# Keeyask Generation Project

## Aquatic Effects Monitoring Plan

# Mercury in Fish Flesh from Gull Lake in 2016 Report

**AEMP-2018-08**

KEEYASK

Manitoba Sustainable Development Client File 5550.00
Manitoba Environment Act Licence No. 3107

**2017 -2018**

# KEEYASK GENERATION PROJECT

## AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2018-08

## MERCURY IN FISH FLESH FROM GULL LAKE, 2016

Prepared for

Manitoba Hydro

By

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June 2018

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# SUMMARY

## Background

The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the Keeyask Generating Station (GS) on the environment. Besides measuring the accuracy of the predictions made and actual effects of the GS on the environment, monitoring results will provide information on how construction and operation of the GS will affect the environment and if more needs to be done to reduce harmful effects.

Construction of the Keeyask GS began in mid-July 2014. During 2014 and 2015, cofferdams were constructed that blocked the north and central channels and a portion of the south channel of Gull Rapids (see map below). In 2016, there was little in-stream construction prior to the completion of field studies in fall: the central portion of the Central Dam Cofferdam was widened in April/May and work on the Tailrace Summer Level Cofferdam was started on August 4 and 5 and then stopped until October. With so little in-stream construction activity prior to completing field work in the fall, possible construction-related impacts to the aquatic environment during this period were limited to indirect effects (*e.g.*, potential impacts to water quality from discharge at the cofferdam, runoff from disturbed terrestrial areas).

Fish mercury is one of the key components for monitoring because it affects the suitability of fish for consumption by people. Flooding of the Keeyask reservoir is predicted to increase mercury levels in fish in Gull Lake and Stephens Lake, though the increase in Stephens Lake will be much less than when the lake was first created by construction of the Kettle GS in the early 1970s.

This report provides the results of mercury concentrations measured in jackfish, pickerel, whitefish, and yellow perch from Gull Lake in 2016. Though not measured for the Keeyask Project in 2016, it also includes results for the same species sampled from Stephens Lake in 2015 and from Split and Assean lakes in 2016. These results are included to provide additional information to explain the results observed in Gull Lake.

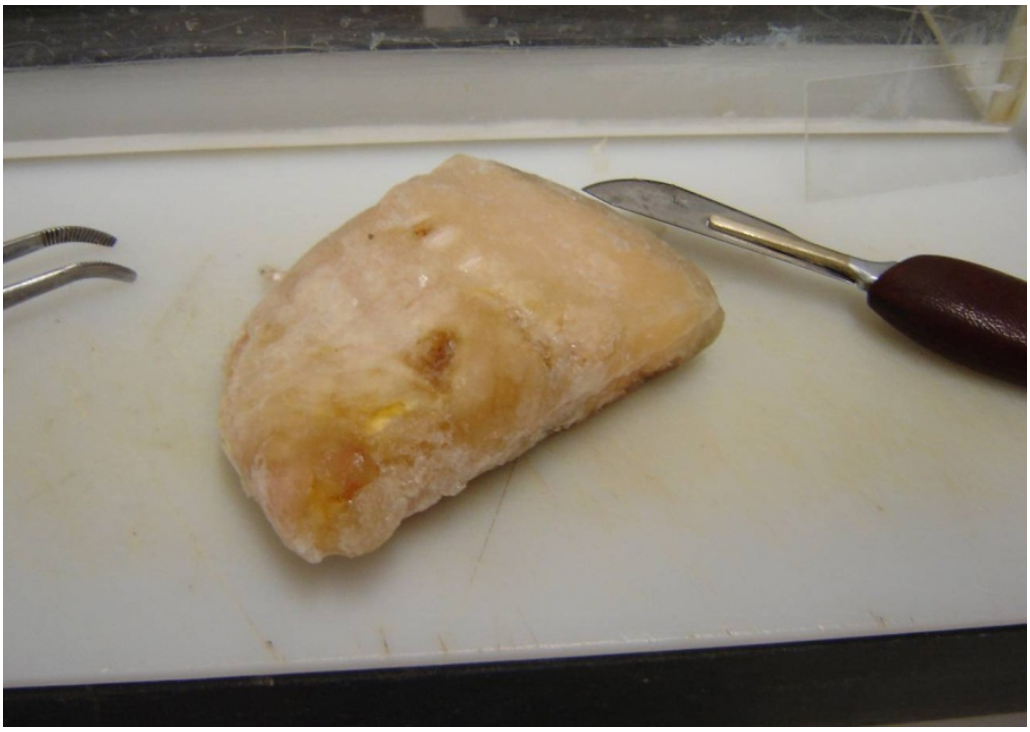
## Why is the study being done?

Monitoring in 2016 at Gull Lake was done in partial fulfillment (year two of two) of a requirement in the Manitoba *Environment Act* Licence issued for the Keeyask Generation Project (the Project) that states KHLP will measure mercury levels in fish twice more before reservoir flooding occurs and the Project goes into operation.

Monitoring in Gull Lake in 2016 helps to answer the following:

- Have mercury concentrations in Northern Pike, Walleye, and Lake Whitefish remained unchanged in Gull Lake in 2016 compared to concentrations measured in 2014 and during environmental studies for the Project?
- How do mercury concentrations in Northern Pike, Walleye, and Lake Whitefish from Gull Lake compare to the established benchmark value to assess if fish are acceptable for commercial marketing?


**Map of instream structures at the Keeyask Generating Station site, September 2016**



**Frozen pickerel muscle sample being prepared for mercury analysis**

### What was done?

Thirty-six jackfish, 35 pickerel, 19 whitefish, and 11 Yellow Perch were analyzed for mercury in Gull Lake in September 2016. Jackfish (104), pickerel (109), whitefish (45), and young Yellow Perch (31) were also analyzed in Stephens, Split, and Assean lakes in September 2015 (Stephens Lake only) and August 2016. Fish were measured for length and weight and a small structure in each fish was collected to determine the age. A piece of muscle was taken from each of the fish for mercury analysis, except for young perch, which were analyzed almost whole, but with their head, tail, and fins removed. Mercury was measured at an accredited laboratory in Winnipeg.

Using the mercury concentration measured in each fish, the average mercury concentration of all fish from each species was calculated. This concentration is referred to as the arithmetic mean. Because the concentration of mercury in fish typically increases with the length (age) of the fish, a second value was calculated that adjusts the concentration to a standard fish length (550 mm for jackfish, 400 mm for pickerel, 350 mm for whitefish, and 100 mm for young perch). This value is called the standard mean. Comparing mercury concentrations between years and waterbodies based on a standard mean is more reliable than using the arithmetic mean since the standard mean accounts for differences in the size of fish sampled each year or between lakes. Standard means can only be calculated if the fish that were sampled show a significant increase in mercury concentration with fish length. Therefore, a standard mean is often not available if the sample size is small and/or the fish are of similar size.

### What was found?

Standard mean mercury concentrations in fish collected from Gull Lake in 2016 were 0.34 ppm in jackfish, 0.30 ppm in pickerel, and 0.04 ppm in whitefish. Only the arithmetic mean was available for the young perch collected from Gull Lake; it was 0.04 ppm.

A comparison of the results for 2016 with past results shows that:

- Mercury concentrations in whitefish and yellow perch from Gull Lake have always been low and have not changed much over time, including between 2014 and 2016;
- Average mercury concentrations in pike and pickerel caught in Gull Lake in 2016 were similar to 2014. These concentrations were higher than average values measured during the environmental studies for the Project (2001, 2002 and 2006); and;
- Mercury concentrations from fish caught in Gull Lake in 2016 were within the range of values used to assess if fish are acceptable for commercial marketing.

Standard means for pike from Stephens, Split and Assean lakes in 2015/2016 were 0.33 ppm, 0.28 ppm, and 0.21 ppm, respectively. Standard means of Walleye for the same three lakes were 0.50 ppm, 0.26 ppm, and 0.26 ppm, respectively, and standard means for whitefish were 0.11 ppm, 0.04 ppm, and 0.04 ppm, respectively. Only the arithmetic mean and a concentration for a single fish caught in Split Lake were available for the young perch collected from the three lakes and mean concentrations were low, ranging from 0.02 ppm for Stephens Lake to 0.03 in Assean Lake.

When compared to fish found in the region, mercury concentrations in large-bodied fish (pike, Walleye and whitefish) in Gull Lake show a similar pattern to those found in Stephens (2015) and Split lakes, where there has been a fluctuating and increasing trend in fish mercury levels observed in recent years. When compared to Assean Lake, which is an “off-system” lake and not influenced by the Nelson River, the same increase was not observed. Based on this pattern, the increase in mercury levels observed in pike and Walleye from Gull Lake in 2014, which persisted in 2016, may be part of a more wide-spread change in fish mercury concentrations in the region.

### What does it mean?

Mercury concentrations measured in Gull Lake in 2016 were similar to those measured in 2014 but are higher than those measured during the Project environmental studies. A similar pattern was found in other lakes on the same river system, further away from construction. This means that mercury concentrations can change due to factors in the environment, not necessarily related to a specific hydroelectric development.

### What will be done next?

Fish mercury concentrations from Gull and Stephens lakes will be monitored again during the first year of operation of the Keeyask GS and annually for several years after that.

# ACKNOWLEDGEMENTS

We would like to thank Manitoba Hydro for the opportunity and resources to conduct this study.

The following members of Tataskweyak Cree Nation (TCN) and Fox Lake Cree Nation (FLCN) are thanked for their local expertise and assistance in conducting the field work: Kelvin Kitchekeesik, Leslie Flett, Saul Mayham, and Tim Flett of TCN and John Henderson of FLCN.

The collection of biological samples described in this report was authorized by Manitoba Conservation and Water Stewardship, Fisheries Branch, under terms of the Scientific Collection Permits #26-15, #08-16, and #24-16.

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# 1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station at Gull Rapids on the lower Nelson River in northern Manitoba. The Project is approximately 725 kilometres (km) northeast of Winnipeg, 35 km upstream of the existing Kettle Generating Station, where Gull Lake flows into Stephens Lake, 60 km east of the community of Split Lake, 180 km east-northeast of Thompson and 30 km west of Gillam (Map 1). Construction of the Project began in July 2014.

The *Keeyask Generation Project: Response to EIS Guidelines*, completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the aquatic environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement: Aquatic Environment Supporting Volume* (AE SV). These documents are jointly referred to as the Keeyask Environmental Impact Statement (EIS). As part of the licensing process for the Project, an Aquatic Effects Monitoring Plan (AEMP) was developed detailing the monitoring activities of various components of the aquatic environment, including fish mercury concentrations, for the construction and operation phases of the Project.

The primary parameter of concern for the mercury monitoring program is the concentration of total mercury in fish skeletal muscle from the following species: Lake Whitefish (*Coregonus clupeaformis*), Northern Pike (*Esox lucius*), Walleye (*Sander vitreus*), and 1-year-old Yellow Perch (*Perca flavescens*). The first three species are sampled because they are important in domestic, commercial, and recreational fisheries and form the primary pathway by which humans ingest (methyl)mercury. Young Yellow Perch were included because mercury concentrations in these small fish will respond more quickly (*i.e.*, within a year) to changes in mercury availability in the ecosystem than the older individuals typically sampled for the three large-bodied species. These larger fish hold a relatively large amount of ‘old’ mercury in their trunk muscles compared to the ‘new’ mercury assimilated in a given year, and thus integrate and reflect temporal changes in the supply of mercury over longer time scales. (*i.e.*, several years). Furthermore, 1-year-old perch are not known to undertake extensive movements and are more likely represent “local” conditions of mercury availability and bioaccumulation.

The waterbodies included in the fish mercury component of the AEMP are Gull Lake, which will become part of the future Keeyask reservoir, Stephens Lake, Split Lake, and the Aiken River. In the event that the mercury concentration in fish from Stephens Lake should exceed predicted maximum concentrations by more than 10%, the fish mercury monitoring program will be extended further downstream on the Nelson River by sampling within the Long Spruce Forebay.

This report provides detailed results on mercury monitoring in Lake Whitefish, Northern Pike, Walleye, and Yellow Perch from four waterbodies. Sampling at Gull Lake in 2016 was conducted in addition to 2014 sampling (Jansen 2016a) to fulfill the requirement in the Project’s *Environment Act* Licence to measure mercury levels in fish twice more before the Project was in

operation. The current report also includes results for the above four species sampled from Stephens Lake in 2015 and from Split and Assean lakes in 2016. This sampling was done under the auspices of the Coordinated Aquatic Monitoring Program (CAMP) and was included here to provide regional context for results observed in Gull Lake.

The key questions to be answered about mercury in fish in relation to monitoring completed in 2016 are:

- Have concentrations of mercury in Northern Pike, Walleye and Lake Whitefish caught in Gull Lake prior to reservoir flooding changed since studies completed for the Keeyask EIS?
- How do mercury concentrations in Northern Pike, Walleye and Lake Whitefish captured in Gull Lake compare to established benchmark values to assess if fish are acceptable for commercial marketing?

For ease of reading, Northern Pike, Lake Whitefish, and Yellow Perch are also referred to as pike, whitefish, and perch in this report. Because targeted ageing of perch indicated that at least some fish were older than age 1, “1-year-old perch” are mainly referred to as young perch.

# 2.0 CONSTRUCTION SUMMARY

Construction of the Keeyask GS began in mid-July 2014 with the construction of a rock groin in the north channel of Gull Rapids, and cofferdams in the north and central channels of Gull Rapids. These cofferdams resulted in the dewatering of the north and central channels and the diversion of all flow to the south channel. Construction of the spillway cofferdam, which extends into the south channel of Gull Rapids, was completed in 2015.

Work began to construct the Tailrace Summer Level Cofferdam on August 4 and 5, 2016 and then was suspended until October. Work also took place to widen the central portion of the Central Dam Cofferdam in late April and early May.

## 2.1 FLOWS AND WATER LEVELS

Due to high flows in the Nelson River (almost a 1:20 year flow event) and the construction of the North Channel Rock Groin, water levels in Gull Lake rose to between 155 m ASL and 156 m ASL during late summer 2014. This resulted in water levels above the existing environment 95$^{th}$ percentile water level for open-water (154.2 m ASL) until the following spring (Manitoba Hydro 2015). Open-water levels on Gull Lake in the existing environment were as high as 155 m and surpassed 156 m during winter on occasion. The amount of land inundated during the 2014-2015 period is not known, but based on estimates of flooded areas expected in the later stages of construction (as presented in the EIS), this area likely included the nearshore areas of much of Gull Lake and some localized areas in and around Gull Rapids, as well as low-lying areas that extended further inland.

Water levels during the open-water season of 2015 declined due to lower discharge in the Nelson River. Water levels on Gull Lake ranged from 154 m ASL to 155 m ASL in 2015, and inundated areas were likely confined to localized sections of low-lying areas around Gull Lake.

Split Lake outflows from late 2015 to the end of June 2016 were relatively high, generally ranging between 3,500–4,000 $m^3/s$. The 75th percentile flow for Split Lake outflow is approximately 3,500 $m^3/s$. Flow increased sharply in July 2016, reaching a peak of 4,700 $m^3/s$ in August, before declining. Gull Lake water levels varied in relation to flow, and some winter staging due to ice formation was apparent from December to May. Water levels rose to approximately 155.5 m ASL during winter 2015/16 and ranged from 154–155 m ASL for most of the open-water season of 2016.

# 3.0 METHODS

## 3.1 FIELD COLLECTIONS

The 2016 sampling program at Gull Lake was conducted using the same methodologies as those used in previous Keeyask environmental studies sampling programs conducted on Gull Lake between 1999 and 2006 and the monitoring done in 2014. Lake Whitefish, Northern Pike, Walleye and Yellow Perch were collected from 16 sites within Gull Lake from September 1–16, 2016 (Map 2). Because of the difficulties obtaining the target numbers of fish from Gull Lake, three pike and one Walleye captured at Pahwaybanik Bay, approximately 5 km to the west of the lake, were included in the sample for Gull Lake (see sites GN-15 and GN-18 on Map 2).

Whitefish, Walleye, and pike were captured using gill nets composed of five panels of: 1, 2, 3, 5, and 6” braided stretched mesh (25, 51, 76, 127, and 152 mm). Each mesh panel was 25 yards (yd) (22.9 m) long and 2.7 yd (2.5 m) deep. Perch were captured using small mesh gill nets consisting of three, 10 m long by 1.8 m deep panels of sequentially ordered, 16, 20, and 25 stretch mm (0.63, 0.79, and 0.98 stretch inch), clear, mono-filament, nylon mesh.

The CAMP sampling programs that included Stephens Lake (2015), Split Lake (2016), and Assean Lake (2016) used similar methodologies to the Gull Lake program, however, gill nets used consisted of 2, 3, 3.25, 4.75, and 5” mesh panels (CAMP 2014). Fish from Stephens Lake were captured at nine sites in the south basin from September 7–9, 2015 (Map 3), fish from Split Lake were collected at 12 sites from August 14–18, 2016 (Map 4), and fish from Assean Lake were caught at 12 sites from August 12–13, 2016 (Map 5).

To be consistent with the methodology described in earlier Manitoba fish mercury monitoring programs (Jansen and Strange 2007), a broad size range of fish was collected. A tally of the fish captured within each consecutive 50 mm length interval (starting at 100 mm) was kept, aiming for an equal distribution of length classes within a target size of 36 fish per species. Upon capture, large-bodied fish were measured for fork length (±1 mm) and round weight. Fish that were less than 2000 g were weighed using a digital balance (±1 g), while heavier fish were weighed on a pan balance (±25 g). Bony structures were removed from fish for age analysis: cleithra were collected from pike, and otoliths were removed from whitefish, Walleye, and perch. A portion of axial muscle weighing between 10 and 40 g was removed from each fish, anterior to the caudal (tail) fin, for mercury analysis of the large-bodied species. The muscle, with the skin attached, was wrapped tightly with commercial “cling-wrap”, placed in mercury-free, internally and externally labelled Whirl-Pac bags or Zip-lock bags, and stored on ice until they could be frozen. Perch were collectively placed into a Zip-lock bag to be frozen, and processed for biological data in the lab (section 2.2). Frozen, whole perch and tissue samples of other species were shipped to the North/South Consultants Inc. in Winnipeg for further processing.

## 3.2 LABORATORY DETERMINATIONS

Whole perch were thawed to the point where they could be processed for length, weight, and other biological data (see Appendix 1). A sample consisting of the body's midsection from (but excluding) the pectoral girdle and pelvic fins to the caudal peduncle was prepared and fully re-frozen for submission to the laboratory for mercury analysis. All perch and the muscle samples from the other species were weighed and shipped frozen to a CALA[1] accredited analytical laboratory for analysis of total mercury (ALS Laboratories, Winnipeg, MB), ensuring the holding time requirement between catching the fish and its analysis was less than one year. Fish muscle samples were analyzed for mercury between January 11 and 24, 2017 (Gull Lake), January 11 and 20, 2017 (Split Lake), February 19 and 27, 2016 (Stephens Lake), and December 21, 2016, and January 19, 2017 (Assean Lake). The skin and a thin surface layer of the exposed muscle tissue on the opposite side were sliced away before the remaining sample was homogenized (see below). This procedure helped to ensure that the percentage of water in the muscle sample was representative of the original sample taken from the fish. Perch samples were processed as shipped without removing any tissues.

Mercury analysis was performed using an adaptation of US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues". In preparation, tissue samples were homogenized and sub-sampled prior to "HotBlock" digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis was by atomic fluorescence spectrophotometry, adapted from US EPA Method 245.7. Samples of two different standard (certified) reference materials (SRM) were analyzed with each sample run (Table 1):

- lobster hepatopancreas (TORT-3; National Research Council Canada, NRC; http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/tort_3.html;last accessed 29 March, 2017); and
- fish protein (DORM-4; NRC; http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/ certificates/ dorm_4 .html; last accessed 29 March, 2017).

Homogenate of submitted fish tissue samples were also run as replicas for quality control purposes. For Gull Lake, mean mercury concentrations obtained from the SRMs were within 28% of the mean certified value for TORT-3 and within 21% for DORM-4. The mean percentage deviation of replicate homogenate analyses was 4.7% with a range of 1.5–11.5% (Table 1). For Stephens Lake, mean SRM mercury concentrations were within 13% of the mean certified value for TORT-3 and within 21% for DORM-4. The mean percentage deviation of replicate homogenate analyses was 5.8% with a range of 0.8–15.0% (Table 2). For Split Lake, mean SRM mercury concentrations were within 20% of the mean certified value for TORT-3 and within 29% for DORM-4. The mean percentage deviation of replicate homogenate analyses was 8.3% with a range of 1.8–11.7% (Table 3). For Assean Lake mean SRM mercury concentrations

[1] Canadian Association for Laboratory Accreditation Ltd.

were within 18% of the mean certified value for TORT-3 and within 23% for DORM-4. The mean percentage deviation of replicate homogenate analyses was 7.6% with a range of 1.1–15.0% (Table 4).

