BC Hydro
Power smart

Fisheries and Aquatic Habitat Management Plan

Site C Clean Energy Project

Revision 2: December 20, 2021

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Revision History

Version	Date	Comments
Rev 0	05-19-2015	**Final**
Rev 1	06-01-2015	**Revision 1**
Rev 2	11-24-2021	• Updated the references to the Project's Fisheries and Aquatic Habitat Monitoring and Follow-up Program (S.2.2). • Updated the references to current revision of the Project's Fish Passage Management Plan (S.2.2). Removed text associated with fish passage management that was out-of-date and now described in the Fish Passage Management Plan (S.6.2.2.1 and S.6.2.2.2). • Updated the distribution list for groups who receive revisions to the Fisheries and Aquatic Habitat Management Plan (FAHMP), to align with Environmental Assessment Certificate Condition 4 and Federal Decision Statement Condition 8, as well as the current names of the agencies (S.2.4). • Replaced Appendix F - Fish and Fish Habitat Technical Data Report, with link to location in Site C Environmental Impact Statement (S.4.0). • Added an update on the Peace River Channel Contouring and Side Channel Enhancement design process given that some sites are no longer feasible following 2018 landslide near the community of Old Fort. Removed Appendix A - Peace River Channel Contouring Side Channel Enhancement describing concept design prior to the 2018 landslide (S.6.2.1.1). • Replaced Appendix C - Site C Reservoir Shoreline Enhancement concept designs, with the updated Site C Reservoir Shoreline Enhancement (RSE) areas based on final designs development. (S.6.2.3). • Updated the map of fish and fish habitat mitigation sites to reflect the revisions described in this version of the FAHMP (Figure 1). • Updated the fish and fish habitat mitigation implementation schedule (Figure 2) based on updated Project construction schedule.

1.0 Background

1.1 The Site C Clean Energy Project

The Site C Clean Energy Project (the Project) will be the third dam and generating station on the Peace River in northeast B.C. The Project will provide 1,100 megawatts of capacity and about 5,100 gigawatt hours of energy each year to the province's integrated electricity system. The Project will be a source of clean, reliable and cost-effective electricity for BC Hydro's customers for more than 100 years.

The key components of the Project are:

- an earthfill dam, approximately 1,050 metres long and 60 metres high above the riverbed;
- an 83 kilometre long reservoir that will be, on average, two to three times the width of the current river;
- a generating station with six 183 MW generating units;
- two new 500 kilovolt AC transmission lines that will connect the Project facilities to the Peace Canyon Substation, along an existing right-of-way;
- realignment of six segments of Highway 29 over a total distance of approximately 30 kilometers; and
- construction of a berm at Hudson's Hope.

The Project will also include the construction of temporary access roads, a temporary bridge across the Peace River, and worker accommodation at the dam site.

1.2 Project Benefits

The Project will provide important benefits to British Columbia and Canada. It will serve the public interest by delivering long term, reliable electricity to meet growing demand; contribute to employment, economic development, ratepayer, taxpayer and community benefits; meet the need for electricity with lower GHG impact than other resource options; contribute to sustainability by optimizing the use of existing hydroelectric facilities, delivering approximately 35 per cent of the energy produced at the W.A.C. Bennett Dam, with only five per cent of the reservoir area; and include an honourable process of engagement with First Nations and the potential for accommodation of their interests.

1.3 Environmental Assessment Process

The environmental assessment of the Project has been carried out in accordance with the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), the *BC Environmental Assessment Act* (BCEAA), and the Federal-Provincial *Agreement to Conduct a Cooperative Environmental Assessment, Including the Establishment of a Joint Review Panel of the Site C Clean Energy Project*. The assessment considered the environmental, economic, social, heritage and health effects and benefits of the Project, and included the engagement of

Aboriginal groups, the public, all levels of government, and other stakeholders in the assessment process.

Detailed findings of the environmental assessment are documented in the Site C Clean Energy Project Environmental Impact Statement (EIS), which was completed in accordance with the Environmental Impact Statement Guidelines (EIS Guidelines) issued by the Minister of Environment of Canada and the Executive Director of the Environmental Assessment Office of British Columbia. The EIS was submitted to regulatory agencies in January 2013, and amended in August 2013 following a 60 day public comment period on the assessment, including open house sessions in Fort St. John, Hudson's Hope, Dawson Creek, Chetwynd, town of Peace River (Alberta) and Prince George.

In August 2013, an independent Joint Review Panel (JRP) commenced its evaluation of the EIS, and in December 2013 and January 2014 undertook five weeks of public hearings on the Project in 11 communities in the Peace region, including six Aboriginal communities. In May 2014, the JRP provided the provincial and federal governments with a report summarizing the Panel's rationale, conclusions and recommendations relating to the environmental assessment of the Project. On completion of the JRP stage of the environmental assessment, the CEA Agency and BCEAO consulted with Aboriginal groups on the JRP report, and finalized key documents of the environmental assessment for inclusion in a Referral Package for the Provincial Ministers of Environment and Forests, Lands and Natural Resource Operations.

Construction of the Project is also subject to regulatory permits and authorizations, and other approvals. In addition, the Crown has a duty to consult and, where appropriate, accommodate Aboriginal groups.

1.4 Environmental Assessment Findings

The environmental assessment of the Project focused on 22 valued components (VCs), or aspects of the biophysical and human setting that are considered important by Aboriginal groups, the public, the scientific community, and government agencies. In the EIS, valued components were categorized under five pillars: environmental, economic, social, heritage and health. For each VC, the assessment of the potential effects of the Project components and activities during construction and operations was based on a comparison of the biophysical and human environments between the predicted future conditions with the Project, and the predicted future conditions without the Project.

Potential adverse effects on each VC are described in the EIS along with technically and economically feasible mitigation measures, their potential effectiveness, as well as specific follow-up and related commitments for implementation. If a residual effect was found on a VC, the effect was evaluated for significance. Residual effects were categorized using criteria related to direction, magnitude, geographic extent, context, level of confidence and probability, in accordance with the EIS Guidelines.

The assessment found that the effects of the Project will largely be mitigated through careful, comprehensive mitigation programs and ongoing monitoring during construction and operations. The EIS indicates that the Project is unlikely to result in a significant adverse effect for most of

the valued components. However, a determination of a significant effect of the Project was found on four VCs: Fish and Fish Habitat, Wildlife Resources, Vegetation and Ecological Communities, and Current Use of Lands and Resources for Traditional Purposes.

1.5 Environmental Assessment Conclusion

On October 14, 2014, the Provincial Ministers of Environment and of Forests, Lands and Natural Resource Operation decided that the Project is in the public interest and that the benefits provided by the Project outweigh the risks of significant adverse environmental, social and heritage effects (http://www.newsroom.gov.bc.ca/2014/10/site-c-project-granted-environmental-assessment-approval.html). The Ministers have issued an Environmental Assessment Certificate setting conditions under which the Project can proceed.

Further, on November 25, 2014, The Minister of Environment of Canada issued a Decision Statement confirming that, while the Project has the potential to result in some significant adverse effects, the Federal Cabinet has concluded that those effects are justified in the circumstances. The Decision Statement sets out the conditions under which the Project can proceed.

1.6 Development of Mitigation, Management and Monitoring Plans

Mitigation, management and monitoring plans for the Project have been developed taking into account the measures proposed in the EIS, information received during the Joint Review Panel hearing process, and the Report of the Joint Review Panel on the Project. Those plans are consistent with, and meet requirements set out in, the conditions of the Environmental Assessment Certificate and of the Decision Statement issued on October 14, 2014 and November 25, 2014 respectively.

1.7 Fish and Fish Habitat

Section 12 of the EIS, as amended (July 2013) describes the assessment of potential effects of the Project on fish and fish habitat including the following:

- Changes in Fish Habitat: Quality and quantity of fish habitats, habitat availability, water depth, velocity, water temperature, sedimentation, water quality, ice regime, aquatic productivity, food resources, and competition for food and habitat
- Changes in Fish Health and Survival: Species diversity; fish population distribution, fish population relative abundance, fish population biomass, sedimentation, stranding, fish entrainment, and total dissolved gas
- Changes in Fish Movement: Fish species population, movement patterns and general life history parameters (i.e., access to habitats), swim speeds, and fish entrainment

The Local Assessment Area for fish and fish habitat includes the following:

- The Peace River in the proposed reservoir area;
- Tributaries entering the proposed reservoir;
- Peace River downstream of the proposed Site C Dam to the Many Islands Area, Alberta;

- Watercourses and water bodies within the transmission line and roadway rights-of-way;
- Watercourses and water bodies within the Project activity zone; and
- Riparian areas adjacent to identified watercourses and water bodies;

Mitigation measures were proposed in the EIS to avoid, reduce, or compensate for the potential adverse effects on fish and fish habitat of construction and operation of the Project. These included standard mitigation measures to be implemented during construction activities, and other mitigation measures such as specific features in the design of the Project, and habitat works at the dam site or in the Local Assessment Area. After implementation of mitigation measures, the EIS predicted a significant adverse effect on the fish and fish habitat as a result of the potential for the loss of indigenous fish populations or distinct groups of fish.

