

# Current Status of Fish Consumption Advisories related to the Fish and Wildlife Consumption Beneficial Use Impairment for the St. Lawrence River (Cornwall) Area of Concern

**Final Report Prepared for the St. Lawrence River Restoration Council  
and Ontario Ministry of the Environment and Climate Change**



**ST. LAWRENCE RIVER  
RESTORATION COUNCIL**

Prepared by

**St. Lawrence River Institute of Environmental Sciences**



**8 Aug 2017**

CORNWALL ON

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St. Lawrence River Restoration Council and the Ontario Ministry of the Environment and Climate Change in support of the St. Lawrence River (Cornwall) Remedial Action Plan and the Canada-Ontario Agreement

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## Executive Summary

This study was undertaken for the purpose of assessing the current status and recent trends of fish consumption advisories in the St. Lawrence River (Cornwall) Area of Concern (AOC). We compared fish consumption advisories in the AOC to upstream St. Lawrence River reference locations using data from the 2015-2016 and 2017-2018 versions of the Guide to Eating Ontario Fish published by the Ontario Ministry of Environment and Climate Change (OMECC).

To benefit general and subsistence consumers of fish, the Guide provided consumption advisories of up to 32 meals/month. To simplify and compare the status of the advisories in the AOC, advisories were categorised as No Restrictions (>8 meals/month), Partial Restrictions (1 – 4 meals/month), or Do Not Eat (0 meals/month) following the categories applied in a similar analysis for the Toronto Harbour AOC. Fish species and lengths common to the AOC and upstream reference locations were compared. The AOC had consistently both lower “Unrestricted” and higher “Do Not Eat” percentages for general and sensitive populations compared with all upstream non-AOC areas, except for a small number instances for fish at the shortest size interval.

To investigate the data in further detail, the analysis was repeated by group the data into five categories as opposed to only three. This approach added categories of Maximum Allowable (Max) Meals (32 meals/month), 50% of Max (16 Meals/month) and 25%-50% of Max (8-12 meals/month) that had previously all been grouped as No Restrictions in the initial analysis. This approach revealed differences between the AOC and upstream St. Lawrence River reference areas are most often located within the “25%-50% of Max” and “50% of Max” categories. This closer look provides a better insight into the overall nature of the consumption restrictions within Lake St. Francis (15) as well as providing better detail for decisions based around subsistence consumption.

Overall, the analysis shows more severe consumption restrictions in the AOC compared to upstream locations for edible size ranges of common sport fish such as Yellow Perch, Largemouth Bass, Smallmouth Bass, Northern Pike and Walleye. The spatial differences in the consumption restriction advisories for the Upper St. Lawrence River suggests continued enhanced availability of contaminants, notably mercury from historical inputs, within the AOC. Additional factors such as food web diversity, fish density, tributary inputs and its water chemistry, yearly weather events, as well as geophysical factors such as mean depth, flow and land use can all influence mercury concentrations in fish and may contribute to the observed differences in consumption advisories between sites. Continued implementation, monitoring and investigation of the efficacy of strategies to control legacy Hg remobilization such as the Cornwall Sediment Strategy within the AOC are recommended. Public outreach should be emphasized to ensure continued awareness of fish consumption advisories, and to orient anglers to species and locations with the least restrictive fish consumption advisories. At the same time, given the cultural

and health benefits of fishing and fish consumption, care must be taken to balance equitably the risks and benefits of fish consumption to the public.

## Introduction

In 1987, the U.S.-Canada Great Lakes Water Quality Agreement established Areas of Concern (AOCs), as recommended by the International Joint Commission (IJC), including the St. Lawrence River AOC at Cornwall and Massena. Each AOC identified by the IJC prepared an assessment of environmental impacts and beneficial uses impairments (BUI). Separate remedial action plans (RAPs) were created for Ontario and New York waters to address the BUIs and achieve the desired environmental state as defined by delisting criteria.

The established delisting criteria for the fish and wildlife consumption beneficial use impairment (BUI) in the St. Lawrence River (Cornwall) AOC are:

1. Contaminant levels in fish in the AOC are the same or less than those in upstream non-AOC areas in the St. Lawrence River.
2. Restrictions same or fewer/less restrictive than upstream non-AOC areas in the St. Lawrence River.
3. No restrictions on the consumption of snapping turtles in the AOC.

Consumption advisories are linked directly to fish body burden contaminant levels and are updated every two years by the Ontario Ministry of the Environment and Climate Change (OMECC). A recent assessment of the status of the fish and wildlife consumption BUI contained in the draft Stage 3 delisting status document prepared by the St Lawrence River Restoration Council (2014) was based on a three-tiered approach assessing (1) contaminant levels and trends, (2) fish consumption restriction advisories and (3) other related evidence. Using this approach, the draft Stage 3 listed this BUI as impaired.