Pike cleithra were cleaned and examined under reflected light aided by a magnified ring light. Whitefish, Walleye, and perch otoliths were cracked by scoring cross-wise across the focus with a scalpel until it snapped. The cracked plane of the otolith was then lightly polished with a bench lathe, toasted in an alcohol filled Bunsen burner, and inserted into modelling clay with the cracked edge (treated with clearing medium) facing up prior to viewing under a microscope with reflected light.

## 3.3 DATA ANALYSIS

A condition factor (K) was calculated for each fish as:

$$K = W \times 10^5 / L^3$$

where: W = total weight (g); and
L = fork length (mm).

Fish obtained in different years from a group of lakes will invariably differ in mean size between years and lakes. Because fish accumulate mercury over their life time, older and, normally, larger individuals have higher levels than younger, smaller fish (Green 1986; Evans *et al.* 2005). In addition to calculating arithmetic mean mercury concentrations (also referred to as arithmetic means), mean mercury concentrations have been standardized to a common fish length under earlier Manitoba fish mercury monitoring programs (Jansen and Strange 2007, CAMP 2014) to facilitate comparisons for the same species of fish between years from one waterbody or between different waterbodies in a given year. The standard lengths used for Northern Pike, Walleye, Lake Whitefish, and Yellow Perch were 550, 400, 350, and 100 mm, respectively.

Length standardized mean mercury concentrations (also referred to as standard means) were calculated from unique regression equations, by species and river location, based on the analysis of logarithmic transformations of muscle mercury concentration and fork lengths using the following relationship:

$$\text{Log}_{10}[\text{Hg}] = a + b\ (\text{Log}_{10}\ L)$$

where: [Hg] = muscle mercury concentration (µg/g or ppm);
L = fork length (mm);
a = Y-intercept (constant); and
b = slope of the regression line (coefficient).

To present data in more familiar units, all standard means and their measures of variance presented in the tables and figures have been retransformed to arithmetic values. Standard means could not be calculated when the relationship between mercury concentration and fish length was not significant.

In order to provide a more comprehensive evaluation of the potential changes in mercury concentrations in fish caught from Gull Lake in 2016 compared to data collected in previous years, mercury concentrations in fish captured from Stephens (2015), Split (2016), and Assean (2016) lakes under CAMP were also examined and compared to data collected in previous years. Some of the historic data come from composite samples taken from commercially caught fish. These samples consist of the combined skinless fillets from a minimum of five fish weighing at least 15 pounds taken randomly from a shipment to the Freshwater Fish Marketing Corporation (McGregor 1980; DFO 1987). The fillets are then homogenized (*i.e.*, composited), analyzed in triplicate for total mercury, and the mean is reported as the sample concentration (hereafter referred to as commercial samples).

Differences in mean length, weight, and age of fish species between locations (and years) were ascertained using a one-way analysis of variance (ANOVA). If F-values were significant, differences between individual means were confirmed by Holm-Sidak's pairwise multiple comparison tests. If normality of data distribution or equality of variances could not be achieved by logarithmic transformation of the data, Kruskal-Wallis one-way ANOVA on ranks was performed, applying Dunn's method for pairwise multiple comparisons. In all cases, significance was established at $p \leq 0.05$. Actual probabilities values are stated in the text if $p < 0.05$. Differences in standard mean mercury concentrations between locations or years were established if the 95% confidence limits (CL) of two means did not overlap. Statistical analyses were completed using Sigma Plot V. 11.0 (SSI 2008) and the plyr package version 1.8 (Wickham 2011) for R Version 2.15.0 (R Development Core Team 2012).

Mercury concentrations were also compared to a benchmark specified in the AEMP (see following section).

## 3.4 BENCHMARKS

In accordance with the AEMP, mercury in fish are compared to the 0.5 ppm total mercury Health Canada standard for commercial marketing of freshwater fish in Canada (Health Canada 2007a, b). Two other benchmarks that were originally included in the AEMP are no longer relevant, as they are not endorsed by the federal agencies that originally supported their application. This is discussed in Jansen (2016a).

# 4.0 RESULTS

## 4.1 SAMPLE DESCRIPTION AND BIOLOGICAL DATA

### 4.1.1 GULL LAKE 2016

Target numbers of 36 Northern Pike and Walleye each were captured for mercury analysis (Table 4); however, only 19 Lake Whitefish and 14 Yellow Perch were captured at Gull Lake in 2016. The latter is not surprising, as whitefish are not abundant in Gull Lake (KHLP 2012) and it has been difficult to catch the target number for mercury monitoring in previous years. Yellow Perch have also been difficult to find in Gull Lake (none were caught in 2014).

The 19 individual whitefish represent the largest number caught and analyzed for mercury since 2002. Three of the larger perch were aged as 3–5 years old and were excluded from data analyses, as only 1-year old perch are applicable for this study. No ageing structures were available for the remaining 11 perch, but they were assumed to be 1-year olds based on their lengths (Table 5; Figure 1).

The mean age of whitefish, pike and Walleye differed significantly between the three species (ANOVA on ranks), with whitefish being on average almost twice as old as pike (Table 5). Pairwise comparisons further indicated that whitefish were significantly older than either pike or Walleye, and that pike and Walleye were of similar ages.

Lake Whitefish were on average 43% larger (*i.e.*, mean length of 500 mm) than the standard length for the species (350 mm) (Table 5). In contrast, the average lengths of pike (554 mm) and Walleye (394 mm) were within 2% of the respective species standard lengths of 550 and 400 mm. Large differences between sample mean length and standard length often occur when the overall catch for a species is relatively small, as was the case for whitefish from Gull Lake in 2016. The 11 perch retained to represent 1-year old fish had a mean length of 58 mm, which was smaller than the 70 mm standard length used for juvenile perch in other Manitoba monitoring programs (Table 5, CAMP 2014).

Biological data for individual fish of all species are presented in Appendix Table A1-2.

### 4.1.2 STEPHENS LAKE 2015

Target numbers of 36 Northern Pike and Walleye each were captured for mercury analysis (Table 6). However, only 11 Lake Whitefish and five Yellow Perch were captured at Stephens Lake in 2015. Whitefish have been difficult to catch at the target number for mercury monitoring in previous sampling years. The 11 individuals represent the largest number of whitefish

analyzed for mercury since 2009. A large (n = 44) sample of juvenile perch was obtained during the EIS studies in 2003, but 1-year old fish of this species have rarely been caught from Stephens Lake since targeted sampling started under CAMP in 2009 (CAMP 2018). The five individuals sampled in 2015 represent the largest number of perch analyzed for mercury since 2009.

Mean age of whitefish, pike and Walleye differed significantly between the three species (ANOVA on ranks), with Walleye being on average twice as old as pike (Table 6). Pairwise comparisons further indicated that Walleye were significantly older than either whitefish or pike, and that pike and whitefish were of similar age. The four, aged perch were all 2-years old.

Lake Whitefish were, on average, 14% smaller (*i.e.*, mean length of 302 mm) than the standard length for the species (350 mm) (Table 6). It should be noted, however, that whitefish length distribution was strongly bimodal, with five individuals measuring between 80 and 95 mm and six fish having a length of 410–549 mm (Figure 2). In contrast, the lengths of pike and Walleye were distributed more evenly and the average lengths of pike (532 mm) and Walleye (416 mm) were within 4% of the respective species standard length of 550 and 400 mm.

Biological data for individual fish of all species are presented in Appendix Table A1-3.

### 4.1.3 SPLIT LAKE 2016

In total, 22 Lake Whitefish, 34 Northern Pike, 36 Walleye, and one Yellow Perch were captured at Split Lake in 2016 (Table 7). Whitefish have been difficult to catch at the target number for mercury monitoring in previous sampling years. The 22 individuals represent the largest number of whitefish analyzed for mercury since 2007. Perch have rarely been caught from Split Lake since targeted sampling started in 2010 (CAMP 2018).

The mean age of whitefish, pike and Walleye differed significantly between the three species (ANOVA on ranks), with whitefish being on average almost twice as old as pike (Table 7). Pairwise comparisons further indicated that whitefish were significantly older than both pike and Walleye, and that pike and Walleye were similar in age.

Lake Whitefish were, on average, 23% larger (*i.e.*, mean length of 429 mm) than the standard length for the species (350 mm) (Table 7). In contrast, pike (504 mm) and Walleye (343 mm) were 8 and 14% smaller, respectively, compared to the respective species' standard length of 550 and 400 mm.

Biological data for individual fish of all species are presented in Appendix Table A1-4.

### 4.1.4 ASSEAN LAKE 2016

In total, 12 Lake Whitefish, 34 Northern Pike, 37 Walleye, and 25 Yellow Perch were captured in Assean Lake in 2016 (Table 8). Whitefish have been difficult to catch at the target number for

mercury monitoring in the previous sampling year (2013) when only 9 fish were captured (CAMP 2018).

Mean age of whitefish, pike and Walleye analyzed for mercury differed significantly between the three species (ANOVA on ranks), with whitefish being on average almost twice as old as pike (Table 8). Pairwise comparisons further indicated that whitefish were significantly older than pike but not Walleye, and that the ages of pike and Walleye were statistically similar.

Lake Whitefish were, on average, 15% larger (*i.e.*, mean length of 403 mm) than the standard length for the species (350 mm) (Table 8). The length distribution of whitefish was strongly bimodal, with three individuals measuring between 148 and 227 mm and nine fish having lengths of between 440 and 525 mm (Figure 4). The average lengths of pike (508 mm) and Walleye (318 mm) sampled for mercury analysis were 8 and 20% smaller, respectively, compared to the respective species' standard length of 550 and 400 mm.

Biological data for individual fish of all species are presented in Appendix Table A1-5.

## 4.2 MERCURY CONCENTRATIONS

### 4.2.1 GULL LAKE

#### 4.2.1.1 RESULTS FOR 2016

Length standardized mean mercury concentrations of fish collected from Gull Lake in 2016 ranged from 0.04 ppm in the benthivorous Lake Whitefish to 0.30 and 0.34 ppm in the two piscivorous species, Northern Pike and Walleye, respectively (Table 9). A standard mean could not be calculated for the 11 young Yellow Perch that were all of similar length. The arithmetic mean of the perch was 0.04 ppm. The standard mean of whitefish was several times smaller than the arithmetic mean of 0.18 ppm, reflecting the fact that all of these fish were larger than the standard length of the species (see section 3.1.1). In contrast, standard and arithmetic means of pike and Walleye were similar (Table 9).

Arithmetic mean mercury concentrations of whitefish, pike, and Walleye were significantly higher than those of perch. Arithmetic mean concentrations of pike were also significantly higher than those of whitefish, whereas all other comparisons between species did not result in significant differences in mercury concentrations (ANOVA on ranks).

The arithmetic mean mercury concentrations of Lake Whitefish, Northern Pike, and Walleye were well below the 0.5 ppm Health Canada standard for commercial sale of fish (Table 9). Based on individual concentrations, eight (*i.e.*, 22% of the sample) of the pike had mercury concentrations higher than 0.5 ppm, with a maximum concentration of 1.1 ppm in an individual measuring 950 mm and with an age of 14 years (Figure 1). Mercury levels in six (17%) of the Walleye analyzed exceeded the Health Canada standard, with one fish of 481 mm length (age

30) having a concentration of 1.3 ppm (Figure 1). The other four fish with concentrations above 1 ppm were also very old (26–29 years). With the exception of one 27-year old fish, all other Walleye were 15 years of age and younger. None of the whitefish exceeded the Health Canada standard. An 11-year old individual measuring 504 mm had the highest mercury concentration (0.41 ppm) on record (since 1999) from Gull Lake.

#### 4.2.1.2 COMPARISON TO PREVIOUS YEARS

Walleye and pike from Gull Lake have been analyzed for mercury since 1982 and mercury data for whitefish exist since 1999 (Figure 2). However, there are large time intervals during which no information on mercury exists (*i.e.*, 1983–1998 and 2007–2013), limiting the interpretation of the existing record. For this reason, data from 2016 are compared to those collected from 1999 onward. A discussion of past trends is presented in Jansen (2016a).

Standard mean mercury concentrations for Northern Pike and Walleye in 2016 (0.34 ppm and 0.30 ppm, respectively) did not differ significantly from those measured in 2014. Standard means in both 2014 and 2016 were significantly higher than those measured between 2001 and 2006. Standard mean mercury concentration for Lake Whitefish in 2016 (0.04 ppm) could not be compared to 2014 due to a small sample size, but was significantly lower than those measured in 2001 and 2002.

### 4.2.2 STEPHENS LAKE

#### 4.2.2.1 RESULTS FOR 2015

Length standardized mean mercury concentrations of fish collected from Stephens Lake in 2015 ranged from 0.11 ppm in the benthivorous Lake Whitefish to 0.33 and 0.50 ppm in the two piscivorous species, Northern Pike and Walleye, respectively (Table 10). A standard mean could not be calculated for the five young Yellow Perch. The arithmetic mean concentration of the perch was 0.02 ppm.

The standard mean of whitefish was several times smaller than the arithmetic mean of 0.18 ppm, reflecting the fact that all of the fish caught in 2015 were larger than the standard length of the species (see section 3.1.1). In contrast, standard and arithmetic means of pike and Walleye were similar (Table 10).

The standard mean mercury concentrations of whitefish was almost identical to the arithmetic mean (0.11 ppm), despite sampled fish being, on average, 14% smaller than the standard length of the species (Table 10). This is likely due to the bimodal size distribution (see section 3.1.2), as the smaller fish that contain low mercury concentrations included in the sample resulted in a lower estimate of standard mean (Figure 3). Northern Pike showed a similar length distribution, however, two small fish (less than 170 mm) had high mercury concentrations. This

resulted in an arithmetic mean (0.37) that was higher than the standard mean (0.33 ppm) despite a mean length that was lower than the standard length of the species.

The standard mean of Walleye (0.50 ppm) was lower than the arithmetic mean (0.59 ppm), reflecting the fact that these fish were larger than the standard length of the species (Table 10).

The arithmetic mean mercury concentration of Walleye was significantly higher than those of pike, whitefish, and perch (ANOVA on ranks). Furthermore, pike had a significantly higher arithmetic mean concentration than whitefish and perch, whereas the means of the two latter species were statistically similar.

The arithmetic means of whitefish and pike were lower than the 0.5 ppm Health Canada standard for commercial sale of fish, whereas the mean for Walleye exceeded the standard (Table 10). This was also reflected in the mercury concentrations of individual fish, for which 64% (*i.e.*, 23) of all Walleye were above 0.5 ppm, reaching a maximum of 1.24 ppm in a 26-year old fish measuring 585 mm (Figure 3). By comparison, 5 (14%) pike exceeded the standard, with one 10-year old, 828 mm long fish reaching 1.64 ppm (Figure 3). No whitefish exceeded the benchmark value, the maximum individual concentration being 0.39 ppm in a 24-year old fish (Figure 3).

#### 4.2.2.2 COMPARISONS TO PREVIOUS YEARS

Mercury concentrations have been measured in Walleye, Northern Pike, and Lake Whitefish in Stephens Lake since 1981. A discussion of past trends is presented in Jansen (2010b) and Manitoba Hydro and the Province of Manitoba (2015). Mercury concentrations in all three species decreased almost continuously between 1981 and 2005, when they reached a record low (Figure 4). In 2007, standard means increased for all three species. Standard means for Walleye and pike were significantly higher than 2005 in all sampling years between 2007 and 2015. Standard means of whitefish were significantly higher than 2005 in 2015.

### 4.2.3 SPLIT LAKE

#### 4.2.3.1 RESULTS FOR 2016

Length standardized mean mercury concentrations of fish collected from Split Lake in 2016 ranged from 0.04 ppm in the benthivorous Lake Whitefish to 0.26 ppm and 0.28 ppm in the two piscivorous species, Walleye and Northern Pike, respectively (Table 11). The single perch analyzed in 2016 had a mercury concentration of 0.01 ppm. The standard mean of whitefish was approximately half the value of the arithmetic mean, reflecting differences between the mean length of the fish analyzed for mercury and the standard length of the species (see section 3.1.2). In contrast, standard and arithmetic means of pike and Walleye were fairly similar (Table 11).

Arithmetic mean mercury concentration of whitefish was significantly lower than those of pike and Walleye, whereas the means of the two piscivores were statistically similar (ANOVA on ranks).

The arithmetic means of pike and Walleye were approximately half of the 0.5 ppm Health Canada standard for commercial sale of fish, and the mean for whitefish was only 14% of the standard value (Table 11). Based on individual concentrations, one (*i.e.*, 3% of the sample), 15-year old pike measuring 832 mm in length had a mercury concentration (0.81 ppm) higher than the standard (Figure 5). Mercury levels in two Walleye (6%) exceeded the Health Canada standard, with one fish of 590 mm length (age 17) reaching 1.1 ppm (Figure 5). No whitefish exceeded the standard (maximum concentration of 0.13 ppm) (Figure 5).

#### 4.2.3.2 COMPARISONS TO PREVIOUS YEARS

Split Lake has one of the oldest and most complete record of fish mercury concentrations in Manitoba. First commercial data are available for 1969 and, over the following 47 years, mercury concentrations have been measured in the three large-bodied, focal species between 18 (whitefish) and 30 (Walleye) times (Figure 6). An in-depth discussion of the full historical record is presented in Jansen (2010b) and Manitoba Hydro and the Province of Manitoba (2015) and is summarized below.

Mean mercury concentrations for Northern Pike and Walleye from Split Lake have fluctuated greatly since sampling began around 1970, without showing any clear trends over the years (Figure 6). This may partially be a result of small fish sample sizes and the variability in sampling/collection by the various agencies that carried out monitoring. Maximum mean concentrations of samples comprised of at least 10 fish were observed in 1982 for both pike (0.52 ppm) and Walleye (0.66 ppm). Although concentrations in Lake Whitefish displayed an overall smaller range of values, the minimum mean concentration in all three species was measured in 2005. In 2016, mean mercury concentrations for Walleye and pike were significantly higher, statistically speaking, than in 2005, but there was no statistically significant difference between the two years observed for Lake Whitefish. Concentrations found in all three species were significantly lower in 2016 than those observed during the previous sampling year (2013).

### 4.2.4 ASSEAN LAKE

#### 4.2.4.1 RESULTS FOR 2016

Length standardized mean mercury concentrations of fish collected from Assean Lake in 2016 ranged from 0.04 ppm in the benthivorous Lake Whitefish, to 0.21 ppm in Northern Pike and 0.26 ppm in Walleye (Table 12). A standard mean could not be determined for Yellow Perch. The arithmetic mean concentration of perch was 0.03 ppm. The standard mean of whitefish was

approximately 20% lower than the arithmetic mean, reflecting differences between the mean length of the fish analyzed for mercury and the standard length of the species (see section 3.1.2). Conversely, the standard mean of the relatively small Walleye was more than 30% larger than the arithmetic mean. The standard and arithmetic means of pike were similar (Table 12).

Arithmetic mean mercury concentrations of pike and Walleye were significantly higher than those of whitefish and perch, whereas the arithmetic means of the two piscivores and the means of whitefish and perch were statistically similar (ANOVA on ranks).

The arithmetic means of pike and Walleye were less than half of the 0.5 ppm Health Canada standard for commercial sale of fish, and the means for whitefish and perch were less than 10% of the standard value (Table 12). Based on individual concentrations, two (*i.e.*, 6% of the sample) pike and Walleye (5%) each had mercury levels higher than or equal to 0.5 ppm, reaching maximum concentrations of 0.95 ppm in a 8-year old pike and 0.53 ppm in a 17-year old Walleye (Figure 7). No whitefish approached the standard (maximum concentration of 0.09 ppm) (Figure 7).

#### 4.2.4.2 COMPARISONS TO PREVIOUS YEARS

Walleye from Assean Lake have been analyzed for mercury since 1978; sampling of Northern Pike and Lake Whitefish started in 1981. Since this time, mean mercury concentrations of all three species have been relatively stable, showing no temporal trends, excepting one commercial sample of pike in 1983 and one sample with small (n = 5) numbers of individual pike in 1982 (Figure 8). Excluding these two years, standard means for pike (range: 0.19–0.25 ppm) did not differ significantly between any of the eight sampling years, including 2016. Similarly, standard means for whitefish (range: 0.04–0.06 ppm) did not differ significantly between any of the five sampling years for which they could be calculated and were very close in value to the arithmetic means for 1985 and 2013 (Figure 8). Almost the same pattern existed for Walleye (range: 0.18–0.32 ppm), except that the standard mean in 2013 was significantly higher when compared to all other previous standard means since 1985, with the exception of 2016 (Figure 8).

