Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Salish Sucker (*Catostomus* sp. cf. *catostomus*) in Canada

Salish Sucker

Original publication 2016
1st amendment 2020

Canada

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(changes made to all sections)

Previous versions of this recovery strategy can be found on the
Species at Risk Public Registry

Recommended citation:

Fisheries and Oceans Canada. 2020. Recovery Strategy for the Salish Sucker (*Catostomus* sp. cf. *catostomus*) in Canada. 1st amendment. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. vii + 71 pp.

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Cover illustration: Adult Salish Sucker photo by Mike Pearson

Également disponible en français sous le titre
« Programme de rétablissement du meunier de Salish (*Catostomus* sp. cf. *catostomus*) au Canada »

ISBN 978-0-660-34054-8
Catalogue no. En3-4/144-2020E-PDF

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the Species at Risk Act (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of a recovery strategy for species listed as extirpated, endangered, or threatened and are required to report on progress five years after the publication of the final document on the Species at Risk Public Registry.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Salish Sucker and has prepared this recovery strategy, as per section 37 of SARA. A recovery strategy was completed for Salish Sucker and posted on the Species at Risk Registry in 2016 (DFO 2016). This 2020 recovery strategy is the first amendment to the 2016 recovery strategy. It updates biology, the recovery feasibility assessment, threats, population and distribution objectives, and areas identified as critical habitat.

In preparing this recovery strategy, the competent minister has considered, as per section 38 of SARA, the commitment of the Government of Canada to conserving biological diversity and to the principle that, if there are threats of serious or irreversible damage to the listed species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty. To the extent possible, this recovery strategy has been prepared in cooperation with the Province of British Columbia as per section 39(1) of SARA.

As stated in the preamble to SARA, success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Fisheries and Oceans Canada, or any other jurisdiction alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Salish Sucker and Canadian society as a whole.

The Action Plan for the Nooksack Dace (*Rhinichthys cataractae*) and the Salish Sucker (*Catostomus* sp.) in Canada (DFO 2017) provides information on recovery measures to be taken by Fisheries and Oceans Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this recovery strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

Fisheries and Oceans Canada (DFO) developed this amended 2020 recovery strategy for Salish Sucker. DFO acknowledges the efforts of Mike Pearson (Pearson Ecological), who made the updates to the document with contributions from Erin Gertzen, Sean MacConnachie and Martin Nantel (DFO).

DFO extends their appreciation to the authors of the 2016 recovery strategy including Tom G. Brown (DFO), Karen Calla (DFO), Todd Hatfield (Ecofish Research), Don McPhail (University of British Columbia (UBC)), Mike Pearson, John Richardson (UBC), Jordan Rosenfeld (B.C. Ministry of Environment (B.C. MOE)), Dan Sneep (DFO), Dolph Schluter (UBC), Heather Stalberg (DFO), Marina Stjepovic (Township of Langley), Eric Taylor (UBC), and Paul Wood (UBC).

Executive summary

The Salish Sucker (*Catostomus* sp. cf. *catostomus*) was listed as Endangered under the Species at Risk Act (SARA) in 2005, and was re-classified as Threatened under SARA in 2019. This recovery strategy is considered one in a series of documents for this species that are linked and should be taken into consideration together, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Report (COSEWIC 2012), the Science Advisory Report from the recovery potential assessment (RPA) (DFO 2015), and the joint Nooksack Dace (*Rhinichthys cataractae* ssp.) and Salish Sucker action plan (DFO 2017). Recovery has been determined to be biologically and technically feasible.

A recovery strategy was completed for Salish Sucker and posted on the Species at Risk Public Registry in 2016 (DFO 2016). This 2020 recovery strategy is the first amendment to the 2016 recovery strategy. It updates the biology, recovery feasibility assessment, threats, population and distribution objectives, and areas identified as critical habitat.

The Salish Sucker is a small-bodied, fine-scaled fish documented in 11 watersheds in the Fraser Valley, British Columbia (B.C.). It is a genetically and physically unique form of the widespread and common Longnose Sucker (*C. catostomus*) that evolved in geographic isolation in Washington State during glaciation (McPhail 2007). Salish Sucker populations have been in decline since at least the 1960s in Canada.

Adults are most abundant in headwater marshes and ponds. Juveniles are generally found in shallow pools and glides containing cover. Spawning occurs in riffle habitats over fine gravel. Most individuals have small home ranges, although some individuals move kilometres during the spawning period. Within watersheds, distribution is concentrated in small areas, with a few sites harbouring most of the population.

The main threats facing the species are described in section 5 and include: hypoxia, seasonal lack of water, harmful substances, sediment deposition, habitat fragmentation, physical destruction of habitat and increased predation from aquatic invasive species.

The population and distribution objectives (section 6) for the Salish Sucker are:

- population objective:
  - long-term: reach or exceed watershed-specific population objectives described in section 6 by 2035
- distribution objectives:
  - short-term: continued presence in all eleven currently occupied watersheds
  - long-term: presence in all critical habitat reaches by 2035

A description of the broad strategies to be taken to address threats to the species' survival and recovery, as well as research and management approaches needed to meet the population and distribution objectives are included in section 7. These informed the development of specific recovery measures in the Action Plan for the Nooksack Dace (*Rhinichthys cataractae*) and the Salish Sucker (*Catostomus* sp.) in Canada (DFO 2017).

For the Salish Sucker, critical habitat is identified to the extent possible, using the best available information, and provides the functions and features necessary to support the species' life-cycle processes and to achieve the species' population and distribution objectives. Section 8 of this recovery strategy identifies critical habitat for Salish Sucker as those reaches in the eleven

occupied watersheds that have more than 50 m in length of continuous pool habitat with a water depth exceeding 70 cm at summer low flows. Critical habitat within those identified reaches includes all the aquatic habitats, including features and attributes identified in section 8, and all riparian areas on both banks for the entire length of the identified aquatic reaches. Riparian critical habitat is continuous and extends laterally (inland) from the top of bank to a width equal to the widest zone of sensitivity calculated for five riparian features and functions. The total length of aquatic critical habitat identified for Salish Sucker in this recovery strategy is 196.5 km (of 384.2 km of surveyed stream channel) and the area of riparian critical habitat associated with the aquatic critical habitat reaches is 818.1 hectares.

A SARA Critical Habitat Order is currently in place to legally protect from destruction Salish Sucker critical habitat identified in the 2016 recovery strategy (DFO 2016). This amended recovery strategy includes updates to critical habitat identification.

Recovery feasibility summary

The purposes of the Species at Risk Act (SARA) are to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened.

Using criteria outlined in table 1 below, DFO determined that the recovery of Salish Sucker is feasible based on species characteristics and thresholds required to approach the historical condition[1] of the species. While uncertainty[2] remains, Salish Sucker's recovery can feasibly be achieved with habitat improvements.

Table 1a. Recovery feasibility evaluation for Salish Sucker; survival threshold.

Fundamental species characteristic	**Survival threshold** (non-precarious species)	**Technically and biologically feasible to achieve threshold before opportunity is lost?** (Yes / No / Unknown)
Species trend	Stable or increasing over 10 years or 3 generations whichever is longer (up to 100 years)	Yes: achievable with additional habitat protection/enhancement (DFO 2015)
Resilience	Sufficiently large to recover from periodic disturbance and avoid demographic and genetic collapse or better	Yes: 5,000 to 10,000 breeding adults across Canadian range. Watershed population estimates range from <100 to 2,250 (DFO 2015)
Redundancy	Enough redundancy in the number of (sub) populations or a large enough area of occupancy to prevent catastrophic loss or better	Yes: currently 11 watersheds in Canada (COSEWIC 2012)
Population connectivity	Not severely and unnaturally fragmented	Yes: relies on habitat improvements across the range (COSEWIC 2012)
Mitigation of anthropogenic threats	Significant threats avoided or mitigated to the extent that they no longer threaten the species	Yes: reversal of severe eutrophication will be required in many reaches (DFO 2015)
Result	If all above conditions can be met, species is above the survival threshold	☒ **Survival threshold met** ☐ **Survival threshold not met**

[1] Condition of the species: combination of the level of redundancy, resilience, representation, population and distribution, trend, threats, ecological role and any other factors that together determine the risk of extinction or extirpation of the species in Canada.

Table 1b. Recovery feasibility evaluation for Salish Sucker; recovery threshold.

Fundamental species characteristic	Minimum recovery threshold (non-precarious species)	Technically and biologically feasible to achieve threshold before opportunity is lost? (Yes / No / Unknown)
Species condition	Improved over when first assessed as at risk	Yes: distribution and abundance could be increased over first assessment if habitat degradation issues are addressed (DFO 2015)
Representation (species presence in appropriate ecological communities)	Approximating historical condition at a coarse scale	Yes: no known population extirpations. At moderate to high densities where habitat conditions permit. Reversal of eutrophication in many habitats required (DFO 2015)
Independent of connectivity with populations outside of Canada	Yes: connectivity may be important but is not necessary	Yes: connectivity to Washington State exists in 3 of 11 watersheds (COSEWIC 2012)
Independent of species intervention	Yes	Yes: no intervention required
Result	If survival threshold and all above conditions can be met, recovery is feasible	☒ **Recovery feasible** ☐ **Recovery not feasible**

[2] As per the Species at Risk Act's preamble "if there are threats of serious or irreversible damage to a wildlife species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty." When the determination of recovery as technically and biologically feasible is uncertain, the recovery strategy required under SARA will be prepared in accordance with requirements for a species for which recovery is feasible and will aim among other things to reduce this uncertainty.

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1. Introduction

The Salish Sucker (*Catostomus* sp. cf. *catostomus*) was listed as Endangered under the Species at Risk Act (SARA) in 2005, and was re-classified as Threatened under SARA in 2019.

This recovery strategy is part of a series of documents regarding Salish Sucker that should be taken into consideration together, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Report (COSEWIC 2012), the Science Advisory Report from the recovery potential assessment (RPA) (DFO 2015), and the joint Nooksack Dace and Salish Sucker action plan (DFO 2017). The COSEWIC Status Report contains basic biological information on the species and an assessment classifying the species as data deficient, not at risk, extinct, extirpated, endangered, threatened or special concern. The RPA is a research document undertaken by DFO Science to provide the information and scientific advice required to implement SARA and inform the recovery strategy, relying on the best available scientific information, data analyses and modeling, and expert opinions. A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets objectives and identifies the main areas of activities to be undertaken. An action plan contains detailed planning aimed to help recover the species.

2. COSEWIC species assessment information

Assessment summary: November 2012

Common name: Salish Sucker

Scientific name: *Catostomus* sp. cf. *catostomus*

COSEWIC status: Threatened

Reason for designation: this small fish has a restricted and fragmented range in southwestern British Columbia where it is susceptible to a continuing decline in habitat quality. An improvement in status from Endangered stems from a small increase in the number of known locations (from 9 to 14), including one location thought to have been extirpated, and some improvements in quality of habitat in areas subject to restoration.

Canadian occurrence: British Columbia

Status history: designated Endangered in April 1986. Status re-examined and confirmed in November 2002. Status re-examined and designated Threatened in November 2012.

3. Species status information

The conservation status of the Salish Sucker within relevant jurisdictions is summarized in table 2. Based on available information, Canada contains approximately 9.3 percent of the global range (COSEWIC 2012).

Table 2. Summary of existing protection or other status designations assigned to Salish Sucker.

Jurisdiction	Authority/ organization	Year	Status/description	Designation level
B.C.	Conservation Data Centre	2011	S1* Red List	Species
Canada	SARA[3]	2019	Schedule 1: Threatened	Species
Canada	COSEWIC	2012	Threatened	Species
Canada	NatureServe	2011	N1*	Species
Washington	NatureServe	2011	S1*	Species
United States	NatureServe	1996	N1*	Species
International	NatureServe	2011	G1*	Species
International	American Fisheries Society	2008	Endangered	Species

*G = Global Status; N = National Status; S = Subnational Status; 1= Critically Imperiled

Upon listing as a Threatened or Endangered species under Schedule 1 of SARA, a species becomes protected wherever it is found by section 32 of SARA:

> “No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species.” [s. 32(1)]
>
> “No person shall possess, collect, buy, sell or trade an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species, or any part or derivative of such an individual.” [s. 32(2)]

Under section 73 of SARA, the competent minister may enter into an agreement or issue a permit authorizing a person to engage in an activity affecting a listed wildlife species, any part of its critical habitat or its residences.

[3] Salish Sucker was listed as Endangered under SARA in 2005, and was re-classified as Threatened under SARA in 2019.

4. Species information

4.1 Description

The Salish Sucker (*Catostomus* sp. cf. *catostomus*) is a genetically and physically unique form of the Longnose Sucker (*C. catostomus*), a widespread fish species in North America (COSEWIC 2012). Salish Sucker arose when a Longnose Sucker population was geographically isolated in the Chehalis River valley (present-day Washington State) during the Pleistocene glaciations (McPhail 2007). The Salish Sucker is considered an evolutionarily significant unit (McPhail and Taylor 1999) and can be considered a "species in the making" (McPhail 1987). Within Canada, the Salish Sucker is present in 11 streams, wetlands and sloughs of the Fraser Valley between Surrey and Chilliwack in southern B.C. A number of populations may contain less than 100 breeding adults, while others number in the low thousands (DFO 2015).

Body colouration is dark-green and mottled with black on the back and whitish on the belly. A broad red stripe develops on the sides during the spring spawning season, especially in males. Scales are fine, the snout is short and blunt, and the small mouth is located on the lower surface of the head (McPhail and Carveth 1994). Few males exceed 200 mm in length and they can reach sexual maturity at less than 100 mm; females seldom exceed 250 mm (Pearson and Healey 2003).

4.2 Population abundance and distribution

Populations of Salish Sucker have been documented in 11 watersheds in the Fraser Valley, B.C. (table 3; figure 1). Each watershed represents a population. Within each population, there may be several subpopulations at specific locations within the watershed.

Table 3. Estimated numbers of adult Salish Sucker in Canadian populations. Estimates were made using mark-recapture methods. An 'X' indicates that too few were caught to allow abundance estimation (adapted from DFO 2015).

Population (watershed)	Specific location	Mean population estimate (95% CI)
Agassiz Slough	Agassiz Slough (2012)[4]	253 (203 to 354
Bertrand Creek	Bertrand mainstem (2013)[5]	735 (638 to 862)
Bertrand Creek	Perry Homestead (2016)	X
Bertrand Creek	Howe's Creek (2012)[4,6]	329 (206 to 711)
Chilliwack Delta[7]	Luckakuck Creek (2014)[5]	378 (345 to 416)
Chilliwack Delta	Semmihault Creek (2015)	547 (327 to 1,029)
Chilliwack Delta	Atchelitz Creek (2015)	239 (212 to 280)

[4] Data from Miners (2015, unpub data).
[5] Data from Pearson (2015, unpub. data).
[6] Howe's Creek is considered to be part of the Bertrand mainstem subpopulation in the Bertrand Creek Watershed.
[7] All locations within the Chilliwack Delta are considered to be a part of the Chilliwack Delta watershed population. Throughout the document, Chilliwack Delta refers to Luckakuck Creek, Semmihault Creek, Atchelitz Creek, Little Chilliwack Creek Mainstem and Interception Ditch.

