Project Report

December 2, 2019

City of Kingston - Third Crossing of the Cataraqui River
Parks Canada Environmental Impact Analysis

Detailed Impact Analysis Report - Section 2

Table of Contents

List of Tables

List of Figures

2. Description of Environmental Components

This section of the Report describes baseline conditions of the Study Area, as it relates to the Valued and Secondary Components outlined in Section 1. This characterization of the existing environment is based on detailed records review completed in August 2019; background research completed throughout the development of the Project; as well as consultation with various regulatory agencies and stakeholders. Existing environment sections are considered open sections, meaning they have the ability to be updated as new information arises, through DIA information gathering commitments and as a result of consultation and engagement activities. It is important to note a relatively large Study Area was developed for this Project during the alternative route selection process, although this Study Area has been carried forward, the Project Location is much smaller in comparison. As a result, existing environment conditions identified within this section that may not necessarily apply to the Project Location. The Project Location is described as the Project footprints as well as any construction areas or mitigation measures associated with those footprints. Section 3 of this DIA will take any Valued and Secondary Components as well as general considerations and evaluate those in an Effects Assessment, including the more focused geographical extent where suitable.

2.1 General Description

The Cataraqui River comprises approximately 4 km² of the approximately 10 km² Study Area. The associated shoreline wetlands occupy approximately 2.5 km²; natural or naturalized upland greenspace occupies approximately 2 km² and the remaining 2.5 km² comprises urban or industrial areas. The Cataraqui River generally flows north to south, with a general widening from immediately below Highway 401 where widths are approximately 250 m to the widest point of approximately 1250 m. Belle Island extends off the western shore narrowing the river to approximately 230 m and contributing half of the greenspace within the Study Area.

Approximately 50% of the Study Area is occupied by the Cataraqui PSW which, on average, is less than 2 m deep. The other half of the river is relatively deep ranging from 2 to 4.5 m within the Rideau Canal navigational channel with additional deeper areas nearing La Salle Causeway. The Study

Area hosts a wide variety of flora and fauna including species at risk (SAR). This natural area contained within an urban area provides many benefits including improved water quality, as well as many opportunities for user enjoyment, the most obvious being boating through the Rideau Canal.

The Rideau Canal is a 202 km long waterway linking the Ottawa River to Lake Ontario. The Rideau Canal was built by the Royal Engineers between 1826 and 1832 to provide a secure alternate supply route in the event of a military blockade by the Americans. The Rideau Canal is also a UNESCO World Heritage Site (designated in 2007), NHSC (designated in 1925), and Canadian Heritage River (designated in 2000).

2.2 Valued Components

A consistent approach has been deployed throughout this DIA for identifying potential presence within the Study Area. In some instances, if there is credible information of a VC being present, that specific species or use is identified as confirmed. In cases where credible information regarding the presence of a VC within the Study Area is not available, the following ranking system is used to assess potential occurrence or uses:

1. A low ranking indicates no suitable habitat is available and/or there have been no recordings of the species within the Study Area. SAR species with a low ranking are not considered further in this Report.
2. A moderate probability indicates suitable habitat is present, and the habitat is in the known range of the species, but there have been no recent recordings of the species within the Study Area.
3. A high probability indicates suitable habitat is present and there have been recent recordings of the species within the Study Area.

2.2.1 Greater Cataraqui Marsh PSW

The Greater Cataraqui Marsh PSW extends from the Woolen Mill/Barriefield area in the southern portion of the Study Area to just north of Highway 401 and covers an area of over 504 ha (Figure 2-1). The PSW is contiguous with the Cataraqui River which adjoins to the northeast portion of Lake Ontario and was originally assessed as significant in 1990, the main driver of the wetlands significance was the presence of Species at Risk and their habitat producing a “special features” score indicative of a PSW, other influencing

significance factors include, biological, hydrological and social components. Due to its hydrological connectivity with a Great Lake, the area is considered to be a Coastal Wetland. A wetland is determined to be a Coastal Wetland if it meets the following criteria:

- Water levels are largely controlled by a Great Lake.
- It is within the floodplain of a Great Lake.
- Tributary to a Great Lake (Lake Ontario).

At 504 ha the PSW represents <1% of all the wetlands in CRCA jurisdiction that hosts approximately 770,000 ha. The wetland itself is permanently flooded and dominated by emergent Broad-leaved Cattails (Typha latifolia) along the riverbanks with varying densities of reed canary grass (Phalaris arundinacea). Water lilies (Nymphaeaceae spp.) are the predominant floating-vegetation found throughout the remainder of the PSW, along with other submergent aquatic species such as coontail (Ceratophyllum demersum), Canada waterweed (Elodea canadensis), tapegrass (Vallisneria spiralis), water milfoil spp., curly pondweed (Potamogeton crispus), flat stem pondweed (Potamogeton zosteriformis), and Richardson's pondweed (Potamogeton richardsonii). Additionally, discontinuous swamp thickets and groves are found throughout the wetland and its margins and provide distinct aquatic communities along the course of the river (CRCA, 2006).

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KINGSTON MILLS ROAD

BATTERSEA ROAD

HIGHWAY 401

MONTREAL STREET

HIGHWAY 15

Cataraqui River

HIGHWAY 2

JOHNSON STREET

N

Legend

Project Location

- Aquatic Exclusionary Turbidity Curtain (AETC)
- Temporary Construction Components
- Permanent Components
- Study
- Greater Cataraqui Marsh

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Sources: Roads, Wetland - Land Information Ontario

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Project:	**City of Kingston - Third Crossing**
Figure Title:	**Project Location and the Greater Cataraqui Marsh Provincially Significant Wetland (PSW)**
Prepared By:	HATCH SYSTRA Kiewit KINGSTON
Date:	**November 18, 2019**
Figure:	**2-1**
Page:	**1 of 1**

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The open water area near the mouth of the Cataraqui river comprises almost half of the surface area of the PSW, with the remainder consisting of fibrous mucklands formed by saturated soil (CRCA, 2006). The soils within the Marsh composed primarily of organic matter (80%) whereas the remaining soils consists of clay, loam and silt (LGL Limited, 2007). The wetland complex itself lies within a limestone valley consisting of mixed and deciduous forests. Surrounding the valley are uplands of limestone plain containing pastures, cultivation, successional forbs and thickets and housing development (CRCA, 2006).

Throughout the center of the PSW, the Rideau Canal navigable channel and a dredged access route have been created and used by the former Music Marina. These two areas are excluded from the PSW boundary due to unsuitable depths and lack of vegetation during previous wetland assessments.

The Greater Cataraqui Marsh PSW provides habitat for a wide range of terrestrial and aquatic wildlife species. The large size of the area allows for a high diversity of habitat features including waterfowl nesting and feeding areas, animal movement corridors, and general foraging habitat for amphibians, reptiles and small mammals. Multiple species of fish also utilize aquatic portions of the wetland as spawning habitat and foraging habitat. The Greater Cataraqui Marsh supports multiple species at risk (SAR) as described further in Section 2.2.6 including SAR bats, birds, reptiles, and fish.

CRCA 2018 watershed card identifies all wetlands within the Study Area as being in excellent condition compared to the “generally healthy” status published in 2013 by CRCA.

The Greater Cataraqui Marsh PSW and the buffering woodlands on both sides of the Cataraqui River are also identified as a Provincially Significant Area of Natural or Scientific Interest (ANSI) for its life science or education values. Obvious boating evidence within the wetland vegetation can be seen within aerial imagery. Boating and fishing are known social uses with wildlife viewing and nature appreciation being other known visitor uses. In addition to the recreational uses the wetland also provides socio-economic opportunities to commercial fisherman known to harvest fish from within it.

Public utilities that are typical of a fully serviced urban area, but which also includes:

- overhead electrical transmission lines along John Counter Boulevard (maintained by Kingston Hydro) that provide service to the west side of the bridge alignment and surrounding area.
- Two pairs of submarine electrical (3-phase 44 kV) cables (owned by Hydro One) that provide service to the east end of the City via on-land connections along John Counter Boulevard (overhead) and Gore Road (underground).
- a 900-mm diameter Rideau Heights trunk sanitary main that extends north-south along the west shoreline.

2.2.2 Fish and Fish Habitat

The Cataraqui River within the Study Area is considered a warm water fishery. The portion of the river that lies within the Study Area was surveyed as part of the studies in support of the Project. Fish and fish habitat associated with the Cataraqui River and wetland were well documented by Blancher (1984) and others. Bowfin Environmental completed site-specific studies and technical reports in relation to the Project in 2009 – 2011 (Bowfin Environmental Consulting, 2011). Table 2.1 below outlines efforts and timing of the sample studies performed by Bowfin as part of the overall DIA process. Over the course of three seasons Bowfin captured 5,404 fish within the Study Area with field notes stating many fish were unable to be retrieved due to thick vegetation. The vast majority of the fish captured were from three species: pumpkinseed, yellow perch and bluegill.

Table 2.1: Overview of Fisheries Investigations Conducted for the Project

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
April 12, 2010	1 – 50 m	Boat Electro-fisher	387 sec	174	11	Pumpkinseed – 74% Yellow Perch – 13% Bluegill - 5%	
	2 – 40 m		325 sec	163	10	Pumpkinseed – 55% Bluegill - 36% Yellow Perch – 4%	
	3 – 40 m		364 sec	155	12	Pumpkinseed – 50% Bluegill – 20% Golden Shiner – 6%	Seven Northern Pike captured, one additional observed
	4 – 60 m		378 sec	107	10	Pumpkinseed – 56% Yellow Perch – 28% Golden Shiner – 5%	
	5 – 40 m		563 sec	173	4	Yellow Perch - 55% Pumpkinseed – 38%	A large number of ripe Yellow Perch as well as their eggs were observed
	6 – 60 m		349 sec	179	6	Pumpkinseed – 53% Yellow Perch – 38% Golden Shiner – 6%	Ripe Yellow Perch and their eggs were also observed

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	7 – 60 m		374 sec	198	7	Yellow Perch – 75% Pumpkinseed – 20% Brown Bullhead – 2%	Ripe Yellow Perch and eggs were observed
	8 – 60 m		340 sec	95	5	Yellow Perch – 62% Pumpkinseed – 29%	
	9 – 60 m		434 sec	165	6	Pumpkinseed – 62% Yellow Perch – 27% Bluegill – 5%	
	10 – 55 m		357 sec	106	5	Pumpkinseed – 47% Yellow Perch – 42% Golden Shiner – 8%	
	11 – 55 m		296 sec	72	6	Pumpkinseed – 44% Yellow Perch – 28% Golden Shiner – 18%	
	12 – 50 m		343 sec	85	4	Golden Shiner – 38% Pumpkinseed – 35% Yellow Perch – 26%	
July 19, 2010	1 – 50m	Boat Electro-fisher	270 sec	59	5	Yellow Perch – 47% Bluegill – 15% Largemouth Bass – 12%	Young of Year (YOY) – Pumpkinseed, Bluegill and Largemouth Bass captured

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	2 – 40m		232 sec	81	7	Pumpkinseed – 46% Bluegill - 36% Yellow Perch – 7%	YOY – Pumpkinseed, Bluegill, Yellow Perch and Largemouth Bass captured
	3 – 40 m		322 sec	125	6	Pumpkinseed – 62% Yellow Perch – 20% Bluegill – 6%	YOY- Pumpkinseed and Largemouth Bass captured
	4 – 60 m		329 sec	106	7	Pumpkinseed – 42% Yellow Perch – 35% Brook Silverside – 8%	YOY – Pumpkinseed, Bluegill, Largemouth Bass, and Yellow Perch captured
	5 – 40 m		329 sec	81	5	Pumpkinseed – 40% Golden Shiner – 21% Yellow Perch – 19% Brook Silverside – 19%	YOY – Pumpkinseed and Yellow Perch captured
	6 – 60 m		364 sec	108	7	Pumpkinseed – 49% Brook Silverside – 22% Yellow Perch – 19%	YOY – Pumpkinseed captured

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	7 – 60 m		332 sec	68	7	Pumpkinseed – 37% Brook Silverside – 21% Yellow Perch – 19%	YOY – Pumpkinseed, Bluegill and Largemouth Bass captured
	8 – 60 m		410 sec	90	10	Pumpkinseed – 33% Yellow Perch – 20% Brook Silverside – 20%	YOY – Pumpkinseed and Bluegill captured
	9 – 60 m		729 sec	54	13	Pumpkinseed – 22% Largemouth Bass – 22% Yellow Perch – 9% Brook Silverside – 9%	YOY – Pumpkinseed, Bluegill, Largemouth Bass and Yellow Perch captured
	10 – 55 m		376 sec	26	8	Pumpkinseed – 23% Bluegill – 23% Yellow Perch – 15%	This site was moved 10 m to the west of the spring site during the summer visit due to the density and height of the aquatic vegetation. YOY – Bluegill captured

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	11 – 55 m		299 sec	29	8	Brook Silverside – 28% Largemouth Bass – 21% Yellow Perch – 21%	This site was moved 10 m to the west of the spring site during the summer visit due to the density and height of the aquatic vegetation. YOY – Largemouth Bass captured
	12 – 50 m		333 sec	20	8	Yellow Perch – 40%	
July 20, 2010	C	Siene Net	3 Passes	102	8	Pumpkinseed – 38% Yellow Perch – 21% Bluegill – 15% Largemouth Bass – 15%	YOY – Pumpkinseed, Bluegill and Yellow Perch captured
	D		1 Pass	99	7	Yellow Perch – 53% Largemouth Bass – 21% Round Goby – 11%	YOY – Rock Bass, Pumpkinseed, Largemouth Bass and Yellow Perch captured

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	E		3 Passes	242	8	Yellow Perch – 41% Round Goby – 29% Pumpkinseed – 12%	YOY – Brown Bullhead, Pumpkinseed, Bluegill, Largemouth Bass and Yellow Perch captured
October 17, 2010	1 – 50m	Boat Electro-fisher	457 sec	97	8	Pumpkinseed – 49% Yellow Perch – 21% Bluegill - 18%	YOY – Bluegill captured
	2 – 40m		291 sec	69	8	Pumpkinseed –39% Yellow Perch – 33% Bluegill - 12%	YOY – Pumpkinseed and Bluegill captured
	3 – 40 m		374 sec	194	11	Yellow Perch – 35% Bluegill – 27% Pumpkinseed – 26%	Site was moved upstream towards the Music Marina due to the density and height of aquatic vegetation

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	4 – 60 m		450 sec	55	7	Bluegill – 36% Yellow Perch – 25% Brown Bullhead 13%	Site moved 22 m to the east due to the density and height of aquatic vegetation. YOY – Bluegill, Brown Bullhead and Largemouth Bass captured
	5 – 40 m		435 sec	147	7	Yellow Perch – 46% Pumpkinseed – 29% Bluegill – 13%	YOY – Bluegill and Largemouth Bass captured
	6 – 60 m		389 sec	183	9	Yellow Perch – 43% Pumpkinseed – 20% Golden Shiner – 15%	YOY – Bluegill, Largemouth Bass and Yellow Perch captured
	7 – 60 m		389 sec	26	5	Yellow Perch – 73%	Netting compromised due to dense aquatic vegetation YOY – Bluegill and Yellow Perch Captured

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	8 – 60 m		368 sec	61	9	Yellow Perch – 75%	YOY – Bluegill, Largemouth Bass and Yellow Perch captured
	9 – 60 m		399 sec	167	9	Yellow Perch – 38% Pumpkinseed – 32% Brook Silverside – 13%	YOY – Bluegill and Largemouth Bass captured
	10 – 55 m		389 sec	161	8	Yellow Perch – 46% Pumpkinseed – 23% Bluegill – 12%	This site was moved 45 m to the east of the spring site during the fall visit due to the density and height of the aquatic vegetation. YOY – Largemouth Bass and Yellow Perch captured
	11 – 55 m		467 sec	436	11	Yellow Perch – 49% Brook Silverside – 32% Pumpkinseed – 8%	Site moved 13 m to the east due to dense aquatic vegetation YOY – Bluegill and Largemouth Bass captured

Date	Transect ID & Length (m)	Sampling Method	Effort	Results Summary			
				# of Fish	# of Species	Relative Abundance	Relevant Notes
	12 – 50 m		396 sec	299	10	Brook Silverside - 40% Yellow Perch – 32% Golden Shiner – 13%	Site moved 44 m to the east of the spring site due to the density and height of the aquatic vegetation. YOY – Pumpkinseed and Bluegill captured
October 18, 2010	C	Siene Net	3 Passes	155	8	Yellow Perch – 86%	YOY – Pumpkinseed, Bluegill and Yellow Perch captured
	D		3 Passes	232	3	Yellow Perch – 94%	YOY – Largemouth Bass and Yellow Perch captured
	E		3 Passes	160	7	Yellow Perch – 84%	YOY – Pumpkinseed, Largemouth Bass and Yellow Perch captured

To supplement Bowfin's work, Hatch has conducted a thorough review the Municipal Class EA as well as various information sources to compile a list of confirmed or likely species to use or migrate through the Study Area, these are presented below in Table 2.2. The table notes if a species is a provincial or federal species at risk, and if in Hatch's opinion it is considered a Commercial, Recreational or Aboriginal (CRA) species given the regional context. Any invasive species presented in Table 2.2 will be discussed further in Section 2.4.1.

Table 2.2: Species Confirmed or Likely to Migrate Through the Study Area

Common Name	Latin Name	Federal COSEWIC	Federal SARA	Provincial (SARO)	Regional CRA	Study or Literature Source
Alewife	Alosa pseudoharengus	-	-	-	No	MNRF
American Eel	Anguilla rostrata	THR	-	END	Yes	MNRF
Banded Killfish	Fundulus diaphanus	-	-	-	No	Bowfin
Black Crappie	Pomoxis nigromaculatus	-	-	-	Yes	Bowfin
Blackchin Shiner	Notropis heterodon	-	-	-	No	Bowfin
Blacknose Shiner	Notropis heterolepis	-	-	-	No	Bowfin
Bluegill	Lepomis macrochirus	-	-	-	Yes	Bowfin
Bluntnose Minnow	Pimephales notatus	-	-	-	No	Bowfin
Bowfin	Amia calva	-	-	-	No	Bowfin
Brook Silverside	Labidesthes sicculus	-	-	-	No	Bowfin
Brown Bullhead	Ameiurus nebulosus	-	-	-	Yes	Bowfin
Carp	Cyprinus carpio	-	-	-	No	Bowfin
Central Mudminnow	Umbra limi	-	-	-	No	Bowfin
Chinook Salmon	Oncorhynchus tshawytshca	-	-	-	Yes	MNRF
Coho Salmon	Oncorhynchus kisutch	-	-	-	Yes	MNRF
Eastern Silvery Minnow	Hybognathis regius	-	-	-	No	Bowfin

Common Name	Latin Name	Federal COSEWIC	Federal SARA	Provincial (SARO)	Regional CRA	Study or Literature Source
Gizzard Shad	Doro soma cepedianum	-	-	-	No	Bowfin
Golden Shiner	Notemigonus crysoleucas	-	-	-	Yes	Bowfin
Johnny Darter	Etheostoma nigrum	-	-	-	No	Bowfin
Lake Sturgeon	Acipenser fulvescens	THR	-	END	Yes	NHIC
Largemouth Bass	Micropterus salmoides	-	-	-	Yes	Bowfin
Longnose Gar	Lepisosteus osseus	-	-	-	Yes	Bowfin
Muskellunge	Esox masquinongy	-	-	-	Yes	MNRF
Northern Pike	Esox lucius	-	-	-	Yes	Bowfin
Pumpkinseed	Lepomis gibbosus	-	-	-	Yes	Bowfin
Rock Bass	Ambloplites rupestris	-	-	-	No	Bowfin
Round Goby	Neogobius melanostomus	-	-	-	No	Bowfin
Smallmouth Bass	Micropterus dolomieu	-	-	-	Yes	MNRF
White Perch	Morone americana	-	-	-	No	MNRF
White Sucker	Catostomus commersoni	-	-	-	No	Bowfin
Yellow Bullhead	Ameirus natalis	-	-	-	Yes	Bowfin
Yellow Perch	Perca flavescens	-	-	-	Yes	Bowfin

The river is proven to provide spawning and rearing habitat for a number of species CRA species, including yellow perch, pumpkinseed, bluegill, crappie, and largemouth bass (Bowfin Environmental Consulting, 2011). Other species expected to spawn within the Study Area include northern pike and muskellunge. Figure 2-2 shows spawning habitat for known large bodied CRA species within the Study Area with the exception of Yellow Bullhead that could potentially spawn in coarser materials along shoreline of the Study Area. A number of non-native species have been documented within the Study Area as noted in Table 2.2. Although all non-native species are fully established within the fish community with Chinook and Coho Salmon actively managed for within Lake Ontario. Rock bass and Common Carp have been long part of the Great Lakes and tributary fish communities. The relatively new species, round goby, was accidently introduced to the Great Lakes in 1990 and since become established within the Lake Ontario and all its major tributaries. Although being established nearly 30 years round gobies are still considered an invasive species and is discussed in Section 2.4.1.

Additionally, a number of mussel species were identified through the review of the Canadian Freshwater Mussel Guide. The Upper St. Lawrence (02MA) Watershed was reviewed using the online mapping tool of the guide outlining 18 different species of mussels occurring within the 02MA area. Two of those 18 are currently listed as Federally endangered (Eastern Pondmussel and Rainbow Mussel), as such both have known populations and habitat mapped. In addition to the above, a joint MNRF and DFO Eastern Pondmussel assessment was conducted in Southeastern Ontario in 2015 and 2016 (Reid et al 2017), this assessment included sampling areas within the Cataraqui watershed. The assessment sampled an area of the Cataraqui River approximately 14 km upstream of the Study Area. The sampling resulted in four (4) species resulting in 29 live individuals being record including five (5) Eastern ellipto, 16 Fatmuket, one (1) Eastern Pondmussel and seven (7) Giant floater. Reid et al (2017) did not find any Rainbow mussels within the Cataraqui watershed, with the closest known occurrence approximately 25 km to the west within the Salmon River, therefore has been excluded from Table 2.3 below. Combining the two information sources a total of 20 species are thought to have potential to inhabit the Study Area with the four (4) noted by Reid et all (2017) likely having the greatest potential. The Zebra Mussel

was also noted as a highly invasive species and any information pertaining to the species is described in Section 2.4.1. The remaining 15 species are shown in Table 2.3.

Table 2.3: Mussel Species with Potential to Occur Within the Study Area

Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)	Habitat Preferences
Mucket	Actinonaias ligamentina	-	-	-	Depth:1 m or less Flow: Riffles with strong current but also quiet water in streams. Substrate: Range from cobble and gravel to sand and mud.
Elktoe	Alasmidonta marginata	-	-	-	Depth:1 m or less. Flow: Moderate to Fast Current. Medium to Large Rivers. Riffles Substrate: Mixture of gravel and sand.
Triangle Floater	Alasmidonta undulata	-	-	-	Small streams to large rivers in mud/sand with moderate current. Flow: Steady flow as opposed to riffles/rough water. Substrate: Coarser to finer gravel with sand and mud.
Cylindrical papershell	Anodontoides ferussacianus	-	-	-	Small streams, creeks, and lakes. Throughout the St. Lawrence and Great Lakes Depth: Shallow/ 1 m or less. Flow: Steady flow as opposed to riffles/rough water. Substrate: Silt, sand or fine gravel.

Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)	Habitat Preferences
Eastern Elliptio	Elliptio complanate	-	-	-	Lake, ponds, streams, and rivers in all substrate types. Not likely to occur in high gradient streams
Spike	Elliptio dilatate	-	-	-	Lakes, ponds, streams, and rivers in all substrate types.
Plain Pocketbook	Lampsilis cardium	-	-	-	Lakes, ponds, streams, and rivers in all substrate types.
Creek Heelplitter	Lasmigona compressa	-	-	-	Prefers headwater streams of small or medium rivers. Often occupy large rivers in soft mud bottoms with slow moving currents near the edge of the river.
Fluted-Shell	Lasmigona Costata	-	-	-	Flow: Medium to Large Rivers, often in riffles or runs. Substrate: sand or mud. In slow moving rivers it can be found in fine gravel.
Fragile Papershell	Leptodea fragilis	-	-	-	Small streams in strong current with coarse gravel and sand substrates but also rivers or river-lakes possessing slow current and a firm substrate composed of sand and mud. Depth: 30 cm to 6 m
Black sandshell	Ligumia recta	-	-	-	Depth: 0.1 to 3 m Flow: Medium to large rivers with strong current. Substrate: Coarse sand and gravel with cobbles

Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)	Habitat Preferences
Pink Heelsplitter	Potamilus alatus	-	-	-	Flow: Variable Substrate: clay, clay mixed with silt, sand, pea gravel and sand, and cobble/sand/silt
Eastern Floater	Pyganodon cataracta	-	-	-	Small streams, creeks, rivers, ponds, lakes, and marshes. It is usually found in slow moving backwaters or standing waters in fine sand, silt, or muddy substrates. Substrate: sand, silt or mud.
Giant Floater	Pyganodon grandis	-	-	-	Shallow creeks to deep Impoundments. Flow: Slow moving or still waters Substrate: sand, silt or mud.
Creeper	Strophitus undulates	-	-	-	Depth: shallow Flow: Small streams and rivers Substrate: Sand, cobble or gravel.

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User Name: vill77807

KINGSTON MILLS ROAD

BATTERSEA ROAD

HIGHWAY 401

MONTREAL STREET

HIGHWAY 15

Cataraqui River

HIGHWAY 2

JOHNSON STREET

N

Spawning Habitat

- Esox High Quality Spawning Habitat
- Largemouth Bass, Gar, and CRA Panfish High Quality Spawning Habitat
- Potential Largemouth Bass, Gar, and CRA Panfish Spawning Habitat

Legend

Project Location

- Aquatic Exclusionary Turbidity Curtain (AETC)
- Temporary Construction Components
- Permanent Components
- Study Area

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Sources: Roads - Land Information Ontario

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Project: City of Kingston - Third Crossing

Figure Title: Fish Spawning Habitat

Prepared By: HATCH, SYSTRA, Kiewit, Kingston

Date: November 18, 2019

Figure: 2-2

Page: 1 of 1

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2.2.2.1 Fish Habitat

The following is a summary of the fish habitat within the Project Location, Study Area and where relevant the regional area. Information pertaining the Project Location and Study Area are primarily derived from Bowfin Environmental 2009 and 2011 reports but also takes into account historical reports as well as information sources pertaining to the PSW. Regional information had been collected through a literature review, previous projects within the regional area and agency consultations. The Study Area is considered warm-water habitat that supports a variety of warm water fishes with seasonal migrations of cool or cold-water species.

The habitat within the Study Area was fairly homogenous consisting primarily of a slow-moving glide with fine sediments and dense submergent vegetation. Much of the Study Area is located within the bay created by Belle Island. The aquatic vegetation along the shoreline within the bay consists primarily of extremely dense floating and submergents with a thin band of emergent (cattails). Further offshore, but still within the bay at the mid channel sites (5 to 8 on Figure 2-3) dense submergent vegetation was present during the summer and early fall months. The navigable channel associated with the Rideau Canal system is located close to the east shoreline. This channel contains the deepest habitat (at 4.5 m) and hosts sparse, shaded tolerant aquatic vegetation.

The restricted activity timing window for identified fish species in the Study Area, including identified SAR fish species discussed in Section 2.2.6 of this Report, is March 15 through June 30. This timing window serves to protect the key spawning periods for the fish identified within the Study Area. During this timing window, no Project works should take place that could affect fish or fish habitat, unless an amendment to the fisheries timing window has been approved by the Ontario Ministry of Natural Resources and Forestry (OMNRF) in advance.

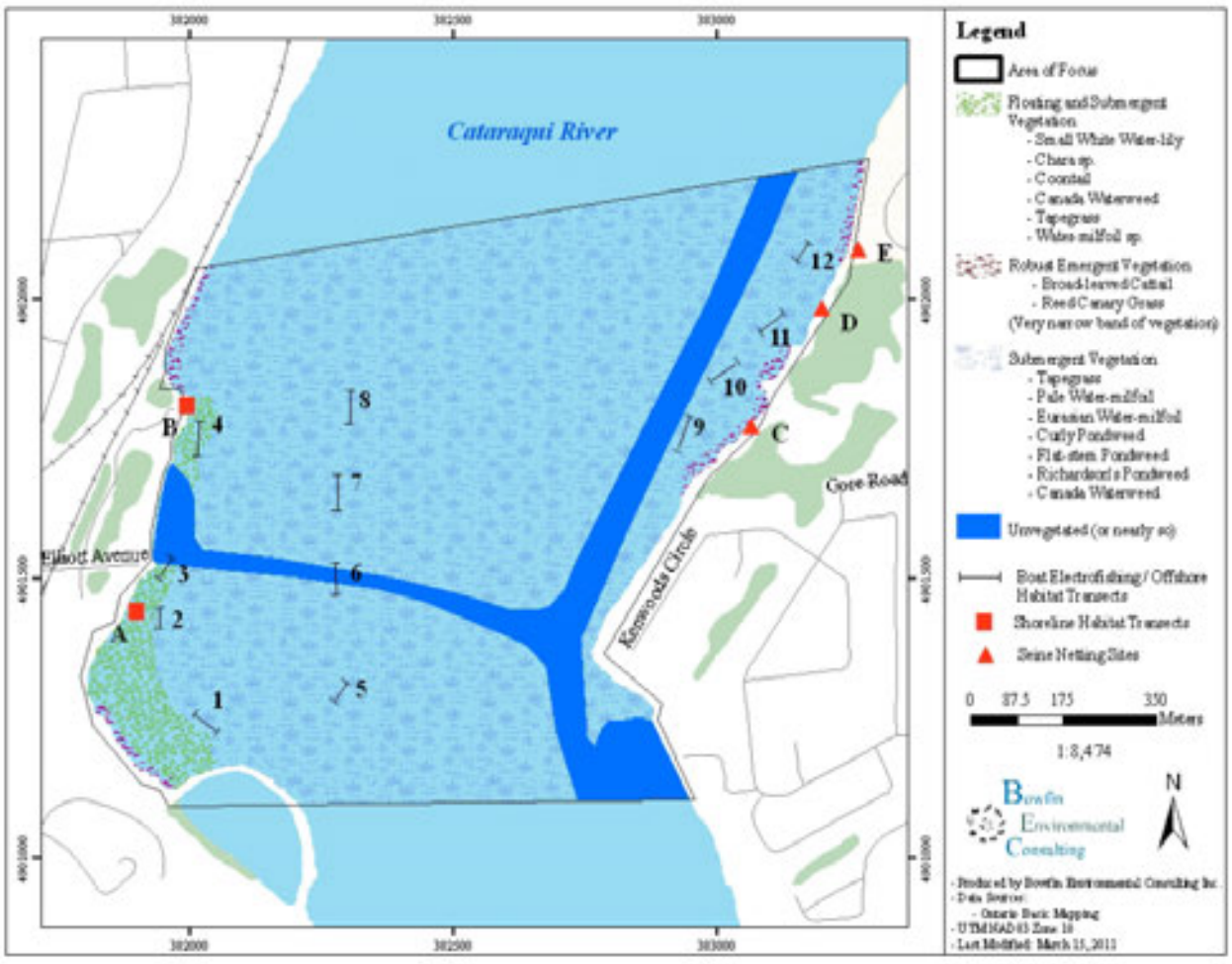


Figure 2-3: The Location of the Fish Sampling and Habitat Transect Sites

There is another route on the west side that represents a dredged access route from the Rideau Canal navigation corridor to the former Music Marina near the end of John Counter Boulevard. Here the vegetation was less dense as well and minimal change in water depth. It is anticipated the previously dredged channel was in the process of being re-filled with sedimentary deposits during the time of the studies and that the vegetation had not yet

become re-established. This process would also be expected to occur post construction within the footprints of the temporary causeways.

