Memo

To: Jackie Wells

From: Jim McCarthy

cc:

Date: January 21, 2019

Re. TF13104119 Comparison of Lake Melville Hg values to recent Smallwood and Control Hg values

Dear Jackie

During our October update presentation to Innu Nation regarding ongoing EEM efforts and results, Mr. Richard Nuna, Manager of Environmental Programs for Innu Nation, asked whether the total mercury (THg) concentrations of fish within Lake Melville could be compared to any values from the Smallwood reservoir or control locations. This comparison may be useful in describing the relative THg levels in fish in Lake Melville to members of Innu Nation and the public in general.

CFL Co. completed a round of THg sampling within the Smallwood reservoir in 2016-2017 as part of its ongoing monitoring. This sampling program focused on three key species within the reservoir; lake trout, northern pike, and lake whitefish. While these species are not captured in high numbers, or at all, within Lake Melville, Nalcor funded the opportunistic collection of additional fish species for THg analysis as part of this program. Target species included brook trout, longnose and white suckers, lake whitefish, and ouananiche (landlocked Atlantic salmon).

Samples were collected from various locations within the Smallwood reservoir system (Lobstick, Gabbro, and Sandgirt reservoir areas), natural lakes (Atikonak and Wilson Lakes), and within the Churchill Falls generating station tailrace area. The collection of morphological data from each fish sample (e.g., fish length, weight, aging structures) as well as THg samples were completed using the same sample team and methods used for the Muskrat Falls EEM Program. Samples of fish muscle tissue were also analysed using the same laboratory as that for Muskrat Falls (AGAT labs), therefore results are comparable.

The THg of each species captured annually from Lake Melville was standardized to a set fish length so comparisons among years could be completed (Anderson 2011). The concentration at the standardized fish length for each species was calculated using linear regression of the log-log relationship between fish length and THg concentration. The length used to standardize the concentrations for each species was within the range of those fish captured. The 95% confidence interval around the standard length THg concentration for each year was also estimated. Similar analysis was completed on corresponding fish samples from the Smallwood sampling program.

Species captured in 2017 included Atlantic salmon (ouananiche), brook trout, lake whitefish, longnose sucker, and white sucker; however, brook trout were not captured within the Smallwood Reservoir in 2017, while Atlantic salmon were not captured in Lake Melville. **Table 1** provides the summary of mean THg concentrations as well as the standardized THg for each species for each year they were captured and analysed.

Figures 1-5 present the annual standardized THg concentrations (with 95% confidence intervals) in Lake Melville and the 2017 Smallwood THg concentrations for those fish sampled in the Smallwood reservoir, natural lakes, and Churchill Falls tailrace area as they compare to those sampled in Lake Melville. Any year where the standardized length could not be accurately estimated, the mean THg concentration was used for comparisons as per Anderson (2011).

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Table 1: Summary sample data from Lake Melville, natural lakes (Atikonak and Wilson Lakes), Smallwood reservoir, and the Churchill Falls tailrace area. Highlighted cells represent non-significant regression values (p>0.05) and where mean THg were used.