Population (watershed)	Specific location	Mean population estimate (95% CI)
Chilliwack Delta	Little Chilliwack Creek Mainstem (2015)	351 (280 to 496)
Chilliwack Delta	Interception Ditch	739 (315 to 794)
Elk/Hope Slough	Elk Creek/Hope Slough (2006)	X
Fishtrap Creek	Fishtrap Creek (2013)	X
Little Campbell River	Little Campbell River (2014)	X
Miami River	Miami River (2012)[4]	102 (67 to 193)
Mountain Slough	Mountain Slough (2016)	X
Pepin Creek	Pepin Creek (2012)[4]	1,754 (1,318 to 2,900)
Salmon River	Upper Salmon River (2013[5]	751 (649 to 915)
Salmon River	Lower Salmon River (2013)	X
Salwein/Hopedale Slough	Salwein Creek (2012)[4]	288 (191 to 635)
Salwein/Hopedale Slough	Hopedale Slough (2012)[4]	469 (346 to 712)

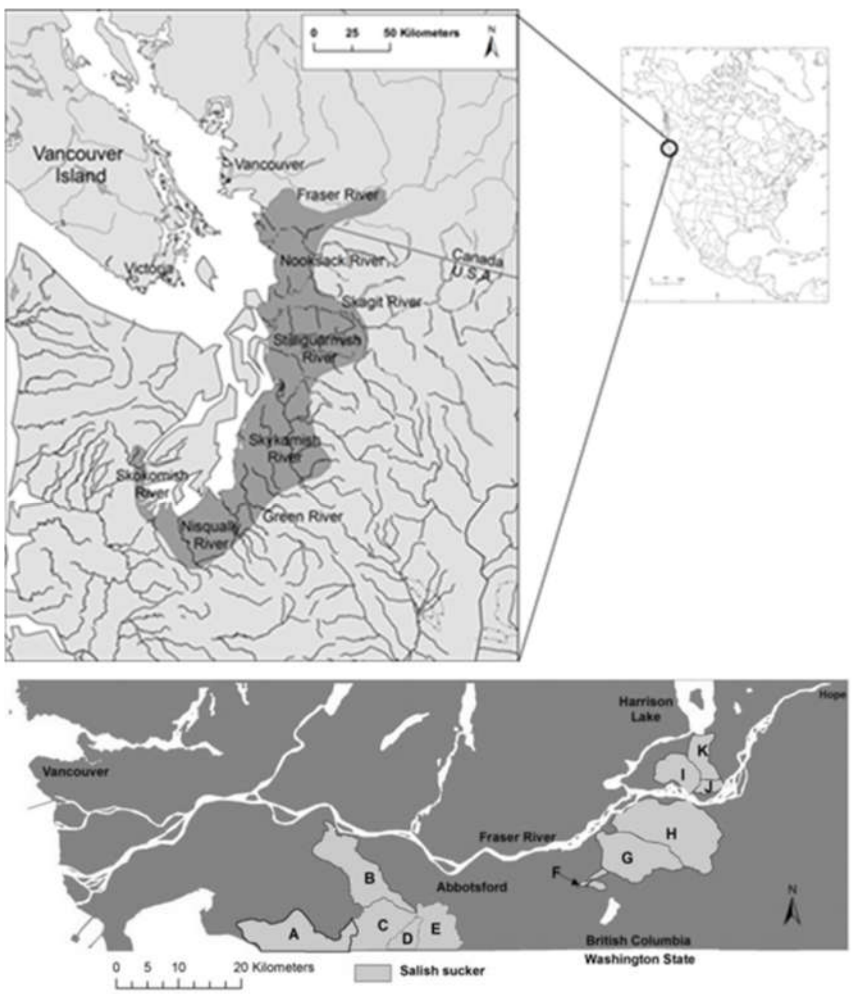

Figure 1. Distribution of the Salish Sucker. In Canada, the Salish Sucker has been observed in eleven watersheds: (A) Little Campbell River, (B) Salmon River, (C) Bertrand Creek, (D) Pepin

Brook, (E) Fishtrap Creek, (F) Salwein Creek/Hopedale Slough, (G) Chilliwack Delta, (H) Elk Creek/Hope Slough, (I) Mountain Slough, (J) Agassiz Slough and (K) Miami Creek. Globally, it is also found in seven other watersheds in northwestern Washington (adapted from COSEWIC 2012).

In the current landscape, there are no aquatic connections between adjacent populations within Canada except for a small headwater pond that feeds both Mountain Slough and Miami Creek and an ephemeral high water connection between Bertrand Creek and the Salmon River via a headwater wetland (M. Pearson pers. comm. 2010). The only other route between watersheds is via the mainstem Fraser River or Nooksack River, although no Salish Sucker have ever been reported from either and captures in larger sloughs are extremely rare (M. Pearson pers. comm. 2010). Prior to the drainage of Sumas Lake in Abbotsford (1920s) and the construction of the dyke system following the 1948 Fraser River flood, permanent and high water connections among populations would have been more common.

The Salish Sucker is also known in seven watersheds in northwestern Washington State (COSEWIC 2012). Range-wide, the Salish Sucker has been in decline since at least the 1960s (McPhail 1987; Pearson 2004; DFO 2015).

4.3 Needs of the species

Biological needs, ecological role, and limiting factors

The Salish Sucker inhabits headwater streams and small sloughs where habitat conditions vary widely on daily, seasonal, and longer time scales. They tolerate higher temperatures and lower dissolved oxygen levels than most other native fish that occur in this region of B.C. The major limiting factor for populations is the availability of high quality habitat. Salish Sucker have life history characteristics that promote rapid population growth, given adequate habitat (Pearson and Healey 2003). Compared to Longnose Sucker, the Salish Sucker is small, short-lived, and early-maturing. The species is a broadcast spawner. Most spawn for the first time in their second year, and they rarely live beyond five years (McPhail 1987). Spawning occurs between early April and mid-July (McPhail 1987; Pearson and Healey 2003), and egg incubation is likely complete by mid-August.

Aquatic habitat

Adults are most abundant in marshes and American Beaver (*Castor canadensis*) ponds with mud or silt substrates. The proportion of channel deeper than 70 cm is the strongest predictor of adult presence in a reach (Pearson 2004). Occupied reaches also have significantly less riffle and more in-stream vegetation than reaches in which Salish Sucker are absent. Young-of-the-year are associated with shallow pool and glide[8] habitats containing abundant vegetation (Pearson 2004). Spawning typically occurs in gravel riffles, but groundwater upwellings in rocky substrate are likely used in systems lacking riffle habitats (M. Pearson pers. obs.). Most individuals appear to have small home ranges (mean of 170 m of channel) although some individuals are known to move kilometers during the spawning period (Pearson and Healey 2003).

Salish Sucker tolerate low oxygen environments and have occasionally been captured in areas with concentrations below 2 mg/L (Pearson unpublished data). Sublethal effects including reduced growth and fecundity likely occur at these concentrations. Based on observation,

[8] Glide: moderately shallow sections of stream with even flow and little turbulence

appropriate targets for dissolved oxygen is ≥4 mg/L for adults and ≥6.5 mg/L for eggs and fry (M. Pearson, pers. comm. 2017). For adults, this is lower than the federal water quality guideline for aquatic life (5 mg/L for adults; CCREM 2015), but the guidelines are intended to protect species like salmonids, which are very intolerant of hypoxia. For early life stages, the federal water quality guideline for early life history stages in warm water streams is used (6.5 mg/L; CCREM 2015). As no data are available for Salish Sucker requirements, this guideline is considered appropriate for Salish Sucker (Pearson 2004). Tolerances of pH are unknown for Salish Sucker or Longnose Sucker, but the White Sucker (*Catostomus commersoni*) shows sublethal effects on reproduction at pH<5.6 and complete mortality at pH<4.3.

Riparian habitat

Riparian habitat is important for maintaining instream habitat features necessary to support Salish Sucker spawning, incubation, rearing and feeding. Benthic insectivores like Salish Sucker are among the most sensitive fish species to loss of wooded riparian areas (Stauffer et al. 2000), probably due to the impacts of riparian loss on siltation and macroinvertebrate community structure (Kiffney et al. 2003; Allan 2004). Riparian habitat helps control sediment entry to streams from overland flow, prevents excessive bank erosion and buffers stream temperatures. Failure to maintain adequate riparian habitats can cause population-level impacts. For example, an absence of shade from overhanging or canopy vegetation may increase water temperatures to harmful levels (>23°C) and result in reduced fitness and mortality of individuals (Lynch et al. 1984; Richardson et al. 2010). Increased erosion due to poorer bank stability can cause sediment deposition in riffles, leading to increased embeddedness, decreased interstitial habitat, impaired spawning and incubation, and decreased invertebrate prey abundance (Richardson et al. 2010).

Location of habitats

Distribution of the Salish Sucker is clumped, with a few sites harbouring most individuals (Pearson 2004). These ‘hotspots’ likely result from rare convergences of optimal levels in a few key environmental variables (Brown et al. 1995). For Salish Sucker these variables likely include extensive areas of deep water (100s of square metres of channel) close to spawning riffles and shallow nursery habitat, adequate water quality, and low predation pressure (Pearson 2004). Most individuals appear to confine their movements to a single reach but some individuals travel more widely (Pearson and Healey 2003). Clumped distribution and bimodal movement patterns suggest that metapopulation and/or source-sink population dynamics characterize the species. If so, factors affecting migration between sub-populations (the proximity of hotspots to one another and the occurrence of movement barriers between them) are likely important to long-term population viability. Natural disturbance and succession may produce a pattern in which the location of hotspots moves throughout the landscape over time, but are occasionally eliminated by catastrophic events (Ives and Klopper 1997). Such catastrophic declines at the reach scale have been documented for the Salish Sucker (Pearson 2004), but the effect on extinction risk for Salish Sucker populations is unknown.

5. Threats

5.1 Threat assessment

An assessment and prioritization of threats to survival and recovery of the Salish Sucker was undertaken in the RPA (DFO 2015) and was based on an earlier work by Pearson (2004). For more details on the threat assessment process, refer to the Guidance on Assessing Threats, Ecological Risk and Ecological Impacts for Species at Risk (DFO 2014). Assessment category definitions are provided in footnotes to the tables and appendix C.

In this recovery strategy, the threat assessment has been updated and revised in accordance with a two-step process, which first characterizes threats at the population (watershed) level and then at the whole Canadian range level. Population level threats analyses for each of the 11 populations appear in appendix D. The Canadian range level threat assessment is presented in table 4.

Seven threats were identified based on knowledge of species biology and habitat conditions across the Canadian range in the RPA (DFO 2015). The threats are: hypoxia, seasonal lack of water, harmful substances, sediment deposition, habitat fragmentation, physical destruction of habitat, and introduction of aquatic invasive species. The revised assessment resulted in changed (mostly elevated) risk levels for a number of threats, including seasonal lack of water, harmful substances and habitat fragmentation.

The most widespread and highest risk threat to Salish Sucker across its Canadian range is severe hypoxia. It degrades areas of otherwise suitable habitat, can kill large numbers of fish quickly, has numerous contributing factors, can easily go undetected, and appears to be occurring with increasing frequency and intensity across watersheds containing Salish Sucker (Pearson 2004; DFO 2015). Seasonal lack of water, harmful substances, sediment deposition, habitat fragmentation and physical destruction of habitat are also considered high risk threats range wide (table 4), but are less pervasive than hypoxia (appendix D). Aquatic invasive species are considered a medium risk threat but are poorly understood.

Table 4. Salish Sucker threat assessment at the Canadian range level, in descending order of severity.[9]

Threat	Canadian range level threat risk[10]	Canadian range level threat occurrence[11]	Canadian range level threat frequency[12]	Canadian range level threat extent[13]
Hypoxia	High	Historic Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	High	Historic Current Anticipatory	Recurrent	Broad
Harmful substances	High	Historic Current Anticipatory	Continuous	Broad
Sediment deposition	High	Historic Current Anticipatory	Continuous	Broad
Habitat fragmentation	High	Historic Current	Continuous	Narrow
Physical destruction of habitat	High	Historic Current Anticipatory	Recurrent	Broad
Increased predation from aquatic invasive species	Medium	Current Anticipatory	Continuous	Extensive

[9] The specific assessment categories and associated rankings definitions for population-level threats are provided in Appendices C and D. Canadian range level threats are a roll-up of population level threats.
[10] Canadian range level threat risk: the highest level of risk for a given population, based on the likelihood and level of impact of a population-level threat
[11] Canadian range level threat occurrence: the timing of occurrence of the threat; may be any combination of historical, current and/or anticipatory representing all categories that have been identified in the population-level assessment
[12] Canadian range level threat frequency: the temporal extent of the threat representing all categories that have been identified in the population-level assessment
[13] Canadian range level threat extent: the proportion of the species affected by the threat

5.2 Description of threats

Hypoxia

Hypoxia, or the presence of low oxygen levels in water, is the most serious threat to Salish Sucker populations in Canada and is considered a high risk threat in every occupied watershed (table 4; appendix D). Occasional reach-scale kills of Salish Sucker due to severe hypoxia are believed to occur. Hypoxia is a seasonal threat, with maximum severity and spatial extent occurring under drought conditions in summer and early fall. Up to two-thirds of critical habitat length is hypoxic, with 45 percent being severely hypoxic (Pearson 2015a). For assessment purposes, areas with dissolved oxygen levels between 2.5 and 4 mg/L are considered moderately hypoxic and likely to cause some impairment of key life history functions. Areas containing less than 2.5 mg/L of dissolved oxygen are considered severely hypoxic and likely to be lethal over the short term or cause severe impairments to key life history functions.

Hypoxia is caused by the cumulative effects of local and watershed-scale impacts. Nutrients in Fraser Valley groundwater and streams are elevated, primarily as a consequence of over-application of manure and fertilizers to agriculture lands (Lavkulich et al. 1999; Schreier et al. 2003), but also from urban stormwater runoff and faulty septic systems (Lavkulich et al. 1999). Such nutrient loading has increased greatly with ongoing agricultural intensification in the Fraser Valley (Schöne et al. 2006; Schindler et al. 2006). Increased nutrients result in algal blooms and rampant growth of plants that deplete oxygen levels at night. Decomposition of dead vegetation may severely depress daytime oxygen levels as well. Further, hypoxia may be exacerbated by the removal of riparian vegetation because shade provided by riparian vegetation helps maintain lower water temperatures. Warmer water has less capacity for dissolved oxygen and increases the metabolic demands of fish and other organisms. In addition, reduced water movement impairs re-oxygenation of water and may be caused by channelization (Schreier et al. 2003), beaver ponds (Fox and Keast 1990; Schlosser and Kallemyn 2000) or low flows.

