected that risk reduction effectiveness for this pathway would be substantially reduced if shoreline areas are excluded. Residual risks in this scenario could be reduced through relatively inexpensive engineering controls (e.g., fencing to prohibit human access to shallow sediments), although such restrictions are generally poorly perceived by the public (as evidenced by the compromised fencing and vandalism for the perimeter of the private property brownfield to the north), are easily circumvented, and may be inconsistent with ecological values (e.g., movements of turtles from aquatic habitat to the riparian areas near Douglas Fluhrer Park). An alternate approach to residual risk management could entail targeted dredging and backfilling following a more detailed delineation of shoreline contaminants (conducted in parallel with, or following, the federal sediment management program). Finally, the considerations of geotechnical stability of the shoreline banks, linkage to the overall development plan for the waterfront recreational corridor, and considerations of turtle nesting and basking habitats, may warrant decoupling of the shoreline areas from the broader sediment management plan for the main federal water lots in these areas.

17.0 COSTS FOR THE CONCEPTUAL SEDIMENT MANAGEMENT PLAN

The preliminary Class C (+/- 30%) cost estimates for the conceptual SMP are provided in Appendix A. The technical basis for cost estimation builds on the rationale provided in Section 12.0, while integrating the engineering aspects of the proposed methods. The technical assumptions used to align the required engineering aspects of the sediment management design with the conceptual characteristics of the SMP are discussed in detail in Section 13.0. Appendix A also provides unit rate estimates to provide transparency in the calculation of costs for each management unit.

The conceptual SMP accounts for the various management alternatives, incorporates professional judgement, and assumes Indigenous and stakeholder satisfaction for the planned actions. It is anticipated that a revised sediment management design following Stakeholder Engagement and Indigenous Consultation will likely remain within the range of costs specified in Appendix A. The Class C cost estimate is conservative (i.e., biased upward to avoid underestimates), including application of a 25% contingency. As a conservative measure, costs were developed assuming each management unit would be managed separately. It would be more practical to combine several management units as a single project, or several projects could be performed concurrently. This would significantly reduce mobilization and demobilization costs and would also likely save costs by attaining lower unit rates for the various sediment management items. Approximately $10 million in cost savings could be obtained by combining management units into larger integrated projects.

18.0 NEXT STEPS

Parks Canada and Transport Canada have started to engage with Indigenous communities and are completing various baseline environmental inventory and assessment studies (i.e., archaeological, fish, plant, wildlife and habitat studies). The following are also planned for next steps in the planning stage:

- Continue to engage/consult with Indigenous communities, and initiate engagement activities with the general public and other stakeholders (e.g., local community groups, adjacent land managers).
- Determine regulatory requirements (e.g., *Impact Assessment Act*, *Fisheries Act*, *Canadian Navigable Waters Act*, other permitting), and engage with other government agencies regarding the proposed project.
- Initiate a Detailed Impact Assessment following Parks Canada's Impact Assessment Directive (IAA 2019). This process will be consistent with the requirements of the Canadian *Impact Assessment Act*, to determine whether any aspects of the SMP would be likely to cause significant adverse environmental effects.
- Explore the potential for partnership with the City of Kingston to coordinate potential work on federal and city lots. A partnership with DND may also be pursued, if DND determines that management action is required on their DND lot (pending confirmation)..
- Refine project plans based on feedback received from Indigenous communities and stakeholders, seek internal project funding and approvals, and initiate the detailed design and specification stage for physical works.

19.0 CLOSURE

We trust that the information presented in this report addresses your immediate requirements. If you have any questions or concerns, please do not hesitate to contact the undersigned at 604-296-4200.

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https://golderassociates.sharepoint.com/sites/15844g/deliverables/issued to client_for wp/1783886-014-r-rev1/1783886-014-r-rev1-kih conceptual sedimentmgmntplan fy2020-21_04aug_21.docx

20.0 REFERENCES

Abel S, Akkanen J. 2018. A Combined Field and laboratory Study on Activated Carbon-Based Thin Layer Capping in a PCB-Contaminated Boreal Lake.

Archaeological Services Inc. 2008. Master Plan of Archaeological Resources—City of Kingston Technical Report. Submitted to Culture and Heritage, City of Kingston. August 2008.

BC CSR (British Columbia Contaminated Sites Regulation). 2019. Schedule 3.4 Generic numerical sediment standards. BC REG. 13/2019, s. 12.

Bowfin Environmental Consulting. 2011. City of Kingston Environmental Assessment for the Third Crossing of the Cataraqui River Fisheries Results and Impact Analysis. Prepared for J.L. Richards and Associates Ltd. version 1.0. May 2011.

Canada (Government of Canada). 1985. Fisheries Act. R.S.C. 1985, c. F-14. Current to: 16 January 2020. Last amended: 28 August 2019.

Canada.1985. Canadian Navigable Waters Act. R.S.C. 1985, C. N-22. Current to: 16 January 2020. Last Amended: 4 October 2019.

Canada. 1994. Migratory Birds Convention Act (S.C. 1994, c. 22) Current to 16 January 2020. Last amended: 12 December 2017.

Canada. 2002. Species at Risk Act. S.C. 2002, c. 29.

Canada. 2002. Metal and Diamond Mining Effluent Regulations (SOR/2002-222). Current to: 16 January 2020. Last amended: 25 June 2019.

Canada. 2019. Impact Assessment Act. S.C. 2019, C.28, s.1). Current to: 16 January 2020. Last amended: 28 August 2019.

CCME (Canadian Council of Ministers of the Environment). 1999 (including updates to 2015). Canadian soil quality guidelines for the protection of environmental and human health, Winnipeg. Available at: http://ceqg-rcqe.ccme.ca/.

CCME (Canadian Council of Ministers of the Environment). 2011. Canadian environmental quality guidelines, 1999 (with 2011 updates). Canadian Council of Ministers of the Environment, Winnipeg. Available at: http://ceqg-rcqe.ccme.ca/.

Chapman PM. 2008. Canada-Ontario Decision-Making Framework for assessment of Great Lakes Contaminated sediment. Prepared by Peter Chapman (Golder Associates Ltd.) with the Canada-Ontario Sediment Task Group on behalf of Environment Canada and the Ontario Ministry of the Environment under the Canada Ontario Agreement. March 2008. Prepared by: The Interstate Technology & Regulatory Council Contaminated Sediments Team.

Chapman PM. 2011. Framework for Addressing and Managing Aquatic Contaminated Sites Under the Federal Contaminated Sites Action Plan (FCSAP). Golder Associates Ltd, Burnaby (BC), Canada. 14 March 2011.

City of Kingston. 2018. City of Kingston Report to Planning Committee Report Number PC-18-021. Meeting minutes dated 8 March 2018. Available at: https://www.cityofkingston.ca/documents/10180/24544147/PLN_A0618-18021.pdf/55b7ea30-843c-4bda-ad28-a263fdc9ddbd.

DFO (Fisheries and Oceans Canada). 2019. Fisheries Protection Policy Statement. Ecosystem Programs Policy. Her Majesty the Queen in Right of Canada.

City of Kingston. 1989. Pollution Control Plan comprehensive review, to address water contamination and capacity limitations of the sewage collection system.

City of Kingston. 2019. City of Kingston Official Plan. Approved 27 January 2010. Consolidated to: 1 November 20019. Available at: https://www.cityofkingston.ca/documents/10180/541790/Official+Plan/17793cad-90db-4651-8092-16c587600001. Accessed: 21 January 2020.

CSMWG (Contaminated Sites Management Working Group). 2009. FCSAP Aquatic sites classification system. Ottawa (ON), Canada.

DFO. 2020. Aquatic Species at Risk Mapping. Available at: http://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html. Accessed 2 January 2020.

Eakins RJ. 2020. Ontario Freshwater Fishes Life History Database. Version 4.86. Online database. Available at: http://www.ontariofishes.ca Accessed 2 January 2020.

Ecological Services. 2008. Species Inventory and Ecological Evaluation: Orchard St. Marsh, Kingston, Ontario. Prepared for the Environmental Sciences Group, Royal Military College, Kingston, ON.

ESTCP (Environmental Security Technology Certification Program). 2009. State-of-the-practice overview: critical evaluation of state-of-the-art in situ thermal treatment technologies for DNAPL source zone treatment. ESTCP Project ER-0314.

Environment Canada and Ontario Ministry of the Environment (EC and MOE). 2008. Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment. Prepared by Peter Chapman (Golder Associates Ltd.) with the COA Sediment Task Group on behalf of Environment Canada and the Ontario Ministry of the Environment under the 2002 Canada Ontario Agreement. March 2008.

FCSAP (Federal Contaminated Sites Action Plan). 2019a. Framework for Addressing and Managing Aquatic Contaminated Sites under the Federal Contaminated Sites Action Plan. Version 2.0 June 2019.

FCSAP. 2019b. Guidance for Assessing and Managing Aquatic Contaminated Sites in Working Harbours, Version 1.0. June 2019. Ottawa: Her Majesty the Queen in Right of Canada. 61 pgs.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421- 0039. 31 March 2012.

Golder. 2013a. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, ON. 26 March 2013.

Golder. 2013b. Parks Canada Water Lot Sediment Quality Update, Kingston Inner Harbour, Kingston, Ontario. Submitted to Public Works and Government Services Canada on behalf of CLAW Environmental Services Inc., Ottawa, ON. 1 April 2013.

Golder. 2014. Transport Canada Water Lot Sediment Investigation – 2013. Kingston Inner Harbour, Kingston, Ontario. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, ON. 27 March 2014.

Golder. 2016. Kingston Inner Harbour—Risk Assessment Refinement and Synthesis. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Revised Final Report. Report Number: 1416134-004-R-Rev0. 17 August 2016.

Golder. 2017a. Kingston Inner Harbour—Conceptual Remedial Options Analysis. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1661792-001-R-Rev1. 17 August 2017.

Golder. 2017b. Kingston Inner Harbour—Preliminary Sediment Transport Study. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1661792-002-R-Rev0. 16 March 2017.

Golder. 2019. Recommended Remedial Option for the Kingston Inner Harbour. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1783886-003-R-Rev A. 24 September 2019.

Ghosh U, Luthy RG, Cornelissen G, Werner D, Menzie CA. 2011. In-situ Sorbent Amendments: A New Direction in Contaminated Sediment Management. Environ. Sci. Technol. 2011,45 (4), 1163−1168.

HCCL. 2011. Hydrotechnical Analysis in Support of Environmental Assessment for Third Crossing of Cataraqui River. Prepared for J.L. Richards & Associates Ltd. and the City of Kingston.

ITRC (Interstate Technology & Regulatory Council). 2014. Guidance Document: Contaminated Sediments Remediation Remedy Selection for Contaminated Sediments.

JLR (JL Richards). 2012. City of Kingston Third Crossing of the Cataraqui River Environmental Assessment. Environmental Study Report under the Ontario Municipal Class Environmental Assessment Framework. 16 April 2012. Document Number: JLR 23446-02. Available at: https://www.cityofkingston.ca/documents/10180/45631/EA_Report_No+Figures.pdf/3d5f7026-6fe5-47a5-a11e-d1fb85ee28a6. Accessed: 13 January 2020.

Long ER, MacDonald DD. 1998. Recommended uses of empirically derived, sediment quality guidelines for marine and estuarine ecosystems. Human and Ecological Risk Assessment 4(5): 1019-1039.

MacDonald DD, Ingersoll CG, Berger TA. 2000. Development of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

MacLatchy P. 2016. RE: Review of Kingston Inner Harbour Risk Assessment and Sediment Management Options. Letter from Paul MacLatchy (Environment Director, Department of Real Estate & Environmental Initiatives, City of Kingston) to Javier Banuelos (Senior Environmental Specialist, Environmental Remediation Services, Environmental Services & Contaminated Sites, PWGSC Ontario Region, Toronto, Ontario). 6 December 2016.

MECP (Ministry of the Environment, Conservation and Parks). 2019. Fish Consumption Advisory: Cataraqui River, Belle Island Area, Leeds Co. (44°15'16"N 76°28'23"W). Updated: 27 March 2019. Available at: https://www.ontario.ca/environment-and-energy/sport-fish-consumption-advisory?id=44167628. Accessed: 13 January 2020.

Moffatt and Nichol. 2020a. Draft Kingston Inner Harbour Remedial Action Plan Development and Stakeholder Engagement. Prepared for Golder Associates Ltd. 21 January 2020.

Moffatt and Nichol. 2020b. Draft Kingston Inner Harbour Remedial Action Plan Draft Designs. Prepared for Golder Associates Ltd. 21 January 2020.

Moore J. 1995. The Boneyard Below the Bridge. Freshwater, 10 3-29.

MNRF (Ministry of Natural Resources and Forestry). 2017. Updated In-Water Work Timing Guidelines in Kemptville District. Available at: https://nationmun.ca/wp-content/uploads/2017/minutes/38-%2018%20december/16.4%2020171208%20eng%20ministry%20of%20natural%20resources%20and%20forestry%20updated%20in-water%20work%20timing%20guidelines%20in%20kemptville%20district.pdf. Accessed: 2 January 2020.

MNRF. 2020. Fish ON-Line Available at: https://www.gisapplication.lrc.gov.on.ca/FishONLine/Index.html?site=FishONLine&viewer=FishONLine&locale=en-US. Accessed: Accessed 2 January 2020.

MNRF. 2020. Land Information Ontario Aquatics Resource Layer. Accessed 2 January 2020O'Connor TP. 2004. The sediment quality guideline, ERL, is not a chemical concentration at the threshold of sediment toxicity. Mar Pollut Bull 49:383-385.

MMAH (Ontario Ministry of Municipal Affairs and Housing). 2014. Provincial Policy Statement.

NRC. 1997. Contaminated Sediments in Ports and Waterways: Cleanup Strategies and Technologies. National Research Council, National Academy Press: Washington, DC.

Ontario (Government of Ontario). 1990. Ontario Environmental Protection Act R.S.O. 1990, c. E.19. Last amendment: 2019. Available at: https://www.ontario.ca/laws/statute/90e19. Accessed: 13 January 2020.

Ontario Legislative Assembly. 2004. Ontario Regulation 97/04 made under the *Conservation Authorities Act*. Content of Conservation Authority Regulations Under Subsection 28(1) of the Act: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

Ontario Legislative Assembly. 2006. Ontario Regulation 148/06 made under the *Conservation Authorities Act*. Cataraqui Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

Ontario. 1990. O. Reg. 153/04: Records Of Site Condition - Part Xv.1 of the Act. under Environmental Protection Act, R.S.O. 1990, c. E.19. Last amended: 4 December 2019. Available at: https://www.ontario.ca/laws/regulation/040153. Accessed. 13 January 2020.

Ontario. 1990. Ontario Water Resources Act, R.S.O. 1990, c. O.40. Last amendment: 10 December 2019. Available at: https://www.ontario.ca/laws/statute/90o40. Accessed: 13 January 2020.

Ontario (Government of Ontario). 2007. Endangered Species Act. S.O. 2007.

OMOE. 2008. Guidelines for Identifying, Assessing and Managing Contaminated Sediments in Ontario: An integrated approach. Environmental Reporting Branch and Standards Development Branch. Prepared by PM Chapman, under the guidance of J Anderson (Environment Canada) and D Boyd (MOE), and the members of the COA Sediment Task Force. May 2008. Available at: http://www.ene.gov.on.ca/environment/en/resources/STD01_076359.html.

OMOE. 2011. Rationale for the development of soil and groundwater standards for use at contaminated sites in Ontario. April 2011. Standards Development Branch.

Palermo M, Maynord S, Miller J, Reible D. 1998. Guidance for In-Situ Subaqueous Capping of Contaminated Sediments. EPA 905-B96-004. Great Lakes National Program Office, Chicago, IL.

Patmont CR, Ghosh U, Larosa P, Menzie CA, Luthy RG, Greenberg MS, Cornelissen G, Eek E, Collins J, Hull J, Hjartland T, Glaza E, Bleiler J, Quadrini J. 2014. In Situ Sediment Treatment Using Activated Carbon: A Demonstrated Sediment Cleanup Technology. Integrated Environmental Assessment and Management. 11. 10.1002/ieam.1589.

Persaud DR, Jaagumagi R, Hayton A. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Water Resources Branch, Ontario Ministry of the Environment. Toronto ON.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2014. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Prepared by: Environmental Sciences Group. Kingston, Ontario. Document Number: RMC-CCE-ES-14-03.

SNC (SNC-Lavalin). 2020. Inner Harbour Sediment Stability Study – Kingston Inner Harbour Transport Canada and Parks Canada Water Lot Kingston, Ontario. Document Number: 653502-EG-L01-PA.

Tocher Heyblom Design Inc. 2014. Development of a High Level Vision for Douglas R. Fluhrer Park, City of Kingston. May 2014.

US EPA. 2008. *Ecological Soil Screening Levels for Chromium. Interim Final.* OSWER Directive 9285.7- 66. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. Revised April 2008.

US EPA. 2013. ProUCL Software, Version 5.0.00. Available at: http://www2.epa.gov/land-research/proucl-software.

Personal Communications

MacLatchy P. 2013. Personal communication 6 March 2013 between Seguin S (Golder Associates Ltd.) and MacLatchy P (City of Kingston).

MacLatchy P. 2016. Personal communication 31 July 2018 between Finan-McKinley H (Transport Canada) and MacLatchy P (City of Kingston).

APPENDIX A

Conceptual Sediment Management Plan Development and Costs

Note: Costs have been redacted so not to bias future competitive contracting processes.

Kingston Inner Harbour Sediment Management Plan

Prepared for:

Golder Associates Ltd.

Revision	Description	Issued By	Date	Checked	Approved
A	Draft Report	PK	Jan 21, 2020	JH	PK
B	Final Report	PK	Mar 31, 2020	ES	PK
C	Revised Report	PK	Oct 2, 2020	PK	PK
D	Revised Report	PK	Dec 17, 2020	PK	PK
E	Revised Report	PK	March 11, 2021	PK	PK

Prepared by:

moffatt & nichol

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1. Introduction

Moffatt & Nichol (M&N) has prepared and completed the development of a Sediment Management Plan (SMP) for the Kingston Inner Harbour (Figure 1-1). Bathymetry of the harbor area is shown in Figures 1-2 and 1-3. This report provides the concept development plans for the nine distinct management units within the harbor area. A Class C Cost Estimate was developed for each of the Sediment Management Plans in each management unit. Costs are estimated using Canadian dollars.

Figure 1-1: Project Location Aerial Photo

Figure 1-2: Southern Project Area Bathymetry (CHS Chart No. 2017 [1990])

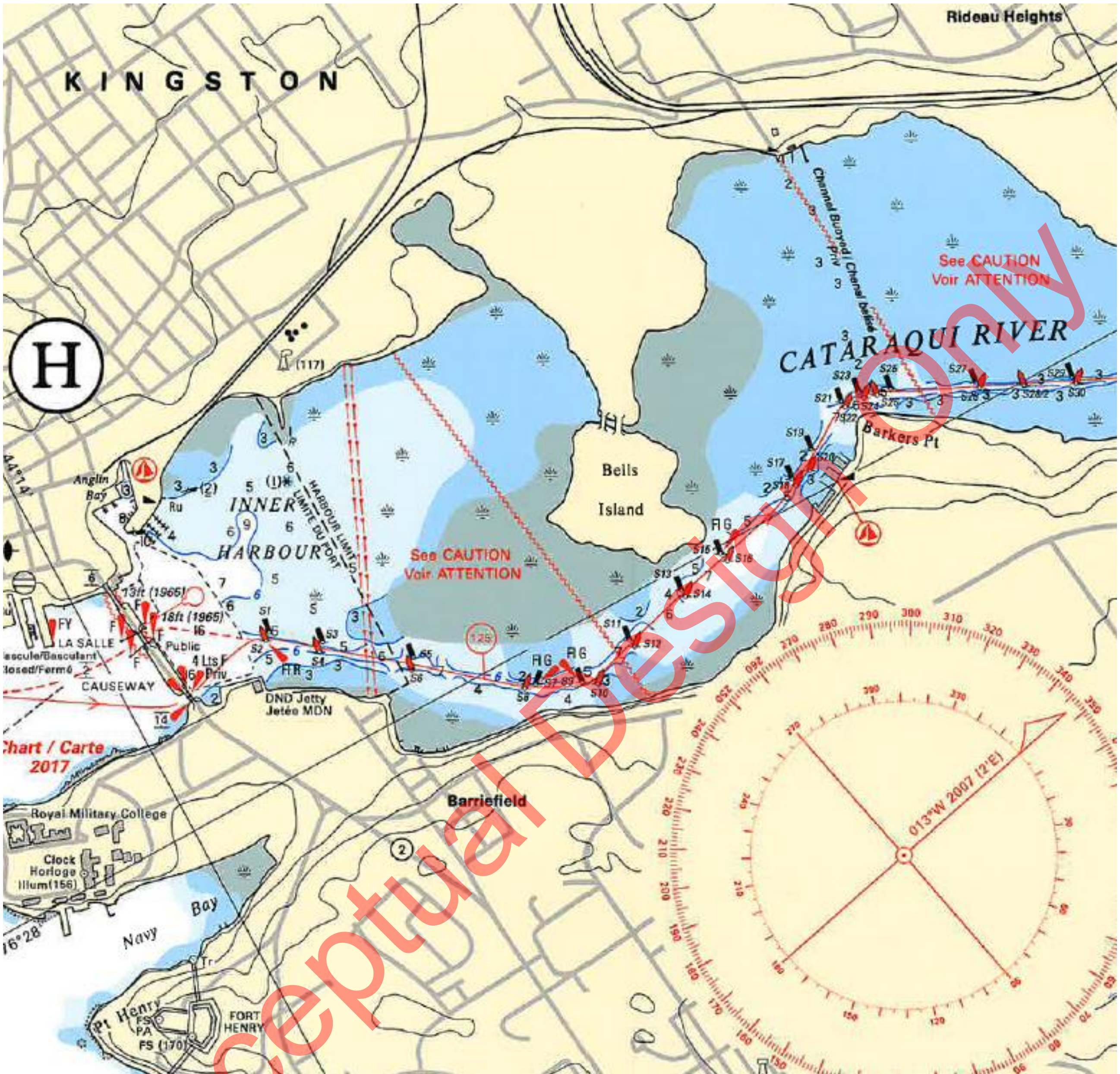


Figure 1-3: Project Area Bathymetry (CHS Chart No. 1513 [2007])

1.1. Sediment Management Units

For the sediment management options, there are nine distinct management units for the area within the Kingston Inner Harbour. These management units have been identified, from north to south, as PC-E, PC-W, TC-OM, TC-RC, WM, TC-2A, TC-3A, TC-4, and TC-AB (Figure 1-4). Parks Canada is the property owner of the management units designated with PC and Transport Canada is the property owner of the management units designated with TC. WM is a former woolen mill owned by the City of Kingston (CoK). The City of Kingston also owns portions of the management units within PC-W, TC-2A, TC-3A, TC-4 and TC-AB. PC-W has been divided into three units designated as PC-W, PC-OM and PP-OM (jurisdiction pending confirmation). The OM acronym is the designation for the Orchard Street Marsh. Sediment management option techniques within each management unit vary based on the levels of contamination and the desired treatment goals, to include:

- Dredging and offsite disposal,
- Conventional capping with sand,
- Thin capping with activated carbon addition,
- Engineering controls using sand capping and rock shoreline revetment installation,
- Engineering controls with boardwalk construction to limit public access into the water, and
- Wetland restoration.

Areas for each management unit and treatment options were computed based on the scenario shown in Figure 1-4. Table 1-1 provides the total area of each management unit, the proposed treatment options and the area for the treatment option. Some areas for treatment overlap for a given treatment. Volumes were computed assuming 1 m mean dredging depth and 30 cm sand cap, except for Anglin Bay where the sand cap would be multi-layered, consisting of 70 cm of sand overlain by 30 cm of sand containing activated carbon.

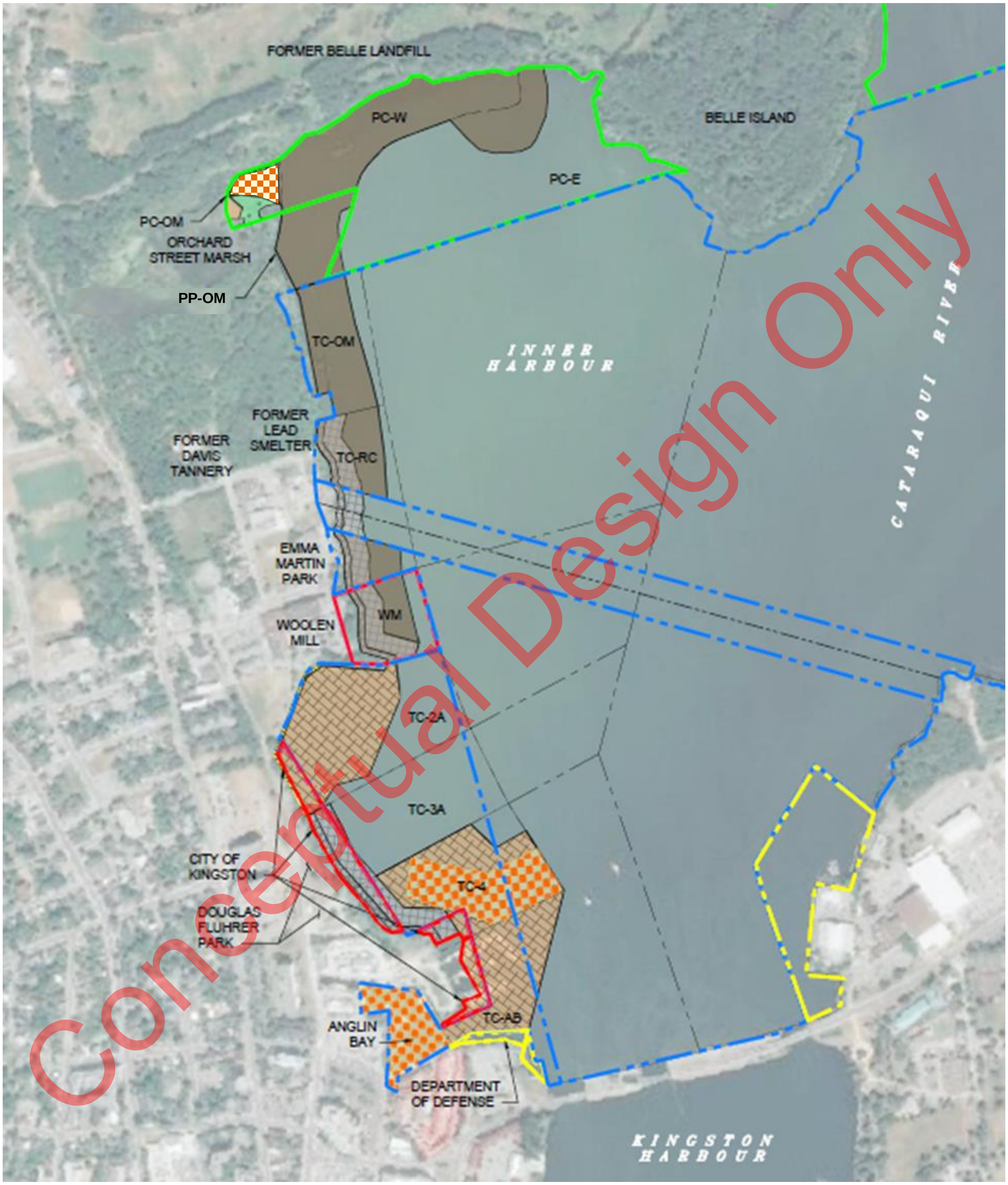


Figure 1-4: Kingston Inner Harbour Sediment Management Units (Golder 2018)

Table 1-1: Sediment Management Units for Kingston Inner Harbour

Management Unit	Total Area Including MNR (hectares)	Selected Sediment Management Option	Treatment Area (hectares)	Volume (m^3)
PC-E	9.5	Dredging	1.2	12,000
PC-W	3.8	Dredging	3.6	36,000
PC-OM	0.7	Dredging	0.36	3,600
		Thin Sand Cap & Activated Carbon	0.44	1,320
		Wetland Restoration	0.2	2,000
PP-OM	1.3	Dredging	1.2	12,000
TC-OM	2.6	Dredging	2.2	22,000
TC-RC	3.6	Dredging	2.1	21,000
		Shoreline Revetment Armor Stone Thin Sand Cap	 0.3 0.9	 3,000 2,700
WM	1.9	Dredging	1.4	14,000
		Shoreline Revetment Armor Stone Thin Sand Cap	 0.15 0.45	 1,500 1,350
TC-2A	4.8	Thin Sand Cap & Activated Carbon	2.1	6,300
		Boardwalk	0.0525	—
TC-2A (CoK)		Thin Sand Cap & Activated Carbon	0.3	900
		Boardwalk	0.0375	—
TC-3A (CoK)	4.1	Shoreline Revetment Armor Stone Thin Sand Cap	 0.15 0.45	 1,500 1,350
TC-4	4.15	Dredging	1.9	19,000
		Thin Sand Cap & Activated Carbon	3.2	9,600
		Shoreline Revetment Armor Stone Thin Sand Cap	 0.03 0.31	 300 930
TC-4 (CoK)		Thin Sand Cap & Activated Carbon	0.1	300
		Shoreline Revetment Armor Stone Thin Sand Cap	 0.15 0.23	 1,500 690
TC-AB	3.9	Thin Sand Cap & Activated Carbon	2.2	6,600
		Dredging	1.3	13,000
		1 m Thick Multi-Level Cap 70 cm Marina Sand Layer 30 cm Thin Sand Cap & Carbon	 1.3 1.3	 9,100 3,900
TC-AB (CoK)		Thin Sand Cap & Activated Carbon	0.5	1,500

1.2. Sediment Management Options Techniques

1.2.1. Dredging, Treatment and Offsite Disposal

The methods for dredging, treatment, and disposal of the dredged material were initially presented in the Recommended Remedial Option for the Kingston Inner Harbour report (Golder 2019); this option is proposed for seven of the nine management units. A description of the method and costs for the Preferred Sediment Management Option are based on in-barge mixing and stabilization of the dredged material; these are developed further in the following sections. The most practical method is mechanical dredging as this method does not add a significant amount of water to the material prior to the implementation of the treatment process.

1.2.1.1. Mechanical Dredging

The mechanical dredging would be performed using a closed clamshell environmental bucket inside of a turbidity control curtain (for example, see Figure 1-5). The vertical length of the curtain will be sized to end above the bottom to minimize potential for scour. The dredge will control the "bite" of the bucket to: (a) minimize the total number of passes needed to dredge the required sediment volume; and (b) minimize the loss of sediment due to extrusion through the bucket's vents openings or hinge area. The dredge will control the rate of descent of the bucket to maximize the vertical cut of the clamshell bucket while not penetrating the sediment beyond the vertical dimension of the open bucket (i.e., overfilling the bucket). This will reduce the amount of free water in the dredged material, will avoid overfilling the bucket, and minimize the number of dredge bucket cycles needed to complete the dredging work. The closed clamshell environmental bucket will be lifted slowly through the water at a rate of 2 feet per second or less. The dredged material will be deliberately placed into the barge to prevent spillage of material overboard. The discharge (i.e., overflow) of water from the scow into which dredged material is placed will be prohibited. The gunwales of the dredge scows will not be rinsed or hosed during dredging except to the extent necessary to ensure the safety of workers maneuvering on the dredge scow.

The barges will be transported to a dewatering location (either a temporary dock barge or anchored within the turbidity curtain at an approved place) where the material will be allowed to settle and the free-standing water will remain at the top. The free water will be decanted by pumping the water (i.e., supernatant) from the loaded barges into water holding (decant) barges that allow for additional settlement. Water shall be pumped from the decant barge through a discharge hose that will be submerged to minimize turbidity. Screens will be used on the dewatering hoses to minimize the passing of solids. Decant water will be held in the decant holding scow a minimum of 24 hours after the last addition of water to the decant holding scow.

Should there be a need or desire to reduce the required 24-hour holding time, it may be demonstrated that a reduced holding time is sufficient to meet a total suspended solids (TSS) less than 25 mg/L above background. No discharge will be permitted from the decant holding scow until the results of a gravimetric analysis have confirmed that the 25 mg/L background level has been achieved. Upon successful demonstration that the reduced holding time is sufficient to meet the TSS within 25 mg/L of background, the monitoring of TSS may be suspended and the demonstrated settling time may replace the 24-hour minimum.

Figure 1-5: Mechanical Dredging Inside Turbidity Control Curtain

1.2.1.2. Stabilization and Solidification Process

The next step would be to treat the dewatered dredged material using a stabilization and solidification process. Stabilization and solidification (S/S) is a soil management process by which contaminants are rendered immobile through reactions with additives or processes. During this process, also called immobilization, fixation, or encapsulation, contaminants may be chemically bound or encapsulated into a matrix. Stabilization is the general term for a process that transforms contaminants into a less mobile or toxic form, while solidification is a more specific process that treats material to increase its solidity and structural integrity. Solidification does not remove nor degrade contaminants but prevents their transport by eliminating or significantly hindering their mobility. Stabilization and solidification as a process accomplishes one or more of the following:

1. Improve handling and physical characteristics of sediment;
2. Decrease surface area of the sediment mass through which transfer/contaminant leakage can occur; and
3. Limit solubility of hazardous constituents in the waste.

Following decant of the excess water, the scow would be brought to a processing barge either anchored within the project site or located at an unloading facility. The processing barge would typically include a deck barge with spuds, a raised and reinforced platform for an excavator, cement silos with automated scale system, a cement mixer, slurry pump, fuel tank, fleeting winches, control house, and mixing head attachment for the excavator. A barge or silos filled with the reagent would be staged nearby to feed the auger/blender system. The excavator would have an auger/blender attachment that would be used to mix in reagents (e.g. Portland cement, lime, etc.) that are piped to the mixing head and blended with the dredged material. Dosage rates for reagents range from approximately 8% to 15% by weight. Figure 1-6 shows an example of a typical operation.

Note that this process produces a soil material in a state that provides the most flexibility in where the material could be used or disposed, whether it be for capping a brownfield or taken to a landfill. Different landfills may have different requirements for the material that one would accept for disposal. If a suitable landfill or other location can be identified that would accept the dredged material that was processed only through dewatering, then the addition of cement would not be necessary. Going forward to the next phase of design, end use of the material would be evaluated to determine the level of processing sufficient for use, placement and/or disposal. To be conservative, in this report it is assumed that addition of cement is part of the process and the costs presented herein reflect this method.

Figure 1-6: In- Barge Stabilization Operation and Typical Mixing Attachments

Important considerations for in-barge stabilization are quality control of the mixing process, which may be difficult, and application rates and consistency of mixing could vary. Once the materials in the barge are fully stabilized (up to 24 hours depending on moisture content of the material) they would be transported to a site (if not at the site) where it could be mechanically offloaded, placed into dump trucks and hauled to the disposal location, assumed to be a landfill. If necessary, a stockpile of processed material (with either Portland cement or lime) could be housed in a sprung structure prior to truck loading. It is estimated that the maximum daily throughput would be 1,000 m^3/day. Costs for this operation include loading the trucks, hauling the material to the disposal location, and placement of the material. Included in costs would be tipping fees for landfill disposal. Figure 1-7 shows a typical unloading operation and stockpile area.

Figure 1-7: Barge Unloading Operation and Stockpile Area

1.2.2. Conventional Capping with Sand

Capping of sediment with sand will be used for seven of the nine management units (all except PC-E and TC-OM). For management unit PC-W the sand cap is associated with wetland restoration and is described in Section 3.4 below. A sand cap having a thickness of 30 cm along the shoreline (out to 33 meters) is associated with the revetment in management units TC-RC, WM, TC-3A (CoK) and TC-4 (CoK). For management unit TC-AB (including CoK property) the sand cap is associated with activated carbon and is described in Section 3.6 below. One method to place the sand could be using a clamshell bucket to remove the sand from a material barge and lower it to the bottom as shown in Figures 1-8 and 1-9.

Figure 1-8: Sand Barge Unloading Operation Using Clamshell Bucket

Figure 1-9: Sand Capping Underwater Using Clamshell Bucket

Another method to place sand could be via hydraulically pumping either out of a barge or land-based containment box and spreading with a discharge end configured to reduce velocity (Figure 1-10). The spreading could be through use of baffle plates, upturned ends, and/or wider end sections (Figure 1-11). Figures 1-12 and 1-13 show examples of an upturned end with a baffle plate and a diffuser system with multiple discharge ports, respectively. Alternatively, the sand may be pumped into a floating box with a grated bottom or through a grate to allow sand to "rain down" to the bottom (Figure 1-14).

Figure 1-10: Hydraulic Sand Unloading Operation from Land-Based Containment Box

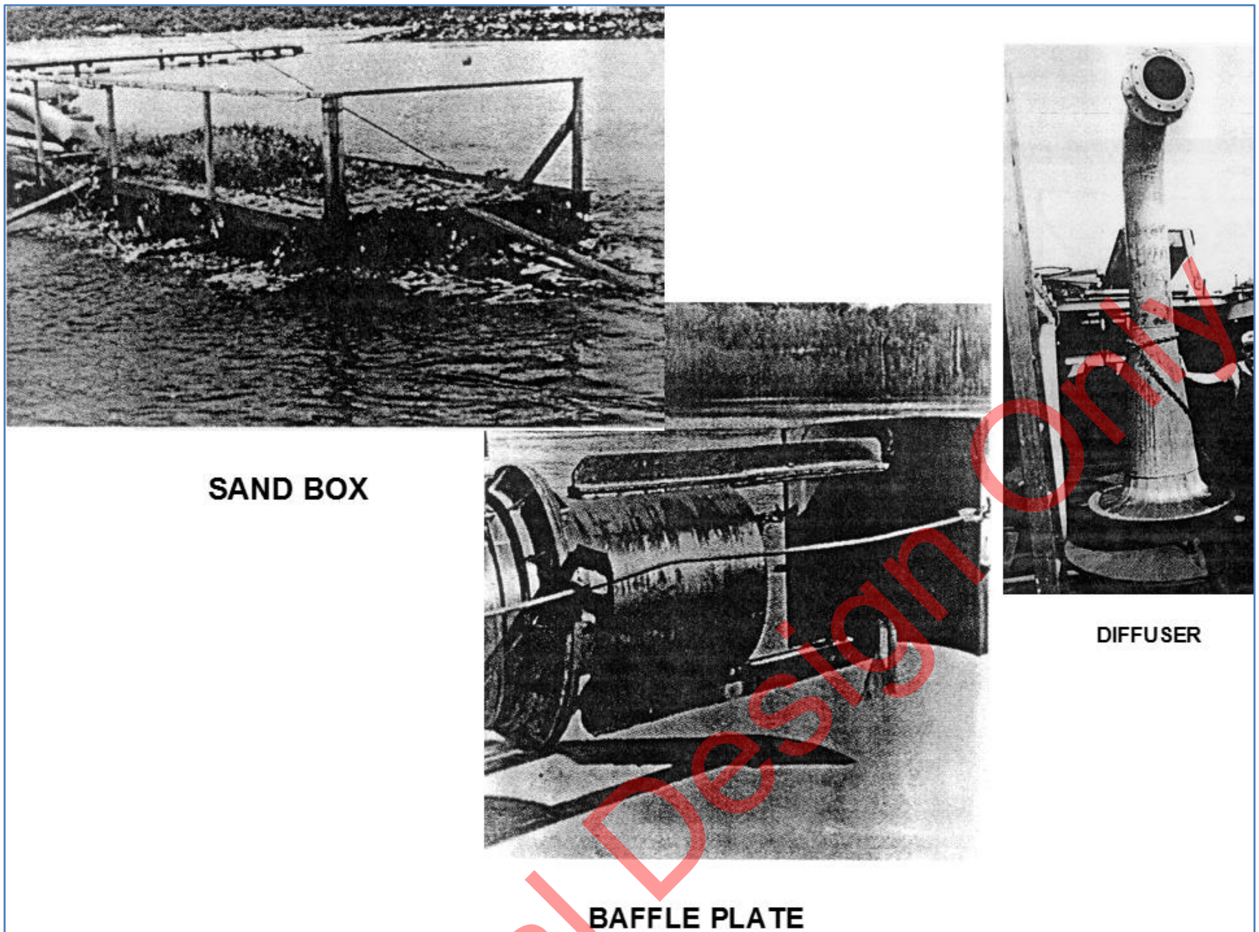


Figure 1-11: Hydraulic Unloading Pipe Discharge Ends for Velocity Reduction and Spreading

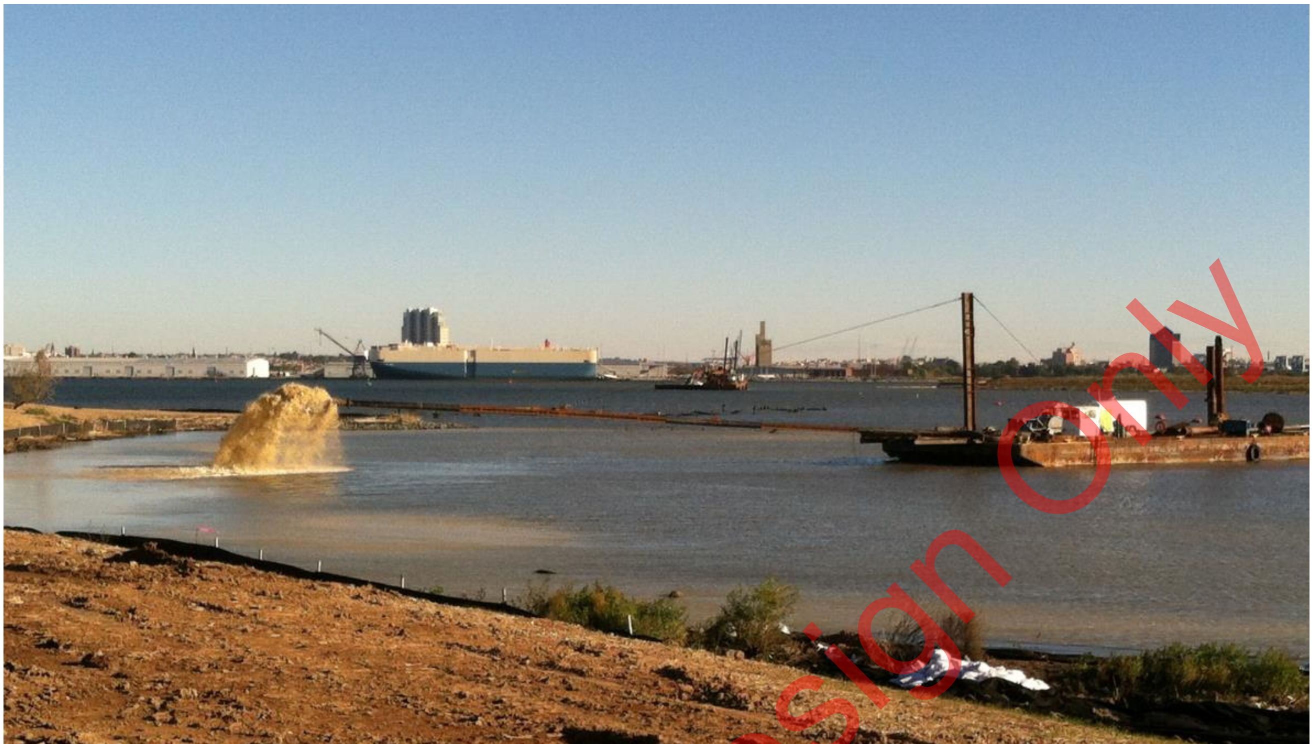


Figure 1-12: Hydraulic Sand Capping Using Upturned End and Baffle Plate at End of Pipe

Figure 1-13: Sand Spreader Barge with Diffuser System

Figure 1-14: Sand Spreading by Pumping through Steel Grate

1.2.3. Thin Capping with Activated Carbon Addition

A thin sand cap will be used for the three management units TC-2A (including CoK property), TC-4 and TC-AB (including CoK property), along with placement of activated carbon to treat the sediment. Management units TC-4 and TC-AB also incorporate dredging prior to the cap and activated carbon placement. See Section 1.2.1 for a discussion on the dredging process. The activated carbon has been shown to be effective for in situ sequestration and immobilization of hydrophobic organic compounds (Patmont, *et* al, 2015). Activated carbon as an amendment has strong sorbent properties that absorb polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dioxins/furans, and chlorinated pesticides (USEPA, 2013). The resulting adsorption is strong enough to lower the pollutant's bioavailability and mobility significantly, limiting its release from sediment into the water and uptake into organisms (Abel and Akkanen, 2018).

The activated carbon will be spread over the entire designated area and the sand cap will be 30 cm thick except for the Anglin Bay marina area, where it will be 0.7 m. Placement of the activated carbon can be accomplished using several different methods. It can be spread out over the bottom as a thin layer, spread out and then "tilled" into the bottom to mix with the existing sediment, placed between two geotextile layers to create a mat that is placed onto the bottom, mixed with the sand cap, or placed as a layer within the sand cap. Equipment such as clamshell buckets, submerged diffusers, energy dissipaters, submerged discharge points, and tremies (specialized underwater pipes, typically used for pouring concrete) can be used to apply amendments evenly to a required thickness. Figure 1-15 shows some schematic examples for some of these techniques.

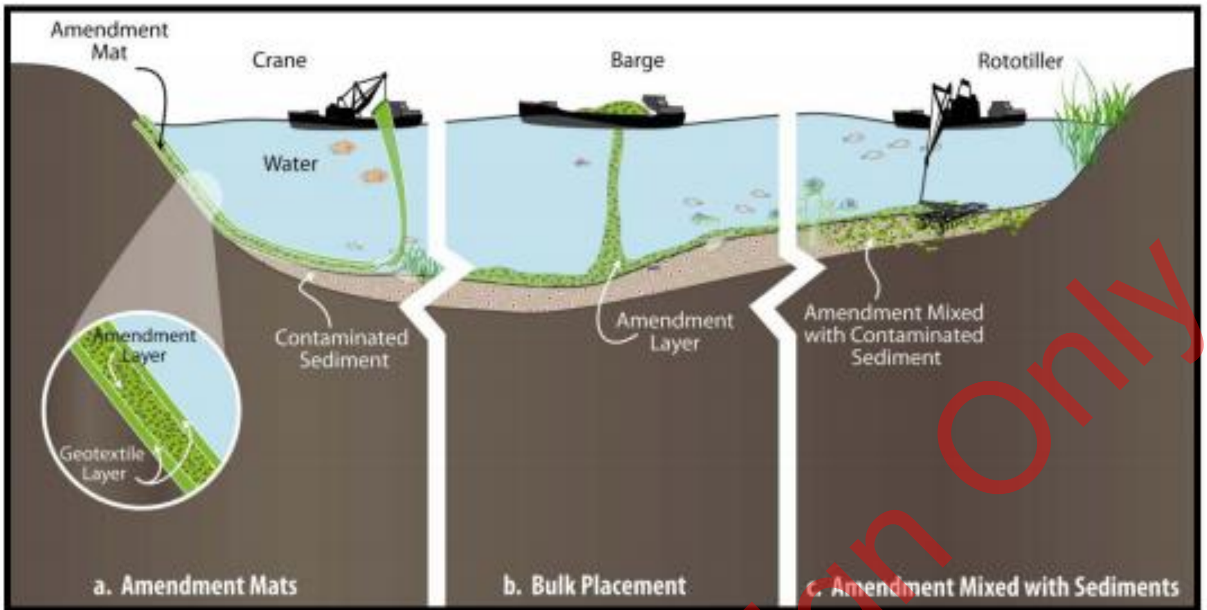


Figure 1-15: Optional Placement Methods for Using Activated Carbon (USEPA 2013)

The material quantity necessary for activated carbon varies by delivery method. Bulk placement typically is incorporated at a rate of 5 to 10 percent activated carbon dry weight to the top 10 cm of sediment which is approximately 5 kg/m^2 (1 lb/ft^2). Laboratory studies indicate that a one centimeter (cm) thick layer of activated carbon or other carbon material beneath a sand cap can effectively mitigate contaminant flux of PCBs from sediment (USEPA 2013). Placement equipment such as a clamshell bucket or backhoe would be used to place the material.

1.2.4. Rock Shoreline Revetment

The shoreline revetment will be placed on top of a sand cap for management units TC-RC, WM, TC-3A (CoK property only) and TC-4 (CoK property only). The revetment will be along the shoreline and be constructed of rock having a median mass of 20 kg. The revetment will be 1 m thick and 10 m wide sloping into the water. Sand material having a thickness of 30 cm and width of 33 m from the shoreline will be first placed on the bottom to provide a smooth surface for constructing the revetment. A geotextile will be placed on top of the smooth sand surface, followed by the rock. As the individual sizes of the rocks are relatively small (a cube having sides of about 20 cm), there is no requirement for an underlayer. The in-place density of rock will be about 1.5 tonnes per cubic meter. The sand, geotextile and rock could be delivered to the site overland via truck haul or over water via barge. A staging and stockpile area would be required for both material delivery options. Figures 1-16 through 1-19 show typical examples of the areas in TC-RC, WM, TC-3A (CoK) and TC-4 (CoK) where the rock would be placed.

Figure 1-16: Shoreline for Revetment Within Management Unit TC-4 (CoK property)

Figure 1-17: Shoreline for Revetment Within Management Unit TC-3A (CoK property)

Figure 1-18: Shoreline for Revetment Within Management Unit WM

Figure 1-19: Shoreline for Revetment Within Management Unit TC-RC

1.2.5. Boardwalk

One management unit will include installation of a boardwalk to provide a means for people to walk along the shoreline without being exposed to contact with the water. The boardwalk will be constructed of timber. The location of the boardwalk within management unit TC-2A (including CoK property) will be along the shoreline (Figure 1-20). Along the shoreline in TC-2A, the existing rock wall and asphalt path will be removed and the shoreline will be graded to a gentle slope and planted, to allow for turtles to crawl up from the water and lay their eggs on shore. Figure 1-21 shows a photograph of a boardwalk concept that could be used for the project.

