Mercury Monitoring Plan

Whale Tail Mine

Prepared for:

Agnico Eagle Mines Ltd
Meadowbank Complex
Baker Lake, NU X0C 0A0

Version 4

Final

March 27, 2023

AZIMUTH

Azimuth Consulting Group Inc.
218-2902 West Broadway
Vancouver, B.C., V6K 2G8

EXECUTIVE SUMMARY

General Information

This document (Mercury Monitoring Plan) describes the sampling methods and data analysis that will be used to assess impacts of flooding caused by the construction and operation of the Whale Tail open pit deposit on methylmercury bioaccumulation in the aquatic food web within the Whale Tail south basin area. The Mercury Monitoring Plan was prepared in accordance with Condition 63 of NIRB Project Certificate No. 008 and as a condition of the original NWB Water License 2AM-WTP1826.

Implementation Schedule

The implementation schedule for this plan is effective immediately subject to any modifications proposed as a result of the review and approval process.

Distribution List

Agnico Eagle Mines Limited will maintain a distribution list for the Mercury Monitoring Plan, providing information about all parties that receive the plan including mine personnel, departments, and outside agencies.

- Agnico Eagle – Environmental and Critical Infrastructures Superintendent
- Agnico Eagle – Environment General Supervisor
- Agnico Eagle – Environmental Coordinator
- Agnico Eagle – Environment Technician

Document Control

All significant changes that have been incorporated in Version 4 of the Mercury Monitoring Plan are noted in the table below.

Version & Date (YMD)	Section	Page	Revision
V1 2018/07/09	All	All	Initial document
V2 2019/03/31	2.1 2.3.2 3.0 3.1	All	Mid-field station A76 added Small-bodied fish tissue analysis added Information on analytical methods added Depth profile confirmatory sampling in 2019 added
V3 2019/04/05	All	All	Updated for the Expansion Project in support of the Nunavut Water Board (NWB) Type A Water License Amendment Process
V4 2023/03/27	1	1-8	Introduction – Minor edits to the study design to clarify the core monitoring requirements and study areas included in the Mercury Monitoring Program
	2.2	10	Water Chemistry – Overview of depth profile sampling in Lake A20 conducted in December 2020 (targeted study)
	3	11-13	Sediment Chemistry – Added details about the inundation zone sediment sampling program within the Impoundment
	4	14-16	Fish Tissue Chemistry – Summarized the scope and purpose of the supplemental small-bodied fish sampling program; minor revisions to the Lake Trout section to highlight that reference areas will be harmonized with the EEM program
	5	16-19	Sampling Schedule – Updated sampling schedule for 2023-2026 and decision-making framework for implementing the Mercury Monitoring Program (**Table 5-2**)

Version 4

Prepared By: Azimuth Consulting Group Inc. and Meadowbank Environment Department

Approved By: Eric Haley

Environment and Critical Infrastructures Superintendent

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACROYNMS

CCME	Canadian Council of Ministers of the Environment
CFIA	Canadian Food Inspection Agency
CREMP	Core Receiving Environment Monitoring Program
dw	dry weight
EEM	Environmental Effects Monitoring
FEIS	Final Environmental Impact Statement
ISQG	Interim sediment quality guidelines (CCME sediment quality guidelines)
LiDAR	Light Detection and Ranging (remote sensing method)
masl	Metres above sea level
MMP	Mercury Monitoring Program
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
PEL	Probable effect level (CCME sediment quality guidelines)
QA/QC	Quality Assurance / Quality Control
SIA	Stable isotope analysis
SOP	Standard Operating Procedure
TOC	Total organic carbon
US EPA	United States Environmental Protection Agency
wwt	wet weight

1 INTRODUCTION

1.1 Background

The Whale Tail Mine (Whale Tail) is located approximately 65 km north of Meadowbank within the Amaruq property, a 408 km^2 exploration area on Inuit and federal crown land (**Figure 1-1**). Whale Tail is a satellite deposit that makes use of existing infrastructure at Meadowbank (camp, airstrip, mill, etc.). Additional infrastructure has been built to facilitate the development of the deposits in the region. The Project is permitted under the Type A Water Licence 2AM-WTP1830.

The Whale Tail gold deposit is being developed using open-pit and underground mining approaches. The first phase of the Project involved conventional open-pit mining. To access the deposit, the Whale Tail Dike was constructed in September 2018 to isolate the north basin of Whale Tail Lake. The north basin was dewatered from March 2019 to May 2020 (Agnico Eagle, 2021).

Construction of the Whale Tail Dike altered the hydrology around Whale Tail Lake and caused the water level to rise approximately 3.5 m in the south basin of Whale Tail Lake. The increase in lake elevation created an impoundment that connected Whale Tail Lake with Lakes A20, A63, and A65 (**Figure 1-2**). The water level in the impoundment is passively managed below 156 masl by a channel that connects Lake A20 with Mammoth Lake. The South Whale Tail Channel was completed before spring freshet in 2020. The FEIS for the Approved Project predicted 157 ha of tundra would be flooded at peak water elevation (Agnico Eagle, 2016). High-resolution LiDAR imagery was collected in 2018 as part of the Whale Tail Expansion Project, and based on these data, approximately 148.5 ha of terrestrial habitat would be flooded if water levels are managed below 156 masl (Agnico Eagle, 2021). The satellite imagery in **Figure 1-2** was taken on July 6, 2022 and shows how much lower current water levels are compared to the peak flooding elevation of 155.84 masl measured in the Impoundment in October 2019.

Flooding terrestrial soil around Whale Tail Lake and adjacent waterbodies has the potential to cause an increase in the production of methylmercury leading to higher concentrations in all components of the ecosystem. Concentrations are highest in the tissue of long-lived, predatory fish species, such as Lake Trout, and peak anywhere from 4 to 12 years after flooding. The increase is temporary, however, and as flooded carbon sources for bacterial decomposition are exhausted, methylmercury concentrations gradually decline throughout the ecosystem. A thorough overview of mercury dynamics and trophic transfer in newly-created reservoirs is available in the report on predicted changes in mercury concentration in Lake Trout within the south basin of Whale Tail Lake (Azimuth, 2017).