2.0 Objective and Scope

2.1 Objective

The objective of the Fisheries and Aquatic Habitat Management Plan (FAHMP) is to describe the measures that will be used to mitigate the adverse effects of the Project on fish and fish habitat during the construction and operation phases. The plan has been developed in accordance with the conditions of the Environmental Assessment Certificate (EAC) and Federal Decision Statement (FDS), as indicated below. FDS conditions 8.3 to 8.7 refer to "a fish and fish habitat management plan", while the EAC condition 4 refers to "a Fisheries and Aquatic Habitat Management Plan". Each refers to similar requirements for fish. For simplicity, BC Hydro developed one plan, entitled "Fisheries and Aquatic Habitat Management Plan." Note that additional information for some of the conditions beloware addressed in plans submitted under a separate cover.

EAC Condition	Condition	Plan Reference
FISH AND FISH HABITAT		
4	The EAC Holder must manage harmful Project effects on fish and fish habitats during the construction and operation phases by implementing mitigation measures detailed in a Fisheries and Aquatic Habitat Management Plan.	
	The Fisheries and Aquatic Habitat Management Plan must be developed by a QEP	This condition is addressed in FAHMP Section 8.0 Qualified Professionals
	The Fisheries and Aquatic Habitat Management Plan must include at least the following:	

EAC Condition	Condition	Plan Reference
	• Remove temporary structures as soon as they are no longer required.	These conditions are addressed in Construction Environmental Management Plan (CEMP) Section 4.5, Fisheries and Aquatic Habitat Management.
	• Maintain a 15 m machine free zone adjacent to watercourses during reservoir clearing (as measured from the Ordinary High Water Mark).	
	• Place material relocation sites (R5a, R5b, and R6) 15 m back from the mainstem to avoid affecting Peace River fish habitat.	
	• Contour mainstream bars to reduce potential for fish stranding, as advised by FLNR.	This condition is addressed in FAHMP Section 6.2.1.1,Peace River Channel Contouring and Side Channel Enhancement.
	• Incorporate fish habitat features into the final capping of material relocation sites upstream of the dam.	This condition is addressed in FAHMP Section 6.2.3.4, Dam Site Material Relocation Site Enhancement.
	• Contour and cap with gravels and cobble substrate the spoil area between elevations 455 m and 461 m to provide a productive fish habitat that will be available to fish during the operation phase.	This condition is addressed in FAHMP Section 6.2.3.4, Dam Site Material Relocation Site Enhancement.
	• Include fish habitat features (e.g., shears, large riprap point bars, etc.) in the final design of the north bank haul road bed material that would be placed in the Peace River.	This condition is addressed in FAHMP Section 6.2.1.2,River Road Habitat Enhancement.
	• Incorporate fish habitat features into the final design of the Highway 29 roadway that would border the reservoir, east of Lynx Creek.	This condition is addressed in FAHMP Section 6.2.3.2,Highway 29 Realignment Fish Habitat.
	• Construct the Hudson‘s Hope shoreline protection with large material that will provide replacement fish habitat.	This condition is addressed in FAHMP Section 6.2.3.3,Hudson’s Hope Shoreline Protection Fish Habitat.

EAC Condition	Condition	Plan Reference
	• Incorporate additional fish habitat features (e.g., shear zones and point bars) into the final design of the Hudson's Hope shoreline protection.	This condition is addressed in FAHMP Section 6.2.3.3, Hudson's Hope Shoreline Protection Fish Habitat.
	• Contour Highway 29 borrow sites prior to decommissioning to provide littoral fish habitat in the reservoir.	This condition is addressed in FAHMP Section 6.2.3.1, Site C Reservoir Shoreline Enhancement.
	• Cap material repositioning areas with gravel and cobble, and contour to enhance fish habitat conditions.	This condition is addressed in FAHMP Section 6.2.3.4, Dam Site Material Relocation Site Enhancement.
	• Plant a 15 m wide riparian area along the reservoir shoreline adjacent to BC Hydro-owned farmland where necessary to provide riparian habitat and bank stabilization except as approved by the onsite environmental monitor.	This condition is addressed in FAHMP Section 6.2.3.5, Reservoir Shoreline Riparian Planting.
	• Increase wetted habitat by creating new wetted channels and restoring back channels on the south bank island downstream of the dam.	This condition is addressed in FAHMP Section 6.2.1.1, Peace River Channel Contouring and Side Channel Enhancement.
	• Enhance side channel complexes between the dam site and the confluence of the Peace and Pine rivers during low flows.	This condition is addressed in FAHMP Section 6.2.1.1, Peace River Channel Contouring and Side Channel Enhancement.
	• Manage reservoir fluctuation within a 1.8 m maximum normal operating range from the maximum operating level of 461.8 m.	This condition is addressed through BC Hydro compliance with Conditional Water Licence 132991.
	• If the reservoir deviates from the normal operating range, the EAC Holder must report the event in accordance with water licence requirements.	This condition is addressed through annual reporting associated with Conditional Water Licence 132991.
	The EAC Holder must manage construction footprints to reduce the harmful Project effects on fish and fish habitat, in accordance with the conditions of the applicable *Fisheries Act* authorization(s)	This condition is addressed in FAHMP Section 3.0 Regulatory Context; specifically through compliance with *Fisheries Act* Authorizations 15-HPAC-00170 (Project Site Preparation) and 15-

EAC Condition	Condition	Plan Reference
	and direction provided by FLNR.	HPAC-00160 (Project Main Civil Works and Facility Operations) as well as conditions associated with Water Sustainability Act in-stream works approvals issued for the Project.
	This draft Fisheries and Aquatic Habitat Management Plan must be provided to FLNR, MOE and Aboriginal Groups for review a minimum of 90 days prior to commencement of construction.	This condition is addressed in FAHMP Section 2.3 Consultation
	The EAC Holder must file the Final Fisheries and Aquatic Habitat Management Plan with EAO, FLNR, MOE and Aboriginal Groups a minimum of 30 days prior to commencement of construction.	
	The EAC Holder must develop, implement and adhere to the Final Fisheries and Aquatic Habitat Management Plan, and any amendments, to the satisfaction of EAO.	

FDS Condition	Condition	Plan Reference
8.	**Fish and Fish Habitat**	
8.1	The Proponent shall undertake efforts to avoid or minimize adverse impacts to fish and fish habitat to ensure the continued availability of fisheries resources in the Local Assessment Area.	
8.2	The Proponent shall prepare and submit to the Agency an annual schedule identifying the location and timing of construction activities that may impact fish or fish habitat 90 days prior to such activities occurring.	Submitted under separate cover.

FDS Condition	Condition	Plan Reference
8.3.	The Proponent shall prepare, in consultation with Fisheries and Oceans Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups, a fish and fish habitat management plan.	These conditions are addressed in the Fisheries and Aquatic Habitat Management Plan (FAHMP).
8.4	The Plan shall include:	
8.4.1.	Identification of baseline conditions for fish and fish habitat in the Local Assessment Area;	This condition is addressed in FAHMP Section 4.0, Fish and Fish Habitat Baseline Conditions.
8.4.2.	Measures to mitigate potential effects on fish and fish habitat during construction and operation of the Designated Project including:	This condition is addressed in FAHMP Section 6.0, Fish and Fish Habitat Mitigation.
8.4.2.1.	Erosion and sediment control measures, riparian zone avoidance measures, best practices for watercourse crossings, in-stream work guidelines, and in-stream work timing windows;	These conditions are addressed in CEMP Section 4.5, Fisheries and Aquatic Habitat Management.
8.4.2.2.	Measures to avoid or reduce fish stranding;	This condition is addressed in CEMP Section 4.5, Fisheries and Aquatic Habitat Management. See also FAHMP 6.2.1.1, Peace River Channel Contouring and Side Channel Enhancement.
8.4.2.3.	Operational practices, technologies and design features that minimize downstream fish entrainment past the dam site;	This condition is addressed inthe Project's Fish Passage Management Plan.
8.4.2.4.	Measures to mitigate the effects of Total Dissolved Gas concentrations in tailwater on fish; and	This condition is addressed in FAHMP Section 6.2.2.3, Mitigation of Total Dissolved Gas.
8.4.2.5.	Measures to mitigate obstructed upstream fish passage for bull trout and, as	This condition is addressed in the Project's Fish Passage Management Plan.