Figure 1-20: Shoreline Along Boardwalk Location Within Management Unit TC-2A

Figure 1-21: Boardwalk Concept

1.2.6. Wetland Restoration

Capping of sediment with sand will be used for wetland restoration followed by wetland plantings. The sand cap will be 1 m thick over the area, and the wetland plants will be spaced between 0.3 to 0.5 meters on center. Similar to above, the sand will be placed via hydraulically pumping either out of a barge or land-based containment box and spreading with a discharge end configured to reduce velocity. Following cap placement, the vegetation will be planted. A suitable native mix of plant species will be used.

2. Sediment Management Plans for the Nine Management Units

This section describes the Sediment Management Plans (SMP) that have been developed for each of the nine distinct management units within the harbor. Concept development plans for the units are based on information provided in the Recommended Remedial Option for the KIH (Golder, 2019) and inputs received from the Harbour Wide Sediment Stability Study. Plans may be refined as a result of feedback received from Indigenous and stakeholder groups, or as part of the Detailed Impact Assessment (DIA).

Included are concept level drawings that include plans and sections for the sediment management actions and sediment management processes to be used onsite. In addition, outline specifications for the elements of work contained are presented. Figure 2-1 shows the overall plan for the project area.

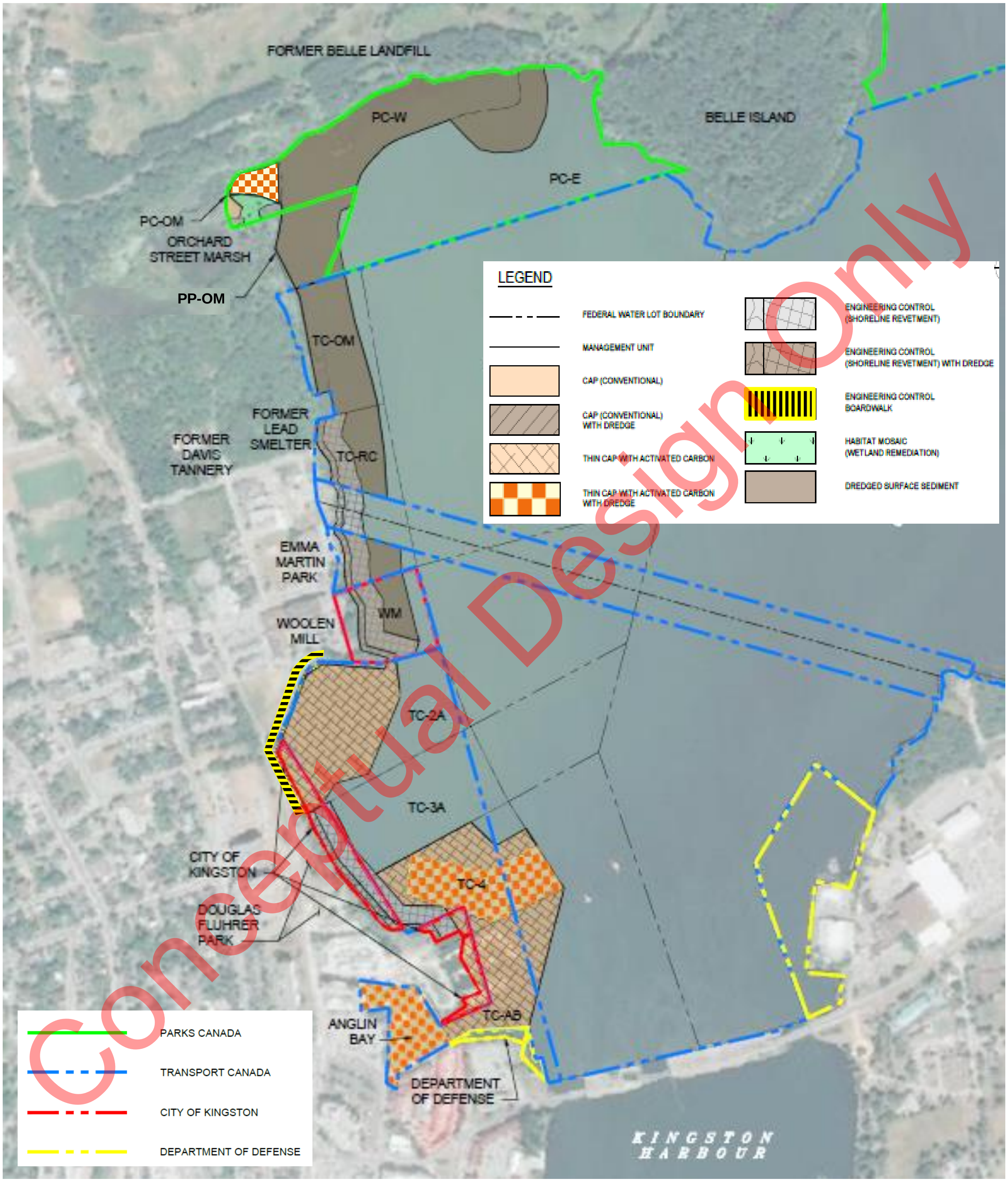


Figure 2-1: Overall Sediment Management Plan for the Kingston Inner Harbour

2.1. Management Unit PC-E

Management unit PC-E covers an area of about 9.5 hectares (ha). The sediment management option for this management unit consists of dredging 1.2 ha of the total area of 9.5 ha (Figure 2-2).

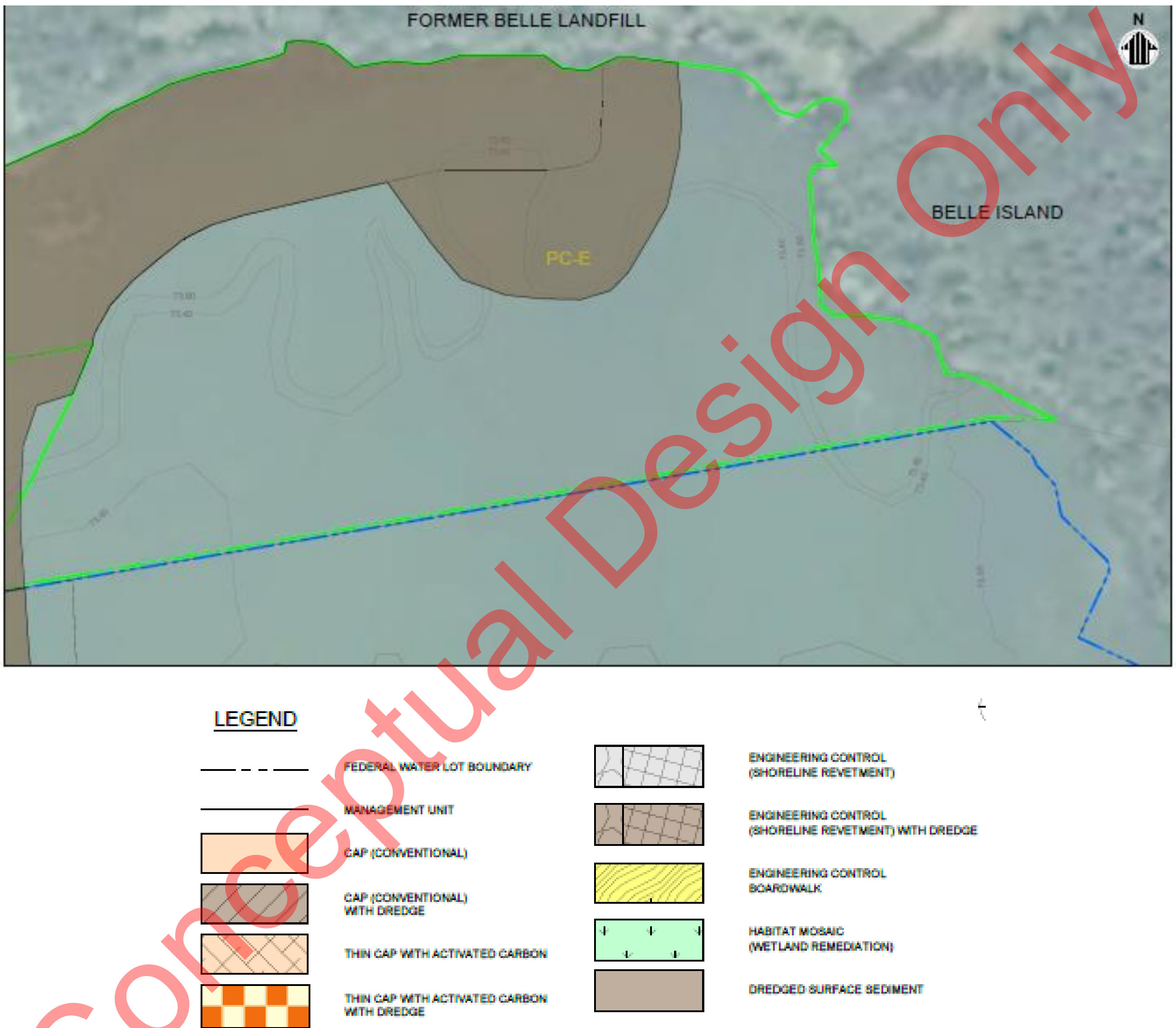


Figure 2-2: Sediment Management Plan for Management Unit PC-E

2.2. Management Unit PC-W

Management unit PC-W covers an area of about 3.8 ha. The sediment management option for this management unit consists of dredging 3.6 ha. (Figure 2-3).

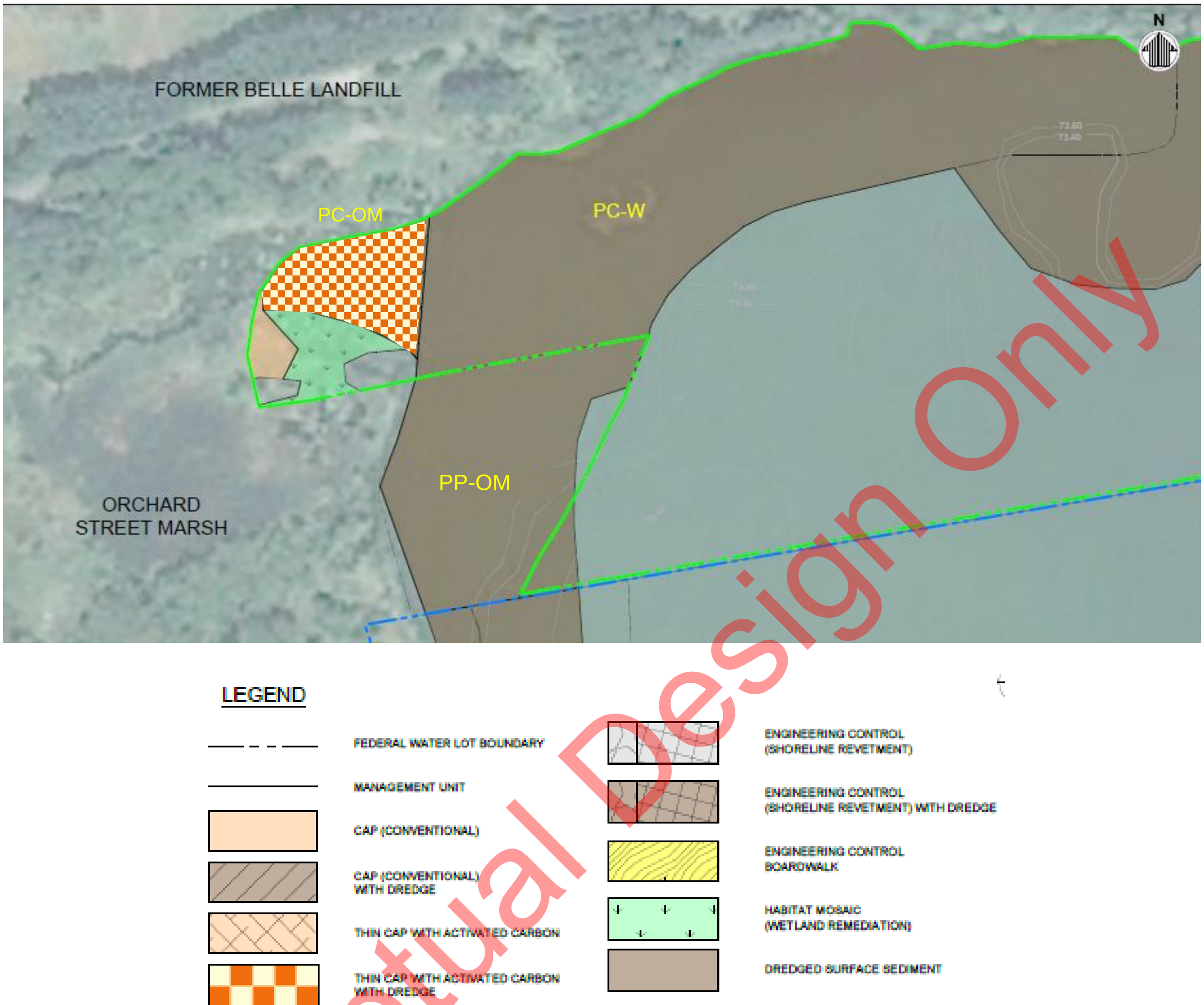


Figure 2-3: Sediment Management Plan for Management Units PC-W, PC-OM and PP-OM

2.3. Management Unit PC-OM

Management unit PC-OM covers an area of about 0.7 ha. The sediment management option for this management unit consists of dredging 0.36 ha, placing a sand cap and activated carbon over 0.44 ha, and restoration of a wetland of approximately 0.2 ha (Figure 2-3).

2.4. Management Unit PP-OM

Management unit PP-OM covers an area of about 1.3 ha. The sediment management option for this management unit consists of dredging 1.2 ha (Figure 2-3).

2.5. Management Unit TC-OM

Management unit TC-OM covers an area of about 2.6 ha. The sediment management option for this management unit consists of dredging 2.2 ha of the total area of 2.6 ha (Figure 2-4).

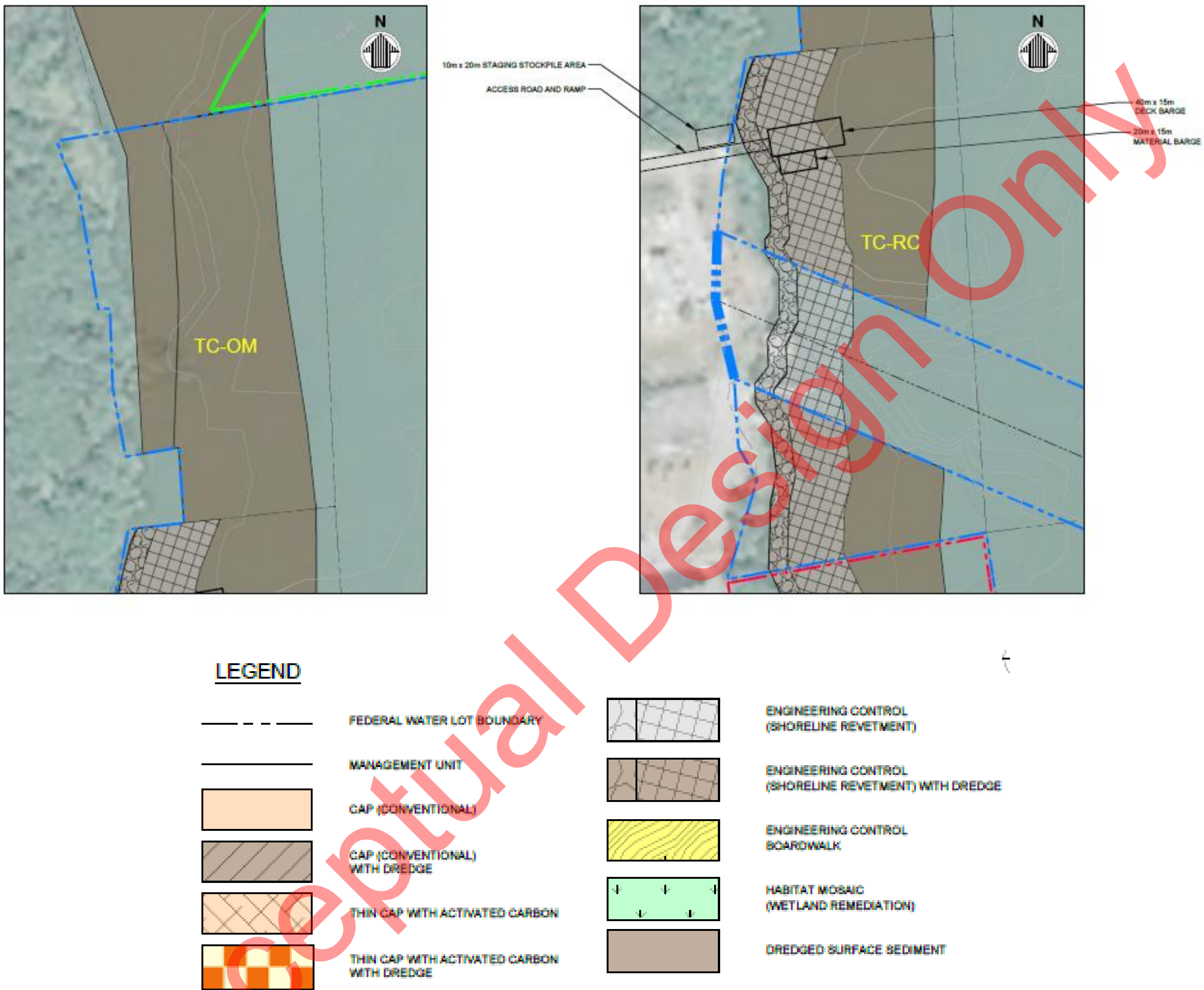


Figure 2-4: Sediment Management Plan for Management Unit TC-OM and TC-RC

2.6. Management Unit TC-RC

Management unit TC-RC covers an area of about 3.6 ha. The sediment management option for this management unit consists of dredging 2.1 ha, placing a 33 m wide sand cap over 0.9 ha along the 300 m shoreline, and constructing a shoreline revetment for a length of about 300 m with a width of 10 m for an area of 0.3 ha (Figure 2-4). The revetment would be placed on top of a geotextile over a portion of the sand cap.

2.7. Management Unit WM

Management unit WM covers an area of about 1.9 ha. The sediment management option for this management unit consists of dredging 1.4 ha, placing a 33 m wide sand cap over 0.45 ha, and constructing a shoreline revetment for a length of 150 m. The revetment would have a width of 10 m for an area of 0.15 ha (Figure 2-5). The revetment would be placed on top of a geotextile over a portion of the sand cap.

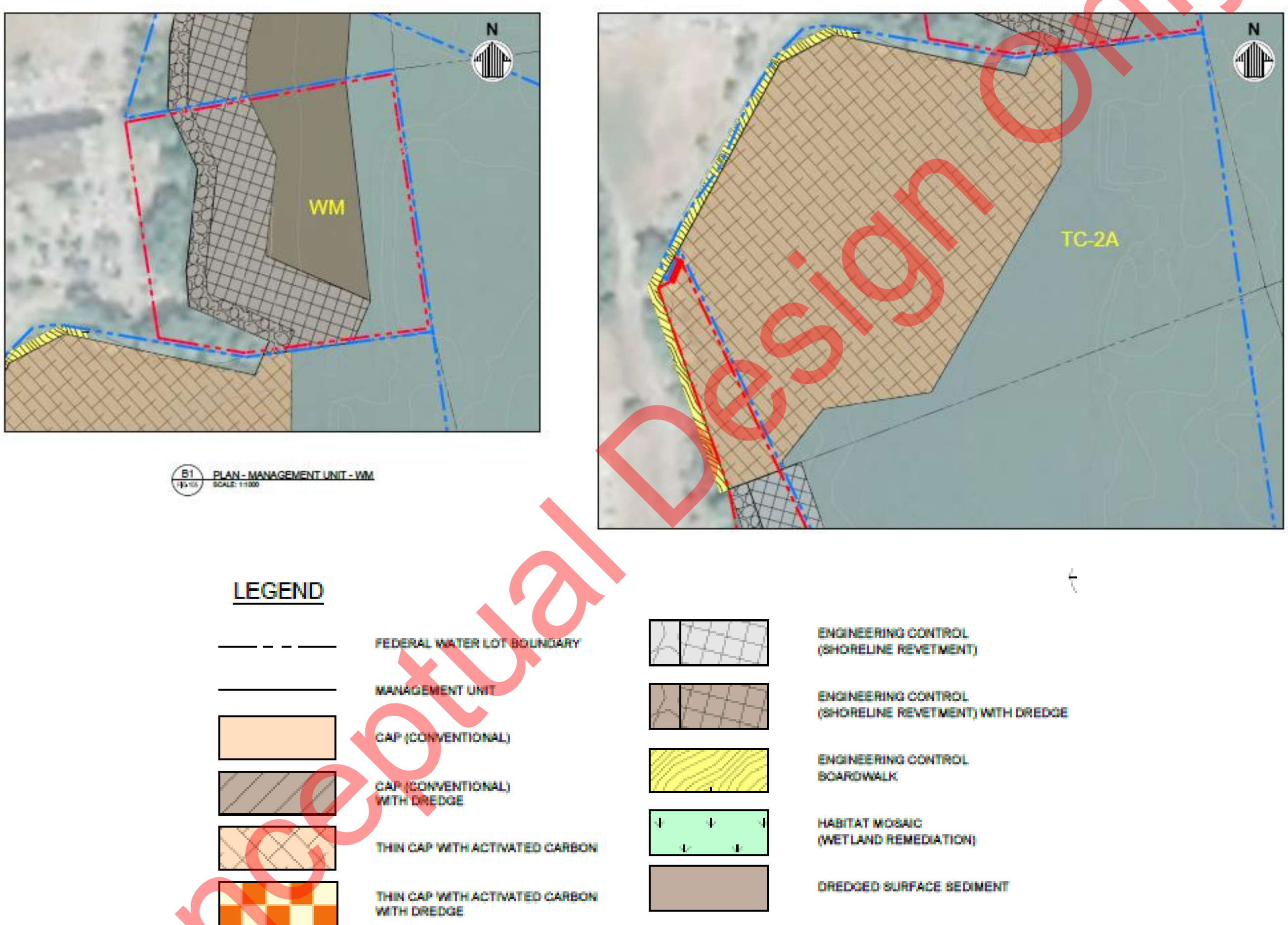


Figure 2-5: Sediment Management Plan for Management Unit WM and TC-2A (including CoK property)

2.8. Management Unit TC-2A

Management unit TC-2A covers an area of about 5.1 ha. The sediment management option for this management unit consists of placing a thin sand cap with activated carbon over 2.4 ha and constructing a 3 m wide boardwalk for a length of 300 m (Figure 2-5). The portion of the management unit that is the property of CoK includes 0.3 ha of thin sand cap with activated carbon and 125 m of the boardwalk.

2.9. Management Unit TC-3A

Management unit TC-3A covers an area of about 4.1 ha. The sediment management option for this management unit consists of placing a 33 m wide sand cap over 0.45 ha and constructing a shoreline revetment for a length of 150 m. The revetment would have a width of 10 m for an area of 0.15 ha (Figure 2-6). The revetment would be placed on top of a geotextile over a portion of the sand cap. All of this sediment management is within the property of the CoK.

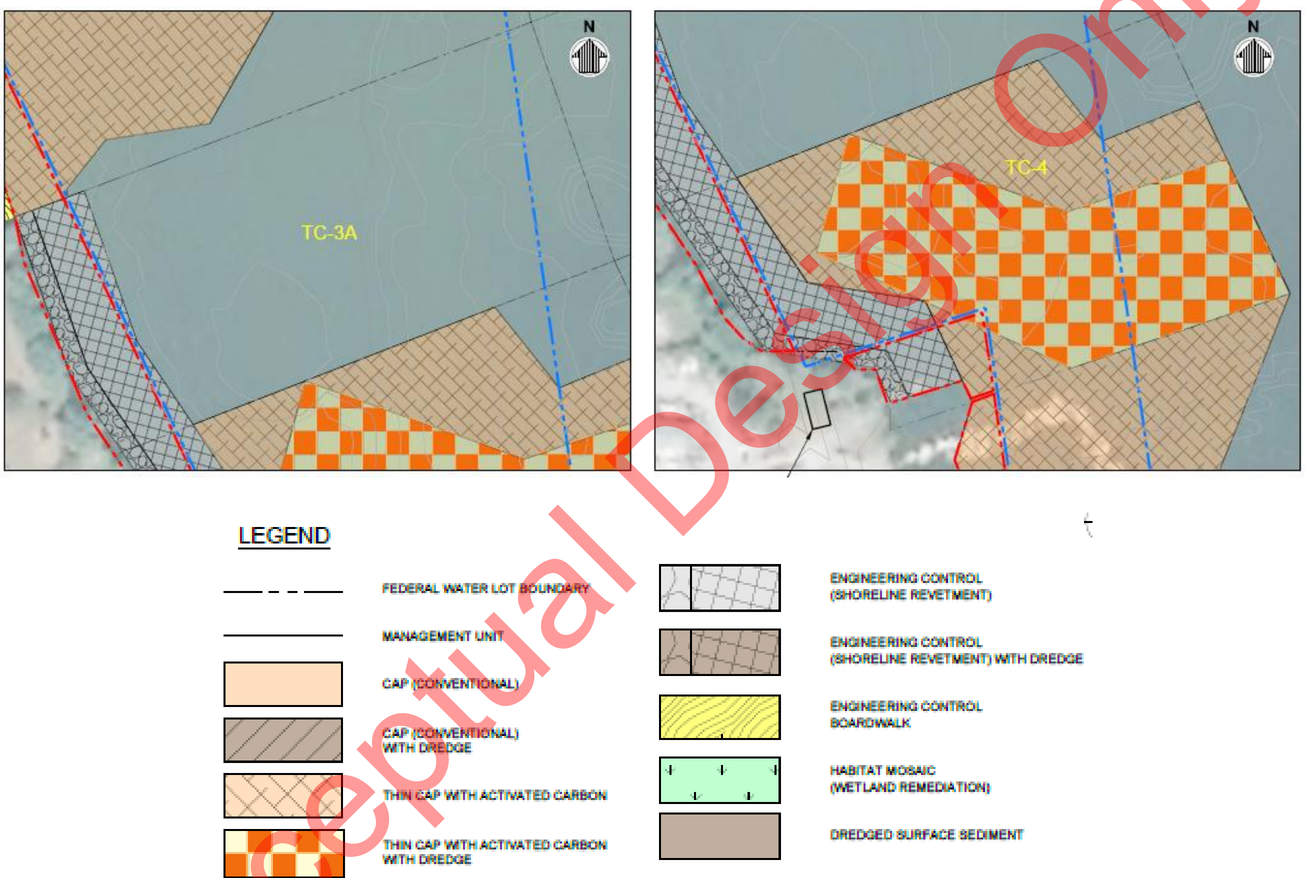


Figure 2-6: Sediment Management Plan for Management Unit TC-3A (CoK property) and TC-4 (including CoK property)

2.10. Management Unit TC-4

Management unit TC-4 covers an area of about 4.3 ha. The sediment management option for this management unit consists of dredging 1.9 ha, placing a 30 cm sand cap with activated carbon over 3.3 ha, placing a 33 m wide sand cap over 0.54 ha and constructing a shoreline revetment for a length of 180 m. The revetment would have a width of 10 m for an area of 0.18 ha (Figure 2-6). The revetment would be placed on top of a geotextile over a portion of the sand cap. The CoK property within this management unit includes 0.1 ha of thin sand cap and activated carbon, 0.15 ha of armor stone and 0.23 ha of the cap for the shoreline revetment work.

2.11. Management Unit TC-AB

Management unit TC-AB covers an area of about 4.4 ha. The sediment management option for this management unit consists of placing a thin sand cap and activated carbon over 2.7 ha, dredging 1.3 ha, and placing a multi-level marina cap within Anglin Bay over 1.3 ha (Figure 2-7). The lower layer for the marina cap would consist of 70 cm of sand and the top layer would consist of 30 cm of sand mixed with activated carbon. The CoK property within this management unit includes 0.5 ha of thin sand cap and activated carbon.

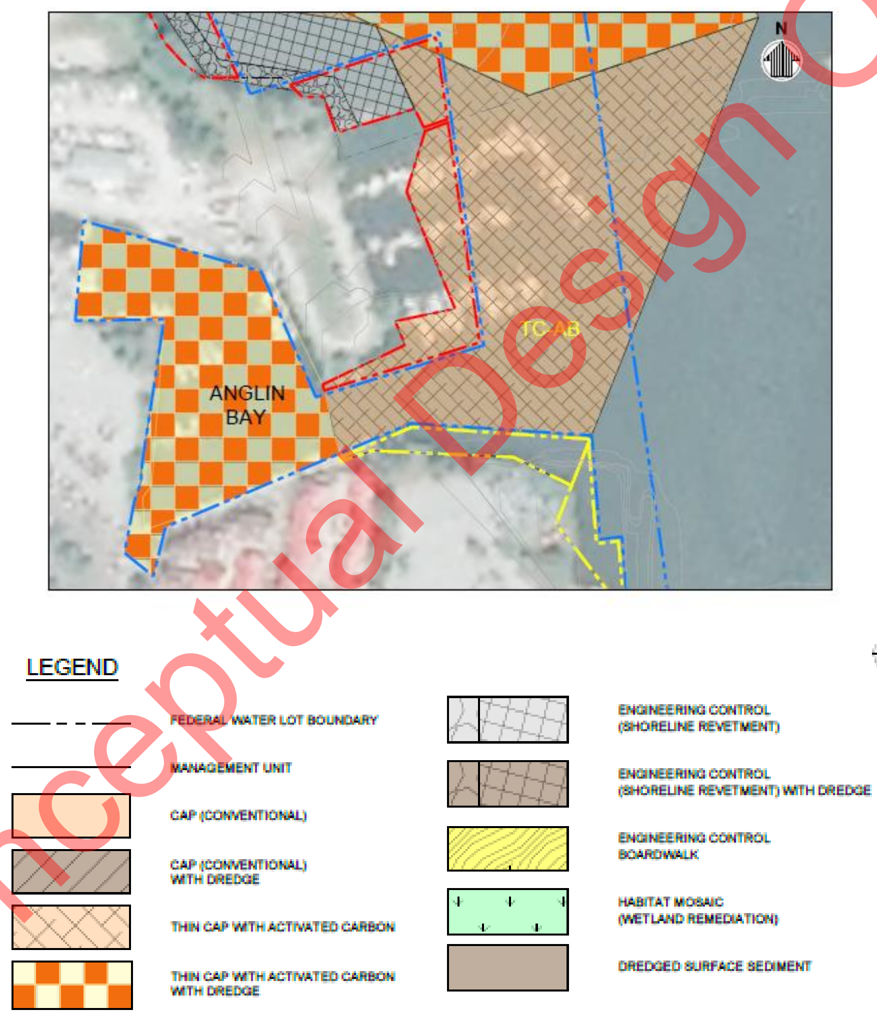


Figure 2-7: Sediment Management Plan for Management Unit TC-AB (including CoK property)

3. Schedule and Class C Cost Estimates

This section provides the schedule for implementation of each SMP along with a Class C level cost estimate. The Class C estimate provides details that include labor, equipment and materials that have been developed for each item of the work. The schedule commences with mobilization and ends with demobilization. Each schedule provides a range of anticipated construction duration.

3.1. Management Unit PC-E

Table 3-1 provides the cost estimate for management unit PC-E; Figure 3-1 provides the implementation schedule.

Table 3-1: Cost Estimate for Management Unit PC-E

Management Unit PC-E
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week											
Task	Description	1	2	3	4	5	6	7	8	9	10	11	12
1	Mobilization	■	■	■	■								
2	Dredging				■	■	■	■					
3	Treatment					■	■	■	■				
4	Hauling and Disposal						■	■	■	■	■		
5	Demobilization									■	■	■	

Figure 3-1: Implementation Schedule for Management Unit PC-E

3.2. Management Unit PC-W

Table 3-2 provides the cost estimate for management unit PC-W; Figure 3-2 provides the implementation schedule.

Table 3-2: Cost Estimate for Management Unit PC-W

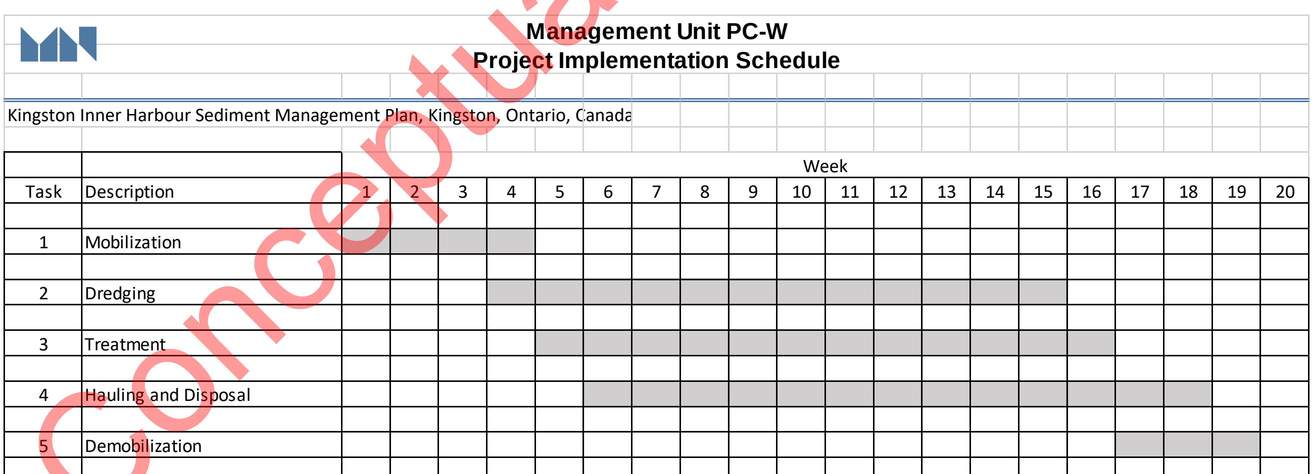


Figure 3-2: Implementation Schedule for Management Unit PC-W

3.3. Management Unit PC-OM

Table 3-3 provides the cost estimate for management unit PC-OM; Figure 3-3 provides the implementation schedule.

Table 3-3: Cost Estimate for Management Unit PC-OM

Management Unit PC-OM
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week											
Task	Description	1	2	3	4	5	6	7	8	9	10	11	12
1	Mobilization	■	■	■	■								
2	Dredging				■	■							
3	Treatment					■	■						
4	Hauling and Disposal						■	■					
5	Thin Sand Cap							■					
6	Activated Carbon							■					
7	Wetland Sand Cap								■	■			
8	Wetland Plantings									■			
9	Demobilization									■	■		

Figure 3-3: Implementation Schedule for Management Unit PC-OM

3.4. Management Unit PP-OM

Table 3-4 provides the cost estimate for management unit PP-OM; Figure 3-4 provides the implementation schedule.

Table 3-4: Cost Estimate for Management Unit PP-OM

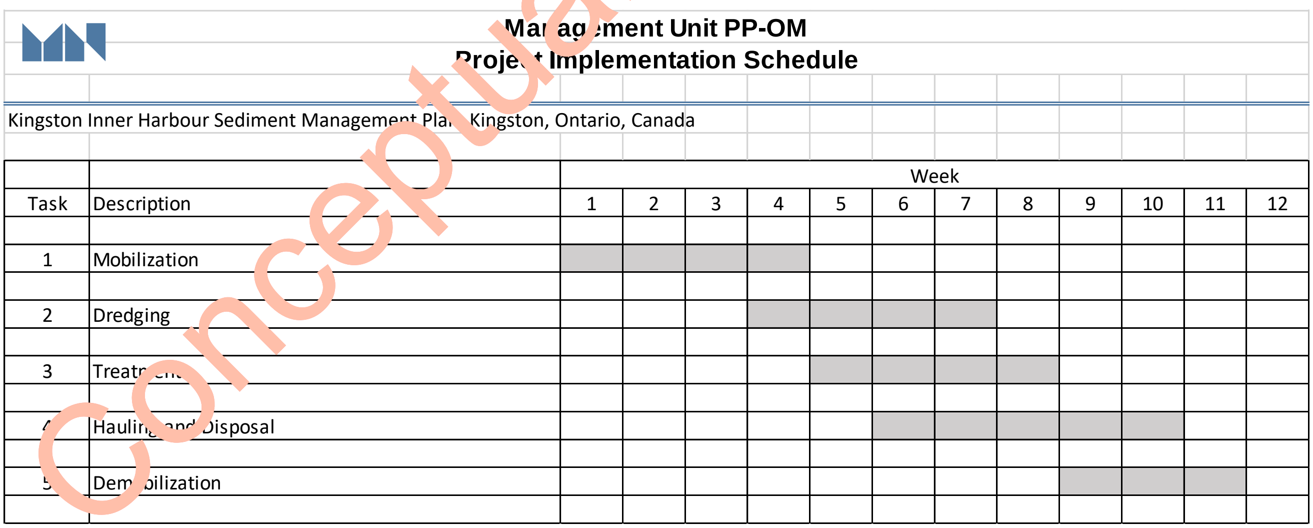


Figure 3-4: Implementation Schedule for Management Unit PP-OM

3.5. Management Unit TC-OM

Table 3-5 provides the cost estimate for management unit TC-OM; Figure 3-5 provides the implementation schedule.

Table 3-5: Cost Estimate for Management Unit TC-OM

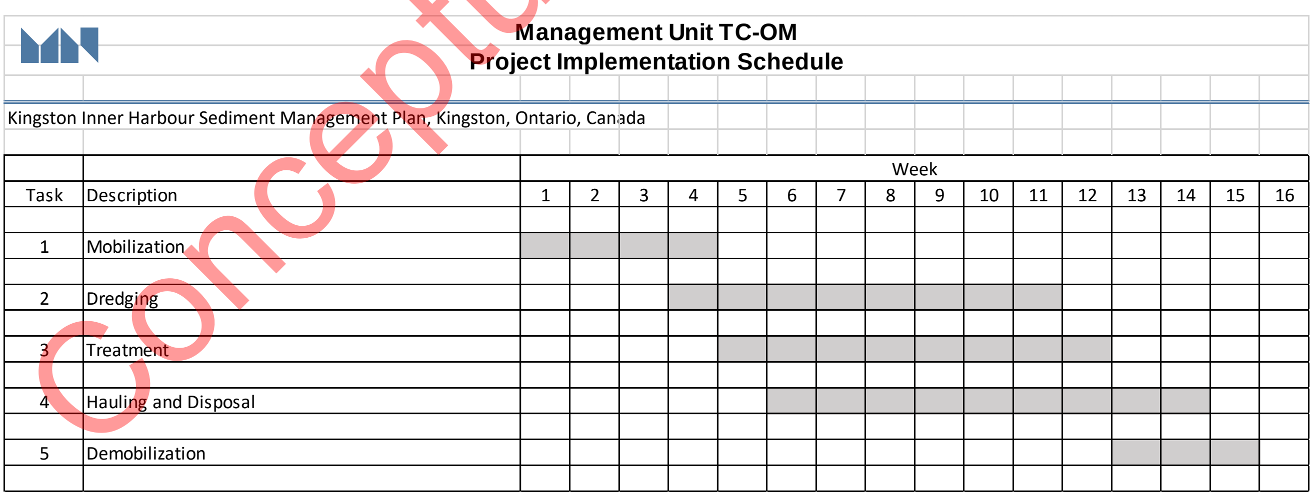


Figure 3-5: Implementation Schedule for Management Unit TC-OM

3.6. Management Unit TC-RC

Table 3-6 provides the cost estimate for management unit TC-RC; Figure 3-6 provides the implementation schedule.

Table 3-6: Cost Estimate for Management Unit TC-RC

Management Unit TC-RC
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week															
Task	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Mobilization																
2	Dredging																
3	Treatment																
4	Hauling and Disposal																
5	Sand Capping																
6	Rock Revetment																
7	Demobilization																

Figure 3-6: Implementation Schedule for Management Unit TC-RC

3.7. Management Unit WM

Table 3-7 provides the cost estimate for management unit WM; Figure 3-7 provides the implementation schedule.

Table 3-7: Cost Estimate for Management Unit WM (City of Kingston)

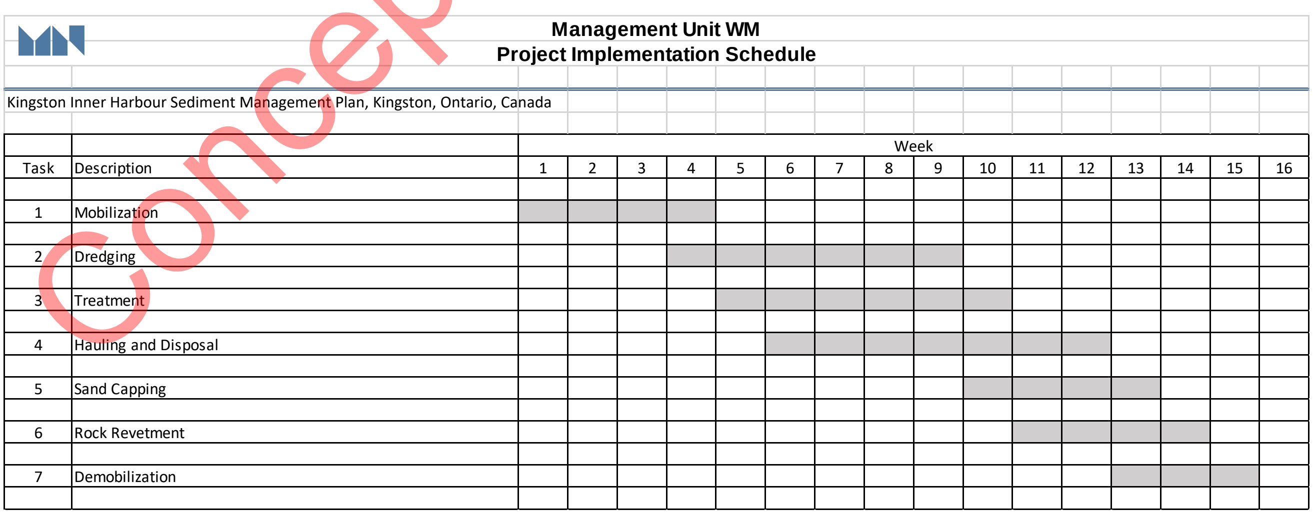


Figure 3-7: Implementation Schedule for Management Unit WM

3.8. Management Unit TC-2A

Table 3-8 provides the cost estimate for management unit TC-2A; Figure 3-8 provides the implementation schedule.

Table 3-8: Cost Estimate for Management Unit TC-2A

Management Unit TC-2A
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week															
Task	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Mobilization																
2	Thin Sand Cap																
3	Activated Carbon																
4	Rock Removal																
5	Shoreline Stabilization																
6	Timber Boardwalk																
7	Demobilization																

Figure 3-8: Implementation Schedule for Management Unit TC-2A

3.9. Management Unit TC-2A (CoK Property)

Table 3-9 provides the cost estimate for management unit TC-2A that includes the CoK property; Figure 3-9 provides the implementation schedule.

Table 3-9: Cost Estimate for Management Unit TC-2A (CoK Property)

Management Unit TC-2A (CoK)
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week									
Task	Description	1	2	3	4	5	6	7	8	9	10
1	Mobilization										
2	Thin Sand Cap										
3	Activated Carbon										
4	Rock Removal										
5	Shoreline Stabilization										
6	Timber Boardwalk										
7	Demobilization										

Figure 3-9: Implementation Schedule for Management Unit TC-2A (CoK Property)

3.10. Management Unit TC-3A (CoK Property)

Table 3-10 provides the cost estimate for management unit TC-3A (CoK Property); Figure 3-10 provides the implementation schedule.

Table 3-10: Cost Estimate for Management Unit TC-3A (CoK Property)

Management Unit TC-3A (CoK Property)
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week					
Task	Description	1	2	3	4	5	6
1	Mobilization						
2	Sand Capping						
3	Rock Revetment						
	Demobilization						

Figure 3-10: Implementation Schedule for Management Unit TC-3A (CoK Property)

3.11. Management Unit TC-4

Table 3-11 provides the cost estimate for management unit TC-4; Figure 3-11 provides the implementation schedule.

Table 3-11: Cost Estimate for Management Unit TC-4

Management Unit PC-OM
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week											
Task	Description	1	2	3	4	5	6	7	8	9	10	11	12
1	Mobilization												
2	Dredging												
3	Treatment												
4	Hauling and Disposal												
5	Thin Sand Cap												
6	Activated Carbon												
7	Wetland Sand Cap												
8	Wetland Plantings												
9	Demobilization												

Figure 3-11: Implementation Schedule for Management Unit TC-4

3.12. Management Unit TC-4 (CoK Property)

Table 3-12 provides the cost estimate for management unit TC-4 (CoK Property); Figure 3-12 provides the implementation schedule.

Table 3-12: Cost Estimate for Management Unit TC-4 (CoK Property)

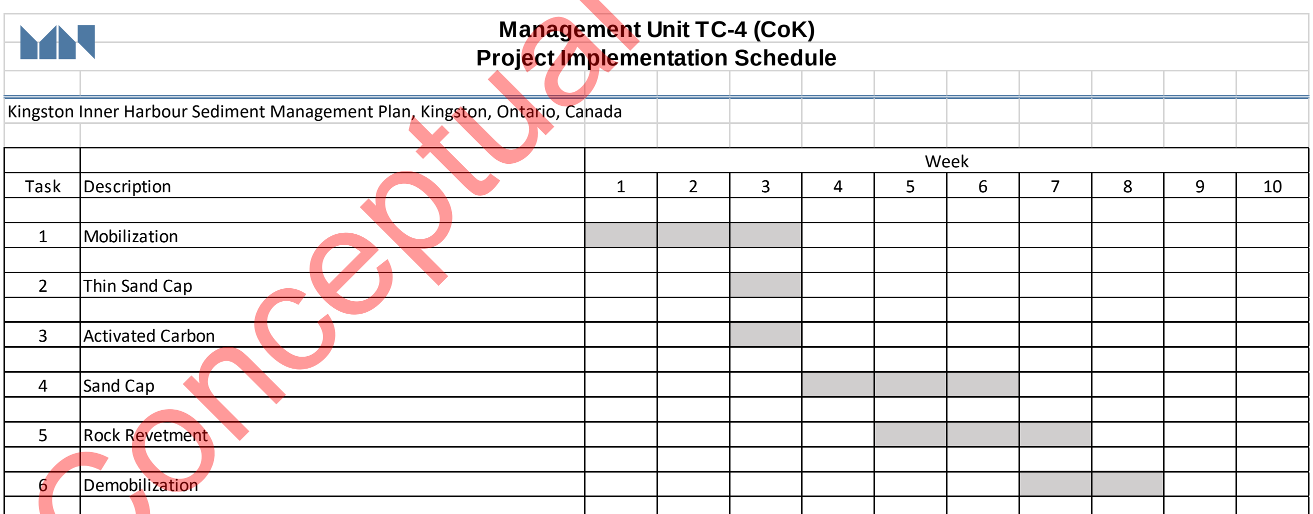


Figure 3-12: Implementation Schedule for Management Unit TC-4 (CoK Property)

3.13. Management Unit TC-AB

Table 3-13 provides the cost estimate for management unit TC-AB; Figure 3-13 provides the implementation schedule.

Table 3-13: Cost Estimate for Management Unit TC-AB

Management Unit TC-AB
Project Implementation Schedule

Kingston Inner Harbour Sediment Management Plan, Kingston, Ontario, Canada

		Week													
Task	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Mobilization	■	■	■	■										
2	Marina Dredging				■	■	■	■	■						
3	Treatment					■	■	■	■	■					
4	Hauling and Disposal						■	■	■	■	■				
5	Marina Sand Cap									■	■	■	■	■	
6	Thin Sand Cap				■	■	■								
7	Activated Carbon				■	■	■								
8	Demobilization												■	■	■

Figure 3-13: Implementation Schedule for Management Unit TC-AB

3.14. Management Unit TC-AB (CoK Property)

Table 3-14 provides the cost estimate for management unit TC-AB (CoK Property); Figure 3-14 provides the implementation schedule.

Table 3-14: Cost Estimate for Management Unit TC-AB (CoK Property)

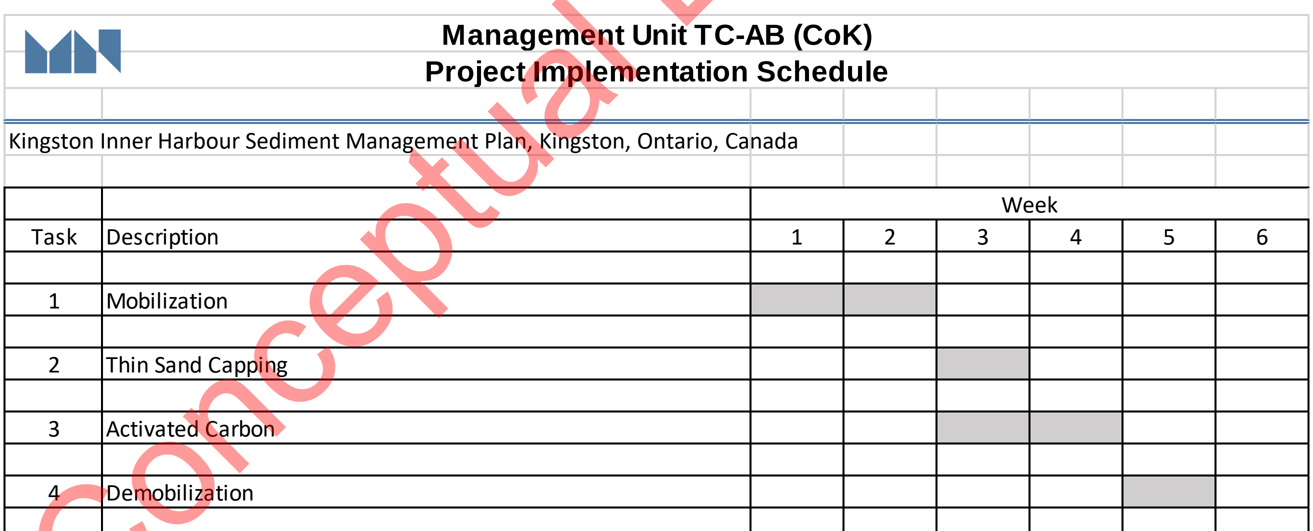


Figure 3-14: Implementation Schedule for Management Unit TC-AB (CoK Property)

4. Summary

A summary of the costs for all the management units is shown in Table 4-1.