# 5.0 DISCUSSION

Fish mercury concentrations measured in pike, Walleye and Lake Whitefish from Gull Lake in 2016 were similar to those recorded during the first sampling event after construction began in 2014 (Jansen 2016a). As per what was observed in 2014, standard means of Northern Pike and Walleye in 2016 continued to be significantly higher than those recorded during studies reported in the EIS (*i.e.*, 2001, 2002, and 2006) for all years, except for Walleye in 2002. As noted in Section 1.0, the start of Keeyask GS construction in July 2014 resulted in flooding along Gull Lake; however, this flooding could not have affected concentrations of mercury in pike and Walleye by the time fish were collected in September that year because mercury concentrations do not immediately increase in larger (older) fish that are higher up the food chain. As noted in Section 2.1, high flows on the Nelson River have continued through much of 2014–2016, resulting in flooding of low-lying areas of Gull Lake.

Similar to what was observed on Gull Lake, significant increases in mercury concentrations of pike and Walleye were also observed in Stephens and Split lakes since the mid-2000s. (Figures 4 and 6) (Jansen 2010a, b; Manitoba Hydro and the Province of Manitoba 2015. The observed increases in Split and Stephens lakes were first recorded in 2007 and mercury concentrations have persisted (Stephens Lake) or persisted with fluctuations (Split Lake) based on the results from sampling between 2010 and 2016 under the CAMP. This same increase has not been observed in fish from Assean Lake, which is not under the influence of the Nelson River and is considered “off-system”.

Based on the above, the increase in mercury levels observed in pike and Walleye from Gull Lake in 2014, which persisted in 2016, may be part of a more wide-spread change in fish mercury concentrations in the region (Jansen 2016a).

In contrast, standard mean mercury concentrations in Lake Whitefish from Gull Lake in 2014 and 2016 have not increased over the respective concentrations reported in the EIS for the years 1999, 2001, and 2002. However, the lack of data for the period between 2003–2013 and the relatively small sample sizes made up of mostly large fish in 2014 and 2016 precludes definitive conclusions about temporal trends in concentrations (*i.e.*, inclusion of only large fish in recent samples may not accurately estimate the standard mean mercury concentration). Similarly, the current relative scarcity of data on mercury concentrations in Yellow Perch from Gull Lake does not allow an interpretation of temporal changes.

Overall, recent standard mean mercury concentrations in Gull Lake were generally within the range measured immediately upstream (Split Lake) and downstream (Stephens Lake). The standard mean of Walleye from Gull Lake in 2016 was 0.30 ppm, which was intermediate between the means in Walleye from Split Lake (0.26 ppm) and Stephens Lake (0.50 ppm). The standard mean of pike from Gull Lake was 0.34 ppm, which was similar or slightly higher compared to the means in their conspecifics from Stephens Lake (0.33 ppm) and Split Lake (0.28 ppm), respectively. Concentrations in Lake Whitefish were much lower than in the two

piscivors in all three lakes, with standard means ranging from 0.04 ppm in Gull and Split lakes to 0.11 ppm in Stephens Lake.

## 5.1 KEY QUESTIONS

The key questions to be answered about mercury in fish in relation to monitoring completed in 2015/2016 are:

*What are the concentrations of mercury in Northern Pike, Walleye and Lake Whitefish caught in Gull Lake prior to reservoir flooding and how have concentrations changed since studies completed for the Keeyask EIS?*

Standard means of Northern Pike and Walleye in 2016 did not differ significantly from those measured in 2014. Standard means in both 2014 and 2016 were significantly higher than those measured during EIS studies (2001–2006). The standard mean of Lake Whitefish in 2016 could not be compared to 2014 due to the small sample of very large fish in 2014, but was significantly lower than the standard means measured during EIS studies.

*How do mercury concentrations in Northern Pike, Walleye and Lake Whitefish in Gull Lake compare to the established benchmark value to assess if fish are acceptable for commercial marketing?*

The arithmetic mean concentrations of Lake Whitefish, Northern Pike, and Walleye (*i.e.*, the species relevant to human consumption) measured in 2016 were well below the 0.5 ppm Health Canada standard for commercial sale of fish. However, 17% of the Walleye and 22% of the pike had concentrations exceeding the standard.

# 6.0 CONCLUSION AND NEXT STEPS

Mercury concentrations in Walleye and Northern Pike from Gull Lake measured in 2016 are similar to concentrations obtained in 2014 (insufficient data exist for whitefish in 2014 to make a meaningful comparison). The concentrations in the two piscivors continue to be significantly higher than what was measured during the EIS studies and may be part of a more wide-spread change in fish mercury concentrations in the region.

The arithmetic mean concentrations of Lake Whitefish, Northern Pike, and Walleye (*i.e.*, the species relevant to human consumption) measured in Gull Lake in 2016 were well below the 0.5 ppm Health Canada standard for commercial sale of fish. A small proportion of individual Walleye and Northern Pike exceeded the standard.

The 2016 monitoring of fish mercury concentrations from Gull Lake has fulfilled the *Environment Act* Licence requirement to collect additional mercury data before the Keeyask GS becomes operational. After the Keeyask reservoir (currently Gull Lake) is created, the AEMP requires mercury concentrations in fish in the reservoir and Stephens Lake to be monitored annually for several years until maximum concentrations (predicted to be just above 1.0 ppm in Northern Pike and Walleye) have been reached.

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# TABLES

**Table 1: Comparison of total mercury concentrations (ppm; mean ± expanded uncertainty1) of certified reference materials (SRM): lobster hepatopancreas (TORT-3; National Research Council Canada, NRC), and fish protein (DORM-4; NRC) with results obtained by ALS Environmental in Winnipeg in conjunction with fish muscle analyses for Gull Lake in 2016.**

| Statistic | TORT-3 | DORM-4 | Replicates |
|---|---|---|---|
| | (0.292 ± 0.022) [2] | (0.41 ± 0.055) [3] | (% difference) |
| Mean | 0.238 | 0.309 | 4.7 |
| Range | 0.224–0.260 | 0.296–0.324 | 1.5–11.5 |
| n [5] | 4 | 4 | 4 |
| RPMD (%) | 20.6 | 28.1 | n/a |

RPMD represents the relative percentage difference between the sample mean and the SRM mean. Replicates refers to the relative percentage difference between first and second sample of replicate analyses of muscle sample digests.

1. Expanded uncertainty is the sum of a 95% confidence limit and an allowance for systematic error between analytical methods and/or sample variation (*i.e.*, batches, bottles).
2. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/tort_3.html; last accessed 29 March, 2017.
3. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/dorm_4.html; last accessed 29 March, 2017; as of February 2015, the concentration is listed as 0.412 ± 0.036 ppm; ALS is still using a batch certified to 0.41 ppm.
4. n represents the number of analyses.

**Table 2: Comparison of total mercury concentrations (ppm; mean ± expanded uncertainty[1]) of certified reference materials (SRM): lobster hepatopancreas (TORT-3; National Research Council Canada, NRC), and fish protein (DORM-4; NRC) with results obtained by ALS Environmental in Winnipeg in conjunction with fish muscle analyses for Stephens Lake in 2016.**

| Statistic | TORT-3 | DORM-4 | Replicates |
|---|---|---|---|
| | (0.292 ± 0.022) [2] | (0.41 ± 0.055) [3] | (% difference) |
| Mean | 0.257 | 0.325 | 5.8 |
| Range | 0.246–0.270 | 0.309–0.331 | 0.8–15.0 |
| n [5] | 5 | 5 | 5 |
| RPMD (%) | 12.7 | 20.6 | n/a |

RPMD represents the relative percentage difference between the sample mean and the SRM mean; Replicates refers to the relative percentage difference between first and second sample of replicate analyses of muscle sample digests.

1. Expanded uncertainty is the sum of a 95% confidence limit and an allowance for systematic error between analytical methods and/or sample variation (*i.e.*, batches, bottles).
2. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/tort_3.html; last accessed 29 March, 2017.
3. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/dorm_4.html; last accessed 29 March, 2017; as of February 2015, the concentration is listed as 0.412 ± 0.036 ppm; ALS is still using a batch certified to 0.41 ppm.
4. n represents the number of analyses

**Table 3: Comparison of total mercury concentrations (ppm; mean ± expanded uncertainty[1]) of certified reference materials (SRM): lobster hepatopancreas (TORT-3; National Research Council Canada, NRC), and fish protein (DORM-4; NRC) with results obtained by ALS Environmental in Winnipeg in conjunction with fish muscle analyses for Split Lake in 2016.**

| Statistic | TORT-3 | DORM-4 | Replicates |
|---|---|---|---|
| | (0.292 ± 0.022) [2] | (0.41 ± 0.055) [3] | (% difference) |
| Mean | 0.240 | 0.305 | 8.3 |
| Range | 0.225–0.255 | 0.292–0.323 | 1.8–11.7 |
| n [5] | 5 | 4 | 4 |
| RPMD (%) | 19.8 | 29.4 | n/a |

RPMD represents the relative percentage difference between the sample mean and the SRM mean; Replicates refers to the relative percentage difference between first and second sample of replicate analyses of muscle sample digests.

1. Expanded uncertainty is the sum of a 95% confidence limit and an allowance for systematic error between analytical methods and/or sample variation (*i.e.*, batches, bottles).
2. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/tort_3.html; last accessed 29 March, 2017.
3. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/dorm_4.html; last accessed 29 March, 2017; as of February 2015, the concentration is listed as 0.412 ± 0.036 ppm; ALS is still using a batch certified to 0.41 ppm.
4. n represents the number of analyses.

**Table 4: Comparison of total mercury concentrations (ppm; mean ± expanded uncertainty[1]) of certified reference materials (SRM): lobster hepatopancreas (TORT-3; National Research Council Canada, NRC), and fish protein (DORM-4; NRC) with results obtained by ALS Environmental in Winnipeg in conjunction with fish muscle analyses for Assean Lake in 2016.**

| Statistic | TORT-3 | DORM-4 | Replicates |
|---|---|---|---|
| | (0.292 ± 0.022) [2] | (0.41 ± 0.055) [3] | (% difference) |
| Mean | 0.245 | 0.324 | 7.6 |
| Range | 0.227–0.259 | 0.315–0.338 | 1.1–13.5 |
| n [5] | 6 | 6 | 5 |
| RPMD (%) | 17.7 | 23.4 | n/a |

RPMD represents the relative percentage difference between the sample mean and the SRM mean; Replicates refers to the relative percentage difference between first and second sample of replicate analyses of muscle sample digests.

1. Expanded uncertainty is the sum of a 95% confidence limit and an allowance for systematic error between analytical methods and/or sample variation (*i.e.*, batches, bottles).
2. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/tort_3.html; last accessed 29 March, 2017.
3. See http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/crm/certificates/dorm_4.html; last accessed 29 March, 2017; as of February 2015, the concentration is listed as 0.412 ± 0.036 ppm; ALS is still using a batch certified to 0.41 ppm.
4. represents the number of analyses.

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**Table 5: Mean (± SE) fork length, round weight, condition factor (K), and age of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch sampled for mercury analysis from Gull Lake in 2016.**

| Species | Length (mm) | n | Weight (g) | n | K | n | Age (years) | n |
|---|---|---|---|---|---|---|---|---|
| Lake Whitefish | 499.6 ± 9.0 | 19 | 2372.1 ± 132.8 | 19 | 1.87 ± 0.03 | 19 | 10.6 ± 0.9 | 19 |
| Northern Pike | 554.4 ± 33.7 | 36 | 1728.6 ± 298.3 | 36 | 0.69 ± 0.02 | 36 | 5.5 ± 0.5 | 36 |
| Walleye | 394.3 ± 17.7 | 36 | 862.1 ± 115.9 | 35 | 1.12 ± 0.02 | 35 | 9.1 ± 1.5 | 36 |
| Yellow Perch | 58.2 ± 0.7 | 11 | 2.47 ± 0.1 | 11 | 1.25 ± 0.03 | 11 | - | - |

**Table 6: Mean (± SE) fork length, round weight, condition factor (K), and age of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch sampled for mercury analysis from Stephens Lake in 2015.**

| Species | Length (mm) | n | Weight (g) | n | K | n | Age (years) | n |
|---|---|---|---|---|---|---|---|---|
| Lake Whitefish | 302.3 ± 63.6 | 11 | 1137.7 ± 378.6 | 11 | 1.46 ± 0.14 | 11 | 7.2 ± 2.7 | 11 |
| Northern Pike | 531.8 ± 27.1 | 36 | 1423.6 ± 223.2 | 36 | 0.70 ± 0.02 | 36 | 5.9 ± 0.4 | 34 |
| Walleye | 416.4 ± 17.9 | 36 | 960.8 ± 96.8 | 36 | 1.13 ± 0.01 | 36 | 12.0 ± 1.2 | 36 |
| Yellow Perch | 89.2 ± 6.6 | 5 | 10.3 ± 2.2 | 5 | 1.40 ± 0.06 | 5 | 2.0 ± 0.0 | 4 |

**Table 7: Mean (± SE) fork length, round weight, condition factor (K), and age of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch sampled for mercury analysis from Split Lake in 2016**

| Species | Length (mm) | n | Weight (g) | n | K | n | Age (years) | n |
|---|---|---|---|---|---|---|---|---|
| Lake Whitefish | 428.9 ± 8.0 | 22 | 1409.1 ± 97.3 | 22 | 1.74 ± 0.03 | 19 | 8.6 ± 0.5 | 22 |
| Northern Pike | 503.8 ± 25.9 | 34 | 1119.7 ± 168.6 | 34 | 0.70 ± 0.01 | 34 | 4.7 ± 0.4 | 34 |
| Walleye | 342.6 ± 21.9 | 36 | 668.5 ± 153.6 | 36 | 1.14 ± 0.03 | 36 | 5.7 ± 0.8 | 36 |
| Yellow Perch | 73 | 1 | 4.8 | 1 | 1.29 | 1 | - | - |

**Table 8: Mean (± SE) fork length, round weight, condition factor (K), and age of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch sampled for mercury analysis from Assean Lake in 2016.**

| Species | Length (mm) | n | Weight (g) | n | K | n | Age (years) | n |
|---|---|---|---|---|---|---|---|---|
| Lake Whitefish | 402.8 ± 40.7 | 12 | 1561.7 ± 287.4 | 12 | 1.68 ± 0.09 | 12 | 8.7 ± 1.8 | 12 |
| Northern Pike | 508.3 ± 27.1 | 34 | 1074.4 ± 182.4 | 34 | 0.64 ± 0.02 | 34 | 4.6 ± 0.3 | 34 |
| Walleye | 317.9 ± 14.1 | 37 | 403.6 ± 54.2 | 37 | 1.02 ± 0.02 | 37 | 6.2 ± 0.5 | 37 |
| Yellow Perch | 84.3 ± 0.9 | 25 | 7.5 ± 0.3 | 25 | 1.23 ± 0.02 | 25 | - | - |

**Table 9: Mean arithmetic (± SE) and standardized (95% confidence limits, CL) mercury concentration (ppm) of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch from Gull Lake in 2016.**

| Species | n | Arithmetic | SE | Standard | 95% CL |
|---|---|---|---|---|---|
| Lake Whitefish | 19 | 0.182 | 0.020 | 0.035 | 0.014–0.086 |
| Northern Pike | 36 | 0.378 | 0.041 | 0.342 | 0.313–0.373 |
| Walleye | 36 | 0.367 | 0.057 | 0.301 | 0.255–0.357 |
| Yellow Perch | 11 | 0.039 | 0.006 | -* | - |

* The relationship between mercury concentration and fish length was not significant

**Table 10: Mean arithmetic (± SE) and standardized (95% confidence limits, CL) mercury concentration (ppm) of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch from Stephens Lake in 2015.**

| Species | n | Arithmetic | SE | Standard | 95% CL |
|---|---|---|---|---|---|
| Lake Whitefish | 11 | 0.110 | 0.037 | 0.107 | 0.014–0.086 |
| Northern Pike | 36 | 0.372 | 0.052 | 0.333 | 0.284–0.390 |
| Walleye | 36 | 0.592 | 0.051 | 0.499 | 0.427–0.582 |
| Yellow Perch | 5 | 0.018 | 0.001 | -* | - |

* The relationship between mercury concentration and fish length was not significant

**Table 11: Mean arithmetic (± SE) and standardized (95% confidence limits, CL) mercury concentration (ppm) of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch from Split Lake in 2016.**

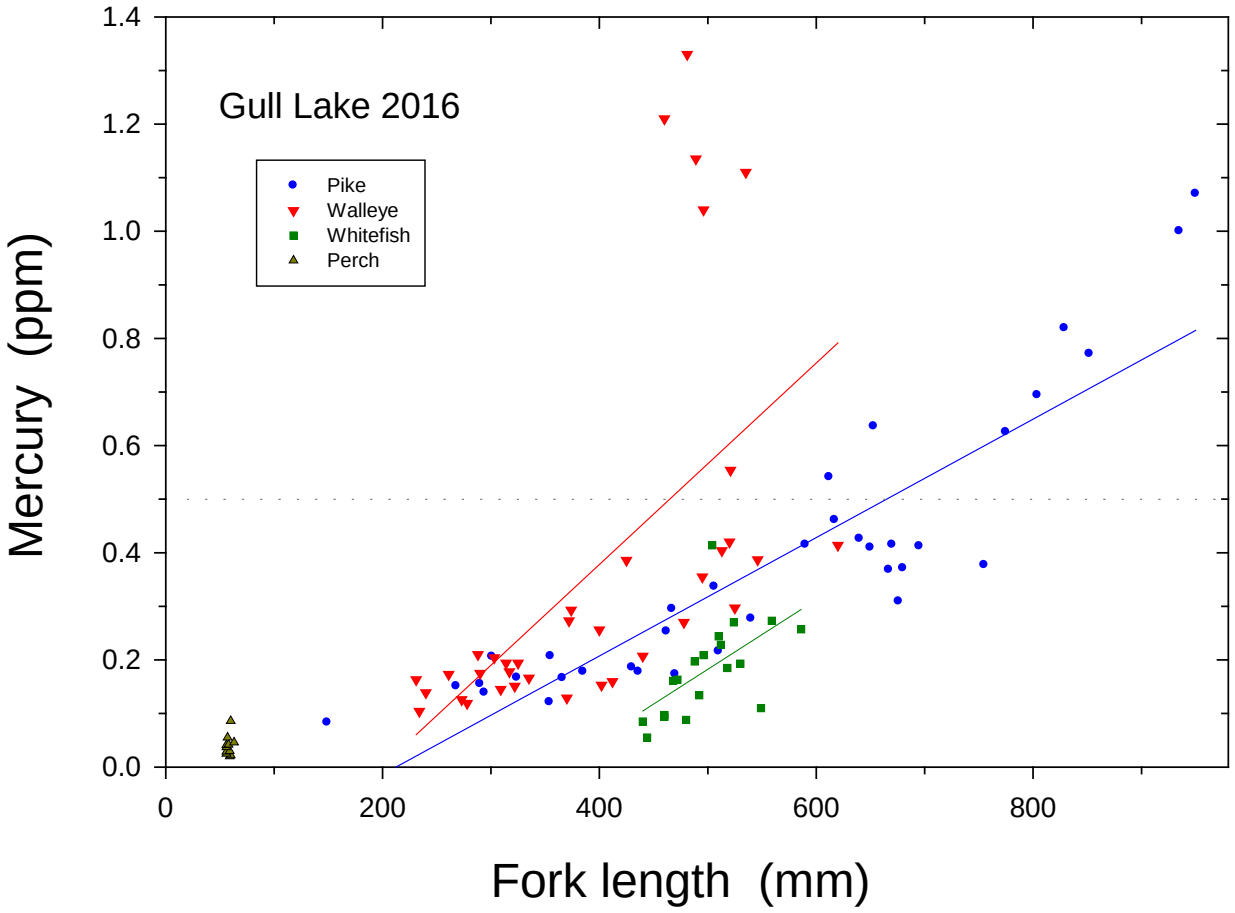
| Species | n | Arithmetic | SE | Standard | 95% CL |
|---|---|---|---|---|---|
| Lake Whitefish | 22 | 0.072 | 0.005 | 0.037 | 0.030–0.047 |
| Northern Pike | 34 | 0.262 | 0.029 | 0.278 | 0.250–0.308 |
| Walleye | 36 | 0.238 | 0.033 | 0.262 | 0.231–0.298 |
| Yellow Perch | 1 | 0.008 | - | - | - |

**Table 12: Mean arithmetic (± SE) and standardized (95% confidence limits, CL) mercury concentration (ppm) of Lake Whitefish, Northern Pike, Walleye, and Yellow Perch from Assean Lake in 2016.**

| Species | n | Arithmetic | SE | Standard | 95% CL |
|---|---|---|---|---|---|
| Lake Whitefish | 12 | 0.049 | 0.007 | 0.039 | 0.030–0.051 |
| Northern Pike | 34 | 0.217 | 0.034 | 0.207 | 0.175–0.245 |
| Walleye | 37 | 0.196 | 0.019 | 0.257 | 0.228–0.289 |
| Yellow Perch | 25 | 0.032 | 0.002 | -* | - |