Species	Sample Location	Year	Sample size (n)	Mean Length (mm)	Mean THg (mg/kg)	95% CI of Mean THg	Standard Length (mm)	Standard THg (mg/kg)	95% CI of Standard THg
Atlantic Salmon[1]	Lake Melville	2011	0	-	-	-	300	-	-
		2013	0	-	-	-		-	-
		2014	0	-	-	-		-	-
		2015	24[2]	-	0.094	0.078-0.110		-	-
		2016	15[2]	-	0.045	0.038-0.052		-	-
		2017	0	-	-	-		-	-
	Reservoir	2017	3	558	0.36	0.19-0.52		0.088	-[3]
	Natural	2017	9	416	0.18	0.12-0.23		0.107	0.000-0.269
	Tailrace	2017	13	319	0.07	0.04-0.10		0.053	0.000-0.235
Brook trout	Lake Melville	2011	0	-	-	-	300	-	-
		2013	30	246	0.062	0.055-0.074		0.067	0.031-0.103
		2014	30	271	0.052	0.050-0.055		0.053	0.033-0.073
		2015	30	323	0.062	0.051-0.073		0.056	0.002-0.110
		2016	30	263	0.058	0.051-0.066		0.058	0.000-0.133
		2017	31	332	0.037	0.030-0.049		0.033	0.000-0.139
	Reservoir	2017	0	-	-	-		-	-
	Natural	2017	14	268	0.164	0.068-0.261		0.099	0.000-0.355
	Tailrace	2017	11	330	0.067	0.048-0.087		0.067	0.000-0.282
Lake whitefish	Lake Melville	2011	0	-	-	-	300	-	-
		2013	0	-	-	-		-	-
		2014	7	225	0.053	0.049-0.056		0.050	0.000-0.184
		2015	2	223	0.060	0.040-0.080		0.020	-[4]
		2016	0	-	-	-		-	-
		2017	0	-	-	-		-	-
	Reservoir	2017	28	135	0.150	0.122-0.177		0.060	0.000-0.245
	Natural	2017	35	400	0.122	0.106-0.158		0.110	0.052-0.168
	Tailrace	2017	48	310	0.132	0.109-0.136		0.130	0.034-0.226
Longnose sucker	Lake Melville	2011	15	246	0.070	0.046-0.094	250	0.064	0.000-0.169
		2013	30	233	0.053	0.050-0.056		0.054	0.035-0.073
		2014	37	191	0.050	-[5]		0.050	-
		2015	30	225	0.051	0.049-0.051		0.052	0.034-0.070
		2016	21	213	0.025	0.020-0.030		0.026	0.000-0.098
		2017	30	226	0.021	0.020-0.022		0.020	0.018-0.022
	Reservoir	2017	11	457	0.190	0.166-0.264		0.007	0.000-0.859
	Natural	2017	6	297	0.132	0.000-0.301		0.043	0.000-0.778
	Tailrace	2017	5	438	0.192	0.159-0.225		0.070	0.000-0.400
White sucker	Lake Melville	2011	1[6]	355	0.140	-	250	-	-
		2013	28	202	0.055	0.048-0.063		0.061	0.016-0.106
		2014	31	231	0.050	-[5]		0.050	-
		2015	18	259	0.052	0.048-0.057		0.051	0.021-0.081
		2016	24	275	0.046	0.039-0.054		0.034	0.000-0.113
		2017	30	249	0.060	0.041-0.080		0.048	0.000-0.131
	Reservoir	2017	3	499	0.113	0.096-0.131		0.028	-[3]
	Natural	2017	30	261	0.075	0.033-0.177		0.044	0.000-0.800
	Tailrace	2017	15	405	0.127	0.087-0.166		0.027	0.000-0.155

1 Reservoir, natural and tailrace are landlocked Atlantic salmon (Ouananiche)

2 Samples from Lake Melville were provided to Wood E & IS by residents as part of subsistence fishery, lengths and weights were not obtained