Table 4-1: Summary Cost Estimate for All Management Units

PROJECT: KINGSTON INNER HARBOUR, ONTARIO, CANADA
ALL MANAGEMENT UNITS
CLASS C CONSTRUCTION COST ESTIMATE SUMMARY

5. References

Abel, Sebastian and Jarkko Akkanen. "A Combined Field and Laboratory Study on Activated Carbon-Based Thin Layer Capping in a PCB-Contaminated Boreal Lake." *Environ. Sci. Technol.* 2018, 52, 8, 4702-4710. Publication Date: April 1, 2018. https://doi.org/10.1021/acs.est.7b05114

Canadian Construction Association. Guide to Cost Predictability in Construction: An Analysis of Issues Affecting the Accuracy of Construction Cost Estimates. Joint Federal Government/Industry Cost Predictability Taskforce. November 2012.

Clean Earth Manufacturing. 2006. Claremont Channel Facility. http://www.cleanearthinc.com/cei/dredging_main.php

Estes, T. J., Waugh, J., Schwartz, R. L., Green, G., Buhr, V., Braddock, B., and Detzner, H.-D. (2004). "Mechanical dewatering of navigation sediments: Equipment, bench-scale testing, and fact sheets," DOER Technical Notes Collection (ERDC TN DOER-T7), U.S. Army Engineer Research and Development Center, Vicksburg, MS

Golder Associates Ltd. 24 September 2019. Recommended Remedial Option for the Kingston Inner Harbour. Submitted to Public Works and Government Services Canada, Toronto, Ontario. Report Number: 1783886-003-R-Rev A.

Grobbel, L. and Z. Wang. Stabilization Solidification (S/S). https://www.geoengineer.org/education/web-class-projects/cee-549-geoenvironmental-engineering-winter-2013/assignments/stabilization-solidification#treatment-costs

Maryland Department of the Environment (MDE). 2017. *Innovative Reuse and Beneficial Use of Dredged Material Guidance Document.* August.

Ontario Provincial Standard Specification. Metric. OPSS.PROV 1004. November 2012. Material Specification for Aggregates - Miscellaneous

Patmont, Clayton R et al. "In situ sediment treatment using activated carbon: a demonstrated sediment cleanup technology." *Integrated Environmental Assessment and Management* Vol. 11,2 (2015): 195-207. doi:10.1002/ieam.1589

Public Services and Procurement Canada. (PSPC). Cost Estimate Definitions. https://www.tpsgc-pwgsc.gc.ca/biens-property/sngp-npms/bi-rp/conn-know/couts-cost/definition-eng.html

RS Means Engineering. 2019. *2019 RS Means Sitework & Landscape Cost Data*.

U.S. Army Corps of Engineers (USACE) ER 1110-2-1302 CECW-EC Washington, DC 20314-1000 June 2016 Engineering and Design CIVIL WORKS COST ENGINEERING

U.S. Army Corps of Engineers (USACE) Cost Engineering Dredge Estimating Program (CEDEP) for Mechanical Dredge Estimating October 1997

U.S. Army Corps of Engineers (USACE). 2015. Engineering and Design - Dredging and Dredged Material Management EM 1110-2-5025. Department of the Army

United States Environmental Protection Agency (USEPA). Office of Superfund Remediation and Technology Innovation. OSWER Directive 9200.2-128FS. April 2013.

APPENDIX B

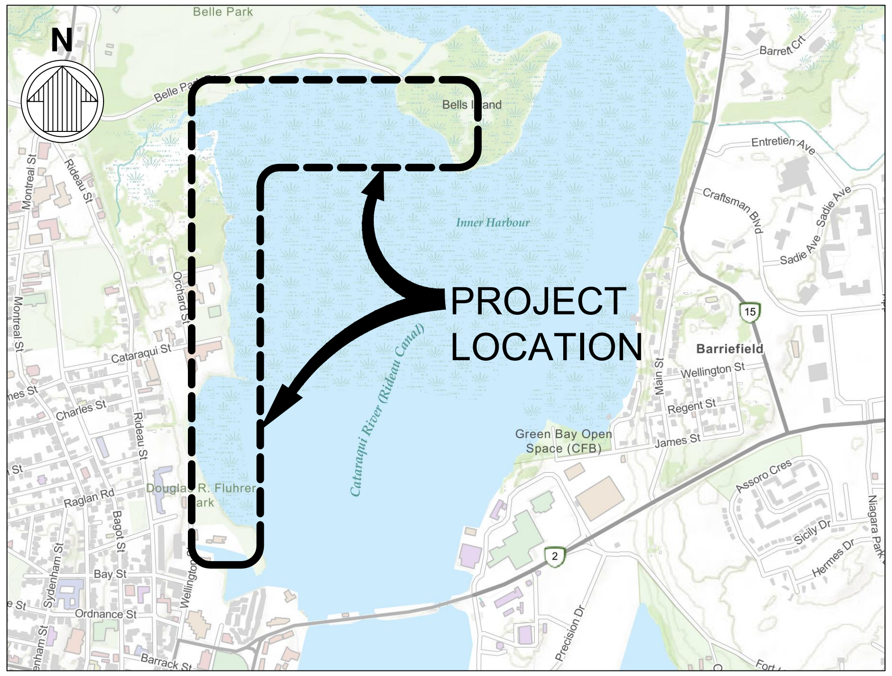
Conceptual Sediment Management Designs

KINGSTON INNER HARBOUR SEDIMENT MANAGEMENT PLAN

KINGSTON, ONTARIO, CANADA

VICINITY MAP
SCALE: NTS

INDEX OF DRAWING		
INDEX	SHEET NUMBER	SHEET TTILE
1	FIG-100	FIG-100 - COVER SHEET
2	FIG-101	PLAN - OVERALL
3	FIG-102	PLAN - MANAGEMENT UNIT PC-E
4	FIG-103	PLAN - MANAGEMENT UNIT PC-W
5	FIG-104	PLAN - MANAGEMENT UNIT TC-OM AND TC - RC
6	FIG-105	PLAN - MANAGEMENT UNIT WM AND TC-2A
7	FIG-106	PLAN - MANAGEMENT UNIT TC - 3A AND TC - 4
8	FIG-107	PLAN - MANAGEMENT UNIT TC-AB
9	FIG-108	SECTIONS - MANAGEMENT UNIT 1 OF 5
10	FIG-109	SECTIONS - MANAGEMENT UNIT 2 OF 5
11	FIG-110	SECTIONS - MANAGEMENT UNIT 3 OF 5
12	FIG-111	SECTIONS - MANAGEMENT UNIT 4 OF 5
13	FIG-112	SECTIONS - MANAGEMENT UNIT 5 OF 5



LOCATION MAP
SCALE: NTS

KINGSTON INNER HARBOUR

FIG-100 - COVER SHEET

Designed by: DSGN | Dwn by: DRFT | Chk'd by: CHKR | Reviewed by: REVR | Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL

Date: DATE | Rev: REVNO | M&N Project No. INSERT PROJ. NO. | Drawing code: | Drawing Scale: | Plot scale: 1:1 (Metric D)

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BALTIMORE, MARYLAND 21224

SEAL

Sheet Reference No.
FIG-100
INDEX: 1 OF 13

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DRAWING SCALES SHOWN BASED ON 594mmx841mm DRAWING

NOTES:

1. BATHYMETRY CONTOURS ARE IN METERS ABOVE INTERNATIONAL GREAT LAKE DATUM (IGLD) 1985.
2. LAKE ONTARIO LOW WATER DATUM (LWD) OF INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985 EQUALS 74.2 METERS ABOVE THE ZERO REFERENCE POINT AT RIMOUSKI, QUEBEC

LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- PARKS CANADA
- TRANSPORT CANADA
- CITY OF KINGSTON
- DEPARTMENT OF DEFENSE
- CAP (CONVENTIONAL)
- CAP (CONVENTIONAL) WITH DREDGE
- THIN CAP WITH ACTIVATED CARBON
- THIN CAP WITH ACTIVATED CARBON WITH DREDGE
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (SHORELINE REVETMENT) WITH DREDGE
- ENGINEERING CONTROL BOARDWALK
- HABITAT MOSAIC (WETLAND REMEDIATION)
- DREDGED SURFACE SEDIMENT

80 0m 80 160

SCALE: 1 : 4000

A1 FIG-101 PLAN - OVERALL SCALE: 1:4000

--- KINGSTON INNER HARBOUR ---

PLAN - OVERALL

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Sheet Reference No.
FIG-101
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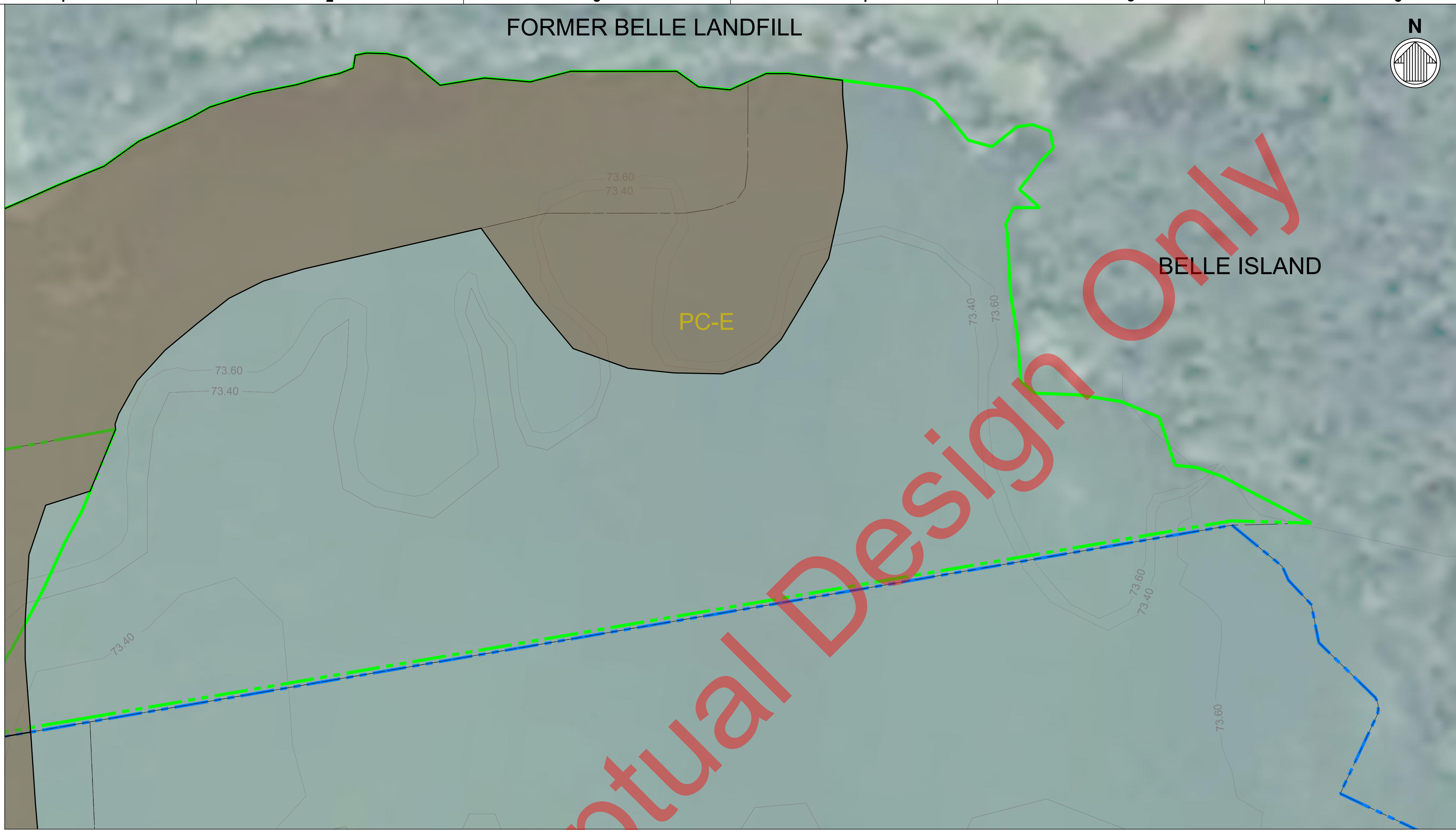

A1 FIG-102 PLAN - MANAGEMENT UNIT PC-E
SCALE: 1:1000

LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- PARKS CANADA
- TRANSPORT CANADA
- CITY OF KINGSTON
- DEPARTMENT OF DEFENSE
- CAP (CONVENTIONAL)
- CAP (CONVENTIONAL) WITH DREDGE
- THIN CAP WITH ACTIVATED CARBON
- THIN CAP WITH ACTIVATED CARBON WITH DREDGE
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (SHORELINE REVETMENT) WITH DREDGE
- ENGINEERING CONTROL BOARDWALK
- HABITAT MOSAIC (WETLAND REMEDIATION)
- DREDGED SURFACE SEDIMENT

NOTES:

1. BATHYMETRY CONTOURS ARE IN METERS ABOVE INTERNATIONAL GREAT LAKE DATUM (IGLD) 1985.
2. LAKE ONTARIO LOW WATER DATUM (LWD) OF INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985 EQUALS 74.2 METERS ABOVE THE ZERO REFERENCE POINT AT RIMOUSKI, QUEBEC

20 0m 20 40
SCALE: 1 : 1000

KINGSTON INNER HARBOUR

PLAN - MANAGEMENT UNIT PC-E

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Sheet Reference No.
FIG-102
INDEX: 3 OF 13

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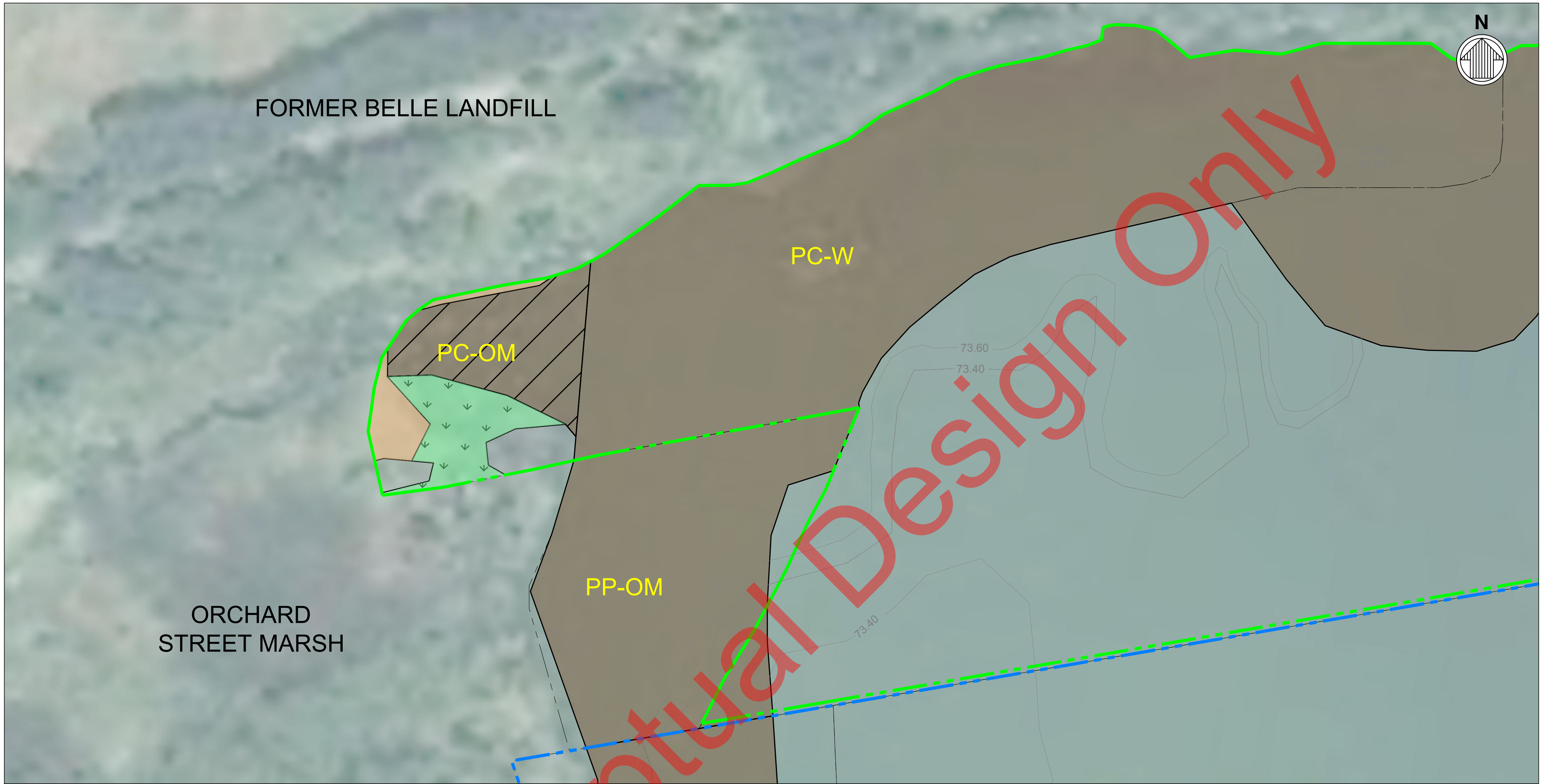

A1 FIG-103 PLAN - MANAGEMENT UNIT PC-W
SCALE: 1:1000

LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- PARKS CANADA
- TRANSPORT CANADA
- CITY OF KINGSTON
- DEPARTMENT OF DEFENSE

- CAP (CONVENTIONAL)
- CAP (CONVENTIONAL) WITH DREDGE
- THIN CAP WITH ACTIVATED CARBON
- THIN CAP WITH ACTIVATED CARBON WITH DREDGE
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (SHORELINE REVETMENT) WITH DREDGE

- ENGINEERING CONTROL BOARDWALK
- HABITAT MOSAIC (WETLAND REMEDIATION)
- DREDGED SURFACE SEDIMENT

NOTES:

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20 0m 20 40
SCALE: 1 : 1000

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PLAN - MANAGEMENT UNIT PC-W

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Sheet Reference No.
FIG-103
INDEX: 4 OF 13

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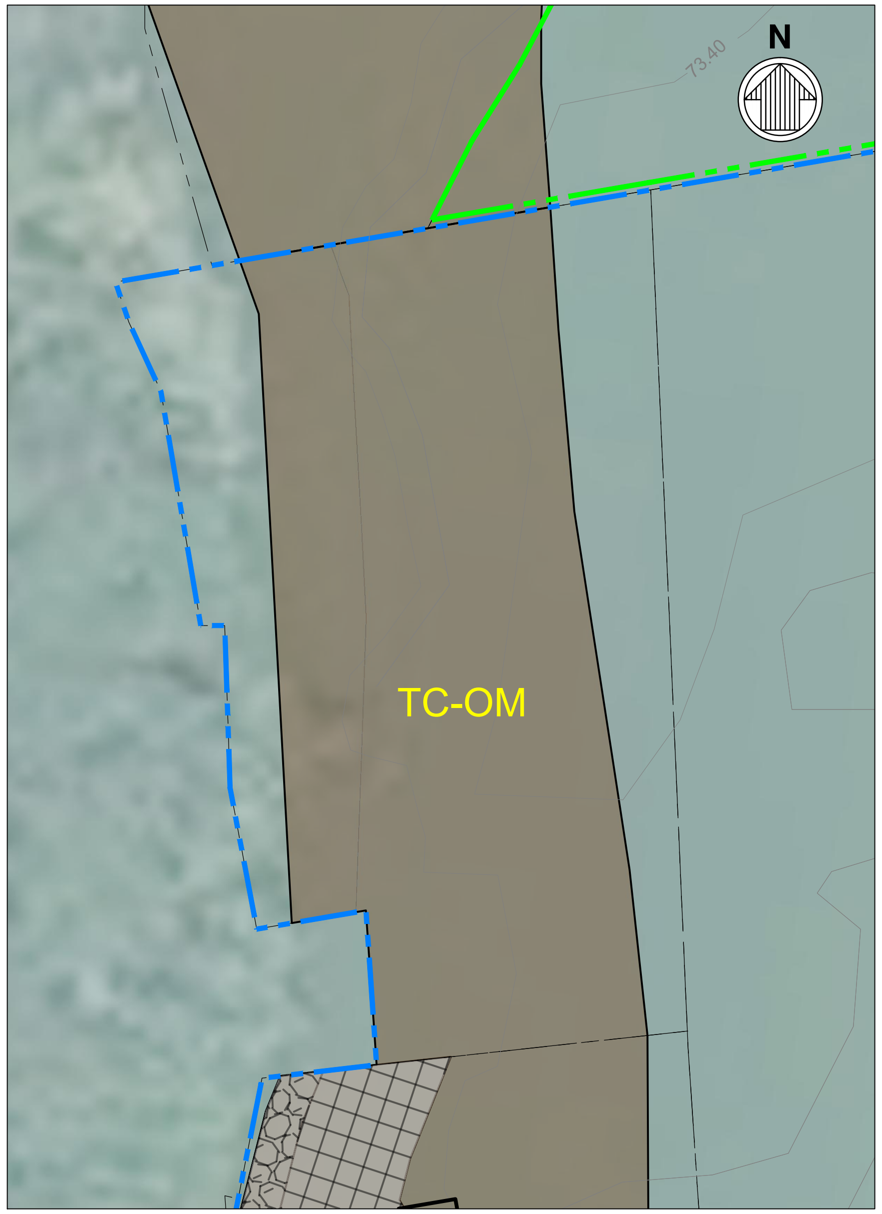

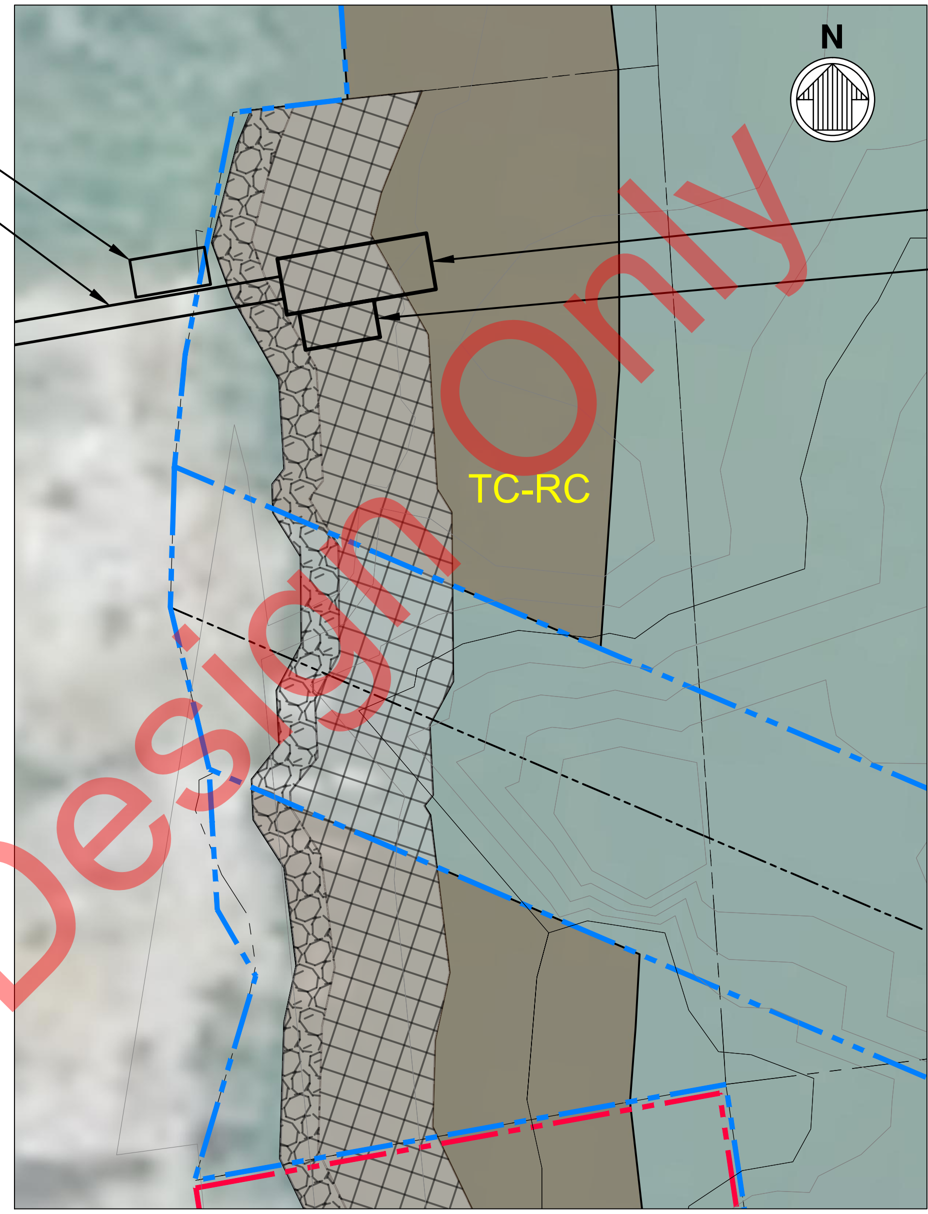

B1 FIG-104 PLAN - MANAGEMENT UNIT TC-OM
SCALE: 1:1000

B3 FIG-104 PLAN - MANAGEMENT UNIT TC-RC
SCALE: 1:1000

LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- PARKS CANADA
- TRANSPORT CANADA
- CITY OF KINGSTON
- DEPARTMENT OF DEFENSE
- CAP (CONVENTIONAL)
- CAP (CONVENTIONAL) WITH DREDGE
- THIN CAP WITH ACTIVATED CARBON
- THIN CAP WITH ACTIVATED CARBON WITH DREDGE
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (SHORELINE REVETMENT) WITH DREDGE
- ENGINEERING CONTROL BOARDWALK
- HABITAT MOSAIC (WETLAND REMEDIATION)
- DREDGED SURFACE SEDIMENT

NOTES:

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20 0m 20 40
SCALE: 1 : 1000

KINGSTON INNER HARBOUR

PLAN - MANAGEMENT UNIT TC-OM AND TC - RC

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Sheet Reference No.
FIG-104
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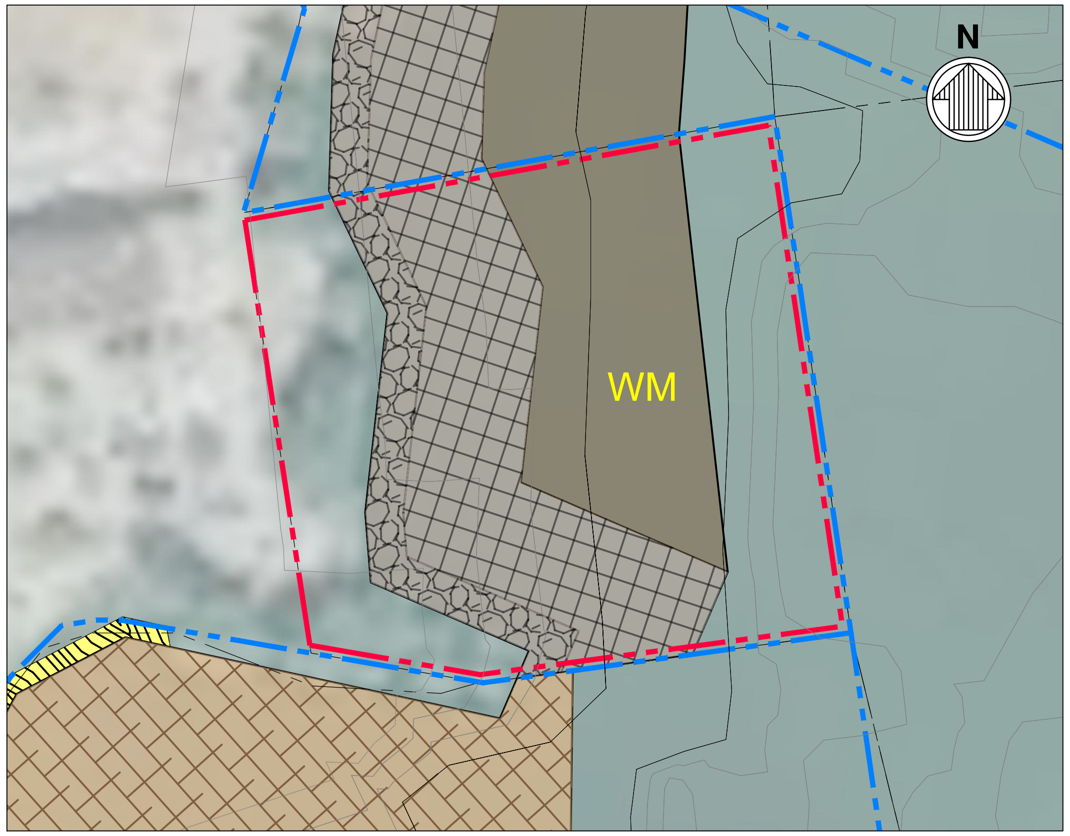
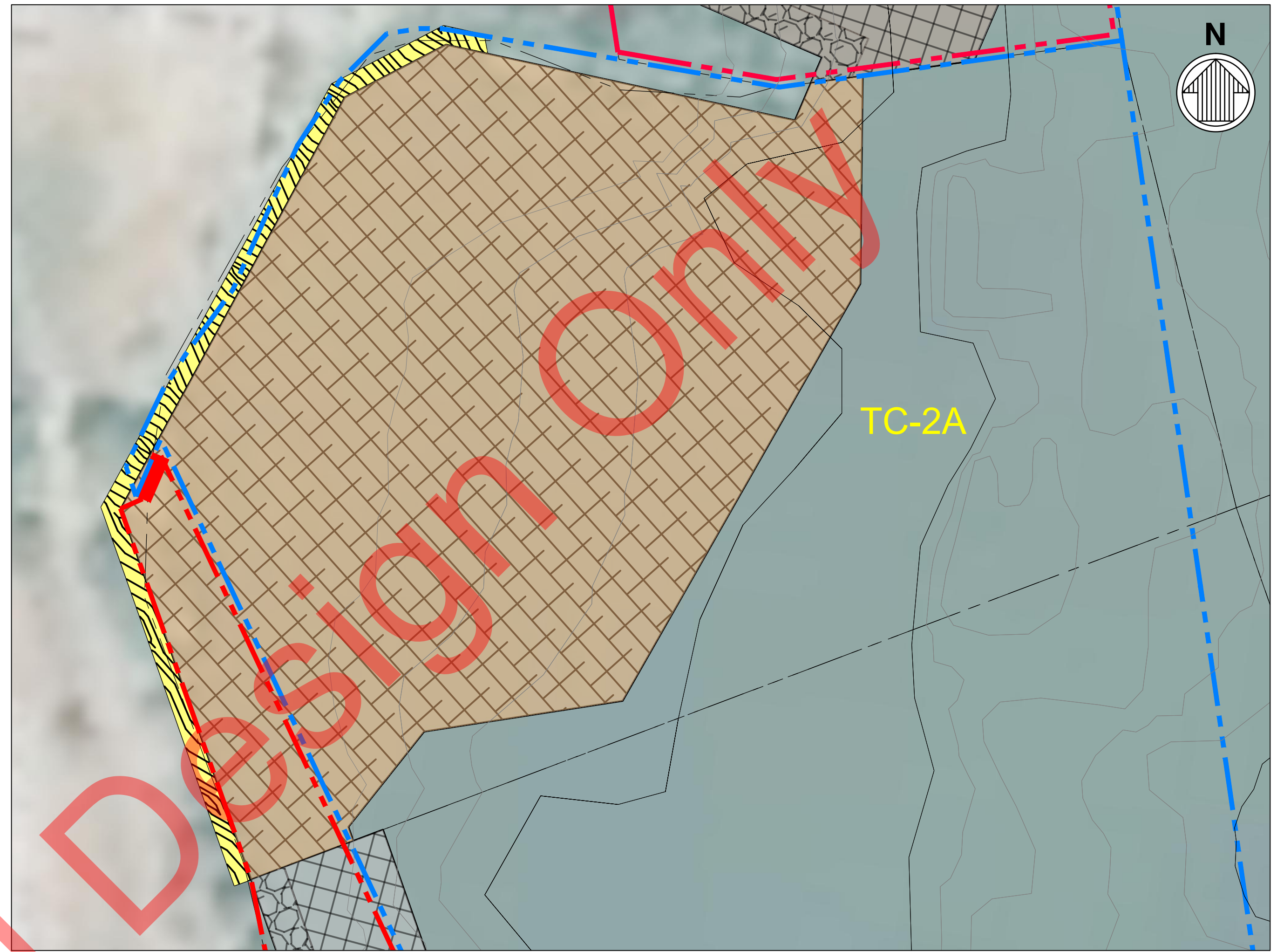


B1 FIG-105 PLAN - MANAGEMENT UNIT - WM
SCALE: 1:1000



B3 FIG-105 PLAN - MANAGEMENT UNIT TC-2A
SCALE: 1:1000

Conceptual Design Only

LEGEND

FEDERAL WATER LOT BOUNDARY
MANAGEMENT UNIT
PARKS CANADA
TRANSPORT CANADA
CITY OF KINGSTON
DEPARTMENT OF DEFENSE

CAP (CONVENTIONAL)
CAP (CONVENTIONAL) WITH DREDGE
THIN CAP WITH ACTIVATED CARBON
THIN CAP WITH ACTIVATED CARBON WITH DREDGE
ENGINEERING CONTROL (SHORELINE REVETMENT)
ENGINEERING CONTROL (SHORELINE REVETMENT) WITH DREDGE

ENGINEERING CONTROL BOARDWALK
HABITAT MOSAIC (WETLAND REMEDIATION)
DREDGED SURFACE SEDIMENT

NOTES:

1. BATHYMETRY CONTOURS ARE IN METERS ABOVE INTERNATIONAL GREAT LAKE DATUM (IGLD) 1985.
2. LAKE ONTARIO LOW WATER DATUM (LWD) OF INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985 EQUALS 74.2 METERS ABOVE THE ZERO REFERENCE POINT AT RIMOUSKI, QUEBEC

20 0m 20 40
SCALE: 1 : 1000

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PLAN - MANAGEMENT UNIT WM AND TC-2A

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Sheet Reference No.
FIG-105
INDEX: 6 OF 13

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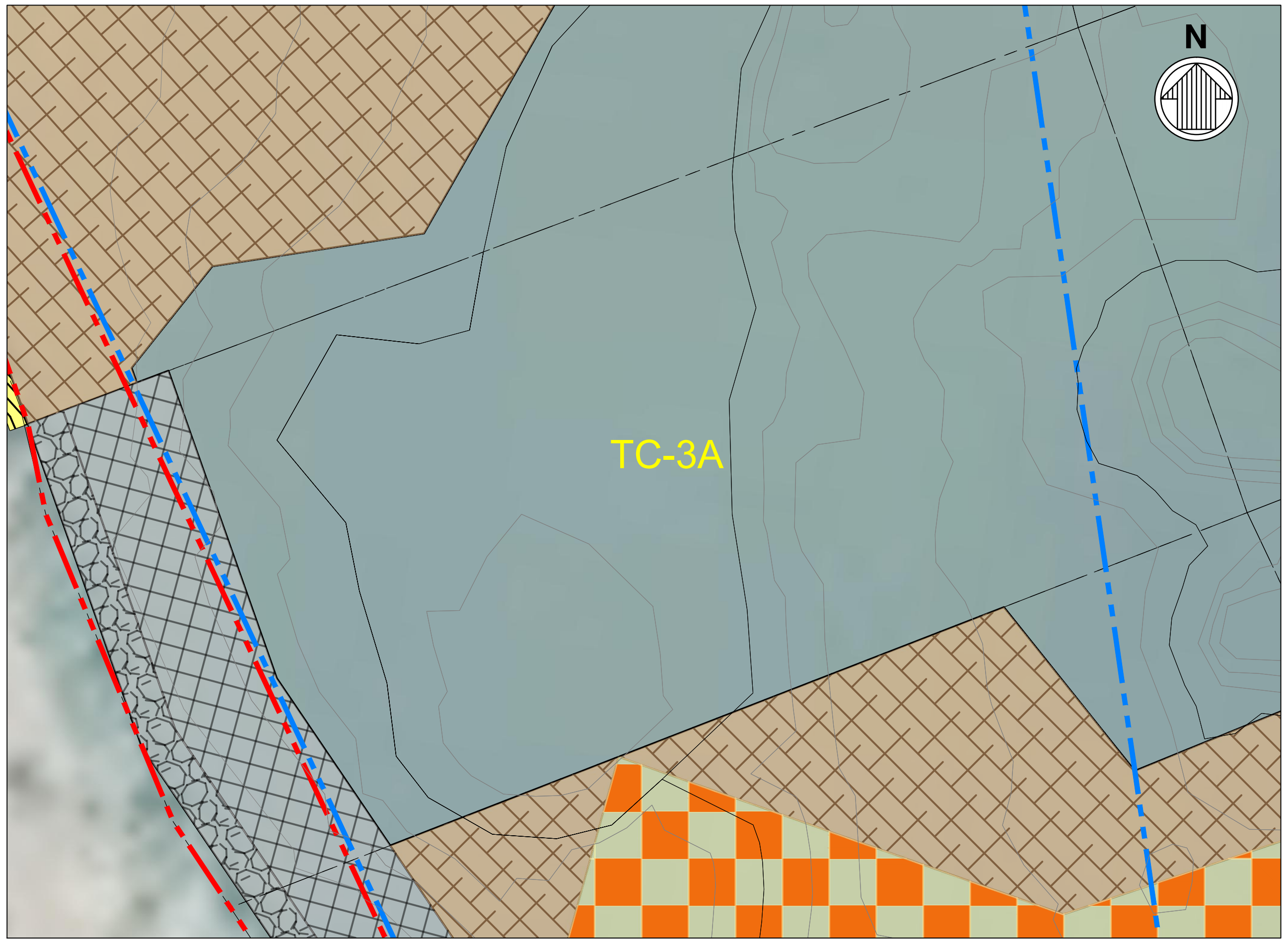
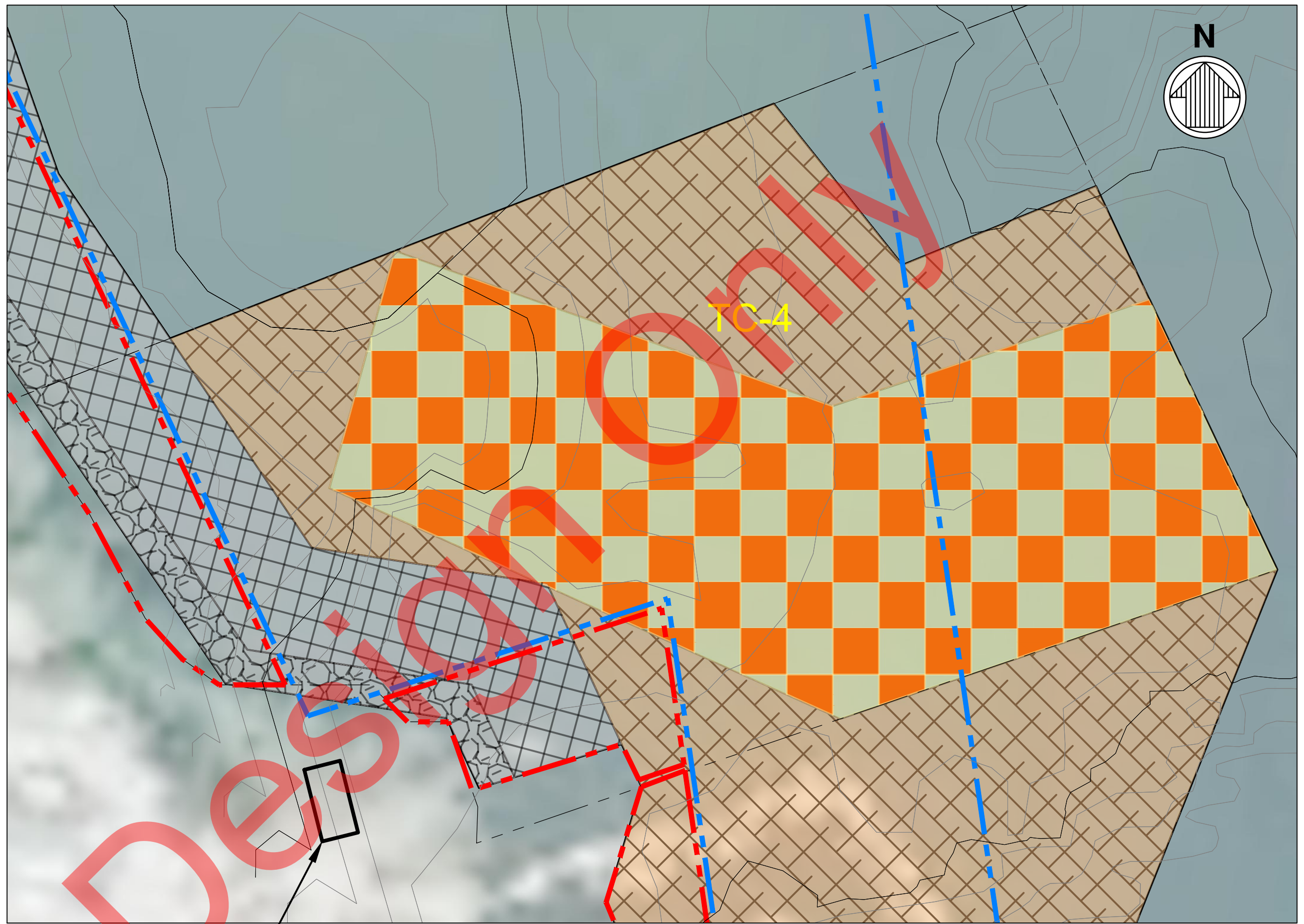


B1 FIG-106 PLAN - MANAGEMENT UNIT TC - 3A
SCALE: 1:1000



10m x 20m STOCK PILE AREA

B3 FIG-106 PLAN - MNAGEMENT UNIT TC - 4
SCALE: 1:1000

LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- PARKS CANADA
- TRANSPORT CANADA
- CITY OF KINGSTON
- DEPARTMENT OF DEFENSE
- CAP (CONVENTIONAL)
- CAP (CONVENTIONAL) WITH DREDGE
- THIN CAP WITH ACTIVATED CARBON
- THIN CAP WITH ACTIVATED CARBON WITH DREDGE
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (SHORELINE REVETMENT) WITH DREDGE
- ENGINEERING CONTROL BOARDWALK
- HABITAT MOSAIC (WETLAND REMEDIATION)
- DREDGED SURFACE SEDIMENT

NOTES:

1. BATHYMETRY CONTOURS ARE IN METERS ABOVE INTERNATIONAL GREAT LAKE DATUM (IGLD) 1985.
2. LAKE ONTARIO LOW WATER DATUM (LWD) OF INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985 EQUALS 74.2 METERS ABOVE THE ZERO REFERENCE POINT AT RIMOUSKI, QUEBEC

20 0m 20 40
SCALE: 1 : 1000

KINGSTON INNER HARBOUR

PLAN - MANAGEMENT UNIT TC - 3A AND TC - 4

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Sheet Reference No.
FIG-106
INDEX: 7 OF 13

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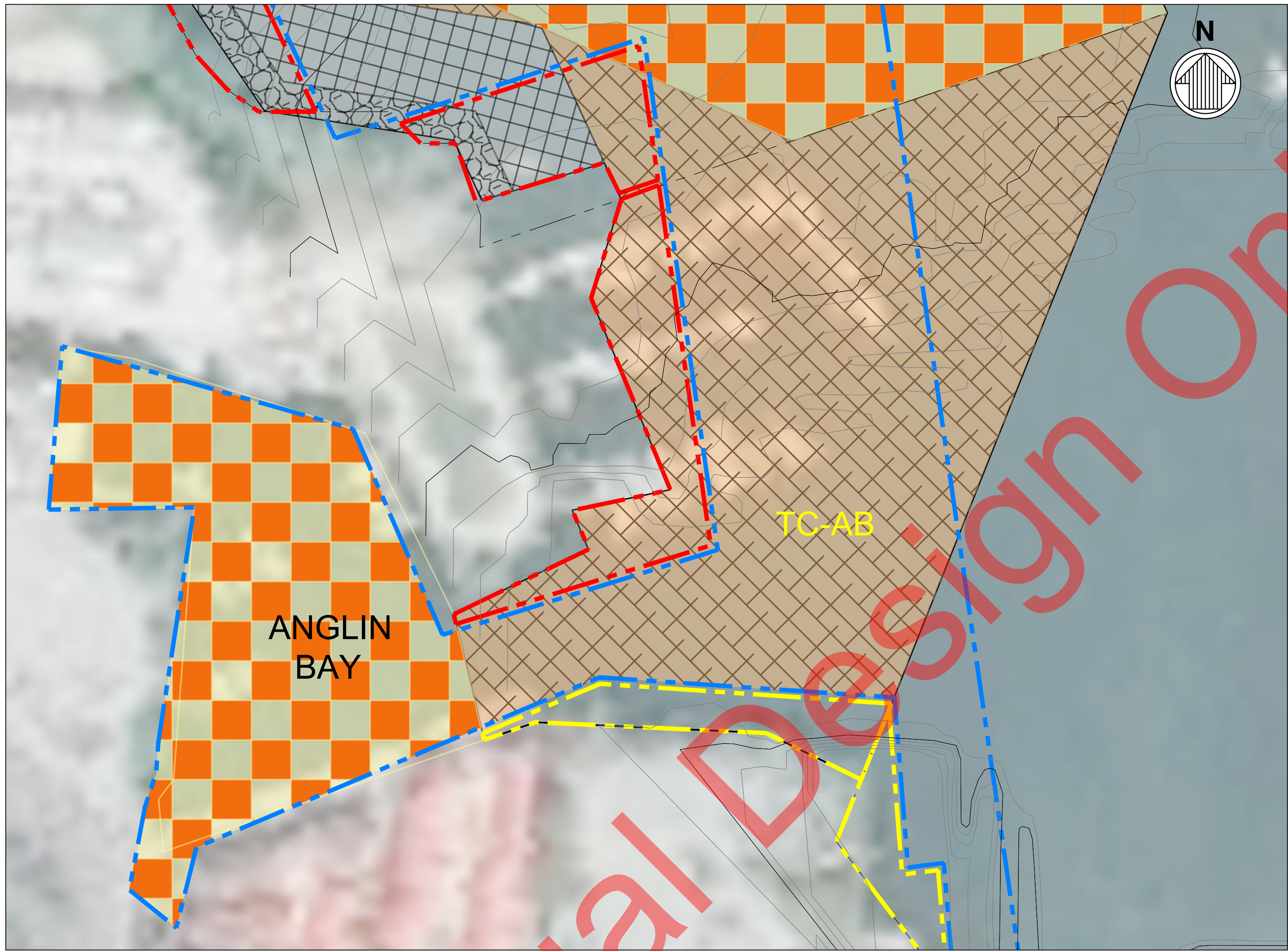

B1 FIG-107 PLAN - MANAGEMENT UNIT TC-AB
SCALE: 1:1000

LEGEND

	FEDERAL WATER LOT BOUNDARY
	MANAGEMENT UNIT
	PARKS CANADA
	TRANSPORT CANADA
	CITY OF KINGSTON
	DEPARTMENT OF DEFENSE

- CAP (CONVENTIONAL)
- CAP (CONVENTIONAL) WITH DREDGE
- THIN CAP WITH ACTIVATED CARBON
- THIN CAP WITH ACTIVATED CARBON WITH DREDGE
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (SHORELINE REVETMENT) WITH DREDGE
- ENGINEERING CONTROL BOARDWALK
- HABITAT MOSAIC (WETLAND REMEDIATION)
- DREDGED SURFACE SEDIMENT

NOTES:

1. BATHYMETRY CONTOURS ARE IN METERS ABOVE INTERNATIONAL GREAT LAKE DATUM (IGLD) 1985.
2. LAKE ONTARIO LOW WATER DATUM (LWD) OF INTERNATIONAL GREAT LAKES DATUM (IGLD) 1985 EQUALS 74.2 METERS ABOVE THE ZERO REFERENCE POINT AT RIMOUSKI, QUEBEC

20 0m 20 40
SCALE: 1 : 1000

KINGSTON INNER HARBOUR

PLAN - MANAGEMENT UNIT TC-AB

moffatt & nichol
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BALTIMORE, MARYLAND 21224