Seasonal lack of water

Seasonal lack of water is considered a high risk threat to Salish Sucker in Canada (table 4). At the population level, it is considered a high risk threat in Bertrand Creek, Little Salmon River, Salmon River and Salwein Creek/Hopedale Slough (appendix D). In addition, Fishtrap Creek historically experienced extensive impacts of low flow. The natural vulnerability of these watersheds to reduced flow is exacerbated by human water use for irrigation and domestic use, which peaks during the late-summer low flow period. Common land use changes that involve installing and maintaining drainage infrastructure (for example,, urbanization, agricultural drainage) also tend to exacerbate problems with water availability during dry periods.

The deep pool habitats preferred by Salish Sucker rarely dry out completely, and spawning and egg incubation occur in spring and early summer, when water is generally plentiful. Extreme low flows in the late summer, however, exacerbate other threats including hypoxia, sediment deposition, habitat fragmentation and predation (COSEWIC 2012; DFO 2015).

Harmful substances

Harmful substances are considered a high risk threat to Salish Sucker in Canada (table 4). At the population level, it is considered a high risk threat in Salwein Creek/Hopedale Slough (appendix D). In the Salwein Creek/Hopedale Slough watershed, there is a risk of railway spills and polycyclic aromatic hydrocarbon contamination (Pearson 2017).

Pathways for the introduction of harmful substances to Salish Sucker habitats include urban storm runoff, contaminated groundwater, direct industrial discharges, aerial deposition, and accidental spills (Hall et al. 1991; Schreier et al. 2003; COSEWIC 2012). Some contaminants, particularly heavy metals, bind to sediments where they may be taken up and bioaccumulated by aquatic invertebrates and subsequently bottom-feeding fish, like Salish Sucker. Data on threshold concentrations for lethal and sublethal effects to the Salish Sucker are lacking. As a bottom-dwelling species they may be sensitive to contaminants bound to sediment as well as those in food items and the water column. Salish Sucker are less likely to be found in reaches where land use within 200 m of the channel is predominantly urban, which may be linked, in part, to harmful substances entering habitat via stormwater runoff (Pearson 2004). The U.S. Environmental Protection Agency lists the closely related Longnose Sucker as having “intermediate” pollution tolerance (EPA 2012).

Sediment deposition

Sediment deposition is considered a high risk threat to Salish Sucker in Canada (table 4). At a population level, it is considered a high risk threat in Fishtrap Creek and Mountain Slough, and a medium risk threat in Agassiz Slough, Bertrand Creek, Chilliwack Delta, Elk Creek/Hope Slough, Miami River, Pepin Creek and Salmon River (appendix D). Significant events where spawning riffles have been clogged with sediment originating from in-stream projects occur regularly in association with drainage maintenance and other in-stream works, particularly in Mountain Slough, Chilliwack Delta, Elk Creek/Hope Slough and Salwein Creek. Major events where gravel pits have filled in pools and largely eliminated instream cover have occurred several times in Pepin Creek (Pearson 2004). Chronic sedimentation occurs in most watersheds in areas lacking riparian vegetation, especially where fields are ploughed to top of bank and around storm sewer discharges.

Sediment deposition is increased by direct discharges, storm runoff and bank erosion, and is accelerated by lack of riparian vegetation and increased peak flows (Waters 1995). All of these factors have increased with urban, agriculture and mining development in Salish Sucker watersheds (COSEWIC 2012; DFO 2015). Impacts include smothering eggs and reducing food (macroinvertebrate) availability. Salish Sucker spawn in riffles between early April and mid-July (Pearson and Healey 2003) and are probably most susceptible to sedimentation in these habitats during this period.

Habitat fragmentation

Habitat fragmentation is considered a high risk threat to Salish Sucker in Canada (table 4). Some fragmentation has occurred within almost all occupied watersheds. At the population level, it is a high risk threat in Agassiz Slough and a medium risk threat in Bertrand Creek, Chilliwack Delta, Elk Creek/Hope Slough, Fishtrap Creek, Salmon River and Salwein Creek/Hopedale Slough (appendix D). It is particularly concerning in Agassiz Slough and upper Bertrand Creek where impassible culverts prevent fish from escaping areas of severe hypoxia during late summer. Three tributaries to Fishtrap Creek that contain suitable habitat but lack Salish Sucker are inaccessible due to perched culverts (Pearson unpub. data). There is also evidence of beaver dams fragmenting habitat in Tyre Creek (Salmon River tributary). At the Canadian range scale, most high-water connections between watersheds have been lost or weakened to dykes and drainage. Such connections between watersheds during floods were much more common prior to the extensive dyking and drainage works of the 20^{th} century.

Most barriers and habitat fragmentation in Salish Sucker watersheds date from the past 50 to 130 years, and surviving populations have shown some resilience (Pearson 2004). The effects of reduced movement between subpopulations within watersheds and reduced ability to colonize new habitat due to physical barriers and degraded habitat, however, may occur over longer time frames (COSEWIC 2012). In addition, the other threats may fragment habitat by preventing or curtailing movement of fish within and among affected reaches.

Physical destruction of habitat

Physical destruction of habitat is considered a high risk threat to Salish Sucker in Canada (table 4). It occurs regularly in the majority of watersheds occupied by Salish Sucker. At the population level, it is a high risk threat in the Chilliwack Delta, Elk Creek/Hope Slough and Mountain Slough (appendix D). Historically, physical destruction of habitat was likely the most significant of the identified threats across Salish Sucker's Canadian range. Approximately 77 percent of pre-settlement wetland areas in the Fraser Valley have been drained or infilled (Boyle et al. 1997). The drainage of Sumas Lake (80 to 100 km^2) and associated wetlands in the 1920s was the largest single historical incident (Woods 2001). Fifteen percent of the area's streams no longer exist, having been paved over or piped (DFO 1998). A large but unknown proportion of those that remain have been channelized and/or repeatedly dredged for agricultural or urban development. Dredging of channels for flood control and agricultural drainage still occurs annually in most watersheds known to have Salish Sucker.

Physical destruction of habitat may occur through channelization, channel maintenance, dredging and infilling activities that directly destroy or degrade stream habitats. The aquatic vegetation required by adult Salish Sucker and the riffle habitat required for spawning and incubation may be targeted for removal or alteration in drainage projects.

Physical destruction of habitat may also occur through the removal of riparian vegetation and may impact Salish Sucker throughout its Canadian range. Riparian vegetation helps control sediment entry to the stream from overland flow, prevents excessive bank erosion and buffers stream temperatures, reduces nutrient loading, and provides terrestrial insects for drift-feeders in streams. Removal of riparian vegetation can also exacerbate other threats, including sediment deposition.

Increased predation from aquatic invasive species

Increased predation from aquatic invasive species is considered a medium risk threat to Salish Sucker in Canada (table 4). At the population level, it is considered a medium risk threat in Bertrand Creek, Chilliwack Delta, Elk Creek/Hope Slough, Fishtrap Creek, Little Campbell River, Pepin Creek and Salwein Creek/Hopedale Slough (appendix D). Introduced predators inhabit every stream known to contain Salish Sucker but the extent of impacts on populations is unknown. Salish Sucker have coexisted with introduced predators, including Largemouth Bass (*Micropterus salmoides*), Brown Bullhead (*Ameiurus nebulosus*), and Bullfrog (*Lithobates catesbaena*) for more than twenty years in parts of their range (Pearson 2004; COSEWIC 2012). All of these species are known to have caused extirpations and extinctions in native fish populations elsewhere (Miller et al. 1989; Hatfield 2001). Impacts may increase when distribution is restricted due to hypoxia or seasonal lack of water or if a new predator is introduced (COSEWIC 2012).

6. Population and distribution objectives

Population and distribution objectives establish, to the extent possible, the number of individuals and/or populations, and their geographic distribution, that is necessary for the recovery of the species. The population and distribution objectives for the Salish Sucker are:

Population objective:

Long-term: reach or exceed watershed-specific population objectives identified in table 5 by 2035.

Rationale: separate recovery targets are required for each population because they are isolated from one another with a very low probability of immigration to prevent or recolonization to reverse extirpation. Insufficient information is available to quantitatively estimate the minimum viable population (MVP) size for Salish Sucker. Based on reviews of MVP estimates for a wide range of vertebrates, target values in the low to mid thousands are considered appropriate (DFO 2015).

Salish Sucker life history characteristics are conducive to rapid population growth under favourable conditions (Pearson and Healey 2003). The key factor in recovery will be the attenuation of severe hypoxia across the range; which will require dramatic reductions in agricultural nutrient loading and significant increases in riparian shading. Two decades is likely required to achieve this long-term objective. No additional net loss of habitat is also assumed.

Table 5. Long term population abundance objectives for reproductive adult Salish Sucker in Canada (adapted from DFO 2015). An 'X' indicates that too few were caught to allow abundance estimation.

Population / specific location	Mark-recapture estimate[14]	Proposed population target	Current population estimate as % of proposed target
Agassiz Slough	253 (203 to 354)	1,500	17
Bertrand Creek Mainstem Howe's Creek Perry Homestead Creek	1,064 735 (638 to 862) 329 (206 to 711) X	4,000	27
Chilliwack Delta Luckakuck Creek Semmihault Creek Atchelitz Creek Little Chilliwack Creek Interception Ditch	2,254 (1,479 to 3,015) 378 (345 to 416) 547 (327 to 1,029) 239 (212 to 280) 351 (280 to 496) 739 (315 to 794)	5,500	41
Elk Creek / Hope Slough	X	2,500	
Fishtrap Creek	X	1,500	
Little Campbell River	X	5,000	

[14] From COSEWIC 2012; Pearson 2016

Population / specific location	Mark-recapture estimate[14]	Proposed population target	Current population estimate as % of proposed target
Miami River	102 (67 to 193)	1,500	6.8
Mountain Slough	X	3,000	
Pepin Creek	1,754 (1,318 to 2,900)	2,500	70
Salmon River Upper River Lower River	 751 (649 to 915) X	2,000	38
Salwein/Hopedale Salwein Creek Hopedale Slough	757 288 (191 to 635) 469 (346 to 712)	2,500	30
All watersheds	<7,500	31,500	<24

Distribution objectives:

Short-term: continued persistence in all eleven currently occupied watersheds.

Long-term: presence in all critical habitat reaches.

7. Broad strategies and general approaches to meet objectives

7.1 Actions already completed

Research and monitoring

DFO, B.C. Ministry of Environment (B.C. MOE), Pearson Ecological, the University of British Columbia (UBC), Western Washington University, A Rocha Canada, Cheam Indian Band, Leq'á:mel First Nation, Seyem'Qwantlen, Matsqui First Nation, Metro Vancouver Regional Parks, the District of Kent, the Township of Langley, the City of Chilliwack, the City of Abbotsford, the B.C. Ministry of Transportation and Infrastructure, and consultants on behalf of proponents have all contributed to research and monitoring activities through various mechanisms, including the Aboriginal Fund for Species at Risk and the Habitat Stewardship Program. Sampling has included: opportunistic weight and length measurements; sampling as part of mandatory fish salvages or pre- and post-construction monitoring; water quality measurements; population estimates; reconnaissance sampling to document unknown populations; mapping potential critical habitat; monitoring tagged individuals and their distribution; studying the effects of hypoxia and land use; genetics research; and habitat suitability assessments.

Habitat restoration

Experimental habitat restoration work targeting the Salish Sucker was initiated by UBC researchers in cooperation with local stewardship groups and landowners in 1999. Population size and habitat conditions have been monitored repeatedly at two sites in the Pepin Brook watershed (Patton 2003; Pearson unpub data). Using this information, additional projects have been constructed in Salwein Creek and Hopedale Slough, Mountain Slough, Bertrand Creek, and the Salmon River by Dr. Mike Pearson, working in cooperation with DFO, the Township of Langley and the District of Kent.

Several organizations conducted habitat restoration activities, including (among others): DFO (in Hope Slough), the British Columbia Conservation Foundation (in Aldergrove Regional Park), Langley Environmental Partners Society (in the Salmon River and Bertrand Creek watersheds), and A Rocha Canada (in the Little Campbell River watershed) and Fraser Valley Watersheds Coalition (in Hope Slough and Chilliwack Delta). Consultants also conducted compensatory habitat restoration in Pepin Brook on behalf of proponents. Dr. Mike Pearson assisted with many of these restoration initiatives.

Integrated channel maintenance pilot projects

In 2003, the City of Chilliwack initiated a pilot project integrating drainage maintenance and fish habitat restoration in Salwein Creek. Hand maintenance protocols and shade from riparian zone plantings reduce the need for machine cleaning of waterways for drainage. Expansion of this program to other watersheds and jurisdictions would be beneficial to the Salish Sucker.

Riparian planting

Since 2000, native plants and livestock fencing have been provided and installed for landowners of riparian habitats along reaches containing the Salish Sucker in Agassiz Slough, Mountain Slough, Miami River, Salmon River, Bertrand Creek, Pepin Brook, the Little Chilliwack River, Elk Creek and Hope Slough. Much of this work has been done by community volunteers organized by three local stewardship groups (Langley Environmental Partners Society, Fraser Valley Watersheds Coalition and Fraser Harrison Smart Growth) working in cooperation with Dr. Mike Pearson. Through various mechanisms, local governments such as the District of Kent, City of Chilliwack, and the Township of Langley have provided support and/or partnership for such projects.

Landowner contact and public education programs

The Langley Environmental Partners Society and the Fraser Valley Regional Watersheds Coalition implemented landowner contact programs in cooperation with DFO and others in all watersheds currently inhabited by the Salish Sucker between 2001 and 2010. Public information meetings were also held in each watershed. Colour display posters on Salish Sucker have also been given to stewardship groups in Chilliwack, Langley and Agassiz for use during public events. Dr. Mike Pearson has provided lectures and habitat enhancement site tours featuring the Salish Sucker and recovery efforts to local schools, universities and stewardship groups through the Langley Environmental Partners Society.

The Langley Environmental Partners Society, A Rocha Canada, Cheam Indian Band, Leq'á:mel First Nation, Seyem'Qwantlen, and Matsqui First Nation have all contributed to education and outreach initiatives through various mechanisms, for example: distribution of print materials, presentations, development of conservation planning documents, and discussions with targeted groups or individuals. The Stewardship Centre for BC published stewardship practices on their "Roles of Local Government" website for Riparian Areas in Settled Landscapes, Guidance for Restoration Activities in Riparian Areas, and Drainage Maintenance in Agricultural Waterways.

7.2 Strategic direction for recovery

A description of the broad strategies to address identified threats and of the research and management approaches needed to meet population and distribution objectives is presented in table 6. These informed the development of specific recovery measures in the Action Plan for the Nooksack Dace (*Rhinichthys cataractae*) and the Salish Sucker (*Catostomus* sp.) in Canada (DFO 2017).