FDS Condition	Condition	Plan Reference
	appropriate and feasible, other migrating fish species;	
8.4.3.	An approach to monitor changes to fish and fish habitat baseline conditions in the Local Assessment Area;	The approach is summarized inthe Project's Fisheries and Aquatic Habitat Monitoring and Follow-up Program
8.4.4.	An approach to monitor and evaluate the effectiveness of mitigation or offsetting measures and to verify the accuracy of the predictions made during the environmental assessment on fish and fish habitat; and	The approach is summarized in the Project's Fisheries and Aquatic Habitat Monitoring and Follow-up Program.
8.4.5.	Any other requirements identified by Fisheries and Oceans Canada in support of its application for an authorization under the *Fisheries Act*.	To date, Fisheries and Oceans Canada has not identified other requirements in support of an application for an authorization under the *Fisheries Act*. Should DFO identify other requirements, these will be taken into account in amendments to the plan, as described in condition 8.7
8.5.	The Proponent shall submit a draft copy of the plan to the Agency, Fisheries and Oceans Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups 90 days prior to submitting its application for authorization under the *Fisheries Act*.	This condition is addressed in FAHMP Section 2.3 Consultation
8.6.	The Proponent shall submit to the Agency the final plan a minimum of 30 days prior to submitting its application for authorization under the Fisheries Act. 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 Fisheries and Oceans Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups and shall describe how it has taken the plan into consideration as part of its application for an authorization under the Fisheries Act.	Submitted under separate cover.
8.7.	The Proponent shall implement the plan and provide to the Agency an analysis and	This condition is addressed in FAHMP Section 7 Reporting

FDS Condition	Condition	Plan Reference
	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 construction and for the first ten years of operation and once every five years for the next 20 years.	
8.8	The Proponent shall develop an offsetting plan, in consultation with Fisheries and Oceans Canada, to offset residual serious harm to fish and monitor the effectiveness of offsets.	Offsetting plans are submitted as a component of the application for authorization under the Fisheries Act. Information from offsetting plans will be submitted to CEAA as described under FDS Condition 8.9.
8.9	The Proponent shall conduct an analysis for any physical fish habitat offsets proposed in the offsetting plan, in consultation with Transport Canada, Environment Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups, that includes:	These conditions will be met in a separate analysis.
8.9.1	the effects on migratory birds and their habitats;	
8.9.2	the effects on terrestrial species and their habitats;	
8.9.3	the effects on species at risk and species at risk habitat;	
8.9.4	the effects on current use of lands and resources for traditional purposes by Aboriginal peoples;	
8.9.5	identification of navigation impacts; and	

FDS Condition	Condition	Plan Reference
8.9.6	identification of potential sources of contamination (e.g. mercury).	
8.10	The Proponent shall submit to the Agency the results of the analysis in condition 8.9, including a description of how the input, views or information received have been taken into account in finalizing its fish habitat offsetting plan.	This condition will be met in a stand-alone document that is expected to be submitted to CEAA prior to implementing the offsetting plan.

2.2 Scope

The project will be constructed in accordance with the EAC and FDS conditions, which will be achieved during construction and operations by the implementation of:

- Standard mitigation measures (e.g., erosion and sediment control measures) described in the CEMP
- Project-specific mitigation measures (e.g. reservoir shoreline habitat enhancement works and capping of dam site material relocation site with fish habitat features) described in the FAHMP

The FAHMP includes five sections supported by BC Hydro's EIS: 1) introduction; 2) regulatory context; 3) description of fish and fish habitat baseline conditions; 4) summary of predicted effects on fish and fish habitat; and 5) fish and fish habitat mitigation measures. Section 5 describes the mitigation measures that will be implemented in accordance with the EAC and FDS conditions, including standard measures and Project-specific measures.

The fish and fish habitat mitigation measures for the Project are those proposed in the EIS, as well as the EAC and the FDS conditions. The FAHMP has been developed in accordance with these conditions described in the table above. Two plans that closely relate to the FAHMP are the Fisheries and Aquatic Habitat Monitoring and Follow-up Program[1] (FAHMFP) and Fish Passage Management Plan[2]. These two plans have been submitted separately.

2.3 Consultation

BC Hydro began consultation on the Project in late 2007, before any decision to advance the Project to an environmental assessment. BC Hydro's consultation with the public, stakeholders, regional and local governments, regulatory agencies, and Aboriginal groups is described in EIS

[1] Fisheries and Aquatic Habitat Monitoring and Follow-up Program, Revision 1, December 22, 2015. Available at https://www.sitecproject.com/sites/default/files/Fisheries-and-Aquatic-Habitat-Monitoring-and-Follow-up-Program.pdf
[2] Fish Passage Management Plan. Revision 2. June 2, 2020. Available at: https://sitecproject.com/sites/default/files/Fish%20Passage%20Management%20Plan.pdf

Section 9, Information Distribution and Consultation. Additional information on the consultation process and a summary of issues and concerns raised during consultation are provided in:

- EIS, Volume 1, Appendix G, Public Information Distribution and Consulting Supporting Documentation
- EIS, Volume 1, Appendix H, Aboriginal Information Distribution and Consultation Supporting Documentation
- EIS, Volume 1, Appendix I, Government Agency Information Distribution and Consultation Supporting Documentation
- EIS, Volume 5, Appendix A01 to A29, Parts 2 and 2A, Aboriginal Consultation Summaries
- Technical Memo: Aboriginal Consultation

In accordance with EAC Condition 4 and FDS Condition 8.5, the draft Fisheries and Aquatic Habitat Management Plan was submitted to the Canadian Environmental Assessment Agency, Fisheries and Oceans Canada, Ministry of Forests, Lands and Natural Resource Operations, BC Ministry of Environment, and Aboriginal groups named in the EAC and FDS conditions for review and comment on October 17, 2014.

BC Hydro is committed to ongoing consultation on fisheries and aquatic habitat management during construction of the Project, and will continue to consider input received in the future development of the plan.

2.4 Revisions to the Plan

The FAHMP provides information on mitigation measures that will be developed and implemented at different times during construction. For example, fish habitat features will be built into River Road, which will be built at the start of construction. Consequently, detailed design has been completed. For other mitigation measures that would be constructed later during construction, such as contouring Highway 29 borrow sites prior to decommissioning to provide littoral fish habitat in the reservoir, preliminary designs are available and included in the FAHMP. Detailed design will be completed in coordination with the detailed design of the associated project components (i.e., Highway 29).

Further information will become available as detailed design progresses and as the results of pre-construction surveys are received. Further input may also be received from contractors, Aboriginal Groups, the public and regulatory agencies that need to be taken into account in the design. It will be beneficial to take this information into account in a revision of the FAHMP.

When the FAHMP is revised, BC Hydro expects to provide the revised plan for review and comment to the executive director of the Environmental Assessment Office (the "Executive Director"), ii) Impact Assessment Agency of Canada , iii) BC Ministry of Environment, BC Ministry of Forests Lands and Natural Resource Operations, and iv) Aboriginal Groups who would potentially be affected by the revised plan.

The period of time provided for review and comment on a proposed material revision will depend on the nature or urgency of the revision and the relative interests or jurisdiction of government agencies and of the rights and relative interests of potentially affected Aboriginal group, and any legal requirement to consult.

3.0 Regulatory Context

In constructing and operating the Project, BC Hydro and its contractors must comply with laws, regulations, and standards of general applicability, as well as Project-specific conditions of approvals, permits, other authorizations, guidelines and protocols that are relevant to the design and implementation of mitigation programs. The following subsections explain how this FAHMP considers and integrates regulatory requirements that pertain to the protection and management of fish and fish habitat.

3.1 Federal

Federal legislation for the *Fisheries Act* and *Species at Risk Act* provided guidance to the fish and fish habitat effects assessment, including determination of the following significance criteria described in EIS Section 12.6.2:

a) The loss of an indigenous fish species, sub-species, populations, or distinct groups or,

b) a reduction in the long-term average standing stock biomass of the fish community relative to the existing baseline condition

The FAHMP takes into account recent amendments to the *Fisheries Act* and follows the guidance provided in the Fisheries Protection Policy Statement (DFO 2013a). More specific guidance is provided in the Fisheries Productivity Investment Policy (DFO 2013b) to undertake effective measures to offset serious harm to fish that are part of, or support a commercial, recreation or Aboriginal fishery, consistent with the Fisheries Protection provisions of Canada's *Fisheries Act*.

Construction and operation of the Project will require authorizations under the *Fisheries Act* for those project components that result in "serious harm to fish". The applications for authorization will an offsetting plan to counterbalance unavoidable residual losses to fisheries productivity and with the goal of providing for the ongoing productivity of recreational and Aboriginal fisheries. BC Hydro has reviewed construction activities with Fisheries and Oceans Canada (DFO), proposed the sequence of applications for authorization, and has submitted an application for authorization for Site Preparation activities.