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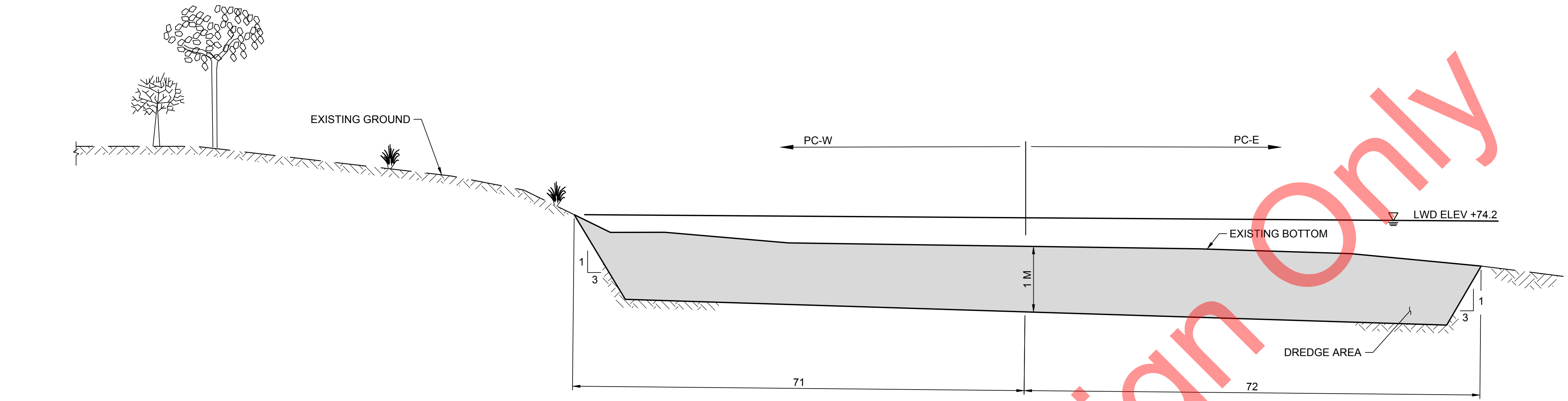
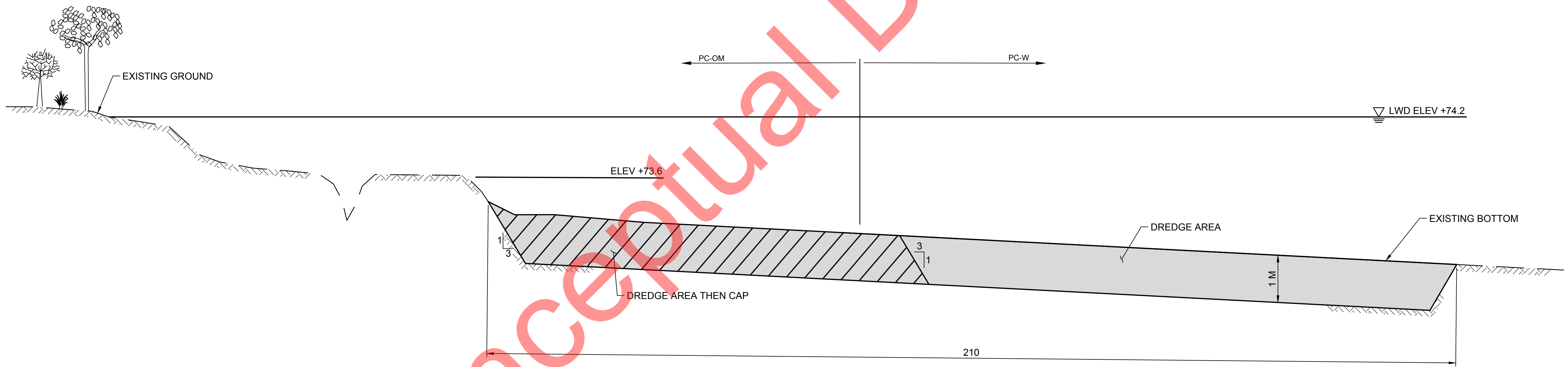
Reviewed by: REVR		Drawing code:	
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL		Drawing Scale: Plot scale: 1:1 (Metric D)	

SEAL

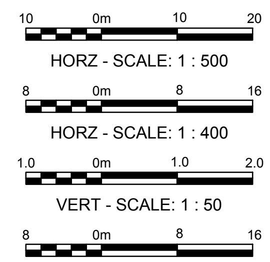
Sheet Reference No.
FIG-107
INDEX: 8 OF 13



C1 FIG-108 SECTION - MANAGEMENT UNIT PC-W & PC-E
HORZ SCALE: 1:400 VERT SCALE 1:40



A1 FIG-108 SECTION - MANAGEMENT UNIT PC-OM & PC-W
HORZ SCALE: 1:500_1 VERT SCALE 1:50



KINGSTON INNER HARBOUR

SECTIONS - MANAGEMENT UNIT 1 OF 5

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2780 LIGHTHOUSE POINT EAST SUITE D
BALTIMORE, MARYLAND 21224

Designed by: DSGN | Dwn by: DRFT | Chk'd by: CHKR | Reviewed by: REVR | Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL | Date: DATE | Rev: REVNO | M&N Project No. INSERT PROJ. NO. | Drawing code: | Drawing Scale: | Plot scale: 1:1 (Metric D)

SEAL

Sheet Reference No.
FIG-108
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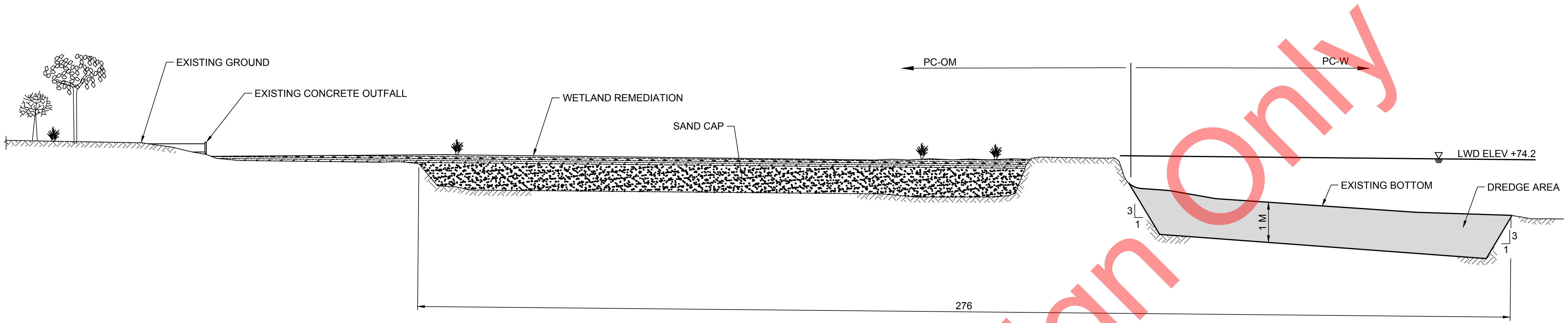
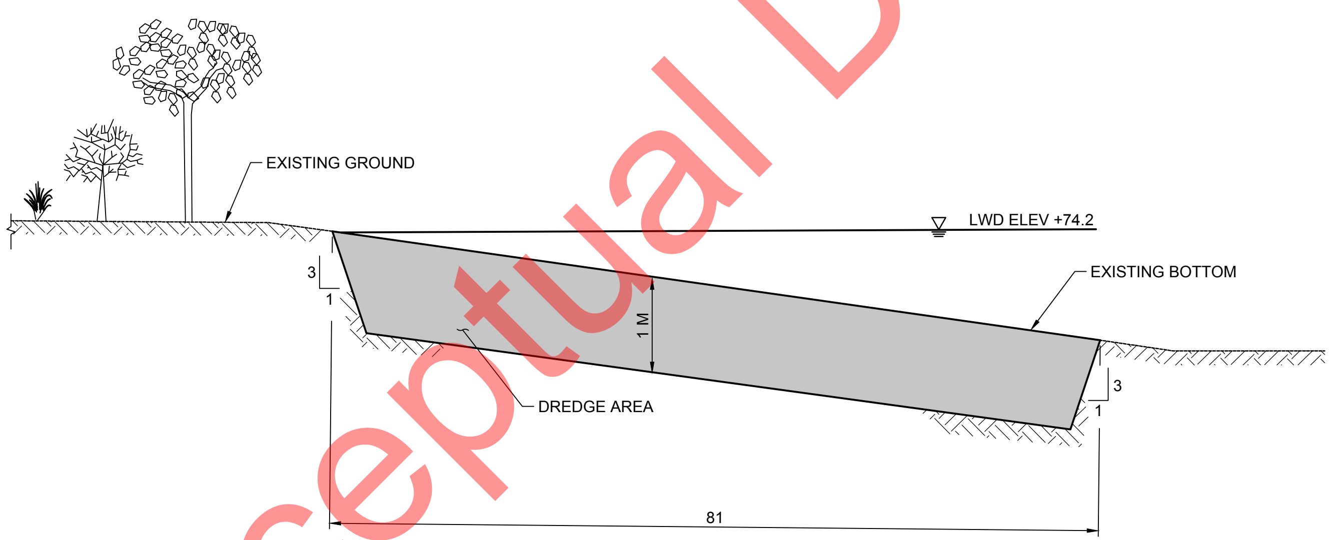
DRAWING SCALES SHOWN BASED ON 594mmx841mm DRAWING

File: Q:\BA\10313 Kingston IH\10313-02\500 CADD_ACTIVE_Exhibits\Remediation\10313C-FIG-108 ; Plotted: 10/2/2020 3:15 PM by WILKINSON, MELISSA ; Saved: 10/2/2020 10:28 AM by MWILKINSON



C1 FIG-109 SECTION - MANAGEMENT UNIT PC-OM & PC-W
SCALE: 1:600



A1 FIG-109 SECTION - MANAGEMENT UNIT TC-OM
SCALE: 1:400

HORZ - SCALE: 1 : 600

HORZ - SCALE: 1 : 400

VERT - SCALE: 1 : 60

VERT - SCALE: 1 : 40

KINGSTON INNER HARBOUR

SECTIONS - MANAGEMENT UNIT
2 OF 5

moffatt & nichol
2780 LIGHTHOUSE POINT EAST SUITE D
BALTIMORE, MARYLAND 21224

Designed by: DSGN | Dwn by: DRFT | Chkd by: CHKR | Reviewed by: REVR | Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL

Date: DATE | Rev: REVNO | M&N Project No. INSERT PROJ. NO. | Drawing code: | Drawing Scale: | Plot scale: 1:1 (Metric D)

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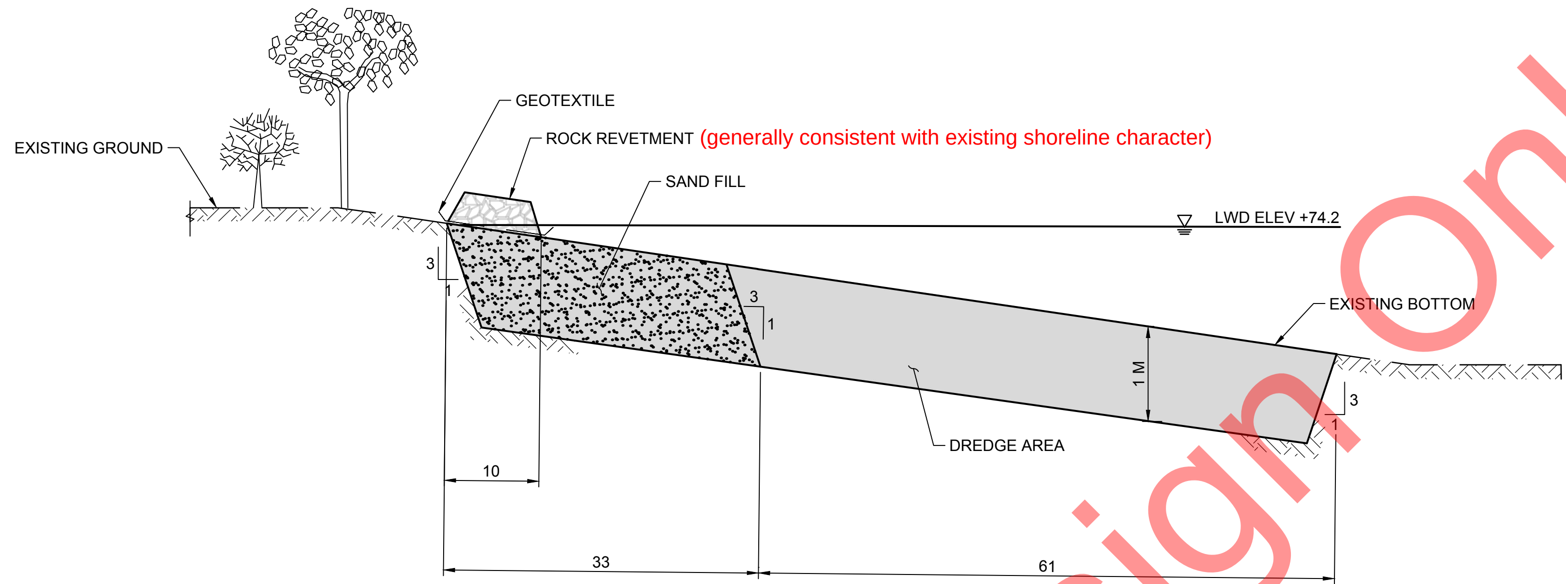
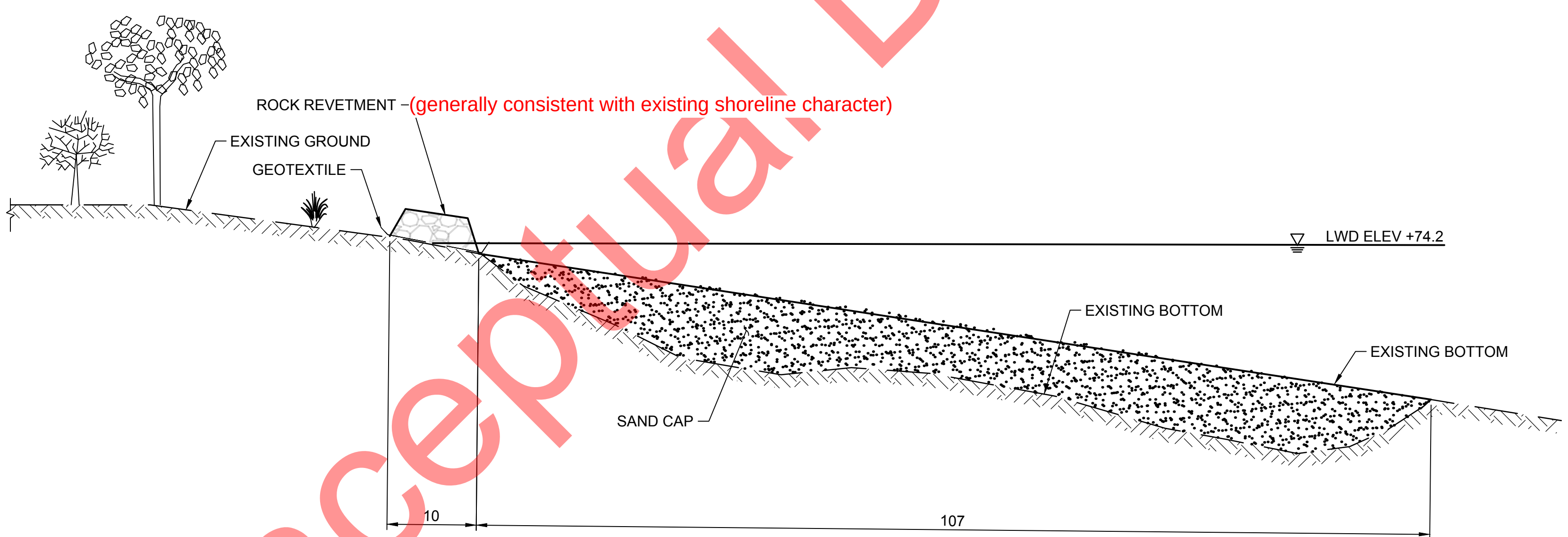
File: Q:\BA\10313 Kingston IH\10313-02\500 CADD_ACTIVE_Exhibits\Remediation\10313C-FIG-109 ; Plotted: 10/2/2020 3:15 PM by WILKINSON, MELISSA ; Saved: 10/2/2020 11:02 AM by MWILKINSON

DRAWING SCALES SHOWN BASED ON 594mmx841mm DRAWING



C1 FIG-110 SECTION - MANAGEMENT UNIT TC-RC & WM
SCALE: Custom



A1 FIG-110 SECTION - MANAGEMENT UNIT TC-3A
SCALE: 1:1400

8 0m 8 16
VERT - SCALE: 1 : 40

8 0m 8 16
HORZ - SCALE: 1 : 400

KINGSTON INNER HARBOUR

SECTIONS - MANAGEMENT UNIT 3 OF 5

moffatt & nichol
2780 LIGHTHOUSE POINT EAST SUITE D
BALTIMORE, MARYLAND 21224

Designed by: DSGN	Date: DATE
Dwn by: DRFT	Chk'd by: CHKR
M&N Project No.	INSERT PROJ. NO.
Reviewed by: REVR	Drawing code:
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL	Drawing Scale:
Plot scale: 1:1 (Metric D)	Rev: REVNO

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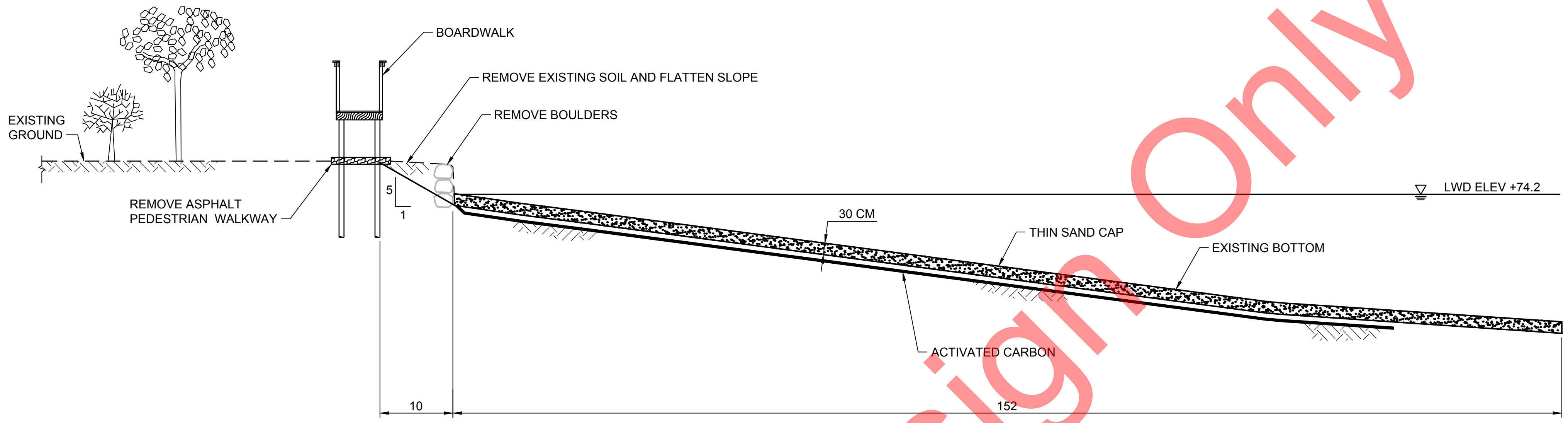

C1 FIG-111 SECTION - MANAGEMENT UNIT TC-2A
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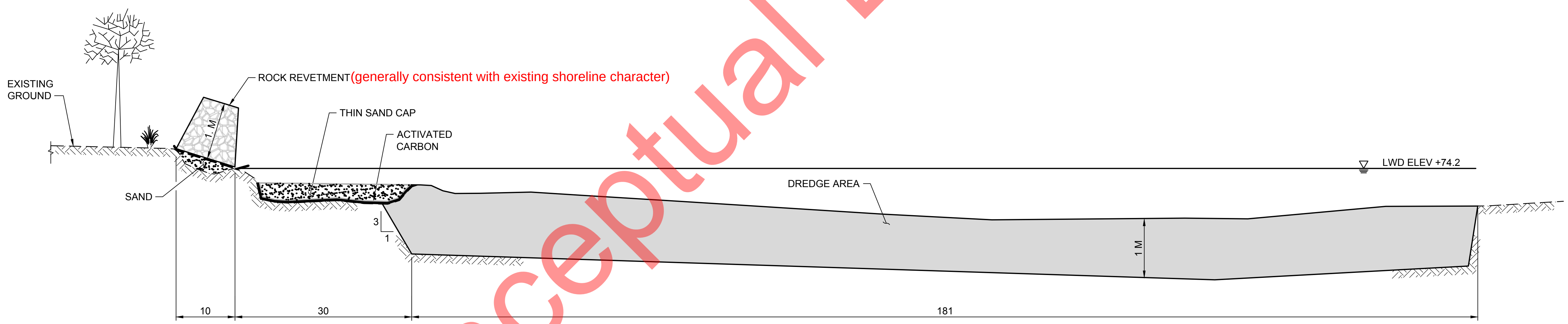

A1 FIG-111 SECTION - MANAGEMENT UNIT TC-4
SCALE: Custom

8 0m 8 16
VERT - SCALE: 1 : 40

8 0m 8 16
HORZ - SCALE: 1 : 400

KINGSTON INNER HARBOUR

SECTIONS - MANAGEMENT UNIT 4 OF 5

moffatt & nichol
2780 LIGHTHOUSE POINT EAST SUITE D
BALTIMORE, MARYLAND 21224

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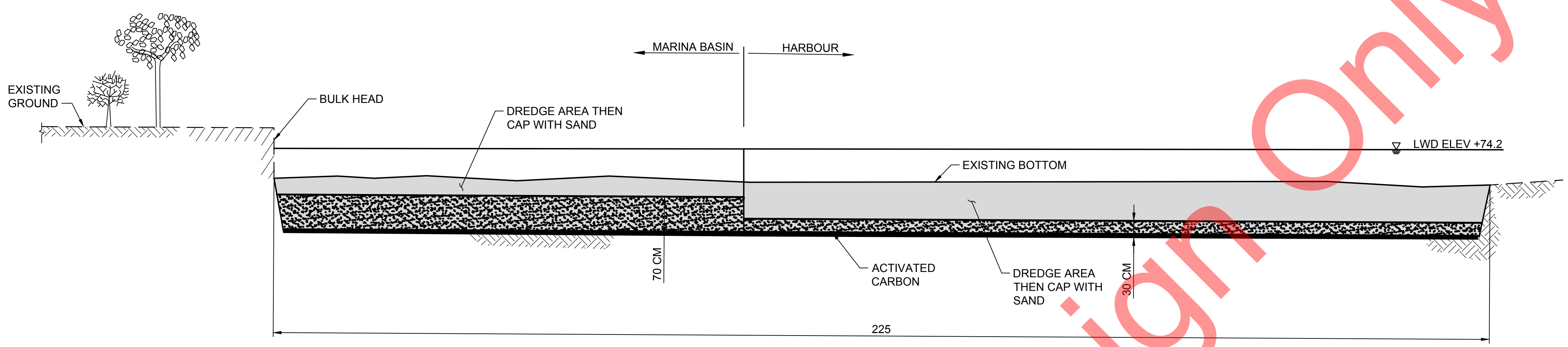
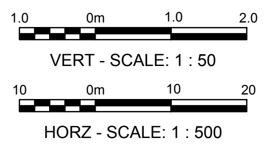


C1 FIG-112 SECTION - MANAGEMENT UNIT TC-AB
SCALE: 1:500



Conceptual Design Only

KINGSTON INNER HARBOUR

SECTIONS - MANAGEMENT UNIT
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APPENDIX C

Species at Risk Screening and Fish Community Results

Taxon	Common Name	Scientific Name	Source(s)*	Ontario Habitat Descriptions	Probability of Occurrence in Study Area	Rationale	ESA Habitat Protection Provisions[6]	SARA Critical Habitat Defined[7] (Yes or No)
Amphibian	Western chorus frog - Great Lakes St. Lawrence / Canadian Shield population	*Pseudacris triseriata*	ORAA	In Ontario, habitat of this amphibian species typically consists of marshes or wooded wetlands, particularly those with dense shrub layers and grasses, as this species is a poor climber. They will breed in almost any fishless pond including roadside ditches, gravel pits and flooded swales in meadows. This species hibernates in terrestrial habitats under rocks, dead trees or leaves, in loose soil or in animal burrows. During hibernation, this species is tolerant of flooding (Environment Canada 2015).	Low	Within the study area, there are no notable wetlands with the tall grass or shrub layers that this species prefers. Further there are no recent records in the vicinity of the study area.		Yes • Suitable wetland habitat (all areas of suitable habitat incorporated): temporary wetlands or shallow portions of permanent wetlands with vegetation structure/composition generally herbaceous with occasional shrubby wildlands, or partially submerged trees forming open/discontinuous canopy (although some pop'n breed in heavily canopied habitat), and an absence of fish and other aquatic predators • Terrestrial habitat (incorporating up to 300 m from boundaries of breeding wetlands) includes same vegetation structure/composition as wetlands, as well as soft substrate with dead leaves, woody debris and burrows for hibernation habitat • Site occupancy: established by selecting point count data from 1992 or later and covering at least two separate years within 20 year period (with at least 1 observation from last 10 years) • Dispersal corridor connects 2 breeding sites that meet habitat occupancy criteria and that are separated by maximum distance of 900 m • 211 critical habitat parcels identified in Ontario • Excludes anthropogenic structures
Arthropod	Monarch	*Danaus plexippus*	OOA	In Ontario, monarch is found throughout the northern and southern regions of the province. This butterfly is found wherever there is milkweed (*Asclepias* spp.) plants for its caterpillars and wildflowers that supply a nectar source for adults. It is often found on abandoned farmland, meadows, open wetlands, prairies and roadsides, but also in city gardens and parks. Important staging areas during migration occur along the north shores of the Great Lakes (COSEWIC 2010).	Moderate	Within the study area, habitat edges provided suitable habitat for this species. Further there are recent records in the vicinity.		No
Bird	Bald eagle	*Haliaeetus leucocephalus*	eBird	In Ontario, bald eagle nests are typically found near the shorelines of lakes or large rivers, often on forested islands. The large, conspicuous nests are typically found in large super-canopy trees along water bodies (Buehler 2000).	Moderate	Although this species was not observed during the site investigations, it could occur in the study area along the River. No raptor nests were observed in the study area.		No
Bird	Bank swallow	*Riparia riparia*	OBBA; NHIC	In Ontario, bank swallow breeds in a variety of natural and anthropogenic habitats, including lake bluffs, stream and riverbanks, sand and gravel pits, and roadcuts. Nests are generally built in a vertical or near-vertical bank. Breeding sites are typically located near open foraging sites such as rivers, lakes, grasslands, agricultural fields, wetlands and riparian woods. Forested areas are generally avoided (Garrison 1999).	Low	Within the study area, no suitable banks for nesting habitat were observed.	General (Draft) Category 1 – Breeding colony, including burrows and substrate between them Category 2 – Area within 50 m of the front of breeding colony face Category 3 – Area of suitable foraging habitat within 500 m of the outer edge of breeding colony	No
Bird	Barn swallow	*Hirundo rustica*	OBBA, Snetsinger	In Ontario, barn swallow breeds in areas that contain a suitable nesting structure, open areas for foraging, and a body of water. This species nests in human made structures including barns, buildings, sheds, bridges, and culverts. Preferred foraging habitat includes grassy fields, pastures, agricultural cropland, lake and river shorelines, cleared rights-of-way, and wetlands (COSEWIC 2011). Mud nests are fastened to vertical walls or built on a ledge underneath an overhang. Suitable nests from previous years are reused (Brown and Brown 2019).	Low	There are no suitable nesting structures along the immediate shoreline.	General Category 1 – Nest Category 2 – Area within 5 m of the nest Category 3 – Area between 5-200 m of the nest	No, but Residence Description Provided: • During period of occupany (May-Aug) any barn swallow nest, whether occupied or not, is considered a residence
Bird	Black tern	*Chlidonias niger*	OBBA,, Snetsinger	In Ontario, black tern breeds in freshwater marshlands where it forms small colonies. It prefers marshes or marsh complexes greater than 20 ha in area and which are not surrounded by wooded area. Black terns are sensitive to the presence of agricultural activities. The black tern nests in wetlands with an even combination of open water and emergent vegetation, and still waters of 0.5-1.2 m deep. Preferred nest sites have short dense vegetation or tall sparse vegetation often consisting of cattails, bulrushes and occasionally burreed or other marshland plants. Black terns also require posts or snags for perching (Weseloh 2007).	Low	There is no suitable nesting habitat for this species in the study area.		No

Taxon	Common Name	Scientific Name	Source(s)*	Ontario Habitat Descriptions	Probability of Occurrence in Study Area	Rationale	ESA Habitat Protection Provisions[6]	SARA Critical Habitat Defined[7] (Yes or No)
Bird	Bobolink	*Dolichonyx oryzivorus*	OBBA, NHIC	In Ontario, bobolink breeds in grasslands or graminoid dominated hayfields with tall vegetation (Gabhauer 2007). Bobolink prefers grassland habitat with a forb component and a moderate litter layer. They have low tolerance for presence of woody vegetation and are sensitive to frequent mowing within the breeding season. They are most abundant in established, but regularly maintained, hayfields, but also breed in lightly grazed pastures, old or fallow fields, cultural meadows and newly planted hayfields. Their nest is woven from grasses and forbs. It is built on the ground, in dense vegetation, usually under the cover of one or more forbs (Renfrew et al. 2015).	Low	There are no suitable large, open hayfields or unmaintained grassy areas for nesting.	General Category 1 – Nest and area within 10 m of nest Category 2 – Area between 10 – 60 m of the nest or centre of approximated defended territory Category 3 - Area of continuous suitable habitat between 60 – 300 m of the nest or centre of approximated defended territory	No
Bird	Canada warbler	*Cardellina canadensis*	eBird	In Ontario, breeding habitat for Canada warbler consists of moist mixed forests with a well-developed shrubby understory. This includes low-lying areas such as cedar and alder swamps, and riparian thickets (McLaren 2007). It is also found in densely vegetated regenerating forest openings. Suitable habitat often contains a developed moss layer and an uneven forest floor. Nests are well concealed on or near the ground in dense shrub or fern cover, often in stumps, fallen logs, overhanging stream banks or mossy hummocks (Reitsma et al. 2010).	Low	There are no mixed forests in the study area.		No
Bird	Cerulean warbler	*Setophaga cerulea*	eBird	In Ontario, breeding habitat of cerulean warbler consists of second-growth or mature deciduous forest with a tall canopy of uneven vertical structure and a sparse understory. This habitat occurs in both wet bottomland forests and upland areas, and often contains large hickory and oak trees. This species may be attracted to gaps or openings in the upper canopy. The cerulean warbler is associated with large forest tracks but may occur in woodlots as small as 10 ha (COSEWIC 2010). Nests are usually built on a horizontal limb in the mid-story or canopy of a large deciduous tree (Buehler et al. 2013).	Low	The woodlots in study area are lacking the structure this species prefers for nesting.	General	Yes • Locations with confirmed breeding observation in any year between 2009-2018, or demonstrated multi-year occupancy AND contiguous habitat within 1 km radius • Breeding habitat includes: -deciduous forest with presence of large diameter trees (>38 cm DHB) AND -basal area >23 m2/ha AND -canopy gaps (typically 40-100 m2 at density of approx. 1 per 0.5ha) • Habitat also includes landscape forest matrix, defined as FOD, FOM or FOC
Bird	Chimney swift	*Chaetura pelagica*	OBBA	In Ontario, chimney swift breeding habitat is varied and includes urban, suburban, rural and wooded sites. They are most commonly associated with towns and cities with large concentrations of chimneys. Preferred nesting sites are dark, sheltered spots with a vertical surface to which the bird can grip. Unused chimneys are the primary nesting and roosting structure, but other anthropogenic structures and large diameter cavity trees are also used (COSEWIC 2007).	Low	There are no suitable nesting structures along the immediate shoreline.	General Category 1 – Human-made nest/roost, or natural nest/roost cavity and area within 90 m of natural cavity	No
Bird	Common nighthawk	*Chordeiles minor*	OBBA	In Ontario, these aerial foragers require areas with large open habitat. This includes farmland, open woodlands, clearcuts, burns, rock outcrops, alvars, bogs, fens, prairies, gravel pits and gravel rooftops in cities (Sandilands 2007)	Low	There do not appear to be any suitable nesting habitats in the study area.		No
Bird	Eastern meadowlark	*Sturnella magna*	OBBA; NHIC	In Ontario, eastern meadowlark breeds in pastures, hayfields, meadows and old fields. Eastern meadowlark prefers moderately tall grasslands with abundant litter cover, high grass proportion, and a forb component (Hull 2019). They prefer well drained sites or slopes, and sites with different cover layers (Roseberry and Klimstra 1970).	Low	There are no suitable large, open hayfields or unmaintained grassy areas for nesting.	General Category 1 – Nest and area within 10 m of the nest Category 2 – Area between 10 – 100 m of the nest or centre of approximated defended territory Category 3 – Area of continuous suitable habitat between 100 – 300 m of the nest or centre of approximated defended territory	No

Taxon	Common Name	Scientific Name	Source(s)*	Ontario Habitat Descriptions	Probability of Occurrence in Study Area	Rationale	ESA Habitat Protection Provisions[6]	SARA Critical Habitat Defined[7] (Yes or No)
Bird	Eastern whip-poor-will	*Antrostomus vociferus*	OBBA	In Ontario, whip-poor-will breeds in semi-open forests with little ground cover. Breeding habitat is dependent on forest structure rather than species composition, and is found on rock and sand barrens, open conifer plantations and post-disturbance regenerating forest. Territory size ranges from 3 to 11 ha (COSEWIC 2009). No nest is constructed, and eggs are laid directly on the leaf litter (Mills 2007).	Low	No suitable nesting habitat is present in the study area.	General Category 1 – Nest and area within 20 m of nest Category 2 – Area between 20-170 m from nest or centre of approximated defended territory Category 3 – Area of suitable habitat within 170-500 m of the nest, or centre of approximated defended territory	Yes • Occupany defined as atlas square where records from 2001 breeding season consist of at least: o 1 confirmed breeding record OR o 2 records where a minimum of 1 record is probably breeding OR o 2 possible breeding records in a single year + at least one possible breeding record from another year OR o 5 possible breeding records (single or different years) • Suitable habitat for nesting and foraging includes all corresponding areas of 3 ha or more within a 10 km x 10 km atlas square: o forests with sparse to moderate tree cover or open habitats + sparse to moderate shrub and herbaceous cover + well-drained soils • Suitable habitat for nesting only includes all corresponding areas up to 30 m on the interior side of the forest edge within a 10 km x 10 km atlas square: o forests with dense tree cover + sparse to moderate shrub and herbaceous cover + well-drained soils • Suitable habitat for foraging only includes all corresponding areas up to 1,250 m from the edge of suitable nesting habitat within a 10 km x 10 km atlas square: o forests with sparse tree cover or open habitats + dense shrub cover + soil drainage is deficient OR o agricultural land with scattered shrubs or trees (e.g. hedgerows) that can be used as perches
Bird	Eastern wood-pewee	*Contopus virens*	eBird	In Ontario, eastern wood-pewee inhabits a wide variety of wooded upland and lowland habitats, including deciduous, coniferous, or mixed forests. It occurs most frequently in forests with some degree of openness. Intermediate-aged forests with a relatively sparse midstory are preferred. In younger forests with a relatively dense midstory, it tends to inhabit the edges. Also occurs in anthropogenic habitats providing an open forested aspect such as parks and suburban neighborhoods. Nest is constructed atop a horizontal branch, 1-2 m above the ground, in a wide variety of deciduous and coniferous trees (COSEWIC 2012).	Moderate	The forested riparian area in the study area may provide suitable nesting habitat for this species.		No
Bird	Evening grosbeak	*Coccothraustes vespertinus*	eBird	In Ontario, evening grosbeak breeds across northern Ontario, as far south as southern Georgian Bay, in open mature coniferous or mixed forests dominated by fir species, white spruce and/or trembling aspen (MECP 2019).	Low	Too far south for breeding habitat. No suitable forested habitats present.		No
Bird	Golden-winged warbler	*Vermivora chrysoptera*	OBBA	In Ontario, golden-winged warbler breeds in regenerating scrub habitat with dense ground cover and a patchwork of shrubs, usually surrounded by forest. Their preferred habitat is characteristic of a successional landscape associated with natural or anthropogenic disturbance such as rights-of-way, and field edges or openings resulting from logging or burning. The nest of the golden-winged warbler is built on the ground at the base of a shrub or leafy plant, often at the shaded edge of the forest or at the edge of a forest opening (Confer et al. 2011).	Low	There are no suitable large, open hayfields or unmaintained grassy areas for nesting.		Yes • Focal areas of suitable nesting and/or foraging habitat meeting occupany criteria (10 x 10 km atlas square is maximum extent) • Occupany defined as atlas square where individuals found in both 1st and 2nd Atlases OR 1+ recrods of confirmed or probable breeding observed since 2001 • Suitable habitat defined as nesting/foraging habitat within appropriate forested landscape o nesting/foraging habitat - entire length of open/shrub habitat and forest habitat interface AND a 200 m from the interface into both the forest and open/shrub habitats (or 50 m into open/shrub habitat if it is grassland) o appropriate forested landscape - 50-75% forest cover within 5 x 5 km area consisting of primarily deciduous or mixed forest (>50%) and coniferous forest cover (<30%)
Bird	Grasshopper sparrow *pratensis* subspecies	*Ammodramus savannarum* (pratensis subspecies)	NHIC	In Ontario, grasshopper sparrow is found in medium to large grasslands with low herbaceous cover and few shrubs. It also uses a wide variety of agricultural fields, including cereal crops and pastures. Close-grazed pastures and limestone plains (e.g. Carden and Napanee Plains) support highest density of this bird in the province (COSEWIC 2013).	Low	Within the study area, there are no suitable large open grasslands.		
Bird	King rail	*Rallus elegans*	OBBA, NHIC	In Ontario, king rail breeds in freshwater marshes, especially large marshes with a variety of water level conditions and a mosaic of habitats. This species prefers relatively shallow wetlands containing dense emergent vegetation (especially cattails), patches of open water, hummocks, mudflats and shrubby swales. Nests are generally well concealed in patches of dense, uniform vegetation over shallow water areas (COSEWIC 2011).	Low	Within the study area, there are no suitable large emergent marshes that would provide nesting habitat for this species.	General	No

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Bird	Least bittern	*Ixobrychus exilis*	eBird	In Ontario, least bittern breeds in marshes, usually greater than 5 ha, with emergent vegetation, relatively stable water levels and areas of open water. Preferred habitat has water less than 1 m deep (usually 10 – 50 cm). Nests are built in tall stands of dense emergent or woody vegetation (Woodliffe 2007). Clarity of water is important as siltation, turbidity, or excessive eutrophication hinders foraging efficiency (COSEWIC 2009).	Low	Within the study area, there are no suitable large emergent marshes that would provide nesting habitat for this species.	General (as of June 30, 2013)	Yes Area of suitable habitat with 500 m of documented breeding activity consisting of either: • 1+ records of confirmed breeding since 2001; or • Min. 2 records of probable breeding (in any year since 2001) or min. 1 record of probable breeding evidence (in each of 2 separate years within floating 5-year window since 2001). Suitable habitat: • areas within high-water mark of permanent wetlands (marshes and shrubby swamps) containing tall and robust emergent herbaceous and/or woody vegetation interspersed with areas of open water • extends up to 500 m of documented breeding activity • All habitat (suitable or not) within 500 m of documented breeding activity referred to as a site
Bird	Peregrine falcon (anatum/tundrius subspecies)	*Falco peregrinus anatum/tundrius*	OBBA	In Ontario, peregrine falcon breeds in areas containing suitable nesting locations and sufficient prey resources. Such habitat includes both natural locations containing cliff faces (heights of 50 - 200 m preferred) and anthropogenic landscapes including urban centres containing tall buildings, open pit mines and quarries, and road cuts. Peregrine falcons nest on cliff ledges and crevices and building ledges. Nests consist of a simple scrape in the substrate (COSEWIC 2017).	Low	No suitable man-made structures or natural cliffs providing suitable nesting habitat for this species.		No Management Plan Available
Bird	Red-headed woodpecker	*Melanerpes erythrocephalus*	OBBA	In Ontario, red-headed woodpecker breeds in open, deciduous woodlands or woodland edges and are often found in parks, cemeteries, golf courses, orchards and savannahs (Woodliffe 2007). They may also breed in forest clearings or open agricultural areas provided that large trees are available for nesting. They prefer forests with little or no understory vegetation. They are often associated with beech or oak forests, beaver ponds and swamp forests where snags are numerous. Nests are excavated in the trunks of large dead trees (Frei et al. 2017).	Moderate	The scattered large trees in the park areas of the study area may provide suitable habitat for this species, although no evidence of them was observed.		No
Bird	Short-eared owl	*Asio flammeus*	OBBA	In Ontario, short-eared owl breeds in a variety of open habitats including grasslands, tundra, bogs, marshes, clear-cuts, burns, pastures and occasionally agricultural fields. The primary factor in determining breeding habitat is proximity to small mammal prey resources (COSEWIC 2008). Nests are built on the ground at a dry site and usually adjacent to a clump of tall vegetation used for cover and concealment (Gahbauer 2007).	Low	There are no suitable large, open hayfields or unmaintained grassy areas for nesting.		No Management Plan Available
Bird	Wood thrush	*Hylocichla mustelina*	OBBA	In Ontario, wood thrush breeds in moist, deciduous hardwood or mixed stands that are often previously disturbed, with a dense deciduous undergrowth and with tall trees for singing perches. This species selects nesting sites with the following characteristics: lower elevations with trees less than 16 m in height, a closed canopy cover (>70 %), a high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soil, and decaying leaf litter (COSEWIC 2012).	Low	Within the study area, the woodlots are lacking the right structure to be considered nesting habitat for this species.		No
Fish	American Eel	*Anguilla rostrata*	Range, MNRF	In Ontario, American eel is native to the Lake Ontario, St. Lawrence River and Ottawa River watersheds. Their current distribution includes lakes Huron, Erie, and Superior and their tributaries. The Ottawa River population is considered extirpated. The preferred habitat of the American eel is cool water of lakes and streams with muddy or silty substrates in water temperatures between 16 and 19°C. The American eel is a catadromous fish that lives in fresh water until sexual maturity then migrates to the Sargasso Sea to spawn (Burridge et al. 2010; Eakins 2016).	High	American Eels are known to migrate through the study area (MNRF)	General (as of June 30, 2013)	
Fish	Bridle shiner	*Notropis bifrenatus*	Range	In Ontario, bridle shiner is a species found only in the St. Lawrence River and its tributaries. Preferred habitat conditions include substrates of sand, silt or organic debris and relatively warm, clear water. Bridle shiner are freshwater fish species that inhabit slow-moving areas of unpolluted streams with abundant aquatic vegetation. Bridle shiner is not acid tolerant and so distribution in Precambrian shield may be limited. Typical spawning habitat is in water depths of 45-120 cm over medium to high density of submerged aquatic vegetation, and fine substrates of clay, silt or sand (Boucher et al. 2011).	Low	Habitat potentially suitable within the study area, although limited in abundance of habitat due to higher turbidity rates. No records in the Cataraqui River. Species are found regionally the east of the study area within the St Lawerence River near Eastview and Howe Island.		No Management Plan Available

Taxon	Common Name	Scientific Name	Source(s)[*]	Ontario Habitat Descriptions	Probability of Occurrence in Study Area	Rationale	ESA Habitat Protection Provisions[6]	SARA Critical Habitat Defined[7] (Yes or No)
Fish	Grass pickerel	*Esox americanus ssp. vermiculatus*	Range	In Ontario, grass pickerel is found in Lake Huron, Lake St. Clair, Lake Erie, Niagara River, Lake Ontario and St. Lawrence River and their tributaries, and an isolated population occurs in the Severn River system. This fish species is found in warm, slow moving streams and shallow bays of lakes. It prefers clear to tea-coloured water and dense aquatic vegetation. The grass pickerel typically occurs over mud substrates but has also been found over rock and gravel. Spawning occurs in vegetated areas of streams and lakes (COSEWIC 2005).	Low	Habitat potentially suitable but no records in the Cataraqui River. No regional occurance records.		No Management Plan Available
Fish	Pugnose shiner	*Notropis anogenus*	Range	In Ontario, pugnose shiner is present at five sites: three sites in southwestern Ontario and two sites in the St. Lawrence River. The species has a limited distribution and it is often absent from apparently suitable habitat within its range. They require areas of quiet, clear water with abundant vegetation and sand, silt, or clay bottoms. Habitat includes large lakes, stagnant channels, and large rivers — primarily on sand bottoms with decomposing organic matter. It is found in the marshy bays of lakes, ponds and in slow-moving streams where the water is clear (COSEWIC 2013).	Low	Habitat potentially suitable within the study area, although limited in abundance of habitat due to higher turbidity rates. No records in the Cataraqui River. Species are found regionally the east of the study area within the St Lawerence River near Eastview and Howe Island.	General (as of June 30, 2013)	Yes For populations in the Teeswater River, Old Ausable Channel, Mouth Lake, St. Clair National Wildlife Area, Little Bear Creek, Long Point Bay/Big Creek, Wellers Bay, West Lake, East Lake, Waupoos Bay, and St. Lawrence River/St. Lawrence Islands National Park, where habitat features are present and capable of supporting the associated function Functions: • Spawning and nursery (areas that seasonally support aquatic vegetation in clear, calm and shallow water <2 m with dense submerged vegetation, warm water, and mix of silt, sand and sometimes gravel substrates) • Feeding and cover YOY (areas that seasonally support heavy aquatic vegetation in shallow water < 2m) • Feeding and cover adults (areas that seasonally support aquatic vegetation in calm water <3 m with low gradients, abundant rooted vegetation and mix of silt, sand and sometimes gravel substrates)
Lichen	Pale-bellied frost lichen	*Physconia subpallida*	Range	In Ontario, pale-bellied frost lichen grows on trees in mature, deciduous forests with relatively open understory, but moderate to high canopy cover. Common host trees include ash, black walnut, hop-hornbeam, and elm, although in Ontario, it is most often found on hop-hornbeam. This lichen has also been found growing on fence rails and rocks (Lewis 2011).	Low	Within the study area, there are no suitable mature forests. Further there are no records within the vicinity of the study area.	Regulated In the geographic areas of: Alonquin Provincial Park, counties of Haliburton, Hastings, Lanark, Lennox and Addington, Peterborough and Renfrew; townships of Central Frontenac, North Frontenac, and South Frontenac within County of Frontenac, townships of Athens, Elizabethtown-Kitley, Merrickville-Wolford and Rideau Lakes within County of Leeds and Grenville, and township of South Alongquin in District of Nipissing; Municipalities of Central Frontenac, Northern Frontenac, Lanark Highlands, Addington Highlands and Greater Madawaska Regulated Habitat: • host tree on which the lichen exists and area within 50 m of trunk • area within 100 m of lichen that falls within water body, watercourse, or area belonging to ELC community and that is (i) suitable for natural colonization from existing population of lichen or (ii) contributes to maintenance of suitable microsite characteristics for the lichen to exist	Yes Critical Habitat is same as Provincial Habitat Regulation
Mammal	Eastern small-footed myotis	*Myotis leibii*	BCI	In Ontario, eastern small-footed myotis is not known to roost in trees, but there is very little known about its roosting habits. The species generally roosts on the ground under rocks, in rock crevices, talus slopes and rock piles, but it occasionally inhabits buildings. Entrances of caves or abandoned mines where humidity is low, and temperatures are cool and sometimes subfreezing may be used as hibernacula (Humphrey 2017).	Low	There is no suitable roosting habitat in the study area; this species would not roost in riprap due to the vulnerability to wave action.	General	n/a
Mammal	Little brown myotis	*Myotis lucifugus*	BCI	In Ontario, this specie's range is extensive and covers much of the province. It will roost in both natural and man-made structures. Roosting colonies require a number of large dead trees, in specific stages of decay and that project above the canopy in relatively open areas. May form nursery colonies in the attics of buildings within 1 km of water. Caves or abandoned mines may be used as hibernacula, but high humidity and stable above freezing temperatures are required (ECCC 2018).	Moderate	Within the study area there are mature trees that could provide suitable maternity roost habitat for this species.	General	Yes • Critical habitat partially identified as: o Any site where little brown myotis has been observed hibernating during the winter at least once since 1995
Mammal	Northern myotis	*Myotis septentrionalis*	BCI	In Ontario, this species' range is extensive and covers much of the province. It will usually roost in hollows, crevices, and under loose bark of mature trees. Roosts may be established in the main trunk or a large branch of either living or dead trees. Caves or abandoned mines may be used as hibernacula, but high humidity and stable above freezing temperatures are required (ECCC 2018).	Moderate	Within the study area there are trees that could provide suitable maternity roost habitat for this species.	General	Yes • Critical habitat partially identified as: o Any site where northern myotis has been observed hibernating during the winter at least once since 1995