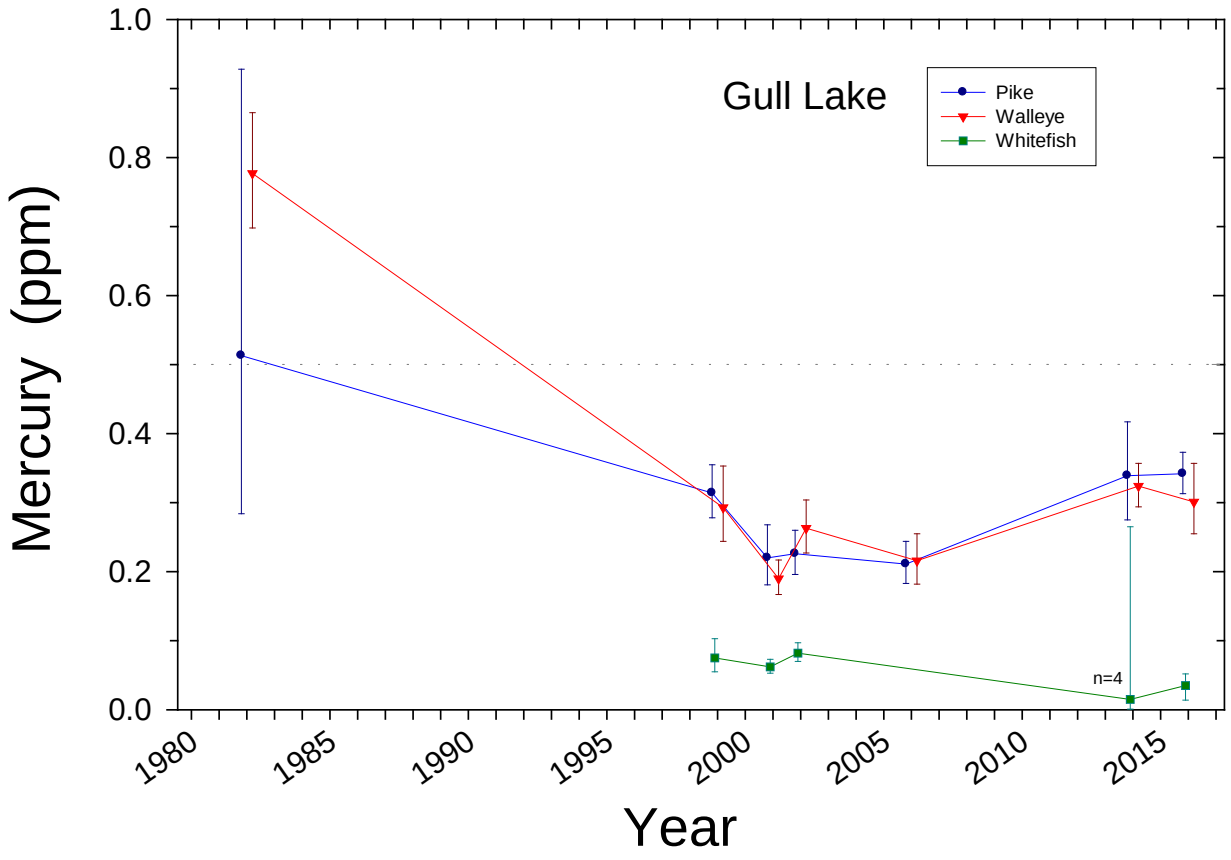
* The relationship between mercury concentration and fish length was not significant

# FIGURES



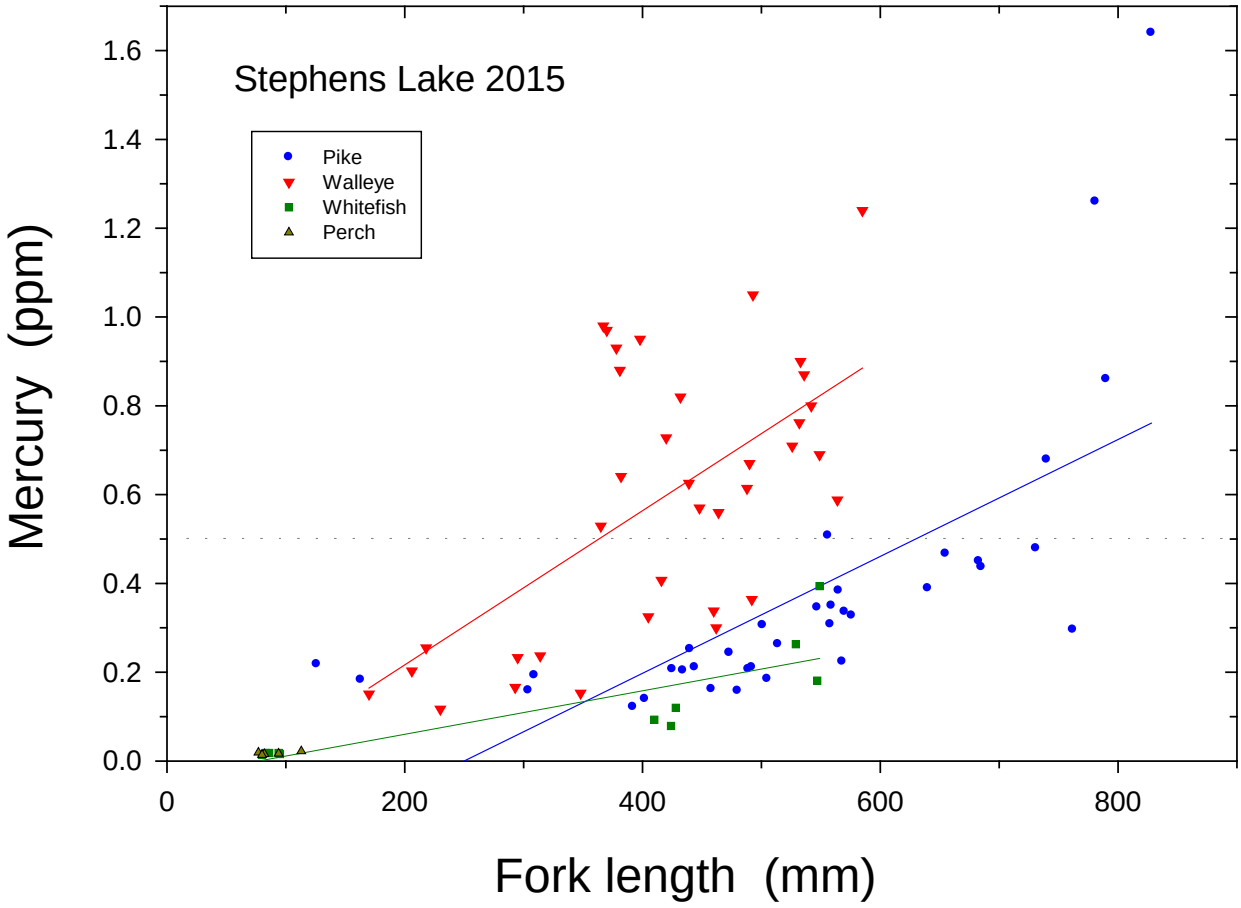

Significant linear regression lines are shown; the stippled line indicates the 0.5 ppm Health Canada standard.

**Figure 1: Relationship between mercury concentration and fish length for Northern Pike Walleye, Lake Whitefish, and Yellow Perch captured from Gull Lake in September 2016.**



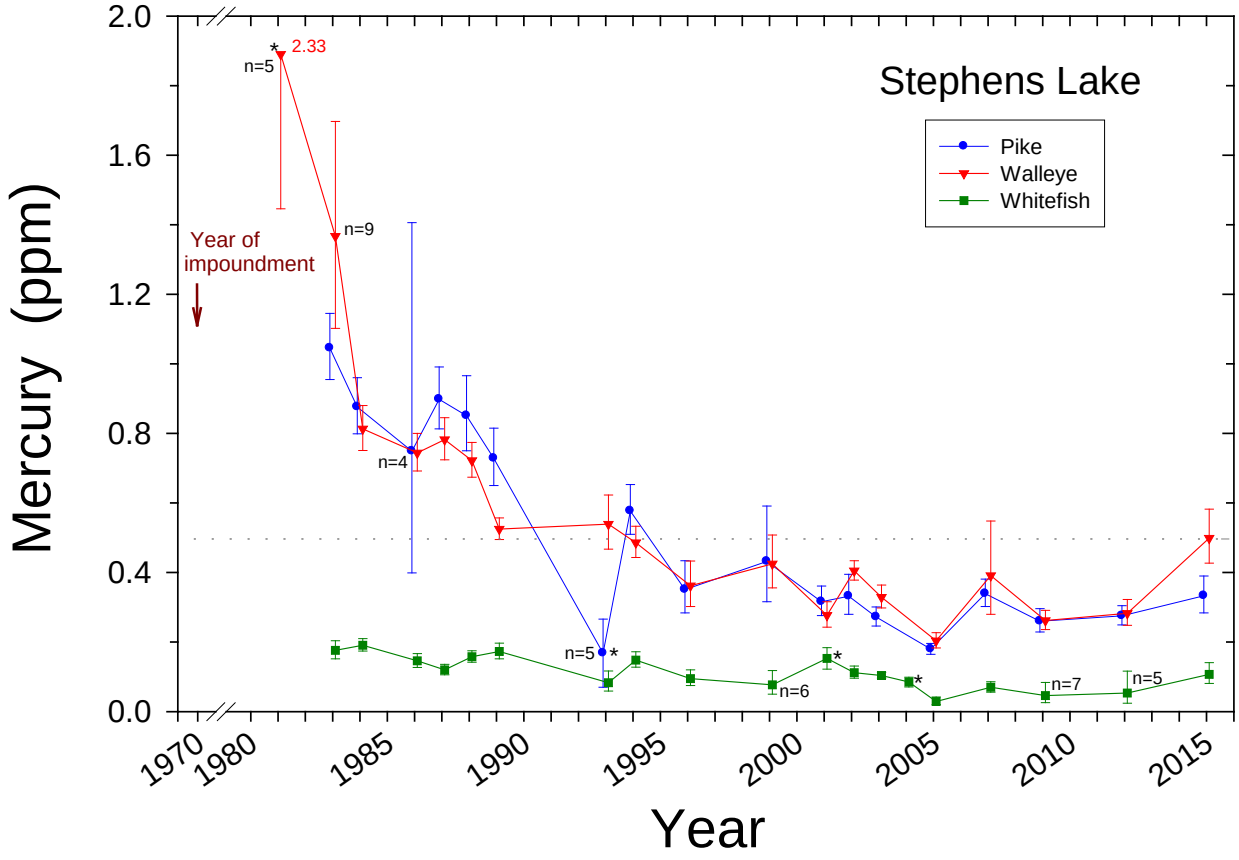

The relationship between fish length and mercury concentration was marginally significant (p = 0.059) for whitefish in 2014; the arithmetic mean was 0.225 ppm; sample sizes (n) of less than ten fish are indicated. The stippled line indicates the 0.5 ppm Health Canada standard.

**Figure 2: Mean (95% confidence limits, CL) length standardized muscle mercury concentrations of Northern Pike, Walleye, and Lake Whitefish from Gull Lake for years 1982–2016.**



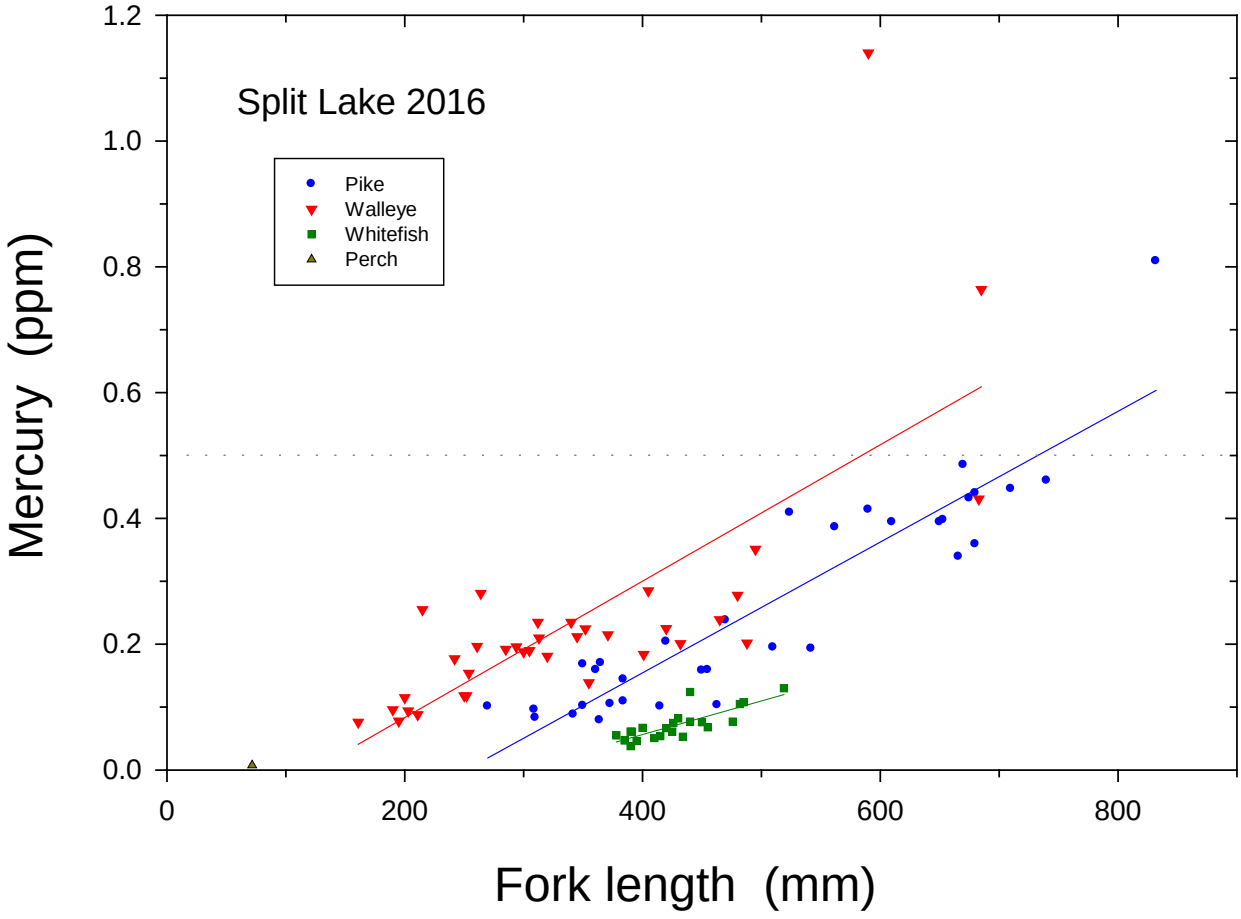

Significant linear regression lines are shown; the stippled line indicates the 0.5 ppm Health Canada standard.

**Figure 3: Relationship between mercury concentration and fish length for Northern Pike Walleye, Lake Whitefish, and Yellow Perch captured from Stephens Lake in September 2015.**



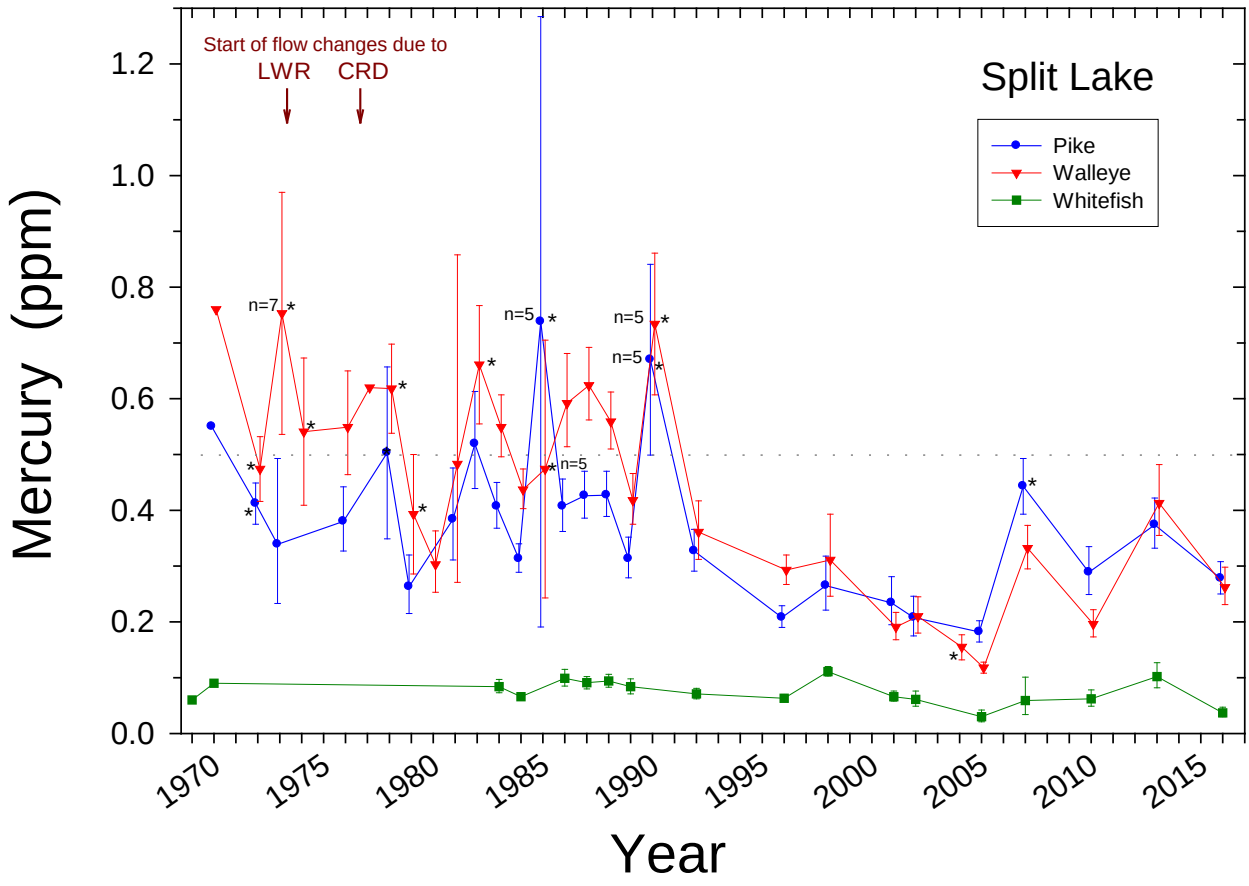

* the relationship between fish length and mercury concentration was not significant and the arithmetic mean was used; sample sizes (n) of less than ten fish are indicated; the upper CL for Walleye in 1981 is shown as a number. The stippled line indicates the 0.5 ppm Health Canada standard.

