Methylmercury Monitoring Plan

Site C Clean Energy Project

Revision 2: April 12, 2024

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Revision History

Version	Date	Comments
Rev 0	28-May-2021	Draft Plan, Revision 0 – Issued for Review by Indigenous Nations, Northern Health, and First Nations Health Authority
Rev 1	23-February-2022	Final Plan, Revision 1 – Issued to EAO,
Rev 2	April 12, 2024	Revision 2– Issued for implementation. Incorporates requested revisions from: BC Environmental Assessment Office including: • Replace "intends to" with “will” throughout MMP • Sections 8.0 and 9.0 expanded upon the communication strategy to enable people to limit exposure to methylmercury to avoid risk to human health. Government of Alberta to: • Section 3.3 replace “temporary changes” with “changes” Updated schedules and years listed to align with 2024 reservoir fill schedule. Addition of land acknowledgement.

Acronyms

AIC	Akaike's Information Criterion
BC	British Columbia
C	Carbon
DOC	Dissolved Organic Carbon
DQO	Data Quality Objective
DTFN	Dene Tha' First Nation
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FAHMFP	Fisheries and Aquatic Habitat Monitoring and Follow-Up Program
FNHA	First Nations Health Authority
FDS	Federal Decision Statement
FLNRO	Forests, Lands and Natural Resource Operations
FWCP	Fish and Wildlife Compensation Program
HHRA	Human Health Risk Assessment
MOE	Ministry of Environment
MMP	Methylmercury Monitoring Plan
MW	Mega Watts
N	Nitrogen
NHA	Northern Health Authority
LOI	Loss On Ignition
pTDI	Provisional Tolerable Daily Intake
SIA	Stable Isotope Analysis
SOP	Standard Operating Procedure
TDR	Technical Data Report
TOC	Total Organic Carbon
TSS	Total Suspended Solids
US EPA	United States Environmental Protection Agency

Definitions

Biota	The types of plant and animal life found in specific regions at specific times.
Baseline	Environmental conditions existing before development against which subsequent changes can be referenced.
Environmental Media	Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.
Benthic	Relating to, or occurring at the bottom of a body of water.
Health Authority	Used in this MMP to specifically refer to the Northern Health Authority and First Nations Health Authority who work together with the British Columbia Ministry of Health to provide health services to British Columbians.
Indigenous Nations	Used in this MMP to specifically refer to Indigenous groups as defined in the Environmental Assessment Certificate and Federal Decision Statement: Blueberry River First Nations, Dene Tha' First Nation, Doig River First Nation, Duncan's First Nation, Fort Nelson First Nation, Halfway River First Nation, Horse Lake First Nation, Kelly Lake Métis Settlement Society, McLeod Lake Indian Band, Métis Nation British Columbia, Prophet River First Nation, Saulteau First Nations, and West Moberly First Nations.
Non-indigenous	Peoples not indigenous or native to a place.
Pelagic	The pelagic zone refers to the water column, where swimming and floating organisms live.

Acknowledgements

We acknowledge the field work associated with the Site C Methylmercury Monitoring Plan will be conducted on the traditional territory of Treaty 8 First Nations of Dunne Zaa, Cree, and Tse'khene cultural descent.

1.0 Introduction

1.1 Project Background

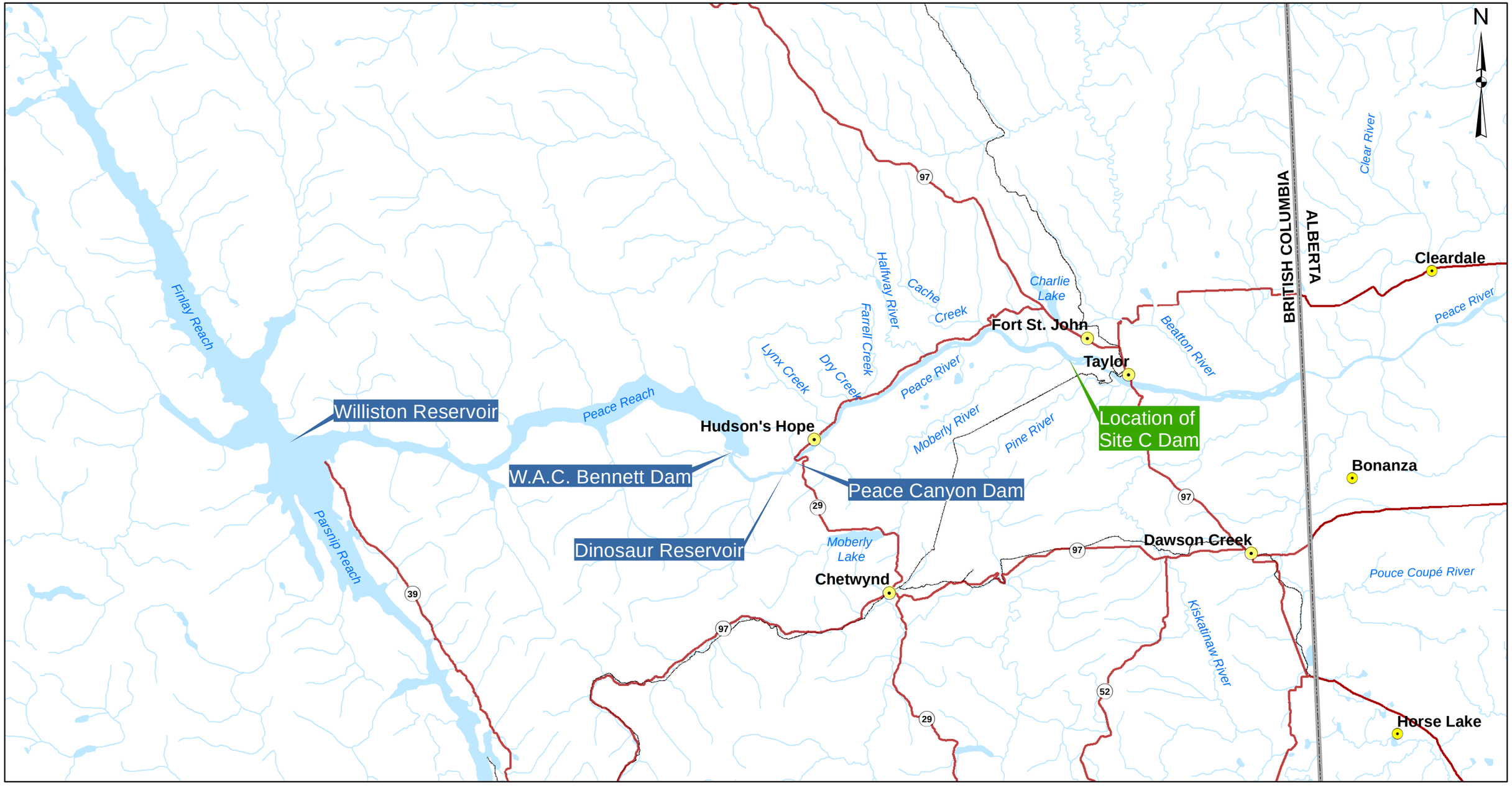
The Site C Clean Energy Project (the Project) will be the third dam and generating station on the Peace River in northeast BC (Figure 1). The Project will provide 1,100 megawatts (MW) of capacity and about 5,100 gigawatt hours of energy each year to the province's integrated electricity system. The project is entering the 6th year of construction of a 9 to 10 year construction period, with diversion of the river into diversion tunnels completed in October 2020.

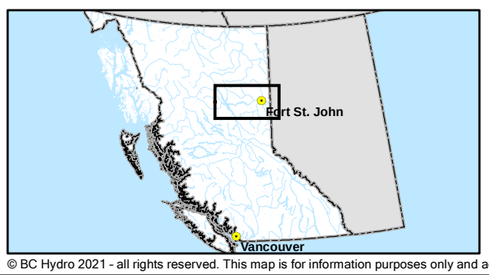
1.2 MMP Regulatory Context

In October 2014, the Provincial Ministers of Environment (MOE) and Forests, Lands and Natural Resource Operations (FLNRO) issued the Environmental Assessment Certificate (EAC) for the Project. In November 2014, the Federal Minister of the Environment issued a Federal Decision Statement (FDS) for the Project. Both the EAC and FDS set out conditions under which the Project can be constructed and operated.

This Methylmercury Monitoring Plan (MMP) for the Project is consistent with, and meets requirements set out in, the conditions listed in EAC, Schedule B, Condition 60 and FDS Condition 13. In addition, the MMP meets the requirement related to development of an MMP, as set out in the Conditional Water Licences for the Project issued in February 2016 by FLNRO.

All MMP EAC Condition 60 and FDS Condition 13 requirements are summarized in Table 1 along with the MMP component that addresses the requirement.





Map Notes:
1. Datum/Projection: NAD83/UTM Zone 10N
2. Data Source: Government of B.C. and Alberta.

Legend

- City/District Municipality
- Highway
- Railway

1:900,000 0 40 km

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Figure 1

Site C Dam Location Map

Date	Apr 20, 2021	DWG NO	1016-N11-01108	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

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Path: X:\ArcGIS\Projects\Environment\Fisheries\SiteC_Dam_LocationMap_1016-N11-01108.mxd

Table 1. Methylmercury Monitoring Plan requirements (and cross-references to MMP sections) stipulated in the Environmental Assessment Certificate (EAC) and in the Federal Decision Statement (FDS).

EAC/FDS Ref #	Condition	MMP Section Where Condition is Addressed (for conditions met within this MMP document)
EAC: METHYLMERCURY		
60	The EAC Holder must, in collaboration with the First Nations Health Authority (FNHA), Northern Health Authority (NHA) and Aboriginal Groups, develop a Methylmercury Monitoring Plan.	Section 1.3 (Consultation)
	The Methylmercury Monitoring Plan must include: Methods for collecting monitoring information must include: • Involving Aboriginal Groups and the FNHA in the design, implementation, management and interpretation and communication of results;	Involvement in design of MMP - Section 1.3 (Consultation) Involvement in the implementation, management and interpretation and communication of results – Section 6.0 (Indigenous Community Sampling Program), Section 7.0 (Fish Consumption Program), and Section 8.0 (Reporting)

EAC/FDS Ref #	Condition	MMP Section Where Condition is Addressed (for conditions met within this MMP document)
	• Use of information regarding consumption of fish by Aboriginal Groups known to consume fish in the methylmercury monitoring study if available, and non-aboriginal harvesters including: ○ species and size of fish caught for consumption; ○ location where fish are caught for consumption; ○ consumption of fish by age group and gender; ○ fish meal sizes by age group and gender; ○ fish meal frequency; ○ parts of fish consumed; ○ fish preparation methods; and other relevant consumption information (e.g. events where consumption is higher over a short period of time such as a camping event); and	Section 7.0 (Fish Consumption Program)
	• Use of baseline methylmercury levels in representative fish species consumed by Aboriginal Groups and non-aboriginal harvesters.	Section 5.4 (Fish).
	Requirements for monitoring the trend and evolution of methylmercury concentrations in fish. Monitoring requirements must include the following: • proposed geographic extent; • proposed monitoring parameters; • proposed monitoring locations; and • proposed monitoring timelines and frequency.	Section 5.0 (Monitoring Program)
	Measures to enable people to limit exposure to methylmercury to avoid risk to human health such as:	

EAC/FDS Ref #	Condition	MMP Section Where Condition is Addressed (for conditions met within this MMP document)
	• a detailed communications strategy developed in consultation with relevant Aboriginal groups and government departments and agencies including consumption advisories or other health related bulletin or information, as may be necessary; and	Section 9.0 (Health Authority Communications)
	• an annual update on the status, results, and trends of methylmercury concentrations in fish and the presence of human health risks associated with the consumption of fish from the affected waterbodies.	Section 8.0 (Reporting)
	Baseline information must be established prior to any project impacts using a minimum of two years of data and operations phase monitoring will occur each year for the first ten years of operations and every 5 years after until such time as methylmercury levels in fish populations have stabilized.	Section 5.3 (Temporal Extent & Monitoring Schedule)
	The EAC Holder must report on the results to EAO, FNHA and NHA in accordance with the monitoring schedule.	Section 8.0 (Reporting)
	The EAC Holder must provide this draft Methylmercury Monitoring Plan to FNHA and NHA for review a minimum of 90 days prior to the commencement of reservoir filling.	
	The EAC Holder must file the final Methylmercury Monitoring Plan with EAO, FNHA and NHA a minimum of 30 days prior to the commencement of reservoir filling.	
	The EAC Holder must develop, implement and adhere to the final Methylmercury Monitoring Plan, and any amendments, to the satisfaction of EAO.	

EAC/FDS Ref #	Condition	MMP Section Where Condition is Addressed (for conditions met within this MMP document)
FDS: HEALTH OF ABORIGINAL PEOPLES – METHYLMERCURY		
13.1.	The Proponent shall monitor and make available information on potential increased exposure to methylmercury from the consumption of fish relative to Health Canada's Provisional Tolerable Daily Intake (pTDI) guidelines.	Section 5.0 (Monitoring Program) Section 9.0 (Health Authority Communications) Appendix C (Reporting and Methods for Calculating Fish Consumption Guidance)
13.2.	The Proponent shall develop, in consultation with First Nations Health Authority, Northern Health, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups, a methylmercury monitoring plan.	Section 1.3 (Consultation)
13.3.	The methylmercury monitoring plan shall include:	
13.3.1 13.3.1.1 13.3.1.2 13.3.1.3 13.3.1.4 13.3.1.5 13.3.1.6 13.3.1.7. 13.3.1.8	• information and analysis regarding consumption of fish by Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups, including: o species and size of fish caught for consumption; o locations where fish are caught for consumption; o consumption of fish by age group and gender; o fish meal sizes by age group and gender; o fish meal frequency; o parts of fish consumed; o fish preparation methods; and o other relevant consumption information (e.g. events where consumption is higher over a short period of time such as a camping event);	Section 7.0 (Fish Consumption Program)
13.3.2.	• methylmercury levels in representative fish species consumed by Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups measured in the year prior to reservoir filling, informed by data gathered in accordance with condition 13.3.1;	Section 5.0 (Monitoring Program)

EAC/FDS Ref #	Condition	MMP Section Where Condition is Addressed (for conditions met within this MMP document)
13.3.3.	• requirements for monitoring the trend and evolution of methylmercury concentrations in fish, informed by data gathered in accordance with conditions 13.3.1 and 13.3.2. Monitoring requirements shall include the following:	
13.3.3.1.	○ geographic extent;	
13.3.3.2.	○ monitoring parameters;	
13.3.3.3.	○ monitoring locations; and	
13.3.3.4.	○ monitoring timelines and frequency;	
13.3.4.	• provisions for the continued collection of consumption information and methylmercury levels in fish, and monitoring of the methylmercury trend and evolution in fish in accordance with conditions 13.3.1, 13.3.2 and 13.3.3, as the composition of fish communities and consumption patterns evolve following the creation of the Site C reservoir;	Sections 5.0 (Monitoring Program) and 9.0 (Fish Consumption Program).
13.3.5.	• measures to enable people to limit exposure to methylmercury to avoid risk to human health such as:	
13.3.5.1.	○ detailed communications strategy developed in consultation with Reservoir Area Aboriginal groups, Immediate Downstream Aboriginal groups and government departments and agencies including consumption advisories or other health related bulletin or information, as may be necessary; and	Sections 8.0 (Reporting) and 9.0 (Health Authority Communications)
13.3.5.2.	○ regular update on the status, results, and trends of methylmercury concentrations in fish and the presence of human health risks associated with the consumption of fish from the affected waterbodies;	
13.3.6.	• a description of how Reservoir Area Aboriginal groups, Immediate Downstream Aboriginal groups and the First Nations Health Authority will be involved in the design, implementation and management of the plan as well as the interpretation and communication of results.	Involvement MMP design – Section 1.3 (Consultation). Involvement in the implementation, management and interpretation and communication of results – Sections 6.0 (Indigenous Community Program), 7.0

EAC/FDS Ref #	Condition	MMP Section Where Condition is Addressed (for conditions met within this MMP document)
		(Fish Consumption Program) and 8.0 (Reporting)
13.4.	The Proponent shall submit to the Agency, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups a draft copy of the plan for review 90 days prior to reservoir filling.	
13.5.	The Proponent shall submit to the Agency the final plan a minimum of 30 days prior to reservoir filling. When submitting the final plan, the Proponent shall provide to the Agency an analysis that demonstrates how it has appropriately considered the input, views or information received from the First Nations Health Authority, Northern Health, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups.	
13.6.	The Proponent shall implement the plan and provide to the Agency an analysis and summary of the implementation of the plan, as well as any amendments made to the plan in response to the results, on an annual basis during the first ten years of operation and once every five years after until such time as methylmercury levels in fish populations have stabilized.	Section 8.0 (Reporting)
13.7.	The Proponent shall provide a copy of the same version of its annual reporting on methylmercury levels as provided to the Agency and in the same timeframe to Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups.	

1.3 Consultation

1.3.1 Overview

Consultation and engagement on the potential human health affects of increased methylmercury concentrations in fish tissue after the formation of the Site C reservoir began during the planning stages and Environmental Assessment for the Project (late 2007 to 2014).

As part of the Project's Environmental Impact Statement (EIS), BC Hydro received input from Indigenous Nations on the locations and fish species that are harvested and important to communities (through Traditional Land Use Studies[1]) as well as issues and concerns regarding methylmercury concentrations in fish tissue. The EIS (Vol. 1, Section 9, Appendix H) provides a summary of the issues, concerns and interests received from Indigenous Nations prior to the filing of the EIS, as well as BC Hydro's responses and considerations. The input received prior to filing the EIS informed the development of a technical memo on methylmercury[2].

An amended EIS was submitted to the Joint Review Panel in August 2013 and in November 2013 the Joint Review Panel announced that the Project would proceed to public hearings in December 2013 and January 2014. The Project received environmental approval from federal and provincial governments in October 2014. Following environmental approval, consultation and engagement with Indigenous Nations continued, including for the conditions of the Project's EAC, FDS and the permits and authorizations required for construction.

Since issuance of the FDS and EAC, additional Indigenous Nation consultation on methylmercury was sought by FLNRO as part of BC Hydro's application for Conditional Water Licences 132990 and132991.

In fall 2019, BC Hydro started to include methylmercury as a topic for discussion during Site C Environmental Forums with Indigenous Nations. Environmental Forums #5 (November 2019), #7 (February 2020), #8 (March 2020), and #9 (May 2020) provided opportunities for Indigenous Nations, Northern Health Authority (NHA), and First Nations Health Authority[3] (FNHA) to discuss the development of the MMP. This engagement included sharing of "Site C Methylmercury in Our Environment: Pictorial" and "Methylmercury in the Site C Reservoir" documents[4], development of a Site C Methylmercury Question and Answer Summary (Azimuth, 2020) , as well as continued discussions regarding MMP implementation and Indigenous Nation involvement. Indigenous Nations and health authorities expressed interest in providing input on MMP study

[1] Traditional Land Use Studies included EIS Vol. 5, Appendix A.
[2] Response to Working Group and Public Comments on the Site C Clean Energy Project Environmental Impact Statement. Technical Memo Methylmercury May 8, 2013. Revision 1 – July 19, 2013. (Link - https://projects.eao.gov.bc.ca/api/document/5887c7ad69dfb5127bd3be3f/fetch)
[3] The Northern Health Authority and First Nations Health Authority are referred to elsewhere in the MMP as 'Health Agency' or 'Health Agencies'.
[4] BC Hydro methylmercury information documents: 1) Methylmercury in Our Environment: Pictorial (Link - https://www.sitecproject.com/sites/default/files/Methylmercury-Poster-11x17.pdf) and 2) Methylmercury in the Site C Reservoir (Link - https://www.sitecproject.com/sites/default/files/SiteC-methylmercury-info-sheet-updates.pdf)

design during the development of the MMP and stressed the importance of communications to support meaningful input by Indigenous Nations.