Taxon	Common Name	Scientific Name	Source(s)*	Ontario Habitat Descriptions	Probability of Occurrence in Study Area	Rationale	ESA Habitat Protection Provisions[6]	SARA Critical Habitat Defined[7] (Yes or No)
Mammal	Tri-colored bat	*Perimyotis subflavus*	BCI	In Ontario, tri-colored bat may roost in foliage, in clumps of old leaves, hanging moss or squirrel nests. They are occasionally found in buildings although there are no records of this in Canada. They typically feed over aquatic areas with an affinity to large-bodied water and will likely roost in close proximity to these. Hibernation sites are found deep within caves or mines in areas of relatively warm temperatures. These bats have strong roost fidelity to their winter hibernation sites and may choose the exact same spot in a cave or mine from year to year (ECCC 2018).	Moderate	Within the study area there are mature trees that could provide suitable maternity roost habitat for this species.	General	Yes • Critical habitat partially identified as: o Any site where tri-colored bat has been observed hibernating during the winter at least once since 1995
Reptile	Blanding's turtle - Great Lakes / St.Lawrence population	*Emydoidea blandingii*	ORAA	In Ontario, Blanding's turtle will use a range of aquatic habitats, but favor those with shallow, standing or slow-moving water, rich nutrient levels, organic substrates and abundant aquatic vegetation. They will use rivers but prefer slow-moving currents and are likely only transients in this type of habitat. This species is known to travel great distances over land in the spring in order to reach nesting sites, which can include dry conifer or mixed forests, partially vegetated fields, and roadsides. Suitable nesting substrates include organic soils, sands, gravel and cobble. They hibernate underwater and infrequently under debris close to water bodies (COSEWIC 2016).	Moderate	This species is known to occur in the wetlands associated with the Cataraqui River. The open areas, gravel shoulders, parking lots and lawns close to the river are potential nesting sites for this species.	General Category 1 – Nest and area within 30 m or overwintering sites and area within 30 m Category 2 – Wetland complex (i.e. all suitable wetlands or waterbodies within 500 m of each other) that extends up to 2 km from occurrence, and the area within 30 m around those suitable wetlands or waterbodies Category 3 – Area between 30 – 250 m around suitable wetlands/waterbodies identified in category 2, within 2 km of an occurrence	Yes • Critical habitat identified as sutiabel habitat occupied by Blanding's turtle • Occupany defined as: o Min 2 individuals observed in any single year in the past 40 years; OR o Single individual observed in 2+ years in the past 40 years • Suitable habitat defined as: o Aquatic habitat (marshes, swamps, bogs, streams, rivers and lakes) o Overwintering habitat (permanent or seasonal wetlands, channels or pooled water with unfrozen water and soft organic substrates) o Nesting habitat of bare ground and sparsely vegetated areas for nesting o Terrestrial habitat (shrubland, grassland and upland forest)
Reptile	Eastern ribbonsnake - Great Lakes population	*Thamnophis sauritius*	Range; MNRF	In Ontario, eastern ribbonsnake is semi-aquatic, and is rarely found far from shallow ponds, marshes, bogs, streams or swamps bordered by dense vegetation. They prefer sunny locations and bask in low shrub branches. Hibernation occurs in mammal burrows, rock fissures or even ant mounds (COSEWIC 2012).	Moderate	Within the study area, the River is likely too large and too deep to be considered suitable habitat for this species; however, it may be present around the marshy area in the study area..		No Management Plan Available
Reptile	Five-lined skink - Great Lakes / St.Lawrence population - southern shield	*Plestiodon fasciatus*	Range	In Ontario, this population of five-lined skink is limited to the southern edge of the Canadian shield. Individuals from this population prefer large rocky outcrops in an area of mixed forests with the presence of loose rocks or other debris for cover. This species also requires abundant basking habitat in the form of stumps, logs, rocky outcrops and brush/wood piles. Nesting takes place under rocks or logs. Hibernation takes place under tree trunks or rocks, below the frost line (Seburn 2010).	Low	Within the study area, there are no large rocky outcrops that is the preferred habitat of this species. Further there are no recent records within the vicinity of the study area.		No
Reptile	Gray ratsnake - Frontenac Axis population	*Pantherophis spiloides*	Range, MNRF	In Ontario, gray ratsnakes of the Frontenac Axis population require a mosaic of habitats, showing a preference for a mixture of forest and open habitats with a strong preference for edge habitats. Microhabitats such as snags, hollow logs, rock crevices and rocks provide shelter. Communal hibernation takes place in underground sites, such as rock fissures, mammal burrows and root systems, often on south-facing, rocky slopes (Kraus et al. 2010).	Low	Discussion with the MNRF indicates this species has been observed between 1-5 km from the study area. The study area is likely too isolated from other habitats, including hibernacula, to be suitable habitat for this species.	Regulated In the geographic areas of: Leeds and Grenville, municipalities of Central Frontenac, Frontenac Islands, South Frontenac, Kingston, Drummond-North Elmsley and Tay Valley Regulated Habitat: • hibernaculum and area within 150 m • naturally occurring egg laying site used in past 3 years, or non natural egg laying site from time of use until following Nov 30 and surrounding 30 m • naturally occurring shedding or basking site used in past 3 years or non natural egg laying site from time of use until following Nov 30 if used by 2+ snakes and surrounding 30 m • any part of rock barren, forest, hedge row, shoreline, old field, wetland or similar area used by ratsnake or on which it depends for life processes and area providing suitable foraging, thermoregulation or hibernation conditions within 1000 m • area with suitable conditions for movement between above habitats	Yes Critical habitat is same as Provincial Habitat Regulations
Reptile	Midland painted turtle	*Chrysemys picta marginata*	ORAA	In Ontario, painted turtles use waterbodies, such as ponds, marshes, lakes and slow-moving creeks, with a soft bottom and abundant basking sites and aquatic vegetation. This species hibernates on the bottom of waterbodies (Ontario Nature 2018).	Moderate	Suitable habitat for this species is present in the shallow water and marshy areas in the study area. The open areas, gravel shoulders, parking lots and lawns close to the river are potential nesting sites for this species.		
Reptile	Milksnake	*Lampropeltis triangulum*	ORAA	In Ontario, milksnake uses a wide range of habitats including prairies, pastures, hayfields, wetlands and various forest types, and is well-known in rural areas where it frequents older buildings. Proximity to water and cover enhances habitat suitability. Hibernation takes place in mammal burrows, hollow logs, gravel or soil banks, and old foundations (COSEWIC 2014).	Moderate	This species is a habitat generalist and so may utilize any portion of the study area.		No

Taxon	Common Name	Scientific Name	Source(s)*	Ontario Habitat Descriptions	Probability of Occurrence in Study Area	Rationale	ESA Habitat Protection Provisions[6]	SARA Critical Habitat Defined[7] (Yes or No)
Reptile	Northern map turtle	*Graptemys geographica*	ORAA, Parks Canada	In Ontario, northern map turtle prefers large waterbodies with slow-moving currents, soft substrates, and abundant aquatic vegetation. Ideal stretches of shoreline contain suitable basking sites, such as rocks and logs. Along Lakes Erie and Ontario, this species occurs in marsh habitat and undeveloped shorelines. It is also found in small to large rivers with slow to moderate flow. Hibernation takes place in soft substrates under deep water (COSEWIC 2012).	High	This species is regularly observed in the study area. The open areas, gravel shoulders, parking lots and lawns close to the river are potential nesting sites for this species.		No Management Plan Available
Reptile	Snapping turtle	*Chelydra serpentina*	ORAA, Parks Canada	In Ontario, snapping turtle uses a wide range of waterbodies, but shows preference for areas with shallow, slow-moving water, soft substrates and dense aquatic vegetation. Hibernation takes place in soft substrates under water. Nesting sites consist of sand or gravel banks along waterways or roadways (COSEWIC 2008).	High	This species is regularly observed in the study area. The open areas, gravel shoulders, parking lots and lawns close to the river are potential nesting sites for this species.		No Management Plan Available
Reptile	Stinkpot or Eastern musk turtle	*Sternotherus odoratus*	ORAA, NHIC, Parks Canada	In Ontario, eastern musk turtle is very rarely out of water and prefers permanent bodies of water that are shallow and clear, with little or no current and soft substrates with abundant organic materials. Abundant floating and submerged vegetation is preferred. Hibernation occurs in soft substrates under water. Eggs are sometimes laid on open ground, or in shallow nests in decaying vegetation, shallow gravel or rock crevices (COSEWIC 2012).	Moderate	Within the study area, the marshy area may provide suitable habitat for this species.		Yes (proposed) • Critical habitat identified as extent of occupied suitable habitat, plus any additional area meeting habitat connectivity criterion • Occupany defined as: o At least one individual observed in any single year in past 40 years • Suitable habitat defined as: o Suitable watercourse/waterbody (up to high watermark) including in-stream wetlands OR suitable portion of feature (i.e., littoral zone from high water mark up to max depth of 9 m), and extending linear distance of 1.5 km parallel to shoreline in both directions from known record OR o Suitable wetland (not recognized as waterbody/watercourse) extending radial distance of 1.5 km from known record AND o Adjacent aquatic and terrestrial habitats extending up to 50 m on either side AND o Confirmed nesting sites and radial distance of 50 m o Habitat connectivity defined as hydrological corridor consisting of surface water features (up to high water mark) OR portions of the feature (from high water mark to max water depth of 9 m) intervening between 2 records and separated by max linear distance of 4.5 km
Vascular Plant	American ginseng	*Panax quinquefolius*	Range	In Ontario, American ginseng is found in moist, undisturbed and relatively mature deciduous woods often dominated by sugar maple. It is commonly found on well-drained, south-facing slopes. American ginseng grows under closed canopies in well-drained soils of glacier origin that have a neutral pH (ECCC 2018).	Low	There are no suitable, mature sugar maple forests in the study area.	General Category 1 – Area occupied by American ginseng and area of forest or treed swamp ELC community classes within 100 m of occupied area Category 2 – Area of forest or treed swamp ELC community classes between 100-150 m of occupied area, and contiguous with category 1	Yes Based on 2 criteria- Habitat Occupancy: established from existing occurrence records based on the data available (at the time of analysis) from conservation data centres. The records associated with imprecise, historical, and extirpated occurrences are excluded. Only data from 1994 to 2013 (inclusive) corresponding to wild plants are considered. Records from other sources that may be awaiting integration into an existing occurrence or the assignment of an occurrence number are included Habitat Suitability: Within 100 m radius surrounding each plant Structure is typical of mature forests (e.g., more than 90 years old) or older secondary forests with few recent disturbances (e.g., large trees, closed-canopy) • Composition of trees is deciduous or mixed with species such as Sugar Maple, White Ash, Bitternut Hickory, Basswood, Red Oak, and Butternut; although some populations are found in White Cedar or Hemlock forests/swamps • Shrub cover is relatively sparse (<25%) and understory companion plant species are generally diverse • Soils are usually of glaciary origin, thick (50 to 100 cm), well drained (drainage classes of 20-well or 30-moderate) and have a relatively neutral pH; although some populations are found on very shallow, rocky soils, sometimes growing directly in small crevices in dolomitic limestone • Light penetration at ground level is low (under 30%; typical of closed-canopy forests) Maximum 50 m radiuos over and above the 100 m radius surrounding each plant • Other forest habitats and treed swamps

Taxon	Common Name	Scientific Name	Source(s)*	Ontario Habitat Descriptions	Probability of Occurrence in Study Area	Rationale	ESA Habitat Protection Provisions[6]	SARA Critical Habitat Defined[7] (Yes or No)
Vascular Plant	Blunt-lobed woodsia	*Woodsia obtusa*	Range	In Ontario, blunt-lobed woodsia occurs on rocky limestone outcrops and rocky slopes that are dry, have a southern aspect and are highly shaded. Ontario populations grow on calcareous rock and are associated with species such as sugar maple, red and white oak and white ash (COSEWIC 2006).	Low	No suitable habitat is present in the study area.	General	Yes Current area the populations occupy plus the surrounding suitable habitat. Critical habitat extends laterally on either side of extant populations for as far as both abiotic and biotic conditions exist. The entire slope (between 20◦ to 60◦) will be considered critical habitat in areas where there are known populations. Suitable habitat: • Calcareous bedrock, thin surficial soils (<15 cm), and canopy openings of 10-40% • Slopes of 20◦ to 60◦ • Southern facing aspect between 110◦N and 250◦N
Vascular Plant	Broad beech fern	*Phegopteris hexagonoptera*	Range	In Ontario, broad beech fern inhabits rich, undisturbed mature deciduous forest dominated by beech and maple. It typically grows in moist to wet, sandy soils of lower valley slopes and occasionally swamps (van Overbeeke et al. 2013).	Low	No suitable habitat is present in the study area.		No
Vascular Plant	Butternut	*Juglans cinerea*	Range	In Ontario, butternut is found along stream banks, on wooded valley slopes, and in deciduous and mixed forests. It is commonly associated with beech, maple, oak and hickory (Voss and Reznicek 2012). Butternut prefers moist, fertile, well-drained soils, but can also be found in rocky limestone soils. This species is shade intolerant (Farrar 1995).	Low	This species was not observed in the study area during the site reconnaissance.	General (as of June 30, 2013)	No

1 Endangered Species Act (ESA), 2007. General (O.Reg 242/08 last amended 29 June 2020 as O.Reg 328/20). Species at Risk in Ontario List (O.Reg 230/08 last amended 1 Aug 2018 as O. Reg 404/18, s. 1.); Schedule 1 (Extirpated - EXP), Schedule 2 (Endangered - END), Schedule 3 (Threatened - THR), Schedule 4 (Special Concern - SC)

2 Species at Risk Act (SARA), 2002. Schedule 1 (Last amended 5 September 2020); Part 1 (Extirpated), Part 2 (Endangered), Part 3 (Threatened), Part 4 (Special Concern)

3 Committee on the Status of Endangered Wildlife in Canada (COSEWIC) http://www.cosewic.gc.ca/

4 Global Ranks (GRANK) are Rarity Ranks assigned to a species based on their range-wide status. GRANKS are assigned by a group of consensus of Conservation Data Centres (CDCs), scientific experts and the Nature Conservancy. These ranks are not legal designations. G1 (Extreemly Rare), G2 (Very Rare), G3 (Rare to uncommon), G4 (Common), G5 (Very Common), GH (Historic, no record in last 20yrs), GU (Status uncertain), GX (Globally extinct), ? (Inexact number rank), G? (Unranked), Q (Questionable), T (rank applies to subspecies or variety). Last assessed August 2011

5 Provincial Ranks (SRANK) are Rarity Ranks assigned to a species or ecological communities, by the Natural Heritage Information Centre (NHIC). These ranks are not legal designations. SRANKS are evaluated by NHIC on a continual basis and updated lists produced annually. SX (Presumed Extirpated), SH (Possibly Extirpated - Historical), S1 (Critically Imperiled), S2 (Imperiled), S3 (Vulnerable), S4 (Apparently Secure), S5 (Secure), SNA (Not Applicable), S#S# (Range Rank), S? (Not ranked yet), SAB (Breeding Accident), SAN (Non-breeding Accident), SX (Apparently Extirpated). Last assessed November 2017.

6 General Habitat Protection is applied when a species is newly listed as endangered or threatened on the SARO list under the ESA, 2007. The definition of general habitat applies to areas that a species currently depends on. These areas may include dens and nests, wetlands, forests and other areas essential for breeding, rearing, feeding, hibernation and migration. General habitat protection will also apply to all listed endangered or threatened species without a species-specific habitat regulation as of June 30, 2013 (ESA 2007, c.6, s.10 (2)). Regulated Habitat is species-specific habitat used as the legal description of that species habitat. Once a species-specific habitat regulation is created, it replaces general habitat protection. Refer to O.Reg 242/08 for full details regarding regulated habitat.

7 Refer to the individual species' federal recovery strategy for a full description of the critical habitat (http://www.sararegistry.gc.ca/sar/recovery/recovery_e.cfm)

General References:

+Species Codes derived from the following sources: Birds – 53rd AOU Supplement (2012); Amphibians – Marsh Monitoring Program (Bird Studies Canada 2003); Fish – Golder; Reptiles – Golder.

*NHIC (Natural Heritage Information Centre); ROM (Royal Ontario Museum); OBBA (Ontario Breeding Bird Atlas); Herp Atlas (Reptiles and Amphibians of Ontario); Odonata Atlas (of Ontario); Mammal Atlas (of Ontario); BCI (Bat Conservation International); Butterfly Atlas (Ontario Butterfly Atlas)

'—' No status

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2017. Status Reports. COSEWIC. Available from: http://www.cosewic.gc.ca/eng/sct2/index_e.cfm

Environment and Climate Change Canada (ECCC). 2017. Species at Risk Public Registry. Available: http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm

Fisheries and Oceans Canada (DFO). 2017. Aquatic Species at Risk. Available at: http://www.dfo-mpo.gc.ca/species-especes/index-eng.htm

Oldham, M.J., and S.R. Brinker. 2009. Rare Vascular Plants of Ontario, Fourth Edition. Natural Heritage Information Centre, Ontario Ministry of Natural Resources. Peterborough, Ontario. 188 pp.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2017. Species at Risk in Ontario List. Queen's Printer for Ontario. Available at: https://www.ontario.ca/environment-and-energy/species-risk-ontario-list

Ontario Ministry of Natural Resources (MNR). 2000. Significant Wildlife Habitat Technical Guide (SWHTG). 151 pp.

Appendix C-2
Fish Species of the Kingston Inner Harbour

Common Name	Latin Name	S Rank[(a)]	G Rank[(a)]	Native/Introduced Common[(a)]	Tolerance to Environmental Disturbances[(a)]	Presence known for the KIH [(b, c, d, e)]
Alewife	*Alosa pseudoharengus*	SNA	G5	Introduced	Intermediate	X
Black Crappie	*Pomoxis nigromaculatus*	S4	G5	Native/Introduced	Tolerant	X
Blackshin Shiner	*Notropis heterodon*	S4	G5	Native	Intolerant	X
Bluegill	*Lepomis macrochirus*	S5	G5	Native	Intermediate	X
Bluntnose Minnow	*Pimephales notatus*	S5	G5	Native	Intermediate	X
Bowfin	*Amia calva*	S4	G5	Native	Intermediate	X
Brook Silverside	*Labidesthes sicculus*	S4	G5	Native	Intermediate	X
Brook Silverside	*Labidesthes sicculus*	S4	G5	Native	Intermediate	X
Brown Bullhead	*Ameiurus nebulosus*	S5	G5	Native	Intermediate	X
Central Mudminnow	*Umbra limi*	S5	G5	Native	Tolerant	X
Chinook Salmon	*Oncorhynchus tshawytscha*	SNA	G5	Introduced	Intolerant	X
Coho Salmon	*Oncorhynchus kisutch*	SNA	G5	Introduced	Intolerant	X
Common Carp	*Cyprinus carpio*	SNA	G5	Introduced	Tolerant	X
Eastern Silvery Minnow	*Hybognathus regius*	S2	G5	Native	Intolerant	X
Golden Shiner	*Notemigonus crysoleucas*	S5	G5	Native	Intermediate	X
Gizzard Shad	*Dorosoma cepedianum*	S4	G5	Native/Introduced	Tolerant	X
Johnny Darter	*Etheostoma nigrum*	S5	G5	Native	Tolerant	X
Largemouth Bass	*Micropterus salmoides*	S5	G5	Native	Tolerant	X
Longnose gar	*Lepisosteus osseus*	S4	G5	Native	Tolerant	X
Muskellunge	*Esox masquinongy*	S4	G5	Native	Intermediate	X
Northern Pike	*Esox lucius*	S5	G5	Native	Intermediate	X
Pumpkinseed	*Lepomis gibbosus*	S5	G5	Native	Intermediate	X
Rock Bass	*Ambloplites rupestris*	S5	G5	Native	Intermediate	X
Round Goby	*Neogobius melanostomus*	SNA	G5	Introduced	Intermediate	X
Smallmouth Bass	*Micropterus dolomieu*	S5	G5	Native/Introduced	Intermediate	X
White Sucker	*Catostomus commersonii*	S5	G5	Native	Tolerant	X
Yellow Bullhead	*Ameiurus natalis*	S4	G5	Native	Tolerant	X
Yellow Perch	*Perca flavescens*	S5	G5	Native	Intermediate	X

Notes: X = present

(a) Eakins, R. J. 2020. Ontario Freshwater Fishes Life History Database. Version 4.86. Online database. Available at: http://www.ontariofishes.ca. Accessed 2 January 2020

(b) MNRF. 2020. Fish ON-Line Availabel at: https://www.gisapplication.lrc.gov.on.ca/FishONLine/Index.html?site=FishONLine&viewer=FishONLine&locale=en-US. Accessed 2 January 2020

(c) MNRF. 2020. Land Information Ontario Aquatics Resource Layer. Accessed 2 January 2020

(d) DFO. 2020. Aquatic Species at Risk Mapping. Availabel at: http://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html. Accessed 2 January 2020

(e) Bowfin Environmental Consulting. 2011. City of Kingston Environmental Assessment for the Third Crossing of the Cataraqui River Fisheries Results and Impact Analysis. Prepared for J.L.Richards and Associates Ltd. version 1.0. May 2011.

APPENDIX D

Historical Sediment Chemistry

Area	Environmental Quality Guidelines	Source	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF
Lot			Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada
UTM 18T Easting			381836	382072	381782	381790	381716	381862	381996	382057	382358	382267	382187	382080	381958	381926
Northing			4900494	4900635	4900533	4900508	4900521	4900576	4900635	4900649	4900587	4900648	4900471	4900512	4900432	4900373
Source			d Dove 2006 (Ap	d Dove 2006 (Ap	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013	Golder 2013
Site Name			83	182	2012-F	2012-G	2012-H	2012-I	2012-J	2012-K	2012-L	2012-M	2012-N	2012-O	2012-P	2012-Q
Date			2002	2002	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12	Nov-12
Sediment Type (%)																
Sand (63 - 200 µm)			19	19	41	13	37	34	50	53	76	66	26	26	23	62
Silt (2 - 63 µm)			66	64	49	67	49	52	40	36	17	24	46	47	55	25
Clay (<2 µm)			15	17	10	21	14	14	10	11	7.1	10	28	28	22	13
Total Percernt Fines			81	81	59	88	63	66	50	47	24.1	34	74	75	77	38
TOC			120	74	-	-	-	-	-	-	-	-	-	-	-	-
TOC			120000	74000	55000	81000	57000	140000	150000	120000	38000	39000	85000	91000	110000	100000
TOC (%)			12	7.4	5.5	8.1	5.7	14	15	12	3.8	3.9	8.5	9.1	11	10
TKN (mg/kg)			8600	5400	-	-	-	-	-	-	-	-	-	-	-	-
TKN			8.6	5.4	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			11000	17000	6000	7900	6400	9000	8000	7900	5300	8400	14000	13000	10000	12000
Antimony [1]			-	-	6	3.7	3.2	3.7	2.6	4.4	<0.20	0.62	0.5	0.71	2.6	1.6
Arsenic	5.9	CCME ISQG	8.8	7.7	3	3.8	3.1	7.1	8	6.8	1.9	2.8	4.8	5.8	6.8	7.8
Barium			290	240	150	180	160	210	240	200	81	130	220	210	240	240
Beryllium			0.6	0.7	0.32	0.42	0.34	0.5	0.5	0.47	0.26	0.41	0.63	0.62	0.48	0.57
Boron			-	-	8.1	8.6	9.1	11	12	8	5.5	5.3	7.4	6.4	8.3	7.7
Cadmium	0.6	CCME ISQG	2.4	0.8	0.9	1.5	0.86	1.5	1.4	1.1	0.17	0.35	0.53	0.57	1.1	0.85
Calcium			110000	39000	130000	130000	130000	87000	52000	38000	35000	29000	69000	68000	120000	110000
Chromium	37.3	CCME ISQG	8200	2000	2700	2700	1400	4300	5000	3900	110	750	540	700	2300	910
Cobalt			9.6	14	5.7	8.1	5.9	9.5	11	11	4.4	8.4	10	11	10	11
Copper	35.7	CCME ISQG	120	44	71	79	65	93	68	52	11	23	33	35	53	43
Iron			22000	26000	16000	18000	23000	20000	19000	18000	9800	17000	24000	23000	21000	24000
Lead	35	CCME ISQG	490	120	270	250	160	340	330	250	18	67	64	82	200	140
Magnesium			12000	14000	13000	15000	14000	12000	9200	8400	12000	11000	13000	12000	13000	12000
Manganese	460	PSQG LEL	380	510	250	300	260	310	400	330	530	280	750	550	570	560
Mercury	0.17	CCME ISQG	0.28	0.24	0.23	0.27	0.25	0.38	0.56	0.4	<0.050	0.13	0.15	0.19	0.25	0.26
Molybdenum			3.1	0.5	1.7	1.8	1.5	1.9	1.6	1.5	<0.50	<0.50	0.72	0.8	1.4	1.2
Nickel	16	PSQG LEL	27	29	17	19	15	21	20	19	8.8	15	23	23	21	23
Phosphorus			-	-	1300	1400	1800	1900	2300	1700	1500	1200	1100	1000	1300	1200
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			-	-	1200	1400	1200	1700	1700	1500	1100	2000	3300	3000	2100	2600
Selenium			-	-	<0.50	0.68	0.55	1.1	1	0.79	<0.50	<0.50	0.66	0.64	0.9	1
Silver [2]			-	-	1.9	0.57	0.34	0.81	0.85	0.78	<0.20	0.36	0.29	0.31	0.5	0.42
Sodium			-	-	390	430	310	590	580	330	200	270	430	390	560	490
Strontium			620	190	390	450	370	410	360	210	110	110	400	420	650	730
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			-	-	0.23	0.27	0.23	0.26	0.25	0.22	0.079	0.18	0.23	0.21	0.23	0.23
Tin			-	-	8.9	7.2	5.4	11	13	15	<5.0	<5.0	<5.0	<5.0	5.9	<5.0
Titanium			580	1200	-	-	-	-	-	-	-	-	-	-	-	-
Uranium			-	-	0.41	0.44	0.36	0.71	0.63	0.58	0.35	0.38	0.67	0.69	0.58	0.68
Vanadium			39	49	19	26	23	29	25	23	13	21	37	35	33	38
Zinc	120	PSQG LEL	470	180	250	350	260	370	340	280	42	110	120	140	280	200
Tributyl tin	0.073	PSDDA (WDOE)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	<0.010	<0.010	<0.010	0.012	<0.020	<0.10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1254	0.06	CCME ISQG	-	-	0.33	0.12	0.057	0.25	0.31	0.27	0.012	0.051	0.063	0.095	0.13	0.089
Aroclor 1260	0.005	PSQG LEL	-	-	0.31	0.19	0.085	0.48	1.1	2.1	0.043	0.11	0.13	0.17	0.24	0.18
Total PCB	0.0341	CCME ISQG	0.76	0.66	0.64	0.31	0.14	0.74	1.4	2.4	0.055	0.17	0.2	0.27	0.37	0.27
PAH's (mg/kg)					-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	0.0346	CCME ISQG	0.36	0.14	0.45	<0.50	0.18	<0.050	<0.10	<0.10	<0.050	<0.050	<0.050	<0.010	<0.050	<0.050
Acenaphthylene	0.00587	CCME ISQG	0.92	0.36	0.32	<0.50	0.16	0.062	<0.10	<0.10	<0.050	<0.050	<0.050	0.012	<0.050	<0.050
Acenaphthene	0.00671	CCME ISQG	0.48	0.1	1.2	0.67	0.48	0.13	0.14	0.15	<0.050	0.14	<0.050	0.031	0.083	0.056
Fluorene	0.0212	CCME ISQG	0.62	0.1	0.21	<0.50	<0.050	0.13	0.23	0.44	<0.050	0.22	<0.050	0.03	<0.050	<0.050
Phenanthrene	0.0419	CCME ISQG	3.4	0.76	0.98	<0.50	0.34	0.21	0.27	0.37	<0.050	0.54	<0.050	0.045	0.082	0.056
Anthracene	0.0469	CCME ISQG	0.6	0.22	1.7	1	0.52	0.94	0.98	1.5	0.061	1.8	0.18	0.24	0.25	0.27
Fluoranthene	0.111	CCME ISQG	5.5	1.7	1.2	0.81	0.27	0.63	0.79	1.4	0.055	1.3	0.2	0.18	0.18	0.28
Pyrene	0.053	CCME ISQG	7.2	2.5	1.3	1.1	0.35	0.77	0.86	1.2	0.06	1.1	0.24	0.22	0.27	0.44
Benzo(a)anthracene	0.0317	CCME ISQG	4	1.4	0.48	<0.50	0.11	0.23	0.3	0.48	<0.050	0.41	0.12	0.065	0.091	0.16
Chrysene	0.0571	CCME ISQG	4.4	1.6	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene			4.6	1.8	0.47	<0.50	0.11	0.24	0.24	0.41	<0.050	0.4	0.069	0.067	0.082	0.14
Benzo(k)fluoranthene			1.6	0.68	1.4	1	0.41	0.74	0.75	1	<0.050	1.2	0.15	0.16	0.21	0.25
Benzo(a)pyrene	0.0319	CCME ISQG	3.8	1.6	0.12	<0.50	<0.050	<0.050	<0.10	0.12	<0.050	0.12	<0.050	0.013	<0.050	<0.050
Indeno(1,2,3 -cd)pyrene			2.6	1.1	4	2.7	1.8	1.8	1.6	1.7	0.095	2	0.26	0.36	0.67	0.58
Dibenz(a,h)anthracene	0.00622	CCME ISQG	0.52	0.28	0.76	<0.50	0.28	0.12	0.14	0.16	<0.050	0.17	<0.050	0.019	0.064	<0.050
Benzo(ghi)perylene			2.7	1.1	0.43	<0.50	0.093	0.23	0.31	0.52	<0.050	0.48	0.11	0.064	0.078	0.16
Perylene			-	-	0.23	<0.50	0.15	0.077	<0.10	<0.10	<0.050	<0.050	<0.050	0.013	<0.050	<0.050
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	0.0202	CCME ISQG	-	-	3.8	2	1.4	0.66	0.94	0.92	<0.050	1.2	0.11	0.11	0.39	0.24
Benzo(j)fluoranthene			-	-	5.8	3.6	2.1	2.8	2.2	2.6	0.11	2.2	0.38	0.56	0.9	0.73
LPAH			6.38	1.68	8.66	4.67	3.11	2.16	2.66	3.48	0.21	3.95	0.42	0.47	0.88	0.70
HPAH			36.92	13.76	16.19	10.71	5.70	7.66	7.29	9.64	0.50	9.41	1.60	1.72	2.60	2.82
Total PAH			43.3	15.44	24.85	15.38	8.803	9.819	9.95	13.12	0.706	13.355	2.019	2.194	3.475	3.512
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.
High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.
1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF
Lot			Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada
UTM 18T Easting			381817	381634	382086	382270.5885	382089.8356	382292	382063	382111	382123.3	382123.3	382123.3	381970.95	382026	381816
Northing			4900400	4900475	4900398	4900493.756	4900523.5	4900471	4900539	4900630	4900523.3	4900523.3	4900523.3	4900509.8	4900462	4900557
Source			Golder 2013	Golder 2013	oit and Dove 2	Chapter 3; Tabl	Chapter 3; Tab	er 2 (draft 2) -	er 2 (draft 2) -	er 2 (draft 2) -	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	RMC Chapter 2
Site Name			2012-S	2012-T	A6	BC6	BC7	BIV2	BIV3	BIV5	C7a	C7b	C7c	C8	C9	Cat 1 (Cattail-1)
Date			Nov-12	Nov-12	07/16/01	Nov-08	Nov-08	Nov-08	Nov-08	Nov-08						Oct-08
Sediment Type (%)																
Sand (63 - 200 µm)			37	71	-	12.5	8	-	-	-	-	-	-	-	-	-
Silt (2 - 63 µm)			45	20	-	54.6	54.2	-	-	-	-	-	-	-	-	-
Clay (<2 µm)			18	8.5	-	32.8	37.8	-	-	-	-	-	-	-	-	-
Total Percernt Fines			63	28.5	0	87.4	92	0	0	0	0	0	0	0	0	0
TOC			-	-	34	-	-	-	-	-	-	-	-	-	-	-
TOC			130000	27000	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			13	2.7	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			8400	3600	26000	-	-	-	-	-	-	-	-	-	-	-
Antimony [1]			1.5	1.8	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	5.6	1.4	-	4	5	-	-	-	-	-	-	1.5	3.1	9.1
Barium			230	64	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium			0.41	0.22	-	-	-	-	-	-	-	-	-	-	-	-
Boron			14	<5.0	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	1	0.44	0.9	-	-	-	-	-	-	-	-	-	-	1.6
Calcium			130000	96000	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	**37.3**	**CCME ISQG**	1200	210	390	933	879	631	958	1,425	-	-	-	-	-	3,595
Cobalt			9	3.3	-	13	15	-	-	-	-	-	-	-	-	9.9
Copper	**35.7**	**CCME ISQG**	60	42	38	32	43	18.6	40.1	43.9	-	-	-	-	-	105.2
Iron			20000	10000	36000	-	-	-	-	-	-	-	-	-	-	-
Lead	**35**	**CCME ISQG**	150	110	60	71	105	52	103	119	-	-	-	-	-	426
Magnesium			11000	13000	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	**460**	**PSQG LEL**	390	180	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	**0.17**	**CCME ISQG**	0.23	0.081	-	0.17	0.33	-	-	-	-	-	-	-	-	-
Molybdenum			1.3	1	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	**16**	**PSQG LEL**	19	11	38	24	29	-	-	-	-	-	-	-	-	26
Phosphorus			1400	730	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			1900	550	-	-	-	-	-	-	-	-	-	-	-	-
Selenium			1.2	<0.50	-	-	-	-	-	-	-	-	-	-	-	-
Silver [2]			0.35	<0.20	-	-	-	-	-	-	-	-	-	-	-	-
Sodium			570	170	-	-	-	-	-	-	-	-	-	-	-	-
Strontium			990	170	-	-	-	-	-	-	-	-	-	-	-	-
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			0.25	0.08	-	-	-	-	-	-	-	-	-	-	-	-
Tin			<5.0	<5.0	-	-	-	-	-	-	-	-	-	-	-	-
Titanium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium			0.52	0.27	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium			31	14	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	**120**	**PSQG LEL**	230	140	120	119	155	81	148	161	-	-	-	-	-	429
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-	<0.003
Aroclor 1254	**0.06**	**CCME ISQG**	0.13	0.092	-	-	-	-	-	-	-	-	-	-	-	0.044
Aroclor 1260	**0.005**	**PSQG LEL**	0.28	0.093	-	-	-	-	-	-	-	-	-	-	-	0.054
Total PCB	**0.0341**	**CCME ISQG**	0.41	0.18	0.36	0.18	-	-	-	-	-	-	-	0.019	-	0.098
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	<0.10	0.062	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	**0.00587**	**CCME ISQG**	<0.10	<0.050	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	**0.00671**	**CCME ISQG**	<0.10	0.34	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	**0.0212**	**CCME ISQG**	<0.10	<0.050	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	**0.0419**	**CCME ISQG**	0.12	0.29	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	**0.0469**	**CCME ISQG**	0.46	1.1	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	**0.111**	**CCME ISQG**	0.36	0.71	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	**0.053**	**CCME ISQG**	0.54	0.97	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	0.17	0.22	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	**0.0571**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene			0.17	0.36	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene			0.41	0.87	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	<0.10	0.062	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3 -cd)pyrene			0.97	3.6	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	<0.10	0.17	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene			0.18	0.29	-	-	-	-	-	-	-	-	-	-	-	-
Perylene			<0.10	0.9	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	0.44	1.7	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			1.1	2.8	-	-	-	-	-	-	-	-	-	-	-	-
LPAH			1.22	3.54	-	-	-	-	-	-	-	-	-	-	-	-
HPAH			4.05	10.95	-	-	-	-	-	-	-	-	-	-	-	-
Total PAH			5.27	14.494	-	2	6	-	-	-	-	-	-	-	-	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.

2 - Non detect <2 an <1 removed for silver

3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated

Samples with duplicate values are presented as the average

Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

APPENDIX D

Area	Environmental Quality Guidelines	Source	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF
Lot			Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada
UTM 18T Easting			382313	382074	382211	381856	382074	381606	381796	382093.8522	382210	382210	382210	381947	381954	381963
Northing			4900651	4900453	4900465	4900386	4900657	4900478	4900464	4900499.78	4900645	4900630	4900615	4900602	4900588	4900577
Source			RMC Chapter 2	t and Burnistor	t and Burnistor	t and Burnistor	t and Burnistor	t and Burnistor	t and Burnistor	Tinney 2006	Malroz 2003	Malroz 2003	Malroz 2003	Malroz 2003	Malroz 2003	Malroz 2003
Site Name			Cat 4 (Cattail-4)	CAT18	CAT19	CAT21	CAT22	CAT23	CAT25	ERA 11	GCR110 - A	GCR110 - B	GCR110 - C	GCR120 - A	GCR120 - B	GCR120 - C
Date			Oct-08							Jun-05						
Sediment Type (%)																
Sand (63 - 200 µm)			-	4	5	2	25	86	17	-	-	-	-	-	-	-
Silt (2 - 63 µm)			-	94	94	97	75	14	83	-	-	-	-	-	-	-
Clay (<2 µm)			-	2	1	0	1	0	0	-	-	-	-	-	-	-
Total Percernt Fines			0	96.03	94.744	97.724	75.499	14.037	83.25	0	0	0	0	0	0	0
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			-	30900	30200	24100	16300	4690	-	27400	-	-	-	-	-	-
Antimony [1]			-	0.5	0.3	1.7	3.2	0.5	-	16.9	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	1.9	8	6	10	12	1	-	4.6	-	-	-	-	-	-
Barium			-	289	277	279	338	46	-	287	-	-	-	-	-	-
Beryllium			-	1.35	1.19	0.91	1.1	0.23	-	<4.0	-	-	-	-	-	-
Boron			-	-	-	-	-	-	-	30.1	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	<1.0	0.7	0.6	1.2	1.5	1.9	-	<1.0	-	-	-	-	-	-
Calcium			-	63000	54700	114000	43700	83400	-	50800	-	-	-	-	-	-
Chromium	**37.3**	**CCME ISQG**	74	972	723	1950	7760	37	-	763	920	980	1100	8400	7600	6300
Cobalt			<5.0	15.5	13.4	12.9	16.9	2.3	-	19.2	-	-	-	-	-	-
Copper	**35.7**	**CCME ISQG**	20.2	48	40	60	73	30	-	50.1	-	-	-	-	-	-
Iron			-	32000	31700	25000	24400	26500	-	37700	-	-	-	-	-	-
Lead	**35**	**CCME ISQG**	22	121	75.3	210	377	19.3	-	86.4	-	-	-	-	-	-
Magnesium			-	17400	17600	15100	12000	15100	-	18600	-	-	-	-	-	-
Manganese	**460**	**PSQG LEL**	-	809	849	575	487	206	-	708	-	-	-	-	-	-
Mercury	**0.17**	**CCME ISQG**	-	0.265	0.198	0.404	0.675	0.034	-	-	-	-	-	-	-	-
Molybdenum			-	0.5	0.5	1.4	3	1.1	-	<2.0	-	-	-	-	-	-
Nickel	**16**	**PSQG LEL**	8.4	36.4	31.9	30.1	28.2	8.7	-	32.8	-	-	-	-	-	-
Phosphorus			-	1130	1110	1230	2170	517	-	1150	-	-	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	1100	-	-	-	-	-	-
Potassium			-	9260	9020	7270	4570	1280	-	7490	-	-	-	-	-	-
Selenium			-	1	1	1	2	<-1	-	<10	-	-	-	-	-	-
Silver [2]			-	-	-	-	-	-	-	0	-	-	-	-	-	-
Sodium			-	998	904	806	545	<-500	-	1110	-	-	-	-	-	-
Strontium			-	391	308	756	313	133	-	252	-	-	-	-	-	-
Sulphur			-	-	-	-	-	-	-	4600	-	-	-	-	-	-
Thallium			-	0.444	0.378	0.369	0.497	0.056	-	<1.0	-	-	-	-	-	-
Tin			-	-	-	-	-	-	-	2.8	-	-	-	-	-	-
Titanium			-	-	-	-	-	-	-	1750	-	-	-	-	-	-
Uranium			-	1.07	0.98	0.98	0.97	0.36	-	<10	-	-	-	-	-	-
Vanadium			-	53	57	29	<-1	17	-	67.7	-	-	-	-	-	-
Zinc	**120**	**PSQG LEL**	53	155	133	259	343	76	-	157	-	-	-	-	-	-
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	-	-	-	-	-	<0.01	-	-	-	-	-	-
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	-	-	-	-	-	0.03	-	-	-	-	-	-
Total PCB	**0.0341**	**CCME ISQG**	-	0.263	0.172	0.441	2.56	0.116	0.086	0.035	0.22	0.16	0.29	0.67	0.69	0.77
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	0.12	0.10	0.26	0.93	0.07	-	0.046	-	-	-	-	-	-
Acenaphthylene	**0.00587**	**CCME ISQG**	-	0.16	0.15	0.18	2.45	0.01	-	0.15	-	-	-	-	-	-
Acenaphthene	**0.00671**	**CCME ISQG**	-	0.04	0.04	0.11	0.67	0.30	-	0.03	-	-	-	-	-	-
Fluorene	**0.0212**	**CCME ISQG**	-	0.04	0.04	0.08	0.59	0.33	-	0.026	-	-	-	-	-	-
Phenanthrene	**0.0419**	**CCME ISQG**	-	0.26	0.25	0.53	4.22	3.17	-	0.14	-	-	-	-	-	-
Anthracene	**0.0469**	**CCME ISQG**	-	0.13	0.13	0.16	2.19	0.64	-	0.082	-	-	-	-	-	-
Fluoranthene	**0.111**	**CCME ISQG**	-	0.60	0.61	1.20	7.33	4.39	-	0.38	-	-	-	-	-	-
Pyrene	**0.053**	**CCME ISQG**	-	0.93	0.95	1.69	9.79	3.47	-	0.6	-	-	-	-	-	-
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	0.52	0.54	0.68	6.69	1.31	-	0.3	-	-	-	-	-	-
Chrysene	**0.0571**	**CCME ISQG**	-	0.70	0.67	1.07	7.99	1.77	-	0.37	-	-	-	-	-	-
Benzo(b)fluoranthene			-	-	-	-	-	-	-	0.26	-	-	-	-	-	-
Benzo(k)fluoranthene			-	-	-	-	-	-	-	0.17	-	-	-	-	-	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	0.93	0.94	1.15	11.40	1.51	-	0.59	-	-	-	-	-	-
Indeno(1,2,3 -cd)pyrene			-	0.56	0.54	0.79	6.17	1.09	-	0.33	-	-	-	-	-	-
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	0.15	0.16	0.19	1.81	0.24	-	0.098	-	-	-	-	-	-
Benzo(ghi)perylene			-	0.62	0.58	0.87	6.55	1.05	-	0.27	-	-	-	-	-	-
Perylene			-	0.22	0.21	0.22	1.60	0.39	.	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	1.29	1.25	1.95	13.10	2.88	-	-	-	-	-	-	-	-
LPAH			-	0.74	0.69	1.32	11.05	4.52	0.00	0.47	-	-	-	-	-	-
HPAH			-	6.53	6.44	9.81	72.43	18.09	0.00	3.37	-	-	-	-	-	-
Total PAH			-	7.27	7.13	11.14	83.48	22.61	0.00	3.842	9.92	11.7	12.75	35.28	29.01	19.91
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.
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Area	Environmental Quality Guidelines	Source	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF	IF
Lot			Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada
UTM 18T Easting			381820	381826	381831	382365	382180	381908	381908	381811	381758	382221	382336	381809	381867.47	381667
Northing			4900538	4900523	4900510	4900617	4900652	4900590	4900590	4900538	4900527	4900609	4900489	4900491	4900472.41	4900485
Source			Malroz 2003	Malroz 2003	Malroz 2003	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2
Site Name			GCR130 - A	GCR130 - B	GCR130 - C	K10	K11	K12	K12	K13	K14	S10	S13	S7	S9	SC
Date						07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silt (2 - 63 µm)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clay (<2 µm)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Percernt Fines			0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC			-	-	-	240	42	180	94	91	120	72	58	85	53	-
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			-	-	-	9300	20000	9600	11000	11000	12000	21000	20000	15000	21000	-
Antimony [1]			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	5.9	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.6	CCME ISQG	-	-	-	0.9	0.9	1.6	2.8	2.2	2.1	1.4	0.9	1.9	0.9	-
Calcium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	37.3	CCME ISQG	4000	4900	4700	440	820	9900	5300	5900	2900	1300	860	4800	1300	-
Cobalt			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	35.7	CCME ISQG	-	-	-	37	36	68	110	110	86	44	35	78	36	-
Iron			-	-	-	20000	33000	20000	23000	21000	23000	30000	31000	25000	30000	-
Lead	35	CCME ISQG	-	-	-	82	77	470	420	440	370	160	120	380	95	-
Magnesium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	460	PSQG LEL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	0.17	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	16	PSQG LEL	-	-	-	18	31	20	24	23	27	34	34	27	31	-
Phosphorus			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver [2]			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strontium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Titanium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	120	PSQG LEL	-	-	-	190	140	320	420	420	340	180	150	320	130	-
Tributyl tin	0.073	PSDDA (WDOE)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	0.06	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1260	0.005	PSQG LEL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total PCB	0.0341	CCME ISQG	0.52	0.37	0.31	-	-	-	-	-	-	-	-	-	-	-
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	0.0346	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	0.00587	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	0.00671	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	0.0212	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	0.0419	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	0.0469	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	0.111	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	0.053	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	0.0317	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	0.0571	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	0.0319	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3 -cd)pyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.00622	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	0.0202	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
LPAH			-	-	-	-	-	-	-	-	-	-	-	-	-	-
HPAH			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total PAH			49.54	46.24	46.66	-	-	-	-	-	-	-	-	-	-	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Lot			Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada
UTM 18T Easting			382118	381701	381645	381615	381804	381596	381613	381580	381637	382087	381911	381924	382175	382244
Northing			4900643	4900520	4900489	4900477	4900446	4900465	4900456	4900465	4900460	4900597	4900545	4900549	4900605	4900435
Source			oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2
Site Name			SE-17	SE-20	SE-21	SE-22	SE-25	SE-3	SE-4	SE-5	SE-6	SS7	SS8	SSM1	SSM3	SSM6
Date			10/02/01	10/03/01	10/03/01	10/03/01	10/03/01	10/01/01	10/01/01	10/01/01	10/01/01			Nov-08	Nov-08	Nov-08
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silt (2 - 63 µm)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clay (<2 µm)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Percernt Fines			0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC			77	92	85	75	150	140	57	27	70	-	-	-	-	-
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			11000	8100	11000	12000	12000	11000	8800	-	8900	-	-	-	-	-
Antimony [1]			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	13	5.5	5
Barium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	1	3	2	2	1	4	2	-	2	-	-	1.1	<1.0	<1.0
Calcium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	**37.3**	**CCME ISQG**	3100	3900	470	98	1900	22000	1200	-	2800	-	-	5,488	1,300	786
Cobalt			-	-	-	-	-	-	-	-	-	-	-	11	14	13
Copper	**35.7**	**CCME ISQG**	39	180	84	110	37	130	99	-	120	-	-	82.2	41.2	32.2
Iron			19000	80000	100000	33000	18000	40000	22000	-	17000	-	-	-	-	-
Lead	**35**	**CCME ISQG**	200	390	180	130	180	2900	130	-	170	-	-	379	101	71
Magnesium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	**460**	**PSQG LEL**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	**0.17**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	**16**	**PSQG LEL**	18	31	26	25	20	30	22	-	19	-	-	23	25	23
Phosphorus			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver [2]			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strontium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Titanium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	**120**	**PSQG LEL**	170	720	300	380	150	630	260	-	300	-	-	342	154	116
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total PCB	**0.0341**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	0.015	-	-	-
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	**0.00587**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	**0.00671**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	**0.0212**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	**0.0419**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	**0.0469**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	**0.111**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	**0.053**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	**0.0571**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3 -cd)pyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
LPAH			-	-	-	-	-	-	-	-	-	-	-	-	-	-
HPAH			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total PAH			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.
High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.
1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	IF	IF	IF	IF	IF	IF	IF	IF	FF5	FF5	FF5	FF5	FF6	FF6
Lot			Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Parks Canada	Reference	Reference	Reference	Reference	Reference	Reference
UTM 18T Easting			382019	382090	382039.63	382282.14	382275.53	382274	382092.49	382128	383151.527	383151.527	382968.7016	382827.9207	382845	382876.1986
Northing			4900387	4900492	4900546.23	4900498.18	4900492.79	4900493	4900522.53	4900541	4900775.189	4900634.644	4900642.275	4900552.305	4900811	4901103.4
Source			RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	Tinney 2006	Tinney 2006	Tinney 2006	Tinney 2006	Golder 2012	Tinney 2006
Site Name			SSM7	SSM9	T13	T14	T7a	T7b	T8a	T8b	SED 14	SED 15	SED 29	SED 36	2011-M	ERA 8
Date			Nov-08	Nov-08							Nov-04	Nov-04	Jun-05	Sep-05	Sep-11	Nov-04
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	-	-	-	-	-	-	47	-
Silt (2 - 63 µm)			-	-	-	-	-	-	-	-	-	-	-	-	36	-
Clay (<2 µm)			-	-	-	-	-	-	-	-	-	-	-	-	18	-
Total Percernt Fines			0	0	0	0	0	0	0	0	0	0	0	0	54	0
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC			-	-	-	-	-	-	-	-	-	-	-	-	140000	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	14	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			-	-	-	-	-	-	-	-	19500	24700	19300	-	17000	19800
Antimony [1]			-	-	-	-	-	-	-	-	-	-	-	-	0.4	-
Arsenic	**5.9**	**CCME ISQG**	6.9	4.4	4.8	3.8	-	4.1	-	5	2.3	2.9	2.5	2.5	3	1.9
Barium			-	-	-	-	-	-	-	-	204	235	181	-	210	223
Beryllium			-	-	-	-	-	-	-	-	<1.0	<1.0	<4.0	-	0.6	<1.0
Boron			-	-	-	-	-	-	-	-	<40	<40	36.8	-	7	<40
Cadmium	**0.6**	**CCME ISQG**	<1.0	<1.0	-	-	-	-	-	-	<0.6	<0.6	<1.0	<1.0	0.8	<0.6
Calcium			-	-	-	-	-	-	-	-	15200	15500	17600	-	25000	15000
Chromium	**37.3**	**CCME ISQG**	962	735	878.7	933.4	-	1001.6	-	815.5	61.7	88.6	80	136	240	47.6
Cobalt			16	16	-	-	-	-	-	-	14.7	15.4	11.3	12.9	12	13.3
Copper	**35.7**	**CCME ISQG**	44.3	40.3	-	-	-	-	-	-	27.1	31.3	27	29	36	29.7
Iron			-	-	-	-	-	-	-	-	28400	30500	22500	-	26000	27000
Lead	**35**	**CCME ISQG**	110	80	-	-	-	-	-	-	31.2	55.8	27.1	43	58	27
Magnesium			-	-	-	-	-	-	-	-	9390	11500	8010	-	9800	9210
Manganese	**460**	**PSQG LEL**	-	-	-	-	-	-	-	-	678	720	706	24.1	890	879
Mercury	**0.17**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-
Molybdenum			-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0	-	0.7	<2.0
Nickel	**16**	**PSQG LEL**	28	30	-	-	-	-	-	-	23.7	28.3	20.9	-	27	23.8
Phosphorus			-	-	-	-	-	-	-	-	1000	865	869	-	950	914
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	924	786	850	60020	-	855
Potassium			-	-	-	-	-	-	-	-	4480	5910	4360	-	3100	4120
Selenium			-	-	-	-	-	-	-	-	2.5	2.8	<10	-	1.3	1.4
Silver [2]			-	-	-	-	-	-	-	-	<0.5	<0.5	0	-	0.2	<0.5
Sodium			-	-	-	-	-	-	-	-	623	667	585	-	390	639
Strontium			-	-	-	-	-	-	-	-	139	132	168	-	210	146
Sulphur			-	-	-	-	-	-	-	-	14900	11200	9860	-	-	9220
Thallium			-	-	-	-	-	-	-	-	<1.0	<1.0	<1.0	-	0.21	<1.0
Tin			-	-	-	-	-	-	-	-	2.4	<2.0	<2.0	-	<5	<2.0
Titanium			-	-	-	-	-	-	-	-	1340	1610	1150	-	-	1310
Uranium			-	-	-	-	-	-	-	-	<10	<10	<10	-	0.79	<10
Vanadium			-	-	-	-	-	-	-	-	39.7	48.2	47.1	-	41	41.4
Zinc	**120**	**PSQG LEL**	170	143	-	-	-	-	-	-	111	141	78.8	111	130	94.2
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	<0.1	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	-	-	-	-	-	-	<0.01	0.019	<0.01	<0.003	<0.1	<0.01
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	-	-	-	-	-	-	0.018	0.028	0.013	0.044	<0.1	<0.01
Total PCB	**0.0341**	**CCME ISQG**	-	-	-	-	-	0.005	-	0.005	0.014	0.047	0.018	0.0455	0.1	0.01
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	-	-	-	-	-	-	-	<0.06	0.07	0.053	0.06	0.006	<0.06
Acenaphthylene	**0.00587**	**CCME ISQG**	-	-	-	-	-	-	-	-	<0.05	<0.05	0.038	<0.05	0.012	<0.05
Acenaphthene	**0.00671**	**CCME ISQG**	-	-	-	-	-	-	-	-	<0.05	<0.05	0.017	<0.05	0.006	<0.05
Fluorene	**0.0212**	**CCME ISQG**	-	-	-	-	-	-	-	-	<0.05	<0.05	0.038	<0.05	0.025	<0.05
Phenanthrene	**0.0419**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.11	0.5	0.22	0.08	0.068	<0.05
Anthracene	**0.0469**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.07	<0.05	0.063	<0.05	0.11	<0.05
Fluoranthene	**0.111**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.34	0.12	0.42	0.24	0.099	0.07
Pyrene	**0.053**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.33	0.12	0.41	0.44	0.073	0.06
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.16	<0.05	0.2	0.29	0.069	<0.05
Chrysene	**0.0571**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.1	0.05	0.24	0.34	0.036	<0.05
Benzo(b)fluoranthene			-	-	-	-	-	-	-	-	0.22	0.06	0.14	0.17	0.041	<0.05
Benzo(k)fluoranthene			-	-	-	-	-	-	-	-	0.16	<0.05	0.056	0.24	0.18	<0.05
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.26	<0.10	0.23	0.33	<0.005	<0.10
Indeno(1,2,3 -cd)pyrene			-	-	-	-	-	-	-	-	0.24	<0.10	0.14	0.29	0.21	<0.10
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	-	-	-	-	-	-	-	0.06	<0.05	0.041	0.22	0.027	<0.05
Benzo(ghi)perylene			-	-	-	-	-	-	-	-	0.2	<0.10	0.11	0.27	0.038	<0.10
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	0.02	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	0.053	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.064	-
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	0.26	-
LPAH			-	-	-	-	-	-	-	-	0.29	0.67	0.43	0.24	0.34	0.16
HPAH			-	-	-	-	-	-	-	-	2.07	0.58	1.99	2.83	1.06	0.41
Total PAH			-	-	-	-	-	-	-	-	2.355	1.245	2.416	3.07	1.3995	0.56
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	<0.03	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	<0.5	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	FF6	FF6	FF7	FF7	FF7	FF8	FF8	FF8	FF8	MF7	MF7	MF7	MF7	MF8
Lot			Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
UTM 18T Easting			382768	382849	382347	382970.6197	382291	382220.2523	382230	382198.06	382199	382698.4467	382643.3298	382269.6067	382702.47	382277.7886
Northing			4901315	4900760	4901493	4901798.07	4901508	4901588.569	4901588	4901649.84	4901536	4901239.648	4901106.231	4900962.089	4901241.31	4901146.4
Source			oit and Dove 2(	Golder 2011	Golder 2012	Tinney 2006	Golder 2011	Chapter 3; Tabl	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	Chapter 3; Tabl	Tinney 2006	Tinney 2006	RMC Chapter 2	Tinney 2006
Site Name			SE-12	Station 10	2011-N	ERA 9	Station 9	BC9	FF4	T11	T19	BC8	SED 30	SED 35	T2	SED 31
Date			10/02/01	Sep-10	Sep-11	Nov-04	Sep-10	Nov-07	2002			Nov-08	Jun-05	Sep-05		Jun-05
Sediment Type (%)																
Sand (63 - 200 µm)			-	74	55	5	70	4.3	-	-	-	20.1	-	-	-	-
Silt (2 - 63 µm)			-	22	32	72	21	42.2	-	-	-	55.2	-	-	-	-
Clay (<2 µm)			-	4	13	23	9	53.5	-	-	-	24.6	-	-	-	-
Total Percernt Fines			0	26	45	95	30	95.7	0	0	0	79.8	0	0	0	0
TOC			110	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC			-	61000	150000	-	150000	-	-	-	-	-	-	-	-	-
TOC (%)			-	6.1	15	-	15	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			19000	7100	15000	17600	13000	-	-	-	-	-	20900	-	-	16300
Antimony [1]			-	<0.2	0.2	-	<0.2	-	-	-	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	-	2	2	1.8	3	2	3.7	-	-	2	2.8	4	-	2.9
Barium			-	94	190	173	160	-	-	-	-	-	181	-	-	148
Beryllium			-	0.3	0.6	<1.0	0.5	-	-	-	-	-	<4.0	-	-	<4.0
Boron			-	<5	6	<40	6	-	-	-	-	-	23.6	-	-	31
Cadmium	**0.6**	**CCME ISQG**	1	0.3	0.9	<0.6	0.9	-	-	-	-	-	1.1	<1.0	-	1.5
Calcium			-	13000	13000	14100	16000	-	-	-	-	-	17500	-	-	23100
Chromium	**37.3**	**CCME ISQG**	37	61	58	36	45	42	34	-	-	50	86.4	84	-	46.6
Cobalt			-	5.1	10	12.3	9.2	11	-	-	-	13	14.6	16	-	12
Copper	**35.7**	**CCME ISQG**	24	16	33	26.9	31	27	27.3	-	-	29	34.3	29	-	28.8
Iron			23000	13000	25000	25000	25000	-	-	-	-	-	29800	-	-	25600
Lead	**35**	**CCME ISQG**	21	27	46	21.3	48	48	59	-	-	32	44.2	42	-	69.9
Magnesium			-	6200	6800	7660	5600	-	-	-	-	-	9690	-	-	8810
Manganese	**460**	**PSQG LEL**	-	430	690	804	760	-	-	-	-	-	778	27.8	-	884
Mercury	**0.17**	**CCME ISQG**	-	<0.05	0.1	-	0.14	0.33	-	-	-	0.17	-	-	-	-
Molybdenum			-	<0.5	0.6	<2.0	0.6	-	-	-	-	-	<2.0	-	-	<2.0
Nickel	**16**	**PSQG LEL**	24	11	22	21.6	20	21	-	-	-	25	25.5	-	-	20.6
Phosphorus			-	800	800	934	800	-	-	-	-	-	943	-	-	761
Phosphorus (B-32 to B-34)			-	-	-	871	-	-	-	-	-	-	1000	640	-	1000
Potassium			-	1200	2600	3940	2200	-	-	-	-	-	4760	-	-	4210
Selenium			-	0.5	1.7	2	1.2	-	-	-	-	-	<10	-	-	<10
Silver [2]			-	<0.2	<0.2	<0.5	0.2	-	-	-	-	-	0	-	-	0
Sodium			-	190	330	685	270	-	-	-	-	-	726	-	-	716
Strontium			-	86	150	136	170	-	-	-	-	-	150	-	-	227
Sulphur			-	-	-	14400	-	-	-	-	-	-	13710	-	-	1310
Thallium			-	0.09	0.22	<1.0	0.21	-	-	-	-	-	<1.0	-	-	<1.0
Tin			-	<5	<5	<2.0	<5	-	-	-	-	-	<2.0	-	-	<2.0
Titanium			-	-	-	1450	-	-	-	-	-	-	1280	-	-	1090
Uranium			-	0.48	0.92	<10	0.96	-	-	-	-	-	<10	-	-	<10
Vanadium			-	23	34	39.9	33	-	-	-	-	-	48.9	-	-	44.6
Zinc	**120**	**PSQG LEL**	76	54	110	86.5	110	110	109	-	-	104	120	111	-	133
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-------	-	-	-------	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	<0.05	<0.05	-	<0.06	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	<0.05	<0.05	<0.01	<0.06	-	-	-	-	-	<0.01	<0.003	-	<0.01
Aroclor 1260	**0.005**	**PSQG LEL**	-	<0.05	<0.05	<0.01	<0.06	-	-	-	-	-	<0.01	0.0235	-	<0.01
Total PCB	**0.0341**	**CCME ISQG**	-	0.05	0.05	0.01	0.06	-	-	-	-	0.03	0.01	0.025	-	0.01
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	<0.005	0.011	<0.06	<0.005	-	0.25	-	-	-	0.046	0.1	-	0.047
Acenaphthylene	**0.00587**	**CCME ISQG**	-	<0.005	0.02	<0.05	<0.005	-	<0.050	-	-	-	0.01	<0.05	-	0.026
Acenaphthene	**0.00671**	**CCME ISQG**	-	<0.005	0.007	<0.05	<0.005	-	<0.050	-	-	-	0.01	<0.05	-	0.006
Fluorene	**0.0212**	**CCME ISQG**	-	<0.005	0.005	<0.05	<0.005	-	<0.050	-	-	-	0.031	<0.05	-	0.023
Phenanthrene	**0.0419**	**CCME ISQG**	-	0.06	0.027	<0.05	0.096	-	0.09	-	-	-	0.092	<0.05	-	0.08
Anthracene	**0.0469**	**CCME ISQG**	-	0.028	0.049	<0.05	0.034	-	<0.050	-	-	-	<0.020	<0.05	-	0.03
Fluoranthene	**0.111**	**CCME ISQG**	-	0.13	0.039	0.08	0.22	-	0.19	-	-	-	0.13	0.13	-	0.23
Pyrene	**0.053**	**CCME ISQG**	-	0.15	0.038	0.07	0.17	-	0.16	-	-	-	0.11	0.23	-	0.29
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	0.066	0.029	<0.05	0.068	-	0.07	-	-	-	0.03	0.16	-	0.083
Chrysene	**0.0571**	**CCME ISQG**	-	0.1	0.028	<0.05	0.092	-	0.1	-	-	-	0.052	0.19	-	0.12
Benzo(b)fluoranthene			-	0.052	0.033	<0.05	0.064	-	-	-	-	-	0.04	0.11	-	<0.020
Benzo(k)fluoranthene			-	0.041	0.093	<0.05	0.042	-	0.08	-	-	-	<0.020	0.13	-	0.053
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	0.074	0.006	<0.10	0.063	-	-	-	-	-	0.042	<0.1	-	0.13
Indeno(1,2,3 -cd)pyrene			-	0.041	0.18	<0.10	0.053	-	<0.10	-	-	-	0.036	<0.1	-	0.062
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	<0.005	0.006	<0.05	<0.005	-	<0.050	-	-	-	0.01	<0.05	-	0.021
Benzo(ghi)perylene			-	0.036	0.022	<0.10	0.054	-	<0.10	-	-	-	0.031	0.11	-	0.057
Perylene			-	0.04	0.02	-	0.075	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	<0.005	0.043	-	<0.005	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	<0.005	0.067	-	<0.005	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	0.046	0.14	-	0.056	-	-	-	-	-	-	-	-	-
LPAH			-	0.10	0.23	0.16	0.15	-	0.44	-	-	-	0.20	0.23	-	0.21
HPAH			-	0.78	0.63	0.43	0.96	-	0.73	-	-	-	0.49	1.19	-	1.06
Total PAH			-	0.8815	0.863	0.58	1.1045	6	1.165	-	-	2	0.69	1.41	-	1.268
Pesticides & Herbicides																
Aldrin			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	<0.03	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	<0.01	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	<0.5	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