1.2 Overview of the Study Design

This document describes the study design for the Mercury Monitoring Program (MMP). The MMP was designed specifically to monitor increases in methylmercury in lakes that were impacted by flooding during the construction and operation of the Whale Tail open pit. The MMP was developed to comply with Condition 63 in Project Certificate No. 008 (NIRB, 2020):

> *The Proponent shall conduct additional studies as part of its freshwater aquatic effects analyses to ensure that methylmercury concentrations anticipated to increase during operations in the aquatic environment (including in fish tissue) do not exceed regulatory requirements. In addition, the Proponent shall consider assessing potential risks from consumption of fish containing methylmercury by using Health Canada's*[1] *hazard quotients as a descriptive tool.*

The MMP is implemented with the Core Receiving Environment Monitoring Program (CREMP) as a requirement of Water License 2AM-WTP1830 (Part I, Item 2). There is considerable overlap between the two programs and the two programs have been implemented in parallel during the baseline pre-flooding period (pre-2018) and in the early flooding years (2018-2022). Sampling for the MMP has also been completed under the mandate of the Environmental Effects Monitoring program (EEM) and the productivity study led by researchers at the University of Waterloo. Given that certain components of the MMP have been sampled under the EEM (3-year cycle) and productivity study (completed in 2021), there was a need to revisit the study design to ensure the scope of the MMP is clearly defined for the next phase of the project. Agnico Eagle commissioned Azimuth Consulting Group Inc. (Azimuth) to prepare an update to Version 3 of the Mercury Monitoring Plan (Agnico Eagle, 2019) that outlines the monitoring strategy for the next four years (2023-2026) based on findings from the early post-flooding phase (2018-2022).

1.2.1 Monitoring Components

Lake Trout (*Salvelinus namaycush*), along with water and sediment, are the "core" monitoring components of the MMP. Lake Trout are the primary focus of the MMP because of concerns expressed during the permitting phase about higher mercury concentrations in the Impoundment impacting people's use of the fishery. In anticipation of higher methylmercury production caused by flooding, predictions were developed for the magnitude of increase expected in Lake Trout. Mercury concentrations in Lake Trout are predicted to increase between 2-3 times above baseline concentrations (Azimuth, 2019). Agnico Eagle committed to further risk-based analyses if mercury concentrations in Lake Trout from the Impoundment exceed model predictions. This approach is reasonable considering

[1] Health Canada (2007)

the low rates of fishing by local residents in the Project area and a non-fishing policy for workers while onsite (Agnico Eagle, 2018).

Mercury concentrations are monitored in water and sediment to provide an early indication of changes in methylmercury within the Impoundment. Water is particularly important for assessing if methylmercury production within the Impoundment is ongoing, has peaked, or is on the decline. Total mercury concentrations in surface water are predicted to peak at 50-100 ng/L (Golder, 2019). No predictions were made for methylmercury in surface water or sediment. In 2022, total mercury concentrations in the Impoundment measured between 2-3 ng/L, well below predictions in the FEIS.

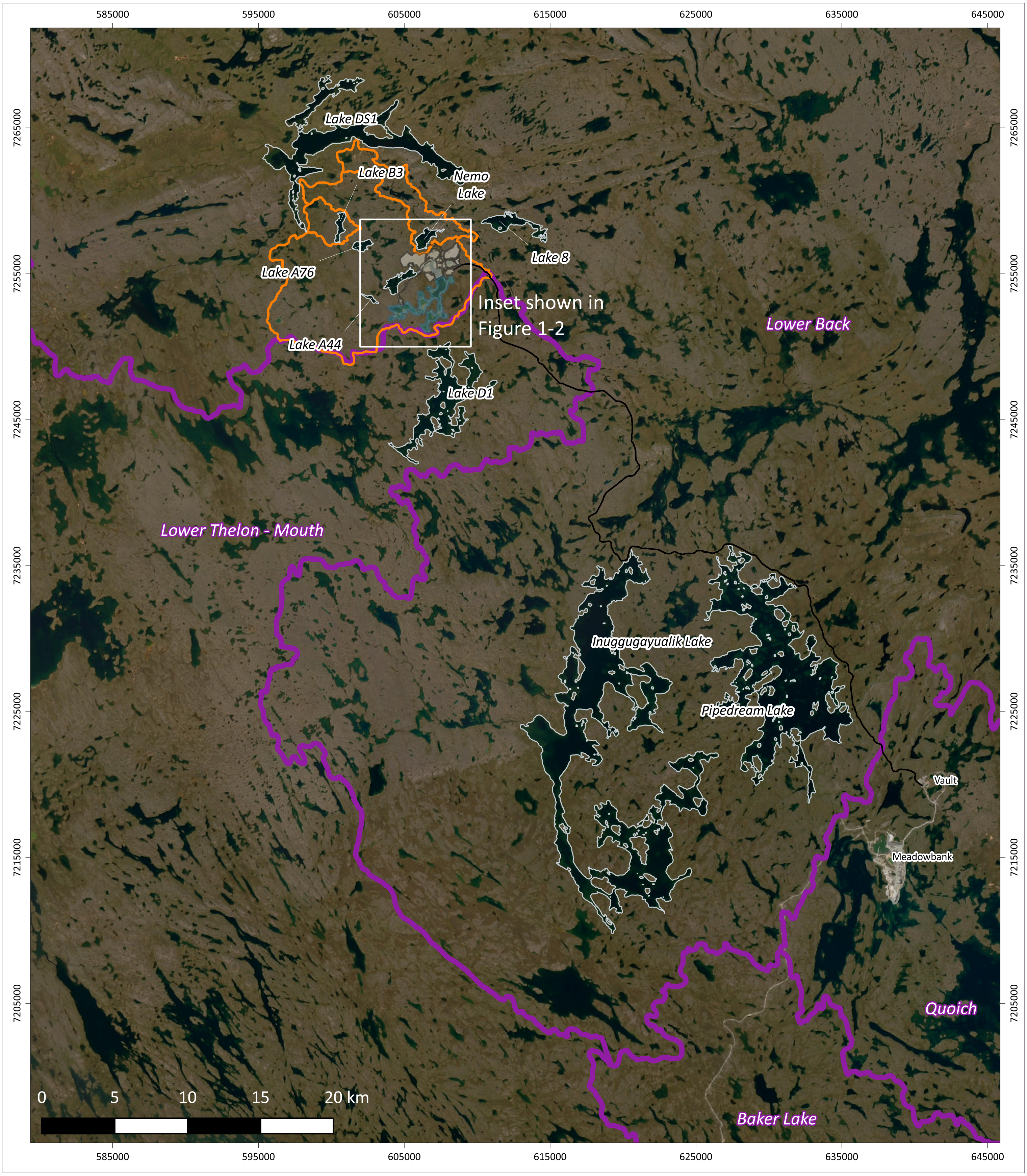
In addition to the core components of the MMP, tissue chemistry data has also been collected for benthic invertebrates, zooplankton, and small-bodied fish. Benthic invertebrates and zooplankton were sampled from the south basin of Whale Tail Lake (WTS) and Mammoth Lake (MAM) in 2016 to provide a baseline estimate of total and methylmercury concentrations at the base of the aquatic food web. Those data, along with the sampling methods, are provided in the baseline mercury data memorandum (Azimuth, 2018). Slimy Sculpin (*Cottus cognatus*) and Ninespine Stickleback (*Pungitius pungitius*) were collected from 2018 to 2021 under the mandate of a research project at the University of Waterloo that investigated changes in lake productivity downstream from the mine. Because there was an overlap in the study areas for the MMP and the productivity study, Agnico Eagle decided to opportunistically analyze some of the small-bodied fish to understand the temporal trend of mercury bioaccumulation lower in the food web during the initial post-flooding period. Mercury concentrations in Lake Trout are of primary importance to the community, but the small-bodied fish data provided insight into mercury bioaccumulation before changes are observed in Lake Trout. Small-bodied fish, benthic invertebrates, and/or zooplankton may be monitored as targeted studies if mercury concentrations in surface water or Lake Trout exceed predictions in the FEIS (Agnico Eagle, 2021).