3 Poor regression (p = 0.766), confidence intervals not presented

4 Regression based on two samples, no confidence intervals were calculated for estimate

5 All samples were below lab detection limits

6 A single sample collected, analysis not completed

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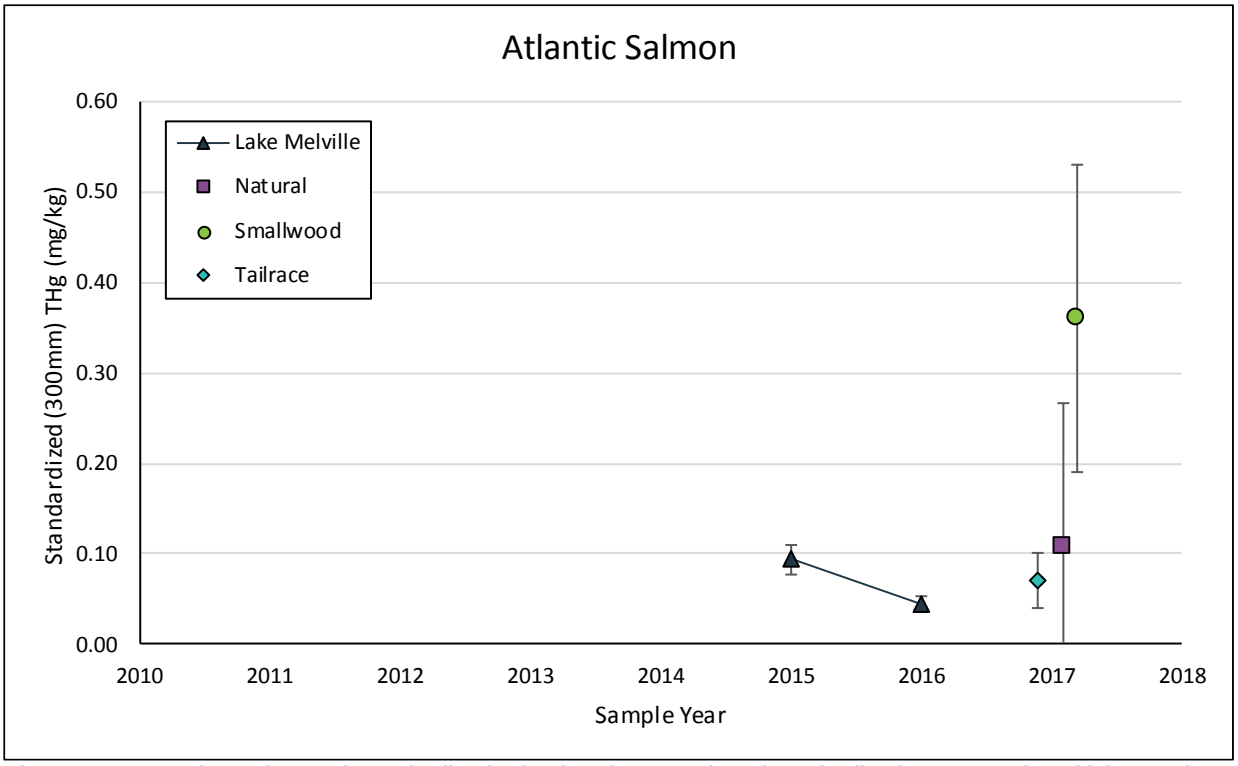

Figure 1: Comparison of annual standardized Atlantic salmon total Hg (standardized to 300mm length) from Lake Melville with samples collected from Natural lakes, and the Churchill Falls tailrace.