**Figure 4: Mean (95% confidence limits, CL) length standardized muscle mercury concentrations of Northern Pike, Walleye, and Lake Whitefish from Stephens Lake for years 1981–2015.**



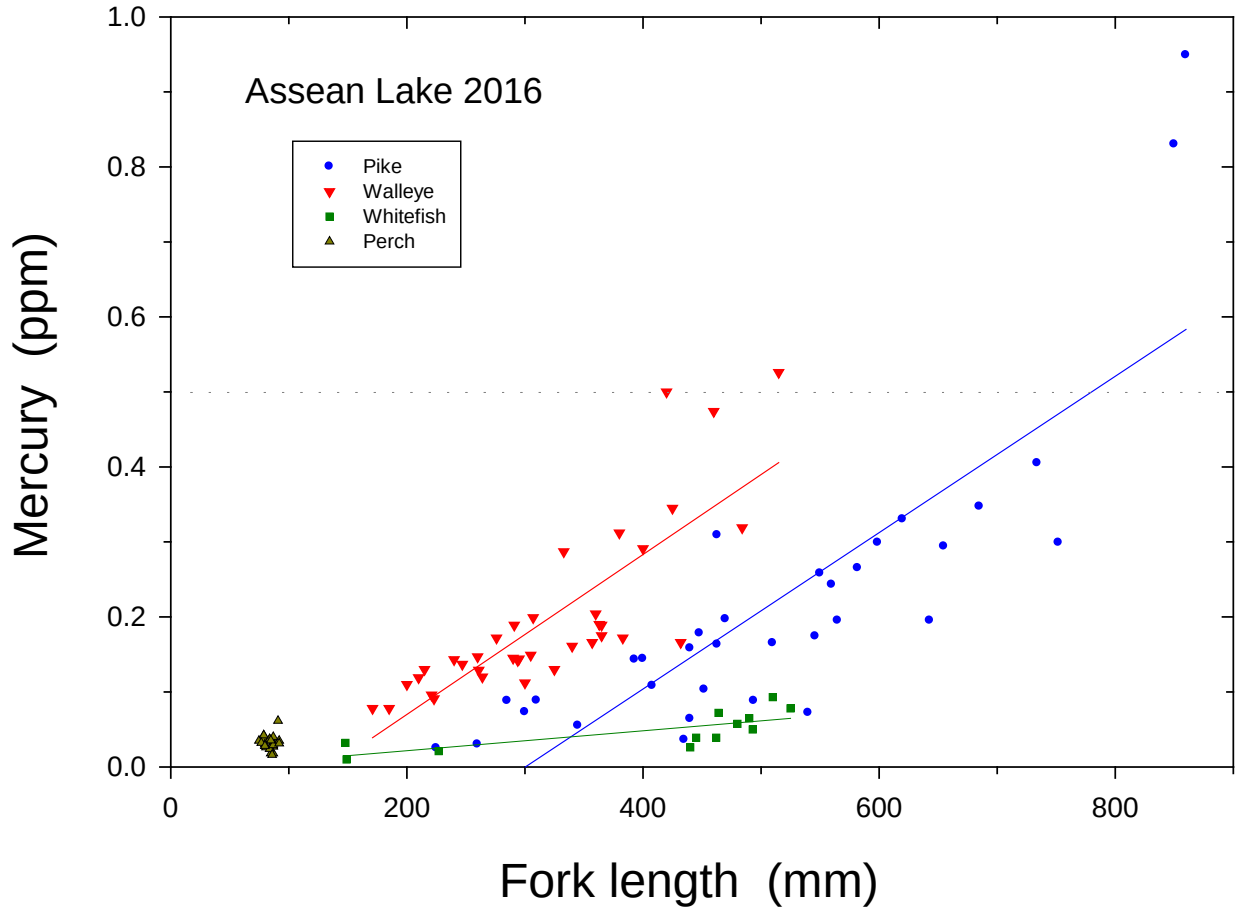

Significant linear regression lines are shown; the stippled line indicates the 0.5 ppm Health Canada standard

**Figure 5: Relationship between mercury concentration and fish length for Northern Pike Walleye, Lake Whitefish, and Yellow Perch captured from Split Lake in August 2016.**



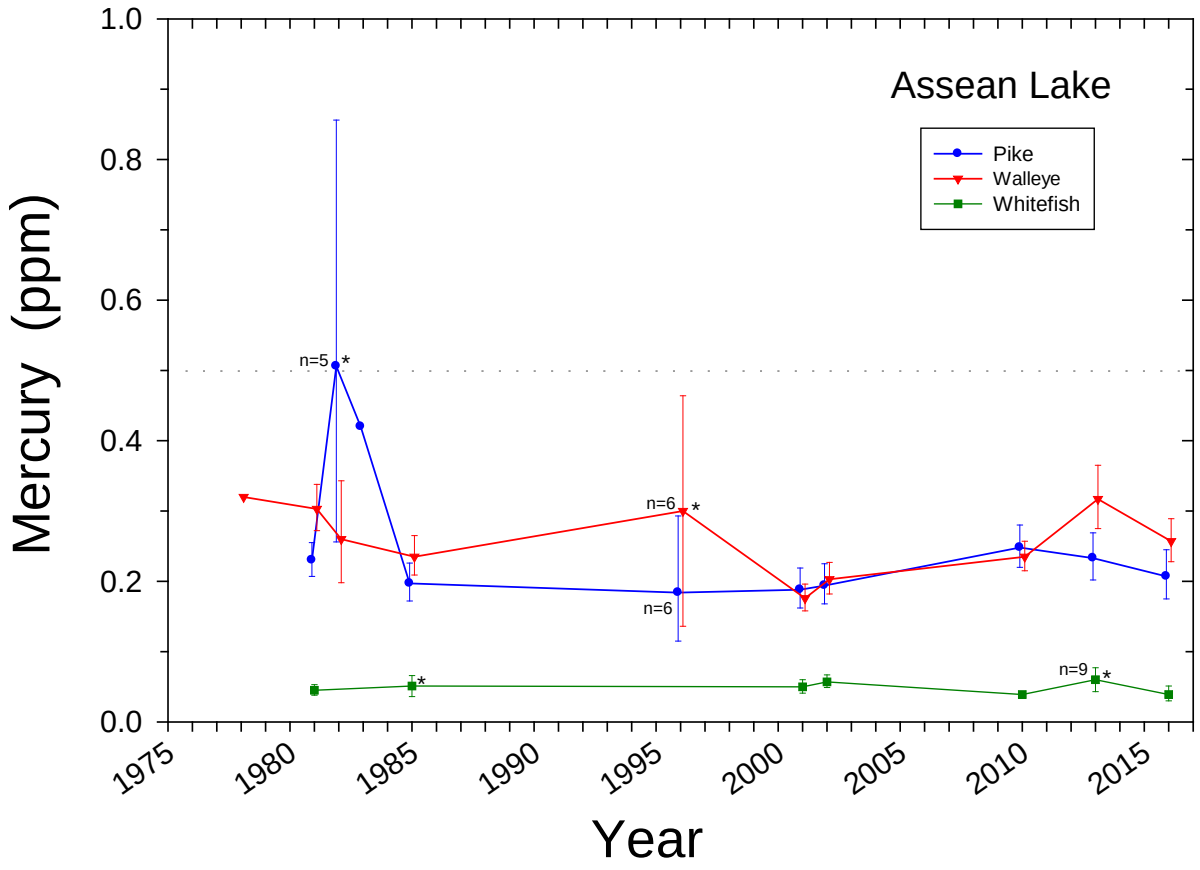

* the relationship between fish length and mercury concentration was not significant and the arithmetic mean was used; sample sizes (n) of less than ten fish are indicated. The stippled line indicates the 0.5 ppm Health Canada standard.

**Figure 6: Mean (95% confidence limits, CL) length standardized muscle mercury concentrations of Northern Pike, Walleye, and Lake Whitefish from Split Lake for years 1969–2016; results for 1969 and 1970 are for 1–6 commercial composite samples.**




Significant linear regression lines are shown; the stippled line indicates the 0.5 ppm Health Canada standard.

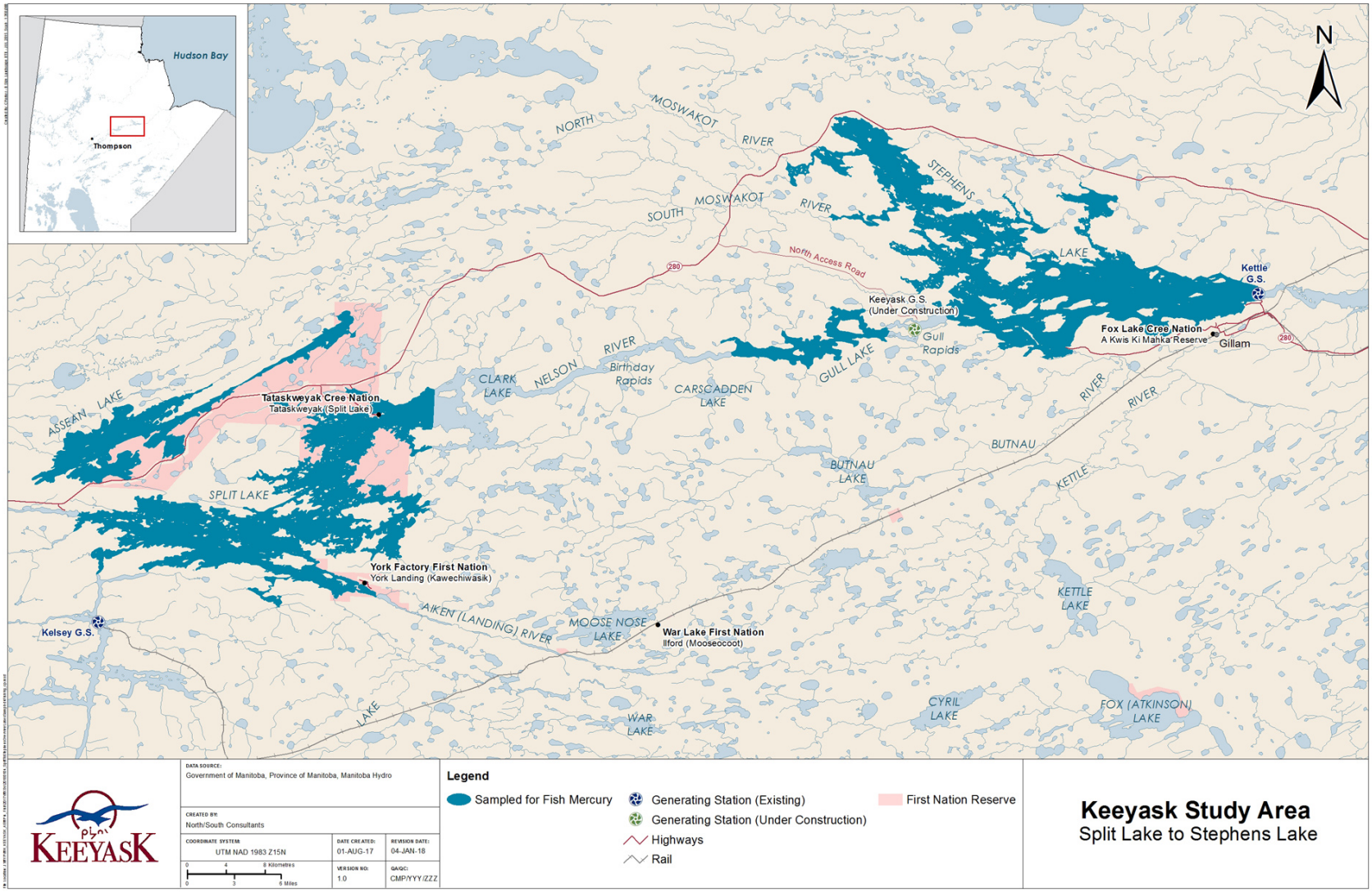
**Figure 7: Relationship between mercury concentration and fish length for Northern Pike Walleye, Lake Whitefish, and Yellow Perch captured from Assean Lake in August 2016.**



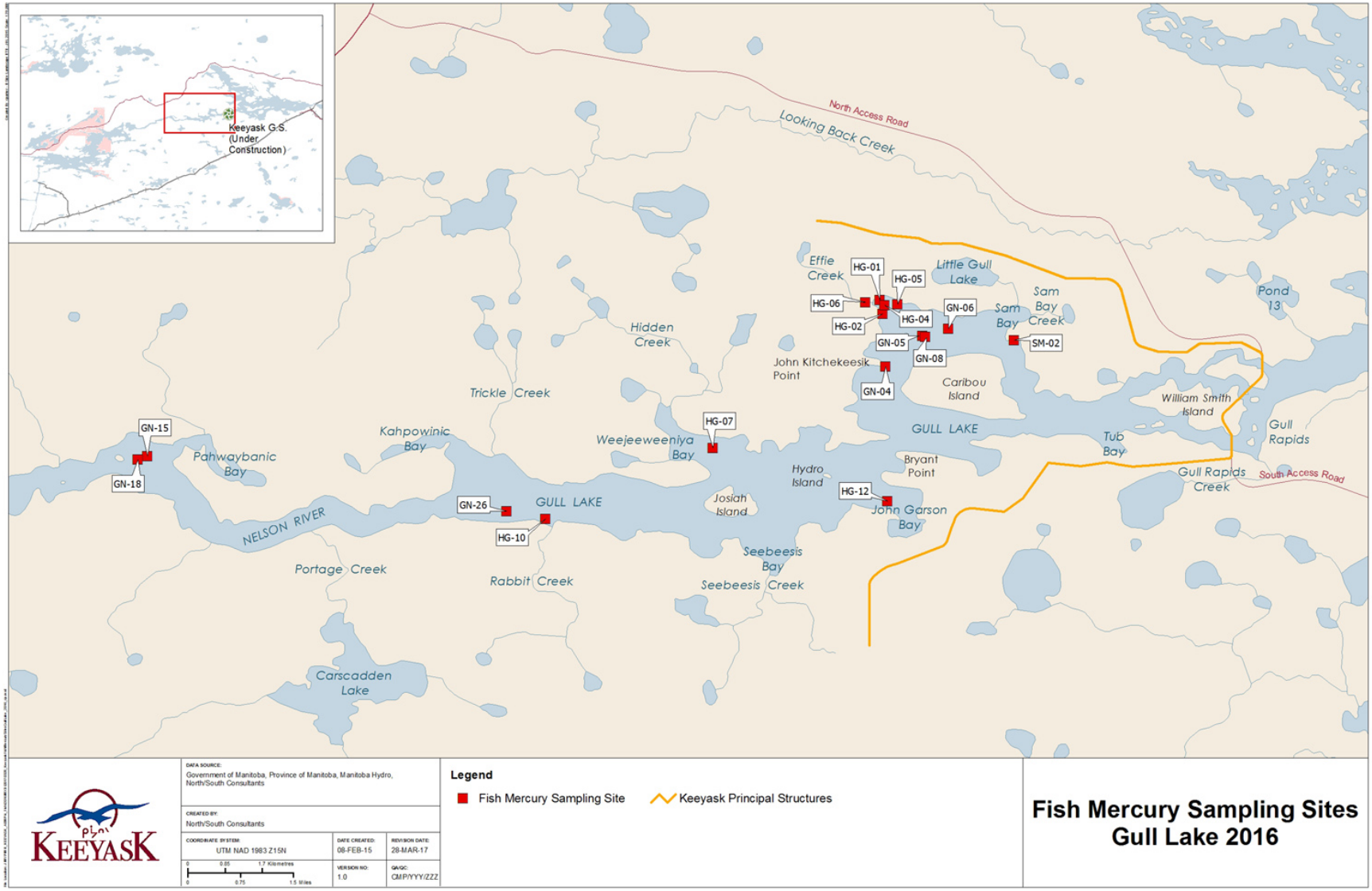

* the relationship between fish length and mercury concentration was not significant and the arithmetic mean was used; sample sizes (n) of less than ten fish are indicated. The stippled line indicates the 0.5 ppm Health Canada standard.

**Figure 8: Mean (95% confidence limits, CL) length standardized muscle mercury concentrations of Northern Pike, Walleye, and Lake Whitefish from Assean Lake for years 1981–2015.**

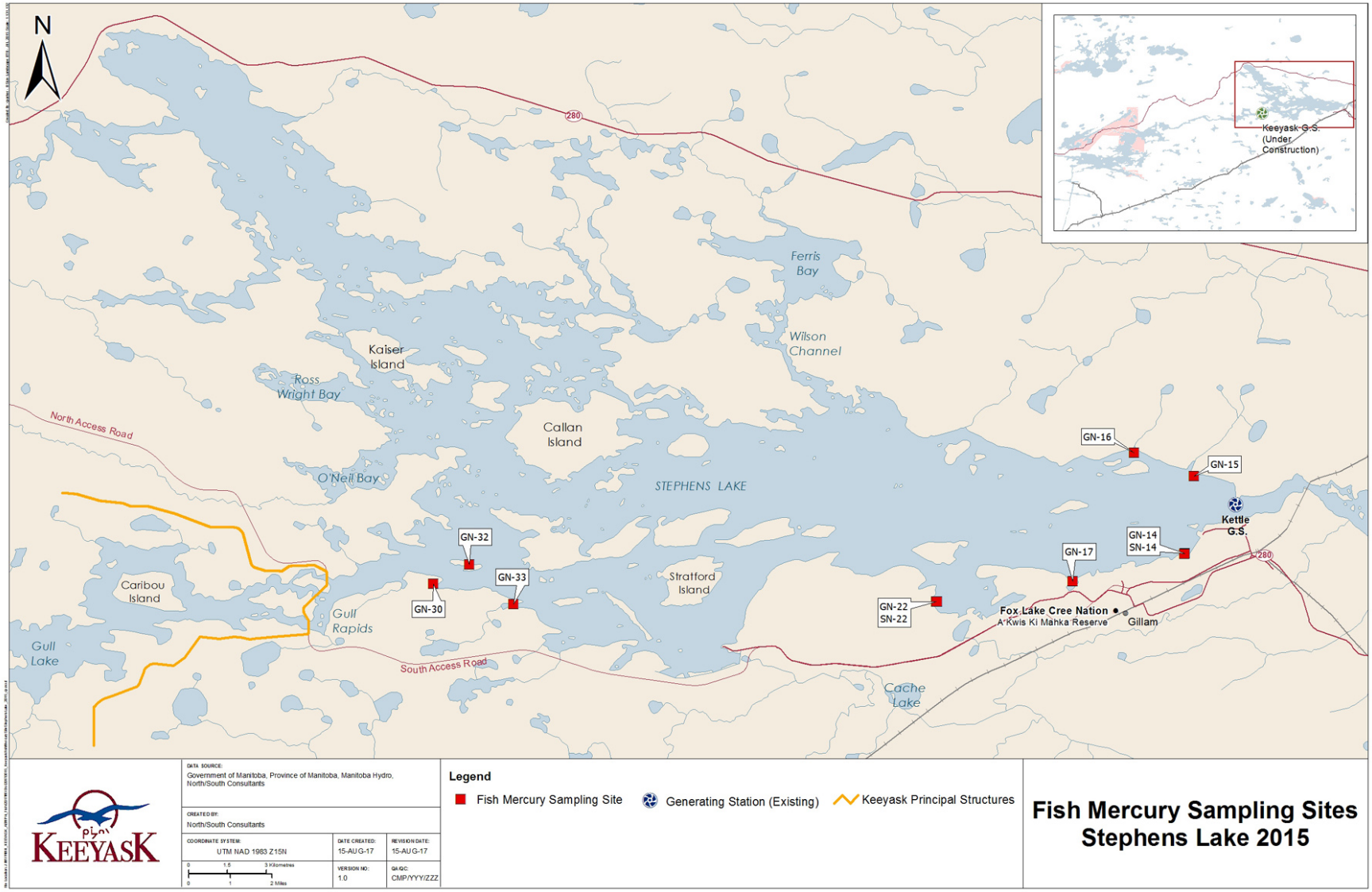
# MAPS



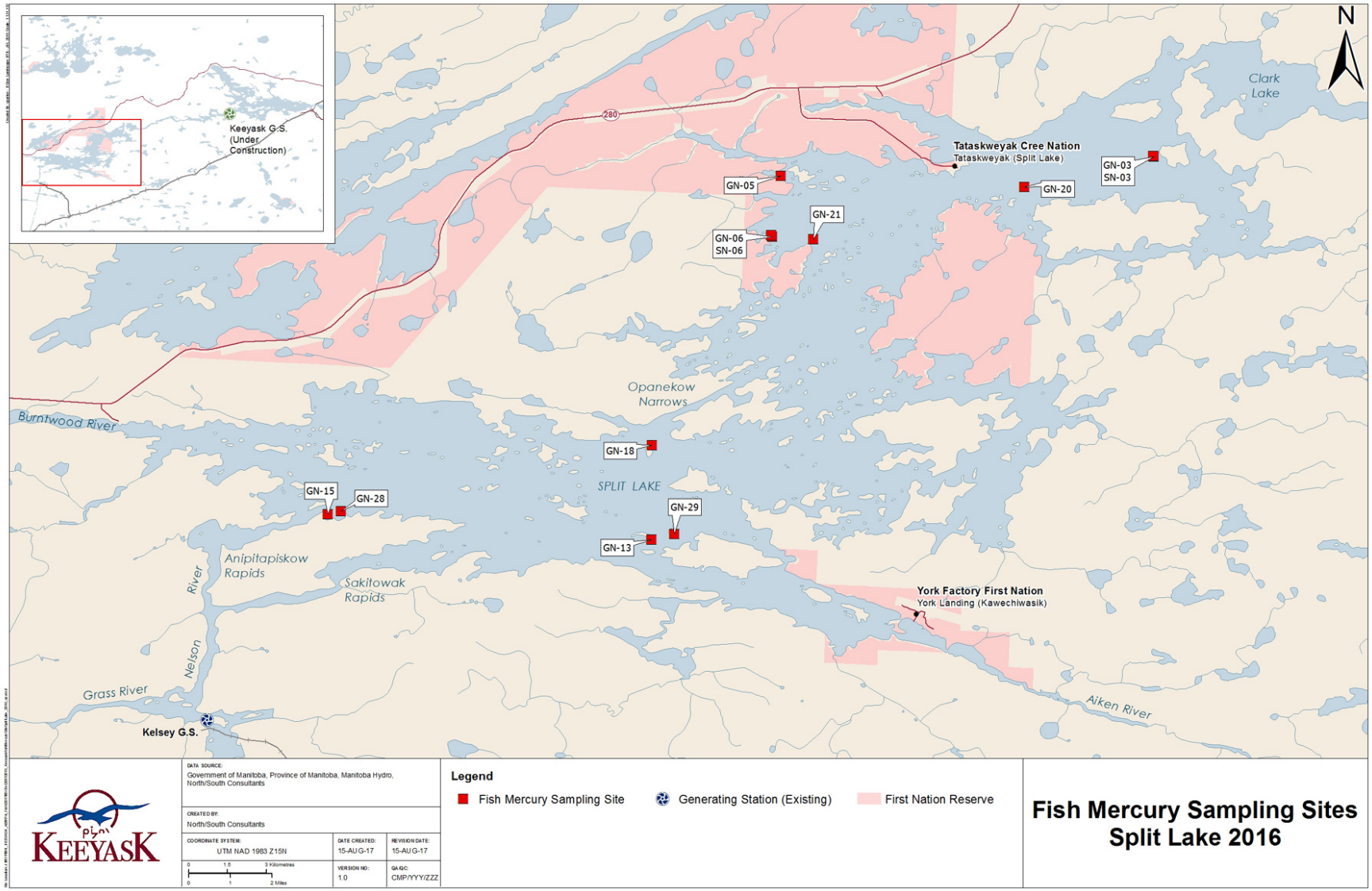

**Map 1:** **Map of the Keeyask study area showing hydroelectric development and waterbodies sampled for fish mercury in 2015/2016.**