While other contaminants exist within the St. Lawrence River (Cornwall) AOC, mercury (Hg) is the main contaminant of concern affecting fish consumption advisories on the Canadian side, due to various sources including legacy mercury from its prior use in local industries (Richman et al, 2001; Ridal et al, 2010) as well as other factors including natural sources from tributaries (Hodson et al., 2014). This toxic metal has the capacity to travel through both the blood brain barrier and the placenta and presents a substantial danger to proper brain development during pregnancy at elevated levels<sup>1</sup> (Walker et al, 2006; Mahaffey et al, 2009). In particular, many populations of Indigenous peoples in Ontario have been found to have above average blood Hg levels (Wheatley and Paradis, 1995). This above average baseline poses a danger due to the long half-life of Hg within

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<sup>1</sup> Elevated levels is reference to the currently defined level of Methyl Mercury, as outlined by the World Health Organization and Health Canada, for pregnant women or 1.6 ug/kg-bw/week.

the body, e.g. 50-70 day half-life for blood Hg (Mergler, 2007). Individuals with sufficiently high Hg body burdens, whether it be due to lifestyle or biological reasons, are at higher risk of developing detrimental effects. In recognition of these risks, the *Guide to Eating Ontario Fish* sets two levels of fish consumption advisories: (1) for the General Population and (2) for Sensitive Populations, defined as children under the age of 15 and women of childbearing age.

Despite these concerns, the beneficial effects of fish consumption should also be considered within the human health context, as most fish contain a multitude of proteins and fats such omega-3 fatty acids that are beneficial to human health and fetal neurodevelopment (Sakamoto, 2004; Mergler, 2007). Consequently, consumption of small fish with low contamination and with beneficial fats will provide more benefits and less risks when eating a comparative portion of a larger predatory fish.

The assessment of the fish consumption advisories in the draft Stage 3 report was based on the *Guide to Eating Ontario Sport Fish (2012-2014)*. Since that time a new documentation *Guide to Eating Ontario Fish (2015-2016)* and *Guide to Eating Ontario Fish (2017 – 2018)* has been published by the OMECC. Along with the change in name, numerous other factors have also changed including an increase from 8 to 32 maximum allowable meals/month. These changes were made in response to concerns that the maximum allowed 8 meal/month, which was based on the consumption frequency typical for sports anglers, was inappropriate for subsistence consumers such as some Indigenous populations and other community sectors than traditionally include fish in their diet. For example, the Mohawks of Akwesasne comprise part of the population base within the St. Lawrence River AOC. The new *Guide to Eating Ontario Fish* is highly relevant to the AOC and therefore an analysis of the new consumption advisories was undertaken to update the assessment of fish consumption advisory criteria in relation to the assessment of this BUI.

## Methods

Comparative analyses of the *Guide to Eating Ontario Fish 2015 – 2016* and *Guide to Eating Ontario Fish 2017 – 2018* were performed using fish consumption advisory data for each of three reference areas upstream of the AOC: Thousand Islands (12), Middle Corridor (13), Lake St. Lawrence (14); and the two zones within the AOC: Lake St. Francis (15), and Lake St. Francis at Raison River (16). All data within these tables was manually transferred into an excel spreadsheet to allow data manipulation. Originally the tables existed in a species vs length by location format, this did not provide an effective means for comparison so the data was reorganized into several smaller tables in a location versus length by species format. This change was primarily due to the difference in

species and length restrictions between zones. The data was further analyzed via color coding to provide a visual contrast for restriction severity.

In the draft Stage 3 report, consumption advisories were simplified into three categories to facilitate comparisons between AOC and reference locations:

No restriction = 8 meals/month  
Partial restrictions = 2 or 4 meals/month  
Do not eat = 0 meals/month

For this report, we followed a similar approach using two approaches to group and simplify the data. Assessment I was undertaken using consumption groupings based on the categories set forth in an analysis of fish advisories for the Toronto Harbour AOC (Bhavsar, 2016). The following groupings were used as they represent the current approach used by the OMECC for the purpose of comparing the Lake St. Francis AOC to upstream locations in relation to the assessment of the BUI criteria:

No restriction = 8 to 32 meals/month  
Partial restrictions = 1 to 4 meals/month  
Do not eat = 0 meals/month

Assessment II was undertaken for the purpose of providing a more granular analysis of the fish advisories within the range 8 to 32/meals per month. This analysis more specifically addresses concerns that subsistence consumers or individuals that habitually consume large amounts of fish per meal may have respecting the relative risks of eating AOC-derived fish compared with upstream reference locations. For example, community surveys indicate that Mohawks of Akwesasne consider a fish meal about four (4) times more than the amount (227g) considered to be a fish meal in the Guide to Eating Ontario Fish (Lickers 2017). Categories were therefore created based on a relationship to the maximum meals per month (Max Meals) provided in the guide. To this end the following categories were selected for use during Assessment II analysis:

Max Meals = 32 meals/month  
50% of Max = 16 meals/month  
25% - 50% of Max = 12 – 8 meals/month  
<25% of Max = 4 – 1 meals/month  
0% of Max = 0 meals/month