1.2.2 Study Areas

The core study area for the MMP includes areas within the Impoundment (WTS, A20, A65) and Mammoth Lake (MAM). The Impoundment is the NF study area because flooded soil in the area south of Whale Tail Lake is the source of methylmercury to the system. MAM is the downstream study area used to monitor the transport of methylmercury downstream from the Impoundment via the South Whale Tail Channel. Monitoring was also conducted at Lake A76 and Lake DS1 to characterize conditions in the downstream receiving environment during the baseline period (2017-2018) and early flooding period (2018-2022). Lake A76 and Lake DS1 are not recommended for yearly monitoring under the MMP unless there is evidence to suggest methylmercury from the Impoundment is being transported downstream and leading to higher concentrations in MAM. Mercury data is collected for Lake A76 and Lake DS1 as part of the CREMP, but with slightly higher detection limits for water and no methylmercury data for water or sediment.

As mentioned above, mercury sampling has been completed under the mandate of the CREMP, EEM, and the U of Waterloo productivity study (**Table 1-1**). The overlap between the MMP and these programs has produced a comprehensive background mercury dataset for water, sediment, and fish for the area around the Whale Tail Mine. In general, reference lakes have been selected to maximize the use of longer-term datasets and facilitate analysis of trends in mercury in the environment over time.

An overview of sampling completed for each monitoring component by year and lake is provided in **Table 1-2**. Details regarding the sample collection methods, quality assurance/quality control (QA/QC) procedures, and approach to analyzing the results are described below.



Legend

- Whale Tail Haul Road
- Whale Tail Mine (2022)
- Impoundment
- Regional Watershed Boundaries
- Amaruq Watershed Boundaries

AZIMUTH

Client	Agnico Eagle Mines Limited - Meadowbank Division
Figure 1-1	Lakes Sampled as Part of the Mercury Monitoring Program
Project	Whale Tail Mine Mercury Monitoring Program

Date: March 16, 2023
Datum: NAD 83 UTM Zone 14N
Scale: 1:350,000
Software: QGIS version 3.22.11-Białowieża

REFERENCES:
1. Mine Plan from Agnico Eagle (2021)
2. Satellite image from ESRI
3. Regional watershed boundaries and waterbodies from NRCan
4. Amaruq watershed boundaries from Agnico Eagle

Legend

Roads

Measured peak flood level (155.84 masl; Oct 2019)

Regional Watershed Boundaries

Amaruq Watershed Boundaries

Dotted line = water elevations prior to flooding (NRCan 1:50K)

AZIMUTH

Client	Agnico Eagle Mines Limited - Meadowbank Division
Figure 1-2	Post-Flood Water Levels in the Impoundment
Project	Whale Tail Mine Mercury Monitoring Program

Date: March 16, 2023
Datum: NAD 83 UTM Zone 14N
Scale: 1:40,000
Software: QGIS version 3.22.11-Białowieża

REFERENCES:
1. Mine Plan from Agnico Eagle (2021)
2. Satellite image from ESRI taken on July 6, 2022
3. Regional watershed boundaries from NRCan
4. Amaruq watershed boundaries from Agnico Eagle

Table 1-1. Lakes sampled as part of the Mercury Monitoring Program.