3.2 Provincial

As described in Section 12.1.1 of the EIS, British Columbia is responsible for regulation of non-salmon freshwater fisheries, including management, conservation, and recreation. The Ministry of Environment and Ministry of Forests, Lands and Natural Resource Operations provide regulatory oversight for the fisheries in the Project area. Development of the FAHMP took into account relevant provincial Plans and Policies[3], as well as the Draft Fish, Wildlife and Ecosystem Resources and Objectives for the Lower Peace River Watershed Site C Project Area (B.C. Government 2011).

The standard fish and fish habitat mitigation measures described in this plan and included in the CEMP support the provincial permitting for the Project, such as the Section 9 Water Act approvals for Project components involving in-stream works.

[3] Relevant provincial Plans and Policies include the B.C. Freshwater Fisheries Program Plan (BCMOE 2007) and Conservation Framework (BCMOE 2009), and alignment with the goals of federal regulatory direction on conservation of fish species and protection of the productivity of fish, fish habitat and fisheries through the *Species at Risk Act*, and the *Fisheries Act*

4.0 Fish and Fish Habitat Baseline Conditions

This section has been developed in accordance with FDS Condition 8.4.1: The Plan shall include: identification of baseline conditions for fish and fish habitat in the Local Assessment Area.

The baseline conditions for fish and fish habitat are described in terms of the following (from EIS, Section 12.3 with amendment as required):

- Fish ecology, including description of fish communities, identification of species composition, distribution, relative abundance, migration and movement patterns, and general life history parameters;
- Fish habitats, including an evaluation of the quality and quantity of fish habitats in the Local Assessment Area. These include critical or sensitive areas such as spawning, rearing, and overwintering habitats and migration routes; and
- Changes in environmental factors (e.g., food, water temperature, sediment transport).

In total, 32 fish species have been recorded in the Fish and Fish Habitat Local Assessment Area. None of the species are officially listed as endangered, threatened, or a special concern under Schedule 1 of the Species at Risk Act (SARA), or are being considered for official listing under Schedule 2 or 3 of SARA.

In British Columbia, one species is listed as “red” (endangered or threatened): spottail shiner; and three are listed as “blue” (special concern): bull trout, goldeye, and pearl dace. The remaining species are designated as “yellow”, described as secure and not at risk of extinction.

In Alberta, two species are identified as “may be at risk” -- pygmy whitefish and spoonhead sculpin. A total of six species have “sensitive” designations, including bull trout, Arctic grayling, lake trout, brook stickleback, northern pikeminnow, and northern redbelly dace. The rainbow trout designation as “at risk” refers to the Athabasca River population. The remaining fish species are “secure”, “not assessed”, or “not determined”.

Table 1. Fish Species Recorded by Baseline Studies in the Local Assessment Area

Group	Species		Provincial Status	
	Common Name	**Latin Name**	**B.C.**	**AB**
Sport fish	Arctic grayling	*Thymallus arcticus*	Yellow	Sensitive
	Bull trout	*Salvelinus confluentus*	Blue	Sensitive
	Brook trout	*Salvelinus fontinalis*	Exotic	Exotic
	Burbot	*Lota lota*	Yellow	Secure
	Goldeye	*Hiodon alosoides*	Blue	Secure

Group	Species		Provincial Status	
	Common Name	**Latin Name**	**B.C.**	**AB**
	Kokanee	*Oncorhynchus nerka*	Yellow	Not assessed
	Lake whitefish	*Coregonus clupeaformis*	Yellow	Secure
	Lake trout	*Salvelinus namaycush*	Yellow	Sensitive
	Mountain whitefish	*Prosopium williamsoni*	Yellow	Secure
	Northern pike	*Esox lucius*	Yellow	Secure
	Pygmy whitefish	*Prosopium coulteri*	Yellow	May be at risk
	Rainbow trout	*Oncorhynchus mykiss*	Yellow	At risk
	Yellow perch	*Perca flavescens*	Yellow	Secure
	Walleye	*Sander vitreus*	Yellow	Secure
Suckers	Largescale sucker	*Catostomus macrocheilus*	Yellow	Sensitive
	Longnose sucker	*Catostomus catostomus*	Yellow	Secure
	White sucker	*Catostomus commersoni*	Yellow	Secure
Minnows	Brook stickleback	*Culea inconstans*	Yellow	Secure
	Finescale dace	*Chourosomus neogaeus*	Unknown	Undetermined
	Flathead chub	*Platygobio gracilis*	Yellow	Secure
	Lake chub	*Couesius plumbeus*	Yellow	Secure
	Longnose dace	*Rhinichthys cataractae*	Yellow	Secure
	Northern pikeminnow	*Ptychocheilus oregonensis*	Yellow	Sensitive

Group	Species		Provincial Status	
	Common Name	**Latin Name**	**B.C.**	**AB**
	Northern redbelly dace	*Phoxinus eos*	Unknown	Sensitive
	Peamouth	*Mylcheilus caurinus*	Yellow	Not rated
	Pearl dace	*Margariscus margarita*	Blue	Undetermined
	Redside shiner	*Richardsonius balteatus*	Yellow	Secure
	Spottail shiner	*Notropis hudsonius*	Red	Secure
	Trout-perch	*Percopsis omiscomaycus*	Yellow	Secure
Sculpins	Prickly sculpin	*Cottus asper*	Yellow	Not assessed
	Slimy sculpin	*Cottus cognatus*	Yellow	Secure
	Spoonhead sculpin	*Cottus ricei*	Yellow	May be at risk

Fish species listed in Table 1 may have traditional use, recreational use, or management value. All fish species listed in Table 1 have ecological function value and have the potential to be affected by the Project.

Fish habitat is defined as any spawning ground and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly to carry out their life processes (Fisheries and Oceans Canada 1998). A distinction is made for important habitat, which is defined as habitat that is essential for the maintenance of a self-sustaining fish population. Removal of important habitat from production by alteration, destruction, or elimination of access might reduce the sustainability of the population.

Important habitats are present throughout the LAA (EIS, Volume 2, Appendix O Fish and Fish Habitat Technical Data Report)[4]. Depending on the species, important habitats are located in the Peace River upstream and downstream of the Site C Dam site, and in Peace River tributaries within and outside of the inundation zone of the Site C reservoir. In general, the lower sections of Peace River tributaries provide important spawning and early rearing habitats for suckers and minnows. Important spawning and rearing habitats for sport fish have been recorded only in upstream areas of large tributaries.

The upper Halfway River watershed provides spawning and rearing habitats for the Peace River bull trout population. The Moberly River provides spawning and rearing habitats for the Peace

[4] Available at https://www.ceaa-acee.gc.ca/050/documents_staticpost/63919/85328/Vol2_Appendix_O.pdf

River Arctic grayling population. Maurice Creek provides spawning and rearing habitats for the Peace River rainbow trout population. The Halfway River, Moberly River, and Pine River provide spawning habitats for the Peace River mountain whitefish population. The Beatton River provides spawning and rearing habitats for walleye and goldeye. All tributaries to the Peace River provide spawning and rearing habitats for suckers, minnows, and sculpins. The Peace River downstream of the Halfway River confluence provides rearing habitat for mountain whitefish. Side channels provide habitats for several fish species, in particular northern pike, yellow perch, and spottail shiner. Finally, the mainstem Peace River is a migration area for several species by providing an upstream and/or downstream movement corridor between habitats. Several species require the Peace River as a movement corridor including Arctic grayling, bull trout, mountain whitefish, burbot, goldeye, walleye, largescale sucker, and longnose sucker.

The complete description of fish and fish habitat baseline conditions is found in EIS, Volume 2, Appendix O Fish and Fish Habitat Technical Data Report[2]

5.0 Potential Effects of the Project on Fish and Fish Habitat

The following is a summary of the effects assessment for Fish and Fish Habitat (EIS, Section 12).

The assessment of the potential effects of the Project on fish and fish habitat was conducted in accordance with the methodology required by the EIS Guidelines. This methodology provided a structured approach to assess and communicate results of the assessment by category of effects for each project component during construction and operations of the Project. An initial step was to assess the potential for interactions between project components or activities, and fish and fish habitat (EIS, Volume 2, Appendix A, Table 2). From this exercise, interactions that may result in an adverse effect were assessed in EIS, Section 12 Fish and Fish Habitat Effects Assessment. Interactions were not carried forward into the effects assessment if standard mitigation measures to avoid or reduce the potential effects are available during construction and well understood to be effective. The implementation of the standard mitigation measures is described in the CEMP.

EIS, Sections 12.1 to 12.2 introduce the assessment approach, and describe the use of models as part of a weight of evidence approach to predictions:

> "The effects assessment of fish and fish habitat uses a first principles approach that includes computer modelling of water quality, water temperature and ice regime, fluvial geomorphology, sediment transport, aquatic productivity, and fish population dynamics. Modelling was used as a tool to inform and support information collected by baseline studies. This combined approach was used to support the prediction of potential effects to fish and fish habitat caused by the Project."