Based on input received during Site C Environmental Forums, BC Hydro proposed the development of a methylmercury technical sub-committee to the Environmental Forum membership. On 10 March 2020, the sub-committee concept was supported by Environmental Forum members. A Terms of reference was drafted, supported by the Forum members and finalized. Sub-committee members include: 1) FNHA and NHA, 2) representatives from McLeod Lake Indian Band, Blueberry River First Nations, Saulteau First Nation, Horse Lake First Nation and Halfway River First Nation. 3) Azimuth Consulting Group[5],and 4) BC Hydro. The intent of the Sub-committee is to:

- to address Indigenous Nation and Health Authority questions about methylmercury and Site C;
- to collaboratively develop the MMP for Site C incorporating Indigenous knowledge and values;
- to support information sharing, mutual exchange of methylmercury related information;
- to support the development of communication approaches to effectively communicate with Indigenous Nations and Health Authorities; and
- to support the implementation of the MMP and associated communications.

In accordance with EAC Condition 60 and FDS Condition 13 and in consideration of input from Indigenous Nations, Revision 0 of the MMP was submitted to Impact Agency of Canada[6], NHA, FNHA, and Indigenous Nations named in the EAC and FDS conditions for review and comment on May 28, 2021.

BC Hydro is committed to ongoing consultation and engagement on the MMP during the construction and operation phases of the Project. BC Hydro will continue to take into account input received in the future and, if required, revise the MMP (see below).

1.3.2 Input Taken Into Account in Plan Development

Revision 0 of the MMP was shared with Indigenous Nations, Northern Health, and the First Nations Health Authority on May 28, 2021. On October 8, 2021 and December 9, 2021, the methylmercury technical sub-committee met to review and discuss proposed updates to the MMP. Appendix C contains the comments provided by Indigenous Nations, Ministry of Health and Northern Health on Revision 0 of the MMP, as well as BC Hydro's responses to the comments. Table 2 below provides examples of the comments provided by Indigenous Nations on Revision 0 of the MMP.

[5] Provides expertise on methylmercury including human health risk assessment and monitoring program design.
[6] formerly known as the Canadian Environmental Assessment Agency

On February 23, 2022 and February 24, 2022, BC Hydro shared Revision 1 of the MMP with the BC Environmental Assessment Office (EAO) and Indigenous Nations respectively. No additional comments from Indigenous Nations were received on Revision 1 of the MMP. The EAO provided comments to Revision 1 of the MMP on July 24, 2023, and further comments on a draft update to Revision 1 on October 19, 2023.

BC Hydro provided Revision 2 of the MMP, reflecting EAO comments, to the Methylmercury Technical Sub-committee on January 11, 2024. The Sub-committee did not make any comments or provide input on Revision 2 of the MMP at this meeting. On February 7, 2024, BC Hydro provided Indigenous Nations with Revision 2 the MMP. No written comments were received on Revision 2 of the MMP.

BC Hydro also presented the proposed revisions to the Environmental Forum attendees at meeting #35 on March 6, 2024. The meeting agenda and presentation, which included the proposed changes, were provided to forum members prior to the meeting. The revisions to the MMP (as well as proposed changes to the Methylmerucry Monitoring Sub-Committee Terms of Reference) were discussed during the meeting, with an opportunity for forum members to ask questions and provide feedback. No input was received during the meeting and no comments were received after the meeting.

Table 2. Indigenous Nation input on draft MMP (Revision 0) development.

Input No.	Summary of input	Source of Input	Consideration
1	Dene Tha' First Nation (DTFN) concern that provision of the MMP 90 days before reservoir filling in accordance with EAC and FDS Conditions will be "too late to consider and implement mitigation measures".	DTFN on BC Hydro's water licence application for the Project dated October 30, 2015.	BC Hydro initiated discussions with Indigenous Nations, including DTFN, in the year prior to diversion, with the intention of developing the MMP for implementation during river diversion, completed in October 2020. This will allow monitoring to commence in accordance with the plan during river diversion (which includes the creation of a headpond), before reservoir filling is planned.
2	DTFN request for the proposed downstream extent of monitoring of methylmercury concentrations in fish be extended from Many Islands, Alberta, approximately 120 km	DTFN on BC Hydro's water licence application for the Project dated September 15, 2015.	Through the MMP Indigenous Community Sampling Program described in Section 6.0, the extent of the monitoring of methylmercury concentration in fish tissue includes an additional 170 km further downstream to the Smoky River, for

Input No.	Summary of input	Source of Input	Consideration
	downstream of Site C, to confirm uncertainty in duration and extent of elevated methylmercury concentrations.		a total downstream extent of 290 km (Figure 2). The predicted downstream extent of effects are described in Section 5.2.1 of the MMP.
3	DTFN request for ongoing involvement of Indigenous Nations in MMP development and implementation.	DTFN water licence hearing submissions and BC Hydro responses dates December 9, 2015 BC Hydro Environmental Forums November 2019 – March 2020	BC Hydro established a Methylmercury Technical Sub-committee as described in MMP Section 1.3. The MMP includes an Indigenous Community Sampling Program to support Indigenous Nation collection of fish tissue samples for mercury analysis at common fishing locations as described in MMP Section 6.0.
4	The understanding of mercury in the environment, and the risks associated with fish consumption, are not well understood by Indigenous communities.	BC Hydro Environmental Forums November 2019 – March 2020	As described in MMP Section 1.3, BC Hydro developed a Site C Methylmercury Question and Answer Summary as well as methylmercury information sheets in collaboration with Nations for distribution to Indigenous communities and posting on BC Hydro website.
5	Indigenous Nation concerns regarding methylmercury concentration in wildlife including birds and mammals.	BC Hydro Environmental Forums November 2019 – March 2020	As described in MMP Section 1.3, BC Hydro developed a Site C methylmercury question and answer document describing levels of methylmercury in wildlife.
6	Indigenous Nation interest in baseline Peace River fish tissue methylmercury concentrations and associated consumption guidance.	Site C Methylmercury Subcommittee meetings dated October 30, 2020, December 10, 2020, and April 30, 2021.	In collaboration with Health Authorities, baseline Peace River fish consumption guidance is being provided to Indigenous Nations through update of methylmercury backgrounder documents, a methylmercury video, and consumption guidance brochure.

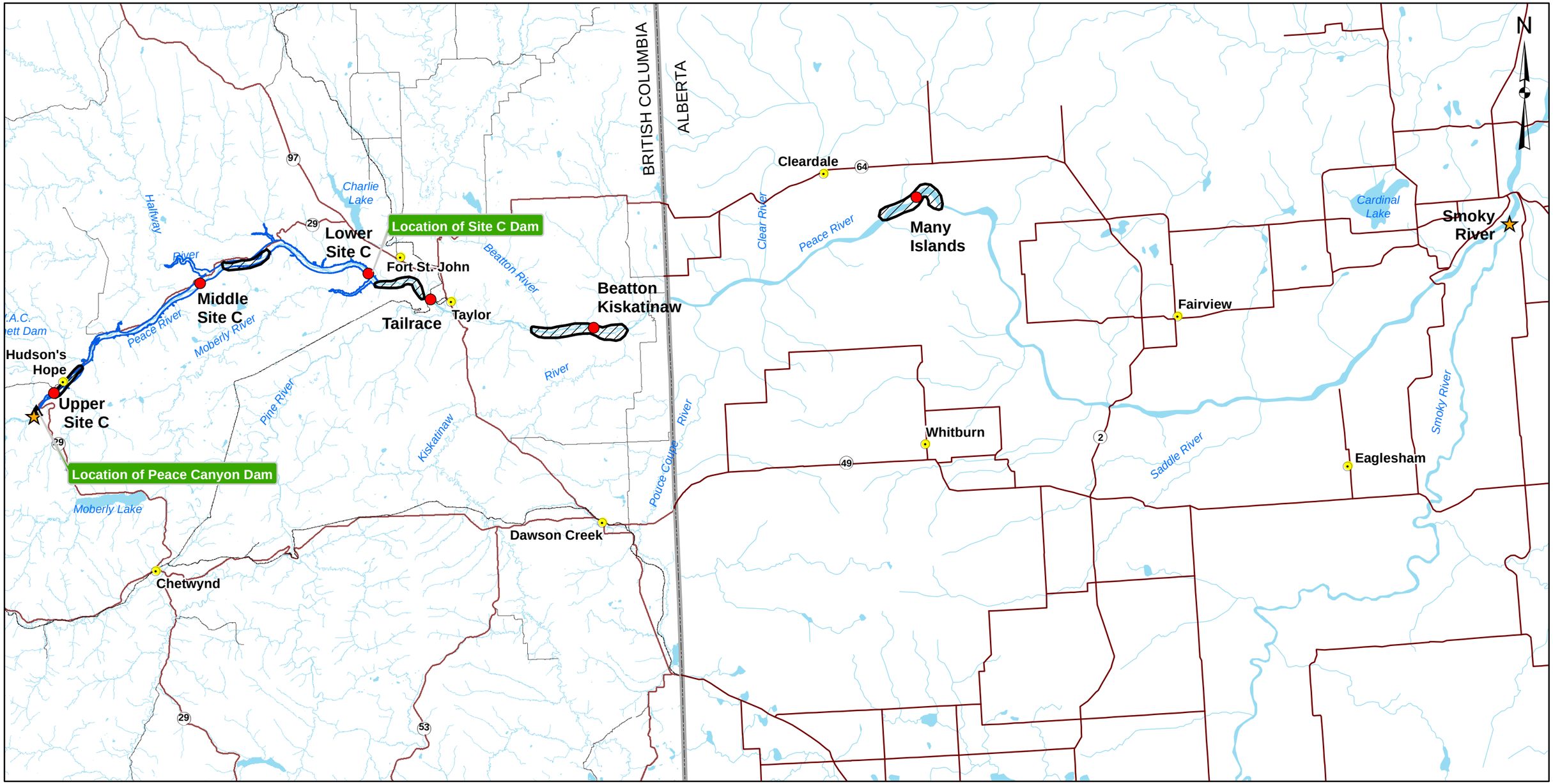
1.4 MMP Objective and Scope

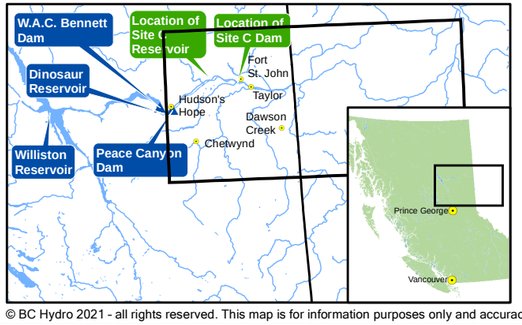
The objective of the MMP is to implement a plan that will meet the requirements set out by Condition 60 of the EAC and Condition 13 of the FDS.

The scope of the MMP is summarized as follows:

1. Monitor changes in methylmercury concentrations in fish prior to Project affects (baseline conditions) and after reservoir formation during Project operations;
2. Work with Indigenous Nations to plan and implement the MMP; and
3. Work with Health Authorities to effectively communicate fish consumption guidance for people eating fish caught in Site C reservoir and downstream of the Project in the Peace River.

These three items broadly summarize the requirements in EAC Condition 60 and FDS Condition 13.





Map Notes:
1. Datum/Projection: NAD83/UTM Zone 10N
2. Data Source: Government of B.C. and Alberta.
3. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.
4. Entire Site C Reservoir becomes a fish collection location after reservoir formation.

Legend

- Fish Collection Locations (See Map Note #4)
- Environmental Media Monitoring Locations
- Example Indigenous Community Sampling Program Locations
- Maximum Normal Reservoir Level (461.8 m)
- BC Hydro Peace Canyon Dam
- City/District Municipality
- Provincial Boundary
- Existing Road
- Existing Highway
- Existing Railway

BC Hydro

Figure 2
Methylmercury Monitoring Plan Sampling Locations for all Media

Date	Nov. 2, 2021	DWG NO	1016-N11-00731-2	R 4

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1.5 Overview

This section provides an overview of the sections that follow:

- **Section 2.0** Mercury Background - summarizes mercury as it relates to natural conditions, creation of a reservoir, and human health.
- **Section 3.0** Methylmercury and Site C - summarizes the methylmercury predictions for the Project and their context the MMP.
- **Section 4.0** Monitoring Overview - presents a high-level look at the main elements of the MMP.
- **Section 5.0** Monitoring Program - provides specific information on the monitoring approach for fish and supporting environmental media (water, sediment, zooplankton and benthic invertebrates).
- **Section 6.0** Indigenous Community Sampling Program - outlines the collection of fish tissue samples for methylmercury analysis by members of Indigenous Nations.
- **Section 7.0** Fish Consumption Program - outlines the approach to collect human fish consumption information during the construction and operation of the Project.
- **Section 8.0** Reporting - describes the BC Hydro MMP reporting requirements to the EAO, Impact Agency of Canada, Health Authorities, reservoir area Indigenous Nations and immediately downstream Indigenous Nations.
- **Section 9.0** Health Authority Communications - describes the approach to communicate the levels of mercury in fish that are measured by the MMP to Health Authorities.
- **Section 10.0** Program Review and Revisions
- **Section 11.0** Qualified Professionals – lists the Qualified Professionals responsible for the MMP.
- **Section 12.0** References – lists the journal studies and reports cited in the MMP.

2.0 Mercury Background

This section summarizes mercury dynamics in the environment under natural and general reservoir conditions to provide context for the sections of the MMP that follow.

2.1 Mercury in the Environment

Under natural conditions, mercury is present in low concentrations in all environmental media including water, soil, sediment, and plants, and in all terrestrial and aquatic animals. Total mercury in the environment is the sum of all chemical forms of mercury including the inorganic and organic forms. Both forms of mercury occur naturally in the environment, and their concentrations vary according to the media (e.g., soil, water, sediment, aquatic insects, fish). In soil, water, and sediment, inorganic mercury is the prevalent form and originates from atmospheric (natural or anthropogenic) and geologic sources.

Sulphate-reducing bacteria transform or “methylate” some of the inorganic mercury present in soil and sediment into organic mercury, primarily methylmercury. The rate of bacterial activity and mercury methylation is governed by many chemical factors, such as the amount and quality of organic carbon, pH, and sulphate, not necessarily the amount of inorganic mercury available. Under natural conditions, the rate of mercury methylation is generally low, although some habitats (e.g., wetlands) produce more methylmercury than others.

Once methylmercury has been created by bacteria, it is part of the food web. Animals absorb mercury almost exclusively from their food (Hall et al., 1997). Once it is inside an animal’s body, methylmercury is stored in the animal’s tissues, including muscles, the liver, and the kidney. Methylmercury accumulates at a greater rate than it degrades or is eliminated, causing it to accumulate over time as the animal grows and gets larger (i.e., bioaccumulation), and becomes more concentrated through successive trophic levels (i.e., biomagnification) (Sandheinrich and Wiener, 2011). Due to higher methylation rates and longer food chains (i.e., more trophic levels), methylmercury concentrations are higher in aquatic environments relative to terrestrial environments and the highest concentrations are typically in large-bodied, longer-living, predatory fish at the top of the food chain (Bodaly et al., 1994). Mercury measurements in fish generally target total mercury and conservatively assume, based on research for a variety of freshwater and marine fish species (Bloom, 1992), that methylmercury is the only form present. Consequently, unless specified otherwise, use of the term “mercury” in the context of fish tissue concentrations implies the form methylmercury. Since the amount of mercury varies by fish species, size, and age, it is important to measure the mercury levels of different fish species and fish of different sizes and ages.

As shown in Figure 3, methylmercury biomagnification in an aquatic food chains occurs via two main pathways: the benthic pathway, which originates in the sediment, and the pelagic pathway, which originates in the water column. In the benthic environment, methylmercury is transferred from bottom sediments to algae and benthic invertebrates, then up through the food chain to fish. The process is similar for the pelagic pathway, except that it starts with methylmercury in water being taken up into the food chain by phytoplankton. These pathways are not exclusive,

and many fish species are exposed to both.

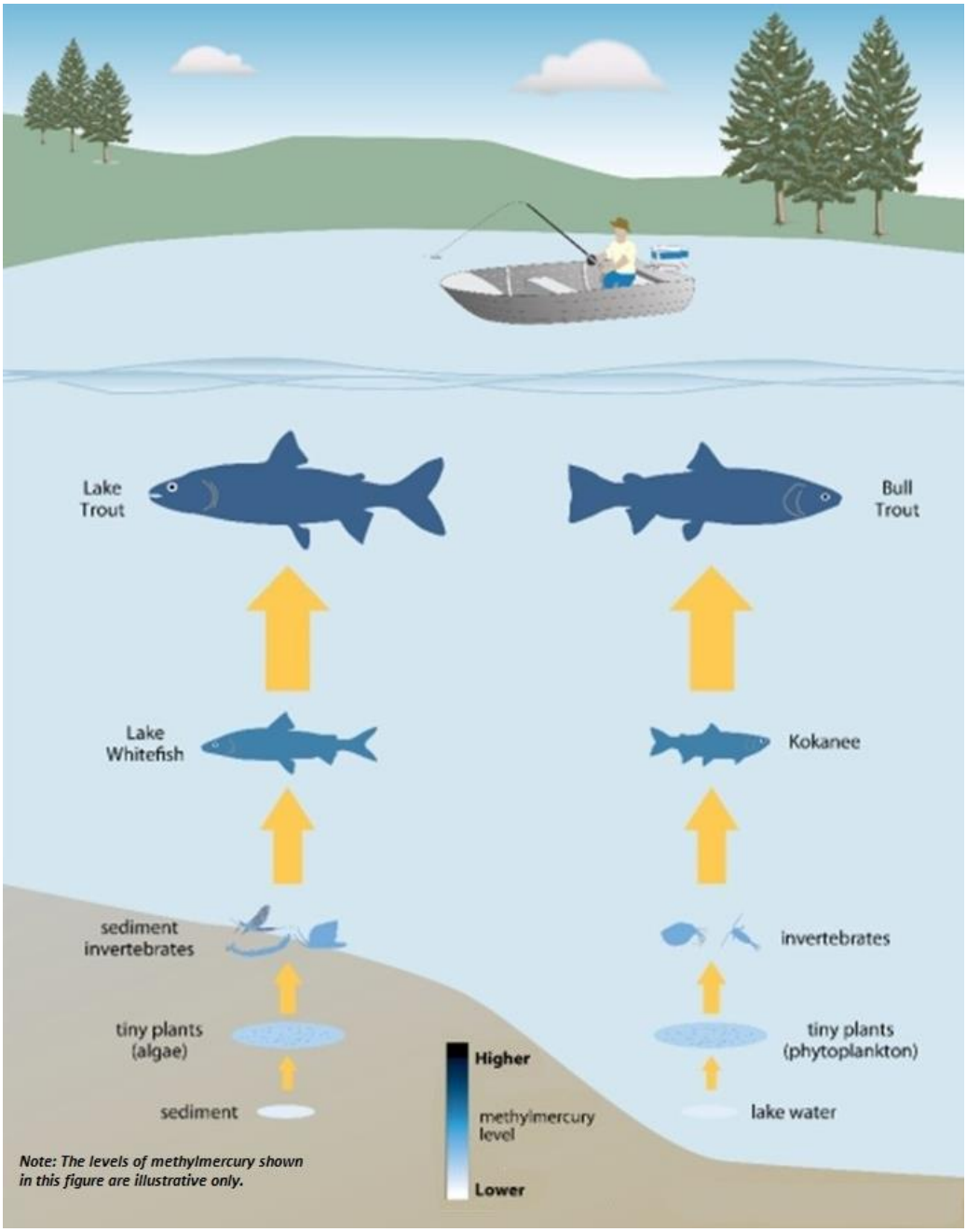
The typical percentage of methylmercury detected in total mercury in various environmental media is as follows:

- In fresh water, methylmercury usually comprises less than 5% of total mercury (Ullrich et al., 2001);
- In sediment, methylmercury is generally less than 2% of total mercury (Ullrich et al., 2001);
- In benthic invertebrates, methylmercury comprises 30 to 50% of total mercury in grazers and 70 to 95% in predatory species (Tremblay et al., 1996);
- In large-bodied/old fish: nearly all the total mercury is present as methylmercury (Bloom, 1992); and
- In small-bodied/young fish: methylmercury percentage of total mercury is highly variable (Lescord et al., 2018);
- In the terrestrial environment, methylmercury typically makes up less than 2% of total mercury measured in soil and vegetation (Kaschak et al. 2014), but can be over 50% in predatory invertebrates (Standish 2016).

Concentrations of methylmercury in wildlife that do not eat fish, like deer, moose and elk, are very low. Concentrations of methylmercury in wildlife that eat fish vary depending on how much of their diet is made up of fish, but in some cases the concentrations of methylmercury in wildlife that eat a lot of fish, like otters or loons, can be higher than concentrations of methylmercury in fish. More information on the concentrations of methylmercury in wildlife can be found in Attachment 1 “Site C Clean Energy Project - Effects of Methylmercury on Wildlife” of the technical memo on methylmercury[7].