Designation	Lake ID	Lake Name	Core Area[a]	Description
Impoundment (Exposure)	WTS	Whale Tail Lake South Basin	Yes	Near-field areas; WTS and A20 are monitored as part of the CREMP
	A20	Lake A20	Yes	
	A65	Lake A65	Yes	A65 provides information on spatial and temporal patterns of change within the Impoundment
	A63	Lake A63	No	Limited sampling for the U of Waterloo productivity study
Downstream (Exposure)	MAM	Mammoth Lake	Yes	Near-field area; downstream from the Impoundment
	A76	Lake A76	No	Mid-field area downstream from MAM
	DS1	Lake DS1	No	Far-field monitoring area to verify changes to water quality do not extend downstream
Reference	INUG	Inuggugayualik Lake	Yes	CREMP and MMP reference area
	PDL	Pipedream Lake	Yes	CREMP and MMP reference area
	Lake 8	Lake 8	No	Reference area for the Cycle 1 EEM (2020)
	D1	Lake D1	No	Reference area for the Cycle 1 EEM (2020)
	NEM	Nemo Lake	No	Reference area for the productivity study
	A44	Lake A44	No	Reference area for the productivity study
	B3	Lake B3	No	Prospective reference area

Notes

[a] Core areas refer to the Impoundment and Mammoth Lake (MAM) and the CREMP reference lakes INUG and PDL. The other reference lakes listed here may be sampled for Lake Trout instead of INUG and PDL to harmonize the MMP with other monitoring programs.

Table 1-2. Overview of sampling completed for the Mercury Monitoring Program from 2016 to 2022.

	Component	Phase	Year	Impoundment			Downstream			Reference						
				WTS WTL	A20	A65	MAM	A76	DS1	INUG	PDL	Lake 8	D1	NEM	B3	A44
Core MMP Components	Water [a]	Baseline	2016	C												
	- Ultra-trace Hg	Baseline	2017	C			C									
	- Methylmercury	Baseline[b]	2018	I	C	C	C	C				C		C		
		Flooded	2019	~~I~~	~~I~~	~~I~~	~~I~~	~~I~~	~~I~~			~~C~~				
		Flooded	2020	I	I	I	I	I	I	C	C	C	C	C	C	C
		Flooded	2021	I	I	I	I	I	I	C	C		C		C	C
		Flooded	2022	I	I	I	I	I	I	C	C				C	C
	Sediment [b]	Baseline	2016	C	C	C	C	C	C	C	C					
		Baseline	2017	C	C	C	C	C	C	C	C					
		Baseline	2018	C	C	C	C	C	C	C	C	C	C	C		
		Flooded	2019	I	I	I	I	I	I	C	C	C	C	C		
		Flooded	2020	I	I	I	I	I	I	C	C	C	C	C	C	
		Flooded	2021	I	~~I~~	~~I~~	~~I~~	I	~~I~~	~~C~~	~~C~~					
		Flooded	2022	I	I	I	I	I	I	C	C				C	
	Lake Trout	Baseline	2015	C			C									
		Baseline	2018	C								C				
		Flooded	2020	I			I		I			C	C			
Supplemental Studies	Small Bodied Fish	Baseline	2018	C	C	C	C					C				
		Flooded	2019	I	I	I	I									C
		Flooded	2020	I	I	I	I					C	C		C	C
		Flooded	2021	I	I	I	I			C	C	C			C	C
	Benthos	Baseline	2016	C			C									
	Zooplankton	Baseline	2016	C			C									

Notes:
C = Control (baseline); I = Impact (post flooding)
[a] Filtered and unfiltered total mercury data for standard detection limits are collected annually under the mandate of the CREMP.
[b] Total mercury analysis was included in grab samples (annual) and cores (3-year cycle). Refer to **Section 3** for details on the sediment sampling program.
[c] Minor flooding, limited to Whale Tail (south basin), during 2018 sampling. Fully flooded during 2019 and 2020 sampling (i.e., connectivity between impounded lakes).
Strikethrough indicates water samples were collected in 2019, but the results were flagged as unreliable because of cross-contamination at the U of Waterloo.
Double strikethrough indicates sediment samples were collected in 2021 but the samples were discarded by the lab prior to analysis.

2 WATER CHEMISTRY

2.1 Surface Water Sampling Program

The purpose of the surface water sampling program is to monitor temporal and spatial changes in ultra-trace and methylmercury within the Impoundment (WTS, A20, and A65) and at MAM, the first lake downstream from the Impoundment. Sampling is conducted annually in August in the Impoundment, MAM, and selected reference lakes in the region. Characterizing the background concentration of mercury is important each year to distinguish between changes in total and methylmercury within the Impoundment caused by flooding vs changes that are related to wider regional trends. INUG and PDL are the preferred reference areas for the MMP given the long-term dataset, but other reference areas may be considered based on other monitoring initiatives.

Ultra-trace mercury samples are collected from two locations in each lake as per the CREMP study design (Azimuth, 2022a). The sampling locations for the MMP are co-located with the sampling locations for the CREMP. Lake A65 is not monitored under the CREMP, so two randomly located stations are selected each year in areas where the water depth is at least 5 m. Sample bottles are provided by the laboratory at Western University (Biotron) double-bagged as part of their internal quality assurance/quality control (QA/QC) procedure. Water is collected as a grab sample just below the surface according to the *clean hands/dirty hands method* (US EPA, 1996). One team member is designated *clean hands* and this person only handles the inner bag and sample container. The second team member is designated the *dirty hands* and this person handles the outer bag but never contacts the sample container or inner bag. After the bottle is filled, it is placed back into the double bag and stored in a cooler until returning to the field lab. Water samples are frozen on Site and shipped to Biotron where they are subsequently thawed, processed, and analyzed for unfiltered and filtered (< 0.45 µm) total[2] and methylmercury.

Unfiltered and filtered mercury samples are also collected as part of the CREMP in March, May, July, August, and September. The CREMP water samples are collected from 3 m below the surface according to the standard operating procedure (SOP) for the CREMP Plan (Azimuth, 2022a). The detection limit for filtered and unfiltered total mercury for the CREMP is 5 ng/L compared to detection limit of 0.056 ng/L for the MMP[3].

---

[2] The *total* in total mercury refers to the inclusion of all species of mercury (i.e., both inorganic and organic forms). To avoid confusion, the term *unfiltered* is used rather than *total* when addressing partitioning between particulate-bound and dissolved phases.

[3] The method detection limit reported by Biotron for 2022.