An important component of the assessment was a quantitative ecosystem approach to analyze the range of possible changes in fish and fish habitat, both upstream and downstream of the proposed Site C Dam (Volume 2, Appendix P Part 3 Future Conditions in the Peace River). The methods used are centred on a weight of evidence approach based on multiple performance measures and analyses to assess a range of possible changes in aquatic habitat and fish biomass that may result from operation of the Project. The modelling examined the pathways of effect and ecosystem interactions illustrated in Figure 12.2 of Section 12. The following key metrics were evaluated:

- Total habitat area before and after construction, and during operation of the Project
- Primary production (biomass and production of phytoplankton and periphyton)
- Secondary production (biomass and production of benthos and zooplankton)
- Fish production and biomass (total, as well as by species groups)
- Fish harvest

This approach was informed by discussions with DFO and MOE staff, allowing the approach and specific methodologies, including modeling and metrics, to address emerging directions in fish habitat assessment, and anticipated changes in the approach to regulation. As a result of this work, the assessment in the EIS is consistent with DFO's Fisheries Protection Policy Statement, which states that "very large-scale impacts that are likely to result in ecosystem transformation which require the most detailed estimates of impacts to productivity, likely involving quantitative fish population models." The above-listed metrics of fisheries productivity are consistent with those recommended in DFO's conceptual framework for a science-based interpretation of ongoing productivity of fisheries (DFO 2013a; Randall et al. 2013).

The potential effects of the project on fish and fish habitat were organized into three categories of effects: changes to fish habitat, changes to fish health and fish survival, and changes to fish movement. Potential effects that could occur during construction and operation phases of the Project were grouped as follows (Section 12.4):

Table 2. **Potential Effects of the Project by Categories of Effects during Construction and Operations of the Project.**

Category of Effect	Construction Phase	Operation Phase
Change in Fish Habitat	• Change in fish habitat due to the construction of the dam and generating station, Highway 29 and Hudson's Hope Shoreline Protection • Change in habitat due to construction headpond and reservoir filling	• Transformation of reservoir habitat during reservoir operations • Downstream habitat changes
Fish Health and Survival	• Sediment inputs from the construction of the dam and generating station, Highway 29 and Hudson's Hope shoreline protection • Sediment inputs from construction headpond and reservoir filling	• Stranding of fish • Fish entrainment

Category of Effect	Construction Phase	Operation Phase
	• Stranding of fish • Fish entrainment • Total dissolved gas supersaturation	• Total dissolved gas supersaturation
Fish Movement	• Hindered fish movement	• Hindered fish movement

Section 12.5 of the EIS addressed the following:

- Assessment of potential effects before mitigation
- Identification of potential mitigation activities
- Assessment of whether there would likely be a potential residual effect after mitigation

A summary of the residual effects of the Project on fish and fish habitat are (from pages 12-37 to 12-39 of the EIS) as follows:

- The reservoir will eliminate 28.0 km^2 of habitat in the Peace River mainstem (predominantly deep run/glide habitat) and 1.63 km^2 of tributary habitat (a mix of pool, riffles, runs and other habitat types). These habitat losses will be offset by the creation of 93 km^2 of reservoir habitat, of which 9.42 km^2 will be littoral habitat (< 6 m deep), and 83.57 km^2 will be limnetic habitat. The total area will increase by 3.3-fold as the river is converted to a reservoir. [pg. 12-37 to 12-38 of EIS]
- Phytoplankton biomass densities ($t \cdot km^{-2}$ or $g \cdot m^{-2}$) are expected to increase about 30X relative to current biomass densities, in both the early and long term. Average periphyton densities in the reservoir are expected to decrease to 5% of their current value in both the early and long term, as only the littoral zone of the Site C reservoir (10.1% of the area) will grow periphyton, and periphyton production per unit area is expected to be less than in the Peace River. When future conditions are compared to current conditions, it is expected that there will be about a 2.7-fold increase in algal biomass (tonnes of periphyton plus phytoplankton) and a 1.8-fold increase in primary production (t/year of primary production). [pg 12-38 of EIS]
- Total secondary production in the Site C reservoir (i.e., littoral and profundal benthic production plus pelagic zooplankton production) is expected to be very similar to the total current rates of benthic production in both the mainstem Peace River and the area of tributaries that will be flooded when the reservoir is created. Overall reservoir secondary production is estimated to be 89% to 121% of current Peace River secondary production. The form of secondary production will change from being 100% benthic in the current system to a mix of benthic (74% to 81%) and zooplankton production (19% to 26%) in the reservoir. [pg 12-38 of EIS]

- Results for the most likely fish community scenario indicate about a 1.8-fold increase in total biomass of harvestable fish in the Site C reservoir relative to what currently exists in the Peace River, though with a very different species composition. Group 1 fish (burbot, lake trout, rainbow trout, walleye, northern pike) are expected to increase in their overall biomass, as increases in burbot, lake trout, northern pike, and rainbow trout offset decreases in walleye. The total biomass of group 2 passage-sensitive species (Arctic grayling, mountain whitefish, bull trout) is expected to decline, due to declines in the biomass of mountain whitefish and Arctic grayling. Bull trout are expected to increase in the reservoir over the longer term under two of the three fish community scenarios (maximum, most likely), and decline under the minimum scenario. The changes in overall biomass are driven most strongly by a substantial increase in group 3 planktivorous fish species (kokanee and lake whitefish) over both the near and long term.

Residual effects were characterized and a determination of significance was made, as described in EIS, Section 12.6 as follows:

> The project is predicted to have a significant adverse effect on the fish and fish habitat VC as a result of the potential for the loss of indigenous fish populations or distinct groups of fish. The three distinct groups of fish that may be lost are the adfluvial component of the Moberly River Arctic grayling, migratory (adfluvial) bull trout that spawn in the Halfway River, and mountain whitefish that rear in the Peace River and spawn in tributaries of the Peace River or the Peace River mainstem upstream of the Site C Dam site. The loss of these distinct groups occurs because of loss of river habitat, reduced fish health and survival during construction and reservoir filling, and hindered fish movement. Although these distinct groups will be affected, the species as a whole of Arctic grayling, bull trout and mountain whitefish will continue to be present in Peace River tributaries and downstream of the reservoir and may persist in the reservoir.[5]

The EIS described the uncertainty associated with these predictions. In accordance with Section 12.8 of the EIS and included as a component of the FAHMFP, follow up monitoring programs will be implemented to verify the accuracy of the predictions and effectiveness of the mitigation measures.

6.0 Fish and Fish Habitat Mitigation

FDS Condition 8.4.2 sets out the requirements for measures to mitigate potential effects on fish and fish habitat during construction and operation of the Designated Project. The requirements for this condition are described below.

In developing these plans for measures to mitigate the potential adverse effects of the Project on Fish and Fish Habitat, an objective is to provide for ongoing productivity of fish ecosystems while following relevant guidance provided in applicable regulations and standards, and through dialogue and consultation with appropriate regulatory authorities and Aboriginal groups. Mitigation measures were considered based on values associated with the conservation and utilization of BC Freshwater Fisheries Program[6] and BC Conservation Framework[7] that articulates three conservation goals: 1) Contribute to global efforts for species and ecosystem conservation, 2) Prevent species and ecosystems from becoming at risk and 3) Maintain the

[5] EIS, Section 12.6.3.2, pp. 19-24
[6] http://www.env.gov.bc.ca/esd/documents/ff_program_plan.pdf
[7] http://www.env.gov.bc.ca/conservationframework

diversity of native species and ecosystems. As described in DFO's Fisheries Productivity Investment Policy (DFO 2013b) central to the mitigation measures will be avoidance, reduction and, where necessary, offsets (or compensation) for adverse effects to fish and fish habitat that may result from the construction and operation of the Project. Information on key standard and Project-specific mitigation measures are described in the following sections.

6.1 Construction Environmental Management Plan

This section has been developed in accordance with:

- FDS Condition 8.4.2.1: erosion and sediment control measures, riparian zone avoidance measures, best practices for watercourse crossings, instream work guidelines, and in-stream working timing windows
- FDS Condition 8.4.4.: measures to avoid or reduce fish stranding
- EAC Condition 4:
    - Remove temporary structures as soon as they are no longer required
    - Maintain a 15 m machine free zone adjacent to watercourses during reservoir clearing (as measured from the Ordinary High Water Mark)
    - Place material relocation sites (R5a, R5b, and R6) 15 m back from the Peace River mainstem to avoid affecting Peace River fish habitat
    - Develop a feasible strategy for the salvage and relocation of stranded fish in habitats that are at risk of dewatering

The CEMP describes the mitigation measures that will be implemented during construction of the Project. All construction must be conducted in compliance with the project's Environmental Requirements:

- The Environmental Specifications described in Section 4 of the CEMP
- The conditions included in the EAC for the Project (BC Environmental Assessment Office, 2014)
- The conditions included in the decision statement issued by the Minister of Environment of Canada (CEAA, 2014)
- The permits, authorizations and approvals for the Project issued by regulatory agencies Statutory requirements

The CEMP outlines the requirements for Environmental Protection Plans (EPPs), which will be prepared and implemented by BC Hydro's contractors.