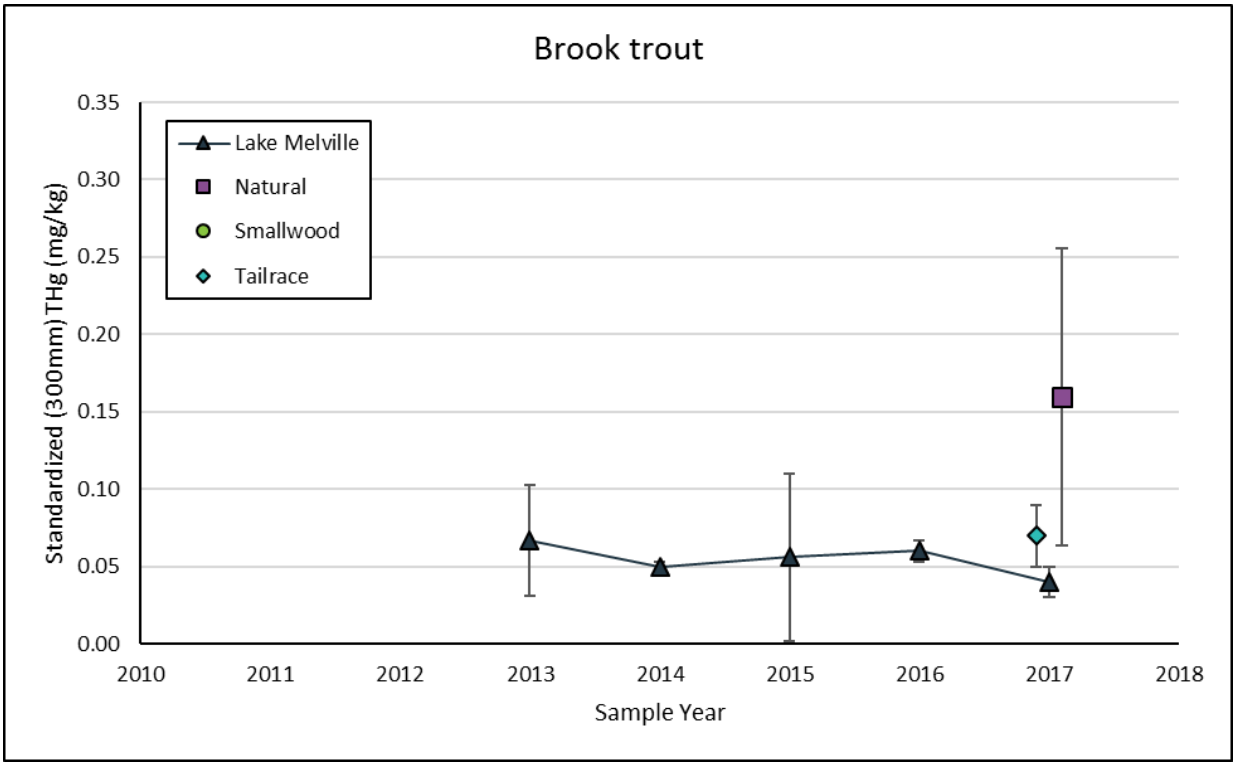

Figure 2: Comparison of annual standardized brook trout total Hg (standardized to 300mm length) from Lake Melville with samples collected from Natural lakes, and the Churchill Falls tailrace (none captured in Smallwood Reservoir).

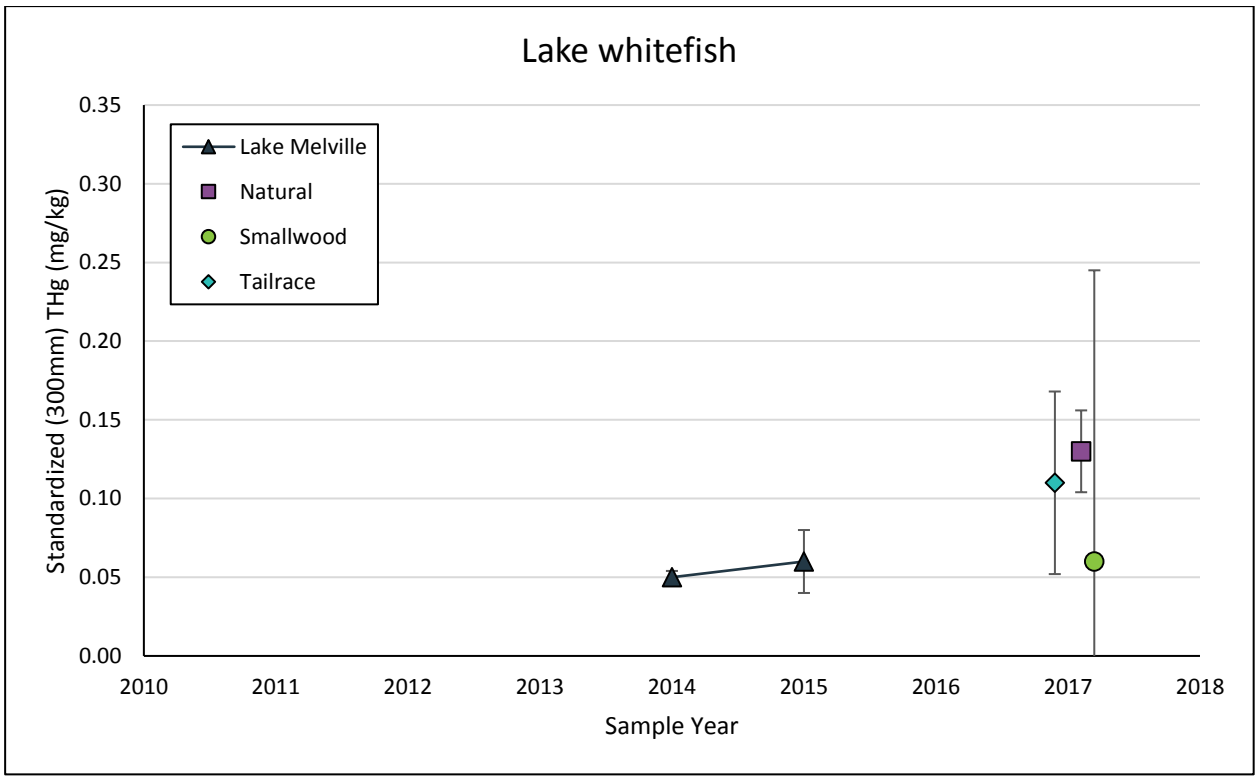

Figure 3:: Comparison of annual standardized lake whitefish total Hg (standardized to 300mm length) from Lake Melville with samples collected from Natural lakes, Smallwood reservoir, and the Churchill Falls tailrace.