2.2 Depth Profile Sampling Program (Targeted Study)

Changes in methylmercury concentrations with depth may be a consideration in stratified systems, as anoxic conditions can promote methylation. Limnology data collected during the baseline period and early operations have consistently shown that lakes in the region are well-oxygenated and unstratified throughout the year. To confirm low rates of methylmercury formation, a depth profile sampling program was completed in Lake A20 in December 2020. Lake A20 was chosen because it is the deepest lake in the Impoundment and therefore more likely to exhibit stratified conditions.

The results of the sampling program confirmed that conditions in Lake A20 are well mixed. Temperature and specific conductivity readings were uniform from surface to the bottom of the lake, and dissolved oxygen remained high throughout the depth profile. Total mercury and methymercuy results were also unstratified. Overall, the high oxygen concentrations and relatively stable mercury concentrations throughout the water column suggest that mercury methylation rates are not elevated near the water-sediment interface. Furthermore, these data demonstrate that discrete sampling near the surface provides an accurate estimate of mercury concentrations throughout the water column.

Based on these results, depth profiles for ultra-trace mercury analysis are not included as a core component of the MMP. However, if there is evidence of axonia within the Impoundment when limnology profiles are collected for the CREMP, ultra-trace mercury and methylmercury may be completed. Anoxic conditions are defined as dissolved oxygen saturation less than 50% or less than 6 mg/L when the water temperature is equal to 4°C.

2.3 Laboratory Analysis

Water samples are analyzed for ultra-trace mercury and methylmercury at Biotron laboratory (Western University). Biotron is a CALA-accredited laboratory, with detection limits for mercury that are lower than those available from commercial analytical labs. Samples are transported in coolers with ice packs to Biotron at the earliest convenience to minimize the possibility of exceeding the recommended hold-times between collection and analysis. Samples are analyzed using ultra-low detection methods for total mercury (Cold Vapour Atomic Fluorescence – Digestion, Method Ref. modified from EPA 1631, Lab Method ID - TM.0811) and methyl mercury (Cold Vapour Atomic Fluorescence Spectrophotometry, Method Ref. modified from EPA 1630, Lab Method ID - TM.0812).

2.4 Quality Assurance / Quality Control

Quality assurance/quality control methods will follow those described in the CREMP: 2022 Plan Update (Azimuth, 2022a). Each sampling event will include a field blank to assess cross-contamination and field duplicates to evaluate the consistency of the sampling and analytical methods. One field duplicate will be collected for every 10 samples.

The following quality control information is included in the certificate of analysis provided by Biotron: the method detection limit, the concentration in the method blank, relative percent difference between duplicate samples, recovery of methyl and total mercury in the quality control samples, and recovery (%) of the matrix spikes.

2.5 Data Analysis

Data analysis focuses on spatial and temporal patterns of increasing mercury concentrations in the Impoundment and lakes downstream of the Mine. Based on a literature review of studies on permanently-flooded reservoirs, methylmercury concentrations could increase 10 to 20 times in water relative to baseline concentrations. The baseline mercury concentration used in the assessment was equivalent to the detection limit for the CREMP of 0.005 µg/L. Assuming a literature-based increase for permanently flooded reservoirs (which is a highly conservative assumption) and the comparatively high detection limit of 0.005 µg/L from the routine CREMP dataset, mercury concentrations could increase to a maximum of 0.05 to 0.1 µg/L (Agnico Eagle, 2019). The lower limit of the predicted change in mercury is above the aquatic life guideline (0.026 µg/L; CCME, 1999) but below the drinking water quality guideline (1 µg/L; Health Canada, 2022). If the lower detection limit of 0.0005 µg/L from the 2017 baseline samples was used in the assessment, the range of predicted concentrations in the Impoundment goes down ten-fold to 0.005 to 0.01 µg/L (or 5 ng to 10 ng/L).

3 SEDIMENT CHEMISTRY

Organic soils in flooded terrestrial habitats are the medium for bacterially-mediated mercury methylation and mobilization of methylmercury into aquatic food chains. After terrestrial areas are flooded, the bulk of mercury methylation occurs in the top 5 to 10 cm of soil (Coleman et al. 1999). Soil erosion from wind and wave action and scour from ice along the shoreline area can transport organic material to depositional areas of lakes where mercury methylation can also occur. Given the ability for methylation to occur in the newly-flooded areas and depositional areas, monitoring is conducted along the shoreline area of the Impoundment as well as in depositional areas sampled as part of the CREMP. An overview of each program is provided below.

3.1 Inundation Zone Sediment Sampling Program

Sediment samples for methylmercury analysis are collected from selected locations in the littoral areas of Whale Tail Lake, Lake A20, and Lake A65 every 3-years, coinciding with the timing of the sediment coring program in the depositional area. The purpose of this program is to monitor increases in mercury and methylmercury in newly-flooded soils within the Impoundment. Sampling was most recently completed in 2022 and as expected, methylmercury concentrations were elevated in the littoral samples compared to baseline concentrations in soil samples collected in 2016 and sediment from the depositional areas in WTS and Lake A20. The next sampling event is planned for 2023. The need to continue monitoring mercury concentrations in the inundation zone will be reassessed before completing the 2026 sampling event (see **Section 5**).

Samples will be collected in the vicinity of where soil samples were collected at WTS and A65 in 2016. Two additional locations will be sampled along the shoreline of Lake A20 to characterize the spatial extent of changes in mercury in the littoral area of the Impoundment. Either the sediment coring device or the Petite Ponar will be used to collect sediment, depending on the substrate at each location. Similar to the coring program, the top 1.5 cm of sediment will be collected and submitted for total mercury, methylmercury, pH, and TOC.

3.2 Depositional Zone Sediment Coring Program

The depositional sediment coring program is conducted every three years to monitor temporal trends in total and methylmercury accumulation in deep areas of WTS, Lake A20, and MAM. The coring program for the MMP is completed in August, coinciding with the sediment coring program for the CREMP. The program was most recently completed in 2020 and included Lake A76 and Lake DS1. These two lakes were sampled to provide baseline data to use in case future monitoring indicates methylmercury is being transport downstream from the Impoundment to MAM in future years. In addition to INUG and PDL, sediment cores were collected for total and methylmercury analysis at Lake 8, Lake D1, and Lake B3 to bolster the background dataset. Beginning in 2023, methylmercury sampling for the sediment coring program will focus on the Impoundment (WTS and A20) and MAM. Total mercury concentrations will continue to be characterized in sediment cores from Lake A76 and Lake DS1 as part of the CREMP.