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Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

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Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	MF9	MF9	MF9	FF0	FF0	FF0	FF0	FF0	FF0	FF0	FF1	FF1	FF1	FF1
Lot			Reference	Reference	Reference	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			382137.6906	382151	382106.87	381820	382021	382022	381848	382044.1592	381891	382076	382241	382240	382219.2434	382317.958
Northing			4901427.13	4901507	4901524.99	4899198	4899133	4899322	4899058	4899257.971	4899105	4899080	4899116	4899285	4899201.082	4899164.042
Source			Tinney 2006	RMC Chapter 2	RMC Chapter 2	Golder 2012	Golder 2012	Golder 2012	oit and Dove 2(	Tinney 2006	Golder 2011	Golder 2011	Golder 2012	Golder 2012	Tinney 2006	Tinney 2006
Site Name			ERA 10	SSM10	T1	2011-A	2011-B	2011-C	SE-24	SED 39	Station 1	Station 2	2011-D	2011-E	SED 23	SED 26
Date			Nov-04	Nov-08		Sep-11	Sep-11	Sep-11	10/03/01	Sep-05	Sep-10	Sep-10	Sep-11	Sep-11	Nov-04	Jun-05
Sediment Type (%)																
Sand (63 - 200 µm)			3	-	-	44	46	43	-	-	53	71	35	47	-	-
Silt (2 - 63 µm)			79	-	-	35	31	37	-	-	29	17	35	32	-	-
Clay (<2 µm)			18	-	-	22	23	21	-	-	18	12	29	22	-	-
Total Percernt Fines			97	0	0	57	54	58	0	0	47	29	64	54	0	0
TOC			-	-	-	-	-	-	74	-	-	-	-	-	-	-
TOC			-	-	-	81000	110000	95000	-	-	88000	78000	98000	100000	-	-
TOC (%)			-	-	-	8.1	11	9.5	-	-	8.8	7.8	9.8	10	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			16500	-	-	17000	16000	15000	18000	-	16000	12000	19000	18000	22400	26300
Antimony [1]			-	-	-	1.8	0.9	0.6	-	-	0.8	0.3	0.4	0.5	-	-
Arsenic	5.9	CCME ISQG	2.6	2.9	-	7	7	7	-	9.7	5	4	4	5	3.9	3.3
Barium			96.5	-	-	200	240	220	-	-	210	200	240	250	239	263
Beryllium			<1.0	-	-	0.7	0.6	0.7	-	-	0.7	0.5	0.7	1	<1.0	<4.0
Boron			<40	-	-	9	9	<5	-	-	7	<5	7	5	<40	41.1
Cadmium	0.6	CCME ISQG	<0.6	1.1	-	1	0.9	0.8	1	<1.0	1	0.6	0.8	0.8	<0.6	1.1
Calcium			14900	-	-	40000	25000	53000	-	-	39000	91000	26000	24000	44700	17400
Chromium	37.3	CCME ISQG	34.5	182	-	170	280	370	120	380	220	150	200	200	167	126
Cobalt			12.2	13	-	10	12	12	-	16.7	12	9.2	12	12	14.3	16.5
Copper	35.7	CCME ISQG	29.9	32.1	-	780	120	65	98	54.2	120	83	43	44	38	38.6
Iron			30800	-	-	32000	29000	26000	30000	-	29000	23000	27000	28000	30200	33100
Lead	35	CCME ISQG	35.8	72	-	160	110	130	93	217	120	140	69	71	56.7	45.3
Magnesium			6500	-	-	10000	10000	11000	-	-	15000	9000	11000	11000	11700	11800
Manganese	460	PSQG LEL	801	-	-	1000	1100	710	-	30.8	870	910	820	1100	1260	1460
Mercury	0.17	CCME ISQG	-	-	-	0.3	0.39	0.36	-	-	0.28	0.17	0.19	0.17	-	-
Molybdenum			<2.0	-	-	2.3	1.2	0.7	-	-	1.2	0.6	0.8	1	<2.0	<2.0
Nickel	16	PSQG LEL	22.9	24	-	28	28	25	31	-	29	21	29	30	29.4	29.2
Phosphorus			829	-	-	1600	1100	1100	-	-	1200	900	930	1100	1050	1000
Phosphorus (B-32 to B-34)			664	-	-	-	-	-	-	600	-	-	-	-	954	-
Potassium			3270	-	-	3400	3400	3000	-	-	3000	2500	3700	3600	5120	6110
Selenium			2.3	-	-	1.4	1.9	1	-	-	1.1	0.8	1.2	1.1	2.4	<10
Silver [2]			<0.5	-	-	0.6	0.8	0.7	-	-	0.6	0.4	0.5	0.5	<0.5	0
Sodium			593	-	-	1700	480	390	-	-	420	510	490	480	729	873
Strontium			172	-	-	130	120	280	-	-	110	350	130	130	179	130
Sulphur			29600	-	-	-	-	-	-	-	-	-	-	-	9080	8080
Thallium			<1.0	-	-	0.32	0.26	0.26	-	-	0.27	0.23	0.26	0.26	<1.0	<1.0
Tin			<2.0	-	-	15	7	160	-	-	5	<5	10	6	2.1	2.8
Titanium			1220	-	-	-	-	-	-	-	-	-	-	-	1350	1600
Uranium			<10	-	-	0.64	0.79	0.75	-	-	0.81	0.71	0.84	1	<10	<10
Vanadium			35.6	-	-	36	41	37	-	-	42	31	43	41	47.2	58.8
Zinc	120	PSQG LEL	104	138	-	460	230	190	370	197	290	140	160	160	142	129
Tributyl tin	0.073	PSDDA (WDOE)	-	-	-	0.02	<0.006	-	-	-	0.21	0.014	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	<0.05	<0.1	0.08	-	-	<0.05	<0.04	<0.05	<0.07	-	-
Aroclor 1254	0.06	CCME ISQG	<0.01	-	-	0.13	0.2	0.76	-	2.11	0.14	0.12	0.06	0.09	0.046	<0.01
Aroclor 1260	0.005	PSQG LEL	0.015	-	-	0.07	0.4	0.25	-	0.39	0.11	0.05	0.08	0.09	0.1	0.012
Total PCB	0.0341	CCME ISQG	0.02	-	-	0.2	0.6	1.01	-	2.5	0.25	0.17	0.14	0.18	0.146	0.017
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	0.0346	CCME ISQG	0.08	-	-	0.056	0.018	0.028	-	0.32	0.11	0.08	0.021	0.014	0.1	0.12
Acenaphthylene	0.00587	CCME ISQG	<0.05	-	-	0.11	0.017	0.026	-	0.18	0.059	0.098	0.013	0.021	0.28	0.026
Acenaphthene	0.00671	CCME ISQG	<0.05	-	-	0.11	0.047	0.13	-	0.13	0.083	0.065	0.09	<0.005	0.09	0.016
Fluorene	0.0212	CCME ISQG	<0.05	-	-	0.1	0.063	0.24	-	0.08	0.074	0.053	0.076	0.08	0.08	0.036
Phenanthrene	0.0419	CCME ISQG	0.07	-	-	0.22	0.27	0.4	-	0.05	0.53	0.27	0.37	0.4	0.49	0.14
Anthracene	0.0469	CCME ISQG	<0.05	-	-	0.85	0.55	1.2	-	0.26	0.18	0.22	0.76	1	0.3	0.046
Fluoranthene	0.111	CCME ISQG	0.18	-	-	0.93	0.56	1.3	-	0.89	1	0.68	0.67	0.7	10.1	0.3
Pyrene	0.053	CCME ISQG	0.14	-	-	0.66	0.39	0.68	-	1.5	1.2	0.99	0.37	0.33	1.7	0.35
Benzo(a)anthracene	0.0317	CCME ISQG	0.06	-	-	0.63	0.38	0.74	-	0.76	0.52	0.51	0.33	0.36	0.88	0.13
Chrysene	0.0571	CCME ISQG	0.07	-	-	0.42	0.27	0.49	-	0.92	0.71	0.54	0.29	0.31	0.86	0.19
Benzo(b)fluoranthene			0.12	-	-	0.37	0.24	0.41	-	0.57	0.54	0.38	0.23	0.24	0.74	0.11
Benzo(k)fluoranthene			0.09	-	-	1.1	0.7	1.3	-	0.79	0.4	0.29	0.86	1.1	0.25	0.07
Benzo(a)pyrene	0.0319	CCME ISQG	0.1	-	-	0.11	0.083	0.18	-	1.4	0.7	0.7	0.079	0.063	1.6	0.18
Indeno(1,2,3 -cd)pyrene			0.1	-	-	1.4	0.93	1.4	-	1	0.44	0.35	1.2	1.3	1.1	0.096
Dibenz(a,h)anthracene	0.00622	CCME ISQG	0.06	-	-	0.088	0.046	0.13	-	0.28	0.11	0.087	0.046	0.027	0.23	0.027
Benzo(ghi)perylene			<0.10	-	-	0.43	0.27	0.55	-	1.1	0.52	0.38	0.24	0.25	0.9	0.078
Perylene			-	-	-	0.091	0.055	0.066	-	-	0.12	0.15	0.036	0.041	-	-
1-Methylnaphthalene			-	-	-	0.18	0.14	0.23	-	-	0.044	0.026	0.17	0.18	-	-
2-Methylnaphthalene	0.0202	CCME ISQG	-	-	-	0.69	0.37	0.62	-	-	0.055	0.033	0.34	0.27	-	-
Benzo(j)fluoranthene			-	-	-	1.6	1.1	2.1	-	-	0.38	0.32	1.5	1.9	-	-
LPAH			0.25	-	-	2.32	1.48	2.87	-	1.02	1.14	0.85	1.84	1.97	1.34	0.38
HPAH			0.97	-	-	7.83	5.02	9.35	-	9.21	6.64	5.38	5.85	6.62	18.36	1.53
Total PAH			1.22	-	-	10.145	6.499	12.22	-	10.23	7.775	6.222	7.691	8.5885	19.7	1.915
Pesticides & Herbicides																
Aldrin			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
alpha-BHC			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
beta-BHC			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
delta-BHC			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
a-Chlordane			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
g-Chlordane			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Chlordane (Total)			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
o,p-DDD			-	-	-	<0.05	<0.02	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
p,p-DDD			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
o,p-DDD + p,p-DDD			-	-	-	<0.05	<0.02	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
o,p-DDE			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
p,p-DDE			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
o,p-DDE + p,p-DDE			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
o,p-DDT			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
p,p-DDT			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
o,p-DDT + p,p-DDT			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
DDT+ Metabolites			-	-	-	<0.05	<0.02	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Dieldrin			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Endosulfan I (alpha)			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Endosulfan II			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Endosulfan sulfate			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Total Endosulfan			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Endrin			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Endrin aldehyde			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Endrin ketone			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Heptachlor			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Heptachlor epoxide			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Hexachlorobenzene			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Lindane			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Methoxychlor			-	-	-	<0.1	<0.04	<0.1	-	-	<0.2	<0.1	<0.03	<0.03	-	-
Mirex			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Octachlorostyrene			-	-	-	<0.05	<0.01	<0.05	-	-	<0.05	<0.04	<0.01	<0.01	-	-
Toxaphene			-	-	-	<2	<0.6	<2	-	-	<2	<2	<0.4	<0.5	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

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Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

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RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	FF1	FF1	FF1	FF2	FF2	FF2	FF2	FF2	FF2	FF2	FF3	FF3	FF3	FF3
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			382172.7969	382136.9905	382111	382507.26	382552.469	382596.3074	382643.518	382414.2095	382544.8399	382497.9915	382998	382917.6099	383013.3242	383057.8302
Northing			4899348.15	4899162.487	4899341	4899118.95	4899110.44	4899390.332	4899484.753	4899623.012	4899568.842	4899250.273	4899601	4899670.363	4899805.427	4899941.287
Source			Tinney 2006	Tinney 2006	Golder 2011	oit and Dove 2(	Tinney 2006	Tinney 2006	Tinney 2006	Tinney 2006	Tinney 2006	Tinney 2006	oit and Dove 2(	Tinney 2006	Tinney 2006	Tinney 2006
Site Name			SED 27	SED 40	Station 4	C1	ERA 1	ERA 2	ERA 3	ERA 4	SED 22	SED 24	SE-9	SED 11	SED 12	SED 13
Date			Jun-05	Sep-05	Sep-10		Nov-04	Nov-04	Nov-04	Nov-04	Nov-04	Nov-04	10/02/01	Nov-04	Nov-04	Nov-04
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	61	-	3	2	3	1	-	-	-	-	-	-
Silt (2 - 63 µm)			-	-	28	-	55	55	60	57	-	-	-	-	-	-
Clay (<2 µm)			-	-	11	-	42	43	37	42	-	-	-	-	-	-
Total Percernt Fines			0	0	39	0	97	98	97	99	0	0	0	0	0	0
TOC			-	-	-	-	-	-	-	-	-	-	100	-	-	-
TOC			-	-	93000	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	9.3	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			-	-	14000	-	22500	24200	23800	22200	23400	25100	17000	21200	23400	22800
Antimony [1]			-	-	0.7	-	-	-	-	-	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	-	3.6	7	-	3	3.4	4.3	2.6	3.8	3.3	-	3.4	2.8	3.7
Barium			-	-	200	-	226	243	199	229	251	251	-	198	102	197
Beryllium			-	-	0.5	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
Boron			-	-	6	-	<40	<40	<40	<40	<40	<40	-	<40	<40	<40
Cadmium	**0.6**	**CCME ISQG**	-	<1.0	0.8	-	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	1	0.6	<0.6	<0.6
Calcium			-	-	61000	-	28200	40200	30900	30600	23900	20000	-	38700	18000	18300
Chromium	**37.3**	**CCME ISQG**	-	208	340	-	113	129	162	189	406	125	97	129	104	86.6
Cobalt			-	16.2	11	-	14.5	14.8	15.3	14.5	15.8	15.3	-	14.5	15.1	14.7
Copper	**35.7**	**CCME ISQG**	-	44.3	43	-	34	39.6	36.6	38.6	40.7	39.6	40	32.4	35.1	32.8
Iron			-	-	24000	-	29500	31400	32400	29900	31800	31700	23000	29000	31000	30100
Lead	**35**	**CCME ISQG**	-	60	110	-	47.1	60.7	60.6	57	75.8	56.9	130	44.1	46.3	44.3
Magnesium			-	-	9600	-	11600	13300	16000	11200	12000	12000	-	15100	10200	9650
Manganese	**460**	**PSQG LEL**	-	32.4	710	-	1290	837	835	884	813	1320	-	745	928	1290
Mercury	**0.17**	**CCME ISQG**	-	-	0.37	-	-	-	-	-	-	-	-	-	-	-
Molybdenum			-	-	0.8	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0
Nickel	**16**	**PSQG LEL**	-	-	25	-	27.5	29.8	29.3	28.9	31	30.7	24	26	27.7	27
Phosphorus			-	-	940	-	1070	927	881	1030	1020	1080	-	927	1100	926
Phosphorus (B-32 to B-34)			-	920	-	-	981	997	866	908	981	988	-	841	808	881
Potassium			-	-	2800	-	5330	4970	4890	4590	5120	5490	-	6200	4800	5580
Selenium			-	-	1	-	2.9	1.9	2.2	3.3	3.1	2.8	-	2.2	2.9	2.4
Silver [2]			-	-	0.6	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	0.5
Sodium			-	-	400	-	676	738	734	722	687	720	-	800	710	676
Strontium			-	-	290	-	139	214	155	176	150	114	-	139	153	159
Sulphur			-	-	-	-	6860	8900	8470	8550	11100	10600	-	9510	12000	15300
Thallium			-	-	0.3	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
Tin			-	-	5	-	2.3	3.1	2.9	<2.0	2.2	2.4	-	2.3	<2.0	<2.0
Titanium			-	-	-	-	1360	1010	934	1240	1690	1630	-	1580	1150	1540
Uranium			-	-	0.79	-	<10	<10	<10	<10	<10	<10	-	<10	<10	<10
Vanadium			-	-	37	-	46.8	49.5	50.6	47.4	48.9	49.1	-	46	48.7	44.3
Zinc	**120**	**PSQG LEL**	-	159	160	-	135	158	144	140	159	157	260	115	136	132
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	<0.01	<0.003	0.48	-	0.03	0.049	0.059	0.025	0.042	0.031	-	0.047	0.011	0.02
Aroclor 1260	**0.005**	**PSQG LEL**	0.013	0.34	0.26	-	0.05	0.089	0.068	0.064	0.11	0.047	-	0.089	0.048	0.021
Total PCB	**0.0341**	**CCME ISQG**	0.018	0.3415	0.74	-	0.08	0.138	0.127	0.09	0.152	0.078	-	0.136	0.059	0.041
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	0.15	0.09	0.29	-	0.09	0.07	0.08	0.2	0.08	0.07	-	0.09	0.07	0.06
Acenaphthylene	**0.00587**	**CCME ISQG**	0.13	<0.05	0.74	-	0.14	0.08	0.08	0.07	0.1	0.05	-	0.06	0.05	<0.05
Acenaphthene	**0.00671**	**CCME ISQG**	0.095	<0.05	0.21	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05
Fluorene	**0.0212**	**CCME ISQG**	0.081	<0.05	0.19	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05
Phenanthrene	**0.0419**	**CCME ISQG**	0.39	0.06	0.87	-	0.38	0.16	0.17	0.13	0.17	0.11	-	0.12	0.12	0.06
Anthracene	**0.0469**	**CCME ISQG**	0.27	<0.05	0.84	-	0.22	0.08	0.1	0.05	0.09	0.06	-	0.06	<0.05	<0.05
Fluoranthene	**0.111**	**CCME ISQG**	0.85	0.06	2.4	-	1.1	0.43	0.5	0.29	0.41	0.29	-	0.34	0.39	0.16
Pyrene	**0.053**	**CCME ISQG**	1.2	0.09	3.6	-	1.5	0.58	0.875	0.39	0.6	0.37	-	0.44	0.43	0.16
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	0.63	<0.05	2.4	-	0.7	0.25	0.31	0.19	0.31	0.16	-	0.19	0.2	0.05
Chrysene	**0.0571**	**CCME ISQG**	0.72	<0.05	2.6	-	0.78	0.3	0.37	0.21	0.32	0.2	-	0.24	0.22	0.08
Benzo(b)fluoranthene			0.42	<0.05	2.7	-	0.6	0.3	0.3	0.24	0.28	0.25	-	0.23	0.21	0.08
Benzo(k)fluoranthene			0.24	<0.05	1.3	-	0.56	0.22	0.29	0.19	0.18	0.13	-	0.16	0.13	0.06
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	0.81	<0.1	3.8	-	0.97	0.41	0.46	0.35	0.54	0.3	-	0.31	0.29	<0.10
Indeno(1,2,3 -cd)pyrene			0.43	<0.1	1.8	-	0.61	0.29	0.33	0.29	0.38	0.23	-	0.25	0.22	0.1
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	0.12	<0.05	0.49	-	0.14	0.07	0.08	0.08	0.08	0.05	-	0.08	0.05	<0.05
Benzo(ghi)perylene			0.34	<0.1	2	-	0.54	0.25	0.29	0.28	0.34	0.2	-	0.24	0.19	<0.10
Perylene			-	-	0.61	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	0.094	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	0.19	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	1.5	-	-	-	-	-	-	-	-	-	-	-
LPAH			1.12	0.25	3.42	-	0.88	0.44	0.48	0.50	0.49	0.34	-	0.38	0.32	0.22
HPAH			5.76	0.43	25.20	-	7.50	3.10	3.81	2.51	3.44	2.18	-	2.48	2.33	0.82
Total PAH			6.876	0.675	28.624	-	8.38	3.54	4.285	3.01	3.93	2.52	-	2.86	2.645	1.035
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

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Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

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RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

APPENDIX D

Area	Environmental Quality Guidelines	Source	FF3	FF3	FF4	FF4	FF4	FF4	MF1	MF1	MF1	MF1	MF2	MF2	MF3	MF3
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			382870.4365	382685.3852	383102.1348	383196.5559	383168	383107.021	381891	381966	381912	381822	382097	382119	382175	382122
Northing			4899988.135	4899803.084	4900273.843	4900550.362	4900213	4900501.126	4899510	4899697	4899352	4899620	4899514	4899617	4899790	4899844
Source			Tinney 2006	Tinney 2006	Tinney 2006	Tinney 2006	oit and Dove 2(	Tinney 2006	Golder 2012	Golder 2012	Golder 2011	Golder 2011	Golder 2012	Golder 2011	Golder 2012	oit and Dove 2(
Site Name			SED 17	SED 20	ERA 6	ERA 7	SE-10	SED 16	2011-F	2011-H	Station 3	Station 5	2011-G	Station 6	2011-I	G4
Date			Nov-04	Nov-04	Nov-04	Nov-04	10/02/01	Nov-04	Sep-11	Sep-11	Sep-10	Sep-10	Sep-11	Sep-10	Sep-11	07/16/01
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	48	46	52	46	54	60	36	-
Silt (2 - 63 µm)			-	-	-	-	-	-	32	32	33	41	27	28	40	-
Clay (<2 µm)			-	-	-	-	-	-	19	21	15	13	20	12	24	-
Total Percernt Fines			0	0	0	0	0	0	51	53	48	54	47	40	64	0
TOC			-	-	-	-	110	-	-	-	-	-	-	-	-	90
TOC			-	-	-	-	-	-	85000	91000	96000	85000	100000	100000	90000	-
TOC (%)			-	-	-	-	-	-	8.5	9.1	9.6	8.5	10	10	9	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			23300	21100	25600	22200	21000	1730	17000	17000	14000	10000	19000	17000	17000	21000
Antimony [1]			-	-	-	-	-	-	1	1	1.3	1.2	0.6	0.7	0.5	-
Arsenic	**5.9**	**CCME ISQG**	3	1.8	2.1	2.7	-	3	10	11	22	11	6	7	5	-
Barium			141	225	94.9	233	-	218	240	220	230	190	240	220	220	-
Beryllium			<1.0	<1.0	<1.0	<1.0	-	<1.0	0.6	0.6	0.5	0.5	0.6	0.5	0.5	-
Boron			<40	<40	<40	<40	-	<40	6	6	6	6	6	6	5	-
Cadmium	**0.6**	**CCME ISQG**	<0.6	<0.6	<0.6	<0.6	1	<0.6	1.2	1.1	1.2	1.2	0.9	1	0.9	1.8
Calcium			23400	34500	18800	18600	-	14700	50000	29000	49000	98000	23000	32000	30000	-
Chromium	**37.3**	**CCME ISQG**	123	109	102	76.7	97	88.7	910	830	630	300	510	770	580	920
Cobalt			15.9	13.4	16.8	14.7	-	15.9	15	15	16	12	13	12	13	-
Copper	**35.7**	**CCME ISQG**	37.3	30.2	39	30.8	53	32.2	61	57	67	98	51	49	48	93
Iron			32900	27100	34000	29000	27000	25800	28000	28000	26000	20000	28000	27000	27000	29000
Lead	**35**	**CCME ISQG**	49.5	38	47.4	42.4	40	53.9	150	140	510	150	100	130	94	150
Magnesium			11300	9920	11900	10300	-	11800	13000	13000	10000	14000	11000	11000	12000	-
Manganese	**460**	**PSQG LEL**	1160	878	854	813	-	736	730	740	590	530	840	760	980	-
Mercury	**0.17**	**CCME ISQG**	-	-	-	-	-	-	0.66	0.65	1.6	1.9	0.33	0.46	0.26	-
Molybdenum			<2.0	<2.0	<2.0	<2.0	-	<2.0	1	1.1	0.7	1.1	1.1	0.9	0.8	-
Nickel	**16**	**PSQG LEL**	29.4	24.5	30.5	26	29	28.8	32	31	29	24	30	29	28	35
Phosphorus			1100	885	1010	921	-	852	1200	1200	1200	1200	1100	1000	1100	-
Phosphorus (B-32 to B-34)			869	844	850	848	-	800	-	-	-	-	-	-	-	-
Potassium			5080	4730	5510	5540	-	6050	3800	3700	3000	2100	3700	3200	3600	-
Selenium			2.9	1.8	2.5	2	-	2	1.4	1.3	1.2	1.6	1.3	1.2	1.3	-
Silver [2]			<0.5	<0.5	<0.5	<0.5	-	<0.5	1.2	1.3	1.1	4.3	0.8	1	0.8	-
Sodium			806	662	809	647	-	690	510	480	370	410	480	370	440	-
Strontium			175	206	162	152	-	135	310	170	250	390	150	190	170	-
Sulphur			15100	13500	13400	13000	-	10700	-	-	-	-	-	-	-	-
Thallium			<1.0	<1.0	<1.0	<1.0	-	<1.0	0.31	0.27	0.35	0.29	0.29	0.28	0.26	-
Tin			<2.0	<2.0	<2.0	<2.0	-	<2.0	11	9	15	8	7	6	6	-
Titanium			1120	1310	1380	1580	-	1210	-	-	-	-	-	-	-	-
Uranium			<10	<10	<10	<10	-	<10	0.84	0.89	0.74	0.73	0.96	0.93	0.79	-
Vanadium			49.1	45.7	55	47.9	-	50.4	47	47	40	35	45	44	43	-
Zinc	**120**	**PSQG LEL**	140	114	145	122	140	140	230	220	340	330	180	190	160	220
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	0.02	0.013	-	-------	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	<0.1	<0.05	0.07	<0.05	<0.1	<0.06	<0.06	-
Aroclor 1254	**0.06**	**CCME ISQG**	0.016	0.016	0.014	0.01	-	<0.01	0.4	0.1	0.88	0.22	0.2	0.51	0.22	-
Aroclor 1260	**0.005**	**PSQG LEL**	0.035	0.041	0.031	0.025	-	0.03	0.4	0.09	0.42	0.14	0.3	0.67	0.38	-
Total PCB	**0.0341**	**CCME ISQG**	0.051	0.057	0.045	0.035	-	0.035	0.8	0.18	1.3	0.36	0.4	1.18	0.6	-
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	0.06	<0.06	0.06	0.06	-	0.06	0.02	0.019	0.17	0.05	0.029	0.083	0.017	-
Acenaphthylene	**0.00587**	**CCME ISQG**	<0.05	<0.05	<0.05	<0.05	-	<0.05	0.025	0.01	0.25	0.039	0.017	0.14	0.026	-
Acenaphthene	**0.00671**	**CCME ISQG**	<0.05	<0.05	<0.05	<0.05	-	<0.05	0.05	0.016	0.15	0.075	0.031	0.066	0.018	-
Fluorene	**0.0212**	**CCME ISQG**	<0.05	<0.05	<0.05	<0.05	-	<0.05	0.087	0.039	0.11	0.083	0.065	0.068	0.079	-
Phenanthrene	**0.0419**	**CCME ISQG**	0.07	0.06	0.09	0.08	-	<0.05	0.15	0.09	0.75	0.9	0.16	0.33	0.12	-
Anthracene	**0.0469**	**CCME ISQG**	<0.05	<0.05	<0.05	<0.05	-	<0.05	0.44	0.25	0.3	0.16	0.38	0.18	0.34	-
Fluoranthene	**0.111**	**CCME ISQG**	0.18	0.14	0.18	0.3	-	0.12	0.57	0.31	1.6	1.9	0.4	0.67	0.38	-
Pyrene	**0.053**	**CCME ISQG**	0.19	0.15	0.16	0.27	-	0.13	0.39	0.22	2.1	1.6	0.25	1.1	0.22	-
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	0.09	0.06	0.06	0.18	-	0.06	0.42	0.22	1.1	0.64	0.25	0.54	0.24	-
Chrysene	**0.0571**	**CCME ISQG**	0.11	0.08	0.08	0.17	-	0.08	0.26	0.16	1.3	1	0.2	0.59	0.17	-
Benzo(b)fluoranthene			0.12	0.1	0	0.21	-	0.08	0.22	0.13	1	1.1	0.16	0.51	0.15	-
Benzo(k)fluoranthene			0.09	0.07	<0.05	0.12	-	0.06	0.5	0.32	0.69	0.59	0.45	0.32	0.41	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	0.16	0.11	0.1	0.24	-	0.1	0.093	0.043	1.6	0.75	0.05	0.85	0.052	-
Indeno(1,2,3 -cd)pyrene			0.13	1.1	<0.10	0.19	-	<0.1	0.68	0.46	0.87	0.55	0.57	0.47	0.47	-
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	<0.05	<0.05	<0.05	<0.05	-	<0.05	0.033	0.012	0.22	0.13	0.022	0.12	0.018	-
Benzo(ghi)perylene			0.12	<0.10	<0.10	0.14	-	<0.10	0.3	0.16	0.88	0.6	0.18	0.48	0.17	-
Perylene			-	-	-	-	-	-	0.046	0.026	0.3	0.11	0.03	0.16	0.033	-
1-Methylnaphthalene			-	-	-	-	-	-	0.13	0.072	0.062	0.032	0.11	0.038	0.096	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	0.26	0.17	0.13	0.036	0.19	0.062	0.15	-
Benzo(j)fluoranthene			-	-	-	-	-	-	0.87	0.54	0.73	0.45	0.77	0.4	0.67	-
LPAH			0.23	0.19	0.25	0.24	-	0.19	1.16	0.67	1.92	1.38	0.98	0.97	0.85	-
HPAH			1.22	1.89	0.73	1.85	-	0.76	4.38	2.60	12.39	9.42	3.33	6.21	2.98	-
Total PAH			1.445	2.075	0.98	2.085	-	0.94	5.544	3.267	14.312	10.795	4.314	7.177	3.829	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
alpha-BHC			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
beta-BHC			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
delta-BHC			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
a-Chlordane			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
g-Chlordane			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Chlordane (Total)			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
o,p-DDD			-	-	-	-	-	-	<0.01	<0.01	<0.1	<0.04	<0.01	-	<0.01	-
p,p-DDD			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	<0.01	<0.01	<0.1	<0.04	<0.01	-	<0.01	-
o,p-DDE			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
p,p-DDE			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
o,p-DDT			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
p,p-DDT			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
DDT+ Metabolites			-	-	-	-	-	-	<0.01	<0.01	<0.1	<0.04	<0.01	-	<0.01	-
Dieldrin			-	-	-	-	-	-	<0.01	<0.01	<0.05	<0.04	<0.01	-	<0.01	-
Endosulfan I (alpha)			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Endosulfan II			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Endosulfan sulfate			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Total Endosulfan			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Endrin			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Endrin aldehyde			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Endrin ketone			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Heptachlor			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Heptachlor epoxide			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Hexachlorobenzene			-	-	-	-	-	-	<0.01	<0.01	<0.05	<0.04	<0.01	-	<0.01	-
Lindane			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Methoxychlor			-	-	-	-	-	-	<0.03	<0.03	<0.1	<0.1	<0.03	-	<0.03	-
Mirex			-	-	-	-	-	-	<0.05	<0.03	<0.05	<0.04	<0.03	-	<0.03	-
Octachlorostyrene			-	-	-	-	-	-	<0.01	<0.01	<0.04	<0.04	<0.01	-	<0.01	-
Toxaphene			-	-	-	-	-	-	<0.5	<0.4	<2	<2	<0.5	-	<0.5	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