Broad strategy 1: inventory and monitoring
Broad strategy 2: research
Broad strategy 3: management and coordination
Broad strategy 4: stewardship and outreach
Broad strategy 5: international collaboration

Table 6. Recovery planning table.

General description of research and management approaches	Broad Strategy	Priority[15]	Threat or concern addressed
Monitor recovery of Salish Sucker	1	High	All
Fill knowledge gaps that inhibit the recovery of Salish Sucker	2	Medium	All
Ensure the integrity and proper function and reduce the fragmentation of riparian areas throughout watersheds	3	High	Hypoxia, sediment deposition, harmful substances, physical destruction of habitat, habitat fragmentation
Reduce incidence of severe hypoxia in instream critical habitat	3	High	Hypoxia
Protect existing habitat, restore lost or degraded habitat and create new habitat	3	High	Physical destruction of habitat, habitat fragmentation
Reduce sediment entry to instream habitats	3	Medium	Sediment deposition
Establish and maintain adequate water depth in all habitats with high potential productivity	3	Medium	Seasonal lack of water, habitat fragmentation
Minimize entry of harmful substances to instream habitats	3	Medium	Harmful substances

[15] "Priority" reflects the degree to which the approach contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species:

- "high" priority approaches are considered likely to have an immediate and/or direct influence on the recovery of the species
- "medium" priority approaches are important but considered to have an indirect or less immediate influence on the recovery of the species
- "low" priority approaches are considered important contributions to the knowledge base about the species and mitigation of threats

General description of research and management approaches	Broad Strategy	Priority[15]	Threat or concern addressed
Reduce fragmentation of instream habitats	3	Medium	Habitat fragmentation
Encourage stewardship amongst private landowners, local governments and the general public	4	Medium	All
Support stewardship projects to increase awareness of aquatic invasive species	4	Low	Increased predation from aquatic invasive species
Explore opportunities for coordinating population assessment and recovery efforts with interested groups in United States	5	Low	All

8. Critical habitat

8.1 Identification of the species' critical habitat

8.1.1 General description of the species' critical habitat

Critical habitat is defined in SARA as "…the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species." [s. 2(1)]

Also, SARA defines habitat for aquatic species as "… spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced." [s. 2(1)]

For the Salish Sucker, critical habitat is identified to the extent possible, using the best available information, and provides the functions and features necessary to support the species' life-cycle processes and to achieve the species' population and distribution objectives.

This recovery strategy identifies aquatic critical habitat for Salish Sucker as relatively homogenous segments of stream demarcated by distinct geomorphic or land use transitions, otherwise known as reaches, within the Little Campbell River, Salmon River, Bertrand Creek, Pepin Brook, Fishtrap Creek, Salwein Creek/Hopedale Slough, Chilliwack Delta, Elk Creek/Hope Slough, Mountain Slough, Agassiz Slough and Miami River watersheds.

More specifically, critical habitat includes the reaches within those watersheds that consist of more than 50 m of continuous pool with a water depth exceeding 70 cm under summer low flow conditions. Critical habitat within these reaches includes all the aquatic habitats, including features and attributes identified in section 8.1.3, and all riparian areas on both banks for the entire length of the identified aquatic reaches. Riparian critical habitat is continuous and extends laterally (inland) from the top of bank to a width equal to the widest zone of sensitivity calculated for five riparian features and functions.

It is unknown if the critical habitat identified in this recovery strategy is sufficient to achieve the species' population and distribution objectives. The schedule of studies outlines the research required to identify additional critical habitat and acquire more detailed information about the critical habitat identified to achieve the species' population and distribution objectives.

8.1.2 Information and methods used to identify critical habitat

Defining critical habitat reaches

Critical habitat for the Salish Sucker was defined using in-stream habitat characteristics at the scale of the reach, a natural unit of stream habitat that ranges from hundreds to thousands of metres in length (Frissell et al. 1986). There are three reasons for adopting this scale. First, the reach scale corresponds to the distribution of subpopulations within the 11 occupied watersheds and usually contains all habitat types used during the life cycle (Pearson 2004). Second, the 'channel units' of critical habitat (riffles and pools) are dynamic and frequently move during flood events in these streams. Effective protection and management of critical habitat in these circumstances must allow for normal channel processes and must, therefore, occur at a spatial scale larger than the channel unit. The reach scale is the next largest in accepted stream habitat classifications (Frissell et al. 1986; Imhof et al. 1996) and by definition represents relatively homogenous segments of stream demarcated by distinct geomorphic or land use transitions. Third, the reach scale corresponds most closely to that of land ownership in these watersheds.

Defining aquatic critical habitat areas

The protocol used to identify Salish Sucker critical habitat was consistent with guidelines for documenting habitat quality and use by freshwater fishes at risk (Rosenfeld and Hatfield 2006; DFO 2007) and the approach and results were peer-reviewed (Pearson 2008). Additions of new critical habitat reaches were informed from Pearson 2013, 2014, 2016 and unpub. data. The amount of critical habitat required to achieve population targets depends upon its quality, its extent, and its spatial configuration on the landscape (Rosenfeld and Hatfield 2006). For all eleven Salish Sucker populations the total amount of suitable habitat available is considered necessary to meet population and distribution objectives (Pearson 2015b).

Defining riparian critical habitat areas

The identification of riparian critical habitat was informed by Pearson 2008 and expert opinion.

Critical habitat includes all riparian areas on both stream banks for the entire length of the identified aquatic reaches. The required widths of riparian critical habitat vary among sites and are defined in reach scale assessments. Riparian vegetation must be of sufficient width to control sediment entry to the stream from overland flow, to prevent excessive bank erosion and to buffer stream temperatures. The effectiveness of riparian vegetation in preventing materials (for example, sediment, nutrients, harmful substances) from entering a stream depends strongly on its longitudinal continuity and lateral width (Weller et al. 1998). Consequently, riparian vegetation adjacent to aquatic critical habitat reaches should be continuous and sufficiently wide.

Widths of riparian critical habitat for Salish Sucker were assessed using a spatially referenced methodology adapted directly from and consistent with the British Columbia Riparian Areas Regulation (RAR) (Riparian Areas Protection Act [S.B.C. 1997, c. 21], Province of British Columbia 2006). The B.C. MOE and DFO developed and implemented this methodology for determining riparian vegetation widths required to maintain riparian function and protect fish habitat. The RAR was developed to protect “salmonids, game fish, and regionally significant fish” from the impacts of land development. In the absence of data on riparian habitat needs for a SARA-listed species, this is a reasonable standard to apply in the identification of critical habitat because it represents a benchmark and standard methodology to which both federal and provincial agencies responsible for management of species at risk have already agreed.

The identified width of the riparian critical habitat for each reach is equal to the widest zone of sensitivity (ZOS) calculated for each of five riparian features and functions: large woody debris supply for fish habitat and maintenance of channel morphology; localized bank stability; channel movement; shade; and, insect and debris fall. The ZOS values are calculated using methods consistent with those used under the RAR. The width of existing riparian vegetation and areas where riparian width is restricted by permanent structures (for example, roads, buildings, yards) were also assessed. Further details of methods and an assessment of existing riparian vegetation in these areas can be found in Pearson (2008).

8.1.3 Identification of critical habitat

Geographic information

Salish Sucker distribution falls within 11 watersheds, including Little Campbell River, Bertrand Creek, Pepin Creek, Fishtrap Creek, Salmon River, Chilliwack Delta, Elk Creek/Hope Slough, Salwein Creek/Hopedale Slough, Mountain Slough, Agassiz Slough and Miami River. Identified critical habitat within these watersheds totals 196.5 km of channel and 818.2 hectares of adjoining riparian habitats. Maps delineating critical habitats are provided in appendix E and geographic coordinates of the starts and ends of each critical habitat reach are provided in appendix F.

The locations of the critical habitat’s functions, features and attributes have been identified using the Critical Habitat Parcel approach for both the aquatic and riparian components of critical habitat. This means that aquatic and riparian critical habitat is the exact area delineated by the identified boundaries.

Biophysical functions, features and attributes

Table 7 summarizes the best available knowledge of the functions, features and attributes for each life stage of the Salish Sucker within the identified geographic locations (refer to section

4.3 'Needs of the species' for full references). Note that not all attributes in table 7 must be present in order for a feature to be identified as critical habitat. If the features as described in table 7 are present and capable of supporting the associated function(s), the feature is considered critical habitat for the species, even though some of the associated attributes might be outside of the range indicated in the table.

Table 7. General summary of the biophysical functions, features and attributes of critical habitat necessary for a species' survival or recovery for reaches within Little Campbell River, Bertrand Creek, Pepin Creek, Fishtrap Creek, Salmon River, Chilliwack Delta, Elk Creek/Hope Slough, Salwein Creek/Hopedale Slough, Mountain Slough, Agassiz Slough and Miami River.

Life stage	Function[16]	Feature(s)[17]	Attribute(s)[18]
Adult	Rearing, feeding, overwintering, refuge	Deep pool habitat	• Length of pool >50 m • Adequate cover (macrophytes/wood) • Little or no additional sediment • Water depth >70 cm • Adequate quantity and quality of food supply (terrestrial and aquatic insects) • Dissolved oxygen >4 mg/L • Water temperature >6 and <23 ° C • Few or no additional nutrients • Few or no additional harmful substances
Egg, adult	Incubation, spawning	Riffle habitat	• Cobble or gravel substrate • Little or no additional sediment • Sufficient water velocity (>25 cm/s) and flow to maintain riffles • Sufficient intragravel flow to maintain eggs • Adequate quantity and quality of food supply (terrestrial and aquatic insects) • Dissolved oxygen >6.5 mg/L (eggs) • Dissolved oxygen >4 mg/L (adult) • Water temperature >6 and <23 ° C • Few or no additional nutrients • Few or no additional harmful substances
Young of year	Rearing, feeding	Shallow pool and glide habitats	• Adequate cover (macrophytes/wood) • Little or no additional sediment • Water depth <40 cm • Current velocity <15 cm/s • Adequate quantity and quality of food supply (terrestrial and aquatic insects) • Dissolved oxygen >4 mg/L • Water temperature >6 and <23 ° C

[16] Function: a life-cycle process of the listed species taking place in critical habitat (for example, spawning, nursery, rearing, feeding and migration).
[17] Feature: features describe how the habitat is critical and they are the essential structural component that provides the requisite function(s) to meet the species' needs. Features may change over time and are usually comprised of more than one part, or attribute. A change or disruption to the feature or any of its attributes may affect the function and its ability to meet the biological needs of the species.
[18] Attribute: attributes are measurable properties or characteristics of a feature. Attributes describe how the identified features support the identified functions necessary for the species' life processes.

Life stage	Function[16]	Feature(s)[17]	Attribute(s)[18]
			• Few or no additional nutrients • Few or no additional harmful substances
All	Spawning, incubation, rearing, feeding	Riparian habitat	• Riparian vegetation extending laterally (inland) from top of bank to a width equal to the widest zone of sensitivity (calculated using methods consistent with those used under the B.C. RAR) (5 to 30 m depending on stream characteristics) (vegetation that is continuous for the entire length of the reach provides more function), in order to ensure the following functions: o protects the integrity of other aquatic features such as riffle and shallow pool habitat o provides large and small woody debris o provides localized bank stability o provides shade to buffer instream temperatures o provides terrestrial insect input o limits entry of added nutrients o maintains natural channel morphology

Deep pool habitat

As the main feeding and rearing habitat for adult and larger juveniles (individuals with fork length >7 cm), deep pools are the primary habitat for the majority of the life cycle. Salish Sucker are concentrated in reaches containing at least one pool that exceeds 70 cm in depth at low flow for a minimum of 50 metres (Pearson 2004). All reaches across Salish Sucker's Canadian range that contain such habitat are identified as critical habitat. This includes reaches where severe hypoxia appears to currently limit Salish Sucker numbers.

Riffle habitat

Riffle habitats are used by Salish Sucker for spawning and incubation. Riffles tend to be rare (and potentially limiting) in the reaches occupied by high densities of Salish Sucker, which consist predominantly of headwater ponds and marshes (Pearson 2004). Consequently, all riffle habitats within reaches containing more than 50 m of habitat with water depths exceeding 70 cm (deep pool habitat) are identified as critical habitat. In some watersheds, fish leave their 'home' reach to spawn (Pearson and Healey 2003). The riffles known as spawning sites are within identified critical habitat reaches but other undocumented spawning sites outside identified critical habitat may exist.

Shallow pool and glide habitats

Shallow pools and glides less than 40 cm in depth are used by young-of-the-year Salish Sucker (<7 cm fork length) as a nursery habitat for feeding and rearing, although they are occasionally captured in deeper water (Pearson 2004). All shallow pool and glide habitats within reaches that contain more than 50 m of continuous habitat and water depths exceeding 70 cm (deep pool habitat) are identified as critical as it is potentially limiting as nursery habitat.

Riparian habitats

All riparian vegetation in identified riparian critical habitat reaches protects the integrity of in-stream critical habitat. Failure to maintain adequate riparian vegetation as part of critical habitat is likely to result in sediment deposition (Waters 1995). Sediment deposition may result in infilling of the interstitial spaces in coarse substrate that Salish Sucker occupy during spawning and incubation. Nutrient loading will be higher in reaches without adequate riparian vegetation (Martin et al. 1999; Dhondt et al. 2002; Lee et al. 2003) and is likely to contribute to hypoxia through eutrophication. Solar radiation in nutrient rich reaches lacking adequate riparian shading will also contribute to eutrophication and hypoxia (Kiffney et al. 2003). In habitats lacking sufficient flow or groundwater, absence of shade may also increase water temperatures to harmful levels.

The effectiveness of riparian vegetation in preventing materials (sediment, nutrients, harmful substances, etc.) from entering a stream depends strongly on its longitudinal continuity and its lateral width (Weller et al. 1998). Consequently, riparian vegetation in critical habitat reaches should be continuous and sufficiently wide. Riparian vegetation as narrow as 5 m provides significant protection from bank erosion and sediment deposition from overland flow. At least 10 m are required to maintain levels of terrestrial food inputs similar to those of forested landscapes. More than 30 m of riparian vegetation may be required to fully mitigate warming water temperatures g (Brown and Krygier 1970; Lynch et al. 1984; Castelle et al. 1994) and siltation, and for long-term maintenance of channel morphology.

Riparian vegetation upstream of critical habitat is important in minimizing sedimentation and other impacts within critical habitat. For this reason stewardship programs should promote the establishment of continuous riparian vegetation throughout the watershed, not just along critical habitat reaches.

Summary of critical habitat relative to population and distribution objectives

These are areas that, based on current best available information, the Minister of Fisheries and Oceans considers necessary to partially achieve the species' population and distribution objectives required for the survival and recovery of the species. Additional critical habitat may be identified in future updates to the recovery strategy.