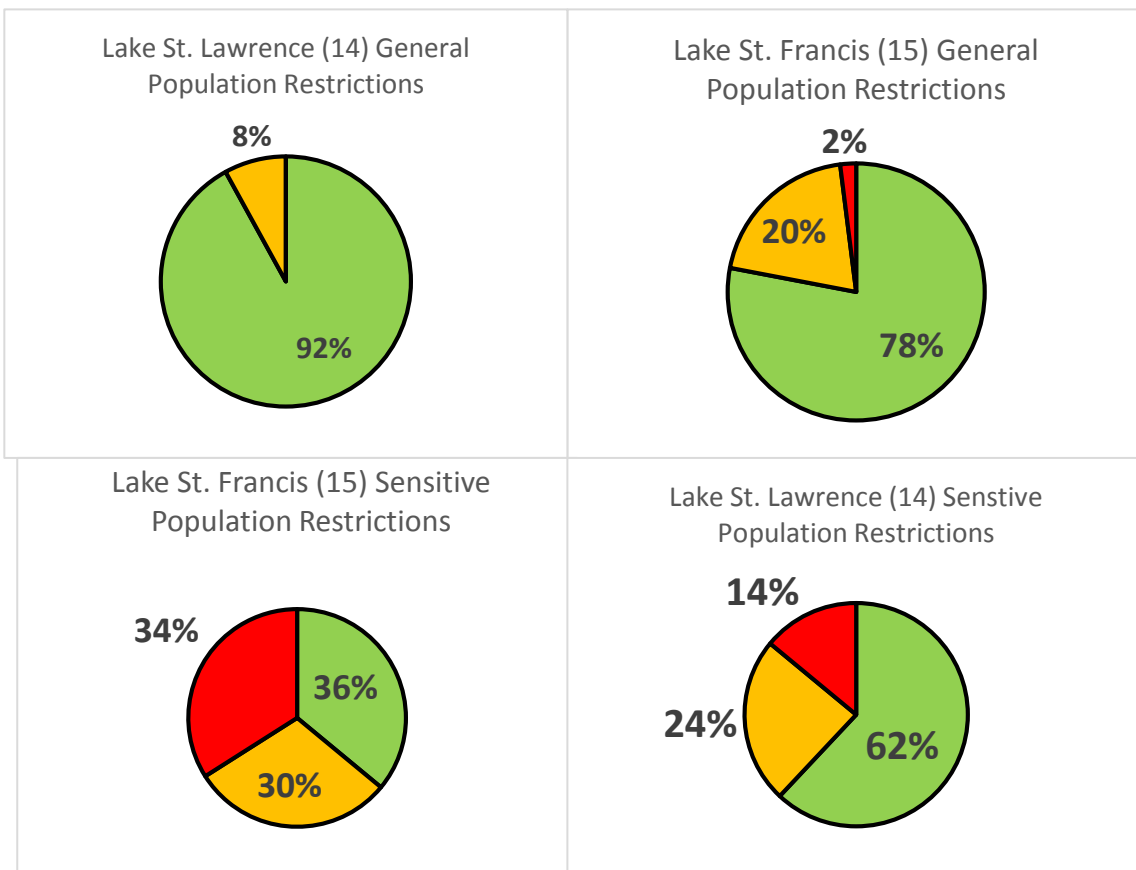
These groupings were used to create charts for both General and Sensitive population restrictions. Consumption advisories were compared by zones based on all common species and common length intervals. The data was compared by number of fish consumption restriction advisories expressed as a percent of the total advisories for the

location, the amount of restrictions and the relative severity between the AOC and upstream locations. Approach, analysis, and breakdown of the consumptions advisories was undertaken identically for Assessments I and II, the data was then categorised according to the respective analysis.

## Results

### Assessment I (Toronto Harbour AOC Approach)

Using the Assessment I fish consumption groupings, consumption advisories are consistently more restrictive for the AOC compared to upstream locations for the general and sensitive consumer groups. For example, when all advisories are taken into account for each species and species length segment, 2% of the fish consumption advisories for the general public rate as “Do Not Eat” for Lake St. Francis fish compared to 0% for Lake St. Lawrence (Figure 1). For sensitive consumers, these numbers increase to 34% “Do



**Figure 1:** Comparison of the severity of consumption restrictions advisories for general and sensitive populations consuming fish from the AOC (Lake St. Francis Block 15) and Lake St. Lawrence (Block 14) based on common species and length intervals for the blocks (2015-2016).  
 No Restriction ■ Partial Restriction ■ Do Not Eat ■



Not Eat” for the AOC fish compared with 14% for Lake St. Lawrence. Similar results are also observed for other locations with the frequency of “Do Not Eat” for general consumers higher in the AOC to Thousand Islands (8% versus 6%) and Middle Corridor (2% to 0%), respectively, when common species and common lengths are compared between zones (detailed results found in Appendix A.1). For the sensitive consumers, the frequency of “Do Not Eat” advisories within the AOC are 40% versus 24% (Thousand Islands) and 28% versus 9% (Middle Corridor).