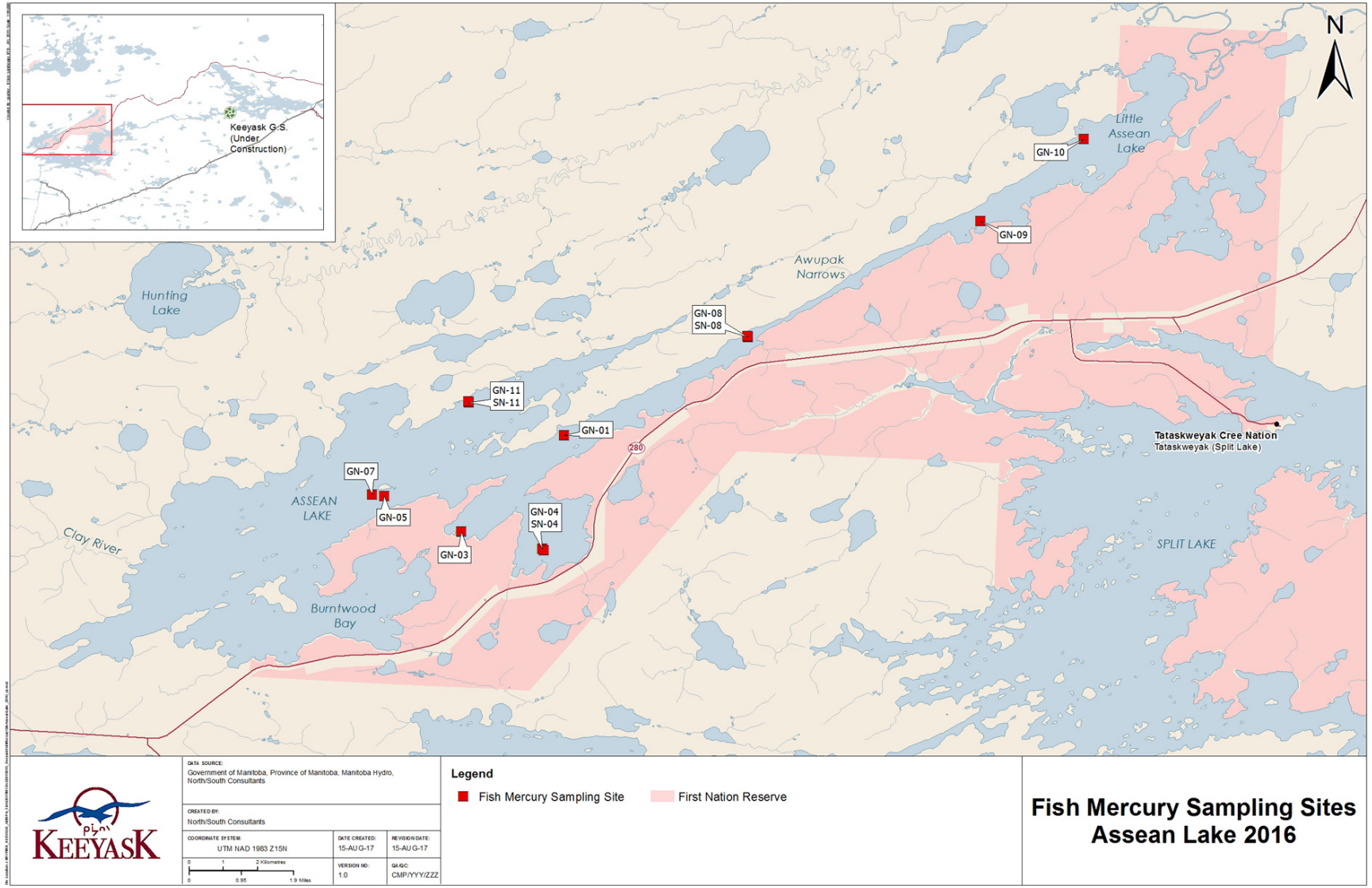

**Map 2: Map of Gull Lake showing sampling sites for fish mercury in 2016.**




**Map 3: Map of Stephens Lake showing sampling sites for fish mercury in 2015.**




**Map 4: Map of Split Lake showing sampling sites for fish mercury in 2016.**




**Map 5: Map of Assean Lake showing sampling sites for fish mercury in 2016.**

# APPENDICES

# APPENDIX 1: MUSCLE MERCURY CONCENTRATIONS AND BIOLOGICAL DATA FOR FISH FROM GULL LAKE IN 2016

**Table A1-1: Definitions of codes used in Appendix tables.**

| Term | Code | Definition |
|---|---|---|
| Date | | Sampling date |
| Species | LKWF | Lake Whitefish |
| | NRPK | Northern Pike |
| | WALL | Walleye |
| | YLPR | Yellow Perch |
| Sex | F | Female |
| | M | Male |
| Maturity (Mat) | 0 | Immature |
| | 1 | Mature |
| Length | | Fork length |
| Weight | | Round weight |
| K | | Condition factor |

**Table A1-2: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Gull Lake in 2016.**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2016 | 17-Sep | HG-01 | LKWF | 549 | 3000 | 1.813 | - | - | 12 | 0.110 |
| 2 | 2016 | 18-Sep | HG-04 | LKWF | 559 | 3320 | 1.901 | - | - | 19 | 0.273 |
| 3 | 2016 | 22-Sep | HG-05 | LKWF | 472 | 1940 | 1.845 | - | - | 9 | 0.163 |
| 4 | 2016 | 23-Sep | HG-07 | LKWF | 492 | 2140 | 1.797 | - | - | 9 | 0.134 |
| 5 | 2016 | 23-Sep | HG-07 | LKWF | 488 | 2400 | 2.065 | - | - | 8 | 0.197 |
| 6 | 2016 | 23-Sep | HG-07 | LKWF | 460 | 1880 | 1.931 | - | - | 7 | 0.097 |
| 7 | 2016 | 24-Sep | HG-07 | LKWF | 586 | 3500 | 1.739 | - | - | 18 | 0.257 |
| 8 | 2016 | 24-Sep | HG-07 | LKWF | 504 | 2620 | 2.046 | - | - | 11 | 0.414 |
| 9 | 2016 | 24-Sep | HG-10 | LKWF | 480 | 1950 | 1.763 | - | - | 7 | 0.088 |
| 10 | 2016 | 24-Sep | HG-10 | LKWF | 512 | 2600 | 1.937 | - | - | 9 | 0.228 |
| 11 | 2016 | 24-Sep | HG-10 | LKWF | 518 | 2800 | 2.015 | - | - | 11 | 0.185 |
| 12 | 2016 | 24-Sep | HG-07 | LKWF | 496 | 2300 | 1.885 | - | - | 8 | 0.209 |
| 13 | 2016 | 24-Sep | HG-12 | LKWF | 460 | 1700 | 1.747 | - | - | 7 | 0.094 |
| 14 | 2016 | 24-Sep | HG-12 | LKWF | 510 | 2250 | 1.696 | - | - | 15 | 0.244 |
| 15 | 2016 | 24-Sep | HG-12 | LKWF | 524 | 3050 | 2.120 | - | - | 11 | 0.270 |
| 16 | 2016 | 24-Sep | HG-12 | LKWF | 444 | 1650 | 1.885 | - | - | 8 | 0.055 |
| 17 | 2016 | 21-Sep | HG-06 | LKWF | 440 | 1560 | 1.831 | - | - | 8 | 0.085 |
| 18 | 2016 | 21-Sep | HG-06 | LKWF | 530 | 2620 | 1.760 | - | - | 18 | 0.193 |
| 19 | 2016 | 23-Sep | SM-HG-02 | LKWF | 468 | 1790 | 1.746 | - | - | 6 | 0.161 |
| 101 | 2016 | 15-Sep | GN-08 | NRPK | 680 | 2280 | 0.725 | - | - | 6 | 0.371 |
| 102 | 2016 | 17-Sep | GN-15 | NRPK | 935 | 6540 | 0.800 | - | - | 10 | 1.000 |
| 103 | 2016 | 17-Sep | HG-01 | NRPK | 385 | 352 | 0.617 | - | - | 3 | 0.178 |
| 105 | 2016 | 18-Sep | GN-18 | NRPK | 640 | 2220 | 0.847 | - | - | 5 | 0.426 |
| 106 | 2016 | 18-Sep | GN-18 | NRPK | 695 | 2740 | 0.816 | - | - | 5 | 0.412 |
| 107 | 2016 | 18-Sep | HG-04 | NRPK | 775 | 3340 | 0.718 | - | - | 8 | 0.625 |

**Table A1-2: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Gull Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108 | 2016 | 18-Sep | HG-04 | NRPK | 470 | 660 | 0.636 | - | - | 4 | 0.173 |
| 109 | 2016 | 18-Sep | HG-04 | NRPK | 354 | 256 | 0.577 | - | - | 2 | 0.121 |
| 110 | 2016 | 18-Sep | HG-04 | NRPK | 290 | 148 | 0.607 | - | - | 2 | 0.155 |
| 111 | 2016 | 18-Sep | HG-04 | NRPK | 268 | 124 | 0.644 | - | - | 2 | 0.151 |
| 112 | 2016 | 16-Sep | HG-02 | NRPK | 301 | 160 | 0.587 | - | - | 2 | 0.206 |
| 113 | 2016 | 16-Sep | HG-02 | NRPK | 149 | 24 | 0.726 | - | - | 1 | 0.083 |
| 114 | 2016 | 16-Sep | HG-02 | NRPK | 612 | 1360 | 0.593 | - | - | 9 | 0.541 |
| 115 | 2016 | 16-Sep | HG-02 | NRPK | 653 | 1920 | 0.690 | - | - | 9 | 0.636 |
| 116 | 2016 | 16-Sep | HG-02 | NRPK | 462 | 640 | 0.649 | - | - | 4 | 0.253 |
| 117 | 2016 | 16-Sep | HG-02 | NRPK | 355 | 380 | 0.849 | - | - | 3 | 0.207 |
| 118 | 2016 | 16-Sep | HG-02 | NRPK | 667 | 2040 | 0.687 | - | - | 6 | 0.368 |
| 119 | 2016 | 16-Sep | HG-02 | NRPK | 324 | 260 | 0.764 | - | - | 2 | 0.167 |
| 120 | 2016 | 16-Sep | HG-02 | NRPK | 294 | 180 | 0.708 | - | - | 3 | 0.139 |
| 121 | 2016 | 16-Sep | HG-02 | NRPK | 366 | 340 | 0.693 | - | - | 3 | 0.166 |
| 123 | 2016 | 17-Sep | HG-04 | NRPK | 436 | 621 | 0.749 | - | - | 4 | 0.178 |
| 124 | 2016 | 17-Sep | HG-04 | NRPK | 590 | 1220 | 0.594 | - | - | 6 | 0.415 |
| 125 | 2016 | 17-Sep | HG-04 | NRPK | 467 | 666 | 0.654 | - | - | 4 | 0.295 |
| 126 | 2016 | 17-Sep | HG-04 | NRPK | 540 | 1120 | 0.711 | - | - | 6 | 0.277 |
| 127 | 2016 | 17-Sep | HG-04 | NRPK | 804 | 4180 | 0.804 | - | - | 8 | 0.694 |
| 129 | 2016 | 17-Sep | HG-04 | NRPK | 506 | 940 | 0.726 | - | - | 5 | 0.337 |
| 130 | 2016 | 17-Sep | HG-04 | NRPK | 755 | 2460 | 0.572 | - | - | 8 | 0.377 |
| 131 | 2016 | 17-Sep | HG-04 | NRPK | 676 | 2580 | 0.835 | - | - | 7 | 0.309 |
| 132 | 2016 | 18-Sep | HG-05 | NRPK | 650 | 1900 | 0.692 | - | - | 6 | 0.410 |
| 133 | 2016 | 18-Sep | HG-05 | NRPK | 430 | 480 | 0.604 | - | - | 4 | 0.186 |
| 134 | 2016 | 18-Sep | HG-05 | NRPK | 510 | 900 | 0.678 | - | - | 5 | 0.216 |
| 135 | 2016 | 18-Sep | HG-05 | NRPK | 829 | 4500 | 0.790 | - | - | 10 | 0.819 |

**Table A1-2: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Gull Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 136 | 2016 | 18-Sep | HG-05 | NRPK | 852 | 4660 | 0.753 | - | - | 9 | 0.771 |
| 137 | 2016 | 18-Sep | HG-05 | NRPK | 617 | 1240 | 0.528 | - | - | 6 | 0.461 |
| 138 | 2016 | 18-Sep | HG-05 | NRPK | 950 | 7180 | 0.837 | - | - | 14 | 1.070 |
| 140 | 2016 | 18-Sep | HG-05 | NRPK | 670 | 1620 | 0.539 | - | - | 7 | 0.415 |
| 201 | 2016 | 14-Sep | GN-04 | WALL | 478 | 1354 | 1.240 | - | - | 8 | 0.270 |
| 202 | 2016 | 14-Sep | GN-05 | WALL | 496 | 1660 | 1.360 | - | - | 27 | 1.040 |
| 203 | 2016 | 14-Sep | GN-06 | WALL | 278 | 236 | 1.098 | - | - | 4 | 0.119 |
| 204 | 2016 | 15-Sep | GN-08 | WALL | 374 | 709 | 1.355 | - | - | 5 | 0.293 |
| 205 | 2016 | 15-Sep | GN-08 | WALL | 309 | 356 | 1.207 | - | - | 3 | 0.145 |
| 207 | 2016 | 18-Sep | GN-18 | WALL | 425 | 740 | 0.964 | - | - | 7 | 0.386 |
| 208 | 2016 | 18-Sep | HG-04 | WALL | 535 | 1380 | 0.901 | - | - | 26 | 1.110 |
| 209 | 2016 | 18-Sep | HG-04 | WALL | 513 | 1700 | 1.259 | - | - | 9 | 0.404 |
| 210 | 2016 | 18-Sep | HG-04 | WALL | 240 | 126 | 0.911 | - | - | 2 | 0.139 |
| 211 | 2016 | 19-Sep | HG-04 | WALL | 520 | 1640 | 1.166 | - | - | 27 | 0.420 |
| 213 | 2016 | 19-Sep | HG-04 | WALL | 525 | 1640 | 1.133 | - | - | 8 | 0.297 |
| 214 | 2016 | 19-Sep | HG-04 | WALL | 495 | 1480 | 1.220 | - | - | 8 | 0.355 |
| 215 | 2016 | 19-Sep | HG-04 | WALL | 234 | 114 | 0.890 | - | - | 2 | 0.104 |
| 216 | 2016 | 19-Sep | GN-26 | WALL | 489 | 1480 | 1.266 | - | - | 26 | 1.14 |
| 217 | 2016 | 19-Sep | GN-26 | WALL | 481 | 1400 | 1.258 | - | - | 30 | 1.330 |
| 218 | 2016 | 19-Sep | GN-26 | WALL | 460 | 1260 | 1.294 | - | - | 29 | 1.210 |
| 220 | 2016 | 21-Sep | HG-04 | WALL | 322 | 379 | 1.135 | - | - | 3 | 0.151 |
| 221 | 2016 | 21-Sep | HG-04 | WALL | 317 | 326 | 1.023 | - | - | 3 | 0.178 |
| 222 | 2016 | 21-Sep | HG-04 | WALL | 372 | 481 | 0.934 | - | - | 6 | 0.273 |
| 223 | 2016 | 21-Sep | HG-04 | WALL | 440 | 980 | 1.150 | - | - | 6 | 0.207 |
| 225 | 2016 | 21-Sep | HG-04 | WALL | 231 | 126 | 1.022 | - | - | 2 | 0.163 |
| 226 | 2016 | 17-Sep | HG-04 | WALL | 620 | 2860 | 1.200 | - | - | 15 | 0.414 |
| 227 | 2016 | 17-Sep | HG-04 | WALL | 290 | 320 | 1.312 | - | - | 3 | 0.175 |

**Table A1-2: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Gull Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 229 | 2016 | 17-Sep | HG-04 | WALL | 288 | 257 | 1.076 | - | - | 3 | 0.210 |
| 230 | 2016 | 18-Sep | HG-04 | WALL | 521 | 1630 | 1.153 | - | - | 9 | 0.554 |
| 231 | 2016 | 18-Sep | HG-04 | WALL | 314 | 340 | 1.098 | - | - | 4 | 0.194 |
| 232 | 2016 | 18-Sep | HG-04 | WALL | 335 | 400 | 1.064 | - | - | 4 | 0.166 |
| 234 | 2016 | 19-Sep | HG-05 | WALL | 402 | 620 | 0.954 | - | - | 7 | 0.153 |
| 235 | 2016 | 19-Sep | HG-05 | WALL | 303 | 290 | 1.042 | - | - | 3 | 0.204 |
| 236 | 2016 | 19-Sep | HG-05 | WALL | 400 | 640 | 1.000 | - | - | 6 | 0.256 |
| 237 | 2016 | 19-Sep | HG-05 | WALL | 546 | 1990 | 1.223 | - | - | 11 | 0.387 |
| 238 | 2016 | 21-Sep | HG-05 | WALL | 325 | 360 | 1.049 | - | - | 4 | 0.194 |
| 239 | 2016 | 21-Sep | HG-05 | WALL | 412 | - | - | - | - | 6 | 0.160 |
| 240 | 2016 | 21-Sep | HG-05 | WALL | 370 | 500 | 0.987 | - | - | 4 | 0.129 |
| 241 | 2016 | 21-Sep | HG-05 | WALL | 261 | 180 | 1.012 | - | - | 3 | 0.173 |
| 242 | 2016 | 21-Sep | HG-05 | WALL | 273 | 220 | 1.081 | - | - | 3 | 0.126 |
| 1001 | 2016 | 24-Sep | SM-HG-02 | YLPR | 60 | 2.8 | 1.297 | - | - | - | 0.022 |
| 1002 | 2016 | 24-Sep | SM-HG-02 | YLPR | 56 | 2.2 | 1.243 | - | - | - | 0.041 |
| 1003 | 2016 | 24-Sep | SM-HG-02 | YLPR | 60 | 2.7 | 1.235 | - | - | - | 0.086 |
| 1004 | 2016 | 24-Sep | SM-HG-02 | YLPR | 57 | 2.2 | 1.207 | - | - | - | 0.055 |
| 1005 | 2016 | 24-Sep | SM-HG-02 | YLPR | 56 | 2.4 | 1.378 | - | - | - | 0.037 |
| 1006 | 2016 | 24-Sep | SM-HG-02 | YLPR | 56 | 1.9 | 1.103 | - | - | - | 0.029 |
| 1007 | 2016 | 24-Sep | SM-HG-02 | YLPR | 59 | 2.7 | 1.294 | - | - | - | 0.030 |
| 1010 | 2016 | 16-Sep | HG-02 | YLPR | 113 | 22 | 1.525 | - | - | 4 | 0.044 |
| 1011 | 2016 | 23-Sep | SM-HG-02 | YLPR | 58 | 2.21 | 1.133 | - | - | - | 0.042 |
| 1012 | 2016 | 23-Sep | SM-HG-02 | YLPR | 63 | 2.94 | 1.176 | - | - | - | 0.046 |
| 1013 | 2016 | 23-Sep | SM-HG-02 | YLPR | 59 | 2.82 | 1.373 | - | - | - | 0.020 |
| 1014 | 2016 | 23-Sep | SM-HG-02 | YLPR | 56 | 2.29 | 1.304 | - | - | - | 0.025 |
| 1015 | 2016 | 24-Sep | HG-07 | YLPR | 176 | 89 | 1.632 | - | - | 5 | 0.105 |
| 1016 | 2016 | 24-Sep | HG-10 | YLPR | 106 | 14 | 1.175 | - | - | 3 | 0.139 |