Sediment cores are collected from ten replicate stations in the vicinity of where benthic invertebrate sampling is completed for the CREMP. A minimum of five replicate samples are submitted for analysis. The remaining samples may be submitted for analysis to support decision-making on a case-by-case basis. The top 1.5 cm of sediment is collected from each sediment core and submitted for metals (including mercury), methylmercury, pH, and TOC. If the sediment is unconsolidated (loose), the top 1.5 cm of sediment from two or more cores may be needed to provide enough sediment to complete the analyses.

In addition to the sediment coring program, sediment grabs (Petite Ponar) are collected annually to support the benthic invertebrate community monitoring program. Sediment grabs are used to characterize grain size and TOC, two parameters that strongly influence the structure of invertebrate communities. Subsamples are also submitted for metals analysis (including mercury), but compared to the sediment coring program (top 1.5 cm), the grab chemistry data are not well-suited for tracking increase in metals caused by mining activities or increases in methylmercury attributed to flooding.

Sediment cores and grabs are collected according to the SOPs in the CREMP: 2022 Plan Update (Azimuth, 2022a).

3.3 Laboratory Analysis

Sediment samples are analyzed at ALS Environmental according to standard laboratory testing procedures. Methylmercury and total mercury are both analyzed by cold vapour atomic fluorescence spectrophotometry. Target detection limits are 5 µg/kg for total mercury and 0.05 µg/kg for methylmercury.

3.4 Quality Assurance / Quality Control

The QA/QC procedures for the MMP mirror those outlined in the CREMP: 2022 Plan Update (Azimuth, 2022a). Field equipment is washed between stations to minimize cross-contamination. Field duplicates are collected in the immediate vicinity of original samples from randomly selected locations as a test of consistency in field methodology and to characterize the heterogeneity of sediment chemistry within discrete areas. The number of field duplicates is approximately 10% of the total number of samples.

3.5 Data Analysis

Predictions were not developed for changing concentrations of mercury in sediment caused by flooding of terrestrial soil. In the absence of predictions, data analysis will focus on assessing temporal trends in mercury concentrations within each lake and spatial changes between areas. Mercury concentrations are also screened against the CCME Sediment Quality Guidelines for the Protection of Aquatic Life. The Interim Sediment Quality Guideline (ISQG) for mercury is 0.17 µg/g or 170 µg/kg and the probable effect level (PEL) concentration is 0.486 µg/g or 486 µg/kg (CCME, 1999). CCME defines concentrations below the ISQG as rarely associated with effects to benthic invertebrates, whereas concentrations above the PEL are classified as frequently associated with adverse biological effects. In reality, there are a multitude of site-specific factors that determine whether mercury concentrations in sediment are sufficiently elevated to cause impacts to the benthic invertebrate community. For this reason, the CCME sediment quality guidelines used only as a qualitative point of comparison for assessing potential risks to aquatic life. Annual benthic invertebrate community monitoring completed as part of the CREMP provides a direct assessment of whether sediment chemistry is impacting the health of the benthic invertebrate community.

4 FISH TISSUE CHEMISTRY

4.1 Large-bodied Fish (Lake Trout)

Lake Trout were selected as the sentinel species to monitor mercury bioaccumulation in the food web. Mercury is well-known to biomagnify in aquatic environments and concentrations are typically highest in piscivorous fish such as Lake Trout in subarctic lakes in Canada (Moslemi-Aqdam et al., 2023). Creation of the Impoundment and subsequent increases in methylmercury production has the potential to contribute to higher concentrations of mercury in Lake Trout.

During operations, collection of large-bodied fish tissue for the MMP will be synchronized with the EEM program, which occurs once every three years. Cycle 1 of the EEM was completed in 2020; Cycle 2 is scheduled for 2023. The exposure area is the Impoundment and up to two reference areas will be sampled. Lake Trout are assumed to migrate throughout WTS, A20, and A65 given the lakes are connected. For this reason, the Impoundment is treated as one study area. Mammoth Lake and Lake DS1 were both included in the monitoring program in 2020, but these lakes will only be monitored in the future if mercury concentrations from Lake Trout in the Impoundment exceed predictions in the FEIS. Reference areas for the Lake Trout tissue chemistry program have not been formally defined because the MMP is harmonized with the EEM. For the Cycle 1 EEM, the two reference areas were Lake D1 and Lake 8. INUG and PDL have also been used as reference areas for EEM program (2017) and may be selected in the future.

A minimum of 20 Lake Trout will be collected from each lake covering a range of size classes. For fish that are lethally sampled, boneless, skinless dorsal muscle is taken from anterior to the dorsal fin. Tissue samples are frozen on site and transported Biotron for mercury analysis (total) and stable isotope analysis (SIA). The ratios of carbon and nitrogen, two principal elements of biological tissue, can be used to quantify the feeding ecology of fish. Other fisheries data included in the MMP is collected under the scope of the EEM program such as length and weight of individual fish, otoliths for ageing, and catch-per-unit-effort. Non-lethal sampling methods may also be used to collect muscle tissue from Lake Trout within the Impoundment to avoid unnecessary fish mortality in this relatively small headwater system. Biopsy sampling methods have been shown to produce mercury concentrations that are comparable to whole-fish (Baker et al., 2004).

4.2 Small-bodied Fish (Supplemental Study)

Small-bodied fish are not a core component of the MMP. Rather, tissue samples were opportunistically collected from a subset of the fish captured for the Productivity Study. The small-bodied fish mercury data were useful for evaluating mercury bioaccumulation in the aquatic food web during the initial years of flooding, before higher concentrations of mercury are predicted to occur in Lake Trout. Small-bodied fish sampling within the Impoundment is planned for 2023 to determine if concentrations have peaked, after which the program will be suspended.