8.2 Schedule of studies to identify critical habitat

Further research is required to identify additional critical habitat and refine the understanding of the functions, features and attributes of the currently identified critical habitat necessary to support the species' population and distribution objectives and protect the critical habitat from destruction. Table 8 outlines further research required to identify and refine critical habitat.

Table 8. Schedule of studies to identify / refine critical habitat.

Description of study	Rationale	Timeline
Winter habitat use	Limited available data shows that Salish Sucker occur during winter in areas not occupied in summer because they are dry, too shallow, or severely hypoxic (M. Connolly, District of Kent, unpub. data.). It is unknown if these captures represent large scale seasonal movements and redistributions within the watershed.	2018 to 2020
Extent and severity of seasonal hypoxia in critical habitat	Hypoxia is a high risk threat in all Salish Sucker watersheds and the leading threat to Salish Sucker across the range. Little information exists regarding the annual extent, severity, and duration of hypoxia within critical habitat.	2018 to 2022
Identify spawning sites for all populations	Visual identification of spawning site use.	2016 to 2021
Improve information used to identify juvenile critical habitat	Intensive trapping/seining in habitats near known spawning sites to gather more information on juvenile habitat use.	2016 to 2020

8.3 Examples of activities likely to result in the destruction of critical habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a final recovery strategy or action plan and included in the Species at Risk Public Registry. For the Salish Sucker critical habitat identified in the 2016 recovery strategy (DFO 2016), legal protection was accomplished on August 7, 2019 through a SARA Critical Habitat Order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of the identified critical habitat. This amended recovery strategy includes updates to critical habitat identification.

The following examples of activities likely to result in the destruction[19] of critical habitat (table 9) are based on known human activities that are likely to occur in and around critical habitat and would result in the destruction of critical habitat if unmitigated. The list of activities is neither exhaustive nor exclusive and has been guided by the threats described in section 5. The absence of a specific human activity from this table does not preclude or restrict the Department's ability to regulate that activity under SARA. Furthermore, the inclusion of an activity does not result in its automatic prohibition, and does not mean the activity will inevitably result in destruction of critical habitat. Every proposed activity must be assessed on a case-by-case basis and site-specific mitigation will be applied where it is available and reliable. Where information is available, thresholds and limits have been developed for critical habitat attributes to better inform management and regulatory decision making. However, in many cases knowledge of a species and its critical habitat's thresholds of tolerance to disturbance from human activities are lacking and must be acquired.

[19] Destruction occurs when there is a temporary or permanent loss of a function of critical habitat at a time when it is required by the species.

Table 9. Examples of activities likely to result in the destruction of critical habitat.

Threat	Activity	Effect - pathway	Function affected	Feature affected	Attribute affected
Physical destruction of habitat Sediment deposition Hypoxia	Land use and work in or around critical habitat with excessive riparian vegetation removal, nutrient loading, or improper sediment and erosion control	Removal of riparian vegetation may: - reduce bank stability - reduce terrestrial supplied food and woody debris - increase sunlight penetration and water temperatures - increase nutrient loading, eutrophication and hypoxia - increase sedimentation rates and alter substrate composition and macrophyte cover Improper sediment and erosion control may: - reduce bank stability - increase sedimentation rates and alter substrate composition and macrophyte cover	Spawning, incubation, rearing, feeding, overwintering, refuge	Deep pool habitat, shallow pool and glide habitats, riffle habitat, riparian habitat	• Adequate cover (macrophytes/wood) • Cobble or gravel substrate • Little or no additional sediment • Adequate quantity and quality of food supply • Dissolved oxygen (>6.5 mg/L for eggs; >4 mg/L for other life stages) • Water temperature >6 and <23°C • Few or no additional nutrients • Riparian vegetation
Seasonal lack of water Physical destruction of habitat Habitat fragmentation Hypoxia	Excessive water extraction or alteration of stream flows resulting in habitat loss, fragmentation or changes to water quality	Surface water or groundwater extraction, especially during dry periods, can reduce stream flows, contribute to hypoxia and increased water temperatures, and result in reduction or elimination of riffle habitats required for spawning and incubation.	Spawning, incubation, rearing, refuge	Deep pool habitat, shallow pool and glide habitats, riffle habitat	• Water depth (>70 cm for deep pool habitat; <40 cm for shallow pool and glide habitats) • Sufficient water velocity (>25 cm/s) and flow to maintain riffles • Dissolved oxygen (>6.5 mg/L for eggs; >4 mg/L for other life stages) • Water temperature >6 and <23°C

Threat	Activity	Effect - pathway	Function affected	Feature affected	Attribute affected
Harmful substances Sediment deposition	Release of harmful substances and sediments (for example, surface runoff, urban storm drainage)	Surface runoff or direct discharge of harmful substances and sediments into aquatic habitats.	Spawning, incubation, rearing, feeding	Deep pool habitat, shallow pool and glide habitats, riffle habitat	• Little or no additional sediment • Water depth (>70 cm for deep pool habitat; <40 cm for shallow pool and glide habitats) • Sufficient water velocity (>25 cm/s) and flow to maintain riffles • Few or no additional harmful substances
Hypoxia	Excessive nutrient input through groundwater and/or surface flows as the result of point and non-point sources	Excess nutrients enter aquatic habitat via surface runoff and groundwater transport, leading to eutrophication and hypoxia.	Rearing, feeding, refuge	Deep pool habitat, shallow pool and glide habitats	• Dissolved oxygen (>6.5 mg/L for eggs; >4 mg/L for other life stages)
Physical destruction of habitat Sediment deposition	Drainage maintenance works resulting in destruction of habitat or increased sediment inputs	Physical removal of riffles (high spots) and macrophytes by dredging and other drainage maintenance works. Drainage maintenance works are often associated with removal of riparian vegetation for stream access, leading to increased erosion and sediment deposition (see activity: Land use and work in or around critical habitat with excessive riparian vegetation removal, or improper sediment and erosion control).	Spawning, incubation, rearing, feeding, overwintering, refuge	Deep pool habitat, shallow pool and glide habitats, riffle habitat, riparian habitat	• Adequate cover (macrophytes/wood) • Cobble or gravel substrate • Little or no additional sediment • Water depth (>70 cm for deep pool habitat; <40 cm for shallow pool and glide habitats) • Adequate quantity and quality of food supply • Dissolved oxygen (>6.5 mg/L for eggs; >4 mg/L for other life stages) • Water temperature >6 and <23°C • Few or no additional nutrients • Riparian vegetation

Threat	Activity	Effect - pathway	Function affected	Feature affected	Attribute affected
Sediment deposition Hypoxia Physical destruction of habitat	Streamside livestock grazing leading to sediment inputs, changes to water quality or habitat destruction	Livestock access to streams may damage habitat through trampling or causing erosion that increases sediment deposition. Access may also contribute to nutrient loading and result in eutrophication and hypoxia.	Spawning, incubation, rearing, feeding	Deep pool habitat, shallow pool and glide habitats, riffle habitat, riparian habitat	• Little or no additional sediment • Cobble or gravel substrate • Dissolved oxygen (>6.5 mg/L for eggs; >4 mg/L for other life stages) • Few or no additional nutrients

9. Measuring progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. A successful recovery program will achieve the overall aim of reaching or exceeding watershed specific abundance targets and restoring Salish Sucker presence to all critical habitat reaches. Progress towards meeting these objectives will be reported on in the Report on the Progress of Recovery Strategy Implementation.

9.1 Distribution performance indicators

Salish Sucker is present in:[20]

- all reaches that have been identified as critical habitat in each watershed, which indicates recovery of a watershed's population distribution
- all reaches that have been identified as critical habitat across all eleven occupied watersheds in B.C., which indicates recovery of the Salish Sucker distribution in Canada

9.2 Population performance indicators

Salish Sucker is found at abundance levels corresponding with population targets, where:[21]

- the population target for each watershed is met or exceeded, which indicates recovery of that watershed's population abundance
- the population targets across all eleven occupied watersheds in B.C. are met or exceeded, which indicates recovery of Salish Sucker in Canada

10. Statement on action plans

The federal government's approach to recovery planning is a two-part approach. The first part is the recovery strategy and the second part is the action plan. An action plan contains specific recovery measures or activities required to meet the objectives outlined in the recovery strategy.

The Action Plan for the Nooksack Dace (*Rhinichthys cataractae*) and the Salish Sucker (*Catostomus* sp.) in Canada (DFO 2017) was posted on the Species at Risk Public Registry on April 26, 2017.

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[20] Presence is indicated by the capture of an individual in the reach within the past 5 years.
[21] Population targets are described in table 5 and use abundance estimates derived from mark-recapture sampling.

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Appendix A: effects on the environment and other species

In accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals (2010), SARA recovery planning documents incorporate strategic environmental assessment (SEA) considerations throughout the document. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy's goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

While this recovery strategy will clearly benefit the environment by promoting the recovery of Salish Sucker, potential effects on other species were also considered. The strategy calls for the protection, creation, and enhancement of deep pool and marsh habitat, which could alter habitats required by species at risk such as Nooksack Dace, Western Painted Turtle (*Chrysemys picta bellii*), Oregon Spotted Frog (*Rana pretiosa*) and others, as well as other fish species, including Steelhead (*Oncorhynchus mykiss*), Cutthroat Trout (*Oncorhynchus clarkia clarkii*) and Coho Salmon (*Oncorhynchus kisutch*). The recovery strategy recommends cooperation with local stewardship groups and agency staff on habitat management. DFO addressed needs for recovery of Nooksack Dace and Salish Sucker together by coordinating recovery activities for both species in watersheds where they coexist through the development of a joint action plan (DFO 2017). The recovery strategy also calls for minimizing probability of predatory aquatic invasive species introductions, by documenting their occurrence and educating the public on their impacts, which could provide benefits to other species that could be affected by introduced predators. Taking these approaches into account, it was concluded that the benefits of this recovery strategy far outweigh any adverse effects that may result.

Appendix B: record of cooperation and consultation

Recovery strategies are to be prepared in cooperation and consultation with other jurisdictions, organizations, affected parties and others as outlined in SARA section 39. DFO prepared the 2016 recovery strategy (DFO 2016) in cooperation with the Province of B.C. DFO consulted extensively on the 2016 recovery strategy (details in appendix 1 of the 2016 recovery strategy).

Consultations on the 2016 recovery strategy occurred through posting the draft recovery strategy online for comments, workshops and community open houses. Letters containing the consultation weblink and offering the opportunity for bilateral meetings or participation in workshops were sent to 29 Indigenous Organizations. Four First Nations representatives participated in workshops but no other responses to letters were received. Invitations to four workshops held in January and February 2011 were distributed by email to representatives from municipalities, regional districts, provincial ministries, federal agencies, industry, agriculture, environmental non-governmental organizations and stewardship groups. Input from 88 workshop participants on the draft recovery strategy was collected.

Over 2400 letters containing the consultation weblink, information on community open houses and maps of proposed critical habitat areas were sent to private landowners whose properties contained or were adjacent to proposed critical habitat. Public notices advertising community meetings were also placed in five area newspapers in English and three area newspapers in French. Over 230 people attended community open houses held in Chilliwack, Harrison Hot Springs and Aldergrove. Comments were received at the open houses, and through online feedback forms, emails and letters submitted directly to DFO.

Key concerns raised by stakeholders were fears regarding the future impacts of the 2016 recovery strategy and proposed critical habitat on existing land use practices and private lands, drainage maintenance issues, questions around the value and importance of the Salish Sucker and comments on stakeholders' relationships with DFO. Most comments related to issues beyond the scope of the 2016 recovery strategy, which was based on the best available scientific information as required under SARA.

The draft amended recovery strategy was circulated to Indigenous organizations, local, regional and provincial governments, academia, environmental non-government organizations, and industry for a 35-day external review in December 2017 and January 2018. Input from the Province of B.C., the B.C. Agriculture Council, and the City of Chilliwack was received during external review.

Additional stakeholder, Indigenous Organizations and public input was sought through the publication of the proposed document on the Species at Risk Public Registry for a 60-day public comment period from November 2019 to January 2020. No comments were received during this period.

Appendix C: threat assessment categories

Likelihood of occurrence	Definition
Known or very likely to occur	This threat has been recorded to occur 91 to 100%.
Likely to occur	There is 51 to 90% chance that this threat is or will be occurring.
Unlikely	There is 11 to 50% chance that this threat is or will be occurring
Remote	There is 1 to 10% or less chance that this threat is or will be occurring.
Unknown	There are no data or prior knowledge of this threat occurring now or in the future.

Level of impact	Definition
Extreme	Severe population decline (for example 71 to 100%) with the potential for extirpation.
High	Substantial loss of population (31 to 70%) or Threat would jeopardize the survival or recovery of the population.
Medium	Moderate loss of population (11 to 30%) or Threat is likely to jeopardize the survival or recovery of the population.
Low	Little change in population (1 to 10%) or Threat is unlikely to jeopardize the survival or recovery of the population.
Unknown	No prior knowledge, literature or data to guide the assessment of threat severity on population.

Causal certainty	Definition
Very high	Very strong evidence that threat is occurring and the magnitude of the impact to the population can be quantified.
High	Substantial evidence of a causal link between threat and population decline or jeopardy to survival or recovery.
Medium	There is some evidence linking the threat to population decline or jeopardy to survival or recovery.
Low	There is a theoretical link with limited evidence that threat is leading to a population decline or jeopardy to survival or recovery.
Very low	There is a plausible link with no evidence that the threat is leading to a population decline or jeopardy to survival or recovery.

Threat occurrence	Definition
Historical	A threat that is known to have occurred in the past and negatively impacted the population.
Current	A threat that is ongoing, and is currently negatively impacting the population.
Anticipatory	A threat that is anticipated to occur in the future, and will negatively impact the population.

Threat frequency	Definition
Single	The threat occurs once.
Recurrent	The threat occurs periodically, or repeatedly.
Continuous	The threat occurs without interruption.

Threat extent	Definition
Extensive	71 to 100% of the population is affected by the threat.
Broad	31 to 70% of the population is affected by the threat.
Narrow	11 to 30% of the population is affected by the threat.
Restricted	1 to 10% of the population is affected by the threat.

Appendix D: population level threats analysis

Threats analyses for the 11 known populations of Salish Sucker in Canada are presented in the following tables. Analyses were done in accordance with the Guidance on Assessing Threats, Ecological Risk and Ecological Impacts for Species at Risk (DFO 2014). Rationale for ratings is presented in a separate document (Pearson 2017).