Contractor(s) will be required to retain a Qualified Environmental Professional and qualified Environmental Monitors who will monitor construction activities with respect to compliance with applicable EPPs. The environmental management roles and responsibilities are described in Sections 2 of the CEMP.

Standard mitigation measures and environmental requirements for fish and fish habitat are addressed under the following sections of the CEMP: Fisheries and Aquatic Habitat Management (Section 4.5), Erosion Prevention and Sediment and Control Management (Section 4.4), and Surface Water Quality Management (Section 4.14). CEMP standard

mitigation measures and associated environmental requirements for fish and fish habitat addressing EAC Condition 4 are summarized in Table 3.

Table 3. EAC Condition 4 Standard Mitigation for Fish and Fish Habitat Addressed in CEMP

EAC Condition	CEMP Section
"Remove temporary structures as soon as they are no longer required"	CEMP Section 4.5
"Maintain a 15 m machine free zone adjacent to watercourses during reservoir clearing (as measured from the Ordinary High Water Mark)"	CEMP Section 4.5
"Place material relocation sites (R5a, R5b, and R6) 15 m back from the Peace River mainstem to avoid affecting Peace River fish habitat.	CEMP Section 4.5
"Develop a feasible strategy for the salvage and relocation of stranded fish in habitats that are at risk of dewatering"	CEMP Section 4.5

CEMP standard mitigation measures and associated environmental requirements for fish and fish habitat addressing FDS Condition 8.4.2.1 and 8.4.2.2 are summarized in Table 4.

Table 4. FDS Condition 8.4.2.1 Standard Mitigation for Fish and Fish Habitat Addressed in CEMP

FDS Condition	CEMP Section
"Erosion and sediment control measures"	CEMP Section 4.4
"Riparian zone avoidance measures"	CEMP Section 4.5
"Best practices for watercourse crossings"	CEMP Section 4.5
"In-stream work guidelines"	CEMP Section 4.5
"In-stream work timing windows"	CEMP Section 4.5
"Measures to avoid or reduce fish stranding"	CEMP Section 4.5

6.2 Project-specific Mitigation Measures

The following sections provide descriptions of key mitigation measures in accordance with the EAC and FDS conditions and are organized by geographic location: 1) downstream of the Site C dam site, 2) at the dam site, and 3) within the Site C reservoir area.

6.2.1 Mitigation Measures Downstream of Site C Dam Site

BC Hydro will undertake a number of physical works to enhance fish habitat in the Peace River downstream of the Site C dam site to mitigate 1) altered fish habitat due to the construction of the River Road[8], 2) altered fish habitat downstream of Site C Dam during operations, and 3) potential effects associated with reduced fish health and survival due to stranding during construction and operations (following the categories of effects listed in the EIS Volume 2 Section 12).

6.2.1.1 Peace River Channel Contouring and Side Channel Enhancement

EAC Condition 4

a) "Contour mainstream bars to reduce potential for fish stranding, as advised by FLNR."
b) "Increase wetted habitat by creating new wetted channels and restoring back channels on the south bank island downstream of the dam."
c) "Enhance side channel complexes between the dam site and the confluence of the Peace and Pine rivers during low flows."

FDS Condition 8.4.2

a) "Measures to avoid or reduce fish stranding." (FDS Condition 8.4.2.2)
b) "Measures to mitigate the effects of Total Dissolved Gas concentrations in tailwater on fish." (FDS Condition 8.4.2.3)

BC Hydro will enhance habitat in Peace River side channels and contour mainstem bars between the dam and the confluence with the Pine River to mitigate potential effects of the operation of the Project (EIS, Table 12.19). Side channels provide unique physical habitat characteristics relative to the Peace River mainstem, provide habitats for smaller-sized fish species and younger age-classes of large-fish species and provide refuge during high river flows and during periods of fry emergence (see EIS Section 12.3.2.6). These mitigation works are focused on: a) reducing the extent of dewatering of shallow habitats to reduce the risk of fish stranding, b) maintaining wetted channel areas by maintaining side-channel connectivity, c) providing a suitable compensation depth for refuge from areas of high total dissolved gas, d) providing stable wetted aquatic habitat across the range of Site C operational flows, and e) providing suitable cover and substrates to support various life stages. The general approach is to use a 'cut and fill' excavation and deposition approach in shallow water habitats that are at risk of being dewatered during operations along a 4 km long area downstream of the Site C dam site (Figure 1). Shallow habitats farther from shore are excavated to below the water elevation that occurs at low flows, and this material is used to 'fill' shallow habitats that are at risk of dewatering near shore.

The main channel and side channel areas targeted by these enhancement sites are currently used for rearing and feeding by several fish species, including mountain whitefish, bull Trout, Arctic grayling, rainbow trout and walleye. Fish use of the enhanced areas is expected to increase for these species with the proposed work. The increased wetted surface area and wetted duration of the habitat is also expected to result in an overall increase in primary and secondary productivity. The effectiveness of these measures will be monitored, and is described in the FAHMFP.

Two side channel andPeace River channel contouring habitat enhancement sites were selected for preliminary design; these are referred to as sites 108R and 109L . Hydraulic modelling

[8] The River Level Road, or River Road, is described as the north bank haul road in the Site C EIS.

estimates that these preliminary designs reduce dewatered areas between Site C and the Pine River and that the side channels remain open under the range of operational flows. The preliminary design for site 109L is under review based on a 2018 landslide near the community of Old Fort that affected the Peace River side channel areas that were planned for enhancement.

Detailed design for these sites is ongoing. The design will also take into: 1) opportunities for side channel complexing including boulder placement, 2) foreshore private property boundaries and input from property owners near the channels, and 3) reviewing the high flow design criteria to reduce changes from the contouring at channel elevations that are wetted less frequently and where grasses and other vegetation occurs and may provide habitat for wildlife.

6.2.1.2 River Road Habitat Enhancement

EAC Condition 4 – "Include fish habitat features (e.g., shears, large riprap point bars, etc.) in the final design of the north bank haul road bed material that would be placed in the Peace River"

Habitat will be enhanced along the River Road by incorporating fish habitat features (e.g., shears, large riprap point bars) in the final design (Figure 1). Designs were completed for the construction of twenty 15 m x 4 m riprap spurs aligned perpendicular to Peace River flows (Appendix A Rock Spurs for Fish Habitat along River Level Road). Modelling results indicate the spurs provide a diversity of shoreline flow velocities during the range of Site C operational flows. This diversity of hydraulic habitat and the backwater habitat created by the spurs provide shoreline habitat conditions (e.g., rearing and feeding) that are expected to support resident and migratory fish species.

6.2.2 Mitigation Measures at the Site C Dam Site

BC Hydro will undertake mitigation at the Site C dam site to mitigate 1) reduced fish health and survival due to fish entrainment during construction and operations, 2) hindered fish movement due to obstruction to fish passage during construction and operations, and 3) reduced fish health and survival due to total dissolved gas during construction and operations (following the categories of effects listed in the EIS Volume 2 Section 12).

6.2.2.1 Fish Entrainment

FDS Condition 8.4.2.3 - "Operational practices, technologies and design features that minimize downstream fish entrainment past the dam site"

This condition is addressed in the Project's Fish Passage Management Plan.

6.2.2.2 Upstream Fish Passage

EAC Condition 6 – "The Fish Passage Management Plan must include at least the following:"

- "Establish a periodic capture data base/protocol/methodology for small-fish species to assess genetic exchange between upstream and downstream fish populations. Data must be provided annually to the relevant federal and provincial agencies."
- "Address genetic differences exceeding beyond a pre-defined threshold (to be determined through discussion with the agencies) by implementing a translocation program."
- "Design the installation and use of a trap and haul facility."

"A draft Fish Passage Management Plan will be submitted to FLNR, MOE and Aboriginal Groups for review a minimum of 90 days prior to Project activities that may impact upstream fish passage."

FDS Condition 8.4.2.5 - “Measures to mitigate obstructed upstream fish passage for bull trout and, as appropriate and feasible, other migrating fish species.”

This condition is addressed in the Project’s Fish Passage Management Plan.

6.2.2.3 Mitigation of Total Dissolved Gas

EAC Condition 5 – “EAC Holder must manage harmful Project effects on fish during reservoir filling, turbine commissioning and operations by developing and implementing mitigation measures detailed in operational procedures developed by a QEP to:”

- “Minimize levels of total dissolved oxygen gas in the tailwater”
- “Minimize levels of dissolved gas super-saturation”

“These operational procedures must be developed in consultation with FLNR and MOE prior to reservoir filling, and include monitoring activities.”