Slimy Sculpin and Ninespine Stickleback were targeted in the sampling programs from 2018 to 2021 in case catch success was low for one of the species in a given year. Specimens were selected for analysis after reviewing the length distributions for each species and each year. Size classes with sufficient sample numbers across collection years and lakes were selected to allow comparisons between areas and across years.

Small-bodied fish dissections in 2018 to 2021 were carried out by researchers at the University of Waterloo. Specimens are analyzed as whole-body samples with viscera and otoliths removed. Samples are freeze dried and homogenized before being sent to Biotron for analysis. A tissue moisture content of 78% was used to convert dry weight concentrations to wet weight (wwt) concentrations. Similar methods will be used in 2023 and in future programs (as needed) to ensure comparability with the results from 2018 to 2021.

4.3 Laboratory Analysis

Concentrations of total mercury in Lake Trout muscle will be analyzed at Biotron at the University of Western Ontario using a Milestone® DMA-80 Direct Mercury Analyzer in accordance with U.S. EPA method 7473 (U.S. EPA, 2007).

4.4 Quality Assurance / Quality Control

Data quality is ensured by following specified sampling procedures, using laboratories that have been certified for all applicable methods, and by staffing the program with experienced technicians. Samples are collected according to standard care and QA/QC procedures:

- Tissue samples are placed in individual Whirl-Pak® bags, labelled with sample ID and date, and placed in a freezer in the field. Samples were placed in coolers with ice or dry ice during shipment to the laboratory.
- Fillets are handled while wearing nitrile gloves and care is taken to avoid introducing foreign particles that may contaminate the sample.
- The equipment (fillet knife and cutting board) was washed with phosphate-free cleaning detergent and site water and wiped dry with paper towel between samples.

4.5 Data Analysis

Baseline total mercury in Lake Trout (not adjusted for size) in Whale Tail Lake ranged from 0.077 to 2.19 µg/g wwt), with an average of 0.49 µg/g wwt (just below the guideline of 0.5 µg/g; CFIA 2014) (Volume 6, Appendix 6-K, Appendix C). Predicted increases in Lake Trout within the Impoundment were initially stated in the FEIS for the Approved Project (Agnico Eagle, 2016). The predictions were based on a review of the literature for reservoirs and conservatively assumed permanently flooded conditions. In this scenario, mercury concentrations for Lake Trout within the Impoundment could range from 4.4 to 19.7 µg/g wwt, with an average mercury concentration ranging from 1.0 to 4.41 µg/g wwt.

The magnitude of change in mercury concentrations for Lake Trout in the Impoundment were initially developed based on the mine plan in the Approved Project (Azimuth, 2017). The predictions were revised for the Expansion Project in 2019 to account for four additional years of flood conditions (2022-2026) in the south Whale Tail Lake area (Azimuth, 2019). The predictions for the Expansion Project were similar to the Approved Project, indicating four additional years of flooding in the Impoundment would have a negligible effect on peak mercury concentrations in Lake Trout. Mercury concentrations in a standard 550 mm Lake Trout were predicted to increase 3 times above baseline concentrations (mean = 1.55 mg/kg wwt; 95% CI = 0.9 to 1.76 µg/g wwt).

Agnico Eagle has committed to further risk-based analyses if measured fish tissue concentrations exceed model predictions. Additional studies may also be implemented to understand the spatial extent of changes in mercury concentrations in Lake Trout farther downstream and/or studies to identify the processes contributing to higher mercury concentrations at the top of the aquatic food web.

5 SAMPLING SCHEDULE

The sampling schedule for the surface water, sediment, and Lake Trout components of the MMP from 2023 to 2026 are presented in **Table 5-1**. The scope of the 2023 program is established and will include water and sediment sampling to track methylmercury production in the Impoundment as well as off-site migration of methylmercury downstream to MAM. Lake Trout sampling is also planned for the Impoundment in 2023. This will be the second sampling event during the post-flood phase. In 2020, mercury concentrations in a standard 550 mm Lake Trout were similar to baseline (2015 and 2018), indicating higher concentrations of mercury observed in small-bodied fish from 2018-2020 were not yet reflected in predatory fish at the top of the food web (Azimuth, 2022b). One more year of small-bodied fish sampling is planned for 2023 to determine if mercury concentrations lower in the food web have stabilized or if concentrations are increasing.

As long as mercury concentrations in Lake Trout in 2023 remain below predictions and there is no evidence to suggest methylmercury is being transported downstream, the scope of the MMP in 2024 and 2025 will focus on monitoring temporal trends for total mercury and methylmercury in water within the Impoundment and downstream in MAM.

The scope of the monitoring program in 2026 will most likely include a repeat of the 2023 study, minus the supplemental small-bodied fish sampling program. The temporal pattern in large-bodied fish mercury concentrations seen at most reservoirs includes an initial increase to a peak (e.g., by 4 to 12 years), followed by a gradual decrease to baseline or near-baseline concentrations over successive years (Azimuth, 2019). Assuming the same timeline applies for the Impoundment, higher concentrations of mercury should be observed in Lake Trout in 2026, which coincides with when water levels in the Impoundment are planned to be drawn down to baseline levels.

The need to continue the MMP beyond 2026 will be determined primarily based on the Lake Trout tissue chemistry results. An overview of the four future monitoring scenarios and corresponding implications for managing methylmercury risks are described in **Table 5-2.** If the weight of evidence from the water, sediment, and fish sampling programs suggests the reservoir effect has peaked and is declining in 2026, then Agnico Eagle will engage with the agencies to discuss the future of the MMP.

Table 5-1. Sampling plan for the Mercury Monitoring Program, 2023-2026.