The differences in the advisories for the AOC versus reference blocks are relatively minor for lower trophic level fish but increase for top predators. For instance, 8 meals/month are advised for Yellow Perch in the size range of 15-20 cm from the AOC compared to 12 meals/month for the same size interval in Lake St. Lawrence (Block 14, Appendix A.1). However, the differences in the advisories are more pronounced for apex predators such as Northern Pike with at least 50% fewer meals/month advised for the AOC compared to Lake St. Lawrence (Block 14) across all intervals.

In a few cases, advisories are less restrictive than upstream reference blocks, e.g. the advisory for 15-20 cm Smallmouth Bass from the AOC is less restrictive compared to Thousand Islands (Block 12) with 12 meals/month versus 8 meals/month advised. However, at longer lengths, the situation is reversed and Smallmouth Bass have more restrictive advisories for the Lake St Francis AOC than the Thousand Islands section.

## **Assessment II**

Our second approach increased the number of categories from three to five to examine the spatial differences in the higher consumption advisories. In this analysis, the differences between sites for “0% of Max” and “<25% of Max” are the same as the “Do Not Eat” and “Partial Restriction” categories at Assessment I. The breakdown of “No Restrictions” category from Assessment I into “Max Meals”, “50% of Max”, and “25% - 50% of Max” however resulted in new differences between AOC and upstream locations.

The percentage of advisories rated “Max Meals” in the AOC (Block 15), 10%, is lower in comparison to the Thousand Islands (Block 12), 16%, for the general population (Table 1). This trend is also seen in comparison to the Middle Corridor (Block 13) and Lake St. Lawrence (Block 14) being 11% vs 22% and 8% vs 22%, respectively. For the sensitive population advisory, the percentage of advisories within the “max Meals” category are very low for all locations with the AOC values lowest compared to Lake St. Lawrence (Block 14), Middle Corridor (Block 13) and Thousand Islands (Block 12) values of 2% vs 3%, 0% vs 4%, and 2% vs 4%, respectively. More substantial differences are observed between AOC and upstream locations with respect to the categories of “50% of Max” and “25% - 50% of Max”. When compared to upstream locations, such as Lake St. Lawrence (Block 14), the percentage of advisories at the “50% of Max” level for both the general

and sensitive populations in the AOC are lower (26% vs 38% G, 8% vs 20% S). This trend is observed in comparison of other upstream locations with only minor differences throughout (Table 1).

**Table 1:** Comparison of 2015-2016 consumption restrictions for general and sensitive populations based on percent of advisories falling within each category for the indicated location using Assessment II categories.

Assessment II Results				
2015-2016				
Location	Thousands Islands (12)		AOC - Lake St. Francis (15)	
Group	General	Sensitive	General	Sensitive
Max Meals	16%	3%	10%	2%
50% of Max	26%	16%	23%	10%
25%-50% of Max	37%	32%	35%	21%
<25% of Max	15%	24%	24%	27%
0% of Max	6%	24%	8%	40%
Location	Middle Corridor (13)		AOC - Lake St. Francis (15)	
Group	General	Sensitive	General	Sensitive
Max Meals	22%	4%	11%	0%
50% of Max	48%	20%	30%	13%
25%-50% of Max	28%	30%	43%	26%
<25% of Max	2%	37%	13%	33%
0% of Max	0%	9%	2%	28%
Location	Lake St. Lawrence (14)		AOC - Lake St. Francis (15)	
Group	General	Sensitive	General	Sensitive
Max Meals	22%	4%	8%	2%
50% of Max	38%	20%	26%	8%
25%-50% of Max	32%	38%	44%	26%
<25% of Max	8%	24%	20%	30%
0% of Max	0%	14%	2%	34%

### Temporal Trends in Fish Consumption Advisories

Comparison of the temporal trend in advisories from 2015-2016 to 2017-2018 shows variable results depending on the Assessment approach. When comparing Assessment I categories over time (Table 2), there are small increases or no change in the No Restriction categories in the AOC relative to reference sites. Additionally, there are decreases in the number of “Do Not Eat” advisories in the AOC relative to reference sites,

and a corresponding increase in “Partial Restrictions”. Overall, the trends are positive based on the Assessment I categories.

On the other hand, trends are mixed for the more detailed Assessment II categories (Table 2). Similar to Assessment I, there is an overall decrease in “0% of Max” advisories with a corresponding increase in the “<25% of Max” category when comparing Lake St. Francis (15) to upstream locations. However, the number of advisories in the “Max meals” category increases or does not change in the AOC relative reference sites indicating no improvement over this time period for the most stringent of the consumption advisories provided by the *Guide to Eating Ontario Fish*.

**Table 2:** Comparison of 2015-2016 and 2017-2018 consumption restrictions for sensitive populations based on difference in percent of whole when comparing upstream locations to Lake St. Francis AOC (15) using groupings from Toronto Harbour AOC. All values calculated with Difference = (% advisories with the category of all block 15 advisories - %advisories within category for individual reference block advisories). Positive and negative numbers correspond to Lake St. Francis AOC (15) being higher or lower, respectively, within the currently analyzed category. Trend not assessed for partial restrictions as changes presented in this format could indicate either a positive or negative trend.