As part of Bowfin's baseline investigation aquatic habitat documentation occurred simultaneously with the before mentioned electro-fishing and seine netting and included two additional areas along west bank. Description of the aquatic habitat at each transect and sampling area is described below with locations shown on Figure 2-3.

2.2.2.2 West Side Investigations

2.2.2.2.1 Transect Site A – Shoreline Habitat Description

The Site A shoreline transect was completed to the south of the boat launch on the west side of the river. The transect was described as a dense patch of white water-lily which started near the Music Marina and continued south in the bay. The thick white water-lily and dense stonewort combined with soft substrates prevented walking through the area. A depth of 1.17 m was reached 22 m from shore. The substrate consisted of unconsolidated muck. In-stream cover was provided by the very dense (100%) floating and submergent vegetation, as illustrated on Figure 2-4 below.

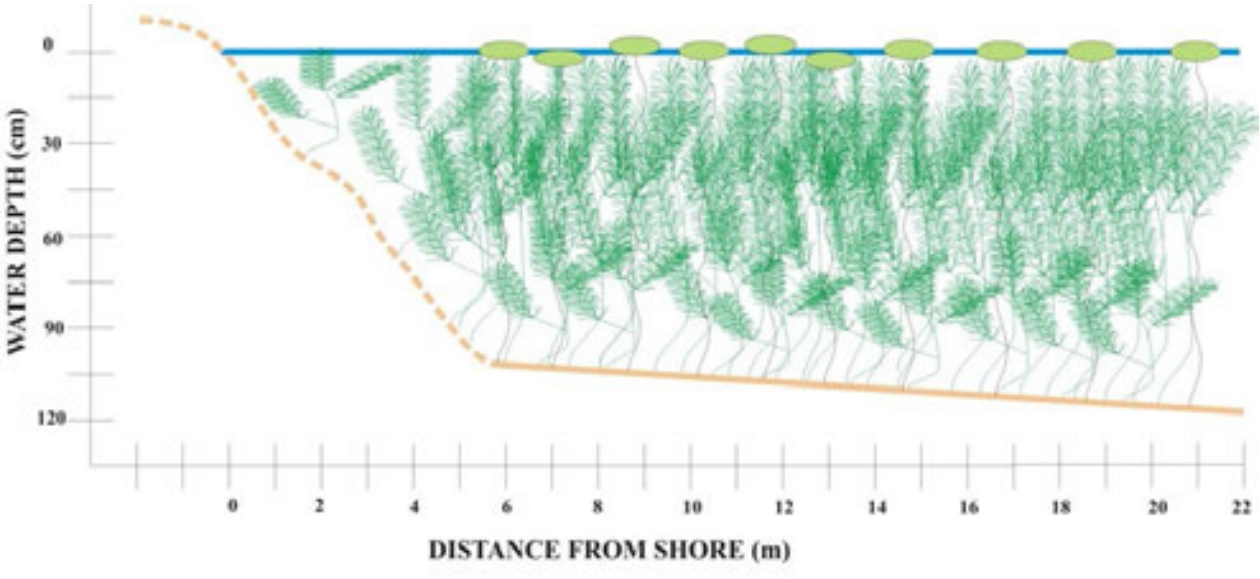


Figure 2-4: Transect Site A – Shoreline Habitat Profile

2.2.2.2.2 Transect Site B – Shoreline Habitat Description

The Site B shoreline was described by Bowfin as a rocky and vegetated with reed canary grass, cattails, flowering rush, buckthorn, nannyberry and staghorn sumac. The slope was gradual. The substrate was firm with fines and cobbles. Cover included algae, blow (aquatic vegetation which has been uprooted and blown into shore), boulders and aquatic vegetation. The aquatic vegetation began approximately 3.5 m from shore and consisted of Tape grass (20% cover; to surface). The amount of vegetation increased further offshore reaching 60% cover and 75% of the column height by 7 m from shore (milfoil, Canada waterweed and Tape grass), as illustrated on Figure 2-5.

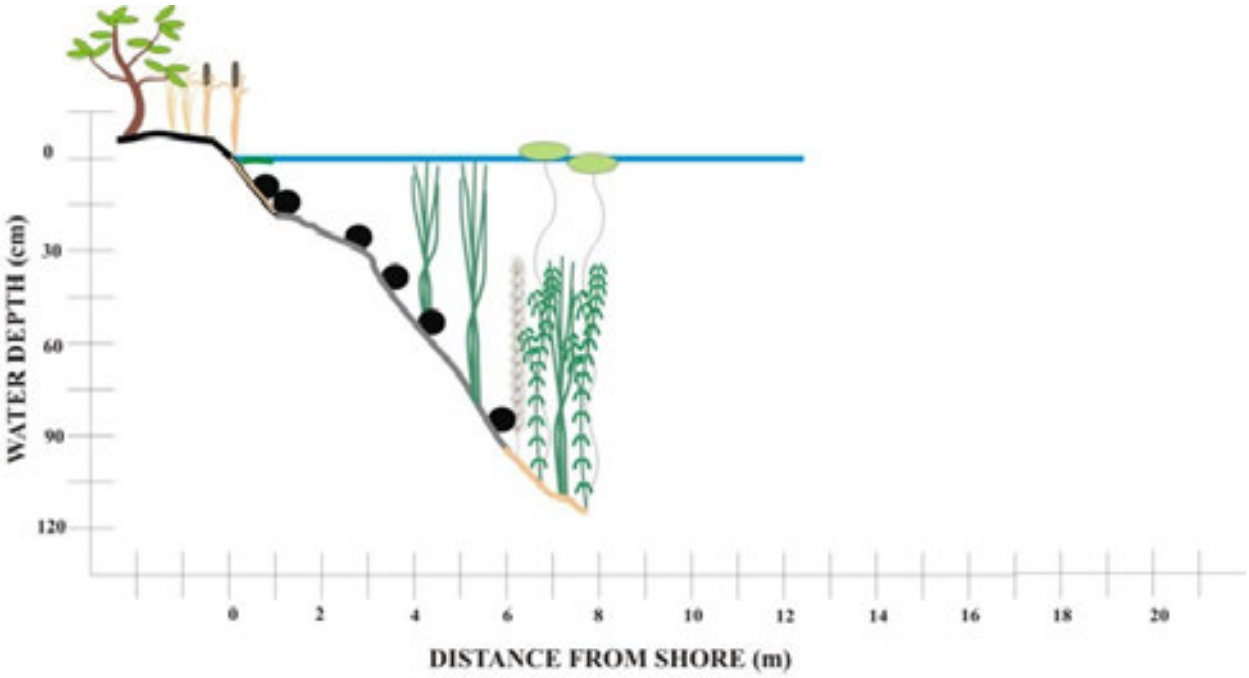


Figure 2-5: Transect Site B – Shoreline Habitat Profile

2.2.2.2.3 Sampling Site 1 – Nearshore Habitat Description

Sampling Site 1 was located on the south side of the bridge alignment. The site length was 50 m. The substrate was unconsolidated fines and densely vegetated with Eurasian milfoil, Tape grass, pondweed and white water-lily.

The water depth averaged 1.7 m. The aquatic vegetation provided 50-100% cover and had reached the surface by the July 20, 2010 visit. By the fall visit the vegetation reached the surface and provided 100% cover.

2.2.2.2.4 Sampling Site 2 – Nearshore Habitat Description

Site 2 was described as having a water depth averaging 1.4 m with unconsolidated substrate fines. The site was densely vegetated with milfoil, Tape grass, Richardson pondweed, water lily and Canada waterweed. The aquatic vegetation provided 50-100% cover and had reached 30-75% of the column height by the July 20, 2010 visit. The shoreline was protected with rocks and was mowed to the water's edge. By the fall visit, the vegetation had become very dense (>80% cover), had reached the surface and was dominated by Tape grass.

2.2.2.2.5 Sampling Site 3 – Nearshore Habitat Description

Sampling Site 3 was located adjacent to the Music Marina. The substrate was unconsolidated fines. The water depth averaged 1.5 m. The site was densely vegetated with milfoil, coontail, Richardson's pondweed, curly pondweed, Canada waterweed, Tape grass and white water-lily. Algae was present within this transect. The aquatic vegetation provided 40-50% cover and had reached 75% of the column height or to surface by the July 20, 2010 visit. The shoreline was rocky with cattails and deciduous trees. By the fall visit, the vegetation had reached the surface with up to 100% cover and was dominated by milfoil, Canada waterweed and stonewort. The area immediately adjacent to the Music Marina contained less vegetation. Curly pondweed was also observed at this site during the spring visit.

2.2.2.2.6 Sampling Site 4 – Nearshore Habitat Description

Sampling Site 4 substrate was unconsolidated fines. The water depth averaged 1.5 m. The site was densely vegetated with milfoil, Tape grass, white water-lily, Canada waterweed, coontail, and bladderwort. The aquatic vegetation provided 90% cover and had reached the surface by the July 20, 2010 visit. There was some rock protection along the banks.

2.2.2.2.7 Mid Channel Investigations

As shown on Figure 2-3, the mid channel was sampled at four locations, Sampling Sites 5 to 8.

2.2.2.2.8 Sampling Site 5 – Mid Channel Habitat Description

Sampling Site 5 was located approximately 180 m to the north of the Belle Island shoreline. The substrate was unconsolidated fines with an average water depth averaged 1.5 m. The site was densely vegetated with Tape grass, Eurasian milfoil, pondweed, and Canada waterweed. The aquatic vegetation provided 60-90% cover and had reached 50-90% of the column height some to the surface by the July 20, 2010 visit. By the fall visit, the aquatic vegetation had reached the surface and provided 100% cover. The dense milfoil present within this site made sampling difficult.

2.2.2.2.9 Sampling Site 6 – Mid Channel Habitat Description

Sampling Site 6 transected the dredged channel leading to/from the Music Marina on the western shore. The substrate was unconsolidated fines and averaged 1.7 m deep. The site was vegetated with Eurasian milfoil, Tape grass, pondweed, Canada waterweed, coontail and Richardson's pondweed. The aquatic vegetation provided 30-75% cover and had reached 30-75% of the column height by the July 20 visit. Within the dredged channel, there was less cover (<5%-30%) and the column height was up to 75%. By the fall visit, the vegetation had reached the surface with abundant cover (>75% cover), though it remained sparse within the dredged channel.

2.2.2.2.10 Sampling Site 7 – Mid Channel Habitat Description

Sampling Site 7 substrate was unconsolidated fines and had an average depth of 1.6 m. The site was vegetated with Tape grass, pondweed, milfoil and Richardson's pondweed. The aquatic vegetation provided 80-90% cover and had reached 30-50% of the column height by the July 20 visit. By the fall visit, the aquatic vegetation community was dominated by milfoil, extremely dense (at over 75% cover) and had reached the surface.

2.2.2.2.11 Sampling Site 8 – Mid Channel Habitat Description

Sampling Site 8 substrate was unconsolidated fines, with an average depth of 1.4 m. The site was vegetated with Tape grass, pondweed, milfoil and Richardson's pondweed, coontail and Canada waterweed. The aquatic vegetation provided 80-70% cover and had reached 50% of the column height by the July 20 visit. By the fall visit, the vegetation was dominated by milfoil and Tape grass. It was very dense and had reached the surface.

2.2.2.3 East Side Investigations

As shown in Figure 2-3, along the eastern shoreline habitat transects (completed by wading) were established at Transect Sites C, D and E. The nearshore area habitat and community were sampled at Sites 9 to 12.

2.2.2.3.1 Transect Site C – Shoreline Habitat Description

The Transect Site C shoreline was fully vegetated primarily by reed canary grass and broad-leaved cattail. Other species included woolgrass, hedge bindweed, spotted jewelweed. There were no trees along the immediate shoreline but some crack willows further back. The shoreline had a steeper slope than at the other sites, reaching 0.94 m at a distance of 8 m from shore. There was some blow along the shoreline.

As illustrated on Figure 2-6, emergents (cattails) were present along the first 2 m of the transect. Submergents were present beginning at 5 m from shore (with <30% cover and <30% column height). The submergent vegetation became denser past 6 m, reaching 70% cover and 75% of the column height by 8 m. The submergent vegetation consisted of Tape grass, Canada waterweed, pale water-milfoil, and flat-stem pondweed. The substrate contained more boulders along the first 5 m followed by a mixture of boulders and fines at 7 m and changing to primarily fines by 8 m. The substrate was firm. The aquatic cover types include submergent, emergent and dislodged aquatic vegetation with scattered boulders. The shoreline was protected with float quarry rocks at this location.

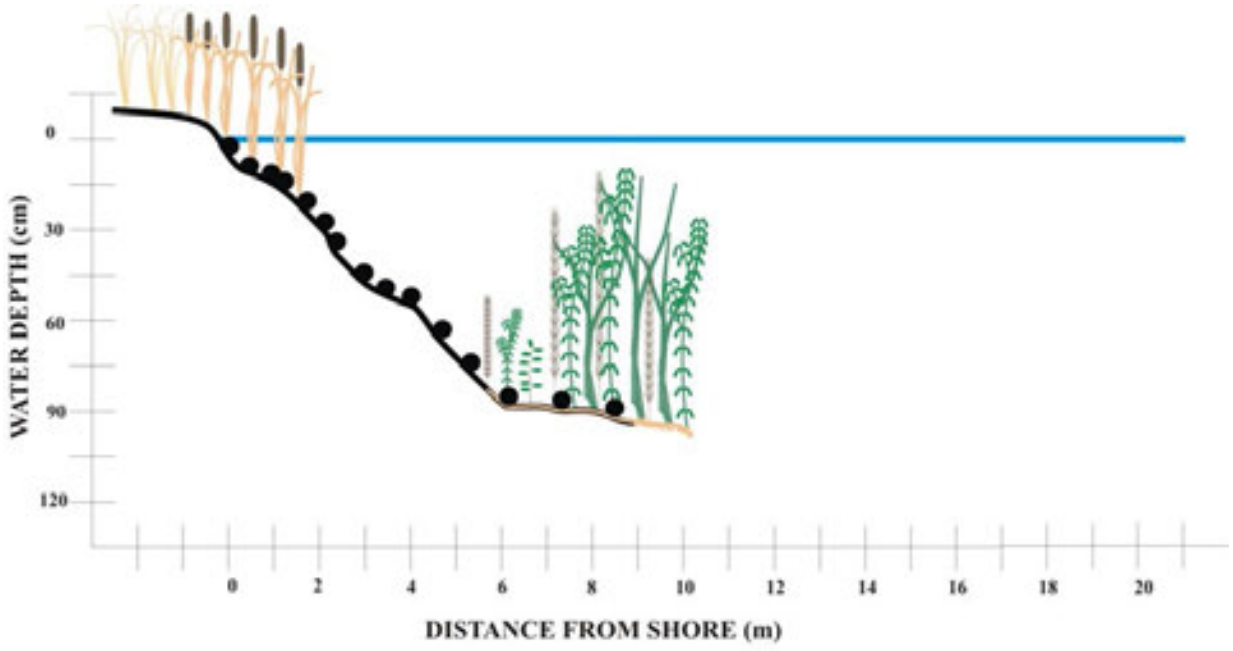


Figure 2-6: Transect Site C – Shoreline Habitat Profile

2.2.2.3.2 Transect Site D – Shoreline Habitat Description

The Transect Site D stream banks were fully vegetated with reed canary grass, hog-peanut, black medick, common buckthorn, red-osier dogwood, red oak, crack willow, and white ash. There was some exposed soil along the shoreline. The shoreline had a gradual slope and was rocky. The water clarity was very poor, and it was difficult to accurately estimate the amount of vegetation cover. As shown on Figure 2-7, the offshore topography was very gentle. A 1-m depth was reached at a distance of 13 m from shore. The substrate was firm and consisted of fines and cobbles with large boulders along the first 10 m. There was no emergent vegetation within the wetted area. Submergent vegetation began near 6 m from shore with some Tape grass that provided 20% cover and had reached the surface. There was no vegetation between 7-9 m from shore. At 10 m, the substrate was a little less firm (sunk in 2 cm) and there was only the occasional cobble.

The submergent vegetation provided 50% cover and had only reached 30% of the column height. The submergent vegetation included stonewort, Tape

grass, Canada waterweed and flat-stem pondweed as well as some remnant milfoil. Carp were observed. The aquatic cover types included aquatic vegetation and as well as dislodged aquatic vegetation accumulating on shore. During the fall it was noted that the deeper area had become fully vegetated and had reached 75% of the column height.

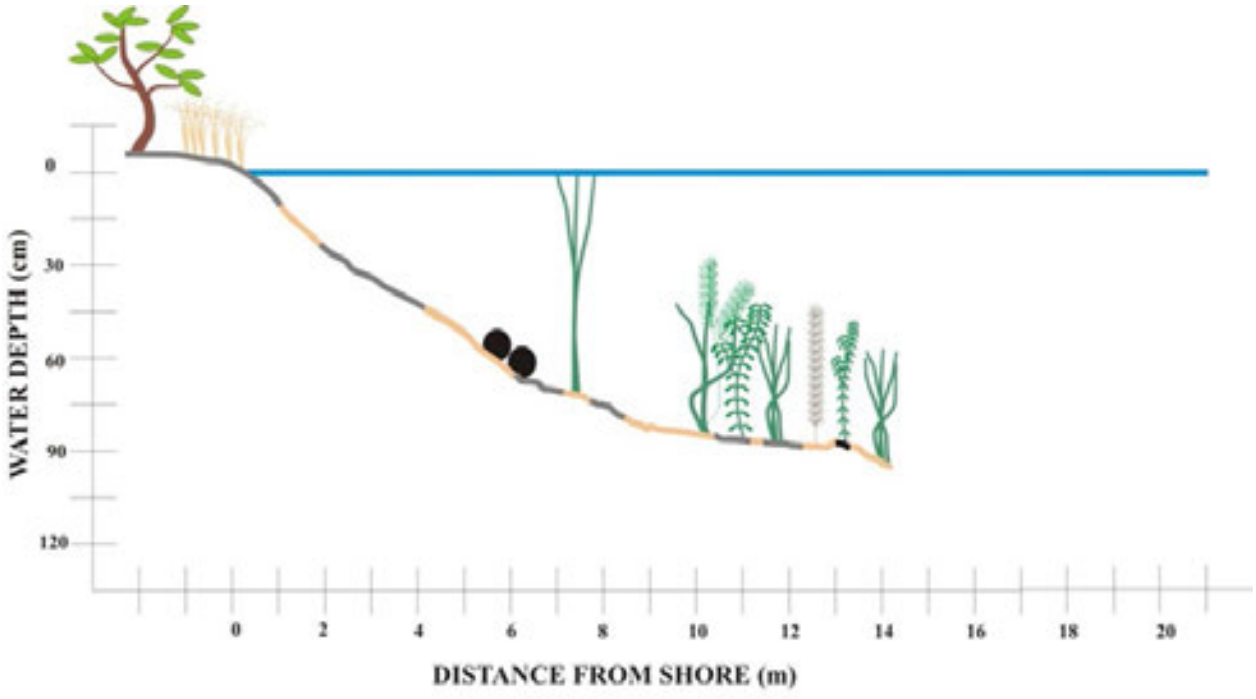


Figure 2-7: Transect Site D – Shoreline Habitat Profile

2.2.2.3.3 Transect Site E – Shoreline Habitat Description

The shoreline at Transect Site E was fully vegetated with cattails, reed canary grass, sensitive fern and clumps of nannyberry, white ash, field bindweed and meadowsweet. There was a small bank that was 0.30 m high and was composed of fines. As shown on Figure 2-8, the offshore topography was very gentle. A 1.1-m depth was reach at a distance of 18 m from shore. The substrate was firm but consisted of fines. There was no aquatic vegetation along this transect. During the fall visit sparse Canada waterweed and Tape grass were observed having 15-20% cover and <30% of column height.

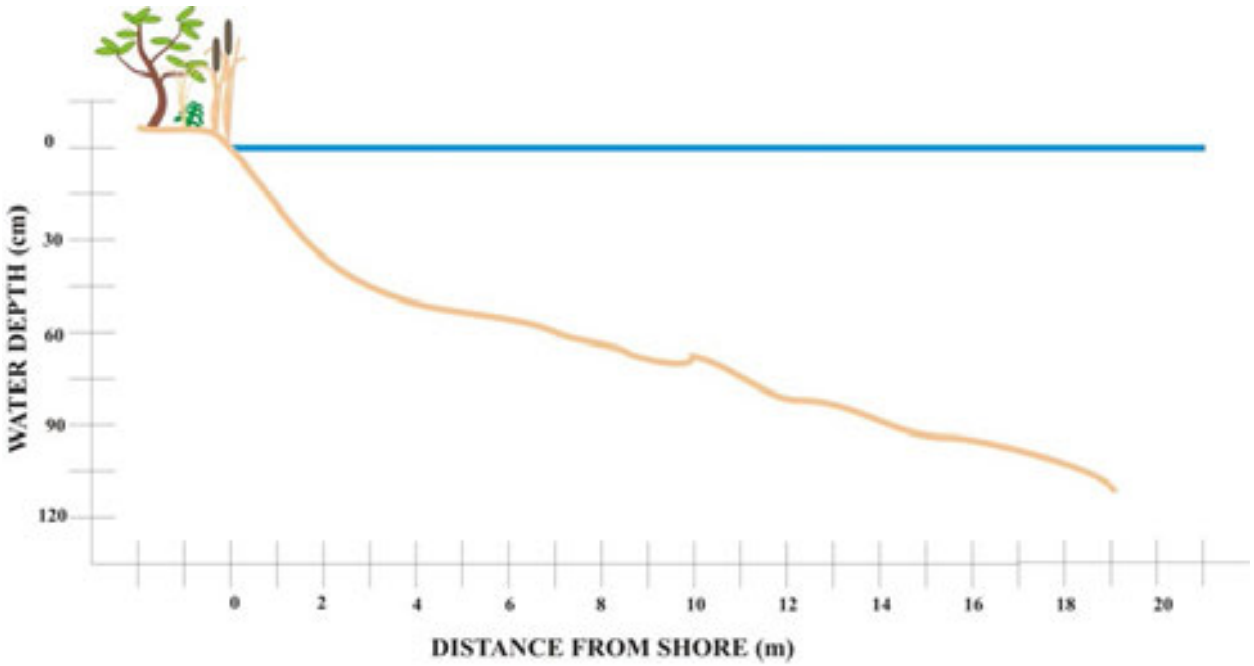


Figure 2-8: Transect Site E – Shoreline Habitat Profile

2.2.2.3.4 Sampling Site 9 – Nearshore Habitat Description

Sampling Site 9 substrate consisted of fines with an average water depth of 1.5 m. The site was poorly vegetated with Tape grass and the occasional milfoil. The aquatic vegetation provided 5% cover and had reached 30-70% of the column height by the July 20 visit. The amount of vegetation cover was difficult to establish due to the turbid water conditions. The shoreline was not developed, with some rock protection and cattails present.

2.2.2.3.5 Sampling Site 10 – Nearshore Habitat Description

Sampling Site water depth averaged 1.1 m. The site was vegetated with pondweed, Tape grass, and occasional Richardson's pondweed and stonewort. The aquatic vegetation provided 5% cover and had reached 50% of the column height by the July 20 visit.

2.2.2.3.6 Sampling Site 11 – Nearshore Habitat Description

Sampling Site 11 water depth averaged 1.5 m. The site was vegetated with Richardson's pondweed, Tape grass, coontail, milfoil, and Canada waterweed. The aquatic vegetation provided 5-10% cover and had reached 20-50% of the column height (with a few individuals having had reached the surface) by the July 20 visit. By the fall visit, the aquatic community had reached 75% of the column height and there was a patchy distribution of Tape grass.

2.2.2.3.7 Sampling Site 12 – Nearshore Habitat Description

Sampling Site 12 water depth averaged 0.7 m. The site was vegetated with Tape grass, coontail and milfoil. The aquatic vegetation provided 5-15% cover and had reached the surface by the July 20 visit.

2.2.2.4 Fish and Fish Habitat Usage Summary

The abundant littoral submerged and emergent vegetation communities within the Study Area, are expected to provide nursery refuge habitat for a variety of forage and CRA fish. The existing Rideau Canal is also expected to contribute by providing deeper cooler thermal refuge areas, overwintering habitat, a corridor for migraters and a conduit for predatory fish to move in, out and around the productive littoral area. The littoral habitat is expected to provide spawning opportunities for a variety of CRA and non CRA species, during baseline studies Young of Year (YOY) of several species were captured as shown in Table 2.4, confirming both that spawning is occurring within the Study Area and that the vegetated shallow waters are in fact being used as nursery habitat. The confirmed or potential uses of all species confirmed or likely using the Study Area is shown in Table 2.4 below.

Beyond the records reviews, baseline studies, literature review, agency consultation has provided the following comments that have been incorporated within Table 2.4:

1. Chinook and Coho salmon are known to migrate from Lake Ontario to Kingston Mills located upstream of the Study Area.
2. Yellow perch migrate and spawn during the spring in the Cataraqui River.
3. Northern pike spawn during the spring in the Cataraqui River.

4. There is a potential however not confirmed for muskellunge to utilize the Cataraqui River for spawning.
5. Sunfish (pumpkinseed and bluegill) and black crappie migrate and spawn in the Cataraqui River during late spring – early summer.
6. American eel migrates through the Study Area on route to waters further inland and back again during the spawning migration back towards the Atlantic Ocean.
7. Longnose gar have been observed spawning near the Study Area.
8. Largemouth bass spawn in the general area during late spring – early summer.