Table D1. Population-level threat assessment for Agassiz Slough.[22]

Threat	Likelihood of occurrence[23]	Level of Impact[24]	Causal certainty[25]	Population-level threat risk[26]	Population-level threat occurrence[27]	Population-level threat frequency[28]	Population-level threat extent[29]
Hypoxia	Known	Extreme	Very high	High	Historical Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	Likely	Low	Very low	Low	Current Anticipatory	Recurrent	Narrow
Harmful substances	Known	Medium	Low	Medium	Current Anticipatory	Continuous	Broad
Sediment deposition	Likely	Low	Low	Low	Current Anticipatory	Continuous	Narrow
Habitat fragmentation	Known	High	High	High	Historical Current	Continuous	Extensive
Physical destruction of habitat	Known	Medium	Medium	Medium	Historical Anticipatory	Recurrent	Narrow
Increased predation from aquatic invasive species	Unlikely	Low	Very low	Low	Anticipatory	Continuous	Broad

22 The specific assessment categories and associated rankings definitions are provided in appendix C.
23 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
24 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
25 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
26 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
27 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
28 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
29 Population-level threat extent: the proportion of the population affected by the threat

Table D2. Population-level threat assessment for Bertrand Creek.[30]

Threat	Likelihood of occurrence[31]	Level of Impact[32]	Causal certainty[33]	Population-level threat risk[34]	Population-level threat occurrence[35]	Population-level threat frequency[36]	Population-level threat extent[37]
Hypoxia	Known	High	Very high	High	Historical Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	Known	High	Very high	High	Historical Current Anticipatory	Recurrent	Broad
Harmful substances	Known	Medium	Low	Medium	Historical Current Anticipatory	Continuous	Broad
Sediment deposition	Known	Medium	Low	Medium	Historical Current Anticipatory	Continuous	Broad
Habitat fragmentation	Known	Medium	Medium	Medium	Historical Current	Continuous	Broad
Physical destruction of habitat	Known	Medium	Medium	Medium	Historical Current Anticipatory	Recurrent	Narrow
Increased predation from aquatic invasive species	Likely	Medium	Low	Medium	Current Anticipatory	Continuous	Broad

30 The specific assessment categories and associated rankings definitions are provided in appendix C.
31 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
32 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
33 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
34 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
35 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
36 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
37 Population-level threat extent: the proportion of the population affected by the threat

Table D3. Population-level threat assessment for Chilliwack Delta.[38]

Threat	Likelihood of occurrence[39]	Level of Impact[40]	Causal certainty[41]	Population-level threat risk[42]	Population-level threat occurrence[43]	Population-level threat frequency[44]	Population-level threat extent[45]
Hypoxia	Known	High	Very High	High	Historical Current Anticipatory	Recurrent	Broad
Seasonal lack of water	Known	Low	Low	Low	Current Anticipatory	Recurrent	Narrow
Harmful substances	Known	Medium	Low	Medium	Historical Current Anticipatory	Continuous	Broad
Sediment deposition	Known	Medium	Medium	Medium	Historical Current Anticipatory	Continuous	Broad
Habitat fragmentation	Known	Medium	Low	Medium	Historical Current	Recurrent	Broad
Physical destruction of habitat	Known	Medium	Medium	High	Historical Current Anticipatory	Recurrent	Extensive
Increased predation from aquatic invasive species	Likely	Medium	Low	Medium	Current Anticipatory	Continuous	Extensive

38 The specific assessment categories and associated rankings definitions are provided in appendix C.
39 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
40 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
41 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
42 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
43 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
44 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
45 Population-level threat extent: the proportion of the population affected by the threat

Table D4. Population-level threat assessment for Elk Creek/Hope Slough.[46]

Threat	Likelihood of occurrence[47]	Level of Impact[48]	Causal certainty[49]	Population-level threat risk[50]	Population-level threat occurrence[51]	Population-level threat frequency[52]	Population-level threat extent[53]
Hypoxia	Known	High	Very high	High	Historical Current Anticipatory	Recurrent	Broad
Seasonal lack of water	Unlikely	Low	Very low	Low	Historical Anticipatory	Recurrent	Broad
Harmful substances	Likely	Medium	Medium	Medium	Historical Current Anticipatory	Continuous	Broad
Sediment deposition	Known	Medium	Low	Medium	Historical Current Anticipatory	Continuous	Broad
Habitat fragmentation	Known	Medium	Medium	Medium	Historical Current	Continuous	Narrow
Physical destruction of habitat	Known	Medium	Medium	High	Historical Current Anticipatory	Recurrent	Broad
Increased predation from aquatic invasive species	Likely	Medium	Low	Medium	Current Anticipatory	Continuous	Extensive

46 The specific assessment categories and associated rankings definitions are provided in appendix C.
47 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
48 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
49 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
50 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
51 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
52 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
53 Population-level threat extent: the proportion of the population affected by the threat

Table D5. Population-level threat assessment for Fishtrap Creek.[54]

Threat	Likelihood of occurrence[55]	Level of impact[56]	Causal certainty[57]	Population-level threat risk[58]	Population-level threat occurrence[59]	Population-level threat frequency[60]	Population-level threat extent[61]
Hypoxia	Known	High	Very high	High	Historical Current Anticipatory	Recurrent	Broad
Seasonal lack of water	Known	Medium	Medium	Medium	Historical Current Anticipatory	Recurrent	Broad
Harmful substances	Known	Medium	Low	Medium	Historical Current Anticipatory	Continuous	Broad
Sediment deposition	Known	High	Medium	High	Historical Current Anticipatory	Continuous	Extensive
Habitat fragmentation	Known	Medium	Low	Medium	Historical Current	Continuous	Broad
Physical destruction of habitat	Known	Medium	High	Medium	Historical Anticipatory	Recurrent	Broad
Increased predation from aquatic invasive species	Likely	Medium	Low	Medium	Current Anticipatory	Continuous	Broad

54 The specific assessment categories and associated rankings definitions are provided in appendix C.
55 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
56 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
57 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
58 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
59 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
60 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
61 Population-level threat extent: the proportion of the population affected by the threat

Table D6. Population-level threat assessment for Little Campbell River.[62]

Threat	Likelihood of occurrence[63]	Level of impact[64]	Causal certainty[65]	Population-level threat risk[66]	Population-level threat occurrence[67]	Population-level threat frequency[68]	Population-level threat extent[69]
Hypoxia	Known	Extreme	Very high	High	Historical Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	Known	High	Medium	High	Historical Current Anticipatory	Recurrent	Broad
Harmful substances	Likely	Low	High	Low	Historical Current Anticipatory	Continuous	Narrow
Sediment deposition	Known	Low	High	Low	Historical Current Anticipatory	Continuous	Narrow
Habitat fragmentation	Known	Low	Very high	Low	Historical Current	Continuous	Restricted
Physical destruction of habitat	Known	Low	Medium	Low	Historical Anticipatory	Recurrent	Restricted
Increased predation from aquatic invasive species	Likely	Medium	High	Medium	Current Anticipatory	Continuous	Extensive

[62] The specific assessment categories and associated rankings definitions are provided in appendix C.
[63] Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
[64] Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
[65] Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
[66] Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
[67] Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
[68] Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
[69] Population-level threat extent: the proportion of the population affected by the threat

Table D7. Population-level threat assessment for Miami River.[70]

Threat	Likelihood of occurrence[71]	Level of impact[72]	Causal certainty[73]	Population-level threat risk[74]	Population-level threat occurrence[75]	Population-level threat frequency[76]	Population-level threat extent[77]
Hypoxia	Known	Extreme	Very high	High	Historical Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	Known	Medium	Low	Medium	Current Anticipatory	Recurrent	Narrow
Harmful substances	Likely	Low	Low	Low	Current Anticipatory	Continuous	Broad
Sediment deposition	Known	Medium	Medium	Medium	Historical Current Anticipatory	Continuous	Broad
Habitat fragmentation	Likely	Low	Low	Low	Current Anticipatory	Recurrent	Restricted
Physical destruction of habitat	Likely	Low	Very low	Low	Historical Anticipatory	Recurrent	Narrow
Increased predation from aquatic invasive species	Unlikely	Low	Very low	Low	Current Anticipatory	Continuous	Broad

[70] The specific assessment categories and associated rankings definitions are provided in appendix C.
[71] Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
[72] Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
[73] Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
[74] Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
[75] Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
[76] Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
[77] Population-level threat extent: the proportion of the population affected by the threat

Table D8. Population-level threat assessment for Mountain Slough.[78]

Threat	Likelihood of occurrence[79]	Level of impact[80]	Causal certainty[81]	Population-level threat risk[82]	Population-level threat occurrence[83]	Population-level threat frequency[84]	Population-level threat extent[85]
Hypoxia	Known	Extreme	Very high	High	Historical Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	Known	Low	Low	Low	Current Anticipatory	Recurrent	Narrow
Harmful substances	Known	Medium	Low	Medium	Current Anticipatory	Recurrent	Narrow
Sediment deposition	Known	High	Low	High	Historical Current Anticipatory	Continuous	Broad
Habitat fragmentation	Unlikely	Low	Very low	Low	Anticipatory	Recurrent	Narrow
Physical destruction of habitat	Known	Medium	Medium	High	Historical Current Anticipatory	Recurrent	Broad
Increased predation from aquatic invasive species	Likely	Low	Low	Low	Current Anticipatory	Continuous	Broad

78 The specific assessment categories and associated rankings definitions are provided in appendix C.
79 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
80 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
81 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
82 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
83 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
84 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
85 Population-level threat extent: the proportion of the population affected by the threat

Table D9. Population-level threat assessment for Pepin Creek.[86]

Threat	Likelihood of occurrence[87]	Level of impact[88]	Causal certainty[89]	Population-level threat risk[90]	Population-level threat occurrence[91]	Population-level threat frequency[92]	Population-level threat extent[93]
Hypoxia	Known	High	Very high	High	Historical Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	Unlikely	Low	Very low	Low	Anticipatory	Recurrent	Broad
Harmful substances	Likely	Medium	Medium	Medium	Current Anticipatory	Recurrent	Broad
Sediment deposition	Known	Medium	Medium	Medium	Historical Current Anticipatory	Continuous	Extensive
Habitat fragmentation	Likely	Low	Very low	Low	Historical Current	Recurrent	Restricted
Physical destruction of habitat	Known	Medium	Medium	Medium	Historical Anticipatory	Recurrent	Restricted
Increased predation from aquatic invasive species	Likely	Medium	Low	Medium	Current Anticipatory	Continuous	Broad

86 The specific assessment categories and associated rankings definitions are provided in appendix C.
87 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
88 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
89 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
90 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
91 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
92 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
93 Population-level threat extent: the proportion of the population affected by the threat

Table D10. Population-level threat assessment for Salmon River.[94]

Threat	Likelihood of occurrence[95]	Level of impact[96]	Causal certainty[97]	Population-level threat risk[98]	Population-level threat occurrence[99]	Population-level threat frequency[100]	Population-level threat extent[101]
Hypoxia	Known	High	Very high	High	Historical Current Anticipatory	Recurrent	Extensive
Seasonal lack of water	Known	High	Medium	High	Historical Current Anticipatory	Recurrent	Broad
Harmful substances	Unlikely	Low	Very low	Low	Anticipatory	Recurrent	Narrow
Sediment deposition	Known	Medium	Low	Medium	Historical Current Anticipatory	Continuous	Narrow
Habitat fragmentation	Known	Medium	Medium	Medium	Historical Current	Continuous	Broad
Physical destruction of habitat	Known	Low	Low	Low	Historical Anticipatory	Recurrent	Narrow
Increased predation from aquatic invasive species	Likely	Low	Low	Low	Current Anticipatory	Continuous	Broad

94 The specific assessment categories and associated rankings definitions are provided in appendix C.
95 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
96 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
97 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
98 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
99 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
100 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
101 Population-level threat extent: the proportion of the population affected by the threat

Table D11. Population-level threat assessment for Salwein Creek/Hopedale Slough.[102]

Threat	Likelihood of occurrence[103]	Level of impact[104]	Causal certainty[105]	Population-level threat risk[106]	Population-level threat occurrence[107]	Population-level threat frequency[108]	Population-level threat extent[109]
Hypoxia	Known	High	Very high	High	Historical Current Anticipatory	Recurrent	Broad
Seasonal lack of water	Known	High	High	High	Current Anticipatory	Recurrent	Broad
Harmful substances	Known	High	Medium	High	Historical Current Anticipatory	Continuous	Broad
Sediment deposition	Likely	Low	Low	Low	Historical Current Anticipatory	Continuous	Broad
Habitat fragmentation	Known	Medium	Medium	Medium	Historical Current	Recurrent	Narrow
Physical destruction of habitat	Known	Medium	High	Medium	Historical Current Anticipatory	Recurrent	Broad
Increased predation from aquatic invasive species	Likely	Medium	Low	Medium	Current Anticipatory	Continuous	Broad

102 The specific assessment categories and associated rankings definitions are provided in appendix C.
103 Likelihood of occurrence: probability of a specific threat occurring for a given population over 10 years or 3 generations, whichever is shorter.
104 Level of impact: the magnitude of the impact caused by a given threat, and the level to which it affects the survival or recovery of the population.
105 Causal certainty: the strength of evidence linking the threat to the survival and recovery of the population.
106 Population-level threat risk: the product of likelihood and level of impact as determined using a risk matrix approach
107 Population-level threat occurrence: the timing of occurrence of the threat and describes whether a threat is historical, current and/or anticipatory
108 Population-level threat frequency: the temporal extent of the threat over the next 10 years or 3 generations, whichever is shorter.
109 Population-level threat extent: the proportion of the population affected by the threat

Appendix E: critical habitat maps

Critical habitat maps for the 11 known populations of Salish Sucker in Canada are presented in the following figures. Critical habitat mapping is also available through DFO's Aquatic species at risk map website and the Government of Canada's Open Maps website.