**Table A1-3: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Stephens Lake in 2015.**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2015 | 07-Sep | GN-33 | LKWF | 549 | 3620 | 2.188 | F | 1 | 24 | 0.394 |
| 2 | 2015 | 07-Sep | GN-33 | LKWF | 547 | 2590 | 1.582 | F | 1 | 15 | 0.181 |
| 101 | 2015 | 08-Sep | GN-22 | LKWF | 424 | 1210 | 1.587 | F | 0 | 6 | 0.079 |
| 114 | 2015 | 08-Sep | SN-22 | LKWF | 94 | 7.4 | 0.891 | - | 0 | 0 | 0.018 |
| 115 | 2015 | 08-Sep | SN-22 | LKWF | 95 | 8 | 0.933 | - | 0 | 0 | 0.016 |
| 116 | 2015 | 08-Sep | SN-22 | LKWF | 86 | 7.7 | 1.211 | - | 0 | 0 | 0.018 |
| 117 | 2015 | 08-Sep | SN-22 | LKWF | 83 | 6 | 1.049 | - | 0 | 0 | 0.018 |
| 122 | 2015 | 08-Sep | GN-17 | LKWF | 529 | 2050 | 1.385 | M | 1 | 22 | 0.263 |
| 173 | 2015 | 09-Sep | SN-14 | LKWF | 80 | 6 | 1.172 | - | 0 | 0 | 0.014 |
| 207 | 2015 | 09-Sep | GN-15 | LKWF | 410 | 1490 | 2.162 | F | 1 | 6 | 0.093 |
| 219 | 2015 | 09-Sep | GN-16 | LKWF | 428 | 1520 | 1.939 | F | 1 | 6 | 0.12 |
| 3 | 2015 | 07-Sep | GN-33 | NRPK | 828 | 5700 | 1.004 | M | 1 | 10 | 1.64 |
| 10 | 2015 | 07-Sep | GN-33 | NRPK | 781 | 3640 | 0.764 | F | 1 | 12 | 1.26 |
| 11 | 2015 | 07-Sep | GN-33 | NRPK | 731 | 3800 | 0.973 | F | 1 | 8 | 0.479 |
| 16 | 2015 | 07-Sep | GN-33 | NRPK | 559 | 1140 | 0.653 | F | 1 | 8 | 0.35 |
| 17 | 2015 | 07-Sep | GN-33 | NRPK | 576 | 1430 | 0.748 | F | 1 | 6 | 0.352 |
| 21 | 2015 | 07-Sep | GN-33 | NRPK | 489 | 780 | 0.667 | F | 1 | 6 | 0.207 |
| 22 | 2015 | 07-Sep | GN-33 | NRPK | 444 | 590 | 0.674 | M | 1 | 4 | 0.211 |
| 23 | 2015 | 07-Sep | GN-33 | NRPK | 501 | 910 | 0.724 | F | 1 | 7 | 0.306 |
| 24 | 2015 | 07-Sep | GN-33 | NRPK | 425 | 540 | 0.703 | M | 1 | 5 | 0.207 |
| 26 | 2015 | 07-Sep | GN-33 | NRPK | 558 | 1140 | 0.656 | F | 1 | 6 | 0.308 |
| 27 | 2015 | 07-Sep | GN-33 | NRPK | 568 | 700 | 0.382 | F | 0 | 6 | 0.224 |
| 28 | 2015 | 07-Sep | GN-33 | NRPK | 440 | 570 | 0.669 | M | 0 | 4 | 0.252 |
| 30 | 2015 | 07-Sep | GN-33 | NRPK | 434 | 550 | 0.673 | F | 1 | 4 | 0.204 |
| 31 | 2015 | 07-Sep | GN-33 | NRPK | 304 | 180 | 0.641 | M | 0 | 3 | 0.159 |

**Table A1-3: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Stephens Lake in 2015 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | 2015 | 07-Sep | GN-33 | NRPK | 309 | 170 | 0.576 | F | 0 | 3 | 0.193 |
| 51 | 2015 | 07-Sep | GN-30 | NRPK | 790 | 4190 | 0.850 | M | 1 | 11 | 0.86 |
| 76 | 2015 | 07-Sep | GN-30 | NRPK | 163 | 28 | 0.647 | M | 0 | - | 0.183 |
| 77 | 2015 | 07-Sep | GN-30 | NRPK | 126 | 11.5 | 0.575 | - | 0 | - | 0.218 |
| 91 | 2015 | 08-Sep | GN-22 | NRPK | 740 | 2560 | 0.632 | F | 1 | 9 | 0.679 |
| 92 | 2015 | 08-Sep | GN-22 | NRPK | 683 | 2090 | 0.656 | F | 1 | 8 | 0.45 |
| 104 | 2015 | 08-Sep | GN-22 | NRPK | 640 | 2170 | 0.828 | F | 1 | 5 | 0.389 |
| 105 | 2015 | 08-Sep | GN-22 | NRPK | 505 | 850 | 0.660 | F | 1 | 5 | 0.185 |
| 106 | 2015 | 08-Sep | GN-22 | NRPK | 570 | 1200 | 0.648 | F | 1 | 4 | 0.336 |
| 111 | 2015 | 08-Sep | SN-22 | NRPK | 556 | 1050 | 0.611 | F | 1 | 6 | 0.508 |
| 112 | 2015 | 08-Sep | SN-22 | NRPK | 473 | 650 | 0.614 | M | 1 | 5 | 0.244 |
| 113 | 2015 | 08-Sep | SN-22 | NRPK | 458 | 650 | 0.677 | M | 1 | 4 | 0.162 |
| 124 | 2015 | 08-Sep | GN-17 | NRPK | 565 | 1150 | 0.638 | M | 1 | 5 | 0.384 |
| 125 | 2015 | 08-Sep | GN-17 | NRPK | 685 | 2150 | 0.669 | F | 1 | 5 | 0.447 |
| 129 | 2015 | 08-Sep | GN-17 | NRPK | 492 | 810 | 0.680 | M | 1 | 5 | 0.211 |
| 143 | 2015 | 09-Sep | GN-14 | NRPK | 655 | 1820 | 0.648 | M | 0 | 7 | 0.467 |
| 155 | 2015 | 09-Sep | GN-14 | NRPK | 762 | 4100 | 0.927 | F | 1 | 10 | 0.296 |
| 156 | 2015 | 09-Sep | GN-14 | NRPK | 480 | 730 | 0.660 | F | 1 | 4 | 0.158 |
| 158 | 2015 | 09-Sep | GN-14 | NRPK | 402 | 460 | 0.708 | M | 0 | 3 | 0.14 |
| 163 | 2015 | 09-Sep | GN-14 | NRPK | 514 | 1200 | 0.884 | M | 1 | 4 | 0.263 |
| 222 | 2015 | 09-Sep | GN-16 | NRPK | 547 | 1140 | 0.697 | M | 1 | 6 | 0.346 |
| 223 | 2015 | 09-Sep | GN-16 | NRPK | 392 | 400 | 0.664 | M | 0 | 3 | 0.122 |
| 4 | 2015 | 07-Sep | GN-33 | WALL | 532 | 1820 | 1.209 | M | 1 | 17 | 0.762 |
| 5 | 2015 | 07-Sep | GN-33 | WALL | 462 | 1170 | 1.186 | F | 1 | 7 | 0.3 |
| 6 | 2015 | 07-Sep | GN-33 | WALL | 492 | 1410 | 1.184 | F | 1 | 7 | 0.364 |

**Table A1-3: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Stephens Lake in 2015 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 2015 | 07-Sep | GN-33 | WALL | 564 | 2150 | 1.198 | F | 1 | 12 | 0.588 |
| 8 | 2015 | 07-Sep | GN-33 | WALL | 493 | 1460 | 1.218 | M | 1 | 25 | 1.05 |
| 9 | 2015 | 07-Sep | GN-33 | WALL | 460 | 1070 | 1.099 | F | 0 | 6 | 0.338 |
| 12 | 2015 | 07-Sep | GN-33 | WALL | 490 | 1270 | 1.079 | M | 1 | 11 | 0.67 |
| 13 | 2015 | 07-Sep | GN-33 | WALL | 448 | 1130 | 1.257 | M | 1 | 11 | 0.57 |
| 14 | 2015 | 07-Sep | GN-33 | WALL | 542 | 1470 | 0.923 | M | 1 | 18 | 0.8 |
| 15 | 2015 | 07-Sep | GN-33 | WALL | 488 | 1300 | 1.119 | M | 1 | 12 | 0.614 |
| 18 | 2015 | 07-Sep | GN-33 | WALL | 464 | 1160 | 1.161 | M | 1 | 12 | 0.56 |
| 19 | 2015 | 07-Sep | GN-33 | WALL | 526 | 1680 | 1.154 | F | 1 | 17 | 0.7095 |
| 37 | 2015 | 07-Sep | GN-32 | WALL | 398 | 720 | 1.142 | M | 1 | 23 | 0.95 |
| 38 | 2015 | 07-Sep | GN-32 | WALL | 367 | 580 | 1.173 | M | 1 | 23 | 0.98 |
| 39 | 2015 | 07-Sep | GN-32 | WALL | 382 | 650 | 1.166 | M | 1 | 12 | 0.641 |
| 40 | 2015 | 07-Sep | GN-32 | WALL | 381 | 710 | 1.284 | M | 1 | 19 | 0.88 |
| 41 | 2015 | 07-Sep | GN-32 | WALL | 378 | 630 | 1.166 | M | 1 | 23 | 0.93 |
| 43 | 2015 | 07-Sep | GN-32 | WALL | 370 | 530 | 1.046 | M | 1 | 19 | 0.97 |
| 44 | 2015 | 07-Sep | GN-32 | WALL | 365 | 620 | 1.275 | M | 1 | 8 | 0.529 |
| 45 | 2015 | 07-Sep | GN-32 | WALL | 432 | 870 | 1.079 | M | 1 | 19 | 0.82 |
| 46 | 2015 | 07-Sep | GN-32 | WALL | 230 | 140 | 1.151 | - | 0 | 2 | 0.117 |
| 49 | 2015 | 07-Sep | GN-30 | WALL | 416 | 840 | 1.167 | M | 1 | 8 | 0.407 |
| 61 | 2015 | 07-Sep | GN-30 | WALL | 405 | 780 | 1.174 | M | 1 | 7 | 0.325 |
| 62 | 2015 | 07-Sep | GN-30 | WALL | 439 | 870 | 1.028 | F | 1 | 11 | 0.6255 |
| 63 | 2015 | 07-Sep | GN-30 | WALL | 420 | 750 | 1.012 | F | 1 | 11 | 0.728 |
| 70 | 2015 | 07-Sep | GN-30 | WALL | 536 | 1640 | 1.065 | M | 1 | 17 | 0.87 |
| 75 | 2015 | 07-Sep | GN-30 | WALL | 218 | 110 | 1.062 | - | 0 | 3 | 0.255 |
| 78 | 2015 | 08-Sep | GN-22 | WALL | 533 | 1570 | 1.037 | F | 1 | 16 | 0.9 |

**Table A1-3: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Stephens Lake in 2015 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 79 | 2015 | 08-Sep | GN-22 | WALL | 549 | 1860 | 1.124 | F | 1 | 11 | 0.69 |
| 80 | 2015 | 08-Sep | GN-22 | WALL | 585 | 2030 | 1.014 | F | 1 | 26 | 1.24 |
| 100 | 2015 | 08-Sep | GN-22 | WALL | 348 | 480 | 1.139 | F | 0 | 5 | 0.153 |
| 103 | 2015 | 08-Sep | GN-22 | WALL | 295 | 320 | 1.246 | F | 0 | 4 | 0.233 |
| 153 | 2015 | 09-Sep | GN-14 | WALL | 314 | 380 | 1.227 | M | 0 | 4 | 0.237 |
| 161 | 2015 | 09-Sep | GN-14 | WALL | 206 | 100 | 1.144 | - | 0 | 2 | 0.203 |
| 169 | 2015 | 09-Sep | GN-14 | WALL | 293 | 270 | 1.073 | F | 0 | 3 | 0.166 |
| 171 | 2015 | 09-Sep | GN-14 | WALL | 170 | 50 | 1.018 | - | 0 | 2 | 0.151 |
| 176 | 2015 | 09-Sep | SN-14 | YLPR | 94 | 11 | 1.324 | - | - | 2 | 0.017 |
| 177 | 2015 | 09-Sep | SN-14 | YLPR | 82 | 8.5 | 1.542 | - | - | - | 0.016 |
| 178 | 2015 | 09-Sep | SN-14 | YLPR | 77 | 7.1 | 1.555 | - | - | 2 | 0.019 |
| 179 | 2015 | 09-Sep | SN-14 | YLPR | 80 | 6.5 | 1.270 | - | - | 2 | 0.014 |
| 180 | 2015 | 09-Sep | SN-14 | YLPR | 113 | 18.5 | 1.282 | - | - | 2 | 0.022 |

**Table A1-4: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Split Lake in 2016.**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 63 | 2016 | 15-Aug | GN-18 | LKWF | 420 | 1410 | 1.903 | F | 1 | 6 | 0.067 |
| 73 | 2016 | 15-Aug | GN-18 | LKWF | 440 | 1250 | 1.467 | M | 1 | 7 | 0.124 |
| 76 | 2016 | 15-Aug | GN-18 | LKWF | 425 | 1200 | 1.563 | M | 1 | 8 | 0.061 |
| 77 | 2016 | 15-Aug | GN-18 | LKWF | 391 | 1100 | 1.840 | F | 1 | 8 | 0.061 |
| 80 | 2016 | 15-Aug | GN-18 | LKWF | 400 | 1100 | 1.719 | - | - | 8 | 0.067 |
| 143 | 2016 | 16-Aug | GN-13 | LKWF | 378 | 850 | 1.574 | M | 0 | 7 | 0.055 |
| 155 | 2016 | 16-Aug | GN-13 | LKWF | 415 | 1250 | 1.749 | F | 1 | 7 | 0.054 |
| 172 | 2016 | 16-Aug | GN-13 | LKWF | 410 | 1150 | 1.669 | F | 1 | 10 | 0.051 |
| 178 | 2016 | 16-Aug | GN-13 | LKWF | 385 | 1050 | 1.840 | M | 1 | 6 | 0.047 |
| 225 | 2016 | 17-Aug | GN-06 | LKWF | 455 | 1600 | 1.699 | F | 1 | 8 | 0.068 |
| 249 | 2016 | 17-Aug | GN-21 | LKWF | 390 | 1020 | 1.720 | F | 1 | 6 | 0.061 |
| 250 | 2016 | 17-Aug | GN-21 | LKWF | 440 | 1480 | 1.737 | M | 1 | 12 | 0.077 |
| 268 | 2016 | 17-Aug | GN-21 | LKWF | 450 | 1450 | 1.591 | F | 1 | 7 | 0.076 |
| 269 | 2016 | 17-Aug | GN-21 | LKWF | 485 | 1920 | 1.683 | F | 1 | 11 | 0.108 |
| 270 | 2016 | 17-Aug | GN-21 | LKWF | 519 | 2750 | 1.967 | F | 1 | 14 | 0.130 |
| 275 | 2016 | 17-Aug | GN-21 | LKWF | 482 | 1980 | 1.768 | F | 1 | 12 | 0.105 |
| 276 | 2016 | 17-Aug | GN-21 | LKWF | 430 | 1550 | 1.950 | M | 1 | 11 | 0.082 |
| 277 | 2016 | 17-Aug | GN-21 | LKWF | 426 | 1430 | 1.850 | M | 1 | 9 | 0.075 |
| 301 | 2016 | 18-Aug | GN-20 | LKWF | 395 | 1150 | 1.866 | F | 1 | 6 | 0.046 |
| 302 | 2016 | 18-Aug | GN-20 | LKWF | 390 | 810 | 1.365 | M | 0 | 8 | 0.038 |
| 316 | 2016 | 18-Aug | GN-20 | LKWF | 476 | 2150 | 1.994 | F | 1 | 12 | 0.077 |
| 317 | 2016 | 18-Aug | GN-20 | LKWF | 434 | 1350 | 1.651 | F | 1 | 6 | 0.053 |
| 17 | 2016 | 14-Aug | GN-15 | NRPK | 524 | 1000 | 0.695 | M | 0 | 5 | 0.409 |
| 18 | 2016 | 14-Aug | GN-15 | NRPK | 510 | 920 | 0.694 | F | 0 | 6 | 0.195 |

**Table A1-4: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Split Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 2016 | 14-Aug | GN-15 | NRPK | 384 | 400 | 0.706 | M | 0 | 3 | 0.109 |
| 27 | 2016 | 14-Aug | GN-15 | NRPK | 384 | 390 | 0.689 | F | 0 | 3 | 0.144 |
| 28 | 2016 | 14-Aug | GN-15 | NRPK | 361 | 300 | 0.638 | M | 0 | 3 | 0.159 |
| 29 | 2016 | 14-Aug | GN-15 | NRPK | 365 | 350 | 0.720 | M | 0 | 3 | 0.170 |
| 71 | 2016 | 15-Aug | GN-18 | NRPK | 675 | 2200 | 0.715 | M | - | 7 | 0.432 |
| 72 | 2016 | 15-Aug | GN-18 | NRPK | 666 | 2120 | 0.718 | F | - | 7 | 0.339 |
| 89 | 2016 | 16-Aug | GN-29 | NRPK | 463 | 720 | 0.725 | M | - | 4 | 0.103 |
| 111 | 2016 | 16-Aug | GN-29 | NRPK | 610 | 1400 | 0.617 | M | - | 5 | 0.394 |
| 115 | 2016 | 16-Aug | GN-29 | NRPK | 740 | 3350 | 0.827 | F | - | 6 | 0.460 |
| 185 | 2016 | 17-Aug | SN-06 | NRPK | 455 | 750 | 0.796 | M | - | 4 | 0.159 |
| 186 | 2016 | 17-Aug | SN-06 | NRPK | 420 | 580 | 0.783 | M | - | 3 | 0.204 |
| 190 | 2016 | 17-Aug | SN-06 | NRPK | 342 | 280 | 0.700 | F | 0 | 2 | 0.088 |
| 191 | 2016 | 17-Aug | SN-06 | NRPK | 350 | 350 | 0.816 | M | - | 4 | 0.102 |
| 194 | 2016 | 17-Aug | GN-06 | NRPK | 373 | 360 | 0.694 | F | 0 | 3 | 0.105 |
| 195 | 2016 | 17-Aug | GN-06 | NRPK | 670 | 1950 | 0.648 | F | - | 5 | 0.485 |
| 196 | 2016 | 17-Aug | GN-06 | NRPK | 650 | 2100 | 0.765 | M | - | 5 | 0.394 |
| 197 | 2016 | 17-Aug | GN-06 | NRPK | 364 | 350 | 0.726 | M | 0 | 2 | 0.079 |
| 233 | 2016 | 17-Aug | GN-21 | NRPK | 653 | 1550 | 0.557 | F | - | 7 | 0.398 |
| 234 | 2016 | 17-Aug | GN-21 | NRPK | 350 | 340 | 0.793 | F | - | 3 | 0.168 |
| 235 | 2016 | 17-Aug | GN-21 | NRPK | 270 | 170 | 0.864 | F | 0 | 2 | 0.101 |
| 236 | 2016 | 17-Aug | GN-21 | NRPK | 309 | 210 | 0.712 | F | 0 | 2 | 0.096 |
| 247 | 2016 | 17-Aug | GN-21 | NRPK | 590 | 1110 | 0.540 | F | - | 5 | 0.414 |
| 280 | 2016 | 18-Aug | GN-05 | NRPK | 310 | 200 | 0.671 | M | 0 | 2 | 0.083 |
| 284 | 2016 | 18-Aug | GN-05 | NRPK | 542 | 1000 | 0.628 | F | - | 5 | 0.193 |
| 291 | 2016 | 18-Aug | GN-05 | NRPK | 680 | 1700 | 0.541 | - | - | 5 | 0.359 |