	2015 - 2016	2017 - 2018	Trend
<b>Sites Compared</b>	<b>(15) vs (12)</b>	<b>(15) vs (12)</b>	<b>(15) vs (12)</b>
No Restriction	-19%	-17%	▲
Partial Restriction	3%	8%	-
Do Not Eat	16%	8%	▲
<b>Sites Compared</b>	<b>(15) vs (13)</b>	<b>(15) vs (13)</b>	<b>(15) vs (13)</b>
No Restriction	-15%	-15%	No change
Partial Restriction	-4%	0%	-
Do Not Eat	20%	15%	▲
<b>Sites Compared</b>	<b>(15) vs (14)</b>	<b>(15) vs (14)</b>	<b>(15) vs (14)</b>
No Restriction	-26%	-25%	▲
Partial Restriction	6%	10%	-
Do Not Eat	20%	16%	▲

**Table 3:** Comparison of 2015-2016 and 2017-2018 consumption restrictions for sensitive populations based on difference in percent of whole when comparing upstream locations to the AOC (Lake St. Francis - 15). All values calculated with Difference = (% advisories with the category of all block 15 advisories - %advisories within category for individual reference block advisories). Positive and negative numbers correspond to the AOC having more or less advisories, respectively, within the category. Trend not assessed for partial restrictions as changes presented in this format could indicate either a positive or negative trend.

	2015 - 2016	2017 - 2018	Trend
<b>Sites Compared</b>	<b>(15) vs (12)</b>	<b>(15) vs (12)</b>	<b>(15) vs (12)</b>
Max Meals	-2%	-2%	No change
50% of Max	-6%	-17%	-
25%-50% of Max	-11%	2%	-
<25% of Max	3%	8%	-
0% of Max	16%	8%	▲
<b>Sites Compared</b>	<b>(15) vs (13)</b>	<b>(15) vs (13)</b>	<b>(15) vs (13)</b>
Max Meals	-4%	-6%	▲
50% of Max	-7%	-4%	-
25%-50% of Max	-4%	-4%	-
<25% of Max	-4%	0%	-
0% of Max	20%	15%	▲
<b>Sites Compared</b>	<b>(15) vs (14)</b>	<b>(15) vs (14)</b>	<b>(15) vs (14)</b>
Max Meals	-2%	-4%	▲
50% of Max	-12%	-8%	-
25%-50% of Max	-12%	-14%	-
<25% of Max	6%	10%	-
0% of Max	20%	16%	▲

## Discussion and Conclusions

Overall, the results indicate an elevated risk for anglers that consume fish caught within the AOC relative to upstream locations independent of the categorization strategy used. This comparative analysis indicates that delisting criterion #2 for assessing the Beneficial Use Impairment, as written, is not met within the AOC. Consumption advisories for fish caught in the AOC are between 1.6 and 4 times more frequently restrictive than upstream locations for members of the sensitive population. Analysis also shows that it is uncommon for completely unrestricted consumption of fish throughout the entire Upper St. Lawrence River, with the majority of the restrictions being in place for members of the sensitive populace. This information provides context for setting goals

with respect to achieving contaminant levels that would allow safe subsistence fishing in the St. Lawrence River.

Breaking the data into categories that would pertain more directly to subsistence and frequent consumers of fish (i.e. Assessment II method) revealed that differences between the AOC and reference restrictions are mainly attributable to the “50% of Max” and “25% - 50% of Max” categories. The added granularity of this approach provides a better insight into the overall nature of the consumption restrictions within Lake St. Francis (15) as well as providing better detail for decisions based around subsistence consumption.

Analysis of the change in the restrictions between 2015-16 and 2017-18 shows that there is a slow increase in the availability of fish safe for consumption both upstream and within the AOC. While the changes do not represent a large improvement in the availability of uncontaminated fish, they do present a trend of possible improvement that has the potential to result in a substantial improvement in future years. A majority of the changes in consumption restrictions also occurred in the Lake St. Francis (15) zone compared to upstream locations showing that the changes are attributable to reducing fish body burdens in the AOC at a greater rate than upstream reference sites.

Using the five category approach to assess the temporal change in restrictions between 2015-2016 and 2016-2017 provides new insights compared to the initial three-category approach. For example, the comparison between Lake St. Francis (15) and the Thousand Islands (12) originally only a 2% improvement in the “No Restrictions” advisory with the three-category approach. However, further analysis with the five categories shows a shift of -11% in “50% of Max” and “25%-50% of Max” categories, respectively. Similar changes to this are seen in comparison to Middle Corridor (13) and Lake St. Lawrence (14), at varying degrees of severity. These differences in percent distribution can be partially attributed to the levels of contamination within the Lake St. Francis (15) AOC, which as a result lead to higher average Hg contamination level in fish as reflected by the regularly lower “Max Meals” percentages within the Lake St. Francis (15) AOC. As a result of this it is observed that though comparison of the AOC consumptions restrictions to upstream locations have improved they still have not yet reached a level that satisfies the BUI criteria.