Table 2.4: Confirmed or Potential Uses of all Species Confirmed or Likely Using the Study Area

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Alewife	planktivore	cold	Prefer open water up to 60 m deep in cool open waters. In the Great Lakes large schools form near the thermocline (except Lake Superior).	In Ontario, landlocked Alewife move to inshore areas to spawn. Typically, spawning occurs in pairs or threes with eggs spread randomly over gravel and sand substrate.	Early spring	Low
American Eel	carnivores	cool	Catadromous, living in freshwater until sexual maturity.	Emigration from Lake Ontario's fresh water typically peaks between July and September. Return migration of juvenile-adult Yellow eels in the Lake Ontario watershed typically peaks between June and August.	Spawning takes place in the Winter within the Saragossa Sea.	Confirmed (Migration & Juvenile Habitat)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Banded Killifish	insectivore	cool	Quiet shallows with sand or gravel substrate and aquatic vegetation.	Occurs in, quiet heavily vegetated waters. Male pursues female until she extrudes an egg from a thread. Once the male fertilizes, female distributes small batches of adhesive eggs that stick to vegetation.	Summer	High (All Life Stages)
Black Crappie	insectivore/ piscivore	cool	Clear, quiet warm water of ponds, large lakes. Associated with abundant growths of aquatic vegetation and sand to mud bottoms. Prefer water temperatures 21-25°C.	Shallow depressions/nests created in areas with aquatic vegetation by male, may occur within a variety of substrates. Males will defend the nests until eggs hatch.	Spring	Confirmed (All Life Stages)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Blackchin Shiner	insectivore	cool	Clear water with aquatic vegetation and slow velocities.	Scatter or deposit adhesive eggs onto submerged live or dead aquatic plants or recently flooded live terrestrial vegetation.	Spring - summer	High (All Life Stages)
Blacknose Shiner	insectivore	cool/ warm	Clear water with aquatic vegetation, shallow depths and slow velocities.	Spawns over sand and aquatic vegetation.	Summer	High (General Adult Habitat)
Bluegill	insectivore	warm	Prefers shallow, well vegetated areas with slow or no flow.	Shallow depressions created in areas with firm bottom. May occur within a variety of substrates. Adhesive eggs. Males defend nests.	Late spring - Summer	Confirmed (All Life Stages)
Bluntnose Minnow	omnivore	warm	Wide range of shallow habitats, typically in warm waters of lakes or streams	Shallow nest created underneath cover (log, stone). Male continuously guards eggs until they hatch.	Summer	High (General Adult Habitat)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Bowfin	carnivore	warm	Found in shallow waters with no of little flow that are heavily vegetated.	Nests created by clearing debris such as sticks and leaves, occurs within shallow waters with aquatic vegetation.	Spring	High (All Life Stages)
Brook Silverside	insectivore	warm	Found in the surface waters of clear streams and nearshore lakes.	Females release eggs with adhesive filamentous fibers that attach to vegetation. Brook silverside are fractional spawners, releasing sperm/eggs in intervals within Spring-summer.	Spring - summer	High (All Life Stages)
Brown Bullhead	omnivore	warm	Shallow, slow moving water with abundant aquatic vegetation or woody cover.	Vegetation and rock debris are cleared to form a saucer shaped nest where spawning occurs. Both parents guard eggs and hatchlings until youth are approximately 50 mm in length.	Late spring-Early summer	High (General Adult Habitat)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Carp	omnivore	warm	Warm vegetated areas of slow-moving rivers and lakes.	Spawning occurs in shallow weedy areas. One female may spawn with several males at once, releasing upwards of 1000,000 eggs at once. No parental care is provided.	Spring - Summer	High (All Life Stages)
Central Mudminnow	insectivore/ omnivore	cool	Ponds and pools with dense aquatic vegetation.	Spawning occurs in shallow weedy areas. Fertilized eggs stick to aquatic vegetation.	Spring	High (All Life Stages)
Chinook Salmon	carnivore	cold	Spends most of life in cold waters within great lakes, typically gather at river mouths in late summer/fall before migrating upstream to spawn.	Females hollow out spawning nests (redds) in stream and tributary riffle areas and pair up with a male to spawn. Males and females may spawn several times and die shortly thereafter.	Late summer - Fall	Confirmed (Migration)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Coho Salmon	carnivore	cold	Deep cold waters of the Great Lakes, spawning in upstream streams	Females hollow out spawning nests (redds) in stream and tributary riffle areas and pair up with a male to spawn. After egg fertilization the female covers the eggs with gravel and guards the nest as long as she can. Both adults die shortly after spawning.	Fall	Confirmed (Migration)
Eastern Silvery Minnow	herbivore/ detrivore	cool	Prefers slow moving small to large rivers with dense macrophytes. Slight preference for sand and gravel bottoms.	Schools migrate into shallows of creeks and backwaters. Several males will surround a female, eggs and sperm are released onto substrate.	Spring	High (All Life Stages)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Gizzard Shad	herbivore	cool	Nearshore and pelagic waters of Great Lakes and turbid vegetated tributaries	Individuals group together near the surface of the water releasing sperm and eggs. Eggs drift downward and stick to aquatic vegetation and bottom substrate.	Early Spring - Summer	Low
Golden Shiner	omnivore	cool	Clear water with aquatic vegetation and slow velocities.	Eggs and sperm are released, and adhesive eggs are deposited on algae and submerged aquatic vegetation.	Late spring – Late summer	High (All Life Stages)
Johnny Darter	insectivore	cool	Variety of habitats but prefers areas with moderate to no current over sandy or mixed substrate.	Males clean a spawning nest on the underside of a rock. After courting a female, a female will release eggs upside down within a male's nest. The male then immediately fertilizes the eggs and guards the nest.	Spring	High (General Adult Habitat)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Largemouth Bass	insectivore/ piscivore	warm	Prefers shallow bays and lakes over rivers. Strongly associated with soft substrate and aquatic vegetation or large woody debris.	Males create a nest in sand/mud substrate within shallow waters with aquatic vegetation. After fertilization, eggs adhere to vegetation. The male guards the eggs and young.	Late summer	Confirmed (All Life Stages)
Longnose Gar	piscivore	warm	Slow moving water, pools, in heavily vegetated areas of lakes and rivers. Often associated with woody debris.	Spawn in shallow waters of lakes and streams. Males and females swim together releasing eggs and sperm over vegetation. The large eggs are adhesive and stick to the vegetation.	Spring - summer	High (All Life Stages)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Muskellunge	piscivore	Cool	Cool waters of lakes and larger rivers and streams. Typically, near aquatic plants	Return the shallow heavily vegetated floodplains of streams or lakes to spawn. Males and females may spawn several times over a week-long period in the Spring.	Spring	High
Northern Pike	piscivore	cool	Wide variety of cool water habitats ranging from headwaters to near shore areas of the Great Lakes	Migrates to shallow heavily vegetated floodplains of streams or lakes. Deposits eggs onto submerged live or dead aquatic plants or recently flooded live terrestrial plants.	Early spring	(All Life Stages)
Pumpkinseed	insectivore	warm	Prefers slow moving water with aquatic vegetation or small woody debris.	Shallow depressions created in areas with aquatic vegetation. May occur within a variety of substrates. Adhesive eggs. May mate several times.	Late spring - early summer	Confirmed (All Life Stages)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Rock Bass	insectivore/ piscivore	cool	Rocky areas in lakes and streams. Prefers water temp between 15-21°C	Creates nests in rock and gravel, male guards eggs and young hatchlings.	Late spring - early summer	High (General Adult Habitat)
Round Goby	invertivore	cool	Found in the lower waters of rivers and in the nearshore habitat of lakes. Invasive species	Nests are created in small cavities under rocks and logs. Female lays eggs (80-600) on a hard surface within the nest. Male will defend nest and young juveniles. The male will die after spawning.	Spring - summer (May - July)	High (All Life Stages)
Smallmouth Bass	omnivore	cool	Typically found over rock bottoms of lakes and rivers, under cover including rocks, logs and docks.	Creates nests in sand and gravel, in shallow water near woody debris or dense vegetation. Males often reuse nesting locations year to year.	Spring-Summer	High (General Adult Habitat – Within the Navigation Channel)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
White Perch	carnivore	Cool	Great Lakes and their lower tributaries	Broadcast spawners over a variety of substrates in shallow waters where eggs adhere to vegetation, logs of the bottom.	Spring (May-June)	High (All Life Stages)
White Sucker	insectivore/ omnivore	cool	Wide range of habitat types, often slow-moving water, pools near the substrates.	Migrate upstream to areas of gravelly bottoms. Males and females group together and release eggs/sperm, fertilized eggs adhere to gravel.	Spring (April-May)	High (General Adult Habitat)
Yellow Bullhead	insectivore	warm	Shallow, slow moving water with some aquatic vegetation.	Nests are created by the male and female in sediment. Eggs and sperm are released into the nest, the males guard the eggs and young juveniles until they reach approximately 50 mm in length.	Spring - summer (May - June)	High (General Adult Habitat)

Species Name	Trophic Class	Thermal Regime	General Habitat (Adult)	Reproduction Habitat or Process	Spawning Period	Likelihood (Anticipated Usage)
Yellow Perch	insectivore/ piscivore	cool	Variable prefer open water with some aquatic vegetation, slow moving water.	Spawning typically occurs at night over vegetation or woody debris. Female is surrounded by males and releases a semi-buoyant gelatinous mass of eggs adhesive eggs, which attach to aquatic vegetation or bottom.	Spring	Confirmed (All Life Stages)

In addition to the finned fish noted above, 15 potential native mussel species were found to be occurring within the regional areas as a result of the records review as shown in Table 2.5. Habitat preferences for each species has been crossed referenced with available habitat within the Study Area to determine the likelihood of the species occurring. Any thought to occur or have potential to occur are carried into the effects assessment in Section 3.

Table 2.5 Identified Mussel Likelihood of Using the Study Area

Common Name	Known Habitat Preferences	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area
Mucket	**Depth**:1 m or less **Flow**: Riffles with strong current but also quiet water in streams. **Substrate**: Range from cobble and gravel to sand and mud.	None	Low
Elktoe	**Depth**:1 m or less. **Flow**: Moderate to Fast Current. Medium to Large Rivers. Riffles **Substrate**: Mixture of gravel and sand.	None	Low
Triangle Floater	Northern populations prefer small streams towards headwaters of watershed, whereas southern populations can be found in large rivers in mud/sand with moderate current. **Depth**: Indistinct. **Flow**: Steady flow as opposed to riffles/rough water. **Substrate**: Coarser to finer gravel with sand and mud.	Potential available at northern end of Study Area immediately below Highway 401	Moderate

Common Name	Known Habitat Preferences	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area
Cylindrical papershell	Thought to inhabit small streams, creeks, and lakes. Individuals have been found throughout the St. Lawrence system and Great Lakes **Depth**: Shallow/ 1 m or less. **Flow**: Steady flow as opposed to riffles/rough water. **Substrate**: Silt, sand or fine gravel.	Potential available at northern end of Study Area immediately below Highway 401	Moderate
Eastern Elliptio	Found in freshwater lakes, ponds, streams, and rivers in all substrate types. Not likely to occur in high gradient streams where no other mussels occur.	Potential Habitat Throughout	Moderate
Spike	Found in freshwater lakes, ponds, streams, and rivers in all substrate types.	Potential Habitat Throughout	Moderate
Plain Pocketbook	Found in freshwater lakes, ponds, streams, and rivers in all substrate types.	Potential Habitat Throughout	Moderate
Creek Heelplitter	Can be found throughout a watershed but typically prefers headwater streams of small or medium rivers. It does often occupy large rivers in soft mud bottoms with slow moving currents near the edge of the river.	Possible Shoreline Usage	Moderate

Common Name	Known Habitat Preferences	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area
Fluted-Shell	**Depth**: Indistinct **Flow**: Medium to Large Rivers, often in riffles or runs. **Substrate**: sand or mud. In slow moving rivers it can be found in fine gravel.	Potential available at northern end of Study Area immediately below Highway 401	Moderate
Fragile Papershell	Found in small streams in strong current with coarse gravel and sand substrates but also rivers or river-lakes possessing slow current and a firm substrate composed of sand and mud. **Depth**: 30 cm to 6 m **Flow**: Variable **Substrate**: Variable	None	Low
Black sandshell	**Depth**: 0.1 to 3 m **Flow**: Medium to large rivers with strong current. **Substrate**: Coarse sand and gravel with cobbles	None	Low
Pink Heelsplitter	**Depth**: N/A **Flow**: Variable **Substrate**: clay, clay mixed with silt, sand, pea gravel and sand, and cobble/sand/silt	Potential available at northern end of Study Area immediately below Highway 401	Moderate

Common Name	Known Habitat Preferences	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area
Eastern Floater	The eastern floater exists in a variety of habitat types including small streams, creeks, rivers, ponds, lakes, and marshes. It is usually found in slow moving backwaters or standing waters in fine sand, silt, or muddy substrates. **Depth**: N/A **Flow**: Slow moving or still waters **Substrate**: sand, silt or mud.	Potential Habitat Throughout	Moderate
Giant Floater	**Depth**: Variable, from shallow creeks to deep Impoundments. **Flow**: Slow moving or still waters **Substrate**: sand, silt or mud.	Potential Habitat Throughout	Moderate
Creeper	**Depth**: shallow **Flow**: Small streams and rivers **Substrate**: Sand, cobble or gravel.	None	Low

2.2.3 Bird and Bird Habitat

The Study Area is located along the Cataraqui River near the north shore of Lake Ontario, a region considered important for migratory and non migratory birds. Although not located within a designated Important Bird Area, the Study Area is centralized between four Important Bird Areas; Wolfe Island 4 km to the southeast, Amherst Island 12.9 km to the southwest, Napanee limestone plain 10.4 km to the west and Frontenac Forest 17.8 km to the north (Figure 2-9).

Figure 2-9: Bird Studies Canada and Nature Canada – Important Bird Areas

The proximity to these important bird areas, combined with the habitat diversity and relatively large human population in the Kingston area, has resulted in robust Ontario Breeding Bird Atlas (OBBA) records. The OBBA data indicates that 202 bird species have been observed within approximately 5 km of the Study Area. Table 2.6 below outlines the OBBA results. Of the 202 OBBA species, 66 species were observed within the Study Area during

field investigations. Species that were observed during field investigations are marked with an asterisk (*). In addition to the 66 OBBA species observed on the site, bufflehead, Common Moorhen, Great-crested Flycatcher and Northern Rough-winged Swallow were also observed during field investigations. It is acknowledged that neither the OBBA, previous wildlife surveys or incidental reports have been completed during the appropriate timeframe to document the number of waterfowl that may use the Study Area as a stopover during the spring or fall migratory period, however antidotal information presented in the ESR indicates a relative high usage by waterfowl during the migratory seasons, with thousands of individuals from dozens of species. The IPD team is working with PCA to develop a spring and fall monitoring program to further document usage during and after construction as proposed in Section 8.

Table 2.6: Birds Species Recorded within ~5 km of the Study Area and Their Potential to Nest

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Alder Flycatcher	Empidonax alnorum	-	-	-	Thicket; Forest (Regenerating)	Yes
American Bittern	Botaurus lentiginosus	-	-	-	Wetland	Yes
American Black Duck*	Anas rubripes	-	-	-	Wetland	Yes
American Coot*	Fulica americana	-	-	-	Wetland	Yes
American Crow	Corvus brachyrhynchos	-	-	-	Forest; Riparian; Meadow; Urban	Yes
American Goldfinch*	Spinus tristis	-	-	-	Regenerating Forest; Meadow/Oldfield	Yes
American Kestrel	Falco sparverius	-	-	-	Grasslands; Meadow/Oldfield; Urban	Yes
American Redstart*	Setophaga ruticilla	-	-	-	Forest; Forest Edge	Yes
American Robin*	Turdus migratorius	-	-	-	Forest; Riparian; Urban	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
American Wigeon*	Anas americana	-	-	-	Upland Shoreline	Yes
American Woodcock	Scolopax minor	-	-	-	Forest	Yes
Bald Eagle*	Haliaeetus leucocephalus	-	-	SC	Riparian, Upland Shoreline	Yes
Baltimore Oriole*	Icterus galbula	-	-	-	Forest; Forest Edge; Urban	Yes
Bank Swallow	Riparia	THR	-	THR	Riparian (Sand/Gravel Banks), Industrial (Gravel Pits)	No
Barn Owl	Tyto alba	END	-	END	Rural (Structures)	No
Barn Swallow*	Hirundo rustica	THR	-	THR	Urban/Rural (Structures)	Yes
Barred Owl	Strix varia	-	-	-	Forest	Yes
Belted Kingfisher*	Megaceryle alcyon	-	-	-	Riparian (Sand/Gravel Banks)	No
Black Tern*	Chlidonias niger	-	-	SC	Wetland	Yes
Black-backed Woodpecker	Picoides arcticus	-	-	-	Forest Edge (Coniferous)	No

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Black-billed Cuckoo	Coccyzus erythropthalmus	-	-	-	Forest; Riparian; Thicket	Yes
Blackburnian Warbler	Setophaga fusca	-	-	-	Forest	Yes
Black-capped Chickadee*	Poecile atricapillus	-	-	-	Forest; Riparian; Thicket; Urban	Yes
Black-crowned Night-Heron	Nycticorax nycticorax	-	-	-	Forest Edge; Wetland	Yes
Black-throated Blue Warbler	Setophaga caerulescens	-	-	-	Forest	Yes
Black-throated Green Warbler	Setophaga virens	-	-	-	Forest	Yes
Black-and-white Warbler	Mniotilta varia	-	-	-	Forest	Yes
Blue Jay*	Cyanocitta cristata	-	-	-	Forest; Forest Edge; Urban	Yes
Blue-gray Gnatcatcher	Polioptila caerulea	-	-	-	Forest; Riparian; Wetland (Swamps)	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Blue-headed Vireo	Vireo solitarius	-	-	-	Forest	Yes
Blue-winged Teal	Anas discors	-	-	-	Wetland; Riparian (open areas)	Yes
Blue-winged Warbler	Vermivora cyanoptera	-	-	-	Forest Edge; Upland; Thicket; Oldfield	Yes
Bobolink	Dolichonyx oryzivorus	THR	-	THR	Grassland; Oldfield	No
Broad-winged Hawk	Buteo platypterus	-	-	-	Forest	Yes
Brown Creeper	Certhia americana	-	-	-	Forest	Yes
Brown Thrasher	Toxostoma rufum	-	-	-	Thicket; Forest Edge	Yes
Brown-headed Cowbird*	Molothrus ater	-	-	-	Forest Edge; Grasslands; Oldfield; Urban; Riparian	Yes
Canada Goose*	Branta canadensis	-	-	-	Wetland	Yes
Canada Warbler	Cardellina canadensis	THR	-	SC	Forest; Thicket (dense)	No

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Canvasback	Aythya valisineria	-	-	-	Wetland	Yes
Carolina Wren*	Thryothorus ludovicianus	-	-	-	Ravine; Forest Edge; Urban	Yes
Caspian Tern*	Hydroprogne caspia	-	-	-	Wetland	Yes
Cedar Waxwing*	Bombycilla cedrorum	-	-	-	Forest; Forest Edge	Yes
Cerulean Warbler	Setophaga cerulea	END	-	THR	Forest (Interior)	No
Chestnut-sided Warbler	Setophaga pensylvanica	-	-	-	Forest; Thicket	Yes
Chimney Swift	Chaetura pelagica	THR	-	THR	Urban	Yes
Chipping Sparrow*	Spizella passerina	-	-	-	Forest Edge; Urban	Yes
Chuck-will's-widow	Antrostomus carolinensis	-	-	-	Thicket; Meadow	No
Clay-colored Sparrow	Spizella pallida	-	-	-	Thicket; Oldfield; Meadow	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Cliff Swallow	Petrochelidon pyrrhonota	-	-	-	Urban (Bridge Structures); Cliffs	Yes
Common Goldeneye*	Bucephala clangula	-	-	-	Riparian; Upland Forest (near shore)	Yes
Common Grackle*	Quiscalus quiscula	-	-	-	Forest; Forest Edge; Urban	Yes
Common Loon	Gavia immer	-	-	-	Shoreline	Yes
Common Merganser*	Mergus merganser	-	-	-	Riparian; Upland Forest (near shore)	Yes
Common Gallinule	Gallinula chloropus	-	-	-	Wetland	Yes
Common Nighthawk	Chordeiles minor	SC	-	SC	Open Areas (rocky); Forest Clearings	Yes
Common Raven	Corvus corax	-	-	-	Cliffs; Forest; Urban	Yes
Common Snipe	Gallinago gallinago	-	-	-	Wetland	Yes
Common Tern*	Sterna hirundo	-	-	-	Wetland; Open Shoreline	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Common Yellowthroat*	Geothlypis trichas	-	-	-	Wetland; Oldfield	Yes
Cooper's Hawk	Accipiter cooperii	-	-	-	Forest; Forest Edge	Yes
Dark-eyed Junco	Junco hyemalis	-	-	-	Forest; Forest Edge	Yes
Double-crested Cormorant*	Phalacrocorax auritus	-	-	-	Open Areas (near shore); Forest Edge (sparsely treed)	Yes
Downy Woodpecker*	Picoides pubescens	-	-	-	Forest; Forest Edge	Yes
Eastern Bluebird	Sialia sialis	-	-	-	Grasslands; Oldfield; Meadow	Yes
Eastern Kingbird*	Tyrannus tyrannus	-	-	-	Forest Edge; Riparian	Yes
Eastern Meadowlark	Sturnella magna	THR	-	THR	Grassland; Oldfield; Meadow	Yes
Eastern Phoebe*	Sayornis phoebe	-	-	-	Forest Edge; Urban	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Eastern Screech-Owl	Megascops asio	-	-	-	Forest; Urban	Yes
Eastern Towhee	Pipilo erythrophthalmus	-	-	-	Thicket; Forest (dense)	Yes
Eastern Wood-pewee	Contopus virens	SC	-	SC	Forest	Yes
European Starling	Sturnus vulgaris	-	-	-	Forest Edge; Urban	Yes
Evening Grosbeak	Coccothraustes vespertinus	SC	-	SC	Forest	Yes
Field Sparrow	Spizella pusilla	-	-	-	Grassland; Meadow; Oldfield	Yes
Forster's Tern	Sterna forsteri	-	-	-	Wetland	Yes
Gadwall*	Anas strepera	-	-	-	Grassland (near shore)	Yes
Golden-crown Kinglet	Regulus satrapa	-	-	-	Forest; Forest Edge	Yes
Golden-winged Warbler	Vermivora chrysoptera	THR	-	SC	Forest Edge; Meadow	Yes
Great Crested Flycatcher	Myiarchus crinitus	-	-	-	Forest	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Grasshopper Sparrow	Ammodramus savannarum	SC	-	SC	Grassland; Meadow; Oldfield	Yes
Gray Catbird*	Dumetella carolinensis	-	-	-	Thicket; Forest Edge	Yes
Gray Partridge	Perdix perdix	-	-	-	Meadow; Oldfield	Yes
Great Black-backed Gull †	Larus marinus	-	-	-	Shoreline (open); Rocky Outcrops	Yes
Great Blue Heron*	Ardea herodias	-	-	-	Wetland; Shoreline (treed)	Yes
Great Horned Owl	Bubo virginianus	-	-	-	Forest; Urban	Yes
Green Heron*	Butorides virescens	-	-	-	Wetland; Shoreline (treed)	Yes
Green-winged Teal	Anas crecca	-	-	-	Grassland/Meadow (near shore)	Yes
Hairy Woodpecker*	Picoides villosus	-	-	-	Forest; Forest Edge	Yes
Henslow's Sparrow	Ammodramus henslowii	END	-	END	Grassland (large contiguous)	No

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Hermit Thrush	Catharus guttatus	-	-	-	Forest; Forest Edge; Thicket	Yes
Herring Gull*	Larus argentatus	-	-	-	Open Shoreline; Rocky Outcrops	Yes
Hooded Merganser*	Lophodytes cucullatus	-	-	-	Forest Edge (near shore)	Yes
Hooded Warbler	Setophaga citrina		-		Forest Edge; Thicket	Yes
Horned Lark	Eremophila alpestris	-	-	-	Grassland; Oldfield	Yes
House Finch*	Haemorhous mexicanus	-	-	-	Forest Edge; Urban	Yes
House Sparrow*	Passer domesticus	-	-	-	Urban	Yes
House Wren*	Troglodytes aedon	-	-	-	Forest Edge; Urban	Yes
Indigo Bunting	Passerina cyanea	-	-	-	Forest Edge; Oldfield; Meadow	Yes
Killdeer*	Charadrius vociferus	-	-	-	Urban (open areas); Oldfield; Grassland (short-grass)	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
King Rail*	Rallus elegans	END	-	END	Wetland	Yes
Least Bittern*	Ixobrychus exilis	THR		THR	Wetland	Yes
Least Flycatcher	Empidonax minimus	-	-	-	Forest	Yes
Lesser Scaup*	Aythya affinis	-	-	-	Grassland (near shore); Wetland	Yes
Lincoln's Sparrow	Melospiza lincolnii	-	-	-	Oldfield; Forest Edge; Wetland (bog)	Yes
Loggerhead Shrike	Lanius ludovicianus	END	-	END	Grassland (large contiguous); Oldfield	No
Long-eared Owl	Asio otus	-	-	-	Forest	Yes
Louisiana Waterthrush	Parkesia motacilla	THR	-	THR	Riparian; Forest (along streams)	No
Magnolia Warbler	Setophaga magnolia	-	-	-	Forest	Yes
Mallard*	Anas platyrhynchos	-	-	-	Shoreline; Wetland	Yes
Marsh Wren*	Cistothorus palustris	-	-	-	Wetland	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Merlin	Falco columbarius		-		Forest; Forest Edge; Urban	Yes
Mourning Dove*	Zenaida macroura	-	-	-	Forest Edge; Urban	Yes
Mourning Warbler	Geothlypis philadelphia	-	-	-	Forest Edge; Meadow	Yes
Mute Swan	Cygnus olor	-	-	-	Shoreline	Yes
Nashville Warbler	Oreothlypis ruficapilla	-	-	-	Forest	Yes
North Rough-winged Swallow	Stelgidopteryx serripennis	-	-	-	Riparian (Sand/Gravel Banks)	Yes
North Saw-whet Owl	Aegolius acadicus	-	-	-	Forest	Yes
Northern Waterthrush	Parkesia noveboracensis	-	-	-	Forest	Yes
Northern Bobwhite	Colinus virginianus	END	-	END	Grassland; Oldfield	No (locally extirpated)
Northern Cardinal*	Cardinalis cardinalis	-	-	-	Forest; Forest Edge; Urban	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Northern Flicker*	Colaptes auratus	-	-	-	Forest; Forest Edge	Yes
Northern Goshawk	Accipiter gentilis		-		Forest	Yes
Northern Harrier	Circus hudsonius		-		Wetland; Grassland	Yes
Northern Mockingbird	Mimus polyglottos	-	-	-	Forest Edge; Meadow	Yes
Northern Parula	Setophaga americana	-	-	-	Forest	Yes
Northern Pintail	Anas acuta	-	-	-	Wetland; Oldfield (near shore)	Yes
Northern Shoveler*	Anas clypeata	-	-	-	Shoreline; Wetland	Yes
Olive-sided Flycatcher	Contopus cooperi	SC	-	SC	Forest (boreal)	No
Orchard Oriole	Icterus spurius	-	-	-	Forest; Forest Edge; Riparian	Yes
Osprey*	Pandion haliaetus	-	-	-	Shoreline (treed); Wetland; Riparian	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Ovenbird*	Seiurus aurocapilla	-	-	-	Forest	Yes
Peregrine Falcon	Falco peregrinus	-	-	SC	Cliffs; Urban	No
Philadelphia Vireo	Vireo philadelphicus	-	-	-	Forest (mixed, boreal); Forest Edge	No
Pied-billed Grebe*	Podilymbus podiceps	-	-	-	Wetland	Yes
Pileated Woodpecker*	Dryocopus pileatus	-	-	-	Forest (mature)	No
Pine Grosbeak	Pinicola enucleator	-	-	-	Forest (boreal/coniferous)	No
Pine Siskin	Spinus pinus	-	-	-	Forest	Yes
Pine Warbler	Setophaga pinus	-	-	-	Forest	Yes
Prairie Warbler	Setophaga discolor		-		Grassland; Meadow; Oldfield	No
Purple Finch	Haemorhous purpureus	-	-	-	Forest	Yes
Purple Martin*	Progne subis	-	-	-	Riparian; Shoreline; Urban	Yes
Red Crossbill	Loxia curvirostra	-	-	-	Forest (boreal/mixed)	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Red-bellied Woodpecker	Melanerpes carolinus	-	-	-	Forest	Yes
Red-breasted Merganser	Mergus serrator	-	-	-	Wetland; Shoreline (thicket)	Yes
Red-breasted Nuthatch	Sitta canadensis	-	-	-	Forest	Yes
Red-eyed Vireo*	Vireo olivaceus	-	-	-	Forest	Yes
Redhead	Aythya americana	-	-	-	Wetland	Yes
Red-headed Woodpecker	Melanerpes erythrocephalus	END	-	SC	Forest Edge; Meadow	Yes
Red-shouldered Hawk	Buteo lineatus	-	-	-	Forest	Yes
Red-tailed Hawk	Buteo jamaicensis	-	-	-	Forest; Forest Edge; Meadow	Yes
Red-winged Blackbird	Agelaius phoeniceus	-	-	-	Wetland; Oldfield	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Ring-billed Gull*	Larus delawarensis	-	-	-	Shoreline (open areas); Rocky Outcrops	Yes
Ring-necked Duck*	Aythya collaris	-	-	-	Wetland	Yes
Ring-necked Pheasant	Phasianus colchicus	-	-	-	Grassland; Oldfield	Yes
Rock Dove	Columbia livia	-	-	-	Urban	Yes
Rose-breasted Grosbeak*	Pheucticus ludovicianus	-	-	-	Forest	Yes
Ruby-crown Kinglet	Regulus calendula	-	-	-	Forest	Yes
Ruby-throated Hummingbird*	Archilochus colubris	-	-	-	Forest Edge; Urban	Yes
Ruddy Duck	Oxyura jamaicensis	-	-	-	Wetland	Yes
Ruffed Grouse	Bonasa umbellus	-	-	-	Forest	Yes
Sandhill Crane	Grus canadensis	-	-	-	Wetland	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Savannah Sparrow	Passerculus sandwichensis	-	-	-	Grassland; Oldfield; Meadow	Yes
Scarlet Tanager	Piranga olivacea	-	-	-	Forest	Yes
Sedge Wren	Cistothorus platensis	-	-	-	Wetland	Yes
Sharp-shinned Hawk	Accipiter striatus	-	-	-	Forest	Yes
Sharp-tailed Grouse	Tympanuchus phasianellus	-	-	-	Forest Edge; Grassland	No
Short-eared Owl	Asio flammeus	SC	-	SC	Grassland; Wetland	Yes
Song Sparrow*	Melospiza melodia	-	-	-	Wetland; Grassland; Oldfield; Forest Edge	Yes
Sora	Porzana carolina	-	-	-	Wetland	Yes
Spotted Sandpiper*	Actitis macularius	-	-	-	Wetland; Shoreline; Riparian	Yes
Swainson's Thrush	Catharus ustulatus	-	-	-	Forest	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Swamp Sparrow*	Melospiza georgiana	-	-	-	Wetland	Yes
Tennessee Warbler	Oreothlypis peregrina	-	-	-	Forest (boreal)	No
Three-toed Woodpecker ‡	Picoides dorsalis	-	-	-	Forest (boreal)	No
Tree Swallow*	Tachycineta bicolor	-	-	-	Grasslands; Oldfield; Meadow; Forest Edge (open clearings)	Yes
Trumpeter Swan	Cygnus buccinator	-	-	-	Wetland; Shoreline	Yes
Tufted Titmouse	Baeolophus bicolor	-	-	-	Forest; Forest Edge	Yes
Tundra Swan*	Cygnus columbianus	-	-	-	Upland Tundra; Shoreline	No
Turkey Vulture	Cathartes aura	-	-	-	Forest Edge; Urban (abandoned structures)	Yes
Upland Sandpiper	Bartramia longicauda	-	-	-	Grassland (large contiguous)	No

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Veery	Catharus fuscescens	-	-	-	Forest	Yes
Vesper Sparrow	Pooecetes gramineus	-	-	-	Grassland; Oldfield	Yes
Virginia Rail	Rallus limicola	-	-	-	Wetland	Yes
Warbling Vireo*	Vireo gilvus	-	-	-	Forest	Yes
Whip-poor-will	Antrostomus vociferus	THR	-	THR	Forest; Forest Edge (open areas)	Yes
White-breasted Nuthatch*	Sitta carolinensis	-	-	-	Forest	Yes
White-throated Sparrow	Zonotrichia albicollis	-	-	-	Forest	Yes
White-winged Crossbill	Loxia leucoptera	-	-	-	Forest (boreal)	No
Wild Turkey	Meleagris gallopavo	-	-	-	Forest; Forest Edge (open)	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Willow Flycatcher	Empidonax traillii	-	-	-	Thicket; Wetland (shrubs)	Yes
Wilson's Phalarope	Phalaropus tricolor	-	-	-	Wetland	Yes
Wilson's Warbler	Cardellina pusilla	-	-	-	Forest Edge; Thicket	Yes
Winter Wren	Troglodytes hiemalis	-	-	-	Forest	Yes
Wood Duck*	Aix sponsa	-	-	-	Forest; Forest Edge; Wetland (Swamp)	Yes
Wood Thrush	Hylocichla mustelina	THR	-	SC	Forest	Yes
Yellow Warbler*	Setophaga petechia	-	-	-	Forest Edge; Wetland; Thicket	Yes
Yellow-bellied Flycatcher	Empidonax flaviventris	-	-	-	Forest (boreal); Wetland (bog)	No
Yellow-bellied Sapsucker	Sphyrapicus varius	-	-	-	Forest	Yes
Yellow-billed Cuckoo	Coccyzus americanus	-	-	-	Forest; Forest Edge (near water)	Yes

Species		At Risk Status			Nesting Habitat Preference	Potential Nesting Habitat in Study Area
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Yellow-breast Chat	Icteria virens	END	-	END	Thicket	No
Yellow-rumped Warbler	Setophaga coronata	-	-	-	Forest (mixed/boreal)	No
Yellow-throated Vireo	Vireo flavifrons	-	-	-	Forest	Yes

2.2.3.1 Bird Habitat

Based on the Ecological Land Classification (For ELC mapping and description refer to Section 2.3.4) the Study Area possesses a variety of habitats potential used by migratory birds, including the PSW, riparian areas, woodlands, thickets, residential areas, and there is also a limited amount of fragmented meadow where the potential for grassland nesting birds is relatively low.

The Greater Cataraqui Marsh PSW provides the greatest value to migratory birds within the Study Area. The PSW contains known nesting habitat for bitterns, waterfowl, gallinules, rails and Black Terns, as well as seasonal roosting for migratory swallows and stopover/foraging habitat for migratory waterfowl.