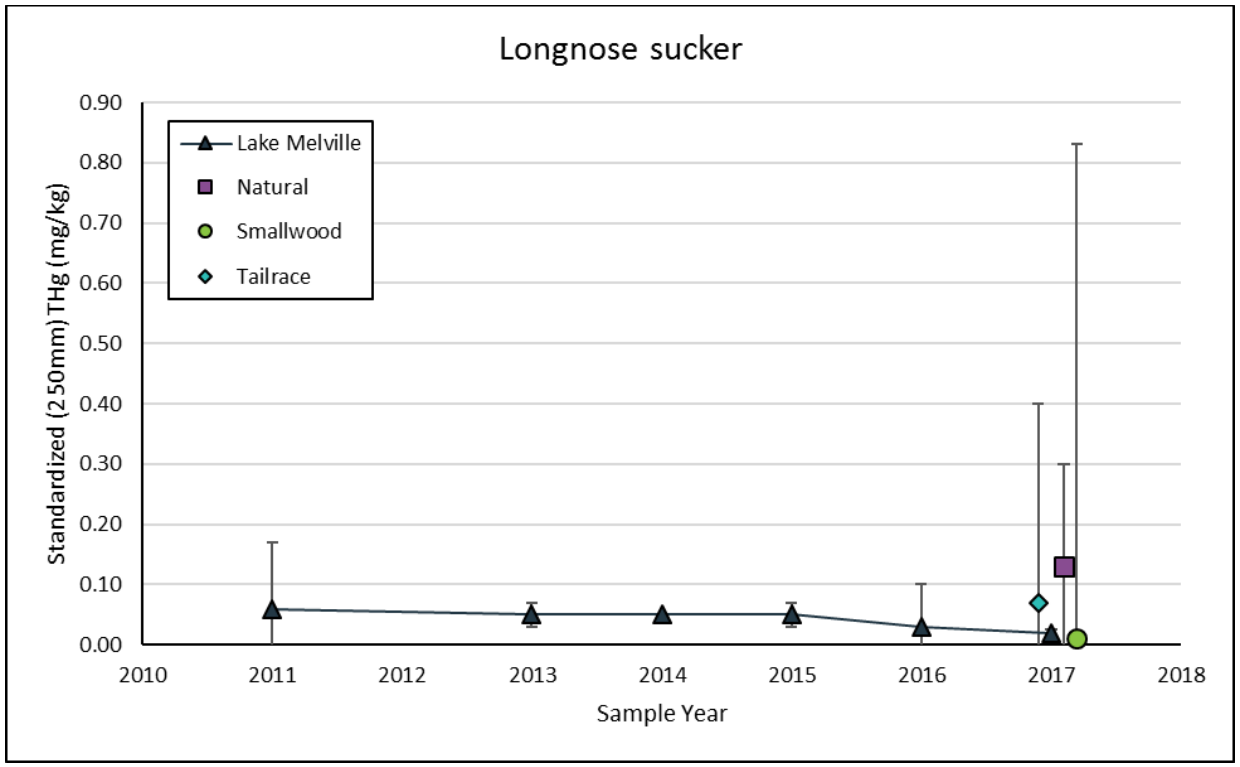

Figure 4: Comparison of annual standardized longnose sucker total Hg (standardized to 250mm length) from Lake Melville with samples collected from Natural lakes, Smallwood reservoir, and the Churchill Falls tailrace.