In conclusion, the results suggest continued enhanced availability of legacy mercury sources in the AOC to the food web and apex predators such as sport fish. While previous studies have seen the Hg levels for the AOC drop by 33-59% for Northern Pike, Yellow Perch, Walleye, and Smallmouth Bass compared to historical values (Neff et al, 2013), the recent trends in fish consumption advisories indicate slow change within the AOC since 2015. These limitations are predominately thought to be due to differences between ecosystem factors within the Upper St. Lawrence River sites that affect mercury

availability and uptake into fish. These factors include legacy Hg and redistribution from contaminated sediments, along with differences in tributary Hg inputs, impacts of invasive species, inputs from agricultural activities and land use changes that vary uniquely in the AOC compared to upstream sites. Continued research and monitoring of Lake St. Francis (15) in comparison to upstream locations is valuable for determining rates of change in fish concentrations and impacts of ecosystem changes such as water level management, invasive species and climate change may have input on mercury inputs and fish concentrations with relevance to the BUI. In particular, characterization of AOC specific sources and monitoring of the effectiveness of measures outlined in the Cornwall Sediment Strategy to identify, remediate, and control Hg input sources will provide further insights into mercury availability in the AOC. Additional information on fish consumption practices within the AOC and especially with sensitive and indigenous populations would be valuable in assessing the current relevance of the fish consumption advisory categories.

Given the complexity of the data associated with fish consumption advice, there is continued need for public education with respect to the species and sizes of fish that can be consumed by different members of the population. Particular care should be taken by children and women of child bearing age with adherence to fish consumption advisories to safeguard against excessive intake of MeHg. High intake of MeHg presents a significant risk to prenatal development and can result in neurological damage and life-long impairment. Multiple studies have found that even low level MeHg intake can lead to neurotoxic effects in a population (Lebel, J et al, 1998) (Mergler et al, 2007), though these effects are limited by dosage and life stage of individuals. This neurodegeneration can occur due in part to the ability of MeHg to pass both the blood-brain barrier and the placenta allowing it to interact with developing brain tissue (Mergler et al, 2007). Concentrations as low as 5.8 ug/L in cord blood can increase the chance of neurodegeneration (Mahaffey et al, 2009). For this reason, sensitive consumers of wild caught fish in the Upper St. Lawrence River should be aware of the appropriate consumption advisory for the area under consideration. In addition public education and awareness should focus on the concept of risk vs benefit and the positive aspects of fish consumption, when in moderation. Attempts should also be made to highlight the beneficial aspects of fish consumption to brain development and growth in perspective to the risks associated with them.

Additional efforts to increase public outreach should be prioritized to ensure awareness of the importance of fish consumption advisories and that there is a risk vs benefit scenario in terms of fish consumption (Sakamoto, 2004; Mergler, 2007). Care must be taken to further highlight the species with the lowest contamination and the benefits of fish consumption but to also allow for continued safe sustainable fishing within Lake St Francis in the context of the diverse interests, communities and jurisdictions found in the region.

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Appendix I

Table A. 1. Species by species comparison of fish consumption advisories for the Upper St. Lawrence River for general (G) and sensitive (S) populations (2015-2016).														
Largemouth Bass														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75+
12	Thousand Islands G	32	16	16	12	8	4	4						
	Thousand Islands S	16	8	4	4	0	0	0						
13	Middle Corridor G	32	16	16	16	12	8	8						
	Middle Corridor S	16	8	8	4	4	4	0						
14	Lake St. Lawrence G	32	32	32	16	16	16	16						
	Lake St. Lawrence S	16	16	12	8	8	8	4						
15	Lake St. Francis G	16	16	12	8	4	4	4						
	Lake St. Francis S	8	4	4	0	0	0	0						
Northern Pike														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75+
12	Thousand Islands G	16	16	16	16	16	16	16	16	12	8	8	8	2
	Thousand Islands S	16	16	16	16	16	12	8	4	4	4	4	0	0
13	Middle Corridor G		32	32	32	16	16	16	12	12	8	8	8	4
	Middle Corridor S		16	16	12	8	8	4	4	4	4	0	0	0
14	Lake St. Lawrence G				32	32	32	32	16	16	12	8	8	2
	Lake St. Lawrence S				16	16	16	12	8	4	4	4	0	0
15	Lake St. Francis G		32	16	16	16	16	16	8	8	4	4	4	0
	Lake St. Francis S		16	8	8	8	8	8	4	0	0	0	0	0
Smallmouth Bass														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75+
12	Thousand Islands G	8	8	8	8	8	8	8						
	Thousand Islands S	8	8	8	8	4	4	4						
13	Middle Corridor G	32	32	16	16	12	12							
	Middle Corridor S	16	12	8	4	4	4							
14	Lake St. Lawrence G	16	16	16	16	12	8	4						
	Lake St. Lawrence S	8	8	8	4	4	0	0						
15	Lake St. Francis G	12	12	12	12	8	8	4	2					
	Lake St. Francis S	12	8	4	4	4	0	0	0					