The active season for migratory birds, in accordance with the Migratory Bird Convention Act – with the exception of specific SAR birds discussed in Section 2.2.6, is early April through late August. Therefore, the conservative migratory bird breeding window is April 1 to August 31, with the caveat that migratory birds protected under the MBCA have such protections at any time of year (Government of Canada, 2018). Conversely, if no migratory breeding or nesting is occurring within the window for a specific area then certain Project activities can be completed.

2.2.4 Surface Water and Sediment Quality

2.2.4.1 Surface Water

As noted in the 1977 ‘Cataraqui River Basin Floodplain Management’ report (Crysler and Latham, 1977) and the 1984 ‘Natural Resource Description and Management Considerations: Cataraqui Marsh - Rideau Canal’ report (prepared by Blancher), the Cataraqui River watershed originates in the vicinity of Newboro, Ontario and has an attendant drainage area of 930 km² that drains southward to Lake Ontario. Most of the watershed is located in the Canadian Shield, and is characterized by numerous rock outcrops, shallow overburden and a predominance of lakes and low-lying swamp areas as seen documented within the Study Area. The Study Area has been and continuous to be subject to potential sources of contamination, including waste from industrial operations; urban and agricultural runoff; sewage and stormwater overflows; leachates from the City’s landfill at Belle Park; pollution from boat

traffic and Highway 401 surface waters. Several studies have examined the extent and sources of such contaminants; and despite various strategies and infrastructure improvements by the City and others, the Cataraqui River still experiences issues with nutrient enrichment, elevated bacteria counts, and high levels of certain metals.

The water levels within the Study Area are effectively controlled by Lake Ontario with the inputs from the upstream Cataraqui River having little influence. This was most recently witnessed in 2017 and 2019 when higher-than-average Lake Ontario water levels reached 75.8 and 75.91 m, respectively, the highest water levels recorded at any time of year on Lake Ontario since 1918. The hydro-mechanical properties of Lake Ontario are also known to create localized changes in lake levels. These changes are more frequent and have a shorter duration, typically represented by surges and waves created by wind blowing over Lake Ontario's open water, in particular southerly winds are known to cause increased water levels and, in some cases, reverse flows within the Study Area in short durations. This mixing zone of the Cataraqui River and Lake Ontario with greatest daily influence changing depending on the daily climatic conditions creates a unique and variable water quality environment within the Study Area. In order to demonstrate the baseline water quality conditions, water quality data was obtained from the Ontario Provincial (Stream) Water Quality Monitoring Network. Two water quality stations (Kingston Mills #12000400202 and Lasalle Causeway #12000400102) were reviewed with Kingston Mills located approximately 1km upstream from the Study Area. Five years of the latest data for each station was summarized by seasonal months and presented as averages based on the following:

- Spring: March, April, May, June
- Summer: July, August, September
- Fall: October, November.

Water quality averages were then compared to both the Provincial Water Quality Objectives (PWQO) and the Canadian Council of Ministers of the Environment (CCME) Guidelines. For many parameters the guidelines recommendation is based on another parameter (i.e. hardness), in these

cases the lowest seasonal average of the dependant parameter was used to develop a conservative guideline for the parameter requiring evaluation. As previously noted, the Study Area is prone to high nutrient levels, and therefore the provincial Phosphorus guideline has been set at 30 µg/L based on the following rationale outlined within the interim provincial water quality guidelines:

- A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10 µg/L or less. This should apply to all lakes naturally below this value.
- To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 20 µg/L.
- Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 30 µg/L.

Results for the two stations are discussed below:

Seasonal water quality averages from 2012 to 2016 at Kingston Mills are presented in Table 2.7. Based on seasonal averages over the five-year period, the following observations were noted:

- Cadmium exceeded Long Term CCME guidelines and PWQO in the Spring, Summer and Fall.
- Silver exceeded PWQO in the Fall.

Table 2.7: Seasonal Water Quality Averages from 2012-2016 at the Kingston Mills

Parameter	Units	Spring Average	Summer Average	Fall Average	PWQO	CCME	
						Short Term	Long Term
Alkalinity	mg/L	79.63	77.98	85.44	Alkalinity should not be decreased by more than 25% of the natural concentration.	N/A	N/A
Aluminium	ug/L	47.48	48.55	57.54	75	ND	100
Ammonium	mg/L	0.03	0.06	0.08	N/A	N/A	N/A
Barium	ug/L	29.59	30.93	36.36	N/A	N/A	N/A
Berylium	ug/L	0.04	0.04	0.04	1100	N/A	N/A
Bismuth	ug/L	<DL	<DL	0.02	N/A	N/A	N/A
Cadmium	ug/L	0.32	0.38	0.46	0.1	1	0.09
Calcium	mg/L	24.90	21.72	25.58	N/A	N/A	N/A
Carbon (Dissolved Inorganic)	mg/L	20.22	18.91	21.17	N/A	N/A	N/A
Carbon (Dissolved Organic)	mg/L	4.70	6.03	5.99	N/A	N/A	N/A
Chloride	mg/L	10.04	10.34	10.07	N/A	640	120
Chromium	ug/L	0.08	0.06	0.44	1	N/A	N/A
Cobalt	ug/L	0.00	0.15	0.23	0.9*	N/A	N/A

Parameter	Units	Spring Average	Summer Average	Fall Average	PWQO	CCME	
						Short Term	Long Term
Conductivity (25c)	USIEM/CM	212.17	201.80	215.67	N/A	N/A	N/A
Conductivity (Ambient)	UMHO/CM	230.00	199.56	287.43	N/A	N/A	N/A
Copper	ug/L	0.62	0.43	0.47	5	ND	2.02
Dissolved Oxygen	mg/L	11.05	8.07	11.48	>7	ND	>5.5
Hardness	mg/L	90.11	83.14	88.31	N/A	N/A	N/A
Iron	ug/L	64.76	86.38	89.14	300	N/A	300
Lead	ug/L	<DL	<DL	<DL	5*	ND	2.52
Lithium	ug/L	0.38	0.76	0.50	N/A	N/A	N/A
Magnesium	mg/L	6.78	6.78	6.69	N/A	N/A	N/A
Manganese	ug/L	18.98	55.91	26.49	N/A	N/A	N/A
Molybdenum	ug/L	0.35	0.67	0.69	40*	ND	73
Nickel	ug/L	0.06	0.45	0.82	25	ND	83.06
Nitrates	mg/L	0.15	0.05	0.09	N/A	550	13
Nitrite	mg/L	0.00	0.00	0.01	N/A	ND	60
Nitrogen (Total Kjeldahl)	mg/L	0.41	0.65	0.58	N/A	N/A	N/A
pH (Lab)		8.07	8.17	8.20	6.5-8.5	ND	6.5 - 9.0
pH (Field)		8.27	8.33	8.01	6.5-8.5	N/A	N/A
Phosphate	mg/L	0.00	0.01	0.01	N/A	N/A	N/A
Phosphorus	ug/L	20.00	30.00	30.00	30	ND	Variable

Parameter	Units	Spring Average	Summer Average	Fall Average	PWQO	CCME	
						Short Term	Long Term
Potassium	mg/L	1.24	1.20	1.15	N/A	N/A	N/A
Residue (Particulate)	mg/L	3.16	7.36	5.07	N/A	N/A	N/A
Silicates	mg/L	0.38	1.09	0.58	N/A	N/A	N/A
Silver	ug/L	<DL	<DL	0.11	0.1	NRG	0.25
Sodium	mg/L	6.85	7.17	6.26	N/A	N/A	N/A
Stream Condition		34.33	31.10	25.33	N/A	N/A	N/A
Strontium	ug/L	300.44	302.50	311.60	N/A	N/A	N/A
Temperature	°C	14.29	23.00	9.56	N/A	N/A	N/A
Tin	ug/L	<DL	<Dl	0.80	N/A	N/A	N/A
Titanium	ug/L	3.37	3.81	4.41	N/A	N/A	N/A
Uranium	ug/L	<DL	<DL	<DL	5*	33	15
Vanadium	ug/L	0.94	1.69	0.91	6*	N/A	N/A
Zinc	ug/L	6.27	4.18	3.69	30	37	7
Zirconium	ug/L	<DL	<DL	<DL	4*	N/A	N/A

DL: Laboratory Detection Limit
NRG: No Recommended Guidelines
ND: No data
N/A: Not Available
Guideline calculated using lowest average Hardness (mg/L)
Exceeds either the PWQO or CCME Guidelines

Seasonal water quality averages from 2009 to 2013 at Lasalle Causeway are presented in Table 2.8. Based on seasonal averages over the five-year period, the following observations were noted:

- Cadmium exceeded Long Term CCME guidelines in the Spring and Summer.
- Silver exceeded Long Term CCME Guidelines and PWQO in the Spring.

Table 2.8: Seasonal Water Quality Averages from 2009-2013 at the Lasalle Causeway

Parameter	Units	Spring Average	Summer Average	Fall Average	PWQO	CCME	
						Short Term	Long Term
Alkalinity	mg/L	89.93	87.61	92.83	Alkalinity should not be decreased by more than 25% of the natural concentration.	N/A	N/A
Aluminium	ug/L	58.19	39.24	62.90	75	ND	100
Ammonium	mg/L	0.04	0.03	0.06	N/A	N/A	N/A
Barium	ug/L	29.53	27.78	35.47	N/A	N/A	N/A
Berylium	ug/L	0.01	0.00	0.04	1100	N/A	N/A
Bismuth	ug/L	0.14	<DL	<DL	N/A	N/A	N/A
Cadmium	ug/L	0.32	0.36	0.10	0.5	1	0.09
Calcium	mg/L	28.19	28.33	29.53	N/A	N/A	N/A
Carbon (Dissolved Inorganic)	mg/L	21.09	20.44	22.57	N/A	N/A	N/A
Carbon (Dissolved Organic)	mg/L	4.27	4.51	4.50	N/A	N/A	N/A
Chloride	mg/L	14.37	18.07	14.77	N/A	640	120
Chromium	ug/L	0.00	0.06	0.26	1	N/A	N/A
Cobalt	ug/L	0.13	0.02	0.44	0.9*	N/A	N/A
Conductivity (25c)	USIEM/CM	241.32	257.15	255.67	N/A	N/A	N/A

Parameter	Units	Spring Average	Summer Average	Fall Average	PWQO	CCME	
						Short Term	Long Term
Conductivity (Ambient)	UMHO/CM	261.21	257.00	259.00	N/A	N/A	N/A
Copper	ug/L	1.09	1.02	1.05	5	ND	2.37
Dissolved Oxygen	mg/L	11.56	7.95	10.07	>7	ND	>5.5
Hardness	mg/L	101.81	104.07	100.10	N/A	N/A	N/A
Iron	ug/L	76.07	62.75	115.27	300	N/A	300
Lead	ug/L	0.45	1.29	<DL	5*	ND	3.19
Lithium	ug/L	<DL	0.48	1.91	N/A	N/A	N/A
Magnesium	mg/L	7.40	7.81	7.76	N/A	N/A	N/A
Manganese	ug/L	19.86	40.79	28.67	N/A	N/A	N/A
Molybdenum	ug/L	0.80	1.46	1.14	40*	ND	73
Nickel	ug/L	0.55	0.08	0.08	25	ND	95.65
Nitrates	mg/L	0.08	0.06	0.12	N/A	550	13
Nitrite	mg/L	0.00	0.00	0.01	N/A	ND	60
Nitrogen (Total Kjeldahl)	mg/L	0.42	0.56	0.59	N/A	N/A	N/A
pH (Lab)		8.27	8.38	8.23	6.5-8.5	ND	6.5 - 9.0
pH (Field)		7.86	8.22	7.78	6.5-8.5	N/A	N/A
Phosphate	mg/L	0.01	0.00	0.00	N/A	N/A	N/A
Phosphorus	ug/L	20.00	30.00	30.00	30	ND	Variable
Potassium	mg/L	1.42	1.55	1.58	N/A	N/A	N/A

Parameter	Units	Spring Average	Summer Average	Fall Average	PWQO	CCME	
						Short Term	Long Term
Residue (Particulate)	mg/L	6.99	6.29	6.73	N/A	N/A	N/A
Silicates	mg/L	0.48	1.31	0.55	N/A	N/A	N/A
Silver	ug/L	0.50	<DL	0.08	0.1	NRG	0.25
Sodium	mg/L	9.58	11.16	9.77	N/A	N/A	N/A
Stream Condition		21.26	32.92	48.50	N/A	N/A	N/A
Strontium	ug/L	333.53	278.77	309.67	N/A	N/A	N/A
Temperature	°C	12.22	22.62	12.85	N/A	N/A	N/A
Tin	ug/L	<DL	<DL	0.89	N/A	N/A	N/A
Titanium	ug/L	3.97	2.53	5.06	N/A	N/A	N/A
Uranium	ug/L	0.02	0.14	1.17	5*	33	15
Vanadium	ug/L	1.41	2.72	1.56	6*	N/A	N/A
Zinc	ug/L	4.5	4.83	6.40	30	37	7
Zirconium	ug/L	<DL	<DL	<DL	4*	N/A	N/A

DL: Laboratory Detection Limit
NRG: No Recommended Guidelines
ND: No data
N/A: Not Available
Guideline calculated using lowest average Hardness (mg/L)
Exceeds either the PWQO or CCME Guidelines

2.2.4.1.1 Total Suspended Solids

Total suspended solids (TSS) at both the Kingston Mills station and the Lasalle Causeway station were examined from 2000-2016 and 2000-2013, respectively. Seasonally, Kingston Mills experienced higher TSS levels on average throughout the fall months, whereas Lasalle Causeway had more variable trends.

Throughout the 16 years that TSS was monitored at Kingston Mills, average levels were 4.8 mg/L; the maximum TSS value recorded was 25.6 mg/L on October 15, 2003. This number is considered abnormal as the TSS levels did not exceed greater than 15 mg/L on more than 7 occasions throughout the 16 years of data collection.

Lasalle Causeway had a maximum TSS value of 61.6 mg/L recorded on March 23, 2010, however this was deemed to be an outlier and was removed from the dataset in order to calculate an average. Lasalle Causeway had a lower average TSS level than Kingston Mills, with 2.8 mg/L over a 13-year period.

2.2.4.1.2 Cyanobacteria

Cyanobacteria, also known as blue green algae, is known for its nuisance properties when thick mats and/or blooms occur in both freshwater and marine environments. Cyanobacteria tend to outcompete other forms of algae due to the presence of specialized buoyancy cells that many species have developed. The cells (intracellular gas vesicles) allow the cyanobacteria to adjust it buoyancy to favour areas within the water column with optimal growth conditions (WHO, 2003). Optimal growth conditions for cyanobacteria include warm water, high light levels and high nutrient levels.

As many species of algae have optimal growth temperatures of 12-15°C, cyanobacteria tend to outcompete them in areas of warm water as their optimal growth occurs in water greater than 25°C (Indiana University-Purdue University, 2019). In waterbodies that have slow moving water, stratification can sometimes occur, causing warmer temperatures near the surface of the water. Due to the buoyancy control mechanism, cyanobacteria can often accumulate in these warm conditions near the surface. Light penetration is also higher in the top layer of water which also provides an area of high

photosynthetic activity, promoting cyanobacteria growth. Though turbid waters do not provide optimal conditions for growth due to low light penetration, cyanobacteria often outcompete other algae in these conditions due to their ability to accumulate near the surface where light exposure is maximized (Indiana University-Purdue University, 2019).

Nutrient enrichment of waterbodies, otherwise known as eutrophication, provides optimal conditions for cyanobacteria and often is the cause of harmful algal blooms. Nutrient enrichment can occur from excess runoff from agricultural operations (fertilizers), urban areas as well as wastewater and sewage pollution. Within the sediment, nutrients are often present in an unavailable form for plants until they are released into the water column; This can happen during storm events or physical disturbance which cause sediment resuspension. To date there has been no documentation of blue/green algae blooms within the Study Area, this is likely in part because no monitoring has being completed. The IPD team is working with PCA to develop a construction and post construction program as outlined in Section 8.

2.2.4.2 Sediment Quality

Sediment quality sampling investigation have been completed in 2010, 2016 and 2018 within the Study Area in close proximity to the bridge alignment (Figure 2-10).

As depicted in Figure 2-10 samples were collected from ten locations in 2010, six (6) locations in 2016 and five (5) locations in 2018. Some sample locations consisted of multiple lab analysis from various depths, while others consisted of a single surface sample. All samples were sent to an accredited lab for analysis of various parameters as outlined in Appendix C. All sample results have been summarized and compared to the CCME sediment quality guidelines for interim sediment quality guidelines (ISQG).

2.2.4.2.1 2010 Sediment Quality Results

Samples taken in 2010 ranged in depths of 0 to 0.34 m below the top of sediment, sediment samples were collected by grab and coring techniques. Analysis was performed for a full suite of Metals, Polycyclic Aromatic Hydrocarbons (PAHs) and Polychlorinated biphenyls (PCBs). Full results of the testing are available in Appendix C Table D-1. As shown many

parameters exceed both the Provincial and Federal Sediment quality guidelines summarized below.

- Metal Exceedances include: arsenic, cadmium, chromium, copper, lead and zinc.
- PAHs Exceedances include: acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(ah)anthracene, fluoranthene, fluorene, phenanthrene and pyrene.

Legend
Project Location

- Aquatic Exclusionary Turbidity Curtain (AETC)
- Temporary Construction Components
- Permanent Components
- 2018 Borehole Investigation (Tulloch)
- 2016 Borehole Investigation (Golder)
- 2010 Borehole Investigation (Golder)

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Sources: Roads - Land Information Ontario;

0 75 150 300 Meters

1:5,000

Project:	**City of Kingston - Third Crossing**
Figure Title:	**Sediment Sampling Locations**
Prepared By:	HATCH, SYSTRA, Kiewit, Kingston
Date:	**November 18, 2019**
Figure:	**2-10**
Page:	**1 of 1**

2.2.4.2.2 2016 Sediment Quality Results

2016 sampling was completed similar to 2010 however at deeper depths and did not include PCB's given the lack of potential recorded during the 2010 investigations, however given the presence of PAH's within 2010 additional Hydrocarbon testing was completed. Similarly, sample depths were increased to 1.3 to 3.2 m below the top of sediment to evaluate the deeper sediment quality. Result exceedances are summarized below with full results available in Appendix C Table D-2.

- Metal Exceedances of CCME Include: chromium, copper and lead.
- PAHs exceedances of CCME include: fluoranthene and pyrene.

2.2.4.2.3 2018 Sediment Quality Results

Sediment samples were collected in the 2018 sampling from depths 0 to 5.96 m below the top of sediment. Analysis of the sediment was also expanded to include general physical tests, chloride, sulfates, Acid Volatile Sulphides. and Volatile Organic Compounds (VOCs) in addition to the metals, PAH's and hydrocarbons previously tested in 2016 with results presented in Appendix C Table D-3. In 2018 the only CCME exceedance recorded was Chromium at two samples locations (SS2 and SS6).

- Metal exceedance of CCME include: chromium, copper and lead.
- PAHs exceedance of CCME include: fluoranthene and pyrene.

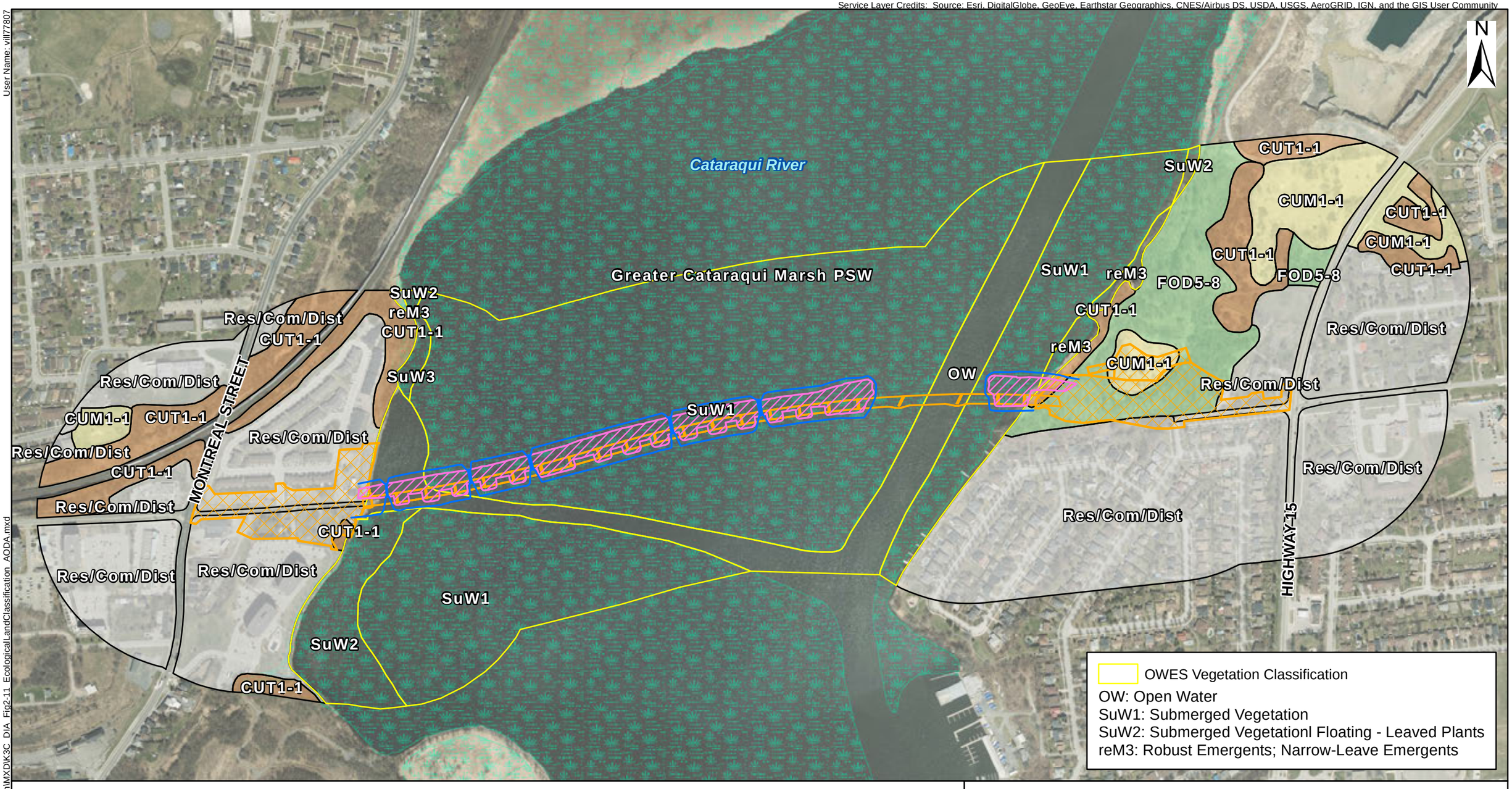
In addition to the sediment quality sampling previously completed, the IPD Team is proposing to collect additional surficial sediment samples and have those analyzed for similar parameters as shown in the tables above. Due to potential for soil and sediment contamination that is normally associated with historic marinas, the IPD team is proposing six sample locations within the boundaries of the decommissioned Music Marina purchased in conjunction with the Project. Furthermore, after consultation with Parks Canada in relation to the 2010, 2016 and 2018 sediment sampling programs, 14 new sampling locations were added to compliment the existing data along the bridge alignment as well as upstream and downstream reference samples.

2.2.5 Aquatic Wildlife and Vegetation

Many species of wildlife and vegetation occur within the Study Area see Figure 2-11, many of which have been discussed in Sections 2.2.1 through 2.2.3. In addition to those species, the following sections address herpetofauna, benthic invertebrates and aquatic vegetation within the Study Area.

2.2.5.1 Herpetofauna

In addition to those the herpetofauna species listed in the Ontario Reptile and Amphibian Atlas, those which could be reliant on the aquatic portion of the Study Area have been listed below in Table 2.9. It is acknowledged certain Herpetofauna information within the Study Area is limited, as a result the IPD team is working with PCA to develop a construction and post construction monitoring to increase the knowledge base as outlined in Section 8.



Legend

Project Location

- Aquatic Exclusionary Turbidity Curtain (AETC)
- Temporary Construction Components
- Permanent Components
- Provincially Significant Wetland (PSW)

Ecological Land Classification

- Mixed Meadow (CUM1-1)
- Deciduous Thicket (CUT1-1)
- Dry-Fresh Sugar Maple White Ash Deciduous Forest Type (GOD5-8)
- Residential, Commercial, Built-Up, and Disturbed Areas

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Sources: Roads, Wetland - Land Information Ontario;
3. ELC Data digitzed from Golder 2017

0 75 150 300 Meters

1:6,000

Project:	**City of Kingston - Third Crossing**
Figure Title:	**Ecological Land Classification and OWES Vegetation Classification**
Prepared By:	HATCH, SYSTRA, Kiewit, Kingston
Date:	**November 18, 2019**
Figure:	**2-11**
Page:	**1 of 1**

Table 2.9: Herpetofauna Species Potentially Reliant on Study Area

Species		At Risk Status			Potential Presence within Study Area	Potential Study Area Use
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
American Bullfrog	Lithobates catesbeianus	-	-	-	Moderate	All Life Stages
American Toad	Anaxyrus americanus	-	-	-	High	Breeding
Blanding's Turtle	Emydoidea blandingii	END	-	THR	High	General and Overwintering Habitat
Blue-spotted Salamander	Ambystoma hybrid	-	-	-	High	Breeding
Eastern Musk Turtle	Sternotherus odoratus	SC		SC	High	General and Overwintering Habitat
Eastern Red-backed Salamander	Plethodon cinereus	-	-	-	High	Breeding
Gray Treefrog	Hyla versicolor	-	-	-	High	Breeding

Species		At Risk Status			Potential Presence within Study Area	Potential Study Area Use
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Green Frog	Lithobates clamitans	-	-	-	High	All Life Stages
Midland Painted Turtle	Chrysemys picta marginata	SC	-	-	High	General and Overwintering Habitat
Mudpuppy	Necturus maculosus	-	-	-	High	All Life Stages
Northern Leopard Frog	Lithobates pipiens	-	-	-	High	Breeding
Northern Map Turtle	Graptemys geographica	SC	-	SC	High	General and Overwintering Habitat
Northern Watersnake	Nerodia sipedon sipedon	-	-	-	High	Summer Habitat
Red-spotted Newt	Notophthalmus viridescens	-	-	-	High	Breeding
Snapping Turtle	Chelydra serpentina	SC	-	SC	High	General and Overwintering Habitat

Species		At Risk Status			Potential Presence within Study Area	Potential Study Area Use
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO)		
Spring Peeper	Pseudacris crucifer	-	-	-	High	Breeding
Western Chorus Frog	Pseudacris maculata	THR	-		Moderate	Breeding

2.2.5.2 Benthic Invertebrate

The macro benthic invertebrate community between Belle Island and Highway 401 has been studied by Ecologistics and WESA (1984), and Tinney (2006) who found benthic numbers and diversity to be low, dominated by species typically found in the fine-grained sediments such as the Chironomidae. Similar benthic fauna was also found at reference sites in Lake Ontario (ESG 2003), and in the River Styx by Ecologistics and WESA (1984) who also found the benthic fauna to be relatively limited in the fine sediments of the river, with the exception of one gravel area, which had greater benthic invertebrate diversity richness. The Cataraqui Region Conservation Authority (CRCA) conducted sampling programs in 2015 and 2018 immediately north of Highway 401. These programs consisted of Ekman dredge grab samples at three locations described as two riffles and one pool, however the pool substrates were described as silt, boulders, cobbles and gravels. The 2018 pool samples were dominated by Hyalella Azteca at 44% (n=1545), Gyraulus parvus 14% (N=489) and Caenidae 10% (n=352). Jaagumagi (1991), ESG (2003), Benoit and Dove (2006), and Ecological Services (2008) reported the benthic community diversity south of Belle Island to be relatively low and dominated by pollution tolerant tubifex worms taxa.

Overall the results noted above align with the understanding that fine or non-consolidated substrates within non-turbulent lentic environments generally contain less benthic invertebrate diversity richness, than those environments with coarser substrates with some form of water movement either through wave action or flow. Although likely similar to the current conditions many of the above noted studies were performed prior to many benthic invertebrate biotic and abiotic influences such as Zebra and Quagga Mussels and the associated water quality changes that has followed stricter effluent regulations, reduced boating pollution and reduction in industry.

2.2.5.3 Aquatic Vegetation

Similar to the aquatic wildlife, aquatic vegetation has been previously described within Sections 2.2.1 and 2.2.2. Specifically, the Greater Cataraqui Marsh PSW, contains soft substrate habitat with abundant submergent throughout with floating vegetation found in dense yet isolated pockets.

Submergent community is dominated by Eurasian milfoil (Myriophyllum spicatum), pondweed (Potamogeton spp.), waterweed (Elodea canadensis), coontail (Ceratophyllum demersum), curly pondweed (Potamogeton crispus) and Tape grass (Vallisneria americana), with the floating vegetation portions dominated by water lily (Nymphaeaceae spp.). Eurasian milfoil and Curly-leaved pondweed are aquatic invasive species as such are discussed within Section 2.4.1. Figure 2-11 illustrates the presence of four (4) dominant wetland compartments, which were documented during the Municipal Class EA in a manner consistent with the Ontario Wetland Evaluation System (OWES). Highlights are as follows:

- The majority of the aquatic Study Area is overlaid by a single vegetation compartment (suW1). The suW1 community has 1 vegetation form (submerged vegetation) that was noted to be dominated by Milfoil.
- The secondary compartment (suW2) is primarily found along the west shoreline. It consists of 2 vegetation forms (submerged vegetation and floating-leaved plants), dominated by Milfoil and Waterlilies.
- The reM3 community is made up of 2 vegetation forms (robust emergent and narrow-leaved emergent), dominated by Cattails and Grasses (including the invasive Reed Canary grass).
- The open water (OW) areas are deep sparsely vegetated areas, in relation to the navigational channel and marina operations.

It was also noted that within the three vegetated compartments, during peak growth, the coverage or space occupied was 100% (Bowfin, 2011). Comparing Ecological Services original 1990 evaluation, Bowfin's work noted above and the pre construction vegetation survey completed in September of 2019 noted there has been very little change the wetland plant communities within the Study Area since the original mapping was prepared over 20 years ago.

For additional supporting information, please refer to the ESR.

2.2.6 Species at Risk and Species at Risk Habitat

At the federal level, 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 Parliament, species are added to the federal List of Wildlife Species at Risk (Schedule 1). Those that are listed as extirpated, endangered or threatened are afforded full protection of individuals, residences, and critical habitat on Federal lands under the Species at Risk Act (SARA). Therefore, for the purpose of the DIA, COSEWIC suggested status are also considered as it is likely Parliament will act on those recommendation at a later date. Furthermore, SARA permitting does not apply to private, Municipal or Provincially-owned lands, with the exception of fish species listed as extirpated, endangered or threatened are protected under the SARA, unless ordered otherwise by the Governor in Council. In addition to the SARA Act protecting Federal SAR all migratory birds are protected under the Migratory Bird Convention Act, this includes all Migratory Bird SAR on any lands within Canada.