FDS Condition 8.4.2.4 - “Measures to mitigate the effects of Total Dissolved Gas concentrations in tailwater on fish”

Measures to reduce total dissolved gas concentrations during construction and operations were taken into account in the design and operation of the spillway and generating station as described in EIS Volume 2, Section 12.5. The specific mitigation measures include:

Construction

- The spillway design has been modified to reduce total dissolved gas generation
- Develop and implement an operational procedure to reduce the number of hold points and duration of the reservoir filling and turbine commissioning to reduce total dissolved gas concentration in tailwater

Operations

- The spillway design has been modified to reduce total dissolved gas generation.
- Develop and implement an operational procedure to manage the rate of discharge at each gate to reduce dissolved gas generation
- Develop and implement an operational procedure to reduce total dissolved gas concentration in tailwater

The operational procedures to reduce total dissolved gas concentration in the Site C dam tailwater will be developed in consultation with FLNR and MOE prior to reservoir filling. Monitoring of total dissolved gas is described in the FAHMFP.

6.2.3 Mitigation Measures in the Site C Reservoir

In the Site C Reservoir, physical works will be undertaken to enhance fish habitat and mitigate the categories of effects (following the EIS) of: 1) altered habitat during construction due to construction headpond and reservoir filling, 2) loss of habitat due to construction of the dam and generating station, Highway 29, and Hudson's Hope shoreline protection and 3) reduced fish health and survival due to stranding during reservoir operations (following the categories of effects listed in the EIS Volume 2 Section 12).

Shallow areas of lakes and reservoirs known as the littoral zone (e.g., <6 m deep) are productive habitats because sufficient sunlight penetrates to the bottom to support the growth of

algae, and hence aquatic invertebrates and other food for fish. The Site C reservoir will have limited shallow water habitat relative to deep habitat[9]. Therefore, mitigation measures described in the following Sections (6.2.3.1 – 6.2.3.4) are proposed that focus on increasing the area of shallow water habitat at select sites along the reservoir shoreline, including relocated surplus excavated material (RSEM) sites.

A diversity of substrate types that include large substrate that provides interstitial space as cover is important fish habitats (Waters et al. 1991). These habitat measures are known to support fish species of key management interest at Site C, such as rainbow trout and kokanee (Beauchamp et al. 1994; Hassemer and Rieman1981). The proposed mitigation measures are similar to artificial reef structures constructed in lakes and reservoirs (Bolding 2004).

6.2.3.1 Site C Reservoir Shoreline Enhancement

Highway 29 Borrow Source Contouring

EAC Condition 4 - "Contour Highway 29 borrow sites prior to decommissioning to provide littoral fish habitat in the reservoir."

One Highway 29 borrow site on the north bank of the Peace River will be contoured prior to decommissioning to provide littoral fish habitat in the reservoir. This site is located at km 77-79, as shown in Figure 1.

Additional Fish Habitat Enhancement Sites

Four additional fish habitat enhancement sites will be developed in the reservoir in accordance with the requirements of BC Hydro's Fisheries Act Authorization. These sites (i.e., km 21-23, km 25-27, km 42-44, km 91-93; Fig. 1) will be enhanced to increase littoral and shoal habitat.

The goal of this Site C Reservoir shoreline and littoral zone[10] (i.e., shallow water) enhancement is to create a diversity of shoreline habitats and increase the area of productive shallow water habitat. Based on final designs, the reservoir habitat enhancement at the five reservoir shoreline sites are expected to create 1) a single spawning shoal of 37,500 m^2, 2) 208,000 m^2 ha of littoral zone habitat enhanced with boulder complexes between elevation 456 m and 458 m , and 3) 330,000 m^2 of littoral zone habitat between elevation 456 m and 459.75 m.

The shallow water habitats will convert predominant sandy shorelines to constructed littoral habitats expected to be dominated by mud bottoms that supports increased primary production through enhanced macrophyte growth and benthic invertebrate density. This habitat is expected to support increased secondary production and higher densities of juvenile fish.

The design criterion for the littoral habitat creation includes a maximum excavation elevation of 459.75 m. This elevation is just below the lower end of the normal reservoir fluctuation zone between the minimum normal reservoir elevation of 460.0 m and maximum normal reservoir level of 461.8 m.

Together, the Site Reservoir shoreline fish habitat enhancements will create a diversity of shoreline habitats and increase the area of productive shallow water habitat available to fish.

[9] EIS, Section 12.4.1.2. P. 12-35.

[10] The littoral zone is the shallow areas along the reservoir shoreline between maximum normal reservoir level (MNRL) of 461.8 m and 6 m below MNRL, which support higher aquatic production considered based on light penetration to bottom sediments supporting algal growth and growth of rooted aquatic plants (EIS, Vol. 2, App P, Part 3).

These final designs are expected to better maintain the form and function compared to the conceptual designs.

6.2.3.2 Highway 29 Realignment Fish Habitat

EAC Condition 4 - "Incorporate fish habitat features into the final design of the Highway 29 roadway that would border the reservoir, east of Lynx Creek."

Riprap, as fish habitat, will be incorporated into the design of the Highway 29 realignment segments that will border the reservoir east of Lynx Creek. Shoreline habitat of the Site C Reservoir will be enhanced by placing riprap in selected littoral areas. In particular, Highway 29, including causeways at Cache, Lynx and Farrell creeks and the Halfway River will be constructed of large riprap. Riprap provides cover habitat for fish species such as rainbow trout, and a diversity of habitat relative to the predominantly sandy shoreline in these areas of the reservoir. Based on the preliminary design, an estimated 21,900 m^2 of rip rap habitat will be placed within the reservoir littoral zone (elevations 456 m to 461.8 m).

Refuges that reduce predation risk are an important factor in the recruitment of many fish (Ahrens et al. 2012; Walters and Korman 1999). For example, juvenile rainbow trout preferentially use complex shorelines as predation refuges and experience higher mortality rates when these areas are not available (Tabor and Wurtsbaugh 1991). Utilization of boulder cover is part of a more general pattern in which many juvenile fish utilize cover to reduce predation risk (Savino and Stein 1982; Werner and Hall 1988; Laplante-Albert et al. 2010).

6.2.3.3 Hudson's Hope Shoreline Protection Fish Habitat

EAC Condition 4 - "Construct the Hudson's Hope shoreline protection with large material that will provide replacement fish habitat. Incorporate additional fish habitat features (e.g., shear zones and point bars) into the final design of the Hudson's Hope shoreline protection."

Riprap, as fish habitat, will be incorporated into the design of the Hudson's Hope Shoreline Protection. An estimated 12,000 m^2 to 30,700 m^2 (depending on final shoreline protection design) of rip rap habitat will be placed within the reservoir littoral zone (elevations 456 m to 461.8 m).

Additional fish habitat features will be incorporated into the design of the Hudson's Hope Shoreline. The design concept is to place large boulders, including complexes of boulder piles at the toe of the riprap on the reservoir bed. The boulders would create reef habitat which would be utilized by larger (i.e., 20-30 cm) rainbow and bull trout. The design of these additional features will be completed by a QEP as the overall design of the Hudson' Hope Shoreline Protection progresses.

Other fish habitat enhancement concepts, such as shear zones and point bars, were reviewed for segments of Highway 29 or Hudson's Hope Shoreline Protection bordering the reservoir. However, these alternatives were deemed to be not biologically effective given outputs from hydraulic modelling of the Site C Reservoir that predict an absence of water velocities at these sites, reducing the effectiveness of such features.

6.2.3.4 Dam Site Material Relocation Site Enhancement

EAC Condition 4

a) "Incorporate fish habitat features into the final capping of material relocation sites upstream of the dam."

b) "Contour and cap with gravels and cobble substrate the spoil area between elevations 455 m and 461 m to provide a productive fish habitat that will be available to fish during the operation phase."
c) "Cap material repositioning areas with gravel and cobble, and contour to enhance fish habitat conditions."

Fish habitat features, including spawning gravel and cobbles, will be incorporated into the final capping of material relocation sites upstream of the dam that will be inundated by the reservoir, to provide productive reservoir littoral fish habitat. Two relocated surplus excavated material sites upstream of dam site will be contoured and capped to increase shallow water habitat creation within elevation 456 m to 458.5 m (including gravel/ cobble capping) at RSEM area R5a and RSEM area L5 (Figure 1). Preliminary design concepts estimate approximately 10 ha of enhanced littoral habitat at RSEM area R5a and 4 ha of enhanced littoral habitat at RSEM area L5. The gravel and cobble habitat will provide cover for juveniles as well as spawning habitat for species such as lake whitefish.