[7] Response to Working Group and Public Comments on the Site C Clean Energy Project Environmental Impact Statement. Technical Memo Methylmercury May 8, 2013. Revision 1 – July 19, 2013. (Link - https://projects.eao.gov.bc.ca/api/document/5887c7ad69dfb5127bd3be3f/fetch)

Figure 3. Infographic of methylmercury biomagnification of two food webs with energy originating in either the benthic environment (left) or the pelagic environment (right).



2.2 Reservoir Creation and Mercury Methylation

Inorganic mercury is known to accumulate in organic soils, being taken up from the air by leaves then deposited on the ground when leaves fall or vegetation dies. This atmospheric mercury can be influenced by local sources (e.g., industrial emissions), but also comes from long-range transport from distant natural (e.g., volcanic activity and forest fires) or human-influenced sources. Due to low methylation rates in terrestrial soils, uptake into the terrestrial food chain is typically lower than in aquatic habitats.

When soils are flooded, such as when a reservoir is formed, degradation of the organic material creates conditions favourable for accelerating bacteria-mediated mercury methylation rates, leading to increased concentrations of methylmercury in environmental media following flooding. In general methylmercury concentrations rise rapidly, peaking three to eight years after impoundment, after which levels decline gradually to reach new baseline concentrations within 15 to 25 years (Munthe et al. 2007). The degree to which methylmercury concentrations peak and how long these conditions persist varies among reservoirs. The physical, chemical, and ecological factors that contribute are explored in detail within the Canadian reservoirs comparison matrix of the Mercury Technical Synthesis Report (EIS, Vol. 2 Appendix J, Part 1).

Of all environmental media, piscivorous (fish-eating) fish species (e.g., Bull Trout) have the highest peak mercury concentrations, take the longest to reach maximum levels, and take longer to return to a baseline level, although there is variability in each of these endpoints (Schetagne et al. 2003, Bodaly et al. 2007). In addition, for a given species, there can be substantial differences in the degree of increase and time to return to baseline concentrations among reservoirs. These differences are related to many reservoir-specific conditions, especially water residence time, ratio of reservoir area to original wetted area, organic carbon in soils, water pH, amount of flooded wetland, and food web complexity (see EIS, Vol. 2 Appendix J, Part 1).

2.3 Fish Consumption and Human Health

The health and cultural benefits of fishing and eating fish are well known; however, consumption of fish and fish-eating animals is primarily how humans are exposed to methylmercury. Excessive exposure to methylmercury can have potential human health effects. To protect consumers from an excess of dietary methylmercury, Health Canada has defined ‘provisional Tolerable Daily Intakes’ (pTDI) for methylmercury (Health Canada, 2007), which are listed in Table 1 in Appendix B of the MMP. A pTDI is the amount of methylmercury that a person can ingest every day for a lifetime without risk of adverse health effects.

3.0 Methylmercury and Site C

This section presents an overview of baseline (i.e., prior to reservoir filling) fish mercury levels (Section 3.1) and predictions for how they may change during the river diversion phase (Section 3.2) and during operations (i.e., after filling; Section 3.3).

3.1 Baseline Conditions

Early baseline monitoring of mercury levels in fish was conducted in 2010 and 2011 (Azimuth 2014) to support the environmental assessment of the Project. During this period, mercury levels in fish from the Peace River were lower than those of similar fish in other lakes and reservoirs in BC (Rieberger 1992; Baker 2002), and among the lowest in Canada (Depew et al. 2013). More recently, the baseline dataset was expanded between 2017 and 2020 in collaboration with Site C's Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP) [8]. Preliminary analysis of the combined baseline dataset (i.e., early and recent periods) suggest that fish mercury concentrations are now higher than measured in 2010 and 2011, by approximately two-fold, than they were in 2010/2011 (Azimuth, 2021). While the reasons behind the difference are not known, the lack of inundation of terrestrial habitats, which drives mercury methylation in new reservoirs, has not yet occurred, which indicates that it is not related to Site C. Other possible explanations for the differences could be climatic trends (e.g., increased precipitation and temperatures in the region), forest fires or logging activity in the watershed. Despite the higher fish mercury concentrations in the recent baseline period, current levels in the Peace River are consistent with BC reference lakes (Rieberger 1992, Azimuth 2019) and remain at the lower end of results for similar species from a Canada-wide perspective (Depew et al. 2013).

Baseline monitoring of environmental media for water and sediment was also collected from 2016 to 2019[9]. Environmental Media collection will occur as described in the MMP commencing 2022.

Field collection methods, laboratory methods, and quality control methods for baseline environmental media supporting the Site C Environmental Impact Statement are described in the 2010 & 2011 Status of Mercury in Benthic Invertebrates and Fish – Peace River and Dinosaur Reservoir by Azimuth Consulting Group[10] . Key results from the early baseline sampling were as follows (EIS Vol. 2 Section 11.9):

- Water – exclusive of conditions with high total suspended solids, total mercury in the Peace River and key tributaries seldom exceeded 1 ng/L. Methylmercury concentrations

[8] Available at: https://www.sitecproject.com/sites/default/files/Fisheries-and-Aquatic-Habitat-Monitoring-and-Follow-up-Program.pdf
[9] FAHMFP MON-8/9, Tasks 2a Peace River and Site C Reesrvoir Water and Sediment Quality annual study reports available at https://www.sitecproject.com/document-library/environmental-and-socio-economic-plans-and-reports
[10] Available at: https://www.sitecproject.com/sites/default/files/2010-11-Peace-River-Mercury-Data-Report-Feb-3-2014.pdf

were consistently below the laboratory reporting limit of 0.05 ng/L.

- Sediment – total mercury concentrations in the Peace River or major tributaries were typically below laboratory reporting limits (0.05 mg/kg dw), or if detected were low (e.g., 0.05 to 0.11 mg/kg dw). Methylmercury concentrations were also low in the Peace River (0.15 to 1.2 µg/kg dw) and slightly higher in its tributaries (0.6 to 2.5 µg/kg dw).
- Zooplankton – total mercury concentrations in Peace River zooplankton (0.004 to 0.009 mg/kg ww) are similar to those in the Williston Reservoir (Baker et al. 2002). Methylmercury concentrations (0.0001 – 0.0007 mg/kg ww) were also low and comprised about 5 to 10% of the total mercury concentration.
- Benthic Invertebrates – total mercury concentrations in Peace River benthic invertebrates ranged from 0.01 to 0.082 mg/kg ww. Methylmercury concentrations ranged from 0.003 to 0.03 mg/kg ww and comprised 20 to 63% of the total mercury concentration.

3.2 River Diversion

The river diversion stage of Project construction (initiated in fall 2020 and scheduled through 2023) is not expected to result in substantial increases in fish methylmercury levels in the Peace River. River diversion will periodically increase water levels in areas upstream of the dam site and create a headpond. The headpond water levels will fluctuate based on upstream flow inputs (e.g. from Peace Canyon Dam, Halfway and Moberly rivers) and the capacity of the two diversion tunnels that allow water to bypass the construction area. While the diversion headpond will result in intermittent backwatering, potentially extending up to 18 km upstream of the Project during high-water events, the overall potential for methylmercury production and subsequent uptake into the food chain is low. The main reason for this is that the majority of land inundated by the diversion headpond was routinely under water during high flow events prior to river diversion, and the duration of inundation of these areas during river diversion is anticipated to be limited. The areas with the highest potential for methylmercury production are those with organic-rich soils (e.g., forested areas, farmland or wetlands); little to none of these areas are expected to be affected by the diversion headpond. Thus, based on the predicted water level increases associated with the diversion headpond, we would not expect to see substantial changes in fish methylmercury concentrations.

3.3 Reservoir Filling

Project-related dynamics of methylmercury and reservoir creation were described in the EIS including the Mercury Technical Data Report (EIS, Vol. 2, Appendix J, Part 1) and a technical memo on methylmercury[11], while Project-related human health considerations are summarized

[11] Response to Working Group and Public Comments on the Site C Clean Energy Project Environmental Impact Statement. Technical Memo Methylmercury May 8, 2013. Revision 1 – July 19, 2013. (Link - https://projects.eao.gov.bc.ca/api/document/5887c7ad69dfb5127bd3be3f/fetch)

in EIS, Vol. 4, Section 33 and EIS, Vol. 2, Appendix J, Part 2 (Technical Data Report: Human Health Risk Assessment of Methylmercury in Fish).

After filling of the Site C reservoir (scheduled for fall of 2023), there will be changes in fish methylmercury levels. Fish methylmercury levels in the Site C reservoir are predicted to initially increase by an average of three to four times the recent baseline levels (based on the 2017 – 2020 data) within 5 to 8 years after the reservoir is created, then are expected to gradually return to levels that are similar to natural lakes and rivers in the region approximately 20 to 30 years after reservoir creation (EIS Vol. 2 Section 11.9). Fish methylmercury levels in the Peace River downstream of the new Site C dam, possibly as far as Many Islands, Alberta, are predicted to initially double, on average, before returning to a new baseline level (EIS Vol. 2 Section 11.9).

4.0 Monitoring Overview

The MMP builds on the general approach developed for baseline studies that were used to characterize methylmercury concentrations in the future Site C reservoir area and downstream Peace River and on which the EIS effects assessment was based. There are three components to the monitoring approach of the MMP, including:

- Monitoring Program (Section 5.0): provides the bulk of the monitoring data for methylmercury levels in fish and supporting environmental media. Sampling will largely rely on monitoring programs under the Project's FAHMFP[12] for the collection of field samples for key fish species and supporting environmental media. The Monitoring Program is specifically designed to build off the baseline fish methylmercury data (e.g., similar species and locations) and will be central to understanding the temporal and spatial changes to fish methylmercury concentrations.
- Indigenous Community Sampling Program (Section 6.0): provides an opportunity for community members to collect fish tissue samples for species/locations of interest from the Peace River. These data should be complementary to the monitoring program and will broaden our understanding of fish methylmercury concentrations across a range of species and locations.
- Fish Consumption Program (Section 7.0): provides the opportunity to collaborate with both Indigenous and non-Indigenous and Indigenous Nations to compile existing information, verify and collect new information on fish consumption habits within the MMP study area. This information will be used to help understand human exposure to methylmercury through fish consumption.

The integration of this information is discussed in Section 8.0 (Reporting) and communication with health authorities in Section 9.0 (Health Authority Communications).

5.0 Monitoring Program

5.1 Overview

The primary focus of the Monitoring Program is to characterize changes in fish methylmercury concentrations related to the construction and operation of the Project. This information will facilitate collaborative efforts with Health Authorities to interpret and communicate information about the levels of mercury in fish measured by the MMP. Additionally, the Monitoring Program will also target a suite of other complementary environmental media (surface water, sediment, zooplankton, benthic invertebrates) that will help support understanding mercury dynamics in the Site C reservoir and downstream of the Project in the Peace River (Table 3).

[12] Available at: https://www.sitecproject.com/sites/default/files/Fisheries-and-Aquatic-Habitat-Monitoring-and-Follow-up-Program.pdf

Table 3. Environmental media sampled under the MMP monitoring program and associated rationale for inclusion.

Environmental Media	Rationale for Inclusion in MMP Monitoring Program
Fish	Direct measure of tissue mercury concentrations in fish species consumed by people and other abundant forage fish species
Surface Water	Primary source of mercury for pelagic food chain
Sediment	Primary source of mercury for benthic food chain
Zooplankton	A food source for fish and associated intake of methylmercury in pelagic environment
Benthic Invertebrates	A food source for fish and associated intake of methylmercury in benthic environment

The specifics of the data collected for each media are driven by the intent to:

- Quantify tissue methylmercury concentrations in fish for a subset of species that are harvested and consumed by people, and in their direct and indirect prey organisms such as benthic invertebrates, zooplankton and forage fish species.
- Characterize feeding relationships (e.g., trophic level or energy origin [benthic or pelagic]) of fish to help understand observed fish mercury concentrations. Data from stable isotope analysis (SIA; targeting nitrogen and carbon, see inset) are used to make inferences about the feeding ecology of invertebrates and fish.
- Track changes in mercury and methylmercury concentrations in water and sediments, and in other parameters in media that influence methylmercury formation rates (as reported in EIS, Vol. 2, Appendix J, Part 1), as the reservoir evolves.

Stable Isotopes & Feeding Ecology

Stable isotopes are slightly different versions (light & heavy) of the same element that are stable in the environment. Both types participate in chemical and biological reactions, but at different rates, which leads to patterns in the ratios of the isotopes in the environment, The ratios of carbon and nitrogen, two important elements in biological tissue, can be used to quantify "you are what you eat".

Nitrogen isotopes ($\delta^{15}N$): *are used to determine the trophic position (i.e., where it sits within the food chain) of consumers in aquatic systems. Organisms become more enriched in the stable isotope nitrogen-15 with each increasing trophic level in the food chain. For example, the $\delta^{15}N$ value in a mature Bull Trout that eats other fish will have higher $\delta^{15}N$ than Rainbow Trout or Mountain Whitefish that eat invertebrates.*

Carbon isotopes ($\delta^{13}C$): *trace the flow of 'energy' (and therefore, mercury) through food webs and can be used to determine whether fish are feeding more from the benthic (bottom) or pelagic (water column) food webs.*

Note: the symbol "δ" is the Greek letter delta, which is often used to signify difference. In this case, delta refers to the isotopic ratio of sample relative to that of a standard reference material.

5.2 Geographic Extent and Monitoring Locations

5.2.1 Geographic Extent

As described in Section 3.3, changes in methylmercury concentrations in environmental media after impoundment are expected to occur most prominently within the Site C reservoir, but are also predicted to extend, at a lower magnitude, downstream in the Peace River, potentially as far as Many Islands, Alberta (EIS, Vol. 2 Appendix J, Part 1).[13]

The MMP monitoring program study area will encompass both the Site C reservoir (once inundated and operational) and the Peace River (from downstream of the Peace-Canyon Dam-

[13] This prediction is consistent with available scientific literature on the downstream extent of changes in fish mercury concentrations (Schetagne et al, 2000).

site to Many Islands, Alberta) where mercury concentrations are expected to increase above baseline levels following construction and during operation of the Project. To address concerns regarding uncertainty in the duration and extent of elevated methylmercury concentrations in fish downstream of the Project, sampling will be conducted even further downstream, to the confluence of the Peace River and Smoky River (approximately 290 km downstream of the Project) under the MMP Indigenous Community Sampling Program (See Section 6.0).

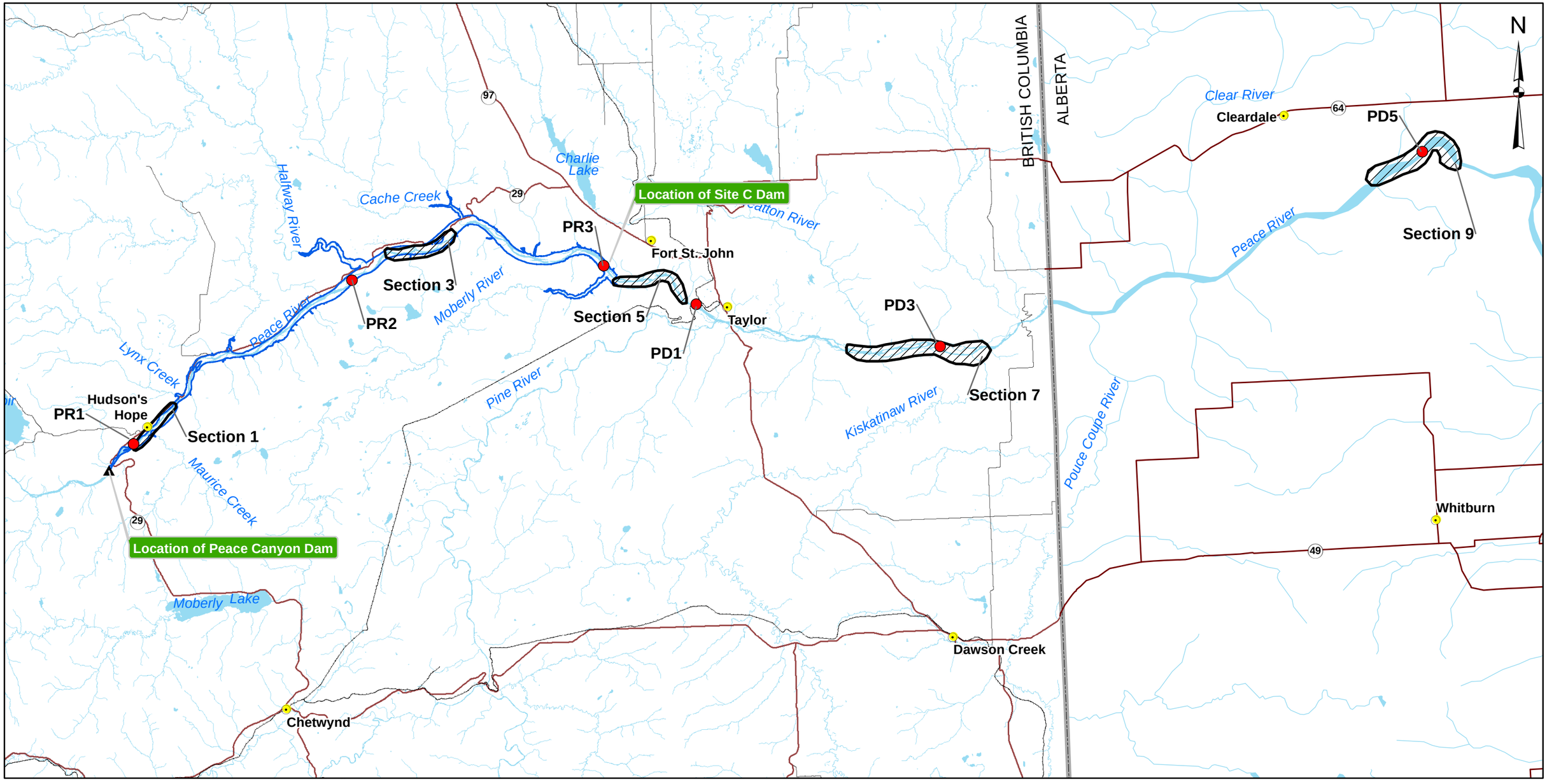
The 290-km downstream extent of the Site C MMP is conservative based on available information. Literature studies suggest that the extent and magnitude of downstream changes are driven by the same factors affecting mercury dynamics within the reservoir (discussed in detail in the Canadian reservoirs comparison matrix, EIS Vol. 2 Appendix J Part 1); these same factors led to Site C's predicted inclusion in the low mercury increase category based on physical, chemical and ecological characteristics. Three key studies are available:

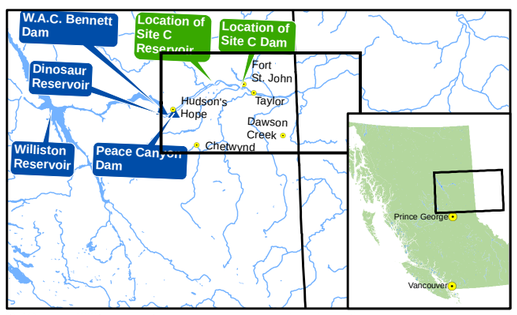
- Wuskwatim Reservoir (reservoir area: 94 km^2; water residence time in reservoir: 3.9 days) - researchers found no changes in fish mercury concentrations in Split Lake (135 km downstream) over a 33-year period after impoundment of the Wuskwatim Reservoir in northern Manitoba (Bodaly et al. 2007). They postulated that the lake was too far downstream to show effects.
- Caniapiscau Reservoir (reservoir area: 4275 km^2; water residence time in reservoir:2+ years) – increases in fish mercury concentrations were documented as far as 275 km downstream of the reservoir, largely attributed to the export of mercury-rich organic debris and zooplankton (Schetagne et al. 2000).
- Smallwood Reservoir (reservoir area: 6650 km^2; water residence time in reservoir : not reported) – increases in fish mercury concentrations were observed for a distance of 300 km in the Churchill River and its estuary.