APPENDIX D

Area	Environmental Quality Guidelines	Source	MF3	MF4	MF4	MF4	MF4	MF4	MF5	MF5	MF5	MF5	NF1	NF1	NF1	NF1
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			382317.958	382503	382401	382594.0308	382453.4855	382484	382550	382549	382732.2336	382689.9999	381882	381882	381915	381963
Northing			4899714.363	4899989	4899801	4899941.287	4899711.73	4900015	4900291	4900247	4900128.681	4900314.922	4899764	4899764	4899835	4899840
Source			Tinney 2006	oit and Dove 2	oit and Dove 2	Tinney 2006	Tinney 2006	Golder 2011	oit and Dove 2	oit and Dove 2	Tinney 2006	Tinney 2006	d Dove 2006 (A	oit and Dove 2	t and Burnisto	t and Burnisto
Site Name			SED 28	A3	G3	SED 19	SED 21	Station 8	K9	S17	SED 18	SED 37	184	06 15 184	CAT10	CAT11
Date			Jun-05	07/16/01	07/16/01	Nov-04	Nov-04	Sep-10		07/16/01	Nov-04	Sep-05	2002	2002		
Sediment Type (%)																
Sand (63 - 200 μm)			-	-	-	-	-	68	-	-	-	-	12	13	6	2
Silt (2 - 63 μm)			-	-	-	-	-	21	-	-	-	-	65	66	93	97
Clay (<2 μm)			-	-	-	-	-	11	-	-	-	-	23	22	1	1
Total Percernt Fines			0	0	0	0	0	32	0	0	0	0	88	88	93.897	97.832
TOC			-	110	120	-	-	-	-	-	-	-	86	78	-	-
TOC			-	-	-	-	-	120000	-	-	-	-	86000	-	-	-
TOC (%)			-	-	-	-	-	12	-	-	-	-	8.6	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	7300	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	7.3	-	-	-
Metals (mg/kg)																
Aluminum			26500	21000	21000	23800	21800	16000	-	-	22600	-	21000	20000	31000	34300
Antimony [1]			16.6	-	-	-	-	0.3	-	-	-	-	-	-	0.9	0.1
Arsenic	5.9	CCME ISQG	6.1	-	-	3.4	3	4	-	-	4.8	3.1	60	-	32	14
Barium			262	-	-	237	234	230	-	-	210	-	270	250	295	317
Beryllium			<4.0	-	-	<1.0	<1.0	0.7	-	-	<1.0	-	0.9	0.8	1.28	1.18
Boron			29.8	-	-	<40	<40	7	-	-	<40	-	-	-	-	-
Cadmium	0.6	CCME ISQG	1.5	1.2	1.4	<0.6	<0.6	0.8	-	-	<0.6	<1.0	1.8	1.4	1.9	1
Calcium			24600	-	-	27400	23900	27000	-	-	18600	-	43000	37000	53400	47400
Chromium	37.3	CCME ISQG	744	380	480	268	341	310	-	-	307	225	940	1000	869	1060
Cobalt			18.2	-	-	15.7	14.8	11	-	-	15.2	16.1	40	40	20.3	16.7
Copper	35.7	CCME ISQG	53.4	36	39	34.6	37.3	36	-	-	35	30.1	77	76	60	54
Iron			35000	28000	28000	31800	3020	26000	-	-	30200	-	31000	30000	32700	35700
Lead	35	CCME ISQG	133	82	93	62.4	64.7	68	-	-	67.8	45	240	250	174	160
Magnesium			14100	-	-	11600	12000	9200	-	-	10400	-	15000	15000	16800	17400
Manganese	460	PSQG LEL	665	-	-	735	1270	880	-	-	783	27.5	700	680	911	1100
Mercury	0.17	CCME ISQG	-	-	-	-	-	0.15	-	-	-	-	2.3	-	0.892	0.657
Molybdenum			<2.0	-	-	<2.0	<2.0	0.8	-	-	<2.0	-	0.7	0.5	0.8	<-0.5
Nickel	16	PSQG LEL	34.5	30	32	28.6	28.8	25	-	-	27.4	-	51	52	39	36.7
Phosphorus			1040	-	-	959	1070	1000	-	-	990	-	-	-	1270	1350
Phosphorus (B-32 to B-34)			1100	-	-	898	1050	-	-	-	807	530	-	-	-	-
Potassium			6270	-	-	5960	4750	3000	-	-	5430	-	-	-	9350	10400
Selenium			<10	-	-	2.8	2.6	1.4	-	-	2.8	-	-	-	2	2
Silver [2]			0	-	-	<0.5	<0.5	0.3	-	-	<0.5	-	-	-	-	-
Sodium			843	-	-	692	691	370	-	-	683	-	-	-	819	1450
Strontium			151	-	-	172	159	200	-	-	128	-	200	170	341	286
Sulphur			7660	-	-	10200	10600	-	-	-	13500	-	-	-	-	-
Thallium			<1.0	-	-	<1.0	<1.0	0.24	-	-	<1.0	-	-	-	0.483	0.525
Tin			4.5	-	-	2.5	<2.0	<5	-	-	3.1	-	-	-	-	-
Titanium			1550	-	-	1560	1430	-	-	-	1450	-	1400	1400	-	-
Uranium			<10	-	-	<10	<10	0.98	-	-	<10	-	-	-	1.05	1.27
Vanadium			59.6	-	-	52.4	44.9	43	-	-	48.7	-	63	61	57	59
Zinc	120	PSQG LEL	202	140	150	141	141	130	-	-	143	127	320	310	275	212
Tributyl tin	0.073	PSDDA (WDOE)	-	-	-	-	-	-------	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	<0.07	-	-	-	-	-	-	-	-
Aroclor 1254	0.06	CCME ISQG	<0.01	-	-	0.032	0.034	0.17	-	-	0.044	<0.003	-	-	-	-
Aroclor 1260	0.005	PSQG LEL	0.12	-	-	0.088	0.082	0.18	-	-	0.083	0.0345	-	-	-	-
Total PCB	0.0341	CCME ISQG	0.125	-	-	0.12	0.116	0.35	-	-	0.127	0.036	0.44	0.49	0.231	0.0711
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	0.0346	CCME ISQG	0.17	-	-	<0.06	0.07	<0.005	-	-	0.07	<0.06	0.16	0.18	0.14	0.19
Acenaphthylene	0.00587	CCME ISQG	0.18	-	-	<0.05	0.06	0.035	-	-	0.07	<0.05	0.12	0.14	0.14	0.13
Acenaphthene	0.00671	CCME ISQG	0.068	-	-	<0.05	<0.05	<0.005	-	-	<0.05	<0.05	0.06	0.06	0.04	0.05
Fluorene	0.0212	CCME ISQG	0.054	-	-	<0.05	<0.05	<0.005	-	-	<0.05	<0.05	0.08	0.08	0.04	0.05
Phenanthrene	0.0419	CCME ISQG	0.27	-	-	0.08	0.11	0.13	-	-	0.13	<0.05	1	1.1	0.31	0.32
Anthracene	0.0469	CCME ISQG	0.13	-	-	<0.05	0.05	0.062	-	-	0.05	<0.05	0.12	0.2	0.11	0.12
Fluoranthene	0.111	CCME ISQG	0.5	-	-	0.21	0.27	0.32	-	-	0.37	0.05	2.1	2.3	0.60	0.63
Pyrene	0.053	CCME ISQG	0.83	-	-	0.27	0.38	0.38	-	-	0.47	0.09	2.2	2.3	0.72	0.86
Benzo(a)anthracene	0.0317	CCME ISQG	0.45	-	-	0.13	0.17	0.15	-	-	0.19	<0.05	1	1.1	0.37	0.47
Chrysene	0.0571	CCME ISQG	0.5	-	-	0.14	0.23	0.19	-	-	0.23	0.05	1.2	1.3	0.49	0.59
Benzo(b)fluoranthene			0.34	-	-	0.14	0.19	0.14	-	-	0.23	<0.05	1.5	1.6	-	-
Benzo(k)fluoranthene			0.22	-	-	0.12	0.16	0.098	-	-	0.17	<0.05	0.56	0.6	-	-
Benzo(a)pyrene	0.0319	CCME ISQG	0.74	-	-	0.22	0.3	0.19	-	-	0.33	<0.1	1	0.2	0.61	0.82
Indeno(1,2,3 -cd)pyrene			0.41	-	-	0.17	0.23	0.12	-	-	0.25	<0.1	0.8	0.88	0.43	0.55
Dibenz(a,h)anthracene	0.00622	CCME ISQG	0.11	-	-	<0.05	0.05	0.025	-	-	0.06	0.06	0.2	0.2	0.11	0.14
Benzo(ghi)perylene			0.34	-	-	0.15	0.21	0.12	-	-	0.23	0.11	0.72	0.84	0.44	0.58
Perylene			-	-	-	-	-	0.099	-	-	-	-	-	-	0.13	0.17
1-Methylnaphthalene			-	-	-	-	-	<0.005	-	-	-	-	-	-	-	-
2-Methylnaphthalene	0.0202	CCME ISQG	-	-	-	-	-	<0.005	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	-	-	0.12	-	-	-	-	-	-	0.99	1.22
LPAH			0.87	-	-	0.21	0.34	0.24	-	-	0.37	0.16	1.54	1.76	0.79	0.86
HPAH			4.44	-	-	1.58	2.19	1.95	-	-	2.53	0.54	11.28	11.32	4.89	6.03
Total PAH			5.312	-	-	1.785	2.53	2.1915	-	-	2.9	0.69	12.82	13.08	5.68	6.89
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	NF1	NF1	NF1	NF1	NF1	NF1	NF1	NF1	NF1	NF1	NF1	NF1	NF1	NF1
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			381896	381921	381967	381879	381928	381872	381854	381853.1542	381898.4651	381944.2851	381864.3547	381904.5744	381943.776	381866.3911
Northing			4899805	4899782	4899779	4899743	4899734	4899839	4899838	4899834.217	4899836.253	4899835.235	4899782.797	4899781.269	4899781.778	4899737.486
Source			t and Burnisto	t and Burnisto	t and Burnisto	t and Burnisto	t and Burnisto	t and Burnisto	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap
Site Name			CAT12	CAT13	CAT14	CAT15	CAT16	CAT9	L14	RC9	RC10	RC11	RC12	RC13	RC14	RC15
Date										6-Nov-03	6-Nov-03	6-Nov-03	6-Nov-03	6-Nov-03	6-Nov-03	6-Nov-03
Sediment Type (%)																
Sand (63 - 200 µm)			29	18	3	29	3	30	-	-	-	-	-	-	-	-
Silt (2 - 63 µm)			71	82	96	71	96	69	-	-	-	-	-	-	-	-
Clay (<2 µm)			0	0	0	1	1	1	-	-	-	-	-	-	-	-
Total Percernt Fines			70.818	82.156	96.798	71.499	96.532	69.684	0	0	0	0	0	0	0	0
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			29700	30800	33200	33200	31000	24400	-	10253	16124	17664	15656	17906	17968	12973
Antimony [1]			0.7	0.2	0.2	0.5	0.1	2.5	10	5	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	72	24	20	63	34	109	52.2	81	13	7	58	19	10	49
Barium			301	318	308	245	307	267	-	204	236	250	236	254	248	203
Beryllium			1.32	1.03	1.68	1.49	1.42	1.13	-	0.4	0.4	0.5	0.4	0.5	0.5	0.4
Boron			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	1.5	1	1.4	1.2	1.2	2	1.9	1.3	0.7	0.9	1.3	1.1	0.9	1
Calcium			62400	73500	3000	62400	57200	47100	-	23221	28900	24173	27648	27692	24788	25138
Chromium	**37.3**	**CCME ISQG**	1080	926	1070	499	896	398	65	397	853	1050	991	1050	1130	534
Cobalt			55.5	18.7	21.9	33.9	25.3	62.6	-	48	16	16	48	18	17	25
Copper	**35.7**	**CCME ISQG**	95	55	75	103	74	118	337	144	56	55	88	62	59	90
Iron			32000	35700	32000	32000	31800	29600	26500	22847	26102	28613	27601	28447	28125	26470
Lead	**35**	**CCME ISQG**	316	1	197	241	205	445	731	491	154	155	284	188	177	234
Magnesium			17400	170	19100	19200	16200	14000	-	9180	13387	13767	13630	14332	13958	11351
Manganese	**460**	**PSQG LEL**	741	848	918	522	933	532	-	402	715	831	623	900	985	457
Mercury	**0.17**	**CCME ISQG**	2.8	1.1	0.715	1.62	1.36	3.85	8.5	3.03	0.76	0.625	2.55	0.965	0.76	1.345
Molybdenum			0.6	<-0.5	0.6	0.8	<-0.5	0.7	-	1	1	2	2	1	2	2
Nickel	**16**	**PSQG LEL**	59.6	35.6	48.3	52.5	48.1	57.8	23	40	28	29	45	33	30	32
Phosphorus			1270	1220	1270	1270	1270	1240	-	-	-	-	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			8740	9230	9130	7220	9130	6990	-	2585	4027	4354	3926	4431	4283	3087
Selenium			2	1	2	2	2	1	-	-	-	-	-	-	-	-
Silver [2]			-	-	-	-	-	-	-	1.9	1.1	1.1	2.2	1.3	1.2	1
Sodium			1210	1260	1090	957	995	1050	-	-	-	-	-	-	-	-
Strontium			366	447	265	160	331	239	-	148	266	199	202	245	209	175
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			0.613	0.446	0.566	0.532	0.525	0.438	-	-	-	-	-	-	-	-
Tin			-	-	-	-	-	-	-	90	<-10	<-10	26	<-10	<-10	14
Titanium			-	-	-	-	-	-	-	767	1160	1280	1160	1270	1290	906
Uranium			1.161	1.07	1.37	1.19	1.16	0.98	-	-	-	-	-	-	-	-
Vanadium			53	53	55	52	53	50	-	37	49	54	53	55	54	47
Zinc	**120**	**PSQG LEL**	327	240	232	315	252	442	-	426	193	187	334	231	207	404
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	-	-	-	-	0.02	0.13	0.19	0.23	0.3	0.48	0.29	0.36
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	-	-	-	-	0.02	0.12	0.25	0.32	0.28	0.69	0.36	0.22
Total PCB	**0.0341**	**CCME ISQG**	0.628	0.272	0.318	0.374	0.473	0.295	0.04	0.25	0.44	0.55	0.58	1.2	0.65	0.58
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	0.61	0.18	0.18	0.99	0.22	0.87	-	0.339	<0.005	0.0239	0.0741	0.0269	0.0255	0.13
Acenaphthylene	**0.00587**	**CCME ISQG**	0.20	0.16	0.12	0.22	0.16	0.13	-	0.36	0.153	0.117	0.26	0.127	0.133	0.261
Acenaphthene	**0.00671**	**CCME ISQG**	0.18	0.06	0.05	0.48	0.07	0.29	-	0.559	0.018	0.017	0.102	0.023	0.02	0.187
Fluorene	**0.0212**	**CCME ISQG**	0.17	0.05	0.05	0.51	0.08	0.36	-	0.903	<0.005	<0.005	<0.005	<0.005	<0.005	0.228
Phenanthrene	**0.0419**	**CCME ISQG**	1.54	0.42	0.33	5.04	0.58	3.53	-	6.34	0.153	0.139	1.07	0.194	0.127	2.35
Anthracene	**0.0469**	**CCME ISQG**	0.38	0.14	0.11	0.98	0.18	0.82	-	1.65	0.0684	0.0696	0.293	0.0885	0.0765	0.561
Fluoranthene	**0.111**	**CCME ISQG**	2.48	0.82	0.67	6.73	1.12	5.68	-	7.66	0.33	0.293	1.95	0.406	0.298	3.84
Pyrene	**0.053**	**CCME ISQG**	2.73	0.97	0.86	6.13	1.29	5.41	-	5.3	0.316	0.302	1.57	0.398	0.341	2.83
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	1.37	0.49	0.45	2.94	0.66	2.95	-	3.31	0.219	0.191	0.916	0.233	0.216	1.65
Chrysene	**0.0571**	**CCME ISQG**	1.73	0.66	0.57	3.65	0.88	3.27	-	3.06	0.218	0.163	0.805	0.194	0.155	1.49
Benzo(b)fluoranthene			-	-	-	-	-	-	-	1.78	0.123	0.133	0.866	0.246	0.178	1.29
Benzo(k)fluoranthene			-	-	-	-	-	-	-	0.898	0.077	0.089	0.41	0.102	0.9	0.572
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	1.83	0.79	0.78	3.38	1.04	3.22	-	2.33	0.24	0.27	0.947	0.275	0.255	1.31
Indeno(1,2,3 -cd)pyrene			1.21	0.55	0.53	2.25	0.72	2.05	-	1.26	0.137	0.135	0.483	0.142	0.122	0.691
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	0.31	0.16	0.15	0.56	0.06	0.55	-	<0.1	<0.02	<0.02	0.128	<0.02	<0.02	0.189
Benzo(ghi)perylene			1.16	0.54	0.55	2.11	0.76	1.79	-	0.801	<0.02	0.111	0.345	0.112	0.098	0.456
Perylene			0.39	0.17	0.16	0.78	0.23	0.70	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			2.98	1.27	1.20	5.92	1.74	5.62	-	-	-	-	-	-	-	-
LPAH			3.08	1.01	0.82	8.22	1.29	6.00	-	10.15	0.40	0.37	1.80	0.46	0.38	3.72
HPAH			16.19	6.41	5.91	34.45	8.50	31.24	-	26.45	1.68	1.70	8.42	2.12	2.57	14.32
Total PAH			19.27	7.42	6.74	42.68	9.79	37.24	-	36.6	2.0774	2.066	10.2216	2.5799	2.9575	18.035
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.
High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.
1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

APPENDIX D

Area	Environmental Quality Guidelines	Source	NF1	NF1	NF2	NF2	NF2	NF2	NF2	NF2	NF2	NF2	NF2	NF2	NF2	NF2
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			381904.5744	381868	381844	381911.3707	381868	381867	381918	381917	381971	381962	381914	381863	381848	381849
Northing			4899736.468	4899833	4900060	4899880.569	4899964	4899939	4899966	4899936	4899936	4899897	4899897	4899902	4900062	4900031
Source			d Dove 2006 (A	oit and Dove 2	oit and Dove 2	Chapter 3; Tab	t and Burniston	t and Burniston	t and Burniston	t and Burniston	t and Burniston	t and Burniston	t and Burniston	t and Burniston	d Dove 2006 (A	d Dove 2006 (A
Site Name			RC16	SE-1	06 15 183	BC1	CAT17	CAT2	CAT3	CAT4	CAT5	CAT6	CAT7	CAT8	L7	L8
Date			6-Nov-03	10/01/01	2002	Nov-08	2006	2006	2006	2006	2006	2006	2006			
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	19	9.3	13	4	1	3	1	2	9	10	-	-
Silt (2 - 63 µm)			-	-	58	48.8	83	90	95	89	97	97	89	82	-	-
Clay (<2 µm)			-	-	23	41.7	4	6	3	9	2	1	2	8	-	-
Total Percernt Fines			0	0	81	90.5	86.544	96.337	98.823	97.459	99.26	97.623	90.943	90.019	0	0
TOC			-	67	120	-	-	-	-	-	-	-	-	-	-	-
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			18787	8200	11000	-	30900	30400	34600	24400	35900	3180	24400	31800	-	-
Antimony [1]			-	-	-	-	2.4	2	0.7	0.4	0.3	0.6	0.8	22.9	14	4
Arsenic	5.9	CCME ISQG	16	-	-	17	70	86	22	13	13	11	17	742	51.1	16.8
Barium			270	-	250	-	302	280	317	305	322	294	290	334	-	-
Beryllium			0.5	-	0.7	-	1.37	1.29	1.38	1.13	1.22	1.17	1.08	1.24	-	-
Boron			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	0.6	CCME ISQG	0.9	1.1	1.7	-	0.8	0.5	0.7	0.4	0.7	0.7	0.7	0.7	1.2	<0.5
Calcium			28857	-	48000	-	48500	63400	40800	60500	36400	5400	4000	47100	-	-
Chromium	37.3	CCME ISQG	710	82	670	653	1070	426	678	497	703	752	750	392	1140	267
Cobalt			17	-	54	20	84.3	36.3	19	17.2	16	15.3	17.5	110	-	-
Copper	35.7	CCME ISQG	66	120	55	45	60	46	49	36	46	47	43	70	49	32
Iron			30323	22000	29000	-	34400	34800	36900	35300	36900	36900	36900	37700	30800	30800
Lead	35	CCME ISQG	178	840	150	115	187	109	107	73	108	114	114	219	191	55
Magnesium			14441	-	14000	-	17400	22100	21200	22900	2120	100	18300	20600	-	-
Manganese	460	PSQG LEL	838	-	580	-	719	881	1840	878	1800	911	806	769	-	-
Mercury	0.17	CCME ISQG	0.925	-	-	0.17	1.45	1.79	0.596	0.349	0.468	0.42	0.606	6.12	1.8	0.5
Molybdenum			1	-	0.5	-	0.8	0.6	0.6	<-0.5	<-0.5	0.8	0.8	0.8	-	-
Nickel	16	PSQG LEL	31	24	52	30	83.2	49.9	38.7	34.4	35.6	34	33.3	92.9	37	29
Phosphorus			-	-	-	-	1210	1190	1470	1250	1430	1260	1250	1290	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			4607	-	-	-	8990	9980	10700	10500	10500	9570	9340	9980	-	-
Selenium			-	-	-	-	1	1	1	1	1	1	1	1	-	-
Silver [2]			1.4	-	-	-	-	-	-	-	-	-	-	-	1	-
Sodium			-	-	-	-	1030	1150	1280	1490	1140	1300	1300	1300	-	-
Strontium			233	-	340	-	250	343	200	287	187	286	368	267	-	-
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			-	-	-	-	0.474	0.401	0.45	0.395	0.453	0.451	0.436	0.453	-	-
Tin			10	-	-	-	-	-	-	-	-	-	-	-	-	-
Titanium			1280	-	1400	-	-	-	-	-	-	-	-	-	-	-
Uranium			-	-	-	-	1.01	0.97	0.88	1.08	0.97	1.14	0.93	1.1	-	-
Vanadium			55	-	53	-	54	65	67	67	64	60	59	67	-	-
Zinc	120	PSQG LEL	240	360	230	178	211	178	192	135	189	170	185	244	-	-
Tributyl tin	0.073	PSDDA (WDOE)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	0.06	CCME ISQG	0.22	-	-	-	-	-	-	-	-	-	-	-	0.18	0.83
Aroclor 1260	0.005	PSQG LEL	0.21	-	-	-	-	-	-	-	-	-	-	-	0.29	0.32
Total PCB	0.0341	CCME ISQG	0.43	-	0.21	0.42	0.62	0.443	0.236	0.227	0.183	0.21	0.231	0.226	0.47	1.15
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	0.0346	CCME ISQG	0.0245	-	1.2	-	0.19	0.10	0.10	0.07	0.09	0.12	0.13	0.29	-	-
Acenaphthylene	0.00587	CCME ISQG	0.0796	-	0.18	-	0.30	0.05	0.08	0.09	0.08	0.09	0.10	0.18	-	-
Acenaphthene	0.00671	CCME ISQG	<0.01	-	0.86	-	0.10	0.05	0.04	0.03	0.03	0.05	0.04	0.13	-	-
Fluorene	0.0212	CCME ISQG	<0.005	-	1.2	-	0.11	0.04	0.03	0.02	0.03	0.05	0.04	0.16	-	-
Phenanthrene	0.0419	CCME ISQG	0.153	-	1	-	0.84	0.31	0.20	0.15	0.18	0.33	0.30	1.56	-	-
Anthracene	0.0469	CCME ISQG	0.0592	-	1.9	-	0.31	0.09	0.07	0.07	0.07	0.12	0.09	0.40	-	-
Fluoranthene	0.111	CCME ISQG	0.341	-	1.4	-	1.68	0.57	0.40	0.34	0.37	0.51	0.55	2.61	-	-
Pyrene	0.053	CCME ISQG	0.304	-	1.2	-	2.24	0.66	0.51	0.51	0.48	0.61	0.67	2.62	-	-
Benzo(a)anthracene	0.0317	CCME ISQG	0.171	-	5.1	-	1.12	0.31	0.25	0.26	0.25	0.34	0.34	1.31	-	-
Chrysene	0.0571	CCME ISQG	0.167	-	5.1	-	1.26	0.42	0.35	0.31	0.35	0.42	0.44	1.54	-	-
Benzo(b)fluoranthene			0.161	-	5.9	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene			0.73	-	2.3	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	0.0319	CCME ISQG	0.157	-	4.8	-	1.65	0.45	0.42	0.40	0.45	0.54	0.55	1.58	-	-
Indeno(1,2,3 -cd)pyrene			0.104	-	3.1	-	0.97	0.29	0.32	0.25	0.33	0.35	0.36	0.95	-	-
Dibenz(a,h)anthracene	0.00622	CCME ISQG	<0.02	-	0.84	-	0.22	0.09	0.08	0.07	0.08	0.10	0.10	0.23	-	-
Benzo(ghi)perylene			0.084	-	2.8	-	0.98	0.30	0.34	0.27	0.36	0.37	0.38	0.92	-	-
Perylene			-	-	-	-	0.32	0.11	0.10	0.09	0.11	0.12	0.12	0.38	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	0.0202	CCME ISQG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	-	2.40	0.73	0.70	0.59	0.72	0.82	0.86	2.57	-	-
LPAH			0.32	-	6.34	-	1.86	0.63	0.52	0.44	0.48	0.74	0.70	2.71	-	-
HPAH			2.23	-	32.54	-	12.84	3.91	3.47	3.09	3.49	4.17	4.35	14.71	-	-
Total PAH			2.5528	-	38.88	700	14.69	4.54	3.99	3.52	3.97	4.91	5.05	17.42	-	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

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Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

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Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

APPENDIX D

Area	Environmental Quality Guidelines	Source	NF2	NF2	NF2	NF2	NF2	NF2	NF2	NF2	NF3	NF3	NF3	NF3	NF3	NF3
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			381857	381901.0107	381898.9742	381944.2851	381900.5016	381943.776	381996	381902.27	382024	382278	382027	382104	382219	382376
Northing			4899996	4899969.64	4899937.566	4899937.566	4899901.929	4899902.438	4899810	4899869.28	4900152	4900213	4900320	4900135	4900305	4900364
Source			d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	d Dove 2006 (Ap	Golder 2011	RMC Chapter 2	Golder 2012	Golder 2012	Golder 2012	Golder 2013	Golder 2013	Golder 2013
Site Name			L9	RC2	RC4	RC5	RC7	RC8	Station 7	T18	2011-J	2011-K	2011-L	2012-A	2012-B	2012-C
Date				6-Nov-03	6-Nov-03	6-Nov-03	6-Nov-03	6-Nov-03	Sep-10		Sep-11	Sep-11	Sep-11	Nov-12	Nov-12	Nov-12
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	52	-	46	41	41	48	45	47
Silt (2 - 63 µm)			-	-	-	-	-	-	27	-	35	38	39	35	39	38
Clay (<2 µm)			-	-	-	-	-	-	21	-	19	21	19	17	17	14
Total Percernt Fines			0	0	0	0	0	0	48	0	54	59	58	52	56	52
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC			-	-	-	-	-	-	74000	-	90000	91000	75000	93000	92000	82000
TOC (%)			-	-	-	-	-	-	7.4	-	9	9.1	7.5	9.3	9.2	8.2
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			-	18428	17601	18009	16654	17947	18000	-	17000	14000	14000	15000	13000	12000
Antimony [1]			22	-	-	-	-	-	0.8	-	1	0.5	0.9	0.86	0.56	0.47
Arsenic	**5.9**	**CCME ISQG**	477	13	12	9	17	8	9	-	7	5	6	6.9	5.2	4
Barium			-	267	231	279	246	256	240	-	240	210	230	240	220	190
Beryllium			-	0.5	0.4	0.5	0.4	0.5	0.7	-	0.6	0.6	0.7	0.69	0.61	0.55
Boron			-	-	-	-	-	-	6	-	7	<5	<5	6.8	5.8	5.9
Cadmium	**0.6**	**CCME ISQG**	3	0.6	<-0.5	0.6	0.8	1	1	-	0.9	0.8	0.8	0.89	0.83	0.63
Calcium			-	28957	30257	31160	29438	25456	42000	-	42000	40000	67000	40000	42000	54000
Chromium	**37.3**	**CCME ISQG**	149	770	740	788	845	947	960	-	1000	870	900	900	800	740
Cobalt			-	17	16	13	17	15	15	-	13	11	12	12	10	8.9
Copper	**35.7**	**CCME ISQG**	123	49	47	49	50	52	55	-	47	40	45	61	41	29
Iron			34500	30026	29517	27996	27717	28319	31000	-	28000	24000	26000	28000	24000	19000
Lead	**35**	**CCME ISQG**	366	130	126	175	137	143	140	-	130	110	110	130	100	73
Magnesium			-	15296	15735	14194	14282	14174	14000	-	13000	11000	13000	12000	12000	12000
Manganese	**460**	**PSQG LEL**	-	756	599	814	789	926	750	-	710	780	640	830	710	660
Mercury	**0.17**	**CCME ISQG**	3	0.56	0.645	0.34	0.5	0.395	0.51	-	0.36	0.24	0.23	0.24	0.25	0.16
Molybdenum			-	1	1	1	1	1	0.8	-	1.1	0.8	1.1	1	0.78	0.65
Nickel	**16**	**PSQG LEL**	322	29	29	28	28	29	31	-	29	25	25	28	23	19
Phosphorus			-	-	-	-	-	-	1100	-	1100	1000	1100	2500	1200	1200
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			-	4824	4868	4503	4324	4434	4100	-	3700	3100	3500	3400	3000	2500
Selenium			-	-	-	-	-	-	0.9	-	1.3	1	1	1.1	0.87	0.7
Silver [2]			9	0.8	1	0.9	0.7	0.9	1.2	-	0.8	0.5	0.5	0.92	0.45	0.27
Sodium			-	-	-	-	-	-	500	-	520	390	480	430	360	360
Strontium			-	272	813	341	267	231	280	-	270	250	410	240	240	300
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			-	-	-	-	-	-	0.31	-	0.26	0.24	0.23	0.29	0.23	0.2
Tin			-	<-10	<-10	55	<-10	<-10	8	-	6	<5	<5	5.8	<5.0	<5.0
Titanium			-	1370	1330	1270	1240	1280	-	-	-	-	-	-	-	-
Uranium			-	-	-	-	-	-	0.82	-	0.84	0.74	0.78	0.92	0.74	0.61
Vanadium			-	56	53	54	52	55	50	-	47	37	43	39	34	29
Zinc	**120**	**PSQG LEL**	-	158	155	160	167	173	190	-	190	150	170	200	140	120
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	0.0092	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	<0.05	-	<0.06	<0.1	<0.1	<0.010	<0.010	<0.010
Aroclor 1254	**0.06**	**CCME ISQG**	0.05	0.17	0.15	0.2	0.19	0.21	0.53	-	0.12	0.1	0.1	0.11	0.089	0.053
Aroclor 1260	**0.005**	**PSQG LEL**	0.03	0.21	0.19	0.26	0.27	0.29	0.49	-	0.27	0.3	0.3	0.33	0.26	0.16
Total PCB	**0.0341**	**CCME ISQG**	0.08	0.38	0.34	0.46	0.46	0.5	1.02	-	0.38	0.4	0.4	0.44	0.35	0.21
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	<0.005	<0.005	<0.005	<0.005	<0.005	0.059	-	0.016	0.015	0.019	<0.020	<0.010	<0.020
Acenaphthylene	**0.00587**	**CCME ISQG**	-	0.148	0.187	0.116	0.135	0.178	0.095	-	0.025	0.009	0.013	<0.020	0.013	<0.020
Acenaphthene	**0.00671**	**CCME ISQG**	-	0.018	0.025	0.012	0.017	0.02	0.032	-	0.014	0.021	0.005	<0.020	0.022	0.038
Fluorene	**0.0212**	**CCME ISQG**	-	<0.005	<0.005	<0.005	<0.005	<0.005	0.036	-	0.068	0.069	0.056	0.035	0.023	<0.020
Phenanthrene	**0.0419**	**CCME ISQG**	-	0.1	0.176	0.0776	0.144	0.159	0.21	-	0.081	0.098	0.085	0.044	0.036	0.032
Anthracene	**0.0469**	**CCME ISQG**	-	0.59	0.0825	0.0388	0.0808	0.683	0.12	-	0.25	0.3	0.26	0.18	0.13	0.1
Fluoranthene	**0.111**	**CCME ISQG**	-	0.256	0.386	0.184	0.279	0.317	0.46	-	0.33	0.35	0.34	0.18	0.11	0.076
Pyrene	**0.053**	**CCME ISQG**	-	0.254	0.368	0.188	0.271	0.307	0.69	-	0.23	0.23	0.25	0.22	0.14	0.096
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	0.164	0.251	0.118	0.163	0.205	0.33	-	0.25	0.24	0.27	0.098	0.053	0.035
Chrysene	**0.0571**	**CCME ISQG**	-	0.169	0.211	0.122	0.156	0.19	0.39	-	0.15	0.18	0.17	-	-	-
Benzo(b)fluoranthene			-	0.148	0.183	0.094	0.104	0.141	0.31	-	0.13	0.13	0.14	0.07	0.044	0.026
Benzo(k)fluoranthene			-	0.079	0.097	0.047	0.06	0.073	0.22	-	0.34	0.37	0.36	0.095	0.085	0.067
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	0.205	0.271	0.141	0.171	0.232	0.5	-	0.054	0.052	0.047	<0.020	<0.010	<0.020
Indeno(1,2,3 -cd)pyrene			-	<0.02	0.171	0.088	0.098	0.144	0.34	-	0.36	0.38	0.39	0.26	0.23	0.19
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	<0.02	<0.02	<0.02	<0.02	<0.02	0.083	-	0.007	0.017	0.018	0.021	0.018	<0.020
Benzo(ghi)perylene			-	<0.02	<0.02	<0.02	<0.02	<0.02	0.36	-	0.18	0.17	0.19	0.099	0.048	0.031
Perylene			-	-	-	-	-	-	0.11	-	0.039	0.026	0.035	<0.020	0.014	<0.020
1-Methylnaphthalene			-	-	-	-	-	-	0.025	-	0.075	0.093	0.081	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	0.041	-	0.13	0.13	0.14	0.11	0.094	0.088
Benzo(j)fluoranthene			-	-	-	-	-	-	0.24	-	0.5	0.56	0.54	0.37	0.32	0.25
LPAH			-	0.86	0.48	0.25	0.38	1.05	0.62	-	0.66	0.74	0.66	0.40	0.32	0.29
HPAH			-	1.31	1.96	1.00	1.32	1.63	4.03	-	2.57	2.71	2.75	1.43	1.07	0.80
Total PAH			-	2.166	2.4335	1.2514	1.7038	2.674	4.651	-	3.229	3.44	3.409	1.832	1.39	1.089
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
alpha-BHC			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
beta-BHC			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
delta-BHC			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
a-Chlordane			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
g-Chlordane			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Chlordane (Total)			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
o,p-DDD			-	-	-	-	-	-	<0.05	-	<0.06	<0.01	<0.01	-	-	-
p,p-DDD			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	<0.05	-	<0.06	<0.01	<0.01	-	-	-
o,p-DDE			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
p,p-DDE			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
o,p-DDT			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
p,p-DDT			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	<0.05	-	<0.06	<0.01	<0.01	-	-	-
Dieldrin			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Endosulfan II			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Total Endosulfan			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Endrin			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Endrin aldehyde			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Endrin ketone			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Heptachlor			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Lindane			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Methoxychlor			-	-	-	-	-	-	<0.1	-	<0.2	<0.03	<0.03	-	-	-
Mirex			-	-	-	-	-	-	<0.04	-	<0.06	<0.03	<0.03	-	-	-
Octachlorostyrene			-	-	-	-	-	-	<0.04	-	<0.06	<0.01	<0.01	-	-	-
Toxaphene			-	-	-	-	-	-	<2	-	<2	<0.5	<0.5	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

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RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			382064	381943	382351	382427	382307	381985	382055	382369.4433	382197.1006	381973.147	381920	382236.61	381902.28	381902.28
Northing			4900272	4900268	4900188	4900147	4900281	4900357	4900058	4900036.413	4900146.459	4900228.347	4900136	4899986.9	4900325.9	4900325.9
Source			Golder 2013	Golder 2013	Golder 2013	oit and Dove 2	oit and Dove 2	oit and Dove 2	Chapter 3; Tab	Chapter 3; Tab	Chapter 3; Tab	Chapter 3; Tab	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2
Site Name			2012-D	2012-E	2012-R	A4	A5	A7	BC2	BC3	BC4	BC5	C12	C3	C4a	C4b
Date			Nov-12	Nov-12	Nov-12	07/16/01	07/16/01	07/16/01	Nov-08	Nov-08	Nov-08	Nov-07				
Sediment Type (%)																
Sand (63 - 200 µm)			46	45	63	-	-	-	3.7	13.6	10.8	2.2	-	-	-	-
Silt (2 - 63 µm)			38	37	27	-	-	-	39.6	50.2	52.9	40.7	-	-	-	-
Clay (<2 µm)			16	18	10	-	-	-	56.7	36.2	36.3	57.2	-	-	-	-
Total Percernt Fines			54	55	37	0	0	0	96.3	86.4	89.2	97.9	0	0	0	0
TOC			-	-	-	110	84	70	-	-	-	-	-	-	-	-
TOC			86000	83000	110000	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			8.6	8.3	11	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			14000	12000	14000	20000	20000	22000	-	-	-	-	-	-	-	-
Antimony [1]			0.74	1	0.4	-	-	-	-	-	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	6.6	7.4	5.7	-	-	-	5	5	6	32	9.9	-	-	-
Barium			230	230	240	-	-	-	-	-	-	-	-	-	-	-
Beryllium			0.63	0.53	0.65	-	-	-	-	-	-	-	-	-	-	-
Boron			7	8	5.4	-	-	-	-	-	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	0.89	0.67	0.86	1.3	1.2	1.3	-	-	-	-	-	-	-	-
Calcium			62000	95000	40000	-	-	-	-	-	-	-	-	-	-	-
Chromium	**37.3**	**CCME ISQG**	880	610	640	840	1200	1700	826	777	1199	1360	-	652	923	-
Cobalt			11	9.8	10	-	-	-	15	15	17	35	-	-	-	-
Copper	**35.7**	**CCME ISQG**	39	36	39	39	42	48	41	43	47	55	-	-	-	-
Iron			25000	23000	23000	28000	29000	32000	-	-	-	-	-	-	-	-
Lead	**35**	**CCME ISQG**	110	100	89	120	130	180	108	108	141	152	-	-	-	-
Magnesium			12000	11000	10000	-	-	-	-	-	-	-	-	-	-	-
Manganese	**460**	**PSQG LEL**	700	630	910	-	-	-	-	-	-	-	-	-	-	-
Mercury	**0.17**	**CCME ISQG**	0.24	0.26	0.18	-	-	-	0.97	0.33	0.33	0.73	-	-	-	-
Molybdenum			0.98	1.1	0.68	-	-	-	-	-	-	-	-	-	-	-
Nickel	**16**	**PSQG LEL**	25	21	24	31	32	35	28	31	32	35	-	-	-	-
Phosphorus			1200	1100	1100	-	-	-	-	-	-	-	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			3100	2700	2800	-	-	-	-	-	-	-	-	-	-	-
Selenium			0.96	0.98	1	-	-	-	-	-	-	-	-	-	-	-
Silver [2]			0.51	0.47	0.43	-	-	-	-	-	-	-	-	-	-	-
Sodium			430	420	350	-	-	-	-	-	-	-	-	-	-	-
Strontium			380	630	270	-	-	-	-	-	-	-	-	-	-	-
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			0.25	0.21	0.21	-	-	-	-	-	-	-	-	-	-	-
Tin			<5.0	<5.0	<5.0	-	-	-	-	-	-	-	-	-	-	-
Titanium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium			0.82	0.74	0.76	-	-	-	-	-	-	-	-	-	-	-
Vanadium			36	36	32	-	-	-	-	-	-	-	-	-	-	-
Zinc	**120**	**PSQG LEL**	160	160	150	160	160	190	161	170	190	184	-	-	-	-
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			<0.010	<0.010	<0.020	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	0.089	0.068	0.097	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1260	**0.005**	**PSQG LEL**	0.27	0.19	0.32	-	-	-	-	-	-	-	-	-	-	-
Total PCB	**0.0341**	**CCME ISQG**	0.36	0.26	0.42	1	0.85	-	0.03	0.69	0.06	0.42	-	-	0.088	-
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	<0.020	<0.10	<0.020	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	**0.00587**	**CCME ISQG**	<0.020	<0.10	<0.020	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	**0.00671**	**CCME ISQG**	0.022	<0.10	<0.020	-	-	-	-	-	-	-	-	-	-	-
Fluorene	**0.0212**	**CCME ISQG**	0.036	<0.10	0.021	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	**0.0419**	**CCME ISQG**	0.048	<0.10	0.03	-	-	-	-	-	-	-	-	-	-	-
Anthracene	**0.0469**	**CCME ISQG**	0.2	0.21	0.1	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	**0.111**	**CCME ISQG**	0.2	0.23	0.1	-	-	-	-	-	-	-	-	-	-	-
Pyrene	**0.053**	**CCME ISQG**	0.26	0.34	0.14	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	0.11	0.17	0.061	-	-	-	-	-	-	-	-	-	-	-
Chrysene	**0.0571**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene			0.069	0.11	0.045	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene			0.13	0.18	0.075	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	0.021	<0.10	<0.020	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3 -cd)pyrene			0.31	0.41	0.19	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	0.026	<0.10	<0.020	-	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene			0.11	0.17	0.056	-	-	-	-	-	-	-	-	-	-	-
Perylene			<0.020	<0.10	0.02	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	0.12	0.15	0.097	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			0.42	0.49	0.25	-	-	-	-	-	-	-	-	-	-	-
LPAH			0.45	0.61	0.28	-	-	-	-	-	-	-	-	-	-	-
HPAH			1.67	2.25	0.96	-	-	-	-	-	-	-	-	-	-	-
Total PAH			2.112	2.86	1.235	-	-	-	2	2	6	2	-	-	-	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

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Area	Environmental Quality Guidelines	Source	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada
UTM 18T Easting			382112.51	382443.95	382443.96	382346	381952.2205	382225.3673	382136	381928	382142	381921	382195	382294	381882.26	381841
Northing			4900266.37	4900244.5	4900244.55	4900382	4900223.261	4900314.31	4900380	4900203	4900256	4900144	4900079	4900071	4900335.11	4900318
Source			oit and Dove 2	oit and Dove 2	oit and Dove 2	t and Burnistor	Tinney 2006	Tinney 2006	RMC Chapter 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2
Site Name			C5	C6a	C6b	CAT20	ERA 12	ERA 5	FF6	S11	S12	S14	S15	S16	S8	SE-26
Date							Jun-05	Nov-04	2002	07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	07/16/01	10/03/01
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	4	-	1	-	-	-	-	-	-	-	-
Silt (2 - 63 µm)			-	-	-	96	-	56	-	-	-	-	-	-	-	-
Clay (<2 µm)			-	-	-	0	-	43	-	-	-	-	-	-	-	-
Total Percernt Fines			0	0	0	96.447	0	99	0	0	0	0	0	0	0	0
TOC			-	-	-	-	-	-	-	86	41	95	110	86	70	250
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			-	-	-	27100	-	24500	-	21000	19000	22000	18000	20000	200000	14000
Antimony [1]			-	-	-	0.5	-	22.4	-	-	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	-	-	3.5	7	-	3.2	3.7	-	-	-	-	-	-	-
Barium			-	-	-	252	-	267	-	-	-	-	-	-	-	-
Beryllium			-	-	-	1.1	-	<1.0	-	-	-	-	-	-	-	-
Boron			-	-	-	-	-	<40	-	-	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	-	-	-	0.7	-	<0.6	-	1.2	0.8	1.5	1.5	1.3	0.9	1
Calcium			-	-	-	46500	-	39800	-	-	-	-	-	-	-	-
Chromium	**37.3**	**CCME ISQG**	1300	755	645	1170	-	1480	1230	1600	960	1700	1100	530	1100	1300
Cobalt			-	-	-	12.4	-	18.4	-	-	-	-	-	-	-	-
Copper	**35.7**	**CCME ISQG**	-	-	-	40	-	48.9	52.5	44	27	47	40	32	41	53
Iron			-	-	-	29400	-	34200	-	29000	28000	30000	26000	29000	29000	24000
Lead	**35**	**CCME ISQG**	-	-	-	107	-	144	111	140	86	180	130	78	110	150
Magnesium			-	-	-	16300	-	16200	-	-	-	-	-	-	-	-
Manganese	**460**	**PSQG LEL**	-	-	-	889	-	870	-	-	-	-	-	-	-	-
Mercury	**0.17**	**CCME ISQG**	-	-	-	0.258	-	-	-	-	-	-	-	-	-	-
Molybdenum			-	-	-	0.7	-	<2.0	-	-	-	-	-	-	-	-
Nickel	**16**	**PSQG LEL**	-	-	-	29.1	-	32.8	-	32	28	35	30	30	31	26
Phosphorus			-	-	-	1230	-	1270	-	-	-	-	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	1200	-	-	-	-	-	-	-	-
Potassium			-	-	-	7700	-	6600	-	-	-	-	-	-	-	-
Selenium			-	-	-	1	-	3.2	-	-	-	-	-	-	-	-
Silver [2]			-	-	-	-	-	0.6	-	-	-	-	-	-	-	-
Sodium			-	-	-	843	-	876	-	-	-	-	-	-	-	-
Strontium			-	-	-	284	-	212	-	-	-	-	-	-	-	-
Sulphur			-	-	-	-	-	6820	-	-	-	-	-	-	-	-
Thallium			-	-	-	0.3780.3	-	<1.0	-	-	-	-	-	-	-	-
Tin			-	-	-	-	-	3.9	-	-	-	-	-	-	-	-
Titanium			-	-	-	-	-	1460	-	-	-	-	-	-	-	-
Uranium			-	-	-	0.88	-	<10	-	-	-	-	-	-	-	-
Vanadium			-	-	-	45	-	53.7	-	-	-	-	-	-	-	-
Zinc	**120**	**PSQG LEL**	-	-	-	151	-	195	172	170	110	190	160	130	140	200
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	-	-	<0.01	0.062	-	-	-	-	-	-	-	-
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	-	-	0.034	0.38	-	-	-	-	-	-	-	-
Total PCB	**0.0341**	**CCME ISQG**	-	-	-	0.0313	0.039	0.442	0.4	-	-	-	-	-	-	-
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	-	-	0.17	0.036	0.12	0.45	-	-	-	-	-	-	-
Acenaphthylene	**0.00587**	**CCME ISQG**	-	-	-	0.36	0.026	0.16	0.36	-	-	-	-	-	-	-
Acenaphthene	**0.00671**	**CCME ISQG**	-	-	-	0.06	0.011	<0.05	0.05	-	-	-	-	-	-	-
Fluorene	**0.0212**	**CCME ISQG**	-	-	-	0.05	<0.020	<0.05	<0.050	-	-	-	-	-	-	-
Phenanthrene	**0.0419**	**CCME ISQG**	-	-	-	0.33	0.074	0.19	0.22	-	-	-	-	-	-	-
Anthracene	**0.0469**	**CCME ISQG**	-	-	-	0.24	0.027	0.09	0.22	-	-	-	-	-	-	-
Fluoranthene	**0.111**	**CCME ISQG**	-	-	-	0.78	<0.020	0.43	0.6	-	-	-	-	-	-	-
Pyrene	**0.053**	**CCME ISQG**	-	-	-	1.25	0.18	0.66	1.1	-	-	-	-	-	-	-
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	-	-	0.86	0.11	0.32	0.54	-	-	-	-	-	-	-
Chrysene	**0.0571**	**CCME ISQG**	-	-	-	1.05	0.13	0.37	0.63	-	-	-	-	-	-	-
Benzo(b)fluoranthene			-	-	-	-	0.082	0.47	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene			-	-	-	-	0.035	0.31	0.54	-	-	-	-	-	-	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	-	-	1.54	0.18	0.68	-	-	-	-	-	-	-	-
Indeno(1,2,3 -cd)pyrene			-	-	-	0.83	0.1	0.57	0.56	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	-	-	0.22	<0.005	0.12	0.1	-	-	-	-	-	-	-
Benzo(ghi)perylene			-	-	-	0.92	0.086	0.1	0.55	-	-	-	-	-	-	-
Perylene			-	-	-	0.27	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	1.84	-	-	-	-	-	-	-	-	-	-
LPAH			-	-	-	1.21	0.18	0.61	1.33	-	-	-	-	-	-	-
HPAH			-	-	-	9.56	0.92	4.03	4.62	-	-	-	-	-	-	-
Total PAH			-	-	-	10.77	1.0995	4.64	5.945	-	-	-	-	-	-	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

APPENDIX D

Area	Environmental Quality Guidelines	Source	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	NF3	Downstream	Upland	Upland
Lot			Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada	Transport Canada			
UTM 18T Easting			381826	381859	382410.1798	382357.6	382172.35	382137.91	382057.46	381977.21	382375.2	382205.29	382360.41	382502.737	381583	381817
Northing			4900317	4900242	4900365.316	4900313.8	4900374.72	4900157.77	4900047.33	4900232.2	4900030.74	4900142.92	4900282.36	4898977.255	4900482	4900441
Source			oit and Dove 2	oit and Dove 2(	Tinney 2006	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	RMC Chapter 2	Tinney 2006	d Dove 2006 (Ap	d Dove 2006 (Ap
Site Name			SE-27	SE-7	SED 38	T15	T16	T17	T3	T4	T5	T6	T9	SED 25	81	82
Date			10/03/01	10/02/01	Sep-05									Jun-05	2002	2002
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	-	-	-	-	-	-	46	22
Silt (2 - 63 µm)			-	-	-	-	-	-	-	-	-	-	-	-	44	64
Clay (<2 µm)			-	-	-	-	-	-	-	-	-	-	-	-	10	14
Total Percernt Fines			0	0	0	0	0	0	0	0	0	0	0	0	54	78
TOC			120	81	-	-	-	-	-	-	-	-	-	-	96	83
TOC			-	-	-	-	-	-	-	-	-	-	-	-	96000	83000
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	9.6	8.3
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	6500	6100
TKN			-	-	-	-	-	-	-	-	-	-	-	-	6.5	6.1
Metals (mg/kg)																
Aluminum			17000	17000	-	-	-	-	-	-	-	-	-	26100	11000	13000
Antimony [1]			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	**5.9**	**CCME ISQG**	-	-	5.4	4.3	3.9	5.5	5.6	6.8	5.2	6.5	4.8	3.6	2.3	4.5
Barium			-	-	-	-	-	-	-	-	-	-	-	282	170	180
Beryllium			-	-	-	-	-	-	-	-	-	-	-	<4.0	0.5	0.6
Boron			-	-	-	-	-	-	-	-	-	-	-	32.3	-	-
Cadmium	**0.6**	**CCME ISQG**	1	1	<1.0	-	-	-	-	-	-	-	-	<1.0	1.2	0.9
Calcium			-	-	-	-	-	-	-	-	-	-	-	43200	88000	65000
Chromium	**37.3**	**CCME ISQG**	780	1200	1023	1059.5	658.3	1056.4	1025.3	1045.3	777.2	1199.4	1025.8	104	59	820
Cobalt			-	-	15.4	-	-	-	-	-	-	-	-	15.1	8.3	8.8
Copper	**35.7**	**CCME ISQG**	37	36	41.7	-	-	-	-	-	-	-	-	36.3	82	28
Iron			26000	25000	-	-	-	-	-	-	-	-	-	32000	21000	18000
Lead	**35**	**CCME ISQG**	61	120	100.2	-	-	-	-	-	-	-	-	41.6	91	100
Magnesium			-	-	-	-	-	-	-	-	-	-	-	12100	16000	9400
Manganese	**460**	**PSQG LEL**	-	-	28.3	-	-	-	-	-	-	-	-	1760	360	370
Mercury	**0.17**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.08	0.14
Molybdenum			-	-	-	-	-	-	-	-	-	-	-	<2.0	1.6	0.5
Nickel	**16**	**PSQG LEL**	26	28	-	-	-	-	-	-	-	-	-	29.1	24	21
Phosphorus			-	-	-	-	-	-	-	-	-	-	-	1040	-	-
Phosphorus (B-32 to B-34)			-	-	770	-	-	-	-	-	-	-	-	-	-	-
Potassium			-	-	-	-	-	-	-	-	-	-	-	6250	-	-
Selenium			-	-	-	-	-	-	-	-	-	-	-	<10	-	-
Silver [2]			-	-	-	-	-	-	-	-	-	-	-	0	-	-
Sodium			-	-	-	-	-	-	-	-	-	-	-	1000	-	-
Strontium			-	-	-	-	-	-	-	-	-	-	-	174	270	410
Sulphur			-	-	-	-	-	-	-	-	-	-	-	4700	-	-
Thallium			-	-	-	-	-	-	-	-	-	-	-	<1.0	-	-
Tin			-	-	-	-	-	-	-	-	-	-	-	24	-	-
Titanium			-	-	-	-	-	-	-	-	-	-	-	1490	700	800
Uranium			-	-	-	-	-	-	-	-	-	-	-	<10	-	-
Vanadium			-	-	-	-	-	-	-	-	-	-	-	55.2	38	35
Zinc	**120**	**PSQG LEL**	120	150	159	-	-	-	-	-	-	-	-	134	240	110
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	<0.003	-	-	-	-	-	-	-	-	<0.01	-	-
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	0.235	-	-	-	-	-	-	-	-	<0.01	-	-
Total PCB	**0.0341**	**CCME ISQG**	-	-	0.2365	-	-	-	-	0.005	-	-	-	0.01	0.1	0.16
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	-	0.06	-	-	-	-	-	-	-	-	0.037	0.04	0.06
Acenaphthylene	**0.00587**	**CCME ISQG**	-	-	<0.05	-	-	-	-	-	-	-	-	0.018	-	0.16
Acenaphthene	**0.00671**	**CCME ISQG**	-	-	<0.05	-	-	-	-	-	-	-	-	0.012	0.08	0.06
Fluorene	**0.0212**	**CCME ISQG**	-	-	<0.05	-	-	-	-	-	-	-	-	<0.020	0.12	0.04
Phenanthrene	**0.0419**	**CCME ISQG**	-	-	0.06	-	-	-	-	-	-	-	-	0.07	1.5	0.46
Anthracene	**0.0469**	**CCME ISQG**	-	-	<0.05	-	-	-	-	-	-	-	-	0.044	0.14	0.12
Fluoranthene	**0.111**	**CCME ISQG**	-	-	0.07	-	-	-	-	-	-	-	-	0.14	3.2	1.6
Pyrene	**0.053**	**CCME ISQG**	-	-	0.11	-	-	-	-	-	-	-	-	0.18	2.7	1.6
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	-	0.06	-	-	-	-	-	-	-	-	0.082	1.4	1
Chrysene	**0.0571**	**CCME ISQG**	-	-	0.08	-	-	-	-	-	-	-	-	0.095	2	1.1
Benzo(b)fluoranthene			-	-	0.05	-	-	-	-	-	-	-	-	0.062	2.1	1.3
Benzo(k)fluoranthene			-	-	0.06	-	-	-	-	-	-	-	-	0.028	0.74	0.52
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	-	<0.1	-	-	-	-	-	-	-	-	0.12	1.1	1
Indeno(1,2,3 -cd)pyrene			-	-	0.1	-	-	-	-	-	-	-	-	0.059	1	0.76
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	-	0.09	-	-	-	-	-	-	-	-	0.017	0.2	0.16
Benzo(ghi)perylene			-	-	0.13	-	-	-	-	-	-	-	-	0.048	0.96	0.64
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
LPAH			-	-	0.22	-	-	-	-	-	-	-	-	0.19	1.88	0.9
HPAH			-	-	0.80	-	-	-	-	-	-	-	-	0.83	15.40	9.68
Total PAH			-	-	1.02	-	-	-	-	-	-	-	-	1.022	17.28	10.58
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.