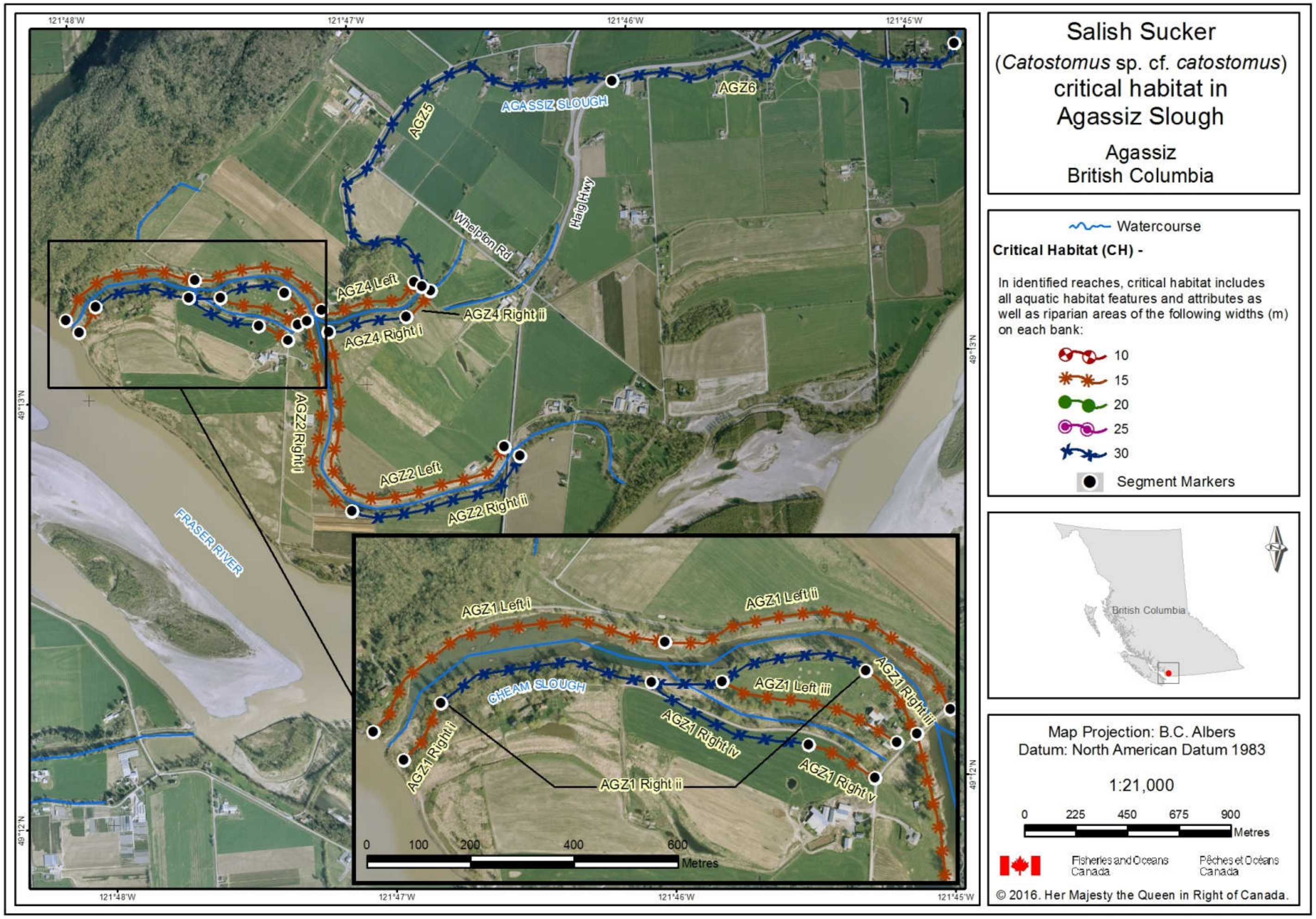

Figure E1. Map of critical habitat reaches for Agassiz Slough.

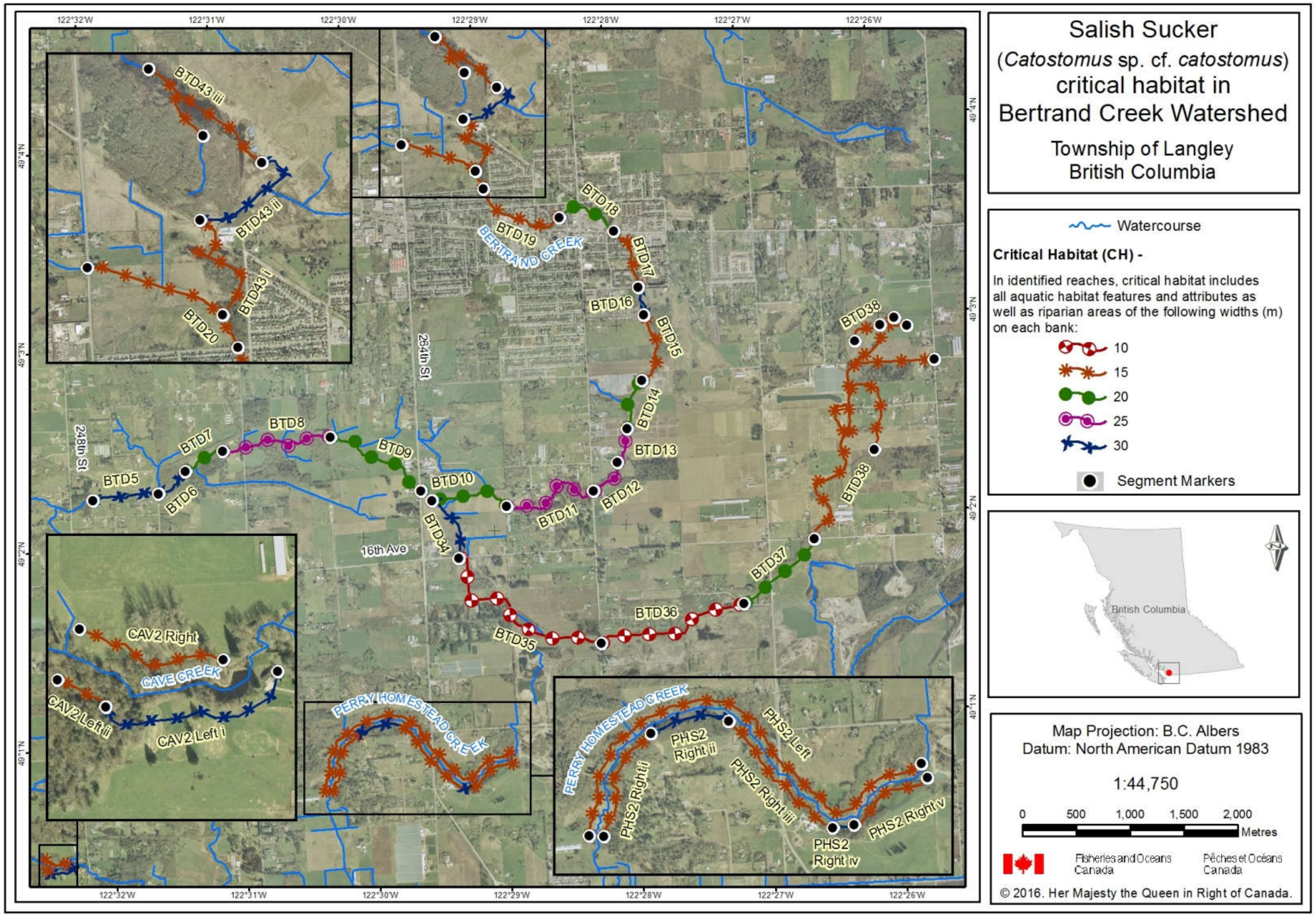

Figure E2. Map of critical habitat reaches for Bertrand Creek.

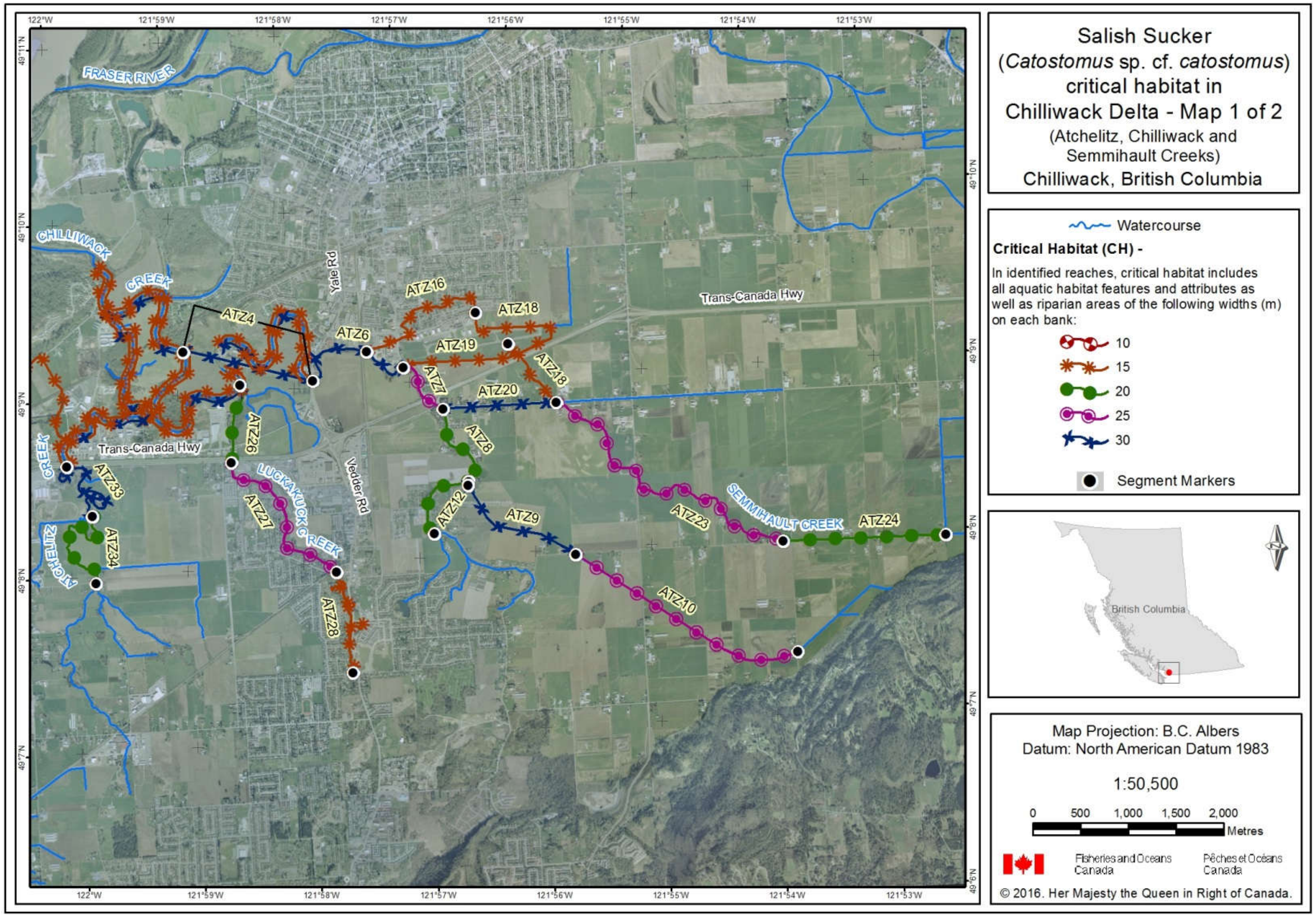

Figure E3. Map of critical habitat reaches for Chilliwack Delta (1 of 2).

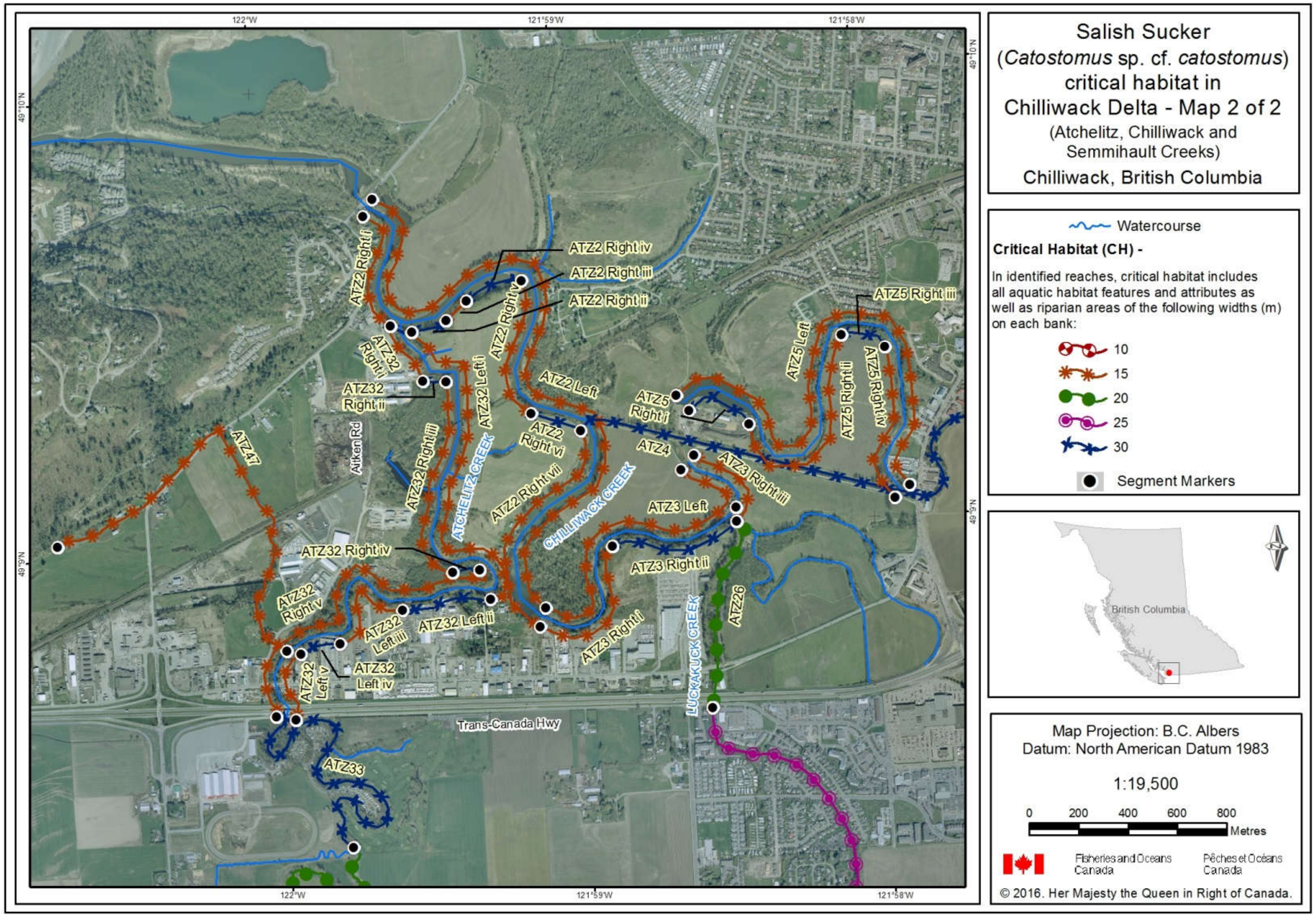

Figure E4. Map of critical habitat reaches for Chilliwack Delta (2 of 2).