In comparison, the Site C reservoir area (9.3 km^2) and water residence time in the reservoir (23 days) are much lower than the respective characteristics of the two reservoir systems where downstream effects extended to 300 km. Thus, it is unlikely that there will be sufficient production of exportable mercury-rich organic matter or biota to have a measurable increase in fish tissue concentrations in the Peace River at the confluence of the Smoky River.

5.2.2 Monitoring Locations

MMP Monitoring Program sampling locations are broadly categorized as Site C reservoir or Peace River Downstream (Figure 4) and are described in Table 4 (fish) and Table 5 (supporting environmental media). Monitoring locations for the MMP Monitoring Program for fish and other environmental media have been selected from existing FAHMFP sampling locations to provide consistency with existing baseline data (2010-2020) and to minimize fish handling events in the future.





Map Notes:
1. Datum/Projection: NAD83/UTM Zone 10N
2. Data Source: Government of B.C. and Alberta.
3. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.
4. Entire Site C Reservoir becomes a fish collection location after reservoir formation.

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Legend

- Fish Collection Locations (See Map Note #4)
- Environmental Media Monitoring Locations
- Maximum Normal Reservoir Level (461.8 m)
- BC Hydro Peace Canyon Dam
- City/District Municipality
- Provincial Boundary
- Existing Road
- Existing Highway
- Existing Railway

1:500,000 7.5 0 15 km

BC Hydro

Figure 4
Methylmercury Monitoring Plan Fish and Environmental Media Sampling Locations

Date	Nov. 2, 2021	DWG NO	1016-N11-00731-3	R 1

Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

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Table 4. MMP fish sampling locations, pre and post Peace River inundation.

Study Area	River KM	MMP Fish Sampling Area			
		Prior to inundation (pre-2025)		Post inundation (2025 onward)	
		Name	Description	Name	Description
Site C Reservoir	83 KM long reservoir: Peace-Canyon dam at upstream terminus and Site C dam at downstream terminus.	Upper Site C (Section 1)	Peace River mainstem, 5km downstream of Peace-Canyon Dam.	Site C Reservoir	Inundated area of the Site C reservoir.
		Mid - Lower Site C (Section 3)	Peace River mainstem, immediately downstream of confluence with Halfway River but upstream of confluence with Moberly River.		
Site C Dam	-	-	-	-	-
Peace River Downstream	Immediately downstream of Site C dam.	Site C Tailrace (Section 5)	Peace River mainstem, immediately downstream of Site C Dam but upstream of confluence with Pine River.	Unchanged post inundation. See left for sampling location information.	
	Approximately 45 KM downstream of Site C dam.	Beatton-Kiskatinaw (Section 7)	Peace River mainstem, downstream of confluence with Beatton River but upstream of the confluence with Kiskatinaw River.		
	Approximately 120 KM downstream of Site C dam.	Many Islands (Section 9)	Peace River mainstem, in the vicinity of Many Islands, AB. Expected downstream terminus of Project-related mercury impacts.		

Table 5. MMP sampling locations for supporting environmental media.

Study Area		MMP Sampling Location	
		Name	**Description**
Site C Reservoir	83 KM long reservoir: Peace-Canyon dam at upstream terminus and Site C dam at downstream terminus.	Upper Site C (PR1)	Peace River mainstem, approximately 2km downstream of Peace-Canyon Dam.
		Mid Site C (PR2)	Peace River mainstem, immediately upstream of confluence with Halfway River.
		Lower Site C (PR3)	Peace River mainstem, immediately upstream of confluence with Moberly River.
Site C Dam	**-**	-	-
Peace River Downstream	Approximately 15 km downstream of Site C dam.	Site C Tailrace (PD1)	Peace River mainstem, immediately upstream of confluence with Pine River.
	Approximately 45 km downstream of Site C dam.	Beatton-Kiskatinaw (PD3)	Peace River mainstem, downstream of confluence with Beatton River but upstream of the confluence with Kiskatinaw River.
	Approximately 120 km downstream of Site C dam.	Many Islands (PD5)	Peace River mainstem, in the vicinity of Many Islands, AB. Expected downstream terminus of Project-related mercury impacts.

Fish Monitoring Locations

Under the FAHMFP (and earlier baseline monitoring programs), fish monitoring locations ("Sections") represent a spatial scale on the order of 10 km. Prior to reservoir inundation, MMP monitoring within the Site C reservoir targets two locations for fish (i.e., Sections 1 and 3). Once the operation phase of the Project begins after reservoir filling, these fish monitoring locations will be combined into one post-impoundment fish sampling location (i.e., Site C Reservoir). The rationale for this design is that collecting fish from discrete areas within the reservoir is not expected to be useful spatially, as target fish species are expected to move throughout the reservoir. Further, baseline sampling results indicate no major differences in fish mercury concentrations between these two sampling locations. Thus, the MMP has five fish monitoring locations (two upstream, three downstream) pre-inundation and will have four monitoring locations (one upstream, three downstream) post-inundation (Table 4).

Fish monitoring locations are positioned between major tributary confluences with the Peace River (Figure 4). The rationale for this design is that large tributaries can influence Peace River mainstem fish and fish habitat, as well as mercury dynamics, so positioning the fish monitoring locations between them allows for more stable conditions within each location.

The expectation is that MMP fish tissue sample needs will be met through the FAHFMP. However, in years where there may be key data gaps, the MMP samples could be augmented with directed fish sampling activities targeting mercury collection (e.g., angling or netting for target species, taking samples from fish at the fish passage facilities) provided that the locations contribute to the MMP objectives.

Supporting Environmental Media Monitoring Locations

Sampling of supporting environmental media (surface water, sediment, zooplankton, benthic invertebrates) is included in the MMP to better understand mercury dynamics in the Site C reservoir and downstream of the Project in the Peace River. These media will be collected from six discrete long-term sampling locations already used by the FAHMFP (Table 5; Figure 4). Sampling locations are expected to remain consistent through all phases of the Project (construction, diversion, reservoir filling and operation).

These monitoring locations are positioned between major tributary confluences with the Peace River. As with the fish sampling locations, the rationale for this design is that large tributaries can influence Peace River mainstem fish and fish habitat as well as mercury dynamics, therefore positioning the fish monitoring locations between each major confluence is expected to allow for mercury characterization at a local scale. Additionally, the spatially-discrete approach set up for baseline monitoring within the Site C reservoir footprint (i.e., stations PR1, PR2 and PR3) will be maintained after inundation to characterize any spatial differences in mercury dynamics among the upper, mid and lower portions of the reservoir.

5.3 Temporal Extent and Monitoring Schedule

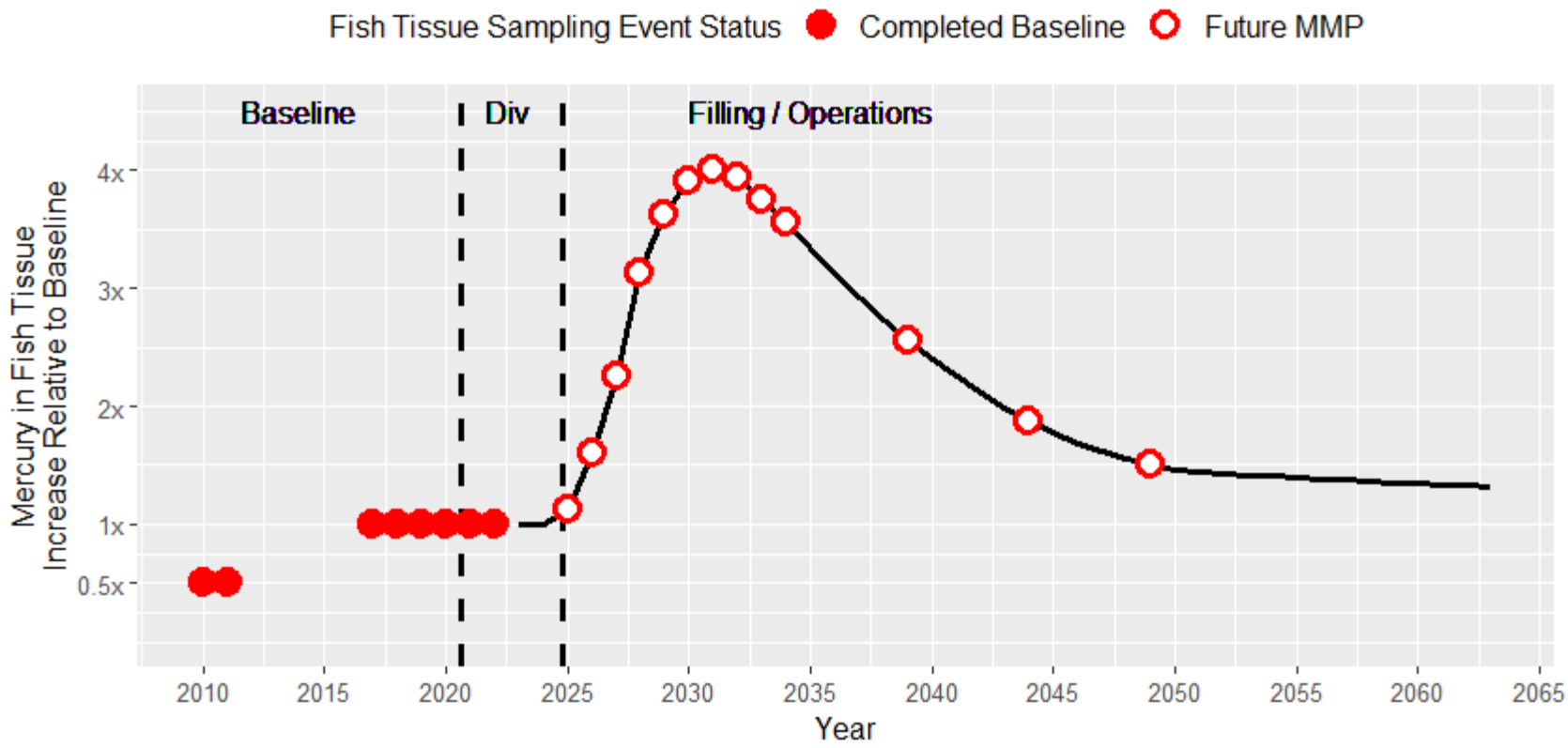
As described in Section 3, Project-related changes in fish methylmercury concentrations are only expected to occur after inundation, when they are expected to rise to a peak (within 5 to 8 year after impoundment), followed by a more gradual return to levels that are similar to natural lakes and rivers in the region (by approximately 20 to 30 years after reservoir creation). The proposed monitoring schedule is based on this predicted temporal response where monitoring is more frequent during the early years, with diminishing frequency over time as the reservoir evolves and stabilizes from a mercury perspective. A single monitoring year is also included during river diversion, Construction Year 8 (2022), to provide one more year of MMP data prior to reservoir creation.

The MMP monitoring is tied to the proposed Project schedule (i.e., Construction Years 1 to 10 and Operation Years 1 to 25; Table 8). MMP monitoring will start in 2022, the second year following river diversion (i.e., Construction Year 8), to capture potential methylmercury increases associated with the diversion headpond (note: the diversion headpond is not expected to affect methylmercury levels). During operations MMP monitoring will occur annually for the first ten years, then reduce to once every 5 years for Operation Years 15, 20 and 25[14]. MMP monitoring in the Site C Reservoir is not scheduled in 2025 due to safety considerations in the newly formed reservoir. This schedule, along with six baseline events already undertaken since 2010, is superimposed onto a conceptual time series of predicted changes in fish tissue methylmercury concentrations in the Site C Reservoir (Figure 5).

Monitoring is planned to continue until fish mercury concentrations have stabilized. A weight-of-evidence approach will be used to assess stability, with consideration of results from all study components (i.e., fish, zooplankton, benthic invertebrates, sediment, and water). There are three possible outcomes of the assessment:

1. *Stable* – evidence aligns across fish species and across environmental media to show that concentrations have decreased from their post-inundation peaks and are now stable. **MMP monitoring can stop.**
2. *Inconclusive* – evidence of stability is not consistent across fish species and across environmental media. **MMP monitoring repeated in five years.**
3. *Decreasing* – evidence shows that fish mercury concentrations are still decreasing from their post-inundation peak. **MMP monitoring repeated in 5 years.**

Figure 5. Planned MMP sampling events during diversion (Div), filling and operation (open red circles), overlain on a conceptual time series of predicted changes in fish tissue methylmercury from the Site C reservoir or reaches of the Peace River that will become the Site C reservoir. (Revision 2 Dated January 30, 2024)



5.4 Fish

Fish will be monitored for methylmercury concentrations as they have among the highest methylmercury concentrations in the aquatic food web, integrate exposure across the entire food chain, and are targeted for consumption by humans.

In choosing which species to select for the MMP monitoring program, there were a few considerations to balance:

1. Target top predator fish species expected to have the highest methylmercury concentrations due to their position at or near the top of the food chain, as well as target prey fish expected to have lower methylmercury concentrations but will assist the MMP in tracking the progression of methylmercury up the food chain.
2. Sufficient numbers of fish need to be present at each monitoring location to accurately characterize the length-methylmercury relationship (see Appendix A for more details, including why length is preferred over size and age).
3. The transition from a riverine environment to a reservoir environment is expected to affect the composition of the fish community. The composition of the fish community is predicted to occur over the first several decades after reservoir filling (EIS, Vol. 2, Section 12).
4. As discussed in Section 3.0, fish methylmercury concentrations are expected to peak during the first 5 to 8 years of operations. Selecting species that can be caught in sufficient numbers during this peak methylmercury window is important.

Catch results (for mercury sampling) by fish species and location for the baseline years in the Peace River from 2010 to 2020 were used to help inform species selection for the MMP monitoring program (Table 6). A complete summary of baseline fish mercury results for Site C is reported in Baseline Peace River (2010 – 2020) Fish Mercury[15] (Azimuth, 2021).

[15] Availabe at https://www.sitecproject.com/sites/default/files/Site-C-Baseline-Peace-River-2010-2020-Fish-Mercury.pdf

Table 6. Baseline fish tissue samples collected for mercury analyses in the Peace River at MMP monitoring locations by the Site C Project to-date (2010 through 2020).Values represent number of individual fish sampled.

Species*:	MMP Key Species						Species Not Targeted in MMP				
Sampling Location	BT	RB	WP	MW	LSU	RSC	AG	BB	GE	LT	NP
Site C- Upper	31	27		52	21					1	2
Site C - Middle	63	38		87	76		3	1		3	4
Tailrace	38	5	33	48	42	19		4			21
Beatton-Kiskatinaw	16	1	40	44	48	4	1	4	3	1	12
Many Islands			55	73	79			13	21		6
Total	148	71	128	231	187	23	4	9	3	5	39

Blank cells indicate no catch.

*BT = Bull Trout, RB = Rainbow Trout, MW = Mountain Whitefish, LSU = Longnose sucker, RSC = Redside Shiner, AG = Arctic Greyling, LT = Lake Trout, NP = Northern Pike, WP = Walleye, GE = Goldeye , BB = Burbot

Key fish species targeted within the Site C reservoir and downstream of the Project in the Peace River are top predator species Bull Trout (*Salvelinus confluentus*) and Walleye (*Sander vitreus*), as well as species that feed on invertebrates and can be prey species these top predators: Rainbow Trout (*Oncorhynchus mykiss*), Mountain Whitefish (*Prosopium williamsoni)*, Longnose Sucker (*Catostomus catostomus*), and Redside Shiner (*Richardsonius balteatus*). These key fish species are predicted to be present in the reservoir and/or downstream over the period when fish methylmercury concentrations are highest. Table 7 provides a summary of key fish species life history, biomass estimates, diet, movement strategy, and harvest by Indigenous Nations. Key information is also summarized below.

Bull Trout

Monitoring of Bull Trout mercury concentrations is important from a human health perspective and as a key indicator species representing the maximum change in mercury concentrations above baseline (EIS Vol. 2, App J, Part 2). Bull Trout are targeted for consumption by people (EIS Vol. 2, App J, Part 2). Because they are highly piscivorous, baseline mercury concentrations of Bull Trout from the Peace River were higher than for other species (EIS Vol. 2 Section 11.9). Bull Trout mercury concentrations are also expected to take longer than some other species to decline to baseline following inundation because Bull Trout are long lived (EIS Vol. 2, App J, Part 2). Bull Trout are expected to be present in the Site C reservoir and downstream into Alberta as migratory species to Peace River tributaries including Pine and Halfway rivers (EIS Vol. 2, Section 12).

Walleye

Monitoring of Walleye mercury concentrations is important from a human health perspective and as a key indicator species representing the maximum change in mercury concentrations above

baseline downstream of the Project (EIS Vol. 2, App J, Part 2).Walleye are targeted for consumption by people (EIS Vol. 2, App J, Part 2). Because Walleye are highly piscivorous, baseline mercury concentrations from the Peace River were higher than for other species; they are also expected to take longer than other species to decline to baseline due to their long lifespan (EIS Vol. 2, App J, Part 2). They are located predominantly downstream of the Pine River and representative of warm/coolwater fauna that are tolerant of turbid conditions (EIS Vol. 2, Section 12).

Rainbow Trout

Monitoring of Rainbow Trout mercury concentrations is important from a human health perspective and as an indicator species that feeds on invertebrates. Rainbow Trout are insectivorous and are commonly targeted for consumption by people (EIS Vol. 2, Section 12). Being as they are insectivorous, mercury concentrations in this species are not as high as Bull Trout. They are expected to be present in sufficient numbers to support the MMP monitoring program in the Site C reservoir but not downstream in the Peace River.

Mountain Whitefish

Monitoring of Mountain Whitefish mercury concentrations can provide information on a species that can be harvested by people. It is an abundant indicator species in the Peace River that feeds on invertebrates and is a prey item for other fish species. Mountain Whitefish are not expected to be abundant over the long term in the Site C reservoir (EIS Vol. 2, Section 12). As a relatively well studied species within the Peace River, this species should be a valuable component to the MMP program in the short-term in the Site C reservoir and short and long-term downstream of the Project in the Peace River.

Longnose Sucker

Monitoring of Longnose Sucker mercury concentrations can provide information on an abundant species throughout the Peace River, that feeds on invertebrates and is a prey item for other fish species. Longnose Sucker forage on algae and benthos and may be an important dietary item for several species including Bull Trout. Their close association with bottom sediment and benthic food items can provide information on the transfer of mercury in the aquatic food web. Longnose Sucker are most abundant downstream of Halfway River with an extended population upstream to Peace Canyon Dam (EIS, Vol. 2, Section 12). They are expected to persist within the Site C reservoir given their ability to rapidly exploit new habitats and tolerate perturbations in the aquatic environment (e.g., elevated suspended sediment concentrations and sedimentation of clean bed materials (EIS, Vol. 2, Section 12)).

Redside Shiner

Monitoring of Redside Shiner can provide information on a small-bodied fish species that feeds on invertebrates and is a prey item for other fish species. Redside Shiner is an abundant species in the Peace River that is expected to increase in abundance within the new reservoir (EIS, Vol. 2, Section 12). Redside Shiner have a mixed invertebrate diet and, in turn, can be an important dietary item for other species such as Bull Trout.

Table 7: MMP key Peace River fish species summary of life history, diet, movement strategy, and harvest by Indigenous Nations.

Species	Life history	Movement Strategy[2]	Diet upstream of Site C[1]		Harvest by Indigenous Groups[3]	Rationale for Inclusion in MMP Monitoring Program
			Peace River (Current)	Site C reservoir (Future)		
Bull Trout	Highly piscivorous and migratory top predator exhibiting complex life history	Extended movements (low site fidelity)	Benthic invertebrates, Suckers, Mountain Whitefish, Arctic Grayling	Kokanee, benthic invertebrates, Lake Whitefish, Suckers, Mountain Whitefish, Arctic Grayling	Yes	Top predator, consumed by people, expected to have mercury concentrations higher than other species in the Peace River, found in good abundance through much of the Project area.
Walleye	Highly piscivorous and migratory top predator present downstream of Site C	Extended movements (low site fidelity)	Benthic invertebrates, Suckers, Mountain Whitefish, Arctic Grayling	N/A	Yes	Top predator, consumed by people, expected to have mercury concentrations higher than other species in the Peace River, found in good abundance downstream of Site C.
Rainbow Trout	Insectivorous species that feed preferentially on benthic invertebrates	Local movements (high site fidelity)	Benthic invertebrates, food sources from upstream reaches or tributaries, small fish, Mountain Whitefish	Benthic invertebrates, food sources from upstream reaches or tributaries, small fish, Mountain Whitefish	Yes	Consumed by people, lower trophic level species expected to have lower mercury concentrations than top predators in the Peace River .
Mountain Whitefish	Abundant intermediary food chain species that feed preferentially on benthic invertebrates and are preyed on by top predators (e.g., Bull Trout)	Local and extended movements (variable site fidelity)	Benthic invertebrates, food sources from upstream reaches or tributaries, copepods	Benthic invertebrates, food sources from upstream reaches or tributaries	Yes (infrequent)	Abundant throughout Project area, important prey to top predators.
Longnose Sucker	Abundant bottom-feeding species that forage indiscriminately on algae and benthos	Local movements (high site fidelity)	Benthic invertebrates, benthic algae, detritus	Benthic invertebrates, benthic algae, detritus	Yes (infrequent)	Abundant throughout Project area, prey to top predators.
Redside Shiner	Abundant forage species with a mixed invertebrate diet	Local movements (high site fidelity)	Benthic invertebrates, benthic algae	Benthic invertebrates, benthic algae	No	Small-bodied prey species in good numbers throughout Project area.