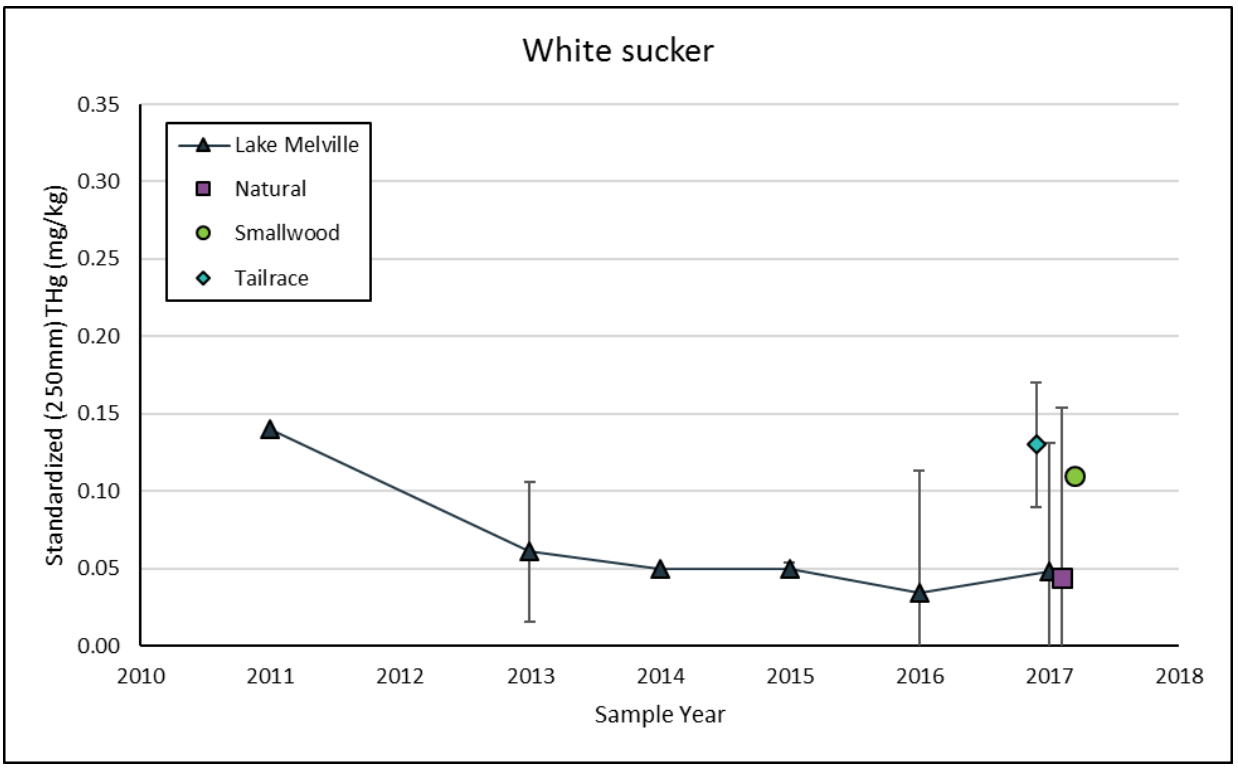

Figure 5: Comparison of annual standardized white sucker total Hg (standardized to 250mm length) from Lake Melville with samples collected from Natural lakes, Smallwood reservoir, and the Churchill Falls tailrace.

As shown above, the time series of standardized THg samples collected from Lake Melville contain concentrations that are within, or below, the ranges measured from the Smallwood reservoir, the Churchill Falls tailrace and those concentrations measured at natural control lakes. Brook trout were not captured within the Smallwood reservoir in 2017; however, samples from Lake Melville were lower than those sampled from both the Churchill Falls tailrace and the natural lakes (see **Figure 2**). The THg values within Lake Melville are for the most part all within levels found in fish in natural or background waterbodies. The values for all are quite low and are comparable to other natural areas.

References

Anderson, M.R. (2011). Duration and extent of elevated mercury levels in downstream fish following reservoir creation. River Systems 19(3): 167-176.

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Closure / Limitations

The THg data collected were based on standard sampling and analysis methods utilized for the Muskrat Falls Environmental Effects Monitoring (EEM) program and used in other similar exercises to determine fish biometrics and contaminant levels. It also includes analysis (standardized length estimations) like previous programs implemented by DFO.

Yours truly,

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