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Yellow Perch														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75+
12	Thousand Islands G	16	16	16										
	Thousand Islands S	12	8	4										
13	Middle Corridor G	16	16	12										
	Middle Corridor S	12	4	4										
14	Lake St. Lawrence G	32	16	12	8	8								
	Lake St. Lawrence S	12	12	4	4	0								
15	Lake St. Francis G	16	12	8	4									
	Lake St. Francis S	8	4	4	0									
Walleye														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75+
12	Thousand Islands G		32	32	32	32	16	16	12	8	4	4	4	0
	Thousand Islands S		16	16	16	16	8	4	4	0	0	0	0	0
13	Middle Corridor G				16	16	16	16	16	12				
	Middle Corridor S				8	8	8	4	4	4				
14	Lake St. Lawrence G	32	32	32	16	16	16	12	8	8	8	4	2	
	Lake St. Lawrence S	32	32	16	8	8	4	4	4	4	0	0	0	
15	Lake St. Francis G	32	16	16	16	12	8	8	8	4	4	4	4	2
	Lake St. Francis S	16	12	8	4	4	4	4	0	0	0	0	0	0
16	Lake St. Francis at Raisin River G					8	8	4	4	4	4	2	2	0
	Lake St. Francis at Raisin River S					4	4	0	0	0	0	0	0	0

Table A. 2. Species by species comparison of fish consumption advisories for the Upper St. Lawrence River for general (G) and sensitive (S) populations (2017-2018).														
<b>Largemouth Bass</b>														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75
12	Thousands Islands G	32	16	16	16	12	4	4						
	Thousands Islands S	12	8	8	4	4	0	0						
13	Middle Corridor G	32	16	16	16	12	8	8						
	Middle Corridor S	16	8	8	4	4	4	0						
14	Lake St. Lawrence G	32	32	32	16	16	16	16						
	Lake St. Lawrence S	16	16	12	8	8	8	4						
15	Lake St. Francis G	16	16	12	8	4	4	4						
	Lake St. Francis S	8	4	4	0	0	0	0						
<b>Northern Pike</b>														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75
12	Thousands Islands G	16	16	16	16	16	16	16	12	12	8	8	4	4
	Thousands Islands S	16	16	16	16	16	12	4	4	4	4	0	0	0
13	Middle Corridor G		32	32	32	16	16	16	12	12	8	8	8	4
	Middle Corridor S		16	16	12	8	8	4	4	4	4	0	0	0
14	Lake St. Lawrence G				32	32	32	32	16	16	12	8	8	2
	Lake St. Lawrence S				16	16	16	12	8	4	4	4	0	0
15	Lake St. Francis G		32	32	32	16	16	16	12	8	8	4	4	2
	Lake St. Francis S		16	16	12	8	8	4	4	4	0	0	0	0
<b>Smallmouth Bass</b>														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75
12	Thousands Islands G	32	32	16	16	16	12	8						
	Thousands Islands S	16	16	12	8	4	4	4						
13	Middle Corridor G	32	32	16	16	12	12							
	Middle Corridor S	16	12	8	4	4	4							
14	Lake St. Lawrence G	16	16	16	16	12	8	4						
	Lake St. Lawrence S	8	8	8	4	4	0	0						
15	Lake St. Francis G	16	16	16	12	12	8	8	2					
	Lake St. Francis S	12	8	4	4	4	4	4	0					

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Yellow Perch														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75
12	Thousands Islands G	16	16	16										
	Thousands Islands S	12	8	4										
13	Middle Corridor G	16	16	12										
	Middle Corridor S	12	4	4										
14	Lake St. Lawrence G	32	16	12	8	8								
	Lake St. Lawrence S	12	12	4	4	0								
15	Lake St. Francis G	16	12	8	4									
	Lake St. Francis S	8	4	4	0									
Walleye														
Length (cm)		15	20	25	30	35	40	45	50	55	60	65	70	75
12	Thousands Islands G		32	32	32	32	16	16	12	8	4	4	4	0
	Thousands Islands S		16	16	16	16	8	4	4	0	0	0	0	0
13	Middle Corridor G				16	16	16	16	16	12				
	Middle Corridor S				8	8	8	4	4	4				
14	Lake St. Lawrence G	32	32	32	16	16	16	12	8	8	8	4	2	
	Lake St. Lawrence S	32	32	16	8	8	4	4	4	4	0	0	0	
15	Lake St. Francis G	32	16	16	16	12	8	8	8	4	4	4	4	2
	Lake St. Francis S	16	12	8	4	4	4	4	0	0	0	0	0	0
16	Lake St. Francis at Raisin River G					8	8	4	4	4	4	2	2	0
	Lake St. Francis at Raisin River S					4	4	0	0	0	0	0	0	0