[1] Site C EIS, Volume 2, Appendix P (Tables 6B.3 and 6B.4)

[2] Site C EIS, Volume 2, Section 12

[3] Site C EIS, Volume 4, Section 33

Fish Sampling Approach

Fish tissue sampling for the MMP is paired with FAHMFP Mon1a Site C Reservoir Fish Community Monitoring Program" and Mon2 Peace River Fish Community Monitoring Program (see FAHMFP and Mon-2a Peace River Large Fish Indexing Survey annual study reports[16] for details on methods). The long-term monitoring schedule for this MMP component is presented in Table 8. MMP fish tissue sampling will start in 2022, the second year following river diversion (i.e., Construction Year 8). As mentioned in Section 5.3, the Site C reservoir will not be included in the 2025 monitoring event after reservoir filling as conditions are expected to be hazardous for sampling due to high levels of floating debris. Site C reservoir sampling is expected to commence in 2025 based on site safety considerations. Sampling is planned to take place in August and September with fish caught primarily through gill-netting (Site C Reservoir) and/or boat electrofishing (Peace River). Information on sample size per location/event, target fish length range and sampling locations for each key species is presented in Table 9. Fish sampling within the target size range is not random, however, attempts to allocate samples across the size range to better support the characterization of the length-mercury relationships. The planned species and location combinations in Table 9 are based on the catch success of baseline sampling (see Azimuth 2021[17] for more details); species and location combinations were not included where the baseline catch results indicated that it would be unlikely to obtain the samples needed for the MMP.

Fish tissue will be sampled non-lethally (released alive) where possible[18], using biopsy techniques to collect muscle samples from captured fish as described in Baker et al. (2004). All fish tissue samples will have two samples collected, one for chemistry analysis (total mercury, moisture, and for a subset methylmercury) and one for stable isotope analysis (SIA, carbon and nitrogen isotopes). Stable isotopes are measured to determine the food web structure and determine possible dietary changes of fish (relative to baseline) that may occur after reservoir creation and will assist with interpreting possible changes in mercury concentrations in fish. All laboratory analyses will be conducted by accredited laboratories and will include appropriate quality assurance/quality control (QA/QC) measures to verify data quality.

The non-lethal "biopsy" methods described above were explicitly developed to produce tissue mercury concentration results that are compatible with lethal "fillet" sampling (Baker et al., 2004). Consequently, results from the Indigenous Community Sampling Program, which are fish caught for consumption (i.e., lethal sampling), will be directly comparable to those generated through the non-lethal sampling methods described above.

The MMP must be adaptive as the fish community is expected to evolve over time within the Site C reservoir. However, given the importance of continuity in tracking changes in fish

[16] Available at: https://www.sitecproject.com/document-library/environmental-and-socio-economic-plans-and-reports
[17] Available at https://www.sitecproject.com/sites/default/files/Site-C-Baseline-Peace-River-2010-2020-Fish-Mercury.pdf
[18] Fish that are too small to biopsy (generally <200 mm) or succumb to handling, will instead have fillet samples collected.

methylmercury by species over time and space, decisions to modify the MMP monitoring program's targeted species will only be made if warranted and defensible.

Table 8. MMP monitoring schedule including number of sampling events in a given year during construction (Revision 2 Dated January 30, 2024).

		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2039	2044	2049
		Construction Year[1]			Operations Year[1, 2]												
	Sampling Locations	8	9	10	1	2	3	4	5	6	7	8	9	10	15	20	25
Surface Water Sampling	Upper Site C	2x				x	x		x		x		x		x	x	x
	Middle Site C	2x				x	x		x		x		x		x	x	x
	Lower Site C	2x				x	x		x		x		x		x	x	x
	Site C Tailrace	2x			x	x	x		x		x		x		x	x	x
	Beatton-Kiskatinaw	2x			x	x	x		x		x		x		x	x	x
	Many Islands	2x			x	x	x		x		x		x		x	x	x
Sediment	Upper Site C	1x				x	x		x		x		x		x	x	x
	Middle Site C	1x				x	x		x		x		x		x	x	x
	Lower Site C	1x				x	x		x		x		x		x	x	x
	Site C Tailrace	1x			x	x	x		x		x		x		x	x	x
	Beatton-Kiskatinaw	1x			x	x	x		x		x		x		x	x	x
	Many Islands	1x			x	x	x		x		x		x		x	x	x
Zooplankton Tissue Sampling	Upper Site C	2x				x	x		x		x		x		x	x	x
	Middle Site C					x	x		x		x		x		x	x	x
	Lower Site C					x	x		x		x		x		x	x	x
	Site C Tailrace				x	x	x		x		x		x		x	x	x
Benthic Invertebrate Tissue Sampling	Upper Site C	1x							x		x		x				
	Middle Site C	1x							x		x		x				
	Lower Site C	1x							x		x		x				
	Site C Tailrace	1x							x		x		x				
	Beatton-Kiskatinaw	1x							x		x		x				
	Many Islands	1x							x		x		x				
Fish Tissue Hg Analysis	Site C Reservoir	1x				x	x	x	x	x	x	x	x	x	x	x	x
	Site C Tailrace	1x			x	x	x	x	x	x	x	x	x	x	x	x	x
	Beatton to Kiskatinaw River	1x			x	x	x	x	x	x	x	x	x	x	x	x	x
	Many Islands	1x			x	x	x	x	x	x	x	x	x	x	x	x	x
Indigenous Community Sampling Program	Areas of Interest	1x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fish Consumption Baseline Information Analysis and Verification		1x	x	x													
Fish Consumption Information Data Collection[3]									x	x	x						

[1]The Site C construction schedule is indicative and subject to change.

[2] Operations monitoring frequency (i.e number of events per monitoring year) to be confirmed based on review of program information requirements.

[3] Schedule to be confirmed in consultation with the Indigenous Nations and health authorities.

Construction (River Diversion)

Full reservoir inundation following end of construction (Year 10)

Sampling to occur every five years after Operations Year 10 until fish mercury concentrations have stabilized (shown through Operations Year 25).

Table 9. MMP monitoring for key fish species in a given sampling year.

	Key Fish Species:	Bull trout	Rainbow trout	Mountain whitefish	Longnose sucker	Redside shiner	Walleye
Sampling Location	**Sampling Details:**	sampling year target 35 samples/event target fish length: 250 - 600+ mm	sampling year target 35 samples/event target fish length: 250 - 500 mm	sampling year target 35 samples/event target fish length: 250 - 500 mm	sampling year target 35 samples/event target fish length: 250 - 500 mm	sampling year target 35 samples/event target fish length: 60 - 120 mm	sampling year target 35 samples/event target fish length: 250 - 600+ mm
Site C Reservoir	**Site C Reservoir (Section 1 and 3)**	**x**	**x**	**x**	**x**	**x**	-
Peace River Downstream	**Site C Tailrace (Section 5)**	**x**	-	**x**	**x**	**x**	-
	Beatton-Kiskatinaw (Section 7)	-	-	**x**	**x**	**x**	**x**
	Many Islands (Section 9)	-	-	**x**	**x**	**x**	**x**

'x' indicated targeted sampling

'-' indicates no targeted sampling for that species at that location.

Fish tissue analytical parameters: Total mercury, moisture, C & N Stable Isotopes. Methylmercury for a sub-set of samples.

5.5 Supporting Environmental Media

5.5.1 Surface Water

Surface water chemistry will be monitored to assess total mercury and methylmercury concentrations (in both filtered and unfiltered water) in water to track changes over time and to provide context to better understand the processes that contribute to the mercury concentrations measured in fish. Monitoring will also include ancillary parameters that influence the rate of methylmercury formation: total suspended solids (TSS), total and dissolved organic carbon (TOC and DOC), pH, sulphate, conductivity, hardness and anions (alkalinity, chloride, fluoride, nitrate, and nitrite). All laboratory analyses will be conducted by accredited laboratories and will include appropriate quality assurance/quality control (QA/QC) measures to verify data quality.

Why Collect Water? *Water typically has very low concentrations of mercury and methylmercury, even in the early-years of reservoir inundation.*

While concentrations are low, water can be an important agent for mercury and methylmercury uptake into the food chain as well as transport downstream. In addition, water transports organic material and total suspended solids (TSS) downstream. Organic material and TSS may contain particulate-bound inorganic mercury and may transport this mercury to depositional areas within the reservoir or downstream. This mercury can, depending on where particles are deposited, contribute to methylmercury formation. Other characteristics of water such as pH, sulphate and total and dissolved organic carbon can also impact concentrations of methylmercury in biota.

Surface water sampling for the MMP is planned to be paired with the FAHMFP Mon-8 “Site C Reservoir Water and Sediment Quality Monitoring Program” and Mon-9 “Peace River Water and Sediment Quality Monitoring Program” programs, (see FAHMFP for details on methods). The long-term monitoring schedule for this MMP component is presented in Table 8. As mentioned in Section 5.3, the Site C reservoir will not be included in the 2025 event as conditions are expected to be hazardous for sampling due to high levels of floating debris. Surface water will be collected two times per year (summer and fall) during construction, to target the general period when methylmercury concentrations in surface water are expected to be the highest (Table 10)[19].

In the Site C reservoir surface water samples will be collected approximately 5 m below water surface, unless stratification is detected, in which case at-depth samples will be collected as well to characterize mercury concentrations in the lower water layer (samples located mid-layer, exact sample depth dependent on the depth of the thermocline). Stratification is expected to occur in lower Site C reservoir (i.e., closer to the Site C Dam location) with a thermocline (stratifying layer) forming in the summer and winter, and mixing completely in the fall and spring (EIS, Vol., 2, Section 11). Stratification can be important because conditions for methylmercury generation can differ above and below a thermocline.

[19] Operations surface water monitoring frequency (i.e. number of events per monitoring year) to be confirmed based on review of program information requirements.

Table 10. MMP monitoring for supporting environmental media in a scheduled monitoring year.

Media Type:		Invertebrates		Surface Water	Sediment
		Zooplankton	Benthic Invertebrates		
Sampling Location		2 events/sampling year 1 sample/event[1,2]	1 event/sampling year 4 samples/event[1]	2 events/sampling year 2 samples/event[1]	1 event/sampling year 2 samples/event[1]
Site C Reservoir	Upper Site C	x	x	x	x
	Mid Site C	x	x	x	x
	Lower Site C	x	x	x*	x
Downstream	Site C Tailrace	x	x	x	x
	Beatton-Kiskatinaw	-	x	x	x
	Many Islands	-	x	x	x

[1]Operations monitoring frequency (i.e. events per monitoring year) to be confirmed based on review of program information requirements.

[2]Construction phase 2022 monitoring not scheduled at Mid Site C, Lower Site C, or Site C Tailrace locations.

'x' indicated targeted sampling

'-' indicates no targeted sampling for thatat that location.

*In addition to surface samples, at depth samples will be collected if stratification is detected)

Invertebrate Analytical Parameters: Total mercury (THg) and methylmercury (MeHg), C & N Stable Isotopes

Water Analytical Parameters: T-Hg, D-Hg, T-MeHg, D-MeHg, TSS, TOC, DOC, pH, Conductivity, Hardness, Anions & Nutrients

Sediment Analytical Parameters: T-Hg, T-MeHg, Particle Size, TOC, pH, LOI, Porewater Chemistry

5.5.2 Sediment

Sediment and porewater chemistry will be monitored to track total mercury and methylmercury concentrations. These data may be useful to help understand the magnitude of methylmercury creation in reservoir sediments including the influence of increased sedimentation from bank erosion on mercury methylation. Ultimately, these data are intended to provide some context to better understand the processes that contribute to the fish mercury concentrations measured in fish.

Why Collect Sediment and Porewater? *Freshly inundated terrestrial soils can be a major source for methylmercury in the aquatic environment. Conversely, if significant bank erosion occurs, low-lying agricultural and forest soils high in methylation activity could be buried under sloughed bank material.*

Like water, sediments can be an important agent for mercury and methylmercury uptake into the food chain. In the newly formed reservoir sediment dynamics are expected to be complex due to freshly inundated soils, bank sloughing, and a newly lentic, depositional environment in lower Site C. Sediments in depositional areas downstream in the Peace River may act as a sink for mercury transported from the reservoir. Other characteristics of sediment and porewater such as particle size, pH, sulphate and total organic carbon can impact methylmercury concentrations.

As part of routine and focused sediment quality monitoring, low-level total mercury and methylmercury will be measured in sediment and in porewater. Ancillary parameters that influence the rate of methylmercury formation will also be monitored. For sediment, these include particle size, TOC, pH and Loss on Ignition (LOI). For porewater, these include the same as those for surface water, within the constraints of sample volume. All laboratory analyses will be conducted by accredited laboratories and will include appropriate quality assurance/quality control (QA/QC) measures to verify data quality.

Sediment sampling for the MMP is planned to be paired with the FAHMFP Mon-8 “Site C Reservoir Water and Sediment Quality Monitoring Program” and Mon-9 “Peace River Water and Sediment Quality Monitoring Program” programs, (see FAHMFP for details on methods). The long-term monitoring schedule for this MMP component is presented in Table 8. As mentioned in Section 5.3, the Site C reservoir will not be included in the 2025 event as conditions are expected to be hazardous for sampling due to high levels of floating debris. Sampling will be targeted once per sampling year in late summer during construction (Table 10)[20]. Methylation rates are tied to water temperature, so it is anticipated that summer sediment samples from depositional areas would provide the highest mercury and methylmercury concentrations of the year.

[20] Operations sediment monitoring frequency (i.e. number of events per monitoring year) to be confirmed based on review of program information requirements.

5.5.3 Zooplankton

Currently in the Peace River, zooplankton density is low and contributes little to secondary productivity, making up only a minor component of fish diet (EIS, Vol 2. App P, Part 1). However, zooplankton are expected to be substantially more abundant after reservoir creation and will be the cornerstone of the pelagic (water-column based) food chain. To track changes related to the construction and operation of the Project, mercury and methylmercury concentrations in zooplankton will be measured in the Site C reservoir area as well as the Site C tailrace (Table 10)[21]. Sampling will not be conducted further downstream as zooplankton densities are expected to decrease sharply downstream and they are not expected to be a significant food resource for fish beyond the tailrace section. Carbon and nitrogen stable isotopes will also be measured in zooplankton to help characterize the food web for better interpreting SIA results in fish. All laboratory analyses will be conducted by accredited laboratories and will include appropriate quality assurance/quality control (QA/QC) measures to verify data quality.

Why Collect Zooplankton? *Zooplankton are aquatic invertebrates residing in the water column of lentic water bodies. The water residency time in Site C reservoir is expected to be 23 days which is potentially sufficient time to support a zooplankton community within the reservoir. While sampling will also be conducted in the tailrace area, zooplankton density is expected to decrease rapidly downstream of the dam, so sampling will not be conducted at locations further downstream (Beatton-Kiskatinaw and Many Islands).*

Zooplankton provide an indication of uptake of mercury from the environment into the pelagic food chain. Also, collecting C and N stable Isotope information provides insights into where the zooplankton are located in the food chain and where their energy is originating from.

Zooplankton sampling for the MMP is currently planned to be paired with the FAHMFP Mon-6 “Site C Reservoir Fish Food Organisms Monitoring Program” and Mon-7 “Peace River Fish Food Organisms Monitoring Program” programs, which focus on benthic invertebrate and zooplankton monitoring within and downstream of the Site C reservoir (see FAHMFP for details on methods). The long-term monitoring schedule for this MMP component is presented in Table 8. These FAHMFP programs are not run on an annual basis, however, MMP targeted events will be completed through discrete events coordinated with the FAHMFP. As mentioned in Section 5.3, the Site C reservoir will not be included in the 2025 event as conditions are expected to be hazardous for sampling due to high levels of floating debris. Zooplankton samples will be collected in the summer and fall using horizontal tows with a zooplankton net.

[21] Operations zooplankton and benthic invertebrate monitoring frequency (i.e. number of events per monitoring year) to be confirmed based on review of program information requirements.

5.5.4 Benthic Invertebrates

Benthic invertebrates are important organisms in the benthic food chain. Where sediments are the dominant bottom substrate (e.g., depositional zones), these organisms live directly within the sediment. In more erosional zones, they are found living on or among the coarser substrates such as gravels, cobbles and boulders. Monitoring of methylmercury concentrations in different groups of benthos (epibenthos [living on substrates], such as caddisfly and mayfly; infauna [living in the substrate], such as chironomid larvae) will provide the foundation for understanding implications for mercury bioaccumulation by fish. To track changes, mercury and methylmercury concentrations in benthic invertebrates will be monitored from various locations (e.g., upstream and downstream of the dam location) before and after inundation. Carbon and nitrogen stable isotopes will also be measured to assist in understanding the origin of energy as well as trophic structure. All laboratory analyses will be conducted by accredited laboratories and will include appropriate quality assurance/quality control (QA/QC) measures to verify data quality.

Why Collect Benthic Invertebrates? *Benthic invertebrates are aquatic organisms residing in (infauna) or on (epifauna) the bottom substrate of a water body. Benthic invertebrates are a key food chain component of the aquatic food web and are an important food group for many fish species including juveniles of piscivorous fish species.*

As benthic invertebrate communities become established in freshly inundated terrestrial soils, the primary location of methylmercury formation, it is expected that benthos will respond quickly to increased methylation rates, more so than fish. Benthic invertebrates provide an indication of food chain uptake of mercury from the sediments in the benthic environment. Also, collecting C and N stable isotope information provides insights into the relative position of benthic invertebrates in the food chain and where the energy is originating in that food chain.

Benthic invertebrate sampling for the MMP is currently planned to be paired with the FAHMFP Mon-6 “Site C Reservoir Fish Food Organisms Monitoring Program” and Mon-7 “Peace River Fish Food Organisms Monitoring Program” programs, which focus on benthic invertebrate and zooplankton monitoring within and downstream of the Site C reservoir. The long-term monitoring schedule for this MMP component is presented in Table 8. These FAHMFP programs are not run on an annual basis, however, MMP targeted events will be completed through discrete events coordinated with the FAHMFP within the timeframe which fish mercury concentrations are expected to peak (i.e., 5 to 8 years after reservoir creation). Benthic invertebrate sampling methods will rely on sediment grabs (followed by sieving to target infauna) for sediment substrates and rock baskets for erosional habitat (to target epifauna). Sampling is planned for once per scheduled sampling year in the late summer/early fall period during construction (Table 10)[15].

6.0 Indigenous Community Sampling Program

The Indigenous Community Sampling Program is an Indigenous Nations led fish mercury collection program including sampling of: 1) fish species not targeted in the Monitoring Program, but of possible cultural or subsistence value, such as Burbot (aka Ling, *Lota lota*), Goldeye (*Hiodon alsoides*) and Northern Pike (aka Jackfish, *Exos lucius*), and 2) harvesting locations of interest, such as Dinosaur Reservoir and Smoky River. The Indigenous Community Sampling Program will commence in 2022 and continue annually through the MMP implementation period including the first ten years of operations, then reduced to once every 5 years for Operation Years 15, 20 and 25 (Table 8).

Indigenous Nations will be engaged to support the collection of fish tissue samples through an assigned Community Champion. The Community Champion, through support from a BC Hydro honorarium, will assist with coordination of the activities associated with community collection of fish tissue including:

- communications and training;
- preparation and distribution of sampling equipment;
- collection of field data and samples; and
- safe storage and transportation of samples.