Component	Frequency (August)	Analyses		Target Sample Numbers per Lake								
				Impoundment			Downstream			Reference Areas[c]		
		Mercury Analyses [a]	Other Analyses	WTS	A20	A65	MAM	A76	DS1	INUG	PDL	Other
Surface Water	Annual	THg & MeHg (unfiltered and filtered)	CREMP parameters [b]	2	2	2	2			2	2	
Sediment Chemistry Depositional Zone Grabs	Annual (CREMP)	THg	Organic carbon, grain size, metals	5	5		5	5	5	5	5	
Sediment Chemistry Depositional Zone Cores	2023, 2026	THg & MeHg	TOC, pH, moisture	5	5		5			5	5	
Sediment Chemistry Inundation Zone	2023, 2026	THg & MeHg	TOC, pH, moisture	2	2	2						
Lake Trout	2023, 2026	THg	Fish health endpoints, age; SIA	20			See footnote [d]			20 fish at each of 2 reference areas [e]		

Notes

[a] THg = total mercury; MeHg = methylmercury

[b] CREMP parameters = limnology profiles; conventional parameters, major ions, nutrients, organic carbon, total and dissolved metals, and chlorophyll-a

[c] Reference areas will be selected in conjunction with the CREMP and EEM.

[d] Fish may be collected from opportunistically from MAM as part of the EEM program in 2023. Sampling in MAM, A76, and DS1 may be completed if mercury concentrations in Lake Trout from WTS exceeded predictions.

[e] The reference areas for the Lake Trout tissue chemistry program will match those areas selected for the EEM program.

Table 5-2. Decision-making framework for implementing the Mercury Monitoring Program.

Scenario	Implications for Managing Methylmercury Risks
1. Reservoir Effect is *Ongoing* • Lake Trout Hg concentrations have not peaked, and • evidence from other media (e.g., water, small-bodied fish) indicate the reservoir effect is ongoing (i.e., no indication that concentrations are decreasing).	Continue monitoring
2. Reservoir Effect has *Peaked* Lake Trout Hg concentrations • show clear evidence of having peaked, • peak concentration is at or below predictions, and • concentrations are trending lower toward a new baseline, and evidence from other media (e.g., water, small-bodied fish) indicate the reservoir effect has peaked and concentrations are decreasing towards a new baseline.	Engage with agencies to discuss the need to continue monitoring
3. Reservoir Effect *Exceeds* Predictions and is *Ongoing* Lake Trout Hg concentrations exceed predictions.	Continue monitoring Conduct risk-based analyses as needed
4. Reservoir Effect *Exceeded* Predictions and have Decreased to New Baseline Lake Trout Hg concentrations • show clear evidence of having peaked, • concentrations have decreased to below predictions, and • concentrations are trending lower toward a new baseline, and evidence from other media (e.g., water, small-bodied fish) indicate the reservoir effect has peaked and concentrations are decreasing towards a new baseline.	Update risk-based analyses Engage with agencies to discuss the need to continue monitoring

6 REFERENCES

Agnico Eagle Mines Limited. 2021. Meadowbank Complex – 2020 Migratory Bird Protection Report. Prepared by Agnico Eagle. March 2021.

Agnico Eagle. 2019.CREMP Addendum – Appendix A: Mercury Monitoring Plan for Whale Tail South Area. Report prepared by Agnico Eagle Mines Limited – Meadowbank Division. March 2019.

Agnico Eagle. 2016. Whale Tail Pit Project - Meadowbank Mine Final Environmental Impact Statement and Type A Water Licence Amendments. Amendment/Reconsideration of the Project Certificate (No. 004/ File No.03MN107) and Amendment to the Type A Water Licence (No. 2AM-MEA1525). Submitted to the Nunavut Impact Review Board. June 2016.

Azimuth Consulting Group Inc. 2022a. Core Receiving Environment Monitoring Program: 2022 Plan Update. April 2022.

Azimuth. 2022b. 2021 Mercury Monitoring Program. Whale Tail Pit Project. March 2022.

Azimuth. 2019. Technical Memorandum – Revised Predictions of Fish Mercury Concentrations in Whale Tail Lake (South Basin). August 19, 2019.

Azimuth. 2018. Whale Tail Pit Project: Mercury Data Compendium and Memorandum. June 2019.

Azimuth. 2017. Whale Tail Pit project: Predicted changes in Fish Mercury Concentrations in the Flooded Area of Whale Tail Lake (South Basin). February 2017.

Baker R.F., Blanchfield J., Paterson M.J., Flett F.J., Wesson L. 2004. Nonlethal methods for the analysis of mercury in fish tissue. T. Am. Fish. Soc. 133:568-576

CCME. 1999. Canadian sediment quality guidelines for the protection of aquatic life: Mercury. In: Canadian environmental quality guidelines, 1999.

Coleman, J., M. Waldron, R. Breault and R.M. Lent. 1999. Distribution and transport of total mercury and methylmercury in mercury-contaminated sediments in reservoirs and wetlands of the Sudbury River, East-Central Massachusetts. US Dept. Interior. US Geological Survey Report 99-4060. 21 p

Golder Associates Ltd. 2019. Mine Site and Downstream Receiving Water Quality Predictions. Whale Tail Pit – Expansion Project. Report Submitted to Agnico Eagle Mines Ltd, Meadowbank Division, May 2019.

Health Canada. 2022. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Health Canada. 2007. Human Health Risk Assessment of Mercury in Fish and Health Benefits of Fish Consumption. Health Canada, Health Products and Food Branch, Food Directorate, Bureau of Chemical Safety, Ottawa, ON.

Moslemi-Aqdam, M., Low, G., Low, M., Laird, B.D., Branfireun, B.A. and Swanson, H.K., 2023. Estimates, spatial variability, and environmental drivers of mercury biomagnification rates through lake food webs in the Canadian subarctic. Environmental Research, 217, p.114835.

NIRB. 2020. Nunavut Impact Review Board Project Certificate No. 008, Amendment 001. February 19, 2020.

NWB. 2018. Nunavut Water Board Amended Water Licence 2AM-WTP1830. May 29, 2018.

United States Environmental Protection Agency (US EPA), 2007. Method 7473: Mercury in solids and solutions by thermal decomposition, amalgamation, and atomic absorption spectrophotometry. Revision 0. Washington, DC. 17 pp.