Table A. 3. Percent breakdown of Restrictions Assessment I Grouping						
2015-2016						
Location	Thousands Islands (12)			Lake St. Francis (15)		
Group	Total	General	Sensitive	Total	General	Sensitive
No Restriction	65%	79%	52%	50%	68%	32%
Partial Restriction	19%	15%	24%	26%	24%	27%
Do Not Eat	15%	6%	24%	24%	8%	40%
Location	Middle Corridor (13)			Lake St. Francis (15)		
Group	Total	General	Sensitive	Total	General	Sensitive
No Restriction	76%	98%	54%	62%	85%	39%
Partial Restriction	20%	2%	37%	23%	13%	33%
Do Not Eat	4%	0%	9%	15%	2%	28%
Location	Lake St. Lawrence (14)			Lake St. Francis (15)		
Group	Total	General	Sensitive	Total	General	Sensitive
No Restriction	77%	92%	62%	57%	78%	36%
Partial Restriction	16%	8%	24%	25%	20%	30%
Do Not Eat	7%	0%	14%	18%	2%	34%

Table A. 4. Percent breakdown of Restrictions Assessment I Grouping						
2017-2018						
<b>Location</b>	Thousands Islands (12)			Lake St. Francis (15)		
<b>Group</b>	Total	General	Sensitive	Total	General	Sensitive
<b>No Restriction</b>	65%	78%	52%	53%	72%	35%
<b>Partial Restriction</b>	19%	15%	23%	28%	25%	32%
<b>Do Not Eat</b>	16%	7%	25%	18%	3%	33%
<b>Location</b>	Middle Corridor (13)			Lake St. Francis (15)		
<b>Group</b>	Total	General	Sensitive	Total	General	Sensitive
<b>No Restriction</b>	77%	98%	56%	64%	85%	42%
<b>Partial Restriction</b>	19%	2%	35%	25%	15%	35%
<b>Do Not Eat</b>	4%	0%	8%	11%	0%	23%
<b>Location</b>	Lake St. Lawrence (14)			Lake St. Francis (15)		
<b>Group</b>	Total	General	Sensitive	Total	General	Sensitive
<b>No Restriction</b>	77%	92%	63%	58%	78%	37%
<b>Partial Restriction</b>	16%	8%	24%	27%	22%	33%
<b>Do Not Eat</b>	7%	0%	14%	15%	0%	29%

Table A. 5. Percent breakdown of Restrictions Assessment II Grouping						
2015-2016						
Location	Thousands Islands (12)			Lake St. Francis (15)		
Parameter	Total	General	Sensitive	Total	General	Sensitive
Max Meals	10%	16%	3%	6%	10%	2%
50% of Max	21%	26%	16%	16%	23%	10%
25%-50% of Max	35%	37%	32%	28%	35%	21%
<25% of Max	19%	15%	24%	26%	24%	27%
0% of Max	15%	6%	24%	24%	8%	40%
Location	Middle Corridor (13)			Lake St. Francis (15)		
Group	Total	General	Sensitive	Total	General	Sensitive
Max Meals	13%	22%	4%	5%	11%	0%
50% of Max	34%	48%	20%	22%	30%	13%
25%-50% of Max	29%	28%	30%	35%	43%	26%
<25% of Max	20%	2%	37%	23%	13%	33%
0% of Max	4%	0%	9%	15%	2%	28%
Location	Lake St. Lawrence (14)			Lake St. Francis (15)		
Group	Total	General	Sensitive	Total	General	Sensitive
Max Meals	13%	22%	4%	5%	8%	2%
50% of Max	29%	38%	20%	17%	26%	8%
25%-50% of Max	35%	32%	38%	35%	44%	26%
<25% of Max	16%	8%	24%	25%	20%	30%
0% of Max	7%	0%	14%	18%	2%	34%

<b>Table A. 6. Percent breakdown of Restrictions Assessment II Grouping</b>						
<b>2017-2018</b>						
<b>Location</b>	Thousands Islands (12)			Lake St. Francis (15)		
<b>Group</b>	Total	General	Sensitive	Total	General	Sensitive
<b>Max Meals</b>	14%	27%	2%	9%	18%	0%
<b>50% of Max</b>	32%	35%	28%	18%	23%	12%
<b>25%-50% of Max</b>	19%	17%	22%	27%	30%	23%
<b>&lt;25% of Max</b>	19%	15%	23%	28%	25%	32%
<b>0% of Max</b>	16%	7%	25%	18%	3%	33%
<b>Location</b>	Middle Corridor (13)			Lake St. Francis (15)		
<b>Group</b>	Total	General	Sensitive	Total	General	Sensitive
<b>Max Meals</b>	17%	25%	8%	14%	25%	2%
<b>50% of Max</b>	32%	46%	19%	20%	25%	15%
<b>25%-50% of Max</b>	28%	27%	29%	30%	35%	25%
<b>&lt;25% of Max</b>	19%	2%	35%	25%	15%	35%
<b>0% of Max</b>	4%	0%	8%	11%	0%	23%
<b>Location</b>	Lake St. Lawrence (14)			Lake St. Francis (15)		
<b>Group</b>	Total	General	Sensitive	Total	General	Sensitive
<b>Max Meals</b>	13%	22%	4%	10%	20%	0%
<b>50% of Max</b>	28%	37%	20%	19%	25%	12%
<b>25%-50% of Max</b>	36%	33%	39%	29%	33%	25%
<b>&lt;25% of Max</b>	16%	8%	24%	27%	22%	33%
<b>0% of Max</b>	7%	0%	14%	15%	0%	29%