At this time, the identified potential means of collecting fish tissues under the Indigenous Community Sampling Program include scheduled community harvesting events such as fishing derbies or fish camps (e.g., Dinosaur Reservoir Hudson's Hope Father's Day Derby), and/or opportunistic individual traditional fishing events. The expectation is that lethal sampling methods will be used, resulting in fillet samples for analysis. As discussed in Section 5.4, these samples will be directly comparable to the primarily biopsy-based fish mercury samples collected under the FAHMFP.

7.0 Fish Consumption Program

Developing an understanding of the amount of fish that people eat within the MMP study area is a key component of the MMP as potential health risks from mercury in fish depend not only on the mercury levels in fish, but also how much fish people eat and the age and gender of the person eating the fish. This section of the MMP describes the approach to collect human fish consumption information during the construction and operation of the Project.

The MMP will support the collection of information on the consumption of fish by specified Indigenous and non-Indigenous consumers in the study area including:

- species and size of fish caught for consumption;
- locations where fish are caught for consumption;
- consumption of fish by age group and gender;
- fish meal size by age group and gender;

- fish meal frequency;
- parts of fish consumed; and
- fish preparation methods.

The MMP may be adapted in the future to account for information from the Fish Consumption Program. For example, the current version of the MMP includes collecting information on the concentrations of mercury in samples of fish muscle. This is because other studies have found that, especially for fish species higher up on the food chain, the concentration of methylmercury in muscle is higher than the concentrations of methylmercury in other fish tissues, like skin, liver, heart, spleen, stomach and intestine (Polak-Juszczak, 2018; Régine et al. 2006; Watanabe et al. 2012). But if the MMP Fish Consumption Program finds people regularly eat fish eggs, then some fish egg sampling and testing may be added to the MMP to see how concentrations of methylmercury in fish eggs compare to concentrations of methylmercury in fish muscle.

7.1 Approach

The Fish Consumption Program will first, estimate fish consumption rates during baseline using existing data; second, verify the baseline estimates through engagement with Indigenous and non-Indigenous harvesters; and third, revisit fish consumption rates during Project operations (operations Year 5) through another round of engagement.

7.1.1 Preliminary Fish Consumption Estimates

Using existing baseline data, preliminary estimates of fish consumption for Indigenous and non-indigenous people will be developed. There are a number of existing sources of information, including data collected as part of the EIS, which will be used to develop preliminary estimates of fish consumption rates. The existing sources of information have been reviewed and summarized in an MMP Summary of Existing Information on Human Consumption of Fish (Azimuth, 2020).

Data from the existing sources of information, and any other relevant sources subsequently identified, will be extracted and analyzed to develop preliminary estimates of fish consumption rates. At a minimum, preliminary fish consumption rates will be developed for the following:

- children, average and high consumer;
- women of reproductive age, average and high consumer; and
- others, average and high consumer.

The existing sources of information on fish consumption are not complete. They do not include data on fish consumption for all of the Indigenous Nations within the MMP study area, nor do they include data on consumption rates for children. Therefore, some degree of extrapolation will be necessary to develop the full range of preliminary consumption estimates.

The development of preliminary fish consumption estimates began during the first year of MMP implementation in 2022 and is scheduled to continue through 2024 (Table 8). This schedule to

develop fish consumption estimates has been guided by the timing of meeting with Indigenous Nations to discuss the consumption of fish.

BC Hydro is not aware of any existing sources of information that would support the development of preliminary estimates of rates of fish consumption during short-term events with unusually high rates of fish consumption (during fish camps, for example). However, information on this topic will be sought during the engagement process described below.

7.1.2 Verify and Refine Preliminary Fish Consumption Estimates

Once the preliminary estimates have been developed, they will be verified through engagement with Indigenous Nations. Non-indigenous fishing groups and organizations, such as rod and gun clubs, will also be invited to comment on the preliminary estimates.

The objective of the verification process is to obtain feedback on the accuracy of the preliminary fish consumption estimates. The general methods of the proposed verification process are described below.

Planning

It is anticipated that engagement agreements would be developed with individual Indigenous Nations to describe the approach to fish consumption information verification and refinement. Obtaining the necessary ethics approval and data security, stewardship, and ownership protocols and agreements will also be included in the verification planning process.

Field Data Collection

It is anticipated that Indigenous Nations will provide feedback on the preliminary fish consumption estimates through a series of facilitated meetings, such as focus group interviews.

Focus group interviews will take place at an appropriate community meeting space as identified by the participating Indigenous Nation. It is expected that an assigned Community Research Assistant will be recruited from the participating Indigenous Nation to help with the planning, facilitation, and reporting for the focus group interviews.

A diverse cross section of the participating Indigenous Nation will be invited to participate in the focus group interviews. It will be important to have representation from youth, elders, fishers and women. Honoraria may be provided to focus group participants.

The focus group interviews or meetings can be facilitated by BC Hydro, with assistance from the Community Research Assistant. The focus group interviews are expected to last two to three hours each and it is anticipated that there may be a total of three to four focus groups per community.

During the focus group interview, the focus group are anticipated to discuss the accuracy and completeness of the preliminary fish consumption estimates. Topics that may be reviewed include, but are not limited to:

- fish consumption rates for children;
- fish consumption rates for high consumers;
- periods of unusually high fish consumption, such as fish camps or fishing trips; and

- methods used to preserve and prepare fish for eating, including what tissue types are eaten.

The facilitators will record data during the focus group interviews. The data will be reviewed for quality assurance, cleaned of any personal identifiers or personal information, and summarized. A summary of the findings from the focus group interview can be provided to the participants for review and feedback.

Refined Fish Consumption Estimates and Implications

Feedback obtained through the verification process will be used, as necessary, to update the preliminary fish consumption estimates to more accurately and completely reflect the patterns of fish consumption among people who eat fish within the MMP study area, including the methods people use to preserve and prepare fish for consumption (e.g., drying or smoking), the different parts of fish that people eat (e.g., muscle, organs, eggs), and information on short-duration events with unusually high rates of fish consumption. The MMP will be adapted, as necessary, to account for information obtained from the Fish Consumption Program

7.1.3 Fish Consumption Information Collected During Operations

It is recognized that changes to the environment, including reservoir formation, the distribution and relative abundance of fish species, will occur after Site C becomes operational. It is therefore expected that the type and amount of fish that people eat may also change which requires periodic updates of fish consumption information. It will be important to know if fish consumption rates change prior to peak mercury levels, anticipated five to eight years after reservoir formation, so that any potential health risks can be anticipated and communicated.

Updated information on fish consumption is tentatively scheduled to start in Operations Year 5, but the final timing can be determined in consultation with the Indigenous Nations and Health Authorities (Table 8). The objective is to collect the updated information on fish consumption long enough after reservoir creation to capture related changes in fish consumption but prior to peak mercury levels. It is anticipated that the methods used to collect fish consumption information will be similar to the methods described above for verifying the preliminary fish consumption estimates but modified based on lessons learned during that process.

The need for collecting additional fish consumption information after Operations Year 5 will be reviewed, at the time, with Indigenous Nations and Health Authorities.

8.0 Reporting

BC Hydro will provide updates on the status, results, and trends of methylmercury concentrations in fish and supporting environmental media, and the human health risks associated with the consumption of fish from the affected waterbodies. Reports will summarize the results of monitoring for each scheduled sampling year and reports are expected to be submitted the following year.

Reports will also include a description of any MMP amendments.

The MMP reports will be submitted to the EAO, Impact Assessment Agency of Canada, FNHA, NHA, reservoir area Indigenous Nations and immediately downstream Indigenous Nations. Data will be summarized and analyzed in the annual MMP report.

Prior to submitting the annual MMP report, updates on the status, results, and trends of methylmercury concentrations in fish and supporting environmental media, and the human health risks will be shared with Health Authorities and Indigenous Nations through the Methylmercury Technical Sub-committee. This sharing of information can support potentially time sensitive actions, including consumption advisories or other health related bulletins, by Health Authorities. These results will be shared within 30 days after completion of appropriate quality assurance/quality control (QA/QC) measures to verify data quality the year following each scheduled sampling year.

9.0 Health Authority Communications

BC Hydro will collaborate with NHA and FNHA in the interpretation and communication of information about the levels of mercury in fish measured by the MMP. All of the information on concentrations of methylmercury in fish, including that from the Indigenous Community Sampling Program, will be communicated through MMP reporting and the Methylmercury Technical Sub-committee to the Indigenous groups and Health Authorities.

MMP reporting will include information on the average number of servings a month of a particular type of fish (species, size, and location) can be eaten without exceeding Health Canada's pTDI for methylmercury. These calculations will be completed in accordance with Health Canada (2007, 2010) guidance on human health risk assessment and will be consistent with the methods used to calculate tolerable fish consumption rates in the Human Health Risk Assessment of methylmercury in fish for the EIS. Similar approaches are used by health authorities in the provinces of Alberta, Saskatchewan, Manitoba, Ontario and Quebec to provide public information on tolerable rates of consumption of fish in those jurisdictions. The proposed approach to calculating tolerable fish consumption rates is described in Appendix B.

It will be the Health Authorities responsibly to issue applicable consumption advisories or other health related bulletins based on MMP reporting included associated consumption advise.

10.0 Program Review and Revisions

Revision 2 of the MMP provides information on methylmercury monitoring in environmental media, collection of fish consumption information and communication of monitoring results that will be implemented and adapted through the construction and operation of the Project. The principle of adaptation covers a spectrum from minor field-based program adjustments to major, larger scale contingent initiatives, implemented in the spirit of meeting the overall objectives of the MMP (Section 0). Potential revisions to the MMP need to be balanced against the benefits of maintaining a consistent sampling design over time.

Further information will become available as MMP implementation progresses. Consistent with adaptive management principles, the monitoring parameters, frequency and intensity may change over time, according to results. For example, there may be a change in fish community structure over time within the Site C reservoir (EIS Vol. 2, Section 12). While the monitoring program (Section 5.0) has taken into account the likely changes in fish distribution and abundance when determining the fish species and locations to be monitored, these may be adapted based on species distribution and abundance.

Further, input may also be received from Indigenous Nations, the public, and regulatory agencies that needs to be taken into account when implementing the MMP.

The Methylmercury Technical Sub-committee provides a venue to review proposed revisions to the MMP and subsequent details of the monitoring program. In addition to such periodic reviews, BC Hydro recommends a review of the program after Operations Year 6.

11.0 Qualified Professionals

Table 10 lists the qualified individuals who prepared Revision 1 of the MMP.

Table 10. Qualified Professionals involved in the preparation of the technical material for the MMP Rev 0.

Qualified Individual	Expertise
Dave Hunter, RPBio	Biologist
Laura Bekar, MSc, RPBio	Biologist
Gary Mann, MSc, RPBio	Technical Lead, Methylmercury
Norm Healey, BSc, DABT	Human Health - Methylmercury

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Appendix A: Characterization of Size-Mercury Relationships

The following provides an overview of how fish mercury data may be analyzed. It is important to note that methods may vary depending on the data.

- Size (length and weight) and age are known to be important covariates for tissue mercury concentrations within a species, with larger/older fish having higher mercury concentrations than smaller/younger fish. Among these variables, length is generally much easier to accurately measure and tends to be result in a less variable relationship with mercury than does weight (which can vary based on the size/timing of last feeding) and age (which has higher relative measurement error). Consequently, the approach will focus on length-mercury relationships.
- A range of mathematical models will be fit to the fish length and tissue mercury concentration data from all monitoring locations and years. These models would be used to identify important spatial and temporal differences in the length-mercury relationship and allow us to track changes over time and space. Sample models testing for spatial differences among locations are shown in Table 1. These sample models range from simple location-specific intercepts through linear forms (with and without length-location interaction term) to quadratic polynomials (with/without various interaction terms). From a size-mercury relationship characterization perspective, this array of models covers the spectrum from no relationship with size (fit0) through general size-dependent relationships to more complex models capable of characterizing more site-specific relationships.
- Models generally fit to raw, log and square root transformed data; diagnostic plots and Shapiro-Wilk's test used to assess the residuals and select the most appropriate transformation.
- A variant of Akaike's Information Criterion (AIC), corrected for bias in small sample sizes (AIC_c), will be used to compare models (Burnham and Anderson 2002)[22], as well as looking at p-values for terms or coefficients and visually examining model fits. In cases where models over-fitted, a next best model, generally more parsimonious, will be selected.
- Given that the models could have not only different intercepts, but also different slopes (linear models) or polynomial curve shapes (quadratic models) for the various locations, multiple standard sizes can be selected for each species to facilitate comparisons among locations within and among all locations (i.e., including reference locations).
- For comparisons among location/year combinations, the selected models for each species will be run centered on each standard size to allow testing the statistical significance of each intercept (i.e., predicted mercury concentration for that species at that location at that size). This method facilitates interpretation of the model coefficients.

[22] Burnham, K. P. and D.R. Anderson. 2002. Model Section and Multimodel Inference: A practical information-theoretic approach. 2nd ed. Springer-Verlag New York, Inc. ISBN 0-387-95364-7

Table 1. Sample models fit to fish length-mercury data.

Model	Comments
fit0 <- lm(use ~ Location, data=x)	simple means by location
fit1 <- lm(use ~ LC, data=x)	linear - all locations same
fit2 <- lm(use ~ LC + LC2, data=x)	quadratic - all locations same
fit3 <- lm(use ~ Location + LC, data=x)	linear - location-specific intercepts
fit4 <- lm(use ~ Location + LC + LC2, data=x)	quadratic - location-specific intercepts
fit5 <- lm(use ~ Location + LC + Location:LC, data=x)	linear - location-specific intercepts/slopes
fit6 <- lm(use ~ Location + LC + LC2 + Location:LC, data=x)	quadratic - location-specific intercepts/slopes (length)
fit7 <- lm(use ~ Location + LC + LC2 + Location:LC2, data=x)	quadratic - location-specific intercepts/quadratics (length^2)
fit8 <- lm(use ~ Location + LC + LC2 + Location:LC + Location:LC2, data=x)	quadratic - location-specific intercepts/slopes/quadratics

Note: "use" = tissue mercury concentration; "LC" = length (centered on standard size for species); "LC2" = length2; "Location" = reach or lake; ":" = interaction

Appendix B: Methods for Calculating Fish Consumption Guidance

Methods for Calculating Fish Consumption Guidance

The average number of servings of fish that can be consumed per month without exceeding Health Canada's provisional Tolerable Daily Intakes (pTDI) for methylmercury for methylmercury will be calculated by Equation 1, which was adapted from equations 3-2 and 3-3 in U.S. EPA (2000).

Equation 1

$$SV = \frac{(pTDI \times BW \times \delta)}{(C \times S)}$$

Where:

SV= Number of servings of fish that can be consumed per month without exceeding the pTDI

pTDI = Health Canada's provisional TDIs for methylmercury (µg/kg/day)

BW = Body weight (kg)

δ = Unit conversion constant = 30.44 days/month

C = Average concentration of methylmercury in fish (mg/kg wet weight)

S = Average serving size of fish (g wet weight)

The number of servings of fish that can be consumed per month without exceeding Health Canada's pTDIs for methylmercury depends on: (1) the average concentration of methylmercury in the fish; (2) the average serving size of fish; (3) the body weight of the person consuming the fish; and (4) the pTDI that applies to the person consuming the fish. The pTDIs for methylmercury as well as standard human body weights used in calculations are prescribed by Health Canada. The input variables used in Equation 1 to calculate tolerable fish consumption rates are summarized in Table 1 and discussed below.

Table 1. Input variables used to calculate tolerable fish consumption rates

Input variable	Units	Children 6 months to 4 yrs	Children 5 to 11 yrs	People who could become pregnant 12-50 yrs	Others
pTDI	µg/kg/day	0.2	0.2	0.2	0.47
Body weight	kg	16.5	32.9	70.7	70.7
Average fish serving Size	g	75	125	163	163

Health Canada pTDI for Methylmercury

A TDI is intended to be a benchmark of acceptable exposure to a chemical that a person can be exposed to from all sources of oral exposure on a daily basis for a lifetime. Health Canada (1996) defines a TDI as the total intake by ingestion "to which it is believed that a person can be

exposed daily over a lifetime without deleterious effect". Health Canada (1996) states that exceedance of a TDI "for a small proportion of the lifespan does not necessarily imply that exposure constitutes an undue health risk".

Health Canada's TDIs are intended to protect all Canadians, including subpopulations that are most susceptible to the potential toxic effects of a chemical. Scientific research has demonstrated that the developing nervous system is sensitive to the potential toxic effects of methylmercury. Therefore, Health Canada has published two TDIs for methylmercury – one TDI for women of child-bearing age and children less than 12 years of age and a second, more permissive, TDI for the general population. Both of Health Canada's published TDIs for methylmercury are provisional TDIs (pTDIs). Provisional indicates that Health Canada does not have the requisite level of certainty about the TDI and that the TDI is subject to updates as new scientific information becomes available. Health Canada's pTDI for methylmercury for the general population, or the oral dose to which the general population can be exposed to on a daily basis for their lifetime, is 0.47 µg methylmercury/kg body weight/day (µg/kg/d) (Health Canada 2007). Health Canada's pTDI for methylmercury for women of child-bearing age and children less than 12 years of age is 0.2 µg/kg/d (Health Canada 2007).

Body Weight

The input values for average body weights are 70.7 kg for adults, 32.9 kg for children 5-11 years old, and 16.5 kg for children 6 months-4 years old. These input values are consistent with receptor characteristics prescribed by Health Canada (2010; 2012) guidance on human health risk assessment.

Average Fish Serving Size

Health Canada guidance recommends that site-specific fish consumption data be used where available. As described in Section 7.0, the MMP includes provisions to collect site-specific data on fish consumption. In the absence of more representative data that may be generated through the implementation of the MMP, the following input values for fish serving sizes are proposed for calculating tolerable fish consumption rates.

Health Canada (2007) conducted a review of Canadian data on fish consumption, including serving sizes, and concluded that the best estimate of the long-term average fish serving size for Canadians was 150 g for adults, 125 g for children 5-11 years old and 75 g for children 1-4 years old. Health Canada (2007) considered these values to be conservative (i.e., health protective) estimates of the average serving size of fish consumed by Canadians.

There are some regional data available on fish consumption by adult First Nations, the most reliable of which are data on fish serving sizes collected for the BC First Nations Food, Nutrition and Environment Study - a 2008-09 study of food consumption among 1,103 self-identified First Nations aged 19 years and older living on-reserve in 21 randomly selected communities in B.C. reported by (Chan et al. 2011). Ninety-five percent of participants in the BC First Nations Food, Nutrition, and Environment Study reported consuming fish in the year prior to the study and the

average serving size for fish ranged from 87-163 g/serving, depending on age group and gender. The mean fish serving size for women of childbearing age (19-50 years) was 109 g/serving.

The results of a Country Food Harvest Consumption Survey of the Duncan's First Nation collected for the Site C EIS reported that the average number of fish servings per month consumed by adult participants was 4.2 (range 0-16 servings per month) and the average serving size of fish was 5.5 oz (approximately equal to 156 g). A similar Country Food Harvest Consumption Survey for the Horse Lake First Nation reported that the average number of fish servings per month consumed by participants was 1.4 (range 0-16 servings per month) and the average serving size of fish was 3.6 oz (approximately equal to 102 g). Age or sex-specific serving sizes were not reported by these surveys.

Based on the above, the following serving sizes are proposed as input values to calculate tolerable fish consumption rates: children 6 months to 4 years old: 75 g/serving; children 5 – 11 years old: 125 g/serving; and adults, including women of child-bearing age: 163 g/serving. These values are, with the exception of the value for adults, based on the conclusions of Health Canada (2007) and used by Health Canada in the national risk assessment of methylmercury in commercially sold fish as conservative (i.e., health protective) estimates of the average serving size of fish. The Health Canada (2007) serving size for adults (150 g/day) is slightly less than the maximum average fish serving sizes recently reported in surveys of local and provincial First Nations populations. Therefore, a higher value of 163 g/serving based on data from these studies is proposed for calculating fish consumption guidance for the MMP. For comparison, a 170 g can of light tuna contains approximately 120 g of fish (the rest being water or oil) (Health Canada 2007).