**Table A1-4: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Split Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 292 | 2016 | 18-Aug | GN-05 | NRPK | 832 | 4200 | 0.729 | M | - | 15 | 0.809 |
| 303 | 2016 | 18-Aug | GN-20 | NRPK | 680 | 2350 | 0.747 | F | - | 8 | 0.440 |
| 308 | 2016 | 18-Aug | GN-20 | NRPK | 710 | 2550 | 0.712 | F | - | 7 | 0.447 |
| 320 | 2016 | 18-Aug | SN-03 | NRPK | 562 | 1000 | 0.563 | M | - | 4 | 0.386 |
| 321 | 2016 | 18-Aug | SN-03 | NRPK | 415 | 520 | 0.728 | F | - | 5 | 0.101 |
| 322 | 2016 | 18-Aug | SN-03 | NRPK | 450 | 650 | 0.713 | M | - | 4 | 0.158 |
| 330 | 2016 | 18-Aug | GN-03 | NRPK | 470 | 650 | 0.626 | F | 0 | 5 | 0.238 |
| 9 | 2016 | 14-Aug | GN-28 | WALL | 495 | 1420 | 1.171 | F | - | 9 | 0.351 |
| 14 | 2016 | 14-Aug | GN-15 | WALL | 294 | 320 | 1.259 | M | 0 | 4 | 0.196 |
| 15 | 2016 | 14-Aug | GN-15 | WALL | 161 | 30 | 0.719 | - | - | 1 | 0.076 |
| 16 | 2016 | 14-Aug | GN-15 | WALL | 203 | 55 | 0.657 | - | - | 2 | 0.094 |
| 20 | 2016 | 14-Aug | GN-15 | WALL | 261 | 200 | 1.125 | M | 0 | 4 | 0.197 |
| 21 | 2016 | 14-Aug | GN-15 | WALL | 215 | 100 | 1.006 | - | - | 3 | 0.255 |
| 22 | 2016 | 14-Aug | GN-15 | WALL | 211 | 100 | 1.065 | - | - | 2 | 0.088 |
| 23 | 2016 | 14-Aug | GN-15 | WALL | 254 | 155 | 0.946 | F | 0 | 3 | 0.154 |
| 24 | 2016 | 14-Aug | GN-15 | WALL | 313 | 450 | 1.468 | F | 0 | 4 | 0.210 |
| 30 | 2016 | 14-Aug | GN-15 | WALL | 312 | 400 | 1.317 | F | 0 | 4 | 0.235 |
| 31 | 2016 | 14-Aug | GN-15 | WALL | 285 | 300 | 1.296 | F | 0 | 4 | 0.192 |
| 32 | 2016 | 14-Aug | GN-15 | WALL | 345 | 420 | 1.023 | F | 0 | 5 | 0.212 |
| 33 | 2016 | 14-Aug | GN-15 | WALL | 340 | 500 | 1.272 | F | 0 | 5 | 0.235 |
| 34 | 2016 | 14-Aug | GN-15 | WALL | 320 | 400 | 1.221 | M | 0 | 4 | 0.181 |
| 35 | 2016 | 14-Aug | GN-15 | WALL | 305 | 405 | 1.427 | F | 0 | - | 0.190 |
| 42 | 2016 | 14-Aug | GN-15 | WALL | 590 | 1420 | 0.691 | F | - | 17 | 1.140 |
| 62 | 2016 | 15-Aug | GN-18 | WALL | 488 | 930 | 0.800 | F | - | 6 | 0.202 |
| 67 | 2016 | 15-Aug | GN-18 | WALL | 371 | 570 | 1.116 | F | - | 6 | 0.215 |

**Table A1-4: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Split Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 68 | 2016 | 15-Aug | GN-18 | WALL | 300 | 300 | 1.111 | F | 0 | 4 | 0.188 |
| 69 | 2016 | 15-Aug | GN-18 | WALL | 264 | 200 | 1.087 | F | 0 | 4 | 0.281 |
| 70 | 2016 | 15-Aug | GN-18 | WALL | 252 | 170 | 1.062 | F | 0 | 3 | 0.118 |
| 84 | 2016 | 16-Aug | GN-29 | WALL | 685 | 3410 | 1.061 | F | - | 26 | 0.764 |
| 86 | 2016 | 16-Aug | GN-29 | WALL | 200 | 100 | 1.250 | F | 0 | 2 | 0.115 |
| 87 | 2016 | 16-Aug | GN-29 | WALL | 190 | 90 | 1.312 | - | - | 2 | 0.096 |
| 102 | 2016 | 16-Aug | GN-29 | WALL | 352 | 500 | 1.146 | F | 0 | 6 | 0.225 |
| 103 | 2016 | 16-Aug | GN-29 | WALL | 432 | 860 | 1.067 | F | - | 6 | 0.201 |
| 104 | 2016 | 16-Aug | GN-29 | WALL | 420 | 890 | 1.201 | F | - | 6 | 0.225 |
| 109 | 2016 | 16-Aug | GN-29 | WALL | 405 | 750 | 1.129 | M | - | 5 | 0.285 |
| 110 | 2016 | 16-Aug | GN-29 | WALL | 401 | 700 | 1.129 | M | - | 6 | 0.184 |
| 118 | 2016 | 16-Aug | GN-13 | WALL | 195 | 100 | 1.349 | - | - | 2 | 0.078 |
| 119 | 2016 | 16-Aug | GN-13 | WALL | 242 | 120 | 0.847 | F | 0 | 3 | 0.177 |
| 130 | 2016 | 16-Aug | GN-13 | WALL | 250 | 150 | 0.960 | - | - | 3 | 0.118 |
| 144 | 2016 | 16-Aug | GN-13 | WALL | 683 | 4600 | 1.444 | F | - | 17 | 0.431 |
| 146 | 2016 | 16-Aug | GN-13 | WALL | 355 | 450 | 1.006 | F | - | 6 | 0.139 |
| 156 | 2016 | 16-Aug | GN-13 | WALL | 465 | 1200 | 1.193 | F | - | 7 | 0.239 |
| 177 | 2016 | 16-Aug | GN-13 | WALL | 480 | 1300 | 1.175 | F | - | 8 | 0.278 |
| 1000 | 2016 | 17-Aug | SN-06 | YLPR | 74 | 4 | 0.987 | - | - | 1 | < 0.010 |

**Table A1-5: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Assean Lake in 2016.**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 63 | 2016 | 10-Aug | GN-08 | LKWF | 480 | 2000 | 1.808 | F | 1 | 8 | 0.058 |
| 64 | 2016 | 10-Aug | GN-08 | LKWF | 493 | 2200 | 1.836 | F | 1 | 11 | 0.050 |
| 133 | 2016 | 10-Aug | GN-01 | LKWF | 464 | 1755 | 1.757 | M | 1 | 7 | 0.072 |
| 255 | 2016 | 12-Aug | GN-11 | LKWF | 525 | 2900 | 2.004 | M | - | 23 | 0.078 |
| 290 | 2016 | 12-Aug | GN-07 | LKWF | 440 | 1500 | 1.761 | F | 1 | 9 | 0.026 |
| 294 | 2016 | 12-Aug | GN-07 | LKWF | 490 | 2250 | 1.912 | F | 1 | 14 | 0.065 |
| 295 | 2016 | 12-Aug | GN-05 | LKWF | 510 | 2700 | 2.035 | F | 1 | 12 | 0.093 |
| 396 | 2016 | 13-Aug | GN-04 | LKWF | 445 | 1660 | 1.884 | M | 1 | 8 | 0.039 |
| 408 | 2016 | 13-Aug | GN-04 | LKWF | 462 | 1570 | 1.592 | F | 1 | 8 | 0.039 |
| 415 | 2016 | 13-Aug | GN-04 | LKWF | 149 | 45 | 1.360 | - | - | 1 | 0.010 |
| 416 | 2016 | 13-Aug | GN-04 | LKWF | 148 | 40 | 1.234 | - | - | 1 | 0.032 |
| 444 | 2016 | 13-Aug | GN-03 | LKWF | 227 | 120 | 1.026 | - | - | 2 | 0.021 |
| 3 | 2016 | 10-Aug | SN-08 | NRPK | 400 | 350 | 0.547 | F | 0 | 3 | 0.144 |
| 5 | 2016 | 10-Aug | GN-08 | NRPK | 285 | 150 | 0.648 | F | 0 | 2 | 0.088 |
| 6 | 2016 | 10-Aug | GN-08 | NRPK | 470 | 610 | 0.588 | F | 0 | 4 | 0.197 |
| 23 | 2016 | 10-Aug | GN-08 | NRPK | 463 | 730 | 0.735 | M | 0 | 4 | 0.309 |
| 39 | 2016 | 10-Aug | GN-08 | NRPK | 494 | 750 | 0.622 | F | 0 | 5 | 0.088 |
| 40 | 2016 | 10-Aug | GN-08 | NRPK | 463 | 655 | 0.660 | F | 0 | 4 | 0.163 |
| 41 | 2016 | 10-Aug | GN-08 | NRPK | 582 | 1150 | 0.583 | F | 0 | 6 | 0.265 |
| 85 | 2016 | 10-Aug | GN-01 | NRPK | 550 | 950 | 0.571 | M | 0 | 5 | 0.258 |
| 86 | 2016 | 10-Aug | GN-01 | NRPK | 440 | 500 | 0.587 | F | 0 | 3 | 0.158 |
| 124 | 2016 | 10-Aug | GN-01 | NRPK | 620 | 1500 | 0.629 | M | 0 | 7 | 0.330 |
| 134 | 2016 | 10-Aug | GN-01 | NRPK | 752 | 3300 | 0.776 | F | - | 8 | 0.299 |
| 144 | 2016 | 11-Aug | GN-10 | NRPK | 440 | 560 | 0.657 | M | - | 4 | 0.064 |

**Table A1-5: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Assean Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | 2016 | 11-Aug | GN-10 | NRPK | 510 | 900 | 0.678 | F | 0 | 5 | 0.165 |
| 146 | 2016 | 11-Aug | GN-10 | NRPK | 560 | 1200 | 0.683 | M | - | 4 | 0.243 |
| 158 | 2016 | 11-Aug | GN-10 | NRPK | 643 | 1090 | 0.410 | M | - | 5 | 0.195 |
| 159 | 2016 | 11-Aug | GN-10 | NRPK | 448 | 630 | 0.701 | M | 0 | 5 | 0.178 |
| 160 | 2016 | 11-Aug | GN-10 | NRPK | 452 | 570 | 0.617 | M | 0 | 3 | 0.103 |
| 161 | 2016 | 11-Aug | GN-10 | NRPK | 408 | 470 | 0.692 | F | 0 | 5 | 0.108 |
| 177 | 2016 | 11-Aug | GN-09 | NRPK | 599 | 1080 | 0.503 | F | 0 | 8 | 0.299 |
| 178 | 2016 | 11-Aug | GN-09 | NRPK | 546 | 950 | 0.584 | F | 0 | 6 | 0.174 |
| 179 | 2016 | 11-Aug | GN-09 | NRPK | 565 | 1220 | 0.676 | F | - | 5 | 0.195 |
| 180 | 2016 | 11-Aug | GN-09 | NRPK | 540 | 1080 | 0.686 | F | - | 5 | 0.072 |
| 187 | 2016 | 11-Aug | GN-09 | NRPK | 345 | 280 | 0.682 | F | 0 | 2 | 0.055 |
| 195 | 2016 | 11-Aug | GN-09 | NRPK | 260 | 110 | 0.626 | M | 0 | 2 | 0.030 |
| 196 | 2016 | 11-Aug | GN-09 | NRPK | 225 | 100 | 0.878 | - | - | 1 | 0.025 |
| 198 | 2016 | 12-Aug | SN-11 | NRPK | 435 | 610 | 0.741 | F | 0 | 5 | 0.036 |
| 212 | 2016 | 12-Aug | GN-11 | NRPK | 860 | 4700 | 0.739 | F | - | 8 | 0.949 |
| 217 | 2016 | 12-Aug | GN-11 | NRPK | 310 | 210 | 0.705 | M | 1 | 2 | 0.089 |
| 249 | 2016 | 12-Aug | GN-11 | NRPK | 685 | 1600 | 0.498 | F | 0 | 6 | 0.347 |
| 269 | 2016 | 12-Aug | GN-07 | NRPK | 300 | 155 | 0.574 | M | 0 | 2 | 0.073 |
| 270 | 2016 | 12-Aug | GN-07 | NRPK | 655 | 1520 | 0.541 | F | 0 | 6 | 0.294 |
| 272 | 2016 | 12-Aug | GN-07 | NRPK | 393 | 400 | 0.659 | F | 0 | 3 | 0.143 |
| 292 | 2016 | 12-Aug | GN-07 | NRPK | 734 | 2500 | 0.632 | M | - | 6 | 0.405 |
| 308 | 2016 | 12-Aug | GN-05 | NRPK | 850 | 3950 | 0.643 | F | - | 7 | 0.830 |
| 1 | 2016 | 10-Aug | SN-08 | WALL | 261 | 197 | 1.108 | F | 0 | 4 | 0.129 |
| 9 | 2016 | 10-Aug | GN-08 | WALL | 215 | 100 | 1.006 | F | 0 | 3 | 0.130 |
| 10 | 2016 | 10-Aug | GN-08 | WALL | 171 | 50 | 1.000 | - | - | 2 | 0.078 |

**Table A1-5: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Assean Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 2016 | 10-Aug | GN-08 | WALL | 185 | 55 | 0.869 | F | 0 | 2 | 0.078 |
| 13 | 2016 | 10-Aug | GN-08 | WALL | 333 | 355 | 0.961 | F | 0 | 6 | 0.287 |
| 14 | 2016 | 10-Aug | GN-08 | WALL | 295 | 250 | 0.974 | M | 0 | 5 | 0.144 |
| 15 | 2016 | 10-Aug | GN-08 | WALL | 276 | 205 | 0.975 | F | 0 | 5 | 0.172 |
| 18 | 2016 | 10-Aug | GN-08 | WALL | 290 | 220 | 0.902 | F | 0 | 5 | 0.145 |
| 19 | 2016 | 10-Aug | GN-08 | WALL | 200 | 90 | 1.125 | M | 0 | 3 | 0.110 |
| 20 | 2016 | 10-Aug | GN-08 | WALL | 247 | 145 | 0.962 | F | 0 | 3 | 0.137 |
| 21 | 2016 | 10-Aug | GN-08 | WALL | 260 | 190 | 1.081 | M | 0 | 5 | 0.147 |
| 25 | 2016 | 10-Aug | GN-08 | WALL | 221 | 105 | 0.973 | M | 0 | 3 | 0.096 |
| 27 | 2016 | 10-Aug | GN-08 | WALL | 264 | 170 | 0.924 | M | 0 | 4 | 0.120 |
| 28 | 2016 | 10-Aug | GN-08 | WALL | 223 | 105 | 0.947 | M | 0 | 3 | 0.091 |
| 30 | 2016 | 10-Aug | GN-08 | WALL | 325 | 400 | 1.165 | M | 0 | 6 | 0.130 |
| 31 | 2016 | 10-Aug | GN-08 | WALL | 294 | 250 | 0.984 | F | 0 | 5 | 0.142 |
| 32 | 2016 | 10-Aug | GN-08 | WALL | 240 | 145 | 1.049 | - | - | 4 | 0.143 |
| 42 | 2016 | 10-Aug | GN-08 | WALL | 340 | 405 | 1.030 | F | 0 | 6 | 0.161 |
| 43 | 2016 | 10-Aug | GN-08 | WALL | 365 | 400 | 0.823 | M | 0 | 8 | 0.175 |
| 44 | 2016 | 10-Aug | GN-08 | WALL | 307 | 320 | 1.106 | - | - | 6 | 0.199 |
| 45 | 2016 | 10-Aug | GN-08 | WALL | 357 | 500 | 1.099 | F | 0 | 8 | 0.166 |
| 46 | 2016 | 10-Aug | GN-08 | WALL | 305 | 305 | 1.075 | F | 0 | 5 | 0.149 |
| 47 | 2016 | 10-Aug | GN-08 | WALL | 360 | 455 | 0.975 | F | 0 | 6 | 0.204 |
| 48 | 2016 | 10-Aug | GN-08 | WALL | 363 | 450 | 0.941 | M | 0 | 8 | 0.190 |
| 49 | 2016 | 10-Aug | GN-08 | WALL | 432 | 857 | 1.063 | F | - | 8 | 0.166 |
| 55 | 2016 | 10-Aug | GN-08 | WALL | 425 | 810 | 1.055 | F | - | 8 | 0.345 |
| 56 | 2016 | 10-Aug | GN-08 | WALL | 380 | 600 | 1.093 | F | 0 | 7 | 0.312 |
| 57 | 2016 | 10-Aug | GN-08 | WALL | 460 | 810 | 0.832 | M | 0 | 13 | 0.474 |

**Table A1-5: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Assean Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 | 2016 | 10-Aug | GN-08 | WALL | 400 | 650 | 1.016 | M | - | 9 | 0.291 |
| 62 | 2016 | 10-Aug | GN-08 | WALL | 291 | 250 | 1.015 | F | 0 | 4 | 0.189 |
| 65 | 2016 | 10-Aug | GN-01 | WALL | 365 | 550 | 1.131 | F | 0 | 7 | 0.189 |
| 66 | 2016 | 10-Aug | GN-01 | WALL | 300 | 290 | 1.074 | F | 0 | 5 | 0.112 |
| 69 | 2016 | 10-Aug | GN-01 | WALL | 383 | 600 | 1.068 | M | 0 | 7 | 0.172 |
| 72 | 2016 | 10-Aug | GN-01 | WALL | 210 | 100 | 1.080 | F | 0 | 4 | 0.119 |
| 89 | 2016 | 10-Aug | GN-01 | WALL | 420 | 800 | 1.080 | M | - | 14 | 0.500 |
| 288 | 2016 | 12-Aug | GN-07 | WALL | 515 | 1350 | 0.988 | F | - | 17 | 0.526 |
| 293 | 2016 | 12-Aug | GN-07 | WALL | 484 | 1400 | 1.235 | F | 1 | 10 | 0.319 |
| 1001 | 2016 | 10-Aug | SN-08 | YLPR | 87 | 8.2 | 1.254 | - | - | - | 0.033 |
| 1002 | 2016 | 10-Aug | SN-08 | YLPR | 85 | 7.3 | 1.189 | - | - | - | 0.035 |
| 1003 | 2016 | 10-Aug | SN-08 | YLPR | 87 | 7.7 | 1.173 | - | - | - | 0.027 |
| 1004 | 2016 | 10-Aug | SN-08 | YLPR | 84 | 6.9 | 1.164 | - | - | - | 0.037 |
| 1005 | 2016 | 10-Aug | SN-08 | YLPR | 79 | 5.8 | 1.182 | - | - | - | 0.042 |
| 1006 | 2016 | 10-Aug | SN-08 | YLPR | 79 | 5.9 | 1.201 | - | - | - | 0.037 |
| 1007 | 2016 | 10-Aug | SN-08 | YLPR | 91 | 8.9 | 1.188 | - | - | - | 0.032 |
| 1008 | 2016 | 10-Aug | SN-08 | YLPR | 92 | 10.6 | 1.368 | - | - | - | 0.035 |
| 1009 | 2016 | 10-Aug | SN-08 | YLPR | 87 | 8.6 | 1.314 | - | - | - | 0.018 |
| 1010 | 2016 | 10-Aug | SN-08 | YLPR | 75 | 5.3 | 1.268 | - | - | - | 0.035 |
| 1011 | 2016 | 10-Aug | SN-08 | YLPR | 84 | 7.9 | 1.338 | - | - | - | 0.037 |
| 1013 | 2016 | 12-Aug | SN-11 | YLPR | 87 | 8.0 | 1.223 | - | - | - | 0.031 |
| 1014 | 2016 | 12-Aug | SN-11 | YLPR | 81 | 6.4 | 1.213 | - | - | - | 0.026 |
| 1015 | 2016 | 12-Aug | SN-11 | YLPR | 85 | 7.4 | 1.213 | - | - | - | 0.018 |
| 1016 | 2016 | 12-Aug | SN-11 | YLPR | 84 | 6.7 | 1.131 | - | - | - | 0.024 |
| 1017 | 2016 | 13-Aug | SN-4 | YLPR | 86 | 7.9 | 1.247 | - | - | - | 0.016 |

**Table A1-5: Muscle mercury (Hg) concentrations and other biological data for Lake Whitefish (LKWF), Northern Pike (NRPK), and Walleye (WALL), and Yellow Perch (YLPR) from Assean Lake in 2016 (continued).**

| Fish # | Year | Date | Site | Species | Length (mm) | Weight (g) | K | Sex | Maturity | Age (yr) | Hg (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1018 | 2016 | 13-Aug | SN-4 | YLPR | 87 | 9.0 | 1.371 | - | - | - | 0.029 |
| 1019 | 2016 | 13-Aug | SN-4 | YLPR | 91 | 9.8 | 1.299 | - | - | - | 0.062 |
| 1021 | 2016 | 13-Aug | SN-4 | YLPR | 80 | 6.1 | 1.202 | - | - | - | 0.030 |
| 1022 | 2016 | 13-Aug | SN-4 | YLPR | 87 | 8.2 | 1.250 | - | - | - | 0.040 |
| 1023 | 2016 | 13-Aug | SN-4 | YLPR | 92 | 9.8 | 1.266 | - | - | - | 0.031 |
| 1024 | 2016 | 13-Aug | SN-4 | YLPR | 79 | 5.0 | 1.018 | - | - | - | 0.042 |
| 1025 | 2016 | 13-Aug | SN-4 | YLPR | 85 | 8.3 | 1.351 | - | - | - | 0.035 |
| 1026 | 2016 | 13-Aug | SN-4 | YLPR | 77 | 5.9 | 1.296 | - | - | - | 0.032 |
| 1027 | 2016 | 13-Aug | SN-4 | YLPR | 80 | 5.3 | 1.052 | - | - | - | 0.028 |