SAR designations for species in Ontario are determined by the COSSARO, the species are automatically are added to the Provincial Endangered Species Act (ESA). The ESA prohibits the killing or harming of species identified as extirpated, endangered or threatened. The ESA provides habitat protection to all species listed as extirpated. For the purpose of this report and for herein all SAR listed within Table 2.10 will be specifically addressed in SAR sections and not included in the general species or habitat sections moving forward.

Table 2.10 includes the majority of the COSEWIC, SARA and SARO identified species within Section 2.2.2, 2.2.3 and 2.2.5 however some SAR species within those sections have not been carried forward as result of the records being historic or the habitat requirements not thought to be present. This is the case for some SAR birds that require large tracts of forest or grasslands. Similarly, there was species identified within the Municipal Class EA, that were not found within any of the 2019 records reviews and are not thought to be present. These species include; Spotted Gar, Bridle Shiner, Pugnose Shiner, Grass Pickerel, Silver Chub, Five-lined Skink, Eastern Ribbonsnake, Eastern Small-Footed Bat, Blunt-lobed Woodsia, Broad Beech Fern, Ogden’s Pondweed, Purple Twayblade and Pale-bellied Frost Lichen.

SAR identified to have potential to inhabit or use the Study Area within the above Sections have been summarized in Table 2.10**.**

Table 2.10: Potential SAR Summary

Species		At Risk Status		
Common Name	**Scientific Name**	**Federal (COSEWIC)**	**Federal (SARA)**	**Provincial (SARO List)**
Fish				
American Eel	Anguilla rostrata	THR	-	END
Lake Sturgeon	Acipenser fulvescens	THR	-	END
Mammals				
Little Brown Myotis	Myotis lucifugus	END	END	END
Northern Myotis	Myotis septentrionalis	END	END	END
Tri-coloured Bat	Perimyotis subflavus	END	END	END
Birds				
Bald Eagle	Haliaeetus leucocephalus	-	-	SC
Barn Swallow	Hirundo rustica	THR	THR	THR
Black Tern	Chlidonias niger	-	-	SC
Chimney Swift	Chaetura pelagica	THR	THR	THR
Common Nighthawk	Chordeiles minor	SC	THR	SC
Eastern Meadowlark	Sturnella magna	THR	THR	THR
Eastern Whip-poor-will	Antrostomus vociferus	THR	THR	THR
Eastern Wood-pewee	Contopus virens	SC	-	SC
Evening Grosbeak	Coccothraustes vespertinus	SC		SC
Golden-winged Warbler	Vermivora chrysoptera	THR	-	SC
Grasshopper Sparrow	Ammodramus savannarum	SC		SC

Species		At Risk Status		
Common Name	Scientific Name	Federal (COSEWIC)	Federal (SARA)	Provincial (SARO List)
King Rail	Rallus elegans	END	END	END
Least Bittern	Ixobrychus exilis	THR	THR	THR
Red-headed Woodpecker	Melanerpes erythrocephalus	END	-	SC
Short-eared Owl	Asio flammeus	SC	-	SC
Wood Thrush	Hylocichla mustelina	THR	-	SC
Herpetofauna				
Blanding's Turtle	Emydoidea blandingii	END	THR	THR
Eastern Musk Turtle	Sternotherus odoratus	SC	SC	SC
Gray Ratsnake	Pantherophis spiloides	THR	-	THR
Midland Painted Turtle	Chrysemys picta marginata	SC	-	-
Milksnake	Lampropeltis triangulum	SC	SC	
Northern Map Turtle	Graptemys geographica	SC	-	SC
Snapping Turtle	Chelydra serpentina	SC	SC	SC
Western Chorus Frog	Pseudacris maculata pop. 1	THR	THR	
Arthropoda				
Monarch	Danaus plexippus	END	-	SC
Vegetation				
White Wood Aster	Eurybia divaricata	THR	-	THR

In addition to the records review, many species have been confirmed within the Study Area with other targeted searches completed, such as vegetation, wildlife visual encounter surveys, breeding birds searches and fish capture studies as part of the Project. In addition to this the impact assessment team has consulted with local biologist and organizations, as well as all levels of

the regulatory systems to gain a comprehensible understanding of the SAR within the regional areas but specifically within the Study Area.

Similar to the above sections Table 2.11 presents the likelihood of each species being present within the Study Area by cross-referencing habitat preferences with habitat present within the Study Area. Where targeted surveys were completed rationale is also given as to why the likelihood ranking is thought to be accurate. As stated in Section 2.2, the likelihood to be within the Study Area does not necessarily equate to the likelihood of being within the Project Location given the relatively large size of the Study Area in comparisons to the Project Location, the relationship between the identified species and the Project and it's associated Project Location are evaluated in Section 3.

Table 2.11: Summary of SAR Screening

Name	General Habitat Description	Residence Habitat	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area	Rationale
Birds					
Bald Eagle	Forested Areas near waterbodies and wetlands.	Nests near shorelines of lakes or large rivers (often on forested islands) in large super canopy trees	Limited available habitat	Low to Moderate	Occurrence within 5 km of Study Area Potentially suitable habitat (along river).
Barn Swallow	Open areas for foraging, waterbodies, roadsides, and wetlands.	Areas with suitable nesting structures (human made structures),	Urban environment and infrastructure throughout Study Area	High	Recent records of occurrence. Suitable nesting habitat (human made structures)
Black Tern	Freshwater marshlands. Requires posts / snags for perching.	Nests in wetlands with open water and emergent vegetation (short-dense or tall-sparse).	Potential nesting habitat within cattail marsh	High	No records of nesting but reported foraging Study Area Suitable Habitat Present
Chimney Swift	Urban, suburban, rural, and wooded areas.	Nests in dark/sheltered spots with vertical gripping surfaces (unused chimneys/large diameter cavity trees).	Potential nesting habitat within urban area	High	Occurrence within 5 km of Study Area Potentially suitable habitat (urban & wooded areas).
Common Nighthawk	Breeds in large open habitat (farmland, open woodlands, clear-cuts, burns, rock outcrops, alvars, bog ferns, prairies, gravel pits).		Gravel parking's, lots, industrial lots and flat roofs	High	Occurrence within 5 km of Study Area Potentially suitable habitat (flat roof and disturbed gravel areas).
Eastern Meadowlark	Breeds Pastures, hayfields, meadows, and old fields. Prefers: moderately tall grasslands with abundant litter cover, and a forb component; well-drained sites/ slopes; and sites with different cover layers.		Minimal suitable habitat within Study Area	Moderate	Recent Records within Study Area, Not observed during surveys. Minimal suitable habitat
Eastern Whip-poor-will	Breeds in semi-open forests with little ground cover, rock/sand barrens, open conifer plantations and post-disturbance regenerating forest. Nests / eggs laid directly on leaf litter.		Potentially available within woodlands	High	Recent Records, Potentially suitable habitat in Woodlands
Eastern Wood-pewee	Forest and Swamps (deciduous, coniferous/mixed) with some degree of openness; intermediate-aged forests with relatively sparse mid-story; edges of younger forests with relatively dense mid-story; and open forested areas in parks/ suburban areas.	Nests on horizontal limb, 1-2 m above ground.	Woodlands along east shore	High	Recent Records, Suitable habitat in Woodlands

Name	General Habitat Description	Residence Habitat	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area	Rationale
Evening Grosbeak	Mature mixed-wood forests dominated by fir species, White Spruce and/or Trembling Aspen, also a frequent user of bird feeders	High in trees or large shrubs, primarily coniferous with some usage of birch, beech, sugar maple, and willow	Likely available within woodlands	High	Recent records Suitable habitat
Golden-winged Warbler	Regenerating scrub habitat with dense ground cover/ patchwork of shrubs, usually surrounded by forest. Disturbed areas (rights-of-way, field edges / openings from logging / burning). .	Nests on ground at base of shrub/leafy plant, often at shaded forest edge/opening	Potentially available within woodlands	Moderate	Occurrence within 5 km of Study Area. Not observed during surveys Potentially suitable habitat .
Grasshopper Sparrow	Breeds and Nests in Medium to large grasslands with low herbaceous cover with few shrubs; farmland (cereal crops, pastures); and limestone plains.		Minimal suitable habitat within Study Area	Low	Occurrence within 5 km of Study Area. Not observed during surveys Minimal suitable habitat within Study Area
King Rail	Breed and Nests in freshwater marshes, especially large marshes with variety of water level conditions/habitats. Shallow wetlands with dense emergent vegetation, patches of open water, hummocks, mudflats, and shrubby swales. Nests well-concealed in patches of dense/uniform vegetation over shallow water areas.		Cattail Marsh	High	Recent Records within Study Area Suitable Habitat Present
Least Bittern	Large marshes with emergent vegetation, relatively stable water levels (less than 1 m deep), and areas of open water.	Nests in tall stands of dense emergent/woody vegetation. Clarity of water critical for foraging efficiency.	Cattail Marsh	High	Recent Records within Study Area Suitable Habitat Present
Red-headed Woodpecker	Open, deciduous woodlands/woodland edges, parks, cemeteries, golf courses, orchards, and savannahs (little or no understory vegetation).	Nests in excavated trunks of large dead trees.	Within and adjacent woodlands	Moderate	Occurrence within 5 km of Study Area. Not observed during surveys Potentially suitable habitat

Name	General Habitat Description	Residence Habitat	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area	Rationale
Short-eared Owl	Grasslands, tundra, bogs, marshes, clear-cuts, burns, pastures, and farmland. Requires sufficient prey resources in vicinity.	Nests on dry ground, and usually adjacent to vegetation for cover.	Potential suitable areas likely too small to provide habitat.	Low	Occurrence within 5 km of Study Area. Not observed during surveys Minimal suitable habitat
Wood Thrush	Moist deciduous hardwood/mixed stands (often previously disturbed), with dense deciduous undergrowth and tall trees for singing perches.	Nests in lower elevations with trees less than 16 m high, and relatively closed canopy cover.	Suitable habitat potentially available in woodlands	Moderate	Records in Study Area Not observed during surveys. Potentially suitable habitat
Fish					
American Eel	Native to Lake Ontario, St. Lawrence River, and Ottawa River watersheds. Prefers cool waters of lakes / streams with muddy/ silty substrates.	Migrates to Sargasso Sea to spawn	Foraging and Migration	High	Confirmed Migration Route & Juvenile Habitat from MNRF
Lake Sturgeon	Bottom dwellers over a variety of habitat prefers mud/ gravel substrates.	Spawns over coarse substrates in moderate to swift velocities in depths 0.2 – 5 m.	Suitable general habitat within navigation channel, no spawning habitat	Moderate	Records within Study Area Suitable General Habitat
Mammals					
Little Brown Myotis	Covers much of Ontario; roosts in both natural/man-made structures. With a preference for area near water or wetlands for foraging opportunities	Roosts in live and dead trees with suitable attributes as well as building with access. Overwinters in Caves & abandoned mines	Suitable roosting habitat	High	Confirmed within the Study Area Suitable roosting habitat present
Northern Myotis	Covers much of Ontario; roosts in both natural/man-made structures. With a preference for area near water or wetlands for foraging opportunities	Roosts in live and dead trees with suitable attributes as well as building with access. Overwinters in Caves & abandoned mines	Suitable roosting habitat	High	Confirmed within the Study Area Suitable roosting habitat present

Name	General Habitat Description	Residence Habitat	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area	Rationale
Tri-colored Bat	Deciduous Forest with Oaks and Maple Canopies (Prefers Oaks). With a preference for area near water or wetlands for foraging opportunities	Roost in foliage, in clumps of old leaves (primarily oaks) and squirrel nests. Overwinters in deep caves or mines	Suitable roosting habitat	Moderate	Records in regional area None found during targeted surveys Suitable roosting habitat present
Herpetofauna					
Blanding's Turtle	Covers a range of aquatic habitats but prefers shallow/ standing / slow moving water; rich nutrient levels; organic substrates; and abundant aquatic vegetation. Known to travel great distances over land in spring to reach nesting sites (dry conifer/mixed forests, partially vegetated fields, and roadsides).	Nests in organic soils, sands, gravel, and cobbles. Overwinters underwater and buried within cattail marshes, in a variety of substrates. Anoxic tolerant	Critical habitat known occur within Study Area	High	Recent records within Study Area Suitable habitat present
Eastern Milksnake	Habitat generalist (may use a wide range of urban/ agricultural/natural landscapes).	Overwinters underground, in rotting logs or in the foundations of old buildings.	Suitable habitat throughout Study Area	Moderate	Occurrence within 5 km of Study Area. Suitable habitat present
Eastern Musk Turtle	Rarely out of water; and prefers shallow/clear water with little/no current and soft substrates with abundant organic materials/floating/submerged vegetation.	Nests in decaying vegetation, shallow gravel or rock crevices. Hibernates in soft substrates underwater and anoxic intolerant	All habitat requirements found within Study Area at various locations	High	Recent records within Study Area Suitable habitat present
Gray Ratsnake	Prefers mixture of forest/open habitats and edge habitats (snags, hollow logs, rock crevices and rocks).	Communal hibernation in underground sites (rock fissures, mammal burrows, and root systems), often on south-facing, rocky slopes.	General habitat present however not likely being utilized	Low	Occurrence within 5 km of Study Area.(likely to the north east) Study Area isolated from other habitats, including hibernacula.

Name	General Habitat Description	Residence Habitat	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area	Rationale
Midland Painted Turtle	Wide variety of wetland and aquatic habitats from small ponds to large lakes, rivers and wetlands	Nests in sand/gravel banks along waterways/roads. Hibernates in soft substrates underwater (anoxic tolerant	All habitat requirements found within Study Area	High	Recent records within Study Area Suitable habitat present
Northern Map Turtle	Prefers large waterbodies with slow-moving currents, soft substrates; abundant aquatic vegetation; shoreline with rocks/logs for basking.	Nests in sand/gravel banks along waterways/roads Hibernates in soft substrates underwater and is anoxic intolerant	All habitat requirements found within Study Area	High	Recent records within Study Area Suitable habitat present
Snapping Turtle	Covers a wide range of waterbodies but prefers areas with shallow/slow-moving water; soft substrates; and dense aquatic vegetation.	Nests in sand/gravel banks along waterways/roads. Hibernates in soft substrates underwater (anoxic tolerant	All habitat requirements found within Study Area	High	Suitable habitat (sand / gravel areas). Recent records of occurrence.
Western Chorus Frog	Marshes / wooded wetlands (dense shrub layers and grasses). Breeds in almost any fishless pond (roadside ditches, gravel pits, flooded swales in meadows). Hibernates in terrestrial habitats under rocks, dead trees/leaves, loose soil, and animal burrows.	Breeds in almost any fishless pond (roadside ditches, gravel pits, flooded swales in meadows). Hibernates in terrestrial habitats under rocks, dead trees/leaves, loose soil, and animal burrows	Potential Habitat along Cattail Shoreline north of the Project Location also potential habitat on Belle Island	Moderate	Suitable habitat present, Last known Occurrence 2012
Arthropoda					
Monarch	Milkweed plants, farmland, meadows, open wetlands, prairies/roadsides, gardens/ parks.	Milkweed Plants	Scattered Throughout Study Area	High	Known to occur within the Study Area, Suitable habitat present.

Name	General Habitat Description	Residence Habitat	Habitat Present within Study Area	Likelihood of Species being Present within the Study Area	Rationale
Vegetation					
Butternut	Found along stream banks, on wooded valley slopes, and in deciduous and mixed forests. Commonly associated with beech, maple, oak and hickory. Prefers moist, fertile, well-drained soils, but can also be found in rocky limestone soils. Shade intolerant.		Suitable habitat within Study Area	Moderate	None noted despite having multiple, arborists, ecologist or SAR biologist onsite. Not all areas of the Study Area viewed.
White Wood Aster	Open deciduous woodlands most commonly dominated by Hard Maple or Beech.		Suitable habitat likely within the Study Area	High	Known to occur within the Study Area, Suitable habitat present.

Similar to the other sections in this assessment, all SAR with a moderate to high likelihood of being present within the Study Area will be carried forward into Section 3 where detailed species tendencies and habitat requirements will be evaluated against the specific Project components. If during agency reviews or public consultation more SAR observations or SAR data are brought forward, those species will be added or likelihood elevated, prompting those species to be included in Section 3. In addition, the IPD team is proposing to conduct amphibian breeding surveys and turtle visual encounter surveys during the construction period as proposed in Section 8.

2.2.7 Cultural Landscape

In the 'Standards and Guidelines for the Conservation of Historic Places in Canada' (Standards and Guidelines) prepared by Parks Canada, a cultural landscape is defined as any geographical area that has been changed, influenced or given special cultural meaning by people, and that has been formally recognized for its heritage value. The guidelines for cultural landscapes in the Standards and Guidelines are divided into 11 subsections: evidence of land use; evidence of traditional practices; land patterns; spatial organizations; visual relationships; circulation; ecological features; vegetation; landforms; water features; and built features. Common threads in these guidelines speak to the need to document and understand the affected cultural landscape(s); and design a proposed development so that it is compatible with the features of the affected cultural landscape(s), and any associated inter-relationships between affected cultural landscapes.

The guidelines for cultural landscapes in the Standards and Guidelines, as applied to the DIA Study Area from Belle Island to the LaSalle Causeway, are captured in the following two interfaces:

- An on-land interface, focusing on:
  - Belle Island, which contains an Indigenous settlement site and cemetery, and serves as a microcosm of the importance of the DIA study area as a whole to the history and heritage of Indigenous Peoples.
  - The historic development of the City's downtown.

- A land-water interface, represented by:
  - Military influences through Fort Henry, the Rideau Canal, harbour facilities, Canadian Forces Base (CFB) Kingston, and Royal Military College (RMC).
  - The City's once-dominant role in the resource-based transshipment economy through its port and railway access.
  - The present accommodations for watercraft navigation, as characterized most notably by the navigable channel and Inner Harbour.
  - The visual and spatial connections between the built features on-land and the waterway.

Key Heritage values which apply to the Cataraqui River Sector of the Rideau Canal, as outlined by Parks Canada during the Municipal Class EA in its report 'Heritage Values and Guiding Principles for The Cataraqui River Sector of the Rideau Canal, Kingston, Ontario' (2010) include:

- Its historic, ecological and visual associations with the certain shore lands and communities along the waterway which contributes to the unique historical environment of the canal system.
- Through-navigation of the Canal system which helps to assure the preservation of the unique historical environment.
- Its extensive wetlands and lakes of the Canal which reveal the relationship between canal construction and the natural environment, and which are an integral part of the unique historical environment of the waterway, and natural ecosystem elements.

Parks Canada's management strategies for the lower Cataraqui section of the Rideau Canal south from Highway 401 to the northern entrance of Kingston's Inner Harbour near Belle Island have focused on protecting the natural character of its lands and waters and managing change on the landscape. This section is a rare example of the waterway where the natural environment was not altered during construction of the Rideau Canal. Over the intervening years, the extensive wetlands of the Great Cataraqui Marsh, as well as the

river valley's sloped physiography and forested landscapes adjacent to the navigable channel have remained largely intact. This natural setting has contributed to the unique environment of this section of the waterway.

As shown on Figure 2-12 and Figure 2-13, as boaters proceed from the Highway 401 crossing southward (roughly 4 km north of the Inner Harbour entrance), the visible cattail portion of the Greater Cataraqui Marsh dominates the landscape, with its shallow water and emergent aquatic plants, near continuous overhanging tree canopy and shrub understory.

Figure 2-12: On Water View Looking South (at Buoy S65)

Figure 2-13: On Water View Looking South (at Buoy S47)

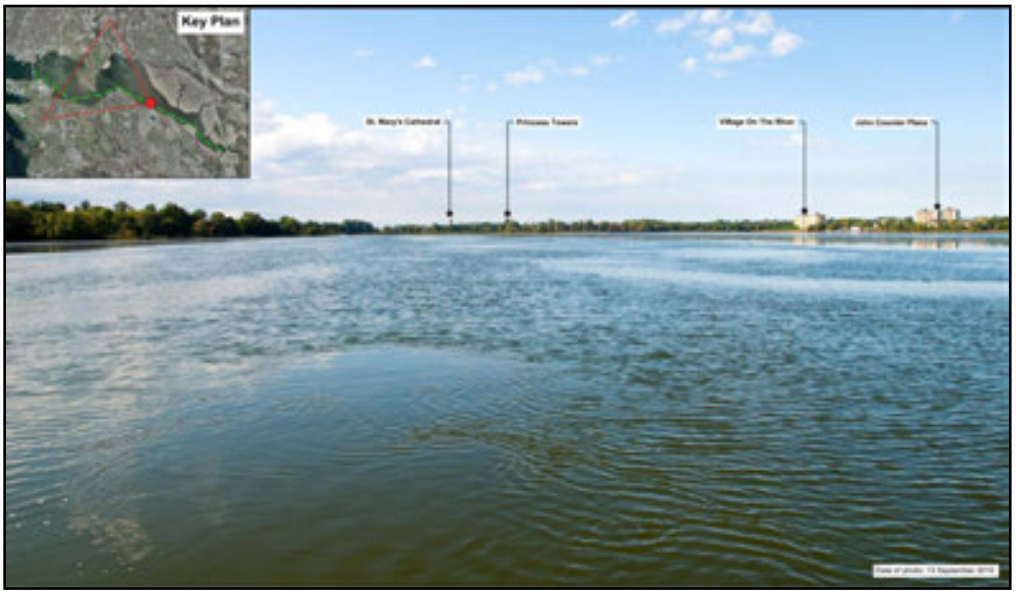


Figure 2-14: On Water View Looking South (at Buoy S33)

As shown on Figure 2-14 (roughly 1 km north of the Inner Harbour), the bridge emerges, where the natural landscape evolves into an urban landscape against the backdrop of Belle Island to the south.

The landscape further south of Belle Island is blocked by the tree line along the northern portion of Belle Park and Belle Island as well as by the extension of the eastern shoreline, whereon the Gore Road Library, Point St. Mark neighbourhood and former Rideau Marina are located. As shown on Figure 2-15, views of the bridge location are similarly blocked by these features for boaters proceeding from the LaSalle Causeway northward.

Figure 2-15: On Water View Looking North (at Buoy S15)

This includes the protected views related to Fort Henry and the Kingston fortifications in the southern portion of the Study Area. As shown on Figure 2-16, views of the Inner Harbour are obscured in the background at Fort Henry, not only by distance but also by the CFB Kingston and RMC facilities in the foreground. Furthermore, the tree line along the southern portion of Belle Park and Belle Island, in conjunction with the proximate

extension of the eastern shoreline, blocks views to the proposed bridge, and the remaining Study Area further north to Highway 401.

Figure 2-16: Fort Henry View Looking North

2.2.8 Archaeological and Cultural Heritage Resources

Table 2.12 highlights the cultural history of the broader Kingston area, which includes the Study Area.

Table 2.12: Cultural Chronology of the Kingston Area

Period	Timeframe	Description
Paleo	Circa 12000-10000 Before Present (BP)	The first inhabitants of Ontario lived in small family-based groups, depending on plants and large game animals (moose, deer, caribou, elk) for their food. These nomadic peoples used stone, skin, antler bone, wood, and plant fibres to produce the tools and goods necessary for their survival. A survey of Allen Point along the Rideau Canal system north of Kingston Mills resulted in the identification of a late Paleo point, the first recorded find from this period in Kingston.
Early Archaic	Circa 5000 Before Christ (BC)	Early Archaic peoples produced a greater variety of items than their predecessors. Of particular importance were the dugout canoes and stone tools made by grinding rather than by flaking. The water craft allowed the Early Archaic peoples to travel greater distances, facilitating the exchange of new ideas and goods.
Middle Archaic	Circa 3000 BC	The early people who inhabited Eastern Ontario during the Middle Archaic Period participated in a trade network that spanned the Great Lakes region (e.g. copper obtained from the shores of Lake Superior was traded in Eastern Ontario, where it was made into awls, needles, knives, fish hooks, spear points, and bracelets). The earliest recorded human burials in Eastern Ontario date to the Middle Archaic Period.
Late Archaic	Circa 700 BC	Changes that characterized the Late Archaic Period include increased population size, distinction in social status, and new hunting techniques. Evidence of these changes is the inclusion of trade goods in the burial of selected individuals and tool kits consisting of a variety of projectile point types.

Period	Timeframe	Description
Early Woodland	Circa 300 BC	Peoples living in Eastern Ontario began to use pottery during the Early Woodland Period. Early pots were crudely made, with thick walls and a distinct cord-marked exterior surface. The practice of including grave goods with burials continued, influenced by the Adena Culture, centered in the Ohio River Valley, and the Middlesex tradition, which was focused in New York State.
Middle Woodland	Circa 900 Anno Domini (AD)	During the Middle Woodland Period regionally distinct pottery styles developed, and trade networks began to disintegrate. Ceramic vessels were of a higher quality than previously and appeared in a greater range of shapes and with a greater variety of decorations. The disintegration of trade networks toward the end of this period coincided with the decline of major cultural influences centered in Ohio and Illinois. Agriculture was introduced to Eastern Ontario towards the end of the Middle Woodland Period. Middle Woodland sites are located throughout the region including the 1000 Islands, the Cataraqui River (Belle Island), the Gananoque River System and along the Napanee River system. Middle Woodland ceramics were recovered in the excavation of Fort Frontenac suggesting that this was once the location of settlement prior to the arrival of the Europeans.
Late Woodland	Circa 1600 AD	Domesticated plants (corn, beans, and squash) increased in significance as supplements to the more traditional foods such as deer, fish, and wild plants during the Late Woodland Period. Agriculture allowed the Late Woodland Peoples to live in permanent villages. Increasing conflict between groups resulted in the construction of palisades around some of these villages. There is

Period	Timeframe	Description
		only one identified permanent settlement that can be attributed to this period in the region and it is located in the Cataraqui Creek area. This is a proto Huron or Middleport site. The Kingston Outer Station was a fishing camp utilized throughout the Late Woodland period.
Proto-Historic	Circa 500 to 350 BP	Distinguished by the introduction of European influences prior to the actual settlement of the region. This was a turbulent period for Indigenous Peoples in the area. The St. Lawrence Iroquois located just east of the region had been absorbed into other Iroquoian peoples, including the Mohawk, Onondaga and Wendat-Huron, by the time of Champlain's arrival in the area in 1612. The Huron, initially located along the north shore of Lake Ontario, moved to the Lake Simcoe-Georgian Bay area where they too were eventually dispersed in 1649. Fort Frontenac, established in 1673, was the first permanent European settlement in the region. Also established were a series of mission sites along the north shore of Lake Ontario including one in the Napanee area and La Presentation near the present-day site of Ogdensberg New York. By the early 18th century, the Iroquois had been driven from the north shore of Lake Ontario by the Mississauga.
Historic	15th Century to Today	Kingston benefited considerably by the presence of the military and developed fairly quickly through the early-to-mid-19th century. The War of 1812 increased activity and development of military property in the region. The potential for shipwrecks and associated aquatic structures in the area is high.

Given the ecological resources of the Cataraqui River and the archaeological evidence found in nearby areas, the Study Area, in all likelihood, would have been used and periodically inhabited by Indigenous Peoples for the last 10,000 years or more. As such, and since most of the Study Area remains unaltered, indicators point to virtually the whole Study Area exhibiting high archaeological potential, except for:

- The land-based areas impacted by urban development.
- The aquatic-based features associated with the in-water development of the LaSalle Causeway; the HMCS Cataraqui Facility; the former Rideau Marina; the Federal dredged sediment disposal site along the north shore of Belle Park; the dredged access route sed by the former Music Marina; the navigable channel; and the two aquatic utility crossings.

Cultural heritage resources, potential impacts to, and conservation recommendations for these resources have been addressed in the Cultural Heritage Protection and Enhancement Plan prepared for the Project by Golder Associates in 2017 and included as Appendix D. Specifically the Rideau Canal World Heritage Site, National Historic Site of Canada and Canadian Heritage River; 80 Gore Road, the location of the Pittsburgh Branch of the Kingston Frontenac Public Library and property designated under Part IV of the Ontario Heritage Act; archaeological site BbGc-127, a late 18th century camp on the banks of the Cataraqui River; and a stone survey marker on the south boundary of 80 Gore Road, Lot 10 in the Concession East of the Great Cataraqui River. Many of the recommendations provided Appendix D have previously been identified in earlier cultural heritage work, however the plan brings multiple areas of cultural heritage interest including heritage policy, archaeology, and heritage impact assessment together.

Areas within the Study Area containing known or potential archaeological resources include the following:

- Significant archaeological resources present on both sides of the LaSalle Causeway. Despite the extent of modern developments in that area, intact archaeological remains representing Pre-Contact Indigenous Peoples, French and British Military Periods (especially at Fort Frontenac, Royal

Military College and Fort Henry), and remains relating to subsequent urban development are present.

- The area between the LaSalle Causeway and Belle Island containing 14 registered Euro-Canadian shipwrecks in its southern portion and intact Euro-Canadian archaeological remains relating to subsequent urban development.
- An extensive Middle Woodland Period archaeological settlement site and cemetery on Belle Island. Only two small portions of the island have been archaeologically tested and the archaeological potential of the untested areas is very high. Despite recent developments, portions of the shoreline opposite Belle Island also have high archaeological potential.

The archaeological significance of Belle Island is further reinforced by the 2001 City Council resolution acknowledging Belle Island as a significant site for Indigenous people. This resolution engaged a strategy that was subsequently formalized through negotiation between the City and representatives of local Indigenous peoples and endorsed by City Council in 2006. The framework of the agreement includes a process that would set Belle Island physically apart from the mainland and place Belle Island under the joint ownership of the City and the Mohawk Nation Council of Chiefs.

The Kingston Outer Station site north of Belle Island and John Counter Boulevard on the west side of the Cataraqui River contain intact archaeological remains of a Pre-Contact Indigenous and Historic Indigenous hunting and fishing camp.

The east side lands are typical of what much of the lower Cataraqui River valley must have looked like before modern development. From the Cataraqui River shoreline, the land rises in a series of steps, controlled by the horizontally bedded limestone bedrock which underlies the area. Exposed limestone bedrock is present at the shoreline. Proceeding easterly, a foreshore backs onto a steep, 2 m high forested bank. The land to the rear of the bank is generally level. The southern half is heavily forested, and the northern half consists of open meadow. The eastern margin of these areas is defined by an abrupt rise in elevation, consisting of a bedrock and talus scarp face. Above the scarp, the terrain is a level limestone plain. The Gore Road

Library is situated on this level plain, between the scarp edge and Highway 15.