The assumed serving (or portion or meal size) varies between different sources of Canadian fish mercury consumption guidance. Some guidance (e.g. Ontario, Quebec) uses larger values than proposed here and others (e.g., Toronto public Health, Parks Canada) use lower values. In some cases, the rationale presented for using larger assumed serving sizes is survey information that indicates some people eat larger than average servings of fish. However, fish serving size is positively correlated with body weight (Health Canada 2007) and fish mercury consumption guidance is calculated on average body weight (see Equation 1). Therefore, one needs to be cautious about using an assumed serving size that is large relative to body weight because it will introduce a systemic bias that over-estimates risk.

Children less than 12 years old have about a 2-fold higher mass of serving size per kg body weight than adults and the PTDI for children less than 12 years old is lower than the pTDI for adults. Therefore, separate guidance for children less than 12 years old is necessary. It is not necessary to calculate separate guidance for teens from adults because both groups have similar serving sizes for their body weights and the same pTDI; the same applies for toddlers (children 6 months to 4 years old) and children 5 to 11 years old. After rounding, there is often no practical difference between the recommended maximum number of servings calculated fora

toddler than a child 5 to 11 years old. Therefore, it may be preferable to simply present a single SV value for children less than 12 years old based on either (1) the calculated SV for a toddler; or (2) a "composite" child based on the averages of the input variables for the toddler and children 5 to 11 years old.

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Appendix C: Draft MMP Input Received from Indigenous Nations and Health Authorities

Site C Permit Consultation Information Requests
BC Hydro responses to comments; Draft Methylmercury Monitoring Plan (MMP) Rev 0 dated May 28, 2021

Table 1. MMP Rev 0 - Indigenous Nation Comments

ID #	Source	Comment / Question	Response
1	Halfway River First Nation (HRFN)	Ref Fig. 2: HRFN questions why zooplankton collection is not included at the Beatton Kiskatinaw and Many Islands locations.	The focus of zooplankton methylmercury monitoring is the Site C reservoir and Site C tailrace based on the expected high abundance of zooplankton (as described in MMP Section 5.4.4). Zooplankton can be abundant in lakes and reservoirs, but generally do not survive long periods in rivers. Zooplankton are a potential food source for fish. Zooplankton is collected in the Peace River prior to reservoir creation as a means of comparison of pre vs post inundation levels of zooplankton density. The following text was added to MMP Section 5.5.3: *"While sampling will also be conducted in the tailrace area, zooplankton density is expected to decrease rapidly downstream of the dam, so sampling will not be conducted at locations further downstream (Beatton-Kiskatinaw and Many Islands"* Currently in the Peace River, zooplankton density is low and contributes little to secondary productivity, making up only a minor component of fish diet. The focus of methylmercury monitoring at Beatton Kiskatinaw and Many Islands locations is benthic invertebrates given their importance as forage for fish and supporting an understanding implications for mercury bioaccumulation by fish.
2	HRFN	It is stated that BC Hydro will undertake mercury monitoring in fish annually for the first 10 years, and every 5 years for Operation Years 15, 20, and 25. In Table 8, however, it is stated that sampling is to occur every 5 years from Operations Year 15 until fish mercury concentrations have stabilized at a new baseline concentration (as is required per Condition 60 of the EAC). HRFN requests more information on how this stabilization will be determined (i.e., what criteria must be met to determine that mercury concentrations have stabilized to a new baseline). HRFN would also like clarification on what will happen if mercury levels are not observed to stabilize at year 25. Will additional monitoring occur after 25 years if mercury levels have not been shown to stabilize?	Mercury levels in fish and lower trophic organisms will be measured during operations years to help determine if mercury stabilization has occurred. Additional monitoring at 5 year intervals would be done if stabilization is not found to occur within the 25 year study period. The following text was added to MMP Section 5.3: "Monitoring is planned to continue until fish mercury concentrations have stabilized. A weight-of-evidence approach will be used to assess stability, with consideration of results from all study components (i.e., fish, zooplankton, benthic invertebrates, sediment, and water). There are three possible outcomes of the assessment: 1. Stable – evidence aligns across fish species and across environmental media to show that concentrations have decreased from their post-inundation peaks and are now stable. MMP monitoring can stop. 2. Inconclusive – evidence of stability is not consistent across fish species and across environmental media. MMP monitoring repeated in five years. 3. Decreasing – evidence shows that fish mercury concentrations are still decreasing from their post-inundation peak. MMP monitoring repeated in 5 years.

3	HRFN	Ref Fig 3.2: The MMP states that it is not expected to see substantial changes in fish methylmercury concentrations due to the diversion (and diversion head pond). Now that diversion has been completed, HRFN asks if this statement has been found to hold true thus far. HRFN understands that BC Hydro may not yet be able to comment on all media tested, as there is a delay to sequestration of mercury in organisms farther up the food chain.	It is premature to comment on diversion effects for the reasons described by HRFN. However, year 1 MMP monitoring in 2022 (approximately 2-years after the initiation of river diversion in fall 2020) will assess both fish tissue from fish sites upstream and downstream of the diversion headpond, and supporting media methylmercury concentration at several sites including one within the diversion headpond. Supporting reporting will describe results and comment on any perceived changes in methylmercury concentration from pre-diversion conditions.
4	HRFN	Ref Fig 5.2.2: Sections 1 and 3 are to be combined into one fish sampling location after impoundment. The MMP explains that these two fish monitoring locations will be combined as it is not expected that there will be spatial differences between the two locations once the reservoir is formed, as target fish are expected to move throughout the reservoir. HRFN requests that this assumption be confirmed through sampling.	This request is noted by BC Hydro. In addition to the rationale provided in the MMP (i.e., that fish are expected to move within the reservoir), baseline data (report forthcoming) indicate no major differences in fish mercury concentrations for target species between the two locations in recent sampling. Given these factors, the sampling design in the MMP has not been changed per this request. The following text was added to MMP Section 5.2.2: "Further, baseline sampling results indicate no major differences in fish mercury concentrations between these two sampling locations."
5	HRFN	Ref Fig 5.2.2: The MMP states that: "if in a given year samples cannot be obtained under the MMP design, supplementing with fish processed at other locations, such as at the fish passage facilities, could provide an alternative source of Samples". HRFN would like to know what circumstances or conditions would need to occur to exclude the collection of samples as written in the MMP design.	Sample collection for the MMP is planned to occur by the crews that are sampling for the existing aquatic monitoring programs under the Project Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP). This approach is consistent with the mercury data collection to date (2010 to 2020; Azimuth 2021[1]). Alternative mercury sampling approaches, such directed boat electrofishing with the sole purpose of collecting mercury samples from a few species, would require a large effort and result undue capture and disturbance of species not targeted for mercury samples. The MMP lists: "The planned species and location combinations in Table 9 are based on the catch success of baseline sampling (see Azimuth 2021for more details); species and location combinations were not included where the baseline catch results indicated that it would be unlikely to obtain the samples needed for the MMP. " Despite this planning, there may be specific times, locations or species where all of the sample sizes targeted in the MMP are not achieved under the FAHMFP sampling. For example, the 6 sessions of boat electrofishing planned in Section 5 of the Peace River in 2022 under the Peace River Fish Indexing Program of the FAHFMP, does not capture all 35 Bull Trout across of range of fish sizes. In such situations, BC Hydro will evaluate the information provided by samples collected, to determine if and how to augment the samples from other sources. The following text was added to MMP Section 5.2.2:

[1] Available at https://www.sitecproject.com/sites/default/files/Site-C-Baseline-Peace-River-2010-2020-Fish-Mercury.pdf

			"The expectation is that MMP fish tissue sample needs will be met through the FAHMFP. However, in years where there may be key data gaps, the MMP samples could be augmented with directed fish sampling activities targeting mercury collection (e.g., angling or netting for target species, taking samples from fish at the fish passage facilities) provided that the locations contribute to the MMP objectives."
6	HRFN	Ref Fig 5.4.2: Surface water will be collected two times per year during construction to characterize annual peak methylmercury concentrations in surface water. It is stated that these sampling events will occur in summer/early fall when methylmercury concentrations are expected to peak. How will BC Hydro confirm this expectation? Will other factors with the potential to impact mercury/methylmercury concentrations potentially contribute to peak concentrations at different times during the year than expected? How will it be confirmed that methylmercury concentrations are in fact at their maximum value during the sampling events in the absence of more frequent sampling?	Fish mercury concentrations are the central focus of the MMP, not only because they are the most important source of methylmercury for humans, but also because they integrate exposure across a dynamic chemical, physical and biological environment. Water, sediment, zooplankton, and benthic invertebrates are included in the MMP to provide some context to better understand the processes that contribute to the mercury concentrations measured in fish. Sampling in the MPP is scheduled to occur during the period when we generally expect the highest seasonal methylmercury concentrations in water. The information provided by supporting media does not require measuring or understanding seasonality, nor is there a need to measure the exact peak methylmercury concentrations in surface water. The following text was added to MMP Section 5.5.1 to clarify role of water sampling: 1. 1st paragraph "…and to provide context for better understanding the processes that contribute to the mercury concentrations measured in fish." 2. 4th paragraph "…to target the general period when methylmercury concentrations in surface water are expected to be the highest…"
7	HRFN	Ref Fig 5.4.3: Sampling of sediments will be targeted once per sampling year in late summer during construction, as it is anticipated that summer sediment samples would provide the highest mercury and methylmercury concentrations of the year due to higher water temperature. As other factors (e.g., bank erosion, pH, sulphate presence) which cannot always be seasonally anticipated, impact methylmercury concentration, how will it be determined that the above assumption is true, and that mercury and methylmercury concentrations are not higher during other periods? How will BC Hydro ensure that exceedances are not missed with only one sampling event occurring per year?	Building on response to HRFN comment #6, sediment chemistry is monitored to provide some general insights into the underlying conditions ultimately affecting fish mercury concentrations. While more intensive sampling may better characterize within-year temporal and spatial variability in methylmercury concentrations in sediments, such specific information is not required for the purposes of the of the MMP, which focuses on changes in fish mercury concentrations associated with Site C. The following text was added to MMP Section 5.5.2: "Ultimately, these data are intended to provide some context to better understand the processes that contribute to the mercury concentrations measured in fish."
8	HRFN	Ref Fig 7.0: As different parts of fish may sequester more mercury, how will this be tested, and will these differences be communicated?	Other studies have found that, especially for fish species higher up on the food chain, the concentration of methylmercury in muscle is higher than the concentrations of methylmercury in other fish tissues, like skin, liver, heart, spleen, stomach and intestine (Polak-Juszczak, 2018; Régine et al. 2006; Watanabe et al. 2012) The following text was added to MMP Section 7:

			"The MMP may be adapted in the future to account for information from the Fish Consumption Program. For example, the current version of the MMP includes collecting information on the concentrations of mercury in samples of fish muscle. This is because other studies have found that, especially for fish species higher up on the food chain, the concentration of methylmercury in muscle is higher than the concentrations of methylmercury in other fish tissues, like skin, liver, heart, spleen, stomach and intestine (Polak-Juszczak, 2018; Régine et al. 2006; Watanabe et al. 2012). But if, for example, the MMP Fish Consumption Program finds people regularly eat fish eggs, then some fish egg sampling and testing may be added to the MMP to see how concentrations of methylmercury in fish eggs compare to concentrations of methylmercury in fish muscle."

Table 2. MMP Rev 0 - Health Authority comments

ID#	Section / page	Source	Comment	Response
1	1.3, p.9	BC Ministry of Health (HLTH)	The two links in footnote 4 return the message: "*Page not Found*".	The web links in MMP Section 1.3 were revised.
2	2.1, p. 15	HLTH	The third paragraph in this section switches between 'methylmercury' and 'mercury'. If it is assumed that 100% of the total mercury in fish tissue is methylmercury, please ensure this is stated in the MMP.	The following text was added to the 3rd paragraph of MMP Section 2.1 "Mercury measurements in fish generally target total mercury and conservatively assume, based on research for a variety of freshwater and marine fish species (Bloom, 1992), that methylmercury is the only form present. Consequently, unless specified otherwise, use of the term "mercury" in the context of fish tissue concentrations implies the form methylmercury."
3	2.1, p.16	HLTH	Please provide references for the information on the percentage of methylmercury detected in total mercury in various environmental media for all the bullets at the end of this section.	MMP Section 2.1 was revised with references added for each bullet.
4	2.2, p.18	HLTH	Recommend that long-range atmospheric transport of mercury is included in the discussion of how atmospheric mercury can be influenced by local and natural sources.	The following text was added to MMP Section 2.2 "long-range transport from distant natural (e.g., volcanic activity and forest fires) or human-influenced sources."

5	2.2, p.18	Northern Health (NH)	Recommend adding 'wildfires' to the example provided for *range of natural sources* and a discussion regarding how climate change may impact accumulation. Wildfires are becoming more frequent and more intense and this is an important consideration as we contemplate impacts in the future.	See previous response to Health Authority comment #4 for addition of forest fires. BC Hydro acknowledges the comment regarding climate change. The temporal element of the MMP study design serves to track changes in fish mercury concentrations due to Site C and a range of other factors (e.g., climate change, logging, forest fires) that might be affecting the region. From a methylmercury human health risk management perspective, future fish consumption guidance will be based on measured fish mercury concentrations, regardless of the underlying source(s). The focus of the MMP is to measure the levels in fish. From a scientific perspective, understanding the relative importance of these factors to methylmercury concentrations in fish would be interesting. However, given the potential influence of these other factors at a regional or provincial spatial scale, understanding the relative importance of these broad-scale factors would be greatly improved if there was more widespread, systematic fish mercury monitoring in BC.
6	2.2, p.18	HLTH	Recommend that some general information on mercury concentrations in other environmental media such as piscivorous wildlife (e.g., bears, river otters) and piscivorous birds (e.g., osprey, eagles) is included in this section. Alternatively, a cross-reference could be provided to documents that contain this information, such as the EIS or the "*Methylmercury Questions and Answers*" document.	Section 2.1 of the MMP was revised with cross reference and hyperlink to technical memo on methylmercury Attachment 1 "Site C Clean Energy Project - Effects of Methylmercury on Wildlife".
7	2.3, p.18	HLTH	Please provide a reference for Health Canada's methylmercury pTDI values. It would be helpful if the pTDI values were provided here or a cross reference provided to Table 1 in Appendix B, where the pTDI values are shown.	A citation for the source of the pTDI values and a cross reference to Appendix B Table 1 was added to MMP Section 2.3.
8	2.3, p.18	NH	This section does not describe methylmercury exposure and health impacts in much detail. This section should provide context regarding the significance of this monitoring program in terms of response to community concerns and human health impacts more broadly. Potential impacts to bio-physical, socio-economic, cultural, and wellbeing outcomes should be described. This context helps to guide how impacted communities and stakeholders can be appropriately engaged during the development and implementation of this plan and helps to inform fish consumption guidance.	Thank you for your input. The intent of the MMP is to describe how BC Hydro will monitor mercury levels in fish and human consumption of fish in the Project area. BC Hydro, in collaboration with the Health Authorities and Indigenous groups, has developed other public communications materials to increase stakeholder knowledge about methylmercury in fish and the health benefits and risks from eating fish. Some of these public communications materials can be found at the following: • Methylmercury in Our Environment: Pictorial (Link - https://www.sitecproject.com/sites/default/files/Methylmercury-Poster-11x17.pdf) • Methylmercury in the Site C Reservoir (Link - https://www.sitecproject.com/sites/default/files/SiteC-methylmercury-info-sheet-updates.pdf)

				The anticipated environmental and socioeconomic impacts of the Project were assessed during the Environmental Assessment process and are documented in related reports, such as the Environmental Impact Statement.
9	3.1, p.19	HLTH	It is unclear why summaries for baseline conditions for the environmental media other than fish (e.g., water, sediment, zooplankton, benthos) are not provided. It is also unclear why for these environmental media, the field collection methods, laboratory methods, and quality control methods are not provided.	The following text was added to MMP Section 3.1: "Baseline monitoring of environmental media for water and sediment was also collected from 2016 to 2019[2]. Environmental Media collection will occur as described in the MMP commencing 2022." Field collection methods, laboratory methods, and quality control methods for baseline environmental media supporting the Site C Environmental Impact Statement are described in the 2010 & 2011 Status of Mercury in Benthic Invertebrates and Fish – Peace River and Dinosaur Reservoir by Azimuth Consulting Group[3]. Key results from the early baseline sampling were as follows (EIS Vol. 2 Section 11.9): • Water – exclusive of conditions with high total suspended solids, total mercury in the Peace River and key tributaries seldom exceeded 1 ng/L. Methylmercury concentrations were consistently below the laboratory reporting limit of 0.05 ng/L. • Sediment – total mercury concentrations in the Peace River or major tributaries were typically below laboratory reporting limits (0.05 mg/kg dw), or if detected were low (e.g., 0.05 to 0.11 mg/kg dw). Methylmercury concentrations were also low in the Peace River (0.15 to 1.2 µg/kg dw) and slightly higher in its tributaries (0.6 to 2.5 µg/kg dw). • Zooplankton – total mercury concentrations in Peace River zooplankton (0.004 to 0.009 mg/kg ww) are similar to those in the Williston Reservoir (Baker et al. 2002). Methylmercury concentrations (0.0001 – 0.0007 mg/kg ww) were also low and comprised about 5 to 10% of the total mercury concentration. • Benthic Invertebrates – total mercury concentrations in Peace River benthic invertebrates ranged from 0.01 to 0.082 mg/kg ww. Methylmercury concentrations ranged from 0.003 to 0.03 mg/kg ww and comprised 20 to 63% of the total mercury concentration."
10	3.1, p.19	HLTH	This section discusses the difference in mercury concentrations in fish tissue between the two sampling periods (2010-2011 vs. 2017-2020). The text states that the reasons behind the increase in concentrations are not known but that current concentrations are consistent with BC reference lakes. This is another section where information on	See response to Health Authority comment #5.

[2] FAHMFP MON-8/9, Tasks 2a Peace River and Site C Reservoir Water and Sediment Quality annual study reports available at https://www.sitecproject.com/document-library/environmental-and-socio-economic-plans-and-reports

[3] Available at: https://www.sitecproject.com/sites/default/files/2010-11-Peace-River-Mercury-Data-Report-Feb-3-2014.pdf

			the increase in global background mercury concentrations could be discussed.	
11	3.3, p.20	HLTH	This section states: "*Fish methylmercury levels in the Site C reservoir are predicted to increase by an average of three to four times the baseline level in the newly created reservoir, and return to a new baseline after approximately 20-30 years*". Is this referring to the 2010-2011 baseline level? Or the approximately two-fold higher 2017-2020 baseline level (as described in Section 3.1)? Is the new baseline level in 20-30 years predicted to be higher than the 2017-2020 baseline? If so, by how much?	Return to a new baseline is referring to the current baseline based on most recent 2017-2020 fish mercury data. The following text was added to MMP Section 3.3: "Fish methylmercury levels in the Site C reservoir are predicted to initially increase by an average of three to four times the recent baseline levels (based on the 2017 – 2020 data) within 5 to 8 years after the reservoir is created, then are expected to gradually return to levels that are similar to natural lakes and rivers in the region approximately 20 to 30 years after reservoir creation."
12	5.2.2, pp.24-26	HLTH	Please also describe the Indigenous Community Sampling Program locations in this section.	The following text was added to MMP Section 5.2.2: "In addition, it is anticipated that sampling of the Dinosaur Reservoir and the Peace River in proximity to its confluence with the Smoky River will be included as part of the Indigenous Community Sampling Program, along with other areas of interest to the participating communities (see Section 6 for more information)."
13	5.2.2, p.25	HLTH	This section, Table 4 (p.26), and Table 5 (p.28) refer to monitoring sites (e.g., Sections 1, 3, 5, 7, 9; PR1, 2, 3; PD1, 3, 5) that are not shown or named in Figure 2. Please include these site names in Figure 2 or in an additional figure.	A new MMP figure (Figure 4) was added to show the MMP sampling locations, including the names for the supporting media, on the same map.
14	Table 4, p.26	HLTH	Table 4 mentions the Peace-Canyon Dam. It would be helpful if the dam was shown on Figure 2.	MMP Figure 2 was revised to include Peace Canyon Dam.
15	Table 4, p.26	HLTH	Please describe why there are no sampling locations further upstream of Upper Site C (Section 1) and no reference locations. Reference locations may help determine increases in background mercury concentrations over time, which would not be attributed to reservoir creation. How will the potential increase in background mercury concentrations be accounted for?	As noted for Comment 5 above, the primary objective with the MMP is to communicate methylmercury risks to human health. This task relies on characterizing fish mercury concentrations and does not necessarily need to partition observed changes by source (e.g., Site C vs regional or other factors). As a results, The MMP, like other monitoring programs for Site C, is a "before-after" (BA) monitoring design, as opposed to a more complex "before-after-control-impact" (BACI) design.
16	5.3, p.29	NH	Will a downward trend in methylmercury levels be confirmed before lowering monitoring frequency (post - first 10 years)? Will the 25 yr mark adequately verify the 'new baseline' level?	See response to HRFN comment #2.