6.2.3.5 Reservoir Shoreline Riparian Planting

EAC Condition 4 – "Plant a 15 m wide riparian area along the reservoir shoreline adjacent to BC Hydro-owned farmland where necessary to provide riparian habitat and bank stabilization except as approved by the onsite environmental monitor."

A 15 m wide riparian area will be planted along the reservoir shoreline adjacent to BC Hydro-owned farmland to provide riparian habitat and bank stabilization. Riparian planting is proposed for an estimated 16 ha[11] of land, identified as currently non-forested, with a slope less than 25% suitable for riparian development, and within a 15 m zone surrounding the 5 year beach line[12]. The planting is proposed to include a mix of balsam poplar (60%), willow (30%) and red-osier dogwood (10%) live staked at densities of 4,000 stems/ha.

7.0 Implementation and Reporting

This section has been developed in accordance with Condition 8.7 of the federal Decision Statement: "The Proponent shall implement each component of 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 construction and for the first ten years of operation and once every five years for the next 20 years".

A proposed implementation schedule for fish and fish habitat mitigation measures in accordance with EAC and FDS conditions is included as Figure 2. The timing of mitigation measure implementation is coordinated with specific Project activities. For example, the CEMP will be implemented at the start of construction and River Road habitat enhancement construction is concurrent with construction of River Road.

BC Hydro will provide annual reports on the implementation of the Fisheries and Aquatic Habitat Management Plan to the Agency. These reports will include a summary and analysis of plan

[11] Comprised of an estimated 4 ha of Crown and 12 ha of BC Hydro owned land.
[12] Five-Year Beach Line is the predicted extent of shoreline retreat at the maximum normal reservoir level five years after impoundment of the proposed reservoir (EIS, Vol. 2, Appendix B, Part 2)

implementation, and will be submitted to the Agency during construction and for the first ten years of operation and once every five years for the next 20 years.

Annual reports will also include a description of any amendments as described in Section 2.4.

8.0 Qualified Professionals

Table 4 lists the qualified individuals who prepared the FAHMP.

Table 4. Qualified Professionals

Qualified Individual	Expertise
Dave Hunter, BSc., RPBio	Fisheries
Brent Mossop, MRM, RPBio	Fisheries

9.0 References

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Cache Creek

KM 77-79
Reservoir
Shallow Water
Habitat Enhancement

Farrell Creek

Halfway River

Wilder Creek

Tea Creek

97

Channel Contouring
and Side Channel
Enhancement

Fort St. John

N

KM 91-93
Reservoir
Shallow Water
Habitat Enhancement

29

Peace River

Boudreau Lake

Moberly River

Dam Site Material Relocation Sites
Shallow Water Habitat Enhancement

North Bank
Enhancement Works
Under Review

Pine River

Dry Creek

Lynx Creek

KM 42-44
Reservoir
Shallow Water
Habitat Enhancement

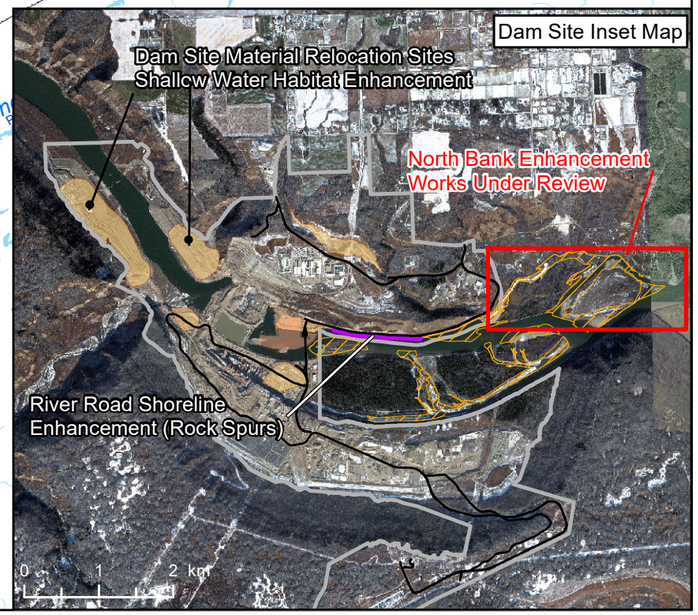
Hudson's Hope
Shoreline
Protection

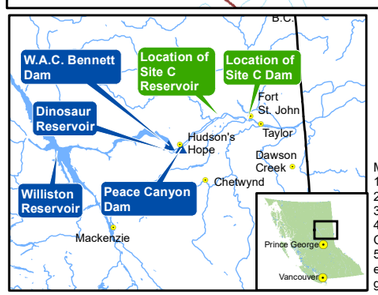
Hudson's Hope

Portage Creek

KM 25-27
Shallow Water
Habitat Complexing

KM 22-24
Reservoir
Spawning Shoal
Enhancement





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Dam Site Imagery © Digital Globe, captured October 24, 2020, TRIM.
5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

Legend

- Proposed Reservoir (FSL 461.8 m)
- Channel Contouring and Side Channel Enhancement
- Hudson's Hope Shoreline Protection
- Highway 29 Realignment
- Dam Site Area
- Relocated Surplus Excavated Materials
- River Road Shoreline Enhancment (Rock Spurs)
- Road
- Highway
- Railway

1:200,000

0 10 km

BC Hydro

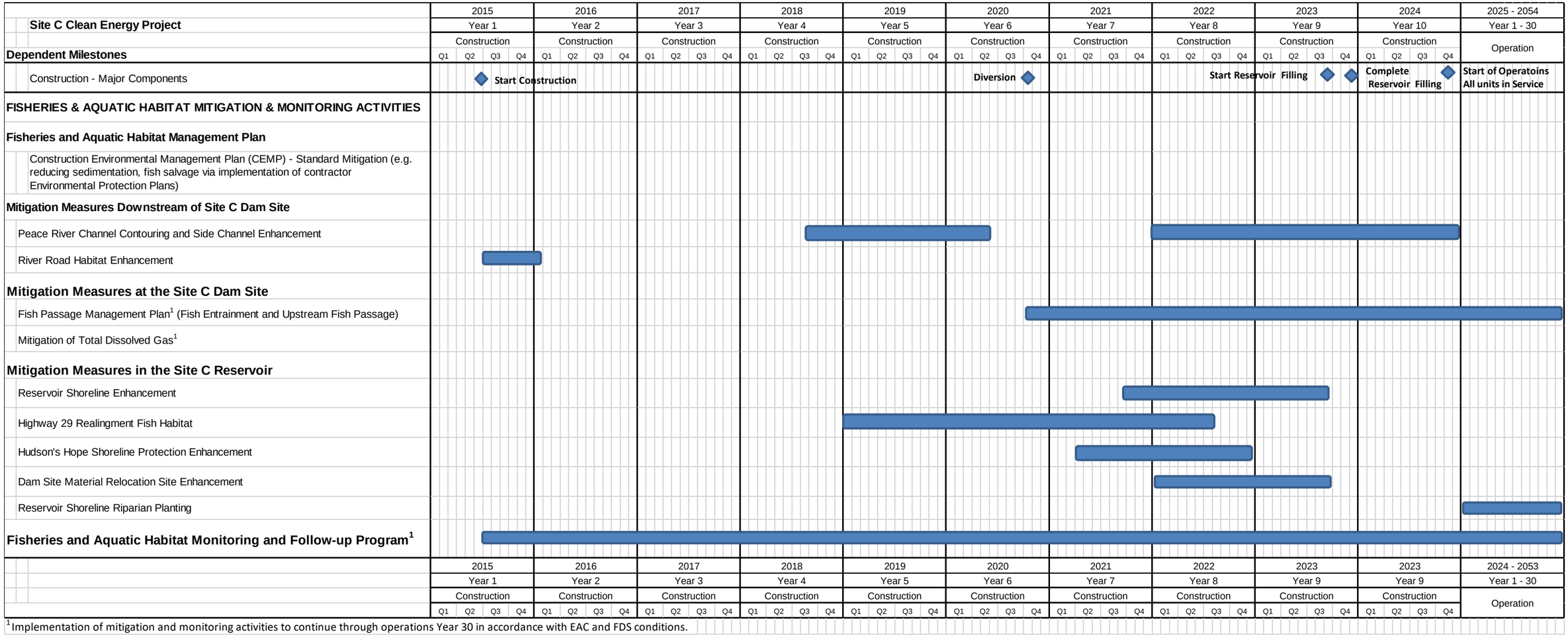
Figure 1
Fish Habitat Enhancement

Date	Nov. 19, 2021	DWG NO	1016-C14-B7650-5	R 3

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification

Path: X:\ArcGISProjects\Permitting\Federal_Permits\NavProtAct\FishHabitatEnhancement_1016_C14_B7650-5.mxd

Figure 2. Fish and fish habitat mitigation implementation schedule.



[1] Implementation of mitigation and monitoring activities to continue through operations Year 30 in accordance with EAC and FDS conditions.