There were two areas from which archaeological materials were recovered as part of Stage 2 (and focused Stage 3) archaeological testing of the east side lands:

- Archaeological Site BbGc-127 which, based on subsequent Stage 3 testing, identified a small dwelling area or camp, dating to the last decades of the 18th century.
- A stone survey marker on the south boundary of the Gore Road Library (Lot 10 in the Concession East of the Great Cataraqui River).

Visual examination of the west side lands suggests that all lands within the existing road rights-of-way have been disturbed to the extent that any archaeological testing in those areas is not warranted.

In November 2018, archaeological investigations took place on the private lands along John Counter Boulevard, including portions of the former Music Marina property, where archaeological potential remained. Until this time, archaeologists had no permission to conduct archaeological testing on these private lands. After these investigations were completed it was determined that these properties held low archaeological potential.

During the Municipal Class EA, a sonar survey of the riverbed within the Project Location was conducted to both locate buried objects and prepare a riverbed profile. Vibrocoring through the riverbed sediment at 10 locations was also undertaken to determine the potential for aquatic archaeological resources. Based on this fieldwork:

- The riverbed is relatively featureless aside from the scour lines caused by boat traffic, which are present near the west shore and at the center of the river. Mounds were also identified near the navigable channel, which were verified as spoil from previous dredging activities of the channel.
- The paleo-environment suggests a marsh environment, similar to the existing marsh to the north, wherein small, isolated areas of raised elevations are evident as opposed to a discrete, submerged paleo-shoreline.

There is a low potential for aquatic archaeological resources within the Project footprint.

Further to the information provided above, archaeological resources have been identified on City of Kingston property on the west side of the Cataraqui River, however these are not located within the Project Location.

2.2.9 Rideau Canal's Commemorative Integrity (National Historic Site of Canada)

The Rideau Canal was designated as a National Historic Site of Canada (NHSC) in 1925 because of the construction of the canal system; the survival of a high number of original canal structures including locks, blockhouses, dams, weirs and original lockmasters' houses plus the integrity of most lock stations; and the unique historical environment of the canal system.

Parks Canada's mandate regarding the Rideau Canal is reflected, in part, in its 'Commemorative Integrity Statement' (CIS), which articulates the physical and associative heritage values of the canal system in the Rideau Canal's NHSC designation. The CIS applies the principles and activity policies of the 'Cultural Resource Management Policy' (CRM) prepared by Parks Canada, which effects Parks Canada's legislated mandate under the Parks Canada Agency Act to manage nationally significant heritage resources.

The CRM Policy reinforces the importance of managing the natural and cultural values of such resources, which is germane to the Rideau Canal context, in that its historic value is derived from the interaction of natural and human activities. It contains the following guiding principles pertinent to the Rideau Canal:

- Understanding Heritage Value: knowing why a cultural resource is significant, and what character-defining elements must be conserved. This involves understanding the history of the cultural resource, its current condition and the threats to its condition, and its past and current importance to Canadians.
- Sustainable Conservation: focusing CRM practice on achievable results that will ensure the conservation of cultural resources that convey the heritage value of Parks Canada's protected heritage places over the long-

term, based on recognized conservation standards and taking into consideration the financial and human resources available.

- Benefit to Canadians: safeguarding cultural resources for present and future generations and sharing their heritage value in ways that inspire discovery and a sense of personal connection with Parks Canada's protected heritage places."

The guiding principles in the CRM policy form the basis of Parks Canada's activity policies. Applicable policies to the Rideau Canal within the Study Area are:

- The 'Canadian Heritage Rivers Policy', which effects Parks Canada's objective of designating river systems such as the Rideau Canal as a Canadian Heritage River (designated in 2000) by recognizing their respective roles in shaping Canada's natural and human history.
- The 'National Historic Sites Policy', which effects Parks Canada's objective of protecting and enhancing the natural and cultural values of the Rideau Canal as a NHSC.
- The 'Historic Canals Policy', which effects Parks Canada's objective of ensuring continued through-navigation of the Rideau Canal system and managing its natural and cultural values.
- The 'Rideau Canal National Historic Site Management Plan' (NHSC Plan) prepared by Parks Canada establishes the long-term strategic direction for the management of the Rideau Canal NHSC. This plan seeks to ensure the commemorative integrity of the NHSC; guides appropriate public use; ensures the application of cultural resource management principles and practices in the decision-making process; and conserves the natural values of the Rideau Canal. This plan is included as Appendix E.

2.2.10 Visitor Experience and Recreational Opportunities

As stated in the NHSC Plan (Appendix E), the Rideau Canal is a valuable resource that contributes to the economy of eastern Ontario. Key actions by

PCA that ensure the visitor experience and recreational opportunities along the Rideau Canal are not impaired are:

- Maintaining through-navigation of the Rideau Canal system to help preserve its unique environment.
- Safeguarding the heritage character of corridor shore lands from inappropriate development or uses. This includes working with Indigenous communities, private property owners, municipalities and other organizations and agencies on:
  - Employing natural and cultural heritage conservation efforts along the Rideau Canal through site-specific actions and broader policy initiatives enabled under Federal and Provincial legislation.
  - Working with proponents on developing architectural design guidelines which promote compatibility with the surrounding built and natural environment; protect key viewscapes; respond to the Rideau Canal's history of engineering innovation; and enhance the visitor experience.
- Providing facilities and services to visitor sites along the Rideau Canal that present and celebrate its story, thereby resulting in greater awareness, understanding and appreciation of the heritage values of the Rideau Canal.

The current visitor experience and recreational opportunities for this area are broken down into the following two components, and further reflects PCA's management strategy of protecting and managing its heritage values:

- The Project, wherein visitors experience the natural landscape to the north, and its evolution into a more urban environment. Notable features that contribute to the current visitor and recreational experience include:
  - The backdrop of Belle Island and the City-owned Belle Park Fairways Golf Course to the south.
  - The Gore Road Library on the east shore which, as a City-owned (and designated cultural heritage) property, has both physical and design values, including its architecture, historic structures, and scenic pathways with views of the Rideau Canal.

  - Other paths and commuter cycling lanes in various states of planned development that ultimately serve the broader active transportation network.

- The navigable channel and adjacent rowing lanes (Figure 2-17), which transect both the Project and natural landscape near the east shoreline and contribute to the passive recreational experience. Other recreational opportunities were also once served by the Music Marina and Rideau Marina, but both operations have recently closed.

South of Belle Island and the Rideau Canal to the southerly limit of the Study Area at the LaSalle Causeway, visitors experience an urban environment both visually and spatially. This experience is characterized by the City's historic downtown, residential neighbourhoods, Inner Harbour, Fort Henry, CFB Kingston and RMC. These features highlight the City's current role as a multi-faceted regional service centre.

User Name: vill77807

THIRD CROSSING OF THE CATARAQUI RIVER
DIA REPORT

ROWING COURSE

Mark Van Buren, P.Eng., Director of Engineering and Deputy Commissioner
Dan Franco, P.Eng., Project Engineer

J.L.Richards

Project No.: 27143
Drawing No.: 2.2.13.1
Sheet No.:
Des: Chk'd:
Dwn: Chk'd:
Scale: N.T.S.
Utility Circ. No.:
Code:
Load:

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)

Last Saved: December 6, 2017 4:21:48 PM
Plot Date: 12/6/2017 4:21:59 PM

DATA SOURCES:
1. Spatial References: NAD 1983 UTM Zone 18N
2. Sources: Roads - Land Information Ontario
3. Rowing Course provided by J.L. Richards 2017.

Project: City of Kingston - Third Crossing

Figure Title: Rowing Course

Prepared By: HATCH, SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES, Kiewit, KINGSTON

Date: November 18, 2019

Figure: 2-17 **Page:** 1 of 1

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2.2.10.1 Rideau Canal's Outstanding Universal Value (UNESCO)

UNESCO World Heritage Site inscriptions are based on 10 criteria. The Rideau Canal's inscription on the UNESCO World Heritage List in 2007 was based on 2 of these criteria[1], namely:

- That it remains the best-preserved example of a slackwater canal in North America demonstrating the use of European slackwater technology in North America on a large scale. It is the only canal dating from the great North American canal-building era of the early 19th century that remains operational along its original line with most of its original structures intact.
- That it is an extensive, well preserved and significant example of a canal which was used for a military purpose linked to a significant stage in human history, that of the fight to control the north of the American continent.

The 'Statement of Outstanding Universal Value' for the Rideau Canal UNESCO World Heritage Site further reflects these two criteria, wherein it states that:

> "The Rideau Canal is a large strategic canal constructed for military purposes which played a crucial contributory role in allowing British forces to defend the colony of Canada against the United States of America, leading to the development of two distinct political and cultural entities in the north of the American continent, which can be seen as a significant stage in human history."

In keeping with its role in managing and protecting the Rideau Canal on behalf of the Federal government, Parks Canada's mandate, as reflected in the 'Rideau Canal World Heritage Site Management Plan', is to ensure that the Outstanding Universal Value is maintained and enhanced and that the integrity (wholeness and intactness) and authenticity (expression of value

[1] There are 8 other UNESCO World Heritage Site designation criteria that do not apply to the Rideau Canal. These criteria relate to the interchange of human values within cultural areas, traditional human settlements, living traditions having outstanding universal significance, or areas representing natural, ecological, or biological phenomena.

through attributes such as use, function, location and setting) of the Rideau Canal are protected and preserved.

2.2.11 Aesthetic Values

As summarized below, the aesthetic values of the Study Area south of Belle Island and the Rideau Canal are represented by its historic and cultural landscapes and influences noted earlier, namely:

- The relationships between Indigenous peoples and the European settlers that established the context for subsequent development.
- The City's downtown, which has also been framed by the evolution of different architectural styles and use of different architectural materials, including their visual and spatial influences on the downtown skyline and internal streetscapes.
- The waterway, which has influenced military, socio-economic and recreational pursuits as well as visual and spatial connections with the built features on-land.

These aesthetic values have contributed to the sense of place in the area. As such, proposed developments must recognize and support this unique environment.

2.2.12 Navigation

Watercraft navigation is an important feature of the Study Area, typified by the following:

- The Inner Harbour north of the LaSalle Causeway, which includes Her Majesty's Canadian Ship (HMCS) Cataraqui Facility and the Kingston Marina.
- The navigable channel and adjacent rowing lanes, which transect the Project Location near the east shoreline.

Focusing on the bridge portion of the Project, and as introduced earlier:

- The navigable channel is a Federally regulated waterway, which extends from the LaSalle Causeway northwards as part of the Rideau Canal. Integral to the Rideau Canal system are a series of lock stations, located north of the Study Area, which accommodate watercraft navigation to-and-

from Kingston and Ottawa. The lock stations are closed to all watercraft between Thanksgiving and Victoria Day.

- The Canadian Coast Guard confirms that the Kawartha Voyageur is the largest vessel that regularly uses the Rideau Canal system. It offers sight-seeing trips to-and-from Kingston and Ottawa within the above-noted operational window of the lock stations. The vessel is 36 m long and 7 m wide and has: 1.3 m draught; a total gross tonnage of 264 tonnes; and a maximum speed of 7.6 knots.
- The 2 km long, 7-lane rowing course, which runs north-south adjacent to the navigable channel. Rowing lanes are divided with 3 northbound lanes on the east side of the navigable channel that are typically used for warm-up; and 4 southbound lanes on the west side of the navigable channel which are used for timing and race preparations. Rowers require the full length of the course and additional room at either end for deceleration and turning.
- The Kingston Rowing Club operates the rowing course, which is open seasonally during non-ice conditions on the water.

While the operational schedule of the lock stations restricts watercraft navigation north of the Study Area during certain periods, it does not preclude watercraft use of the navigable channel within the Study Area.

2.2.13 Hydrologic Processes

As noted in the 1977 ‘Cataraqui River Basin Floodplain Management’ report (prepared by Lathem) and the 1984 ‘Natural Resource Description and Management Considerations: Cataraqui Marsh – Rideau Canal’ report (Blancher, 1984), the Cataraqui River watershed originates in the vicinity of Newboro, Ontario approximately 60 km upstream of the project location and discharges into Lake Ontario 4 km downstream.

The Cataraqui watershed posses a drainage area of approximately 930 km^2 (sq. km) that slopes southward to Lake Ontario. Most of the watershed is located in the Canadian Shield, and is characterized by numerous rock outcrops, shallow overburden and a predominance of lakes and low-lying swamp areas. The average water depth of the Cataraqui River is 1.2 m. Within the Project location the river is approximately 1,150 m wide and has

water depths ranging from 0.1 to 4.5 m within the navigable channel located along the eastern shore. Outside the navigable channel, shallow waters extend towards the west bank (approximately 900 m) ranging from 0.7 to 1.7 m deep before ascending a gradually sloped bank.

The shallow areas are historically heavily vegetated and are part of the Greater Cataraqui Marsh Provincially Significant Wetland (PSW). Immediately south of the project location a dredged channel exists that allowed larger boats and low water access to and from the former Music Marina and the Rideau Canal navigable channel. Aerial imagery illustrates that the area immediately north and south of dredged access route has also been historically impacted from boats accessing the navigation channel. This impacted area is estimated to be 2-3 times the size of the historically dredged channel.

The City of Kingston purchased the former Music Marina in 2014 and it has been closed as part of this project, helping restore the river's physical characteristics. Dredging had historically been required within this reach of river to maintain navigable channel, this is primarily due to the wide nature of the river confluence with Lake Ontario and dissipating and reversing flows depositing, resuspending and redepositing suspended sediments. This deposition area is evident in the soft sediments found throughout the project location and associated PSW.

The Project portion of the Cataraqui River is a slow-moving channel, with maximum velocities of 0.4 m/s occurring towards the mid-channel area, just west of the navigable channel. Lower velocities are typically found along the western side of the river where the channel is broad and relatively shallow. Under low flow conditions and southerly winds, the analysis shows reverse flows within portions of the channel, with circulation cells generated upstream and downstream of Belle Island. During average low flow conditions approximately 4 m^3/s is passed while during an average freshet flow, rates are approximately 50 m^3/s. This reach is heavily influenced by Lake Ontario water levels and wind patterns. Moving further upstream the first substantial vertical change in river elevation occurs at Kingston Mills Lock located 5 km upstream of the Project Location. A hydraulic analysis of the Project Area

confirmed these characteristics and revealed relatively higher velocities near Belle Island, as shown in Figure 2-18.

The average velocity scenario was designated to represent “average” conditions in the study area and the environmental factors driving water movement under these conditions were as follows:

- Average through the Cataraqui River of 4.5 m^3/s
- Monthly mean lake level of 74.42 m (T = 1.003 years)
- A wind from the south at 14.5 m/s for one hour (T = 1.003 years).

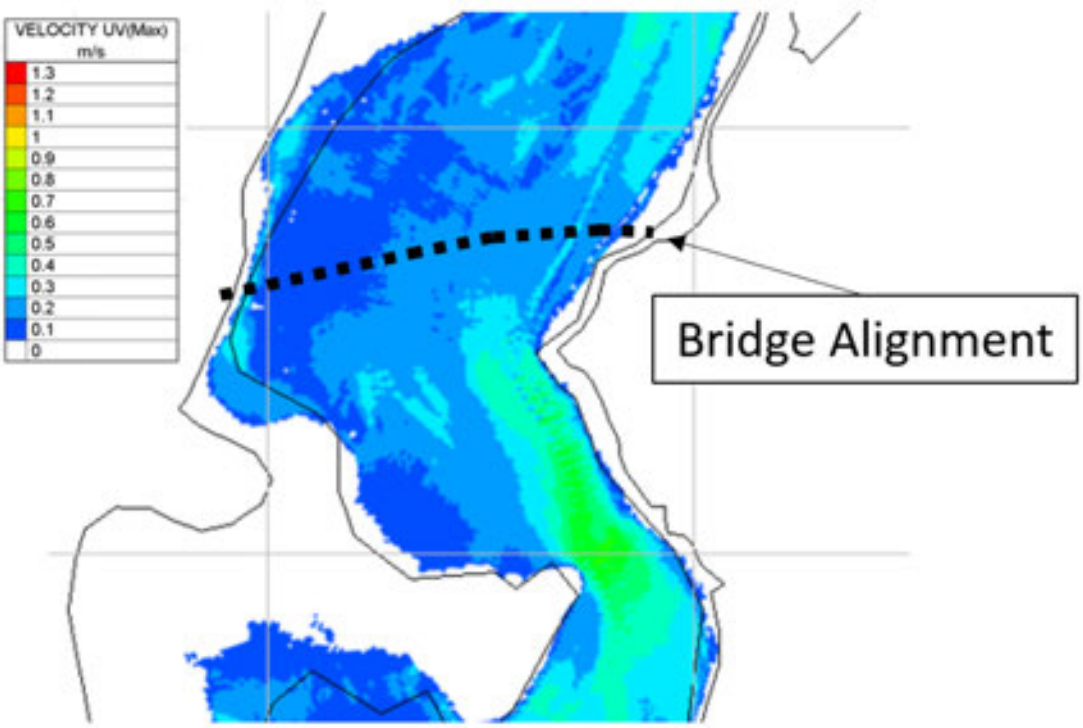

Figure 2-18: Water Velocity - Average Conditions

The average water depth of the Cataraqui River within the Project Area is approximately 1.2 m. Greater depths are present within the Inner Harbour,

and the aquatic utilities crossing or previously dredged Music Marina channel south of Belle Island as shown in Figure 2-19.

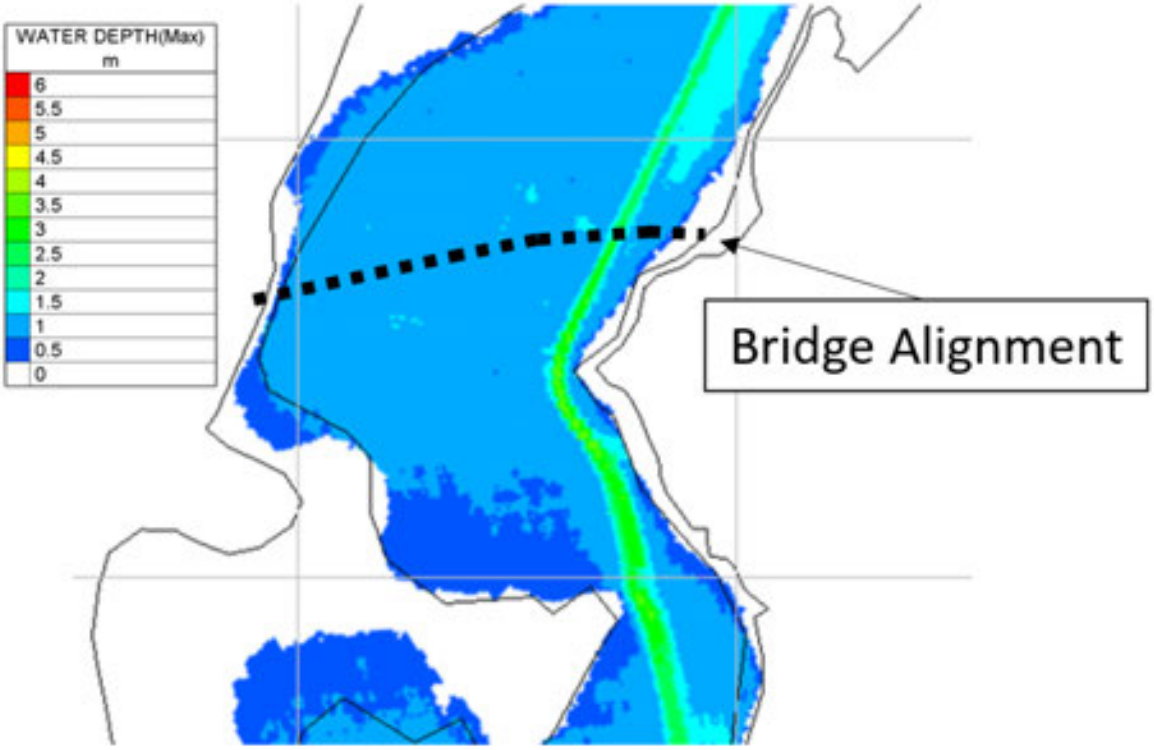

Figure 2-19: Water Depth - Average Conditions

The water level below Kingston Mills is the same as the water level in Lake Ontario, which is regulated at the dam located upstream of Cornwall, Ontario. In addition to the direct influence of the dam on water levels, other factors which affect seasonal and yearly water level fluctuations on Lake Ontario are:

1. Natural factors: During spring and early summer, Lake Ontario normally experiences a rising stage, as the net inflow from snowmelt and precipitation on the watershed exceeds the losses by outflow and evaporation. Following the summertime highs, the water levels typically fall due to lower precipitation and higher evaporation rates. However, during periods of low or high annual precipitation, the lake water levels

respond accordingly. This was most recently witnessed in 2017 when higher-than-average precipitation caused water levels in Lake Ontario to reach 75.8 m, the highest water level recorded at any time of year on Lake Ontario since 1918. Based on Cataraqui River Conservation Authority (CRCA) data recorded at the time, this had a similar effect on the lower Cataraqui River water levels.

The hydro-mechanical properties of Lake Ontario are also known to create changes in lake levels. These changes are more frequent and have a shorter duration, typically represented by surges and waves created by wind blowing over open water. The fetch, or distance over open water to which winds are exposed, is very limited to the lower section of the Cataraqui River below Kingston Mills, due to the islands and shoals lake-ward to its mouth.

2. Other artificial factors: The LaSalle Causeway structure, including the 3 openings through it, further absorb and diffract the effect of surges and waves from Lake Ontario to the south on the Cataraqui River. As such, wave energy passing into the Cataraqui River is low and sporadic.

The variation of historic lake levels at Kingston, by month, is presented in Figure 2-20 and reveals that higher water levels, in Lake Ontario at Kingston and (consequently) in the Project Area, generally occur May to July while the lowest levels occur October to January. Key water levels adopted for design are presented in Table 2.13. Due to the effect of Lake Ontario water levels, design high water levels are to be expected during the late spring and early summer months and are therefore typically associated with ice-free conditions. Similarly, Table 2.13 shows low and high-water elevations as well as CRCA's 1 in 100-year flood elevation.

Winter ice cover is not typically established until mid-to-late December and can last up to late April. Maximum ice thickness is not generally reached until early February. Historical ice data for the Project Area is limited. The 100-year ice thickness was estimated to be 0.84 m (HCCL 2011). Due to the low flow velocity of the Cataraqui River, the ice tends to melt in place. Ranges of historical water levels under ice conditions are shown in Table 2.14.

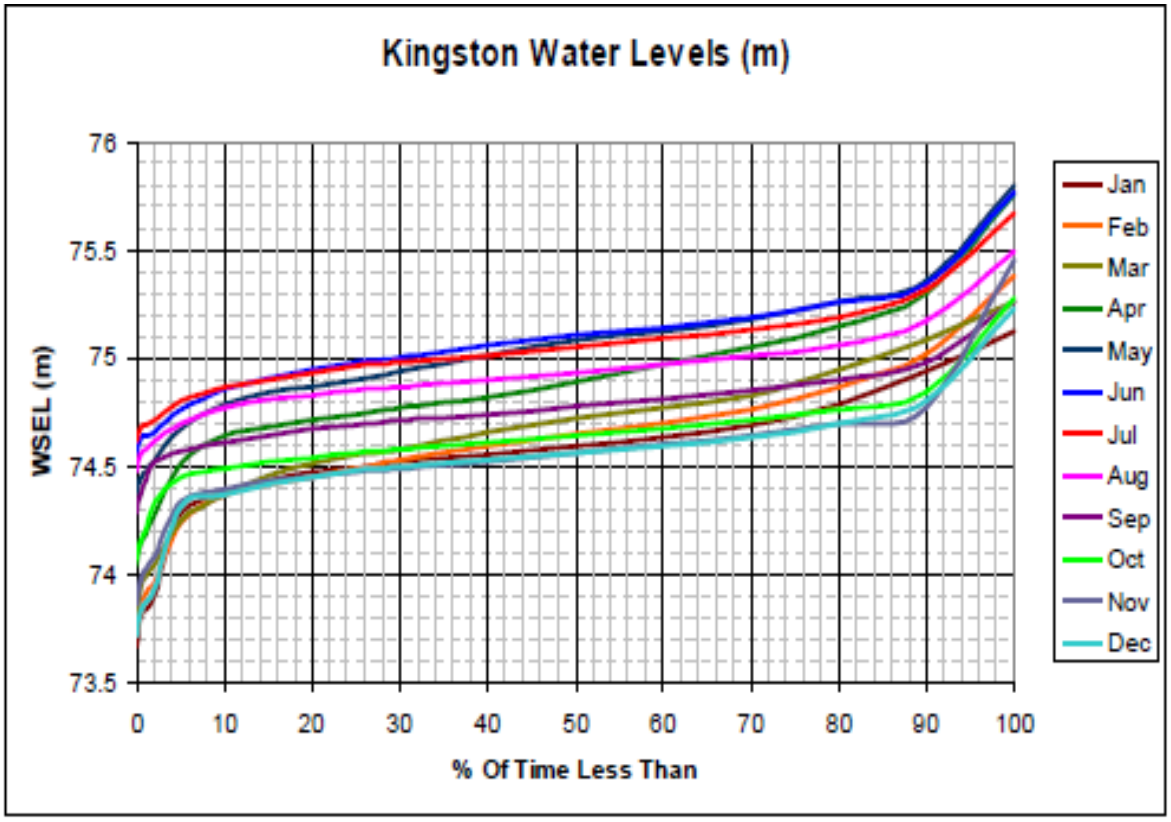

Figure 2-20: Historic Water Levels at Kingston (REF: HCCL 2011)

Table 2.13: Relevant Water Levels (REF: HCCL 2011)

Condition	Water Surface Elevation (WSEL)	Reference
Low Water Datum (LWD)	74.16 m	Canadian Hydrographic Service (Lake Ontario)
Average High Water (AHW)	75.26 m	Ministry of Natural Resources (Lake Ontario)
Regulatory Floodplain	76.3 m	CRCA

Table 2.14: Ice Cover Water Levels (December through April) (REF: HCCL 2011)

Conditions	WSEL	Source
Long Term Average (Static Ice)	74.49 to 74.84 m	USACE Lake Ontario Mean Monthly WSEL (1918-2010)
Historic Extremes (Static Ice)	73.70 to 75.61 m	USACE Lake Ontario Mean Monthly WSEL (1918-2010)
100 Year Extremes (Dynamic Ice)	73.65 to 75.86 m	Statistical analysis of CHS Hourly WSEL (1962-2010)
Winter Surge Conditions	-0.25 to +0.47 m	Extracted surge values from CHS Hourly WSEL (1962-2010)

The variation in flow velocity and depth within the Project Area is heavily influenced by wind and surges in Lake Ontario levels. Predominant winds are from the south to west direction as illustrated in Figure 2-21. The orientation of the Project Area relative to this predominate wind direction facilitates a relatively large fetch and consequently makes the site particularly sensitive to wind influenced water movement. Historical surges in Lake Ontario at Kingston over a one-hour period have ranged between -0.44 and 0.39 m with the maximum recorded surge of 0.72 m occurring over three hours. A frequency analysis was conducted on historical surge levels to determine key surge quantiles. The results are presented in Table 2.15.

Table 2.15: Lake Ontario Surge Quantiles at Kingston

Return Period (year)	Duration					
	1 hour	2 hour	3 hour	4 hour	5 hour	6 hour
2	0.24	0.29	0.34	0.35	0.33	0.34
5	0.29	0.37	0.43	0.44	0.41	0.43
10	0.32	0.41	0.49	0.50	0.47	0.48
20	0.35	0.46	0.55	0.55	0.52	0.53
25	0.36	0.47	0.57	0.57	0.54	0.55
50	0.39	0.51	0.62	0.62	0.59	0.59
100	0.42	0.55	0.68	0.67	0.64	0.64

Large currents may be induced through wind and surges in lake level and these factors, when combined, can produce significantly higher velocities and water levels within the Project Area than flow (for the same recurrence frequency). An analysis of water movement within the Project area, however, determined that wind is the most influential factor and was the key component of the design scenario.

The bed of the river in the vicinity of the bridge consists of very loose, fibrous silty peat to fibrous peat and organic silt, which ranged in thickness from 0.5 to 3.6 m with an average thickness of 1.4 m. The Geotechnical Investigation described the peat as “fibrous to amorphous with high organic content ranging from 16 to 84 percent… The material was dark brown, and the fines were silty often with low plasticity.” Below this material is organic clayey silt and organic silty clay with a standard lower limit grain size generally classified to be 0.002 mm (nominal diameter). A hydraulic analysis revealed relatively low bed shear stress under both normal and design event flow conditions (i.e. excluding the temporary works and the bridge) but sufficient to disturb the loose, soft organic materials, clay and silt that make up the bed.

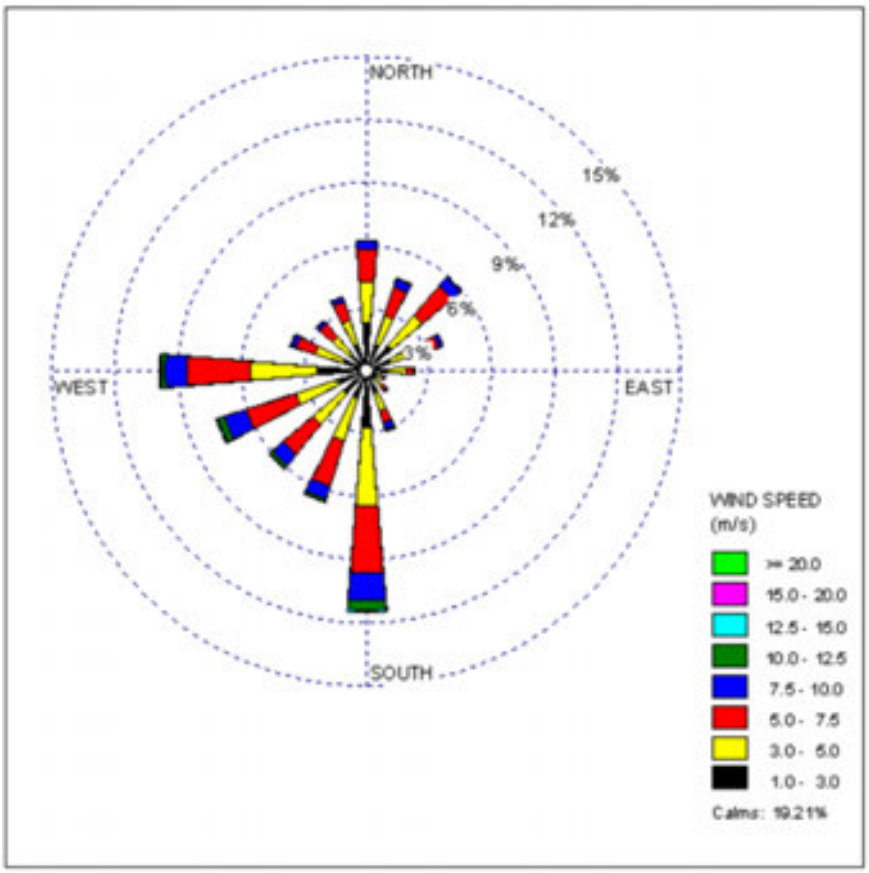

Figure 2-21: Wind Rose at Kingston for Historical Wind Recorded 1987 to 2007 (REF: HCCL 2011)

2.3 Secondary Components

2.3.1 Groundwater Quality and Quantity

Regional groundwater within the westerly and easterly portions of the Study Area generally flows towards the Cataraqui River and/or Lake Ontario. Geotechnical investigations within the Study Area have noted the following:

- Groundwater levels are hydraulically connected to the Cataraqui River and fluctuate both seasonally and with precipitation events.