17	Figure 4, p.30	HLTH	Figure 4 displays the fish mercury monitoring data from 2010-2011 and 2017-2020 as the same level (1x baseline). However, Section 3.1 (p.19) states the 2017-2020 fish methylmercury levels were approximately two-fold higher than the 2010-2011 baseline levels. Please explain the discrepancy between Figure 4 and the text in Section 3.1. An explanation for this was provided at the June 16, 2021 sub-committee meeting, please provide this information in the MMP.	MMP Figure 5 updated to confirm 2017-2020 fish methylmercury levels were approximately two-fold higher than the 2010-2011 baseline levels.
18	Figure 4, p.30	HLTH	Figure 4 shows peak fish tissue mercury concentrations occur in 2030. However, Section 5.3 (p.29) states methylmercury concentrations in fish tissue are expected to peak approximately a decade after inundation (planned for fall 2023, as described in Section 3.3). Please explain the discrepancy between Figure 4 and the text in Sections 3.3 and 5.3.	MMP Figure 4 (Figure 5 in MMP Rev 1) shows a conceptual trajectory for fish mercury concentrations. The text in MMP Sections 3.3 and 5.3 was revised as follows: “Fish methylmercury levels in the Site C reservoir are predicted to initially increase by an average of three to four times the recent baseline levels (based on the 2017 – 2020 data) within 5 to 8 years after the reservoir is created, then are expected to gradually return to levels that are similar to natural lakes and rivers in the region approximately 20 to 30 years after reservoir creation” “As described in Section 3, Project-related changes in fish methylmercury concentrations are only expected to occur after inundation, when they are expected to rise to a peak (within 5 to 8 year after impoundment), followed by a more gradual return to levels that are similar to natural lakes and rivers in the region (by approximately 20 to 30 years after reservoir creation)”
19	Figure 4, p.30	HLTH	Mercury concentrations in fish tissue are shown to stabilize at approximately 1.5 times current concentrations. It would be helpful if this was also specifically mentioned in the text.	See response to Health Authority comment #18.
20	5.4.1, pp.31-34	HLTH	This section does not include the average lifespan, weight, and length for the various fish species to be sampled under the MMP. Since methylmercury concentrations increase with age and size, it is important to include this information to clearly show how these species differ in their bioaccumulation of methylmercury. This information could also be displayed in Table 7 (e.g., Redside Shiner information indicates it's a small bodied species, that type of info could be included for all species).	MMP Table 7 was included to provide an overview of the targeted MMP species and includes information on life history, movement, diet, Indigenous Group harvest, and rationale for inclusion into the program. While age, weight and length are important when looking at within-species variability (and older, larger fish within a species generally have higher mercury concentrations), this information is not as important as diet when looking across species. Apart from the Redside Shiner, where we have included it, the lifespan/size information of the other species can have substantial overlap, so will not help clarify (and may even take away from) the mercury-related message included in the rationale column (i.e., why we picked a particular species).

21	5.4.1, p.31	HLTH	The characterization of the size-methylmercury relationship is limited to fish length. Please explain in the MMP why fish weight and age relationships were not conducted, as explained at the June 16, 2021 sub-committee meeting.	In accordance with the response during the June 16, 2021 Site C Methylmercury sub-committee meeting, the following text was revised in MMP Section 5.4.1 and added to MMP Appendix A: "Sufficient numbers of fish need to be present at each monitoring location to accurately characterize the length-methylmercury relationship (see Appendix A for more details, including why length is preferred over size and age)." "Size (length and weight) and age are known to be important covariates for tissue mercury concentrations within a species, with larger/older fish having higher mercury concentrations than smaller/younger fish. Among these variables, length is generally much easier to accurately measure and tends to be result in a less variable relationship with mercury than does weight (which can vary based on the size/timing of last feeding) and age (which has higher relative measurement error). Consequently, the approach will focus on length-mercury relationships."
22	Table 6, p.32	HLTH	Since the 2017-2020 baseline mercury fish concentrations were approximately two-fold higher than the 2010-2011 baseline levels (as described in Section 3.1), it may be more appropriate to split the two different baseline levels in Table 6 so that it's clear how many samples represent these two different baseline levels.	Details for catch by year are provided in the forthcoming Baseline (2010 – 2020) Fish Mercury report. The following text was revised in MMP Section 5.4: "A complete summary of baseline fish mercury results for Site C is reported elsewhere (Azimuth, 2021)."
23	5.4.1, p.36	HLTH	How do mercury concentrations in biopsy samples compare to mercury concentrations in other types of fish tissue samples (e.g., whole fish, fish fillet, roe, organs)? If it is assumed for the purposes of the assessment that biopsy samples are representative of the concentrations of mercury throughout the body of the fish that could be consumed, please ensure this assumption is clearly stated. If the focus group interviews identify that various fish tissues are consumed, how will that be accounted for when only biopsy and fillet samples are planned for sampling? Please describe the potential for over- or under-estimating fish mercury concentrations with the sampling methodology and the uncertainties and assumptions involved.	The MMP assumes that the concentrations of mercury measured in muscle biopsy samples are representative of the concentrations of mercury in skin off muscle tissue samples, but not other fish tissues. The following text was added to MMP Section 5.4: "The non-lethal "biopsy" methods described above were explicitly developed to produce tissue mercury concentration results that are compatible with lethal "fillet" sampling. Consequently, results from the Indigenous Community Sampling Program, which is anticipated to primarily use fish caught for consumption (i.e., lethal sampling), will be directly comparable to those generated through the non-lethal sampling methods described above" See response to HRFN comment #8 with respect to the relative concentrations of methylmercury in different types of fish tissues and how the MMP will be adapted to account for information generated through the Fish Consumption Program.

24	5.4.1, p.36	HLTH	Please describe the methodology to be applied if any mercury concentrations in fish tissue samples are below the method detection limit. Please indicate how statistics and calculations will be conducted for sample(s) where mercury could not be detected.	Measurable mercury concentrations should be found in every fish sample. It would be rare to have a case of <MDL for total mercury; this situation would be more likely indicative of a lab problem than a real value. Consequently, unlike other media, this is not an issue for MMP fish tissue analysis.
25	5.4.1, p.36	HLTH	Footnote 12 states fish too small for biopsy (<200 mm in length) will have the fillet sampled instead. Are fish <200 mm typically consumed? Why is this fish size being considered? Are these smaller fish prey items? Additional information is requested to clarify why fish this small will be collected. Please also describe how mercury concentrations in biopsy samples compare to mercury concentrations in fillet samples.	Targeted size ranges for each species are listed in MMP Table 9. Redside Shiner, a forage fish, is the only species where the targeted range includes fish < 200 mm; we are unaware of any harvesting of this species. Refer to response to Comment #23 for a description of how mercury concentrations in biopsy samples compare to mercury concentrations in fillet samples.
26	Table 8, p.37	HLTH	It would be helpful if cross-references were provided to explain the gaps in the sampling program (e.g., benthic invertebrates from 2024-2027; fish in 2023). For example, footnotes to Table 8 could cross-reference where the information is in the MMP.	Additional text has been added to the fish and supporting environmental media subsections of the MMP Section 5 to provide more context for the schedule (Table 8).
27	Table 9, p.38	HLTH	Please explain the gaps in the sampling program for fish species at the various sampling locations (e.g., Bull Trout at the Beatton-Kiskatinaw and Many Islands sampling locations). If this is discussed elsewhere in the MMP, please provide a cross-reference.	The following text was added to MMP Section 5.4: “In addition, the planned species/location combinations shown in Table 9 are based on the catch success of baseline sampling (see Azimuth 2021 for more details); species/location combinations were not included where the baseline catch results indicated that it would be unlikely to obtain the samples needed for the MMP.”
28	Table 10, p.39	HLTH	Please explain why zooplankton will not be sampled at the downstream sampling locations Beatton-Kiskatinaw and Many Islands. If this is discussed elsewhere in the MMP, please provide a cross-reference.	See response to HRFN comment #1.
29	6.0, p.42	HLTH	Is there baseline tissue mercury concentration data available for the fish species collected under the Indigenous Community Sampling Program (e.g., Burbot, Goldeye)? If so, it would be helpful to summarize that baseline data here or in an appendix to the MMP.	Indigenous Nation monitoring under the Indigenous Community Sampling Program will be supported by available baseline mercury concentration data for the specific location and species of interest. The following text was added to MMP Section 6: “It is anticipated that the inclusion of two years of data collection prior to reservoir creation under this program will provide an opportunity to characterize baseline conditions for locations like the Smoky River

				where no current information is available on fish mercury concentrations."
30	6.0, pp.42-43	HLTH	Will there be differences in the fish tissue sampling methods between the MMP (biopsy samples) and the Indigenous Community Sampling Program? If the methodology is different, will the results be comparable? Information on this was provided at the July 7, 2021 sub-committee meeting. It would be helpful if the information provided at the meeting was also included in the MMP.	The following text was added to MMP Section 6: "The expectation is that lethal sampling methods will be used, resulting in fillet samples for analysis. As discussed in Section 5.4, however, these samples will be directly comparable to the primarily biopsy-based fish mercury samples collected in the FAHMFP."
31	7.1.1, p.44	HLTH	Can the referenced report: "*MMP Summary of Existing Information on Human Consumption of Fish*" (Azimuth, 2020), be provided?	The referenced document was forwarded to Northern Health and First Nation Health Authority on Sept 2, 2021.
32	7.1.1, p.44	HLTH	It appears that a very high consumption scenario (e.g., during a fish camp) has not been included. It is noted that fish camps are mentioned later in Section 7.1.2 (p. 45), but it is unclear how this information will be incorporated.	The following text was added to MMP Section 7.1: "BC Hydro is not aware of any existing sources of information that would support the development of preliminary estimates of rates of fish consumption during short-term events with unusually high rates of fish consumption (during fish camps, for example). However, information on this topic will be sought during the engagement process described below."
33	7.1.2, p.44-45	NH	Placeholder comment regarding *verifying and refining preliminary fish consumption estimates*: Has this approach been informed by best practices and local communities? Who provides ethics approval? Should BC Hydro facilitate the sessions? Should other cultural or wellbeing topics be included in the interviews? How will cumulative effects be considered?	The proposed approach to verifying and refining preliminary fish consumption estimates was recommended by one of the principal Azimuth MMP study designers (L. Chan) and a senior researcher and Registered Dietician (K. Feduik) from the First Nations Food, Nutrition and Environment Study (FNFNES) and is modeled after the methods used for Indigenous community diet research used in that study and current guidance on Indigenous Ownership, Control, Access and Possession (OCAP®) of data. It is not clear, at this point, what ethics review and approval will be required. Approval for the methods will be sought from the Indigenous communities from which data are collected and that is why an engagement agreement is proposed. It is proposed that a third-party contractor, with assistance from a community research assistant, facilitate the engagement sessions. The MMP does not propose to include other cultural or wellbeing topics in the research. It is anticipated that perceptions of cumulative effects will be reflected in the reported rates of fish consumption.

34	9.0, p.46	NH	Placeholder comment regarding *Health Authority Communications*: Health Authorities will need adequate time and information, providing confidence, to inform the consumption advisories. (more discussion on this section is forthcoming)	Thank you for your comment. BC Hydro will endeavour to provide the information once it is available to support to Health Authorities to support issue of fish mercury consumption advisories.
35	9.0, p.46	HLTH	Will the Health Authority Communications also include the results obtained under the Indigenous Community Sampling Program (in addition to the results from the MMP)?	The following text was added to MMP Section 9: "All of the information on concentrations of methylmercury in fish, including that from the Indigenous Community Sampling Program, will be communicated through MMP reporting to the Indigenous groups and Health Authorities."
36	9.0, p.46	HLTH	This section states that calculations will follow Health Canada guidance. Please provide references for the guidance that was followed.	MMP Section 9 Health Canada guidance citations and references added.
37	Appendix A, p.51	HLTH	Were fish weight- and age-mercury relationships considered?	See to response to Health Authority comment #21.
38	Appendix B, p.53	HLTH	Equation 1 is missing "SV =". Please provide a reference for source of the equation.	MMP Appendix B text was edited to correct the equation. An equation reference was added to MMP Appendix B. The equation was based on combining and simplifying equations 3-2 and 3-3 from U.S. Environmental Protection Agency. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories; Volume 2: Risk Assessment and Fish Consumption Limits. Third Edition. U.S. Environmental Protection Agency, Office Science and Technology, Standards and Health Protection Division, Office of Water, Washington, DC. EPA 823-B-00-008.
39	Appendix B, p.53	HLTH	Average mercury concentrations in fish tissue are proposed as an input in the SV calculations. Both Health Canada (2012, 2019) and the Ministry of Health (2021) recommend the use of upper end statistical values (e.g., 95% UCLM) as exposure point concentrations when assessing baseline conditions, unless there is adequate representative data available. In addition, fish sampled under the MMP may be of widely varying lengths and weights, while larger fish tend to be the most desirable for consumption and sport and they tend to have the highest mercury concentrations. Will fish tissue data collected	Fish tissue data collected under the MMP will be assessed to ensure that the mean concentration is an appropriate input value. The length-mercury models used to predict the mean mercury concentration for a given "standard" length fish include 95th percentile prediction limits. The 95th upper percentile of the prediction limits could be used as an alternate input value, if it is determined that there is too much uncertainty in the predicted mean value.

			under the MMP be assessed to ensure the use of mean values in SV calculations is appropriate? Health Canada. (2012). *Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0*. Ottawa, ON: Contaminated Sites Division, Safe Environments Directorate, Health Canada. Retrieved from: http://publications.gc.ca/collections/collection_2018/sc-hc/H128-1-11-632-eng.pdf Health Canada. (2019). *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment*. Ottawa, ON: Health Canada. Retrieved from: https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-evaluating-human-health-impacts-risk-assessment.html Ministry of Health. (2021). *British Columbia Guidance for Prospective Human Health Risk Assessment, Version 1.0*. Victoria, B.C.: Health Protection Branch, Population and Public Health Division, Ministry of Health. Retrieved from: https://www2.gov.bc.ca/assets/gov/health/keeping-bc-healthy-safe/healthy-communities/bc-hhra-guidance.pdf	
40	Appendix B, Table 1, p.53	HLTH	Please provide references for the pTDIs and other input variables shown in Table 1. It appears that the values shown for “Children < 12 yrs” (e.g., body weight) are for toddlers aged 1-4 years old (Health Canada 2012, 2019). Please consider providing SV calculations for both toddlers (1-4 years) and children (5 to 11 years). Later (e.g., p.54-55), there is discussion and input values provided for both toddlers and children, which makes this confusing when compared to Table 1. Health Canada. (2012). *Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0*. Ottawa, ON: Contaminated Sites Division, Safe Environments Directorate, Health Canada. Retrieved from: http://publications.gc.ca/collections/collection_2018/sc-	Input values for children 5 to 11 years were added to MMP Appendix B, Table 1. Citations for the pTDIs and other input variables shown in MMP Appendix B, Table 1 are provided in the text sections that follow Table 1. After rounding, there is often no practical difference between the recommended maximum number of servings calculated for a toddler than a child 5 to 11 years old. Therefore, it may be preferable to simply present a single SV value for children less than 12 years old based on either (1) the calculated SV for a toddler; or (2) a “composite” child based on the averages of the input variables for the toddler and children 5 to 11 years old.

			hc/H128-1-11-632-eng.pdf Health Canada. (2019). *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment*. Ottawa, ON: Health Canada. Retrieved from: https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-evaluating-human-health-impacts-risk-assessment.html	
41	Appendix B, p.54	HLTH	The text cites a Health Canada (2010) guidance document as the source of the pTDI. Please note that while the pTDIs for methylmercury are unchanged, Health Canada has recently updated the 2010 guidance document to: Health Canada. 2021. *Federal Contaminated Site Risk Assessment in Canada: Toxicological Reference Values (TRVs)*. Version 3.0. Available from: https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/contaminated-sites/federal-contaminated-site-risk-assessment-canada-part-health-canada-toxicological-reference-values-trvs-chemical-specific-factors-version-2-0.html	The MMP Appendix B reference for the source of the pTDIs was revised.

42	Appendix B, pp.54-56	HLTH	It appears that total exposure to methylmercury from other foods (e.g., retail fish) has not been accounted for. Health Canada (2012, 2021) recommends under the conservative pathway of a preliminary quantitative risk assessment, a 20% reduction of TRV (or TDI) may be appropriate. However, under the scope of a detailed quantitative risk assessment (where methylmercury exposure from most or all background sources is known), then risk characterization and consumption advice can be based on 100% of the TDI. Please provide rationale to account for other sources of exposure to methylmercury. If this is to be incorporated into the risk communication, then additional information should be provided recommending that individuals consider all potential sources of fish when estimating their mercury intake. Health Canada. (2012). *Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0*. Ottawa, ON: Contaminated Sites Division, Safe Environments Directorate, Health Canada. Retrieved from: http://publications.gc.ca/collections/collection_2018/sc-hc/H128-1-11-632-eng.pdf Health Canada. (2021). *Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA)*. Version 3.0. Ottawa, ON: Contaminated Sites Division, Safe Environments Directorate, Health Canada, Retrieved from: https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/contaminated-sites/federal-contaminated-site-risk-assessment-canada-part-guidance-human-health- preliminary-quantitative-risk-assessment-pgra-version-2-0.html	Information on cumulative exposure to methylmercury from eating different types of fish has been incorporated into the BC Hydro and Fish & Wildlife Compensation Program Peace Region fish consumption information brochure. BC Hydro will continue to collaborate with Health Authorities and the affected Indigenous groups to find effective methods to account for cumulative exposure.

43	Overall	HLTH	A discussion of the consumption of dried, smoked, or salted fish could not be found in the MMP. If the focus group interviews indicate consumption of dried fish is high at certain times of year, will that be considered in the SV calculations (e.g., separate recommendations for dried fish)?	Information on how people preserve and prepare fish for eating will be collected by the Fish Consumption Program and the MMP will be adapted as described in Section 7, as necessary, to account for this information.
44	General	BC Ministry of Environment	Most monitoring plans have a methodology section. The MMP does not mention planned field methodology, laboratory methodology, or QA/QC methodology that will be followed. **Field Methodology** The MMP should include that sampling for surface water, sediment, tissue, and biota will follow the procedures outlined in the most recent version of the BC Field Sampling Manual. **Laboratory Methodology** The MMP should include that the ENV approved laboratory test methods specified in the latest version of BC Environmental Laboratory Manual will be followed. There is no mention in the MMP of the samples being taken to an accredited laboratory. In fact if you search for “laboratory” there is no mention of “laboratory” in the entire document. **QA/QC Methodology** QA/QC is included in the MMP acronym list but then there is no QA/QC section or any other information detailing planned QA/QC methodology. QA/QC is important in every aspect of a sampling program from program design through the field work and laboratory/taxonomic analyses and finally to interpretations of results. The MMP should include mention to an appropriate QA/QC program to evaluate and ensure confidence in the data collected. Consistent and documented field procedures, collection methods, transportation times, and laboratory procedures, as well as the use of replicates and blanks are all necessary elements in the quality assurance program. General guidance for QA/QC in sampling programs is given in the most recent version of the BC Field Sampling Manual.	The following additions were made to MMP Section 5.4: • Web link to Site C Fisheries and Aquatic Habitat Monitoring and Follow-Up Program[4] (FAHMFP) fish and supporting environmental media field methods; • Web link to the Mon-2a Peace River Large Fish Indexing Survey annual study report for details on field methods; • Statement regarding laboratory accreditation and QA/QC for the laboratory analyses; and • Web link to the baseline fish mercury report (see Azimuth 2021) providing additional details on model fitting methods and data quality.

[4] Available at: https://www.sitecproject.com/sites/default/files/Fisheries-and-Aquatic-Habitat-Monitoring-and-Follow-up-Program.pdf