2 - Non detect <2 an <1 removed for silver

3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated

Samples with duplicate values are presented as the average

Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

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APPENDIX D

Area	Environmental Quality Guidelines	Source	Upland	Upland	Upland	Upland	Upland	Upland	Upland	Upland	Upland	Upland	Upland	Upland	Upland	Upland
Lot																
UTM 18T Easting			381589	381583	381817	381589	381726		382073	382243	381744	381816	381848	381852.136	381683	381397
Northing			4900398	4900482	4900441	4900398	4901247		4900663	4902687	4901241	4900433	4899883	4899901.929	4901279	4900901
Source			d Dove 2006 (A	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	ter 2 (draft 2) - /	RMC Chapter 2	RMC Chapter 2	t and Burnistor	t and Burnistor	d Dove 2006 (A	d Dove 2006 (A	oit and Dove 2	oit and Dove 2
Site Name			84	06 15 81	06 15 82	06 15 84	06 15 85	BIV6	Cat 3 (Cattail-3)	Cat Ref	CAT24	CAT26	L13	RC6	S1	S2
Date			2002	2002	2002	2002	2002	Nov-08	Oct-08	Oct-08				6-Nov-03	07/16/01	07/16/01
Sediment Type (%)																
Sand (63 - 200 µm)			46	32	28	33	-	-	-	-	46	5	-	-	-	-
Silt (2 - 63 µm)			44	52	62	58	-	-	-	-	53	95	-	-	-	-
Clay (<2 µm)			10	16	10	9	-	-	-	-	1	0	-	-	-	-
Total Percernt Fines			54	68	72	67	0	0	0	0	53.509	95.373	0	0	0	0
TOC			230	63	82	150	54	-	-	-	-	-	-	-	1	22
TOC			230000	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			23	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			18000	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			18	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			7900	12000	12000	15000	9800	-	-	-	19800	21000	-	15837	3200	5000
Antimony [1]			-	-	-	-	-	-	-	-	1	2.3	7	7	-	-
Arsenic	**5.9**	**CCME ISQG**	17	-	-	-	-	-	4.6	4.7	3	9	129	201	-	-
Barium			120	170	190	370	400	-	-	-	128	262	-	242	-	-
Beryllium			0.5	0.5	0.5	0.6	0.5	-	-	-	0.57	0.8	-	0.4	-	-
Boron			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	2	1.6	1.1	1.5	3.4	-	<1.0	<1.0	2.5	1.5	1.2	0.5	0.4	5
Calcium			55000	94000	73000	58000	94000	-	-	-	109000	114000	-	31915	-	-
Chromium	**37.3**	**CCME ISQG**	25000	66	1600	9100	42	45	1,559	10	58	1670	83	503	21	26
Cobalt			4.4	9.1	9.1	9.2	7.4	-	5.9	<5.0	6.3	11.6	-	51	-	-
Copper	**35.7**	**CCME ISQG**	62	89	34	56	53	32	61.7	21	62	75	59	55	34	40
Iron			32000	22000	18000	35000	69000	-	-	-	25000	25500	36000	28115	15000	10000
Lead	**35**	**CCME ISQG**	270	100	150	190	170	66	77	51	10	266	158	153	69	720
Magnesium			4500	17000	8500	7200	15000	-	-	-	16300	13500	-	14290	-	-
Manganese	**460**	**PSQG LEL**	570	360	390	620	340	-	-	-	356	464	-	792	-	-
Mercury	**0.17**	**CCME ISQG**	0.34	-	-	-	-	-	-	-	0.615	0.307	4.3	1.215	-	-
Molybdenum			4.3	1.6	0.7	0.9	0.5	-	-	-	1.5	2	-	<-1	-	-
Nickel	**16**	**PSQG LEL**	22	25	21	28	24	-	11	9.3	20.3	30.3	70	43	8.4	11
Phosphorus			-	-	-	-	-	-	-	-	1280	1280	-	-	-	-
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			-	-	-	-	-	-	-	-	3630	7060	-	-	-	-
Selenium			-	-	-	-	-	-	-	-	1	2	-	-	-	-
Silver [2]			-	-	-	-	-	-	-	-	-	-	2	1.3	-	-
Sodium			-	-	-	-	-	-	-	-	<-500	555	-	-	-	-
Strontium			740	250	580	590	520	-	-	-	267	735	-	308	-	-
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			-	-	-	-	-	-	-	-	0.167	0.431	-	-	-	-
Tin			-	-	-	-	-	-	-	-	-	-	-	16	-	-
Titanium			330	780	720	660	580	-	-	-	-	-	-	1170	-	-
Uranium			-	-	-	-	-	-	-	-	0.72	1.06	-	-	-	-
Vanadium			29	41	31	41	36	-	-	-	33	31	-	49	-	-
Zinc	**120**	**PSQG LEL**	520	260	140	520	260	123	152	98	262	286	-	197	56	500
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	<0.003	<0.003	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	-	-	-	-	0.051	0.015	-	-	0.01	0.21	-	-
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	-	-	-	-	0.13	0.015	-	-	-	0.15	-	-
Total PCB	**0.0341**	**CCME ISQG**	0.08	0.078	0.24	0.025	0.047	-	0.18	0.03	0.0313	0.533	0.01	0.36	0.026	0.022
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	0.8	0.06	0.08	0.2	0.12	-	-	-	0.07	0.20	-	<0.005	0.12	-
Acenaphthylene	**0.00587**	**CCME ISQG**	0.14	0.02	0.16	0.04	0.1	-	-	-	0.05	0.27	-	0.125	0.05	-
Acenaphthene	**0.00671**	**CCME ISQG**	0.3	0.08	0.02	0.08	0.34	-	-	-	0.04	0.14	-	0.03	<0.05	-
Fluorene	**0.0212**	**CCME ISQG**	0.12	0.12	0.04	0.04	0.78	-	-	-	0.06	0.10	-	<0.005	<0.05	-
Phenanthrene	**0.0419**	**CCME ISQG**	0.32	1.9	0.28	0.16	1.7	-	-	-	0.54	0.70	-	0.414	0.15	-
Anthracene	**0.0469**	**CCME ISQG**	0.08	0.26	0.08	0.04	0.42	-	-	-	0.11	0.21	-	0.105	<0.05	-
Fluoranthene	**0.111**	**CCME ISQG**	0.6	5	0.64	0.32	3.3	-	-	-	1.14	1.52	-	0.767	0.27	-
Pyrene	**0.053**	**CCME ISQG**	0.8	4.2	0.78	0.38	2.7	-	-	-	1.08	2.26	-	0.588	0.28	-
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	0.36	2	0.44	0.16	0.8	-	-	-	0.47	0.87	-	0.36	0.2	-
Chrysene	**0.0571**	**CCME ISQG**	0.48	2.9	0.52	0.22	1.1	-	-	-	0.72	1.51	-	0.349	0.2	-
Benzo(b)fluoranthene			0.58	3.2	0.66	0.28	1.3	-	-	-	-	-	-	0.226	-	-
Benzo(k)fluoranthene			0.2	1.2	0.22	0.08	0.44	-	-	-	-	-	-	0.118	0.27	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	0.44	1.8	0.56	0.2	0.84	-	-	-	0.61	1.38	-	0.321	-	-
Indeno(1,2,3 -cd)pyrene			0.36	1.8	0.44	0.16	0.8	-	-	-	0.51	1.00	-	0.2	0.25	-
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	0.08	0.36	0.12	0.04	0.2	-	-	-	0.11	0.24	-	<0.02	<0.05	-
Benzo(ghi)perylene			0.36	1.5	0.4	0.16	0.72	-	-	-	0.54	1.06	-	<0.02	0.24	-
Perylene			-	-	-	-	-	-	-	-	0.15	0.28	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	1.22	2.49	-	-	-	-
LPAH			1.76	2.44	0.66	0.56	3.46	-	-	-	0.88	1.63	-	0.68	0.40	-
HPAH			4.26	23.96	4.78	2.00	12.20	-	-	-	6.55	12.60	-	2.95	1.74	-
Total PAH			6.02	26.4	5.44	2.56	15.66	-	-	-	7.42	14.23	-	3.628	2.13	-
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Lot																
UTM 18T Easting			381413	381680	381711	381739	383161	381471	381773	382396	381655	381584	381720	382580	384503	384535
Northing			4900489	4899599	4899606	4899309	4900966	4900902	4901234	4900750	4901193	4900467	4899345	4899260	4904475	4904558
Source			oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	oit and Dove 2	t and Burnistor
Site Name			S3	S4	S5	S6	SE-11	SE-15	SE-16	SE-18	SE-19	SE-2	SE-23	SE-8	06 15 177	CAT1
Date			07/16/01	07/16/01	07/16/01	07/16/01	10/02/01	10/02/01	10/02/01	10/02/01	10/03/01	10/01/01	10/03/01	10/02/01	2002	
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	-	-	-	-	-	-	31	43
Silt (2 - 63 µm)			-	-	-	-	-	-	-	-	-	-	-	-	49	57
Clay (<2 µm)			-	-	-	-	-	-	-	-	-	-	-	-	20	0
Total Percernt Fines			0	0	0	0	0	0	0	0	0	0	0	0	69.1	57.456
TOC			14	1	8	28	45	57	72	160	11	32	13	100	35	-
TOC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOC (%)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
TKN			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals (mg/kg)																
Aluminum			4600	8	4200	7100	19000	12000	15000	15000	3500	7300	4500	18000	15000	20100
Antimony [1]			-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
Arsenic	**5.9**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Barium			-	-	-	-	-	-	-	-	-	-	-	-	180	203
Beryllium			-	-	-	-	-	-	-	-	-	-	-	-	0.6	0.77
Boron			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	**0.6**	**CCME ISQG**	5.3	0.7	0.4	4.8	1	20	8	1	-	0.6	-	1	0.4	0.3
Calcium			-	-	-	-	-	-	-	-	-	-	-	-	11000	15800
Chromium	**37.3**	**CCME ISQG**	28	50	17	52	33	42	48	110	27	44	19	94	140	39
Cobalt			-	-	-	-	-	-	-	-	-	-	-	-	12	9.5
Copper	**35.7**	**CCME ISQG**	38	23	43	230	31	120	71	58	25	87	81	34	15	17
Iron			9300	29000	10000	13000	23000	14000	40000	35000	14000	14000	10000	23000	23000	23700
Lead	**35**	**CCME ISQG**	720	710	30	150	24	3100	430	110	59	51	50	46	12	21.5
Magnesium			-	-	-	-	-	-	-	-	-	-	-	-	8900	8190
Manganese	**460**	**PSQG LEL**	-	-	-	-	-	-	-	-	-	-	-	-	840	1320
Mercury	**0.17**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	0.067
Molybdenum			-	-	-	-	-	-	-	-	-	-	-	-	0.5	<-0.5
Nickel	**16**	**PSQG LEL**	11	67	9	14	27	36	28	31	11	18	12	24	24	17
Phosphorus			-	-	-	-	-	-	-	-	-	-	-	-	-	1140
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			-	-	-	-	-	-	-	-	-	-	-	-	-	5080
Selenium			-	-	-	-	-	-	-	-	-	-	-	-	-	1
Silver [2]			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium			-	-	-	-	-	-	-	-	-	-	-	-	-	737
Strontium			-	-	-	-	-	-	-	-	-	-	-	-	74	108
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			-	-	-	-	-	-	-	-	-	-	-	-	-	0.254
Tin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Titanium			-	-	-	-	-	-	-	-	-	-	-	-	1300	-
Uranium			-	-	-	-	-	-	-	-	-	-	-	-	-	0.97
Vanadium			-	-	-	-	-	-	-	-	-	-	-	-	44	46
Zinc	**120**	**PSQG LEL**	500	18000	100	280	120	1900	580	2200	91	160	140	140	63	76
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1254	**0.06**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aroclor 1260	**0.005**	**PSQG LEL**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total PCB	**0.0341**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.009	0.00239
PAH's (mg/kg)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	**0.0346**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.0508
Acenaphthylene	**0.00587**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.0186
Acenaphthene	**0.00671**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.0138
Fluorene	**0.0212**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.0227
Phenanthrene	**0.0419**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.1990
Anthracene	**0.0469**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.0522
Fluoranthene	**0.111**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.16	0.4210
Pyrene	**0.053**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.12	0.3360
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.2110
Chrysene	**0.0571**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.3000
Benzo(b)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	0.08	-
Benzo(k)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	0.04	-
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.2010
Indeno(1,2,3 -cd)pyrene			-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.1290
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.0391
Benzo(ghi)perylene			-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.1230
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	0.1320
1-Methylnaphthalene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	0.42
LPAH			-	-	-	-	-	-	-	-	-	-	-	-	0.18	0.36
HPAH			-	-	-	-	-	-	-	-	-	-	-	-	0.68	2.31
Total PAH			-	-	-	-	-	-	-	-	-	-	-	-	0.86	2.67
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.

2 - Non detect <2 an <1 removed for silver

3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated

Samples with duplicate values are presented as the average

Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

APPENDIX D

Area	Environmental Quality Guidelines	Source	Upstream	Upstream	Upstream	Upstream	Upstream	Upstream	Upstream	Upstream	FF0	FF0	FF0	MF1	MF1	MF1
Lot																
UTM 18T Easting			383341.5598		384488	382061	382880.329	382414.3644	383338.2597							
Northing			4902954.729		4904469	4902027	4902307.295	4902030.126	4902399.684							
Source			Tinney 2006	d Dove 2006 (A	oit and Dove 2	oit and Dove 2(	Tinney 2006	Tinney 2006	Tinney 2006	Tinney 2006	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014
Site Name			ERA 13	REF	SE-13	SE-14	SED 32	SED 33	SED 34	SED15	CORE1-0-10	CORE2-0-10	CORE3-0-10	CORE4-0-10	CORE5-0-10	CORE6-0-10
Date			Jun-05		10/02/01	10/02/01	Jun-05	Jun-05	Jun-05	Nov-04	10-Sep-13	10-Sep-13	09-Sep-13	09-Sep-13	09-Sep-13	09-Sep-13
Sediment Type (%)																
Sand (63 - 200 µm)			-	-	-	-	-	-	-	-	49	45	24	48	33	47
Silt (2 - 63 µm)			-	-	-	-	-	-	-	-	33	39	29	35	49	36
Clay (<2 µm)			-	-	-	-	-	-	-	-	19	16	17	16	18	17
Total Percernt Fines			0	0	0	0	0	0	0	0	52	55	46	51	67	53
TOC			-	30	9	22	-	-	-	-	8.6	8.3	10	9.3	6.5	8.3
TOC			-	30000	-	-	-	-	-	-	86000	83000	100000	93000	65000	83000
TOC (%)			-	3	-	-	-	-	-	-	8.6	8.3	10	9.3	6.5	8.3
TKN (mg/kg)			-	1900	-	-	-	-	-	-	11000	7680	10500	9440	4410	9310
TKN			-	1.9	-	-	-	-	-	-	11000	7680	10500	9440	4410	9310
Metals (mg/kg)																
Aluminum			7320	15000	22000	7100	18500	16300	17000	24700	17000	15000	16000	13000	7500	17000
Antimony [1]			-	-	-	-	-	-	-	-	1.2	1.2	0.7	1.1	1.4	1.8
Arsenic	**5.9**	**CCME ISQG**	1.8	1.6	-	-	2.3	2.3	3.1	3	7.2	5.3	7.0	12	5.9	22.0
Barium			108	170	-	-	184	177	183	200	230	200	230	230	150	240
Beryllium			<4.0	0.7	-	-	<4.0	<4.0	<4.0	<1.0	0.65	0.66	0.7	0.62	0.37	0.73
Boron			22.6	-	-	-	28.4	30.3	32.1	<40	7	7.7	7	6.8	7.5	9.3
Cadmium	**0.6**	**CCME ISQG**	<1.0	0.7	1	-	<1.0	1.1	<1.0	<0.6	0.8	0.9	0.8	1.1	0.7	1.2
Calcium			14000	11000	-	-	19800	13600	17000	16600	31000	52000	29000	60000	120000	49000
Chromium	**37.3**	**CCME ISQG**	<20	180	45	22	35.4	34.4	32	88.7	180	170	330	470	86	730
Cobalt			6	11	-	-	13.8	12.9	12.3	16.4	12	12	12	16	8.1	19
Copper	**35.7**	**CCME ISQG**	23	14	21	33	30.1	29.9	26.1	33.1	390	120	63	66	76	72
Iron			11300	23000	34000	12000	28000	27600	24200	31800	32000	27000	27000	24000	16000	29000
Lead	**35**	**CCME ISQG**	25.3	11	17	30	31.9	31.9	24.9	52	130	110	100	200	96	190
Magnesium			3340	9100	-	-	7160	6770	7330	12000	13000	15000	11000	11000	15000	15000
Manganese	**460**	**PSQG LEL**	452	500	-	-	883	670	720	751	1300	960	900	580	340	650
Mercury	**0.17**	**CCME ISQG**	-	0.01	-	-	-	-	-	-	0.28	0.28	0.4	1.4	1.2	1.1
Molybdenum			<2.0	0.5	-	-	<2.0	<2.0	<2.0	<2.0	1.2	1.3	0.73	0.83	1.1	1.3
Nickel	**16**	**PSQG LEL**	10.7	23	32	11	21.6	20.2	20	29.3	31	28	28	29	19	34
Phosphorus			533	-	-	-	909	891	794	838	1400	1200	1100	1100	930	1200
Phosphorus (B-32 to B-34)			650	-	-	-	880	1300	680	773	-	-	-	-	-	-
Potassium			1380	-	-	-	3730	3550	3850	6180	3500	3000	3400	3100	1700	3900
Selenium			<10	-	-	-	<10	<10	<10	2.2	1.2	0.96	1.4	1.2	1	1.4
Silver [2]			0	-	-	-	0	0	0	<0.5	0.87	0.58	0.73	1.3	2.4	1.9
Sodium			406	-	-	-	637	625	648	712	770	430	400	440	300	550
Strontium			169	72	-	-	189	136	173	138	110	130	150	320	310	250
Sulphur			7850	-	-	-	12800	16400	12300	10200	-	-	-	-	-	-
Thallium			<1.0	-	-	-	<1.0	<1.0	<1.0	<1.0	0.340	0.3	0.3	0.37	0.26	0.36
Tin			<2.0	-	-	-	<2.0	<2.0	<2.0	<2.0	10	5.9	5.3	13	14	11
Titanium			452	1400	-	-	1240	1180	1030	1550	-	-	-	-	-	-
Uranium			<10	-	-	-	<10	<10	<10	<10	0.75	0.76	0.84	0.84	0.58	0.9
Vanadium			16.9	45	-	-	43.6	39.7	44	52.6	42	39	41	37	28	48
Zinc	**120**	**PSQG LEL**	63	60	95	81	94.8	97.3	81.7	139	370	300	200	280	290	290
Tributyl tin	**0.073**	**PSDDA (WDOE)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			-	-	-	-	-	-	-	-	<0.050	<0.040	<0.050	<0.040	<0.030	<0.050
Aroclor 1254	**0.06**	**CCME ISQG**	<0.01	-	-	-	<0.01	<0.01	<0.01	0.011	0.18	0.09	0.2	0.25	0.046	0.3
Aroclor 1260	**0.005**	**PSQG LEL**	<0.01	-	-	-	0.012	<0.01	<0.01	0.018	0.11	0.07	0.1	0.18	<0.030	0.2
Total PCB	**0.0341**	**CCME ISQG**	0.01	-	-	-	0.017	0.01	0.01	0.029	0.28	0.16	0.3	0.43	0.046	0.5
PAH's (mg/kg)			-	-	-	-	-	-	-	-						
Naphthalene	**0.0346**	**CCME ISQG**	0.051	-	-	-	-	-	-	0.07	0.66	<0.20	<0.30	0.021	0.19	0.3
Acenaphthylene	**0.00587**	**CCME ISQG**	<0.005	0.04	-	-	-	-	-	<0.05	<0.10	0.31	<0.30	0.06	<0.050	<0.10
Acenaphthene	**0.00671**	**CCME ISQG**	0.007	-	-	-	-	-	-	<0.05	<0.10	0.35	<0.30	0.03	<0.050	<0.10
Fluorene	**0.0212**	**CCME ISQG**	0.038	-	-	-	-	-	-	<0.05	<0.10	0.33	<0.30	0.035	<0.050	<0.10
Phenanthrene	**0.0419**	**CCME ISQG**	0.11	0.06	-	-	-	-	-	0.07	0.38	2.10	1.2	0.28	0.52	0.4
Anthracene	**0.0469**	**CCME ISQG**	<0.020	-	-	-	-	-	-	<0.05	<0.10	0.65	0.5	0.095	0.054	<0.10
Fluoranthene	**0.111**	**CCME ISQG**	0.11	0.14	-	-	-	-	-	0.16	0.41	4.30	2.6	0.53	0.97	0.5
Pyrene	**0.053**	**CCME ISQG**	0.079	0.12	-	-	-	-	-	0.17	0.52	4.50	3.0	0.62	0.76	0.5
Benzo(a)anthracene	**0.0317**	**CCME ISQG**	0.021	0.08	-	-	-	-	-	0.08	0.24	1.90	1.4	0.24	0.22	0.2
Chrysene	**0.0571**	**CCME ISQG**	0.041	0.1	-	-	-	-	-	0.1	0.21	1.80	1.2	0.23	0.32	0.2
Benzo(b)fluoranthene			0.023	0.12	-	-	-	-	-	0.12	0.29	2.5	1.7	0.35	0.32	0.3
Benzo(k)fluoranthene			<0.020	0.04	-	-	-	-	-	0.08	0.1	0.75	0.6	0.1	0.097	0.1
Benzo(a)pyrene	**0.0319**	**CCME ISQG**	0.024	0.08	-	-	-	-	-	0.13	0.25	1.60	1.3	0.25	0.16	0.2
Indeno(1,2,3 -cd)pyrene			0.021	0.08	-	-	-	-	-	0.11	0.14	0.94	0.8	0.14	0.1	0.1
Dibenz(a,h)anthracene	**0.00622**	**CCME ISQG**	0.011	-	-	-	-	-	-	<0.05	<0.10	0.23	<0.30	0.03	<0.050	<0.10
Benzo(ghi)perylene			<0.020	0.08	-	-	-	-	-	0.11	0.17	1.10	0.9	0.15	0.13	0.1
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			-	-	-	-	-	-	-	-	<0.10	<0.20	<0.30	0.014	<0.050	<0.10
2-Methylnaphthalene	**0.0202**	**CCME ISQG**	-	-	-	-	-	-	-	-	<0.10	0.26	0.33	0.02	<0.050	<0.10
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
LPAH			0.22	0.10	-	-	-	-	-	0.24	1.2	3.6	2.3	0.7	0.8	0.9
HPAH			0.35	0.84	-	-	-	-	-	1.09	2.4	19.6	13.6	2.7	3.1	2.4
Total PAH			0.5685	0.94	-	-	-	-	-	1.325	3.7	23.8	16.5	3.2	4.0	3.4
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.

2 - Non detect <2 an <1 removed for silver

3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated

Samples with duplicate values are presented as the average

Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	MF1	MF1	MF2	MF2	FF0	MF1	MF1	FF0	FF0	FF0	FF0	FF0	MF1	MF1
Lot																
UTM 18T Easting																
Northing																
Source			Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014
Site Name			CORE7-0-10	CORE8-0-10	CORE9-0-10	CORE10-0-10	CORE11-0-10	CORE12-0-10	CORE13-0-10	GRAB 1	GRAB 2	GRAB 3	GRAB 4	GRAB 5	GRAB 6	GRAB 7
Date			09-Sep-13	09-Sep-13	09-Sep-13	09-Sep-13	10-Sep-13	10-Sep-13	10-Sep-13	11-Sep-13	11-Sep-13	11-Sep-13	11-Sep-13	11-Sep-13	12-Sep-13	12-Sep-13
Sediment Type (%)																
Sand (63 - 200 µm)			55	59	58	56	52	43	46	49	58	47	46	54	48	49
Silt (2 - 63 µm)			31	27	28	25	30	41	38	32	32	33	38	34	37	34
Clay (<2 µm)			14	14	15	20	18	16	17	19	9.8	20	16	12	16	17
Total Percernt Fines			45	41	43	45	48	57	55	51	41.8	53	54	46	53	51
TOC			9.1	9.4	9.5	10	8.5	8.1	8.9	8.9	4.6	9.4	10	9.5	9.1	13.0
TOC			91000	94000	95000	100000	85000	81000	89000	89000	46000	94000	100000	95000	91000	130000
TOC (%)			9.1	9.4	9.5	10	8.5	8.1	8.9	8.9	4.6	9.4	10	9.5	9.1	13
TKN (mg/kg)			8490	7900	11100	9920	9690	9450	8940	6390	2960	9940	10200	9330	8960	12600
TKN			8490	7900	11100	9920	9690	9450	8940	6390	2960	9940	10200	9330	8960	12600
Metals (mg/kg)																
Aluminum			17000	17000	15000	18000	18000	13000	14000	18000	4600	17000	20000	14000	16000	12000
Antimony [1]			1.1	0.85	1.1	0.6	1.2	0.89	1.1	0.88	1.4	0.74	0.72	1.8	0.66	1.7
Arsenic	5.9	CCME ISQG	9.7	7.6	6.1	5.7	7.1	9.5	15	6.9	3.4	5.3	7.5	8.4	7.4	32
Barium			230	230	230	230	240	230	230	240	79	230	240	440	230	210
Beryllium			0.75	0.67	0.61	0.68	0.69	0.58	0.56	0.68	0.24	0.63	0.73	0.58	0.62	0.54
Boron			8.6	8.5	7.6	8.8	9.7	6.8	10	7.1	6.2	7.6	8.9	6.4	6	11
Cadmium	0.6	CCME ISQG	1.1	1.0	0.7	0.9	0.9	1.1	1.2	0.9	0.3	0.7	0.8	0.9	0.9	0.8
Calcium			42000	51000	59000	37000	42000	99000	97000	28000	120000	33000	24000	74000	66000	75000
Chromium	37.3	CCME ISQG	920	590	330	550	190	370	520	210	50	190	340	290	470	340
Cobalt			14	13	11	12.0	12	12	14	12	4.9	11	13	11	12	21
Copper	35.7	CCME ISQG	57	51	49	47	210	62	61	270	68	77	56	65	51	77
Iron			28000	27000	25000	27000	31000	24000	24000	31000	12000	27000	29000	25000	25000	23000
Lead	35	CCME ISQG	160	120	90	100	110	150	160	140	59	84	93	160	130	230
Magnesium			13000	11000	10000	11000	13000	11000	12000	13000	17000	11000	12000	10000	11000	9500
Manganese	460	PSQG LEL	780	820	920	990	930	740	720	1200	320	1400	1500	790	870	730
Mercury	0.17	CCME ISQG	0.72	0.48	1.1	0.31	0.27	0.97	0.94	0.24	0.099	0.26	0.32	0.5	0.46	1.5
Molybdenum			0.84	0.87	1.1	0.65	1.3	1.00	1.2	1.30	1.30	0.69	0.69	0.77	0.91	1.20
Nickel	16	PSQG LEL	32	29	27	29	31	25	27	31	13	28	32	26	27	27
Phosphorus			1100	1100	890	1000	1200	1200	1200	1200	820	1300	1200	1100	1100	1300
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			3700	3600	3200	3600	3500	2900	2900	3300	960	3100	3600	2700	3000	2600
Selenium			1.3	1.4	1.3	1.3	1.40	1.3	1.7	1.1	<0.50	1.2	1.5	1.3	1.2	1.9
Silver [2]			1.3	0.82	0.65	0.76	0.62	1	1.7	0.64	<0.20	0.47	0.63	0.82	0.76	1.2
Sodium			500	550	500	480	610	460	460	520	240	400	460	460	420	530
Strontium			260	300	340	210	150	500	520	110	190	130	140	360	370	350
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			0.34	0.33	0.3	0.29	0.34	0.31	0.33	0.34	0.11	0.28	0.33	0.29	0.3	0.38
Tin			8.3	6.6	<5.0	5.3	6.6	9.9	9.7	7.2	5.3	<5.0	<5.0	6.4	6.4	11
Titanium			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium			0.91	0.93	0.96	0.83	0.98	0.73	0.91	0.83	0.4	0.74	0.75	0.75	0.74	0.97
Vanadium			46	43	39	43	47	35	37	42	20	37	45	34	35	38
Zinc	120	PSQG LEL	220	190	160	170	300	230	270	320	190	210	200	420	190	240
Tributyl tin	0.073	PSDDA (WDOE)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)																
Aroclor 1242			<0.040	<0.040	<0.050	<0.050	<0.050	<0.050	<0.050	<0.040	<0.020	<0.050	<0.050	<0.050	<0.040	<0.060
Aroclor 1254	0.06	CCME ISQG	0.27	0.18	0.23	0.23	0.11	0.18	0.44	0.067	0.067	0.08	0.12	0.18	0.22	0.24
Aroclor 1260	0.005	PSQG LEL	0.32	0.19	0.12	0.22	0.077	0.12	0.18	0.059	<0.020	0.076	0.12	0.12	0.19	0.11
Total PCB	0.0341	CCME ISQG	0.59	0.36	0.35	0.45	0.18	0.3	0.62	0.13	0.067	0.16	0.24	0.3	0.41	0.35
PAH's (mg/kg)																
Naphthalene	0.0346	CCME ISQG	<0.020	0.95	<0.10	<0.020	<0.10	0.33	<0.25	0.35	0.26	<0.020	<0.10	6.1	<0.25	0.15
Acenaphthylene	0.00587	CCME ISQG	0.08	<0.25	<0.10	0.03	<0.10	<0.10	0.25	<0.050	<0.050	0.04	<0.10	0.51	0.75	<0.10
Acenaphthene	0.00671	CCME ISQG	0.03	<0.25	<0.10	<0.020	<0.10	<0.10	<0.25	0.06	0.15	0.03	<0.10	<0.10	<0.25	<0.10
Fluorene	0.0212	CCME ISQG	0.029	<0.25	<0.10	<0.020	<0.10	<0.10	<0.25	0.05	0.17	0.026	<0.10	0.14	<0.25	<0.10
Phenanthrene	0.0419	CCME ISQG	0.18	0.58	0.16	0.09	0.29	0.43	1.1	0.34	1.5	0.15	<0.10	0.59	1.1	0.27
Anthracene	0.0469	CCME ISQG	0.089	<0.25	<0.10	0.041	<0.10	<0.10	0.32	0.07	0.27	0.077	<0.10	0.15	0.61	<0.10
Fluoranthene	0.111	CCME ISQG	0.38	1.1	0.34	0.21	0.6	0.66	2.3	0.44	2.1	0.37	0.16	0.61	2.5	0.53
Pyrene	0.053	CCME ISQG	0.54	1.4	0.48	0.28	0.69	0.7	2.6	0.53	1.6	0.44	0.2	0.67	3.6	0.54
Benzo(a)anthracene	0.0317	CCME ISQG	0.21	0.53	0.2	0.1	0.26	0.3	1.1	0.25	0.59	0.2	<0.10	0.27	2	0.24
Chrysene	0.0571	CCME ISQG	0.14	0.41	0.13	0.075	0.23	0.27	1	0.21	0.65	0.18	<0.10	0.25	1.6	0.25
Benzo(b)fluoranthene			0.35	0.740	0.23	0.15	0.33	0.38	1.8	0.3	0.67	0.28	<0.10	0.31	2.5	0.42
Benzo(k)fluoranthene			0.099	<0.25	<0.10	0.043	<0.10	0.13	0.56	0.11	0.23	0.098	<0.10	0.11	0.88	0.14
Benzo(a)pyrene	0.0319	CCME ISQG	0.29	0.68	0.21	0.11	0.24	0.29	1.1	0.26	0.42	0.23	<0.10	0.25	2.4	0.29
Indeno(1,2,3 -cd)pyrene			0.15	0.39	0.11	0.062	0.13	0.16	0.79	0.14	0.24	0.13	<0.10	0.14	1.3	0.23
Dibenz(a,h)anthracene	0.00622	CCME ISQG	0.034	<0.25	<0.10	<0.020	<0.10	<0.10	<0.25	<0.050	0.056	0.03	<0.10	<0.10	0.33	<0.10
Benzo(ghi)perylene			0.16	0.43	0.12	0.07	0.16	0.18	0.84	0.16	0.25	0.14	<0.10	0.16	1.3	0.24
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			<0.020	<0.25	<0.10	<0.020	<0.10	<0.10	<0.25	<0.050	0.05	<0.020	<0.10	<0.10	<0.25	<0.10
2-Methylnaphthalene	0.0202	CCME ISQG	<0.020	<0.25	<0.10	<0.020	<0.10	<0.10	0.34	<0.050	0.07	<0.020	<0.10	0.13	<0.25	<0.10
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
LPAH			0.4	2.0	0.4	0.2	0.5	1.0	1.9	0.9	2.4	0.3	0.3	7.1	2.2	0.6
HPAH			2.4	5.8	1.9	1.1	2.7	3.1	12.2	2.4	6.8	2.1	0.8	2.8	18.5	2.9
Total PAH			2.8	8.2	2.4	1.3	3.4	4.2	14.7	3.4	9.3	2.5	1.2	10.5	21.5	3.7
Pesticides & Herbicides																
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.

2 - Non detect <2 an <1 removed for silver

3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated

Samples with duplicate values are presented as the average

Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

Area	Environmental Quality Guidelines	Source	MF1	MF1	MF1	MF1	MF1	MF1	MF2	MF3	MF2	MF2	FF1	FF1	FF1
Lot															
UTM 18T Easting															
Northing															
Source			Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014	Golder 2014
Site Name			GRAB 8	GRAB 9	GRAB 10	GRAB 11	GRAB 12	GRAB 13	GRAB 14	GRAB 15	GRAB 16	GRAB 17	GRAB 18	GRAB 19	GRAB 20
Date			12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13	12-Sep-13
Sediment Type (%)															
Sand (63 - 200 µm)			44	47	43	50	53	49	55	59	59	59	54	49	53
Silt (2 - 63 µm)			38	36	39	35	33	34	26	28	27	27	31	33	30
Clay (<2 µm)			18	17	17	16	14	17	18	13	14	14	15	19	18
Total Percernt Fines			56	53	56	51	47	51	44	41	41	41	46	52	48
TOC			8.9	8.5	8.6	9.3	9.2	8.8	9.3	11.0	12	11	11	8.6	11
TOC			89000	85000	86000	93000	92000	88000	93000	110000	120000	110000	110000	86000	110000
TOC (%)			8.9	8.5	8.6	9.3	9.2	8.8	9.3	11	12	11	11	8.6	11
TKN (mg/kg)			9360	11100	9300	9530	8160	9330	11000	9450	11700	8450	11600	8160	12100
TKN			9360	11100	9300	9530	8160	9330	11000	9450	11700	8450	11600	8160	12100
Metals (mg/kg)															
Aluminum			18000	11000	16000	12000	16000	18000	17000	17000	17000	19000	20000	13000	18000
Antimony [1]			1.1	1.1	1.4	1.2	1.1	0.75	0.6	0.52	0.46	0.49	0.54	0.44	0.39
Arsenic	5.9	CCME ISQG	17	12	19	17	13	7.4	6.8	5.3	5.2	5.3	5.4	8.2	5
Barium			240	240	220	200	240	240	230	230	230	240	240	200	240
Beryllium			0.73	0.48	0.66	0.5	0.67	0.65	0.66	0.67	0.66	0.74	0.73	0.51	0.7
Boron			8	9.8	9.3	8.7	6.7	8.8	6.2	6.8	6.2	7.6	8.7	<5.0	6.4
Cadmium	0.6	CCME ISQG	1.0	1.0	1.0	1.0	1.1	0.9	1.0	1.0	0.9	0.8	0.9	0.5	0.7
Calcium			64000	120000	82000	97000	60000	65000	39000	38000	28000	31000	28000	81000	18000
Chromium	37.3	CCME ISQG	670	380	540	270	940	620	660	470	360	360	270	150	180
Cobalt			14	12	15	12	16	12	13	12	12	12	12	11	12
Copper	35.7	CCME ISQG	54	57	63	73	57	48	53	44	42	45	45	35	43
Iron			28000	22000	26000	20000	26000	26000	27000	27000	26000	28000	29000	22000	28000
Lead	35	CCME ISQG	140	130	140	140	170	120	120	95	82	83	79	170	64
Magnesium			12000	12000	13000	12000	13000	12000	12000	11000	10000	11000	11000	8800	10000
Manganese	460	PSQG LEL	1000	730	800	610	850	1000	1000	1200	1200	1300	1200	820	1700
Mercury	0.17	CCME ISQG	0.62	0.66	0.76	1.5	0.95	0.45	0.47	0.26	0.23	0.26	0.25	0.33	0
Molybdenum			0.98	1.30	1.40	1.40	0.98	0.78	0.78	0.68	0.7	0.73	0.76	0.66	0.56
Nickel	16	PSQG LEL	31	24	30	23	31	29	29	29	28	30	31	22	30
Phosphorus			1800	1200	1300	1100	1200	1100	1100	2100	1000	1100	1000	1200	1100
Phosphorus (B-32 to B-34)			-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium			3600	2700	3400	2400	3400	3300	3300	4100	3200	3500	3500	2500	3300
Selenium			1.5	1.6	1.7	1.6	1.2	1.3	1.2	1.1	1.2	1.2	1.4	1.0	1.30
Silver [2]			1.1	1.6	1.5	2.8	1.3	0.89	1.3	0.65	0.53	0.61	0.49	0.33	0.4
Sodium			550	540	620	410	540	500	410	460	350	460	450	400	370
Strontium			380	680	380	430	330	390	250	220	180	180	170	380	100
Sulphur			-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium			0.32	0.26	0.32	0.29	0.3	0.32	0.3	0.26	0.26	0.3	0.32	0.26	0.28
Tin			7.4	6.5	8.5	6.7	8.4	5.6	6	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium			-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium			0.88	0.91	0.98	0.91	0.88	0.78	0.86	0.87	0.86	0.89	0.9	0.7	0.8
Vanadium			44	35	43	35	41	42	40	36	38	41	45	28	38
Zinc	120	PSQG LEL	210	240	250	290	240	180	190	180	160	170	160	130	160
Tributyl tin	0.073	PSDDA (WDOE)	-	-	-	-	-	-	-	-	-	-	-	-	-
PCB's (mg/kg)															
Aroclor 1242			<0.050	<0.060	<0.050	<0.060	<0.040	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.040	<0.060
Aroclor 1254	0.06	CCME ISQG	0.26	0.19	0.23	0.22	0.19	0.19	0.17	0.18	0.14	0.096	0.13	0.15	0.06
Aroclor 1260	0.005	PSQG LEL	0.18	0.15	0.15	0.094	0.23	0.25	0.29	0.21	0.21	0.14	0.1	0.074	0
Total PCB	0.0341	CCME ISQG	0.44	0.34	0.38	0.31	0.42	0.44	0.47	0.39	0.36	0.24	0.23	0.22	0.13
PAH's (mg/kg)															
Naphthalene	0.0346	CCME ISQG	0.17	0.12	0.2	0.98	<0.010	<0.020	<0.020	<0.020	0.11	<0.10	<0.10	0.049	<0.10
Acenaphthylene	0.00587	CCME ISQG	<0.10	<0.10	<0.10	0.10	0.04	0.09	0.04	0.03	<0.10	<0.10	<0.10	0.21	<0.10
Acenaphthene	0.00671	CCME ISQG	<0.10	<0.10	<0.10	<0.10	0.02	0.03	0.02	<0.020	<0.10	<0.10	<0.10	0.10	<0.10
Fluorene	0.0212	CCME ISQG	<0.10	<0.10	<0.10	<0.10	0.023	0.032	<0.020	<0.020	<0.10	<0.10	<0.10	0.11	<0.10
Phenanthrene	0.0419	CCME ISQG	0.21	0.3	0.3	0.45	0.15	0.17	0.11	0.087	0.14	0.12	0.11	0.56	0.30
Anthracene	0.0469	CCME ISQG	<0.10	<0.10	<0.10	<0.10	0.054	0.09	0.045	0.04	<0.10	<0.10	<0.10	0.27	0.24
Fluoranthene	0.111	CCME ISQG	0.41	0.38	0.51	0.65	0.3	0.35	0.25	0.19	0.25	0.29	0.24	0.88	0.76
Pyrene	0.053	CCME ISQG	0.54	0.35	0.48	0.54	0.34	0.5	0.33	0.28	0.35	0.39	0.34	1.2	1.00
Benzo(a)anthracene	0.0317	CCME ISQG	0.24	0.15	0.19	0.19	0.12	0.21	0.13	0.086	0.13	0.14	0.11	0.59	0.48
Chrysene	0.0571	CCME ISQG	0.2	0.16	0.21	0.25	0.1	0.14	0.098	0.058	<0.10	0.11	<0.10	0.45	0.39
Benzo(b)fluoranthene			0.4	0.28	0.35	0.38	0.18	0.3	0.19	0.11	0.17	0.18	0.12	0.58	0.48
Benzo(k)fluoranthene			0.14	<0.10	0.11	0.11	0.051	0.087	0.052	0.03	<0.10	<0.10	<0.10	0.21	0.17
Benzo(a)pyrene	0.0319	CCME ISQG	0.35	0.16	0.24	0.22	0.14	0.27	0.14	0.085	0.13	0.13	<0.10	0.62	0.44
Indeno(1,2,3 -cd)pyrene			0.23	0.12	0.18	0.17	0.076	0.12	0.074	0.038	<0.10	<0.10	<0.10	0.25	0.21
Dibenz(a,h)anthracene	0.00622	CCME ISQG	<0.10	<0.10	<0.10	<0.10	0.018	0.028	<0.020	<0.020	<0.10	<0.10	<0.10	0.066	<0.10
Benzo(ghi)perylene			0.25	0.14	0.2	0.19	0.08	0.14	0.081	0.042	<0.10	<0.10	<0.10	0.26	0.22
Perylene			-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene			<0.10	<0.10	<0.10	<0.10	<0.010	<0.020	<0.020	<0.020	<0.10	<0.10	<0.10	0.039	<0.10
2-Methylnaphthalene	0.0202	CCME ISQG	<0.10	<0.10	<0.10	<0.10	<0.010	<0.020	<0.020	<0.020	<0.10	<0.10	<0.10	0.04	<0.10
Benzo(j)fluoranthene			-	-	-	-	-	-	-	-	-	-	-	-	-
LPAH			0.6	0.6	0.7	1.6	0.3	0.3	0.2	0.2	0.5	0.4	0.4	1.1	0.7
HPAH			2.8	1.8	2.5	2.8	1.4	2.2	1.4	0.9	1.3	1.4	1.1	5.1	4.2
Total PAH			3.5	2.6	3.3	4.5	1.7	2.6	1.6	1.1	1.8	1.9	1.6	6.5	5.0
Pesticides & Herbicides															
Aldrin			-	-	-	-	-	-	-	-	-	-	-	-	-
alpha-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-
beta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-
delta-BHC			-	-	-	-	-	-	-	-	-	-	-	-	-
a-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-
g-Chlordane			-	-	-	-	-	-	-	-	-	-	-	-	-
Chlordane (Total)			-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDD + p,p-DDD			-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDE + p,p-DDE			-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-
p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-
o,p-DDT + p,p-DDT			-	-	-	-	-	-	-	-	-	-	-	-	-
DDT+ Metabolites			-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin			-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I (alpha)			-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan II			-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan sulfate			-	-	-	-	-	-	-	-	-	-	-	-	-
Total Endosulfan			-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin			-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin aldehyde			-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin ketone			-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor			-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide			-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene			-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane			-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor			-	-	-	-	-	-	-	-	-	-	-	-	-
Mirex			-	-	-	-	-	-	-	-	-	-	-	-	-
Octachlorostyrene			-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene			-	-	-	-	-	-	-	-	-	-	-	-	-

Low Molecular Weight PAHs includes those with less than four rings i.e., acenaphthene, acenaphthylene, anthracene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene and phenanthrene. For non-detect PAHs, half the detection limit was used in the sum.

High Molecular Weight PAHs includes those with four or more rings i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b&j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, perylene and pyrene. For non-detect PAHs, half the detection limit was used in the sum.

1 - Non detects <10 and <5 for antimony have been removed.
2 - Non detect <2 an <1 removed for silver
3 - Environmental Quality Guidelines (EQG) from CCME ISQG unless otherwise indicated
Samples with duplicate values are presented as the average
Total PCBs presented as the sum of aroclor 1254 and 1260 using half the detection limit for non-detected values.

References:

Benoit N, Dove A. 2003. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Technical Memorandum Prepared for Eastern Region Ministry of the Environment.

Benoit N, Dove A. 2006. Polychlorinated Biphenyl Trackdown in the Cataraqui River: Results of the 2002 and 2003 Monitoring Programs. Technical Report Prepared for the Ministry of Environment, Eastern Region, by Ministry of the Environment (Environmental Monitoring and Reporting Branch) and Environment Canada (Ecosystem Health Division – Ontario Region). September 2006.

Benoit, N. Burniston, D. 2010. Cataraqui River Project Trackdown: Follow-up Study on Success of Remediation Efforts in the Cataraqui River 2006. Prepared for: Eastern Region Ministry of the Environment.

Derry A, Dove A, Fletcher R, Benoit N. PCB Source Trackdown in the Cataraqui River: 2001 Findings. Prepared for Eastern Region Ministry of the Environment.

Golder Associates Ltd. (Golder). 2011b. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2011. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment - Kingston Inner Harbour, Framework Steps 4 and 5 (PQRA). Prepared by Golder Associates Ltd. Project No. 10-1421-0039. PWGSC Project R.034858.001. 31 March 2011.

Golder. 2012a. Implementation of the Canada-Ontario Decision Making Framework for Assessment of Great Lakes Contaminated Sediment Kingston Inner Harbour: Framework Step 6 (Detailed Quantitative Assessment). Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Report Number: PWGSC Project# R.034858.001. Golder Project 10-1421-0039. 31 March 2011.

Golder 2013. Kingston Inner Harbour - Parks Canada Water Lot Sediment Quality Update. Submitted to Public Works and Government Services Canada, on behalf of Parks Canada, Toronto, Ontario. Golder Project 12-1122-0199. 1 April 2013.

Golder. 2013b. Kingston Inner Harbour – Source Investigation for Southwest Transport Canada Water Lot. Submitted to Public Works and Government Services Canada, on behalf of Transport Canada, Toronto, Ontario. Golder Project 13-1421-0002

Malroz Engineering Inc. 2003. Kingston Inner Harbour Data Compilation and Gap Analysis - Great Cataraqui River, Kingston, Ontario. Prepared for: Kingston Environmental Advisory Forum Inner Harbour Group.

RMC-ESG (Royal Military College, Environmental Sciences Group). 2011a. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter III: Ecological effects – evaluation of bioaccumulation of contaminants in biota, sediment toxicity, and benthic community structure. Draft report. March 2011.

RMC-ESG. 2011b. Application of the Canada-Ontario Decision Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter IV: Human Health and Ecological Risk Assessment. Draft report. March 2011.

RMC-ESG. 2011c. Application of the Canada-Ontario Decision-Making Framework for Contaminated Sediments in the Kingston Inner Harbour. Chapter V: An Options Analysis of Management Scenarios for the Kingston Inner Harbour. Prepared by Environmental Sciences Group, Royal Military College, Kingston, Ontario. Draft. March 2011.

Tinney M. 2006. Site Investigation and Ecological Risk Assessment of the Kingston Inner Harbour. Master of Applied Science Thesis submitted to the Faculty of the Royal Military College of Canada. July 2006.

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