- Groundwater levels at the east and west abutments are anticipated to be at or near the river level.

These findings are consistent with previous groundwater level measurements that were taken in 2010, 2016 and 2019.

On August 16, 2010 groundwater levels on the east and west bank were measured to be within 3 cm each other at 75.06 and 75.09 m above sea level (masl), respectively. This equates to a groundwater elevation 16 and 19 cm higher then the recorded average water level within Lake Ontario (74.90) for August 2010 (Gronewald et al., 2019).

On October 6, 2016 water elevation adjacent the bridge alignment was noted to be 74.7 +/- masl, which equates a groundwater elevation of 16 cm +/- above the average Lake Ontario water level of 74.54 masl for October 2016.

Similarly, in April 2019, water elevations were measured to be approximately 75.4 and 75.1 masl on the east and west shoreline respectively, whereas the average Lake Ontario level for April 2019 was 75.15 masl further indicating a close relationship between shoreline groundwater levels and the lake/river. It is important to note the average Lake Ontario water level for the month of May 2019 was 0.55 m higher.

Groundwater quality sampling occurred in April of 2019, at four (4) monitoring well locations that will be sampled throughout construction and post construction, as proposed in Section 8. Results of the 2019 water quality sampling are presented in Table 2.16 below, with comparison to the Provincial and Canadian drinking water standards. As shown, benzene is the only exceedance when compared against the provincial guidelines with no exceedances when compared to CCME.

Table 2.16: 2019 Water Quality Results

Borehole No.						BH-19-501	BH-19-406	BH-19-102	BH-19-103
Date Sampled						18-Apr-2019	18-Apr-2019	18-Apr-2019	18-Apr-2019
Time Sampled						10:20	11:35	14:30	13:30
Parameter	**Reported Detection Limit**	**Units**	**O. Reg. 169/03 Ontario Drinking Water Guidelines**	**Guidelines for Canadian Drinking Water Quality Table 1**	**Guidelines for Canadian Drinking Water Quality Table 2**	Water	Water	Water	Water
Volatile Organic Compounds (VOCs)									
Dichlorodifluoromethane	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
Vinyl Chloride	0.17	ug/L	1	NA	2	<0.17	<0.17	<0.17	<0.17
Bromomethane	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
Trichlorofluoromethane	0.40	ug/L	NA	NA	NA	<0.40	<0.40	<0.40	<0.40
Acetone	1.0	ug/L	NA	NA	NA	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethylene	0.30	ug/L	5	NA	140	<0.30	<0.30	<0.30	<0.30
Methylene Chloride	0.30	ug/L	NA	NA	NA	<0.30	<0.30	<0.30	<0.30
trans- 1,2-Dichloroethylene	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
Methyl tert-butyl ether	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
1,1-Dichloroethane	0.30	ug/L	NA	NA	NA	<0.30	<0.30	<0.30	<0.30
Methyl Ethyl Ketone	1.0	ug/L	NA	NA	NA	<1.0	<1.0	<1.0	<1.0
cis- 1,2-Dichloroethylene	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
Chloroform	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
1,2-Dichloroethane	0.20	ug/L	5	NA	5	<0.20	<0.20	<0.20	<0.20
1,1,1-Trichloroethane	0.30	ug/L	NA	NA	NA	<0.30	<0.30	<0.30	<0.30
Carbon Tetrachloride	0.20	ug/L	2	NA	2	<0.20	<0.20	<0.20	<0.20
Benzene	0.20	ug/L	1	NA	5	<0.20	**1.5**	<0.20	<0.20
1,2-Dichloropropane	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
Trichloroethylene	0.20	ug/L	5	NA	5	<0.20	<0.20	<0.20	<0.20
Bromodichloromethane	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
Methyl Isobutyl Ketone	1.0	ug/L	NA	NA	NA	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
Toluene	0.20	ug/L	60	NA	60	1.6	7.5	0.36	0.38
Dibromochloromethane	0.10	ug/L	NA	NA	NA	<0.10	<0.10	<0.10	<0.10

Borehole No.						BH-19-501	BH-19-406	BH-19-102	BH-19-103
Date Sampled						18-Apr-2019	18-Apr-2019	18-Apr-2019	18-Apr-2019
Time Sampled						10:20	11:35	14:30	13:30
Parameter	Reported Detection Limit	Units	O. Reg. 169/03 Ontario Drinking Water Guidelines	Guidelines for Canadian Drinking Water Quality Table 1	Guidelines for Canadian Drinking Water Quality Table 2	Water	Water	Water	Water
Ethylene Dibromide	0.10	ug/L	NA	NA	NA	<0.10	<0.10	<0.10	<0.10
Tetrachloroethylene	0.20	ug/L	10	NA	10	<0.20	<0.20	<0.20	<0.20
1,1,1,2-Tetrachloroethane	0.10	ug/L	NA	NA	NA	<0.10	<0.10	<0.10	<0.10
Chlorobenzene	0.10	ug/L	NA	NA	80	<0.10	<0.10	<0.10	<0.10
Ethylbenzene	0.10	ug/L	140	NA	140	<0.10	0.59	<0.10	<0.10
m & p-Xylene	0.20	ug/L	NA	NA	NA	0.42	2.9	<0.20	<0.20
Bromoform	0.10	ug/L	NA	NA	NA	<0.10	<0.10	<0.10	<0.10
Styrene	0.10	ug/L	NA	NA	NA	<0.10	<0.10	<0.10	<0.10
1,1,2,2-Tetrachloroethane	0.10	ug/L	NA	NA	NA	<0.10	<0.10	<0.10	<0.10
o-Xylene	0.10	ug/L	NA	NA	NA	0.21	1.4	0.53	<0.10
1,3-Dichlorobenzene	0.10	ug/L	NA	NA	NA	<0.10	<0.10	<0.10	<0.10
1,4-Dichlorobenzene	0.10	ug/L	5	NA	5	<0.10	<0.10	<0.10	<0.10
1,2-Dichlorobenzene	0.10	ug/L	200	NA	200	<0.10	<0.10	<0.10	<0.10
1,3-Dichloropropene	0.30	ug/L	NA	NA	NA	<0.30	<0.30	<0.30	<0.30
Xylene Mixture	0.20	ug/L	90	NA	90	0.63	4.3	0.53	<0.20
n-Hexane	0.20	ug/L	NA	NA	NA	<0.20	<0.20	<0.20	<0.20
TPgH/THE									
TPgH (gasoline range, C5 to C10)	8.0	ug/L	NA	NA	NA	15	NV	28	9.0
TEH (Diesel Range, C10-C24)	29.0	ug/L	NA	NA	NA	<29	NV	220	<29
TPH Gas/Diesel	37.0	ug/L	NA	NA	NA	<37	NV	250	<37
Metals & Inorganics									
Antimony	1.0	ug/L	6	NA	6	<1.0	<1.0	<1.0	<1.0
Arsenic	1.0	ug/L	10	NA	10	<1.0	<1.0	<1.0	<1.0
Barium	2.0	ug/L	1000	NA	1000	99.3	64.9	106	174
Beryllium	0.5	ug/L	NA	NA	NA	<0.5	<0.5	<0.5	<0.5
Boron	10.0	ug/L	5000	NA	5000	35.4	23.5	43.0	180
Cadmium	0.2	ug/L	5	NA	5	<0.2	<0.2	<0.2	<0.2

Borehole No.						BH-19-501	BH-19-406	BH-19-102	BH-19-103
Date Sampled						18-Apr-2019	18-Apr-2019	18-Apr-2019	18-Apr-2019
Time Sampled						10:20	11:35	14:30	13:30
Parameter	**Reported Detection Limit**	**Units**	**O. Reg. 169/03 Ontario Drinking Water Guidelines**	**Guidelines for Canadian Drinking Water Quality Table 1**	**Guidelines for Canadian Drinking Water Quality Table 2**	Water	Water	Water	Water
Chromium	2.0	ug/L	50	NA	50	5.6	3.5	2.7	4.9
Cobalt	0.5	ug/L	NA	NA	NA	<0.5	<0.5	<0.5	0.8
Copper	1.0	ug/L	NA	NA	2000	1.0	1.5	4.4	1.3
Lead	0.5	ug/L	10	NA	5	<0.5	<0.5	<0.5	<0.5
Molybdenum	0.5	ug/L	NA	NA	NA	3.6	3.1	13.1	4.7
Nickel	1.0	ug/L	NA	NA	NA	1.2	2.9	4.6	2.5
Selenium	1.0	ug/L	50	NA	50	2.7	2.5	<1.0	2.6
Silver	0.2	ug/L	NA	NA	NA	<0.2	<0.2	<0.2	<0.2
Thallium	0.3	ug/L	NA	NA	NA	<0.3	<0.3	<0.3	<0.3
Uranium	0.5	ug/L	20	NA	20	1.6	0.7	0.9	1.0
Vanadium	0.4	ug/L	NA	NA	NA	0.7	0.4	0.8	0.7
Zinc	5.0	ug/L	NA	NA	NA	<5.0	<5.0	<5.0	7.2
Mercury	0.02	ug/L	1	NA	1	<0.02	<0.02	<0.02	<0.02
Chromium VI	5	ug/L	NA	NA	NA	<5	<5	<5	<5
Cyanide	2	ug/L	200	NA	200	<2	<2	<2	<2
Sodium	500	ug/L	NA	NA	NA	99600	24800	32000	73700
Chloride	200	ug/L	NA	NA	NA	234000	46100	26800	151000
Electrical Conductivity	2	uS/cm	NA	NA	NA	1220	590	694	1230
pH	NA	pH Units	NA	NA	7.0-10.5	7.86	7.87	7.97	7.81

Notes:

NV = No value derived, NA - Not analyzed. NC - Not calculated.

Bold	Exceeds Ontario Regulation 169/03: Ontario Drinking Water Quality Standards
Grey Shaded	Exceeds Health Canada Guidelines for Canadian Drinking Water Quality Table 2

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2.3.1.1 Source Water Protection

The Project Location is within the Cataraqui Source Protection Area (Figure 2-22), approximately 5 km northeast of the Point Pleasant & Kingston Central Intake Protection Zones and approximately 5 km southwest of the Cana Wellhead Protection Area.

2.3.2 Terrain, Geology and Soils

2.3.2.1 Regional Geology

The Study Area is located in the physiographic region of Southern Ontario known as the Napanee Plain. The Napanee Plain is flat to undulating and is characterized by relatively shallow soil deposits overlying bedrock. Geologic mapping indicates that the bedrock within the Napanee Plain consists of grey limestone/dolostone of the Gull River Formation, which contains some shale partings and seams.

The overburden soils within the Napanee Plain generally consist of glacial till, although alluvium is present in river and stream valleys. In the southern portion of the Plain, low-lying areas are typically covered with deposits of stratified clay. Water well records indicate that the average depth to bedrock within the Napanee Plain is approximately 2 m. However, in many areas, bedrock outcrops are observed at ground surface, while deeper soil deposits (in the order of 10 m) are present in the northern portion of the Plain and within and adjacent to river valleys throughout the Plain.

2.3.2.2 Study Area Geology and Soils

The Study Area is generally characterized by shallow limestone bedrock and where overburden is present, it consists mostly of post-glacial silts and clays Much of the Cataraqui River bank south of Highway 401 up to Weller Avenue as well as Belle Park excluding the Federal dredged sediment disposal site along the north shore is lined with organic deposits (Figure 2-23). The bedrock surface appears to be variable along the proposed bridge alignment (Figure 2-24). Bedrock is exposed or near surface on both sides of the Cataraqui River (at an elevation of 73 masl at the east bank and 76 masl at the west bank) and then dips to elevations ranging from 30 to 55 masl within the river. Limestone, present on the banks of the Cataraqui River, is underlain by a 3 to 5 m layer of Shadow Lake shale.

The subsurface river conditions of the bridge alignment consist of overburden soils that vary from limited thickness (2 to 3 m) at the Cataraqui shoreline to about 40 m within the river. Along the shoreline, the overburden consists of fill over peat over silty clay or glacial till. Within the Cataraqui River, the overburden consists of peat over silty clay.

2.3.2.2.1 Potentially Reduced Soil Quality Areas

Within or adjacent to the Project Location several potential areas of potential soil quality concerns have been noted, all areas are along the western shore and are as follows:

- 919 Montreal Street is currently occupied by an automobile collision centre. An above ground storage tank (AST) was formerly present at the collision centre (no longer present based on a visual assessment of the exterior of the building). Due to the historic presence of the tank, combined with the on-site land use, this location is considered an area of concern as it related to soil quality. Given the nature of the operation, this Potential Contaminating Activity is considered to have resulted in an Area of Potential Environmental Concern (APEC).
- 931 Montreal Street is the former location of B & S Transmission Service. It is possible that this former land use was located on the northeast corner of Montreal Street and John Counter Boulevard. The presence of a former transmission service garage is considered a Potential Contaminating Activity. Previous information also identifies this property was contaminated by metals and petroleum hydrocarbons but was subsequently remediated and redeveloped. However, impacts may have subsequently migrated off property (with no remediation) and is therefore considered a potential APEC.
- A fenced yard was observed at the east end of John Counter Boulevard where it meets the Cataraqui River. The yard contained several drums, an abandoned recreational vehicle, a shipping container and several piles covered with tarps. Drum and vehicle storage are considered a Potential Contaminating Activity. Since this site is within the proposed laydown area on the west shore, it is considered an APEC.

- Fill and vent pipes were observed at 630 and 612 John Counter Boulevard indicating the presence (or former presence) of a heating oil storage tank at the residences. The operation of fuel oil storage tanks is considered a Potential Contaminating Activity; however, it is likely that these storage tanks are ASTs which are more common in residential homes. If the latter applies, this would lower the degree to which the Potential Contaminating Activity may have resulted in an APEC. But regardless, both Potential Contaminating Activities are still considered APEC.
- 603 John Counter Boulevard was previously occupied by a marina. Marinas typically offer fueling services for boats which is considered a Potential Contaminating Activity. In addition, boat building and repairs at the marina also occurred, which is a Potential Contaminating Activity. These Potential Contaminating Activities are considered an APEC.
- Fill of unknown origin may be present under the roadways and is considered a Potential Contaminating Activity and an APEC. In addition, fill was reportedly placed along the west shoreline and likely associated with the former railway alignment between John Counter Boulevard and the Cataraqui River.
- Past use of de-icing agents (road salt) along the roadways should be considered a Potential Contaminating Activity in the context of off-site soil management. However, this is not considered an APEC in terms of in-situ condition.

Geotechnical investigations have been completed within the Project Location in 2016, 2018 and 2019 with a total of 27 onshore boreholes drilled for various geotechnical and chemical analyses. A summary of the boreholes as well as the chemical analysis results are provided in Appendix F. Appendix F shows exceedances for PAH's, metals and electrical conductivity to be sporadic with exceedances on the east and west approach areas. Relatively high levels of barium were shown to persist with exceedances at 50% of the sampled boreholes.

User Name: vill77807

Document Path: T:\Maps\GIS_Data\CityOfKingston\MXD\K3C_DIA_Fig2-22_SourceWaterProtectionAreas.mxd

TOWNSHIP OF ADDINGTON HIGHLANDS

TOWNSHIP OF CENTRAL FRONTENAC

Mississpi - Rideau Source Protection Area

TOWNSHIP OF TAY VALLEY

VILLAGE OF WESTPORT

TOWNSHIP OF RIDEAU LAKES

TOWNSHIP OF ATHENS

TOWNSHIP OF ELIZABETHTOWN-KITLEY

TOWNSHIP OF EDWARDSBURGH/CAR

TOWN OF ESCOTT

Raisin - South Nation Source Protection Area

CITY OF BROCKVILLE

TOWNSHIP OF FRONT OF YONGE

TOWNSH OF SOUT FRONTEN

Cataraqui Source Protection Area

MUNICIPALITY OF TWEED

TOWNSHIP OF STONE MILLS

Quinte Source Protection Area

TOWNSHIP OF LEEDS AND THE THOUSAND ISLANDS

TOWN OF GANANOQUE

CITY OF KINGSTON

TOWNSHIP OF TYENDINAGA

TOWN OF GREATER NAPANEE

TOWN OF DESERONTO

COUNTY OF PRINCE EDWARD COUNTY

TOWNSHIP OF LOYALIST

TOWNSHIP OF FRONTENAC ISLANDS

N

Schedule

- Cana Wellhead Protection Area
- Lansdowne Wellhead Protection Area
- Miller Manor Wellhead Protection Area
- Bath Intake Protection Zone
- Brockville Intake Protection Zone
- Fairfield Intake Protection Zone
- James King Intake Protection Zone
- Point Pleasant & Kingston Central Intake Protection Zones
- Sandhurst Shores & AL Dafoe Intake Protection Zones
- Sydenham Intake Protection Zone

Legend

- Project Location
- Road
- Source Protection Area
- Municpal Boundary
- Waterbodies

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Sources: Roads - Land Information Ontario
3. Source water protection data derived from Land Information Ontario, Clean Water Cataraqui

0 5 10 20 Kilometers

1:350,000

Project: City of Kingston - Third Crossing

Figure Title: Cataraqui Region Source Water Protection Area

Prepared By: HATCH SYSTRA Kiewit KINGSTON

Date: November 18, 2019

Figure: 2-22

THIRD CROSSING OF THE CATARAQUI RIVER

DIA REPORT

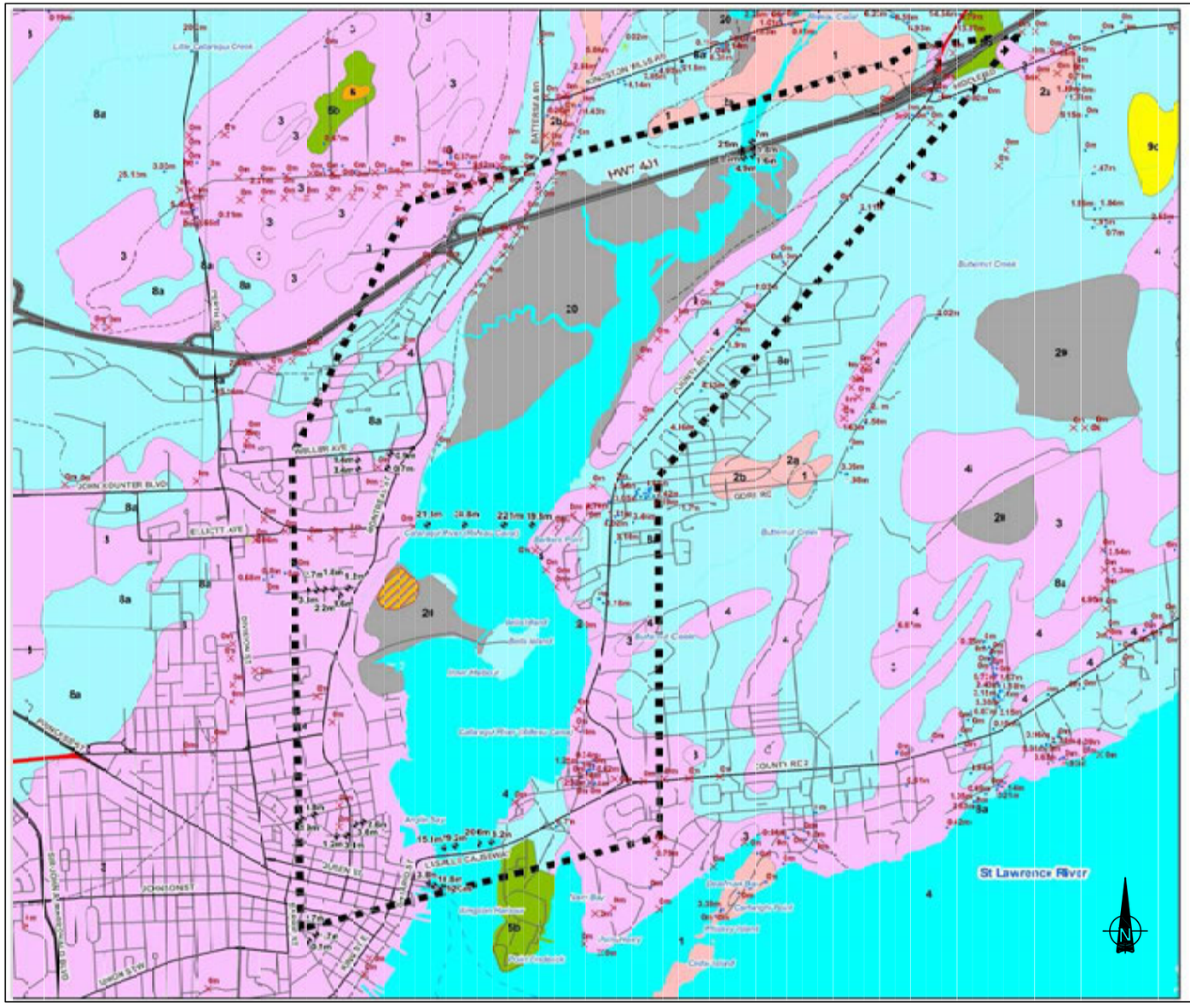
GEOTECHNICAL CONDITIONS

Mark Van Buren, P.Eng. — Director of Engineering and Deputy Commissioner
Dan Franco, P.Eng. — Project Engineer

J.L.Richards

KINGSTON

N



LEGEND

Data Point - Overburden Thickness (m)

- Outcrop
- Water Wells
- Water Wells dot Reaching Bedrock
- Other
- Borehole
- Major Road
- Minor Road
- Contact - Approximate
- Contact - Observed
- Former Landfill
- Study Area Boundary

- **2f** **Organic deposits**: peat, muck, marl
- **9** **Coarse-textured glaciolacustrine deposits**: sand, gravel, minor silt and clay
  - 9a: Deltaic deposits
  - 9b: Littoral deposits
  - 9c: Foreshore and basinal deposits
- **8** **Fine-textured glaciolacustrine deposits**: silt and clay, minor sand and gravel
  - 8a: Massive to well laminated
  - 8b: Interbedded silt and clay and gritty, pebbly flow till and raincut deposits
- **5a** **Till**: Silty sand to sand-textured till on Precambrian terrain
  - 5a: Shield-derived silty to sandy till
- **5b** Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain
- **5c** Stony, sandy silt to silty sand-textured till on Paleozoic terrain
- **5d** Clay to silt-textured till (derived from glaciolacustrine deposits or shale)
- **5e** Undifferentiated older till may include stratified deposits
- **4** **Bedrock-drift complex in Paleozoic terrain**
  - 4a: Primary till cover
  - 4b: Primary stratified drift cover
- **3** **Paleozoic limestone bedrock (Gull River Formation)**
- **2** **Bedrock-drift complex in Precambrian terrain**
  - 2a: Primary till cover
  - 2b: Primary stratified drift cover
- **1** **Precambrian bedrock**

NOTE

This figure is to be read in conjunction with the accompanying Golder Associates Ltd report No. 09-1121-0016

REFERENCE

Produced by Golder Associates Ltd. under License with ENS Ministry of Northern Development and Mines © Queen's Printer for Ontario, 2009.
Armstrong, D.K. and Bodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 219
Gao, C., Shirota, J., Kelly, R.I., Brunton, F.R. and van Haaften, S. 2006. Bedrock topography and overburden thickness mapping, southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 207

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18

0 375 750 1,500 2,250 3,000 METRES

1:30,000

Project No.: 27143
Drawing No.: 2.3.2.1
Sheet No.:
Desc: Chk'd:
Dwn: Chk'd:
Scale: N.T.S.
Utility Circ. No.:
Code:
Load:

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Sources: Roads - Land Information Ontario
3. Geotechnical conditions provided by Golder & J.L. Richards 2017.

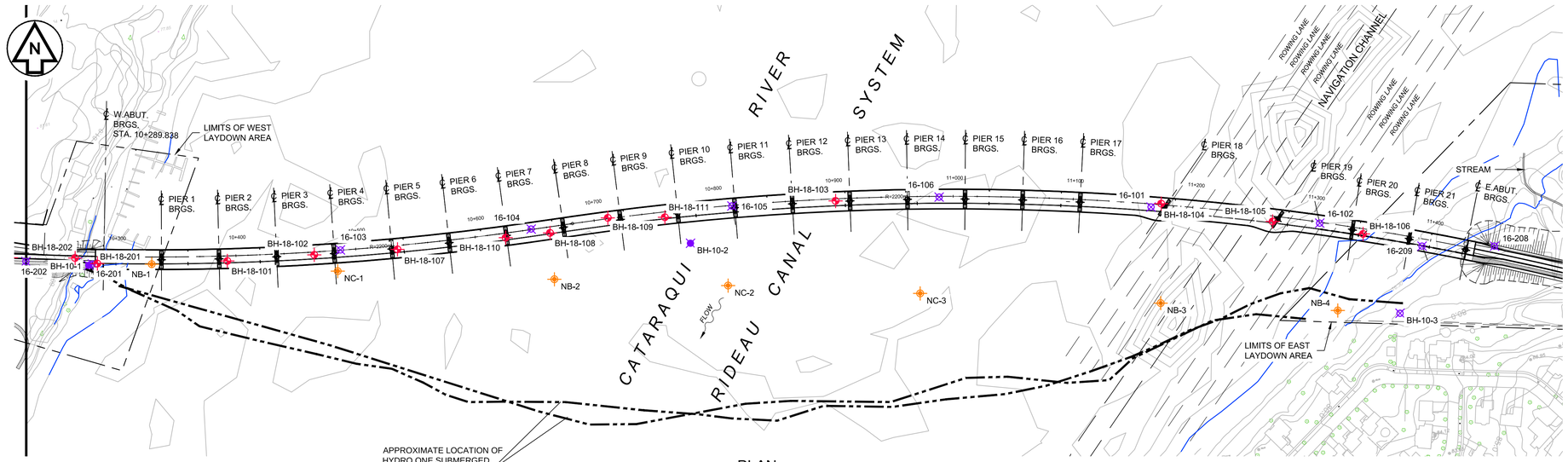
Project: City of Kingston - Third Crossing

Figure Title: Surficial Geology of the Study Area

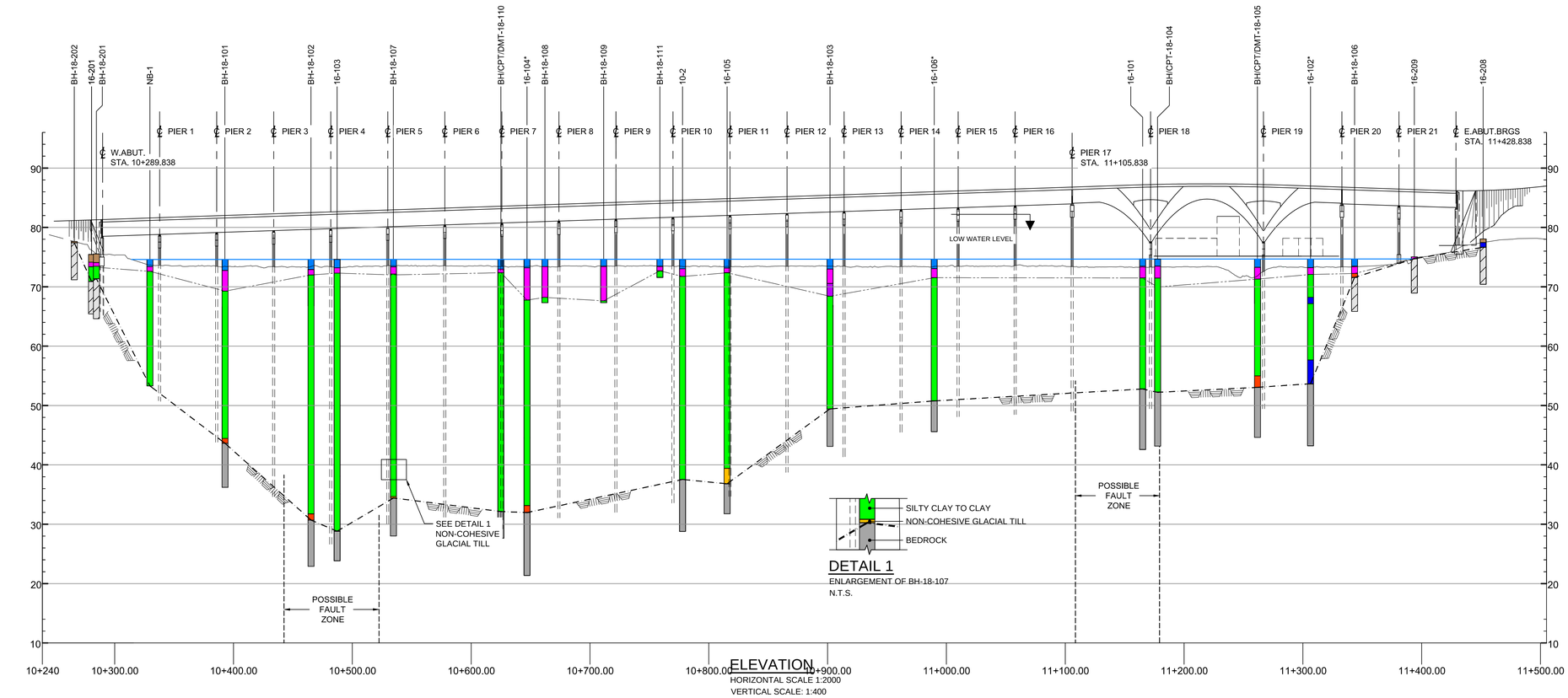
Prepared By: HATCH SYSTRA Kiewit KINGSTON

Date: November 18, 2019

Figure: 2-23



PLAN
SCALE: 1:2000



ELEVATION
HORIZONTAL SCALE 1:2000
VERTICAL SCALE: 1:400

DETAIL 1
ENLARGEMENT OF BH-18-107
N.T.S.

NOTES:

METRIC

1. HORIZONTAL & VERTICAL CO-ORDINATES ARE UTM ZONE 18 (NAD83 CSRS).
2. PIER LOCATION UPDATED AS PER PLAN PROVIDED BY HATCH (H357883-03-260-WIP0-1000) 2019-01-09.
3. WATER LEVEL DATUM BELOW;

LOW WATER DATUM	EL. 74.16	CANADIAN HYDROGRAPHIC SERVICE (LAKE ONTARIO)
AVERAGE HIGH WATER	EL. 75.26	MINISTRY OF NATURAL RESOURCES (LAKE ONTARIO)
REGULATORY WATER LEVEL	EL. 76.30	CATARAQUI REGION CONSERVATION AUTHORITY "REGULATORY LIMIT WITHIN STUDY AREA"

LEGEND:

- BH-18-101 — 2018 BOREHOLE INVESTIGATIONS (TULLOCH)
- 10-2 — 2010 BOREHOLE INVESTIGATIONS (GOLDER, REPORT NO. 09-1121-0016)
- 16-201* — 2016 BOREHOE INVESTIGATIONS (GOLDER), * FOR SCPT AND BOREHOLES
- NB-1 — 1991 INVESTIGATIONS (STRATA, APPROXIMATE LOCATION)
- SUBMERGED HYDRO ONE UTILITY LINES (HYDRO ONE 2018-10-19)
- INFERRED BEDROCK PROFILE
- INFERRED INTERFACE BETWEEN PEAT / SILT AND CLAY
- WATER
- PEAT
- ORGANIC SOIL / SILT
- SILTY CLAY TO CLAY
- SILT AND SAND
- COHESIVE GLACIAL TILL
- NON-COHESIVE GLACIAL TILL
- GRANITE / GNEISS
- LIMESTONE / DOLOSTONE
- FILL

BOREHOLE COORDINATES

WORK POINT	EASTING	NORTHING
BH-18-101	382 018	4 901 546
BH-18-102	382 089	4 901 561
BH-18-103	382 513	4 901 665
BH-18-104	382 782	4 901 700
BH-18-105	382 876	4 901 698
BH-18-106	382 952	4 901 698
BH-18-107	382 157	4 901 575
BH-18-108	382 281	4 901 606
BH-18-109	382 327	4 901 625
BH-18-110	382 245	4 901 597
BH-18-111	382 374	4 901 632
BH-18-201	381 911	4 901 529
BH-18-202	381 892	4 901 531

0 20 40 60 80 100 m
HORIZONTAL SCALE 1:2000
0 4 8 12 16 20 m
VERTICAL SCALE 1:400

DRAWING NAME: Drawing 2.3.2.3 Geotechnical Fieldwork Results.dwg PLOT DATE: 3/11/2019 9:55 AM
SAVED BY: kevin.kortekaas SAVE DATE: 3/11/2019 9:44 AM

INTEGRATED PROJECT DELIVERY TEAM:

HATCH · SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES · Kiewit · KINGSTON

No.	DATE	REVISIONS	BY	CHECKED
1	2019-03-11	ISSUED FOR DETAILED IMPACT ANALYSIS REPORT	K.K.	G.Q.
0	2018-12-17	ISSUED FOR DETAILED IMPACT ANALYSIS REPORT	K.K.	G.Q.

DESIGN COMPANY: HATCH

DESIGN: G.Q.
DRAWN: K.K.
CHECKED: B.N.
DATE: 2018-12-17
SCALE: AS NOTED

KINGSTON THIRD CROSSING

Drawing 2.3.2.3:
Geotechnical Fieldwork Results

DRAWING NO. 0
SHEET NO. 1
REVISION REV 1

2.3.3 Other Terrestrial Wildlife

Available data on other terrestrial wildlife species present within the Study Area, not previously included above, is limited with the exception of Arthropoda that dos have an atlas. In addition to the anthhropoda atlas that identified 35 species Table 2.17**,** identifies any other terrestrial wildlife found during records review or observed within the Study Area. All are either confirmed or have a high likelihood of occurring within the Study Area.

Table 2.17: Other Terrestrial Wildlife Species (Excluding Arthropoda)

Species	
Herpetofauna	
American Bullfrog	Dekay's Brownsnake
American Toad	Eastern Gartersnake
Mammals	
Beaver	Muskrat
Coyote	Norway Rat
Eastern Chipmunk	Porcupine
Eastern Cottontail	Raccoon
Eastern Grey Squirrel*	Red Fox
Ermine	Red Squirrel
European Hare	River Otter
Longtail Weasel	Short-tailed Shrew
Masked Shrew	Striped Skunk
Meadow Jumping Mouse	White-footed Mouse
Meadow Vole	White-tailed Deer
Mink	Woodchuck

2.3.4 Terrestrial Vegetation

Based on the ‘Central Cataraqui Region Natural Heritage Study Final Report’, many of the woodlands within the Study Area are considered significant or contributory. Consistent with their location in an urban area, most are narrow, fragmented strips, along areas historically difficult most often associated with watercourse or ravines. A few exceptions within the Study Area are the former Davis Tannery site; Belle Island; and the emergent vegetative portion of the Greater Cataraqui Marsh. It is recognized that the CRCA study involved

only limited field checking. The significance of the impacted woodlands within the Study Area will be evaluated in Section 3.

During the Municipal Class EA, Ecological Land Classification (ELC) mapping was completed within the Study Area within the Project Location In support of the DIA and as shown on Figure 2-11**,** there are 4 ELC community types on the west side[2] and east side lands, which have remained unchanged to date:

- 'Cultural Thicket' (CUT) community is found in several areas throughout the Study Area. It is characterized as having a shrub cover greater than 25% and a tree cover of less than 25%. There are a range of shrubs and immature trees such as Manitoba maple, common buckthorn, staghorn sumac and red raspberry. There are also various escarped garden and landscape plants as well as some low-lying areas wherein moisture-tolerant species such as glossy buckthorn are present.

  On the east side lands in particular, there are a few large diameter sugar maple, red oak, white oak and bur oak trees that are likely over 100 years old, and a number of shrub-sized white ash and Manitoba maple, but the overall dominant species that characterizes this area is European buckthorn. Other shrub species include tartarian honeysuckle, staghorn sumac, and riverbank grape. The ground cover is mostly weedy non-native species such as knapweed, burdock, trefoil, fragrant bedstraw (native), thistles, dames rocket, crown vetch, and garlic mustard. Many of the dominant plant species present are considered invasive species. The main tree species along the shoreline is crack willow, but Manitoba maple and European buckthorn are also present.

- 'Dry-Fresh Sugar Maple - White Ash Deciduous Forest' (FOD5-8) community is found north of the Gore Road right-of-way and extends northward in fragmented segments. This forest type is typical of lands that have a history of disturbance. This includes an underlay of large rock fill,

[2] There were no ELC community types on the west side lands documented in the ESR as the geographic scope was focused on the area proximate to the John Counter Boulevard right-of-way. The four ELC community types are cited herein due to the expanded geographic scope of the DIA.

making much of the Gore Road right-of-way roughly 6 to 8 m higher in elevation than the woodlot area to the north.

The dominant canopy tree species is sugar maple, with lesser amounts of white ash. Manitoba maple, ironwood, black cherry, shagbark hickory, basswood, red oak and white oak are also present. It appears, based on historic photographs from 1945, 1953, 1962 and 1978, that much of the FOD5-8 forest area was used for agricultural purposes. This would coincide with the mostly young age of the woodlot, with many of the trees in the 30-year range. There are older trees in the 80-100-year range that, in the historic aerial photographs, are isolated within the agricultural areas.

This woodlot has a high degree of edge due to its uneven shape and has high fragmentation due to the numerous trails within it. Common trees in the edge include Manitoba maple and white ash, but European buckthorn dominates, with garlic mustard as a common understory plant. Overall, the buckthorn-dominated edge areas are almost greater in size than the area dominated by sugar maple. The shoreline component of the FOD5-8 area has an approximate 15 m wide verge of wetland vegetation that is too small to be considered a separate ELC community type.

- The 2 ‘Cultural Meadow’ (CUM) communities on the east side lands, like most cultural meadows within urban settings, are dominated by weedy species and both have a history of disturbance. The more easterly CUM area adjacent to Highway 15 is part of the off-leash dog park.
- The RES-COM-IND community dominates the Study Area and contains tree species and landscape vegetation characteristic of urban developments.

None of the vegetation observed on the west side and east side lands are listed under the ESA or SARA, although several candidate Brainerd’s hawthorn were documented during field investigations completed in November 2018 near the meadow north of the east abutment.

2.3.5 Climate Change and Air Quality

The climate of the Lake Simcoe-Rideau Ecoregion, in which the Study Area is located, is generally mild and moist, with cool winters and warm summers. The Ecoregion is prone to changeable weather, as it is proximate to 1 of the major storm tracks of North America.

Table 2.18 shows recent average climate conditions and climate projections to the years 2020 and 2050 for the City of Kingston, as excerpted from the City's 2014 'Kingston Climate Action Plan'. As noted, by 2050, average temperatures and precipitation levels are projected to increase across the seasons, as are the number of extreme events related to precipitation, ice storms and wind.

Table 2.18: Kingston Weather Modelling Projections

	Climate Variable	1981-2010 Average	2020 Projection	2050 Projection
Temperature (°C)	Average	7.8°C	9.2°C	11.1°C
	Winter	-5.1°C	-3.4°C	-1.2°C
	Spring	6.3°C	7.5°C	9.4°C
	Summer	20.2°C	21.5°C	23.4°C
	Autumn	9.7°C	11.0°C	12.8°C
Extremes (°C)	Cold (minimum)	-34.0°C	-32.2°C	-29.7°C
	Heat (maximum)	35.0°C	36.4°C	38.5°C
	Days/Year >30°C	4 days	12 days	30 days
Indices	Cooling Degree Days	280	404	611
	Heating Degree Days	3984	3597	3096
	Growing Season Days	203 days	219 days	233 days
	Freeze-Free Days (>0°C)	172 days	190 days	206 days
Precipitation (mm)	Total Annual	951 mm	980 mm	1,024 mm
	Average Winter	232 mm	247 mm	266 mm
	Average Spring	219 mm	228 mm	347 mm
	Average Summer	218 mm	218 mm	217 mm
	Average Autumn	283 mm	289 mm	299 mm
Extreme Precipitation (mm)	Average Annual No. of Days with >25 mm	4.6 days	5.9 days	8.1 days
	Maximum Daily	72 mm	76 mm	83 mm
	50 Day Maximum	91.2 mm	95.5 mm	101.9 mm

	Climate Variable	1981-2010 Average	2020 Projection	2050 Projection
Ice Storms	No. Freezing Rain Events lasting 6 hrs or more (Dec.-Feb.)	1.5 events	N/A	3.2 events
Wind	No. of Days with Wind Gusts >90 km/hr	0.7 days	N/A	0.8 days

The primary indicator used for air quality in Ontario is the Air Quality Index (AQI) which is a calculated index developed by MECP. It provides a standardized measure of air quality across the Province and a scientific basis on which to issue smog alerts. The AQI is based on the following pollutants that adversely affect human health and the environment: ozone, particulate matter (aerosols, smoke, fumes, dust, fly ash, and pollen), nitrogen dioxide, sulphur dioxide and carbon monoxide.

The following are highlights from the 2015 'Air Quality in Ontario' report, based on measurements taken at the Kingston site at 23 Beechgrove Lane, which is approximately 6 km southwest of the Study Area:

1. There were zero occurrences in which the AQI for ozone exceeded Ontario's Ambient Air Quality Criteria (AAQC) of 80 parts per billion (ppb) for at least 1 hour.
2. There were zero occurrences in which the AQI for particulate matter exceeded Ontario's 24-hour level of 28 micrograms per cubic metre ($\mu g/m^3$).
3. There were zero exceedances of Ontario's 1-hour (200 ppb) and 24-hour (100 ppb) AAQC for nitrogen dioxide.
4. There were zero exceedances of Ontario's 1-hour (250 ppb) and 24-hour (20 ppb) AAQC for sulphur dioxide.
5. There were zero exceedances of Ontario's 1-hour [30 parts per million (ppm)] and 24-hour (13 ppm) AAQC for carbon monoxide.

6. In regard to real-time air quality measurements, the City recorded:
   i) Low risk air quality (enjoy outdoor activities) 95.8% of the time.
   ii) Moderate risk air quality (consider reducing or rescheduling strenuous outdoor activities if experiencing symptoms such as coughing or throat irritation) 4.2% of the time.
   iii) High-to-Very-High risk air quality (reduce, reschedule or avoid strenuous outdoor activities) 0% of the time.
7. There were zero occurrences of Special Air Quality Statements, which are issued by the Province if degrading air quality is in the High-to-Very-High risk category and lasts for 1 or 2 hours.

2.4 General Considerations

2.4.1 Invasive Species

2.4.1.1 Records Review

A records review for invasive species was completed in August 2019. Within the Early Detection and Distribution Mapping System (EDDMapS), all records within a 5 km radius of the Study Area were recorded. The Cataraqui Region Lake Management Plan was also used to record invasive species known to occur within the Cataraqui Region. Habitat descriptions for the species noted in Table 2.19 were derived from the following sources:

- Ontario Ministry of Agriculture, Food and Rural Affairs
- Ontario Government
- Northern Ontario Flora
- Invasive Species Council of Manitoba
- Turtle Island Invaders
- Ontario's Invading Species Awareness Program
- Conservation Halton
- Ontario Fishes
- CRCA Cataraqui Region Lake Assessment Report 2017.

Table 2.19: Records Review of Potential Invasive Species found within the Cataraqui Region

Common Name	Scientific Name	Habitat Description	Status	Legislation
Bird Vetch	Vicia cracca	Cultivated fields, pastures, waste places, roadsides and gardens	Not Regulated	N/A
Bitternsweet Nightshade	Solanum dulcamara	Open woods, edges of fields, fence lines, roadsides and occasionally in hedges and gardens	Not Regulated	N/A
Chicory	Cichorium intybus	Waste places, fence lines, roadsides and occasionally in gardens	Not Regulated	N/A
Common Carp	Cyprinus carpio	Warm, shallow, weedy lakes and rivers; urban areas and habitats unsuitable for other fish	Not Regulated	N/A
Common Chickweed	Stellaria media	Gardens, lawns, cultivated fields, pastures, waste areas and under deciduous forests	Not Regulated	N/A
Curly Leaved Pondweed	Potamageton crispus	All water systems in silt, clay and sand	Listed	Public Lands Act
Dog-strangling Vine	Vincetoxicum rossicum	Ravines, hillsides, waste areas, fence lines and hedges	Restricted; Noxious Weed	Invasive Species Act; Weed Control Act
Eurasian Water-Milfoil	Myriophyllum spicatum	Shallow water one to three metres deep, but can root in up to 10 m of water	Listed	Public Lands Act

Common Name	Scientific Name	Habitat Description	Status	Legislation
European Buckthorn	Rhamnus cathartica	Along fence lines, woodlands, pastures and abandoned farmyards	Noxious Weed	Weed Control Act
European Common Reed	Phragmites australi	Shallow waters in freshwater wetlands, stream banks, shorelines and ditches.	Provincially Restricted; Listed	Invasive Species Act; Public Lands Act
European Frog-bit	Hydrocharis morsus-ranae	Slow moving waters such as sheltered inlets, ponds, slow-running rivers and ditches	Listed	Public Lands Act
European Water Chestnut	Trapa natans	Found in freshwater bodies that are less than 4-5 m deep; Found throughout the Ottawa River and surrounding area	Provincially Prohibited; Public Lands Act	Invasive Species Act; Public Lands Act
Flowering Rush	Butomus Umbellatus	Shallow freshwater (2 m depth) systems and often found in ditches	Listed	Public Lands Act
Garlic Mustard	Alliaria petiolata	Moist woods, swampy areas and ditches along roadsides and railway embankments; occasionally can invade adjacent cultivated lands	Not Regulated	N/A
Giant Hogweed	Heracleum mantegazzianum	Along roadsides, ditches, streambanks, old fields and open woodlands	Noxious Weed	Weed Control Act

Common Name	Scientific Name	Habitat Description	Status	Legislation
Helleborine	Epipactis helleborine	Woods (especially over calcareous soils), ravines, lawns and disturbed areas	Not Regulated	N/A
Japanese Knotwood	Reynoutria japonica	Gardens, around old buildings or former building sites, waste places and roadsides	Provincially Restricted	Invasive Species Act
Narrow-leaved Cattail	Typha angustifolia	Wetlands, sedge meadows, streams, river banks, ditches and lake shores	Not Regulated	N/A
New Zealand Mud Snail	Potamopyrgus antipodarum	Silty sand sediments of freshwater systems; Cannot tolerate freezing waters but can survive at 0°C in low salinity	Not Regulated	N/A
Purple Loosestrife	Lythrum salicaria	Marshes, floodplains, edges of waterbodies and ditches	Listed	Public Lands Act
Quagga Mussel	Dreissena bugensis	Freshwater areas (shallow, warm or deep, cold) and attaches to hard surfaces	Not Regulated	N/A
Reed Canarygrass	Phalaris arundinacea	Wetlands, riverbanks, wet ditches/grasslands, lowland pastures and other wet areas	Not Regulated	N/A
Round Goby	Neogobius melanostomus	Waters with rocky and sandy bottoms; Found throughout the Great Lakes	Federally prohibited	Fisheries Act
Rusty Crayfish	Orconectes rusticus	Wetlands, ponds, lakes, rivers in areas of rock and woody debris	Not Regulated	N/A

Common Name	Scientific Name	Habitat Description	Status	Legislation
Sea Lamprey	Petromyzon marinus	Young lampreys found in silt rivers and streams, and adults found in open areas or large lakes and rivers	Not Regulated	N/A
Water Soldier	Stratiotes aloides	Ponds, ditches, inlets, and nutrient-rich water.	Provincially Prohibited; Public Lands Act	Invasive Species Act; Public Lands Act
White Perch	Morone americana	Pools and quiet water areas of medium to large rivers as well as the shallows of lakes and bays; prefers mud substrate	Not Regulated	N/A
Wild Parsnip	Pastinaca sativa	Abandoned yards, waste places, meadows, old fields, roadsides and railway embankments	Noxious Weed	Weed Control Act
Zebra Mussel	Dreissena polymorpha	Rocky shorelines, natural debris, or in-water manmade structures in colonies; Found throughout the Great Lakes	Not Regulated in the connecting waters of the Great Lakes	N/A

2.4.1.2 Site Investigations

A site investigation was conducted in 2019 to inventory the non-native vegetation located within the Project Location, to facilitate the 2019 site investigation the site was sub-divided into five areas:

1. West approach gravel parking areas (WAP).
2. West approach lay down area (WAL).

3. West approach shoreline and near-shore aquatic area (WAS).
4. East approach woodland (EAW).
5. East approach shoreline and near-shore aquatic area (EAS).

In addition to the invasive plant species seen in the 2019 site investigation, Round Goby was also observed on site visits in 2018. In total, sixty-four non-native species were observed within the Study Area as summarized in Table 2.20.

Table 2.20: Non-native Plants Kingston Third Crossing site

Common Name	Scientific Name	Location and Comments	Status	Applicable Legislation
Annual sow thistle	Sonchus oleraceus	WAL. Uncommon.	Noxious Weed	Weed Control Act
Austrian pine	Pinus nigra	EAW. Mature.	Not Regulated	N/A
Barnyard grass	Echinochloa crusgalli	WAL. Uncommon.	Not Regulated	N/A
Bird-foot trefoil	Lotus corniculatus	WAL.	Not Regulated	N/A
Bitter dock	Rumex obtusifolius	WAP, WAL, WAS. Several specimens at each location.	Not Regulated	N/A
Bittersweet nightshade	Solanum dulcamara	WAP, WAS, EAW. Occurs in low numbers throughout much of the site.	Not Regulated	N/A
Black medick	Medicago lupulina	WAL, WAS. Common.	Not Regulated	N/A
Bladder campion	Silene vulgaris	WAP. Uncommon.	Not Regulated	N/A
Bouncing-bet	Saponaria officinalis	EAP. Uncommon.	Not Regulated	N/A

Common Name	Scientific Name	Location and Comments	Status	Applicable Legislation
Broad-leaf plantain	Plantago major	WAP, WAS, EAW. Common and found throughout site.	Not Regulated	N/A
Canada thistle	Cirsium arvense	WAP, WAS. Few plants in disturbed areas.	Noxious Weed	Weed Control Act
Catnip	Nepeta cataria	WAL, WAS. Uncommon.	Not Regulated	N/A
Chicory	Cichorium intybus	WAP, WAL. Common.	Not Regulated	N/A
Cocklebur	Xanthium strumarium	WAP. Uncommon.	Not Regulated	N/A
Coltsfoot	Tussilago farfara	EAW	Noxious Weed	Weed Control Act
Common buckthorn	Rhamnus cathartica	WAL, WAS, EAW. Found throughout with many large tree-size specimens in woodland.	Noxious Weed	Weed Control Act
Common Dandelion	Taraxacum officinale	WAS, EAW, EAS. Common. Found in both terrestrial and wetland habitats.	Not Regulated	N/A
Common mallow	Malva neglecta	WAS. Common.	Not Regulated	N/A
Common motherwort	Leonurus cardiaca	WAL. Common.	Not Regulated	N/A
Common mullein	Verbascum thapsus	WAL, WAS. A few specimens in florets.	Not Regulated	N/A
Common Ragweed	Ambrosia artemisiifolia	WAP. Uncommon	Noxious Weed	Weed Control Act
Cypress spurge	Euphorbia cyparissias	WAL. Uncommon.	Noxious Weed	Weed Control Act

Common Name	Scientific Name	Location and Comments	Status	Applicable Legislation
Day lily	Hemerocallis spp.	WAS. A few specimens.	Not Regulated	N/A
Elecampane	Inula helenium	EAW. Scattered throughout woodland.	Not Regulated	N/A
Eurasian watermilfoil	Myriophyllum spicatum	WAS, EAS. Common.	Listed	Public Lands Act
European frog-bit	Hydrocharis morus-ranae	WAS, EAS. Found on both sides of the river, but more common in EAS.	Listed	Public Lands Act
Field bindweed	Convolvulus arvensis	WAL, WAS, EAW, EAS	Not Regulated	N/A
Flowering rush	Butomus umbellatus	WAS. Three localized patches that span the entire Project Location western shoreline.	Listed	Public Lands Act
Flower-of-an-hour	Hibiscus trionum	WAL. Small patch in lay-down area.	Not Regulated	N/A
Garlic mustard	Alliaria petiolata	EAW. Extensive in EAW.	Not Regulated	N/A
Goat's beard	Tragopogon dubius	WAP. Uncommon.	Not Regulated	N/A
Great burdock	Arctium lappa	WAP, WAL, WAS, EAW. Several specimens at each location.	Not Regulated	N/A
Green foxtail	Setaria viridis	WAL. Uncommon.	Not Regulated	N/A
Herb robert	Geranium	EAW. Specimens throughout woodland.	Not Regulated	N/A
Hybrid cattail	Typha glauca	WAS, EAS. Common.	Not Regulated	N/A

Common Name	Scientific Name	Location and Comments	Status	Applicable Legislation
Japanese knotweed	Polygonum \cuspidatum	WAP. Large expanse between the parking lot and roadway.	Restricted	Invasive Species Act
Kentucky bluegrass	Poa pratensis	WAP	Not Regulated	N/A
Lamb's quarters	Chenopodium album	WAP. Uncommon.	Not Regulated	N/A
Lilac	Syringa vulgaris	WAL, WAS. Small groves near the embankment.	Not Regulated	N/A
Manitoba maple	Acer negundo	WAP, WAL, WAS. Mostly small trees growing along property edges with a few specimens in EAW.	Not Regulated	N/A
Mayweed	Anthemis cotula	WAP, several specimens.	Not Regulated	N/A
Myrtle	Myrtus spp.	EAW. Locally dominant ground cover in small section of woodland.	Not Regulated	N/A
Norway spruce	Picea abies	EAW. Large specimen, no regeneration.	Not Regulated	N/A
Orchard grass	Dactylis glomerata	WAL. Uncommon, indicative of previous pasture land.	Not Regulated	N/A
Philadelphia fleabane	Erigeron philadelphicus	WAP. Common.	Not Regulated	N/A

Common Name	Scientific Name	Location and Comments	Status	Applicable Legislation
Purple loosestrife	Lythrum salicaria	WAS. One plant found at northern limit.	Listed	Public Lands Act
Quackgrass	Elytrigia repens	WAP, WAL. Common.	Not Regulated	N/A
Red clover	Trifolium pratense	WAP, WAL. Common.	Not Regulated	N/A
Reed canary grass	Phalaris arundinacea	WAS, EAW, EAS. Common. Found in both terrestrial and wetland habitats.	Not Regulated	N/A
Round Goby	Neogobius melanostomus	Cataraqui River	Federally prohibited	Fisheries Act
Sheep sorrel	Rumex acetosella	WAL. Uncommon.		
Smooth brome	Bromus inermis	WAL. Uncommon.		
Spotted knapweed	Centaurea maculosa	WAP, WAL, WAS. Colonizing much of the disturbed sites on the western side.	Noxious Weed	Weed Control Act
St. John's wort	Hypericum perforatum	WAS. Mostly found at the southern shoreline.	Not Regulated	N/A
Sweet pea	Lathyrus odoratus	WAL. Small patch.	Not Regulated	N/A
Tansy	Senecio jacobaea	WAP, WAL. Common.	Noxious Weed	Weed Control Act
Tartarian honeysuckle	Lonicera tatarica	WAS, EAW. Several small groups along embankment of WAS and near top of ridge EAW.	Not Regulated	N/A

Common Name	Scientific Name	Location and Comments	Status	Applicable Legislation
Timothy	Phleum pratense)	WAP, WAL. Incidental.	Not Regulated	N/A
Tufted vetch	Vicia cracca	WAL, EAW. Common	Not Regulated	N/A
Viper's bugloss	Echium vulgare	WAP. Uncommon	Not Regulated	N/A
White clover	Trifolium repens	WAL	Not Regulated	N/A
White sweet clover	Melilotus alba	WAP. Common.	Not Regulated	N/A
Wild carrot	Daucus carota	WAP, WAL, EAW. Common but not dominant.	Not Regulated	N/A
Wild parsnip	Pastinaca sativa	WAP, EAW. Small, localized infestations.	Noxious Weed	Weed Control Act

2.4.2 Lighting

Lighting within the Study Area is currently influenced by many sources from adjacent developments and roadways. Main existing potential light sources within the Study Area are listed below:

- More than 20 km of City streets.
- Two (2) lit bridges over the Cataraqui River.
- Five (5) distinct residential areas.
- Two operating marina's.
- One industrial/commercial area.

Light from anthropogenic sources contribute to night time light levels in urban skies that can range in the order of 0.015 to 0.15 lux between clear skies and overcast skies in urban areas with light pollution (Dick, 2018). For comparison, full moon conditions in a cloudless sky can range between 0.1 lux typical and 0.26 lux maximum (Dick, 2018).

The Visible Infrared Imaging Radiometer Suite Day Night Band (VIIRS DNB) measures radiance from National Oceanographic and Atmospheric Administration satellites. Figure 2-25 provides an indication of the radiance in the vicinity of the City of Kingston that indicates the extent of light pollution in the vicinity of the Cataraqui River.

Guidance provided to the Proponent during agency consultation has recommended that the Project should use minimal lighting to reduce the potential for adverse effects on nocturnal wildlife, while still meeting safety requirements and aesthetic goals through the application of the PCA Guidelines and Specification for Outdoor Lighting at Parks Canada, February 2016. Further it was also recommended that the Project develop a Lighting Plan specifically engineered to meet operational requirements while also considering wildlife, navigation, and visitor experience. These will be further addressed in subsequent sections of this DIA.

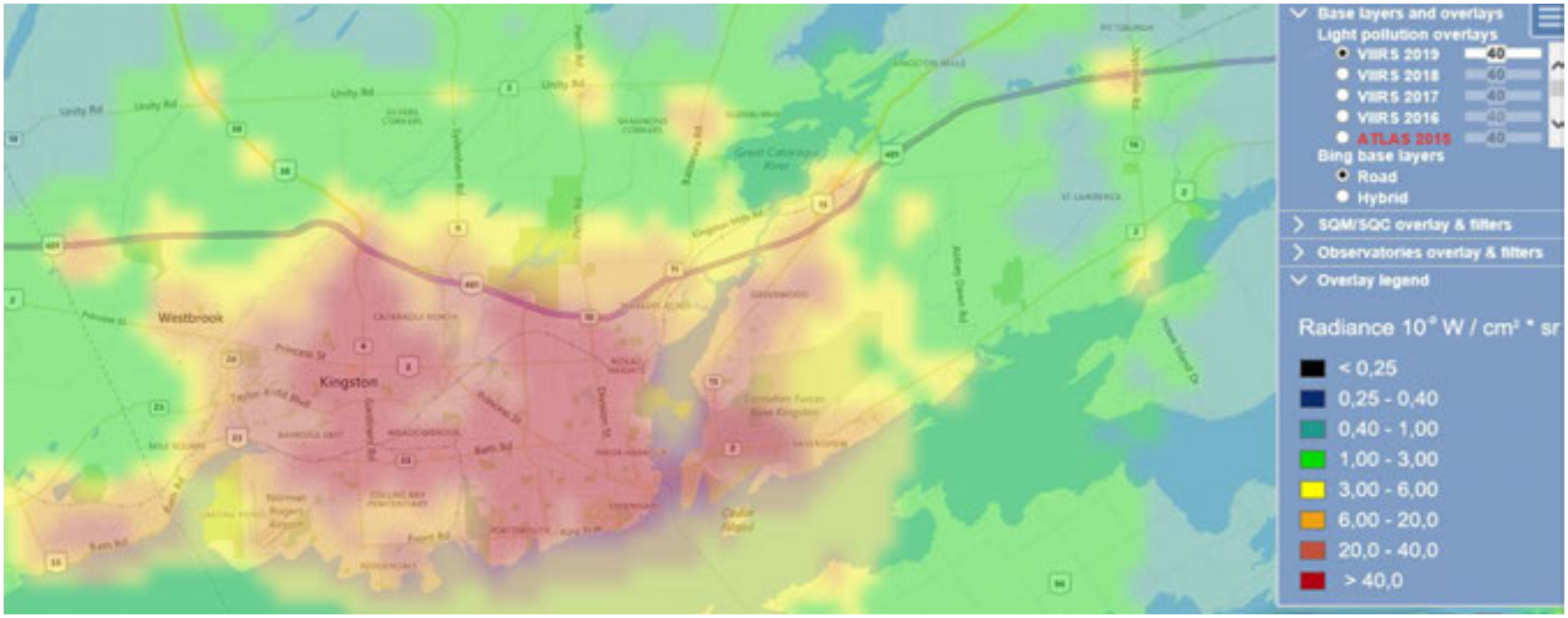


Figure 2-25: VIIRS DNB 2019 Projection for Greater Kingston Area[3]

[3] www.lightpollutionmap.info