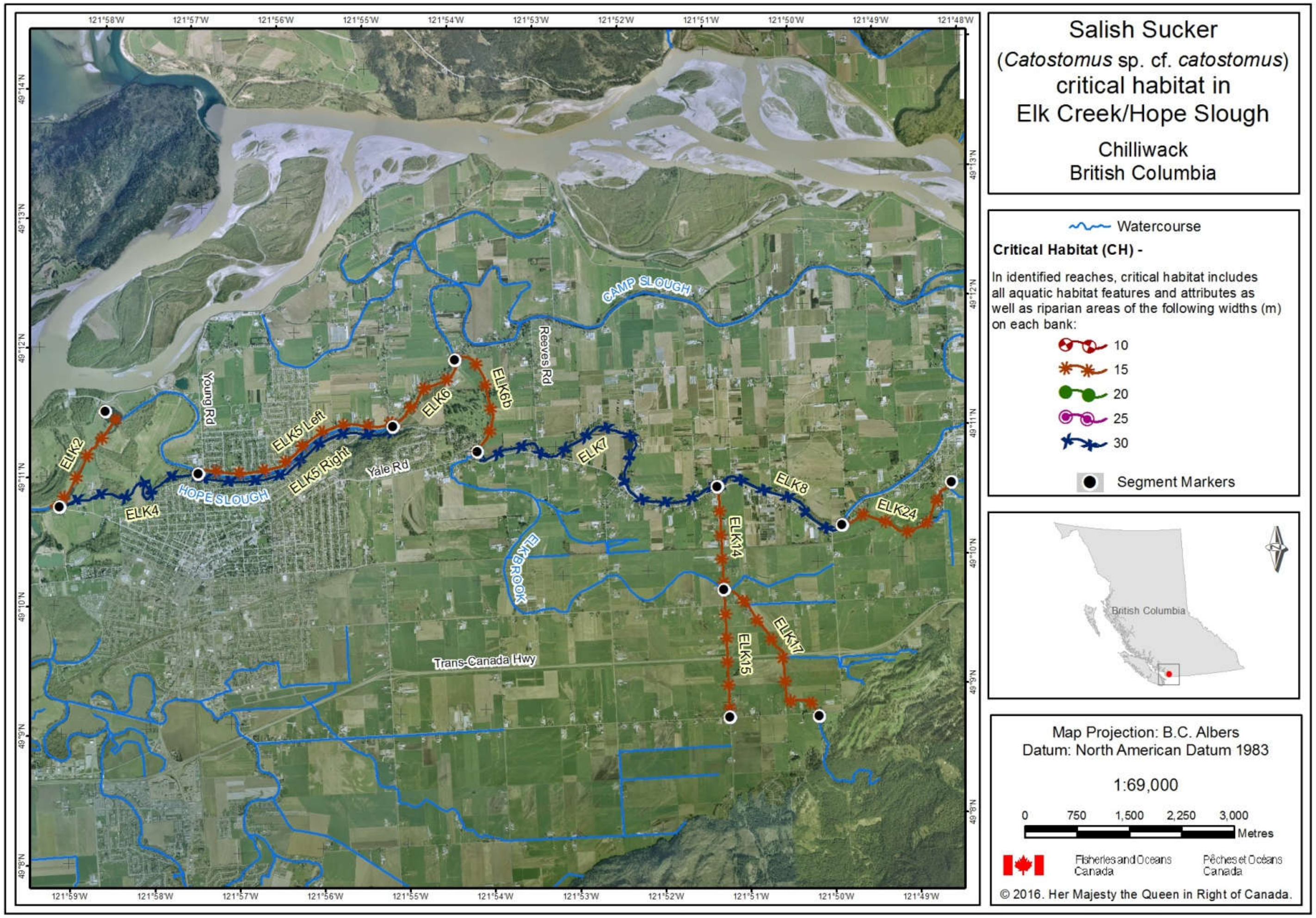

Figure E5. Map of critical habitat reaches for Elk Creek / Hope Slough.

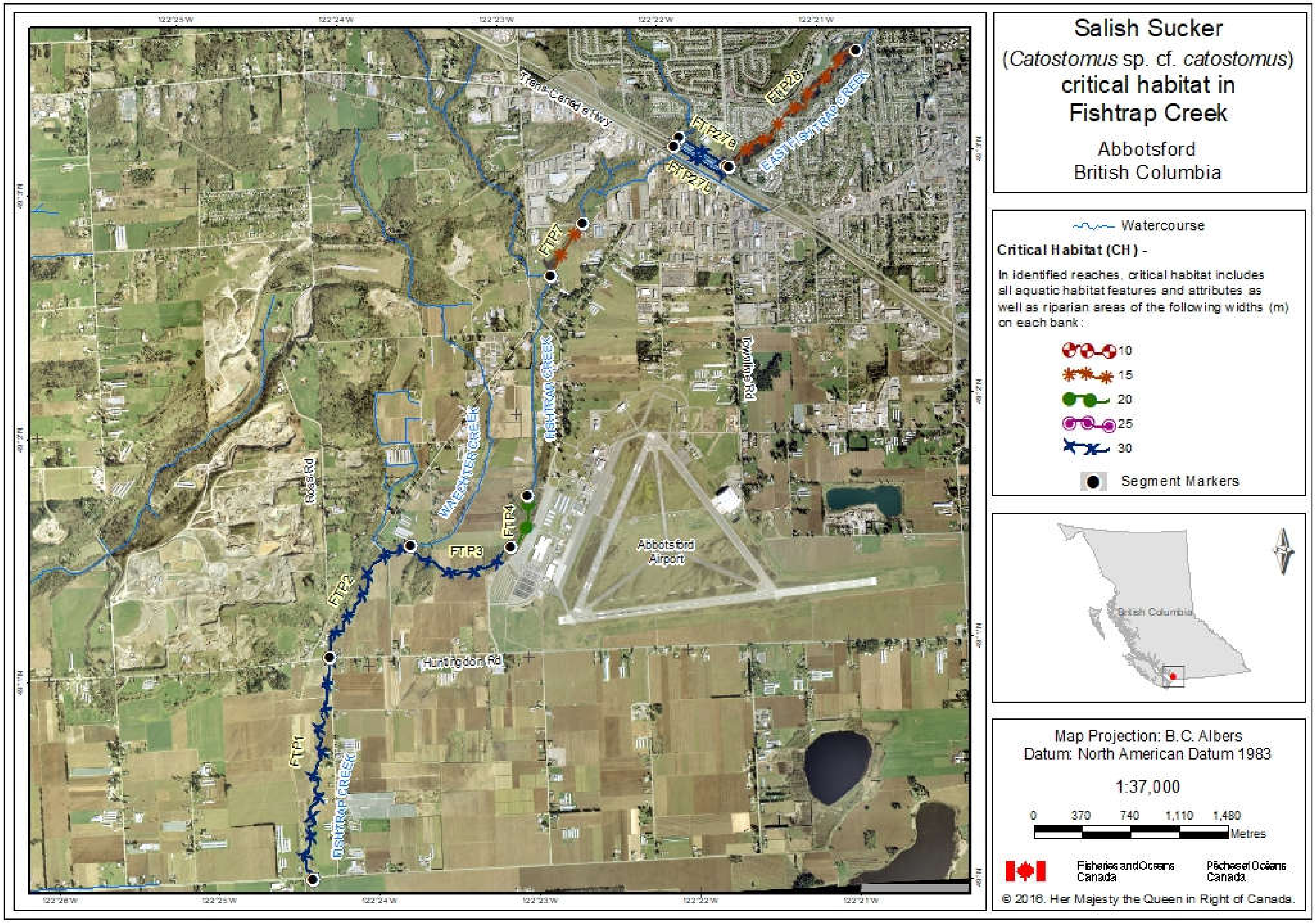

Figure E6. Map of critical habitat reaches for Fishtrap Creek.

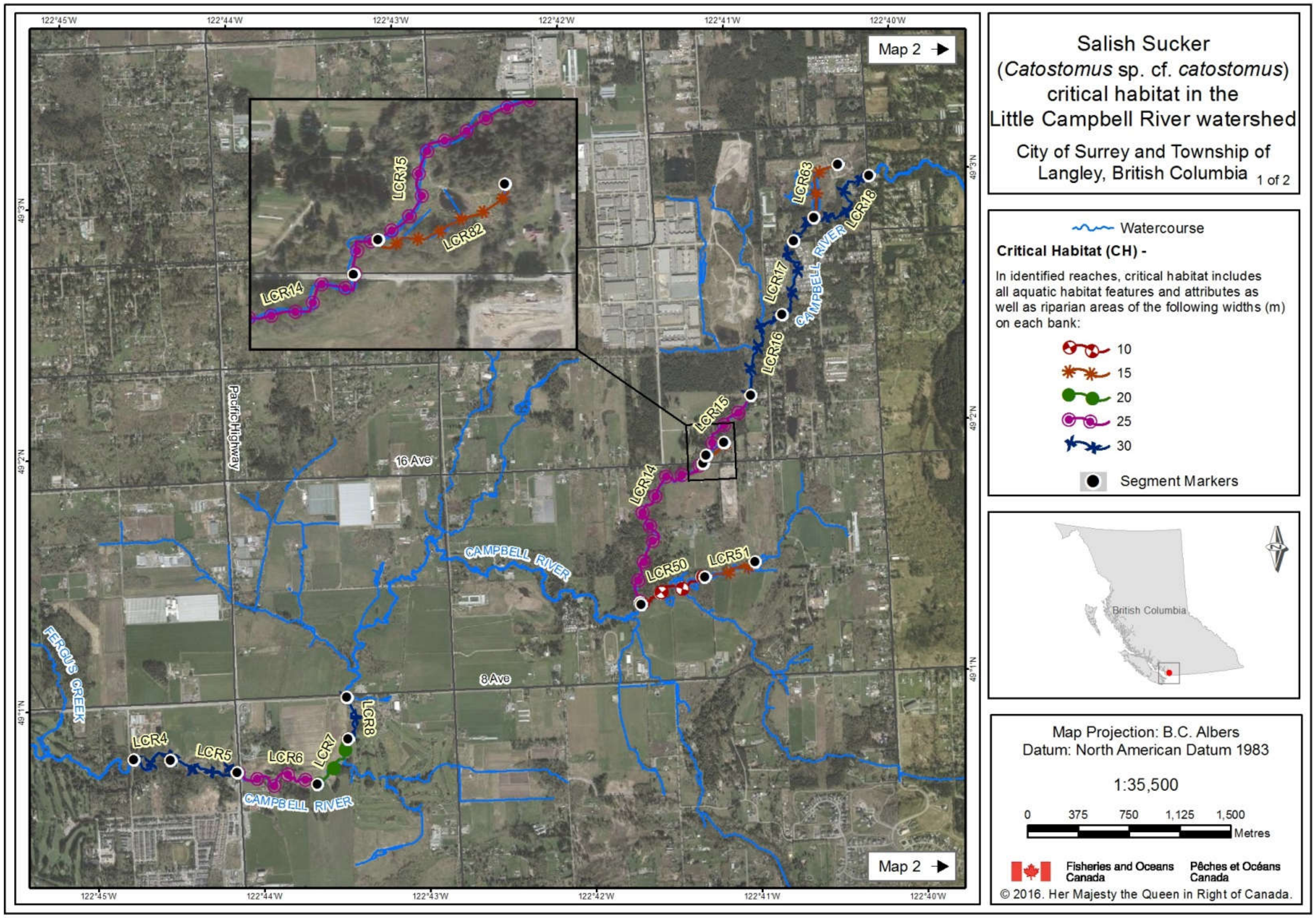

Figure E7. Map of critical habitat reaches for Little Campbell River (1 of 2).

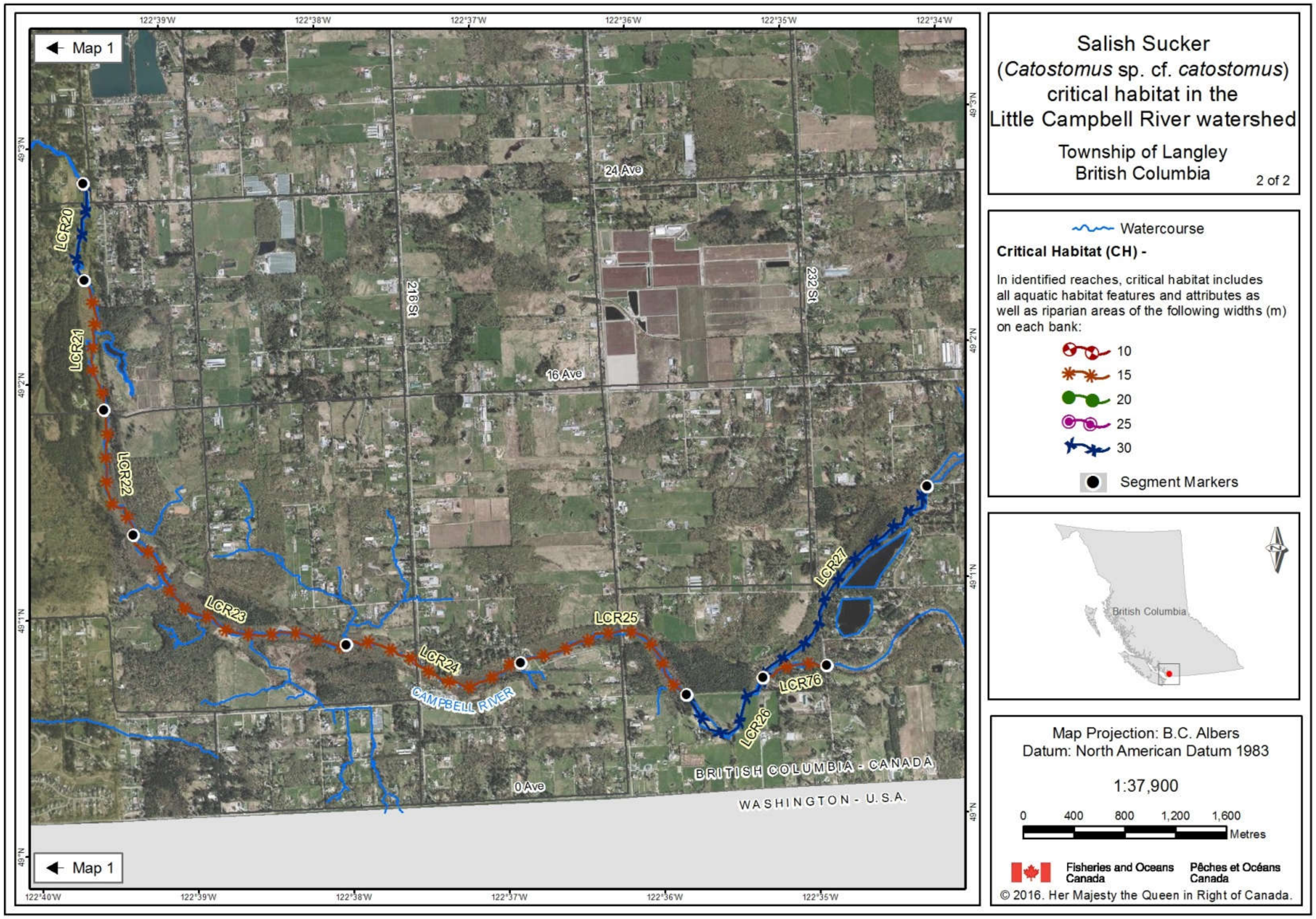

Figure E8. Map of critical habitat reaches for Little Campbell River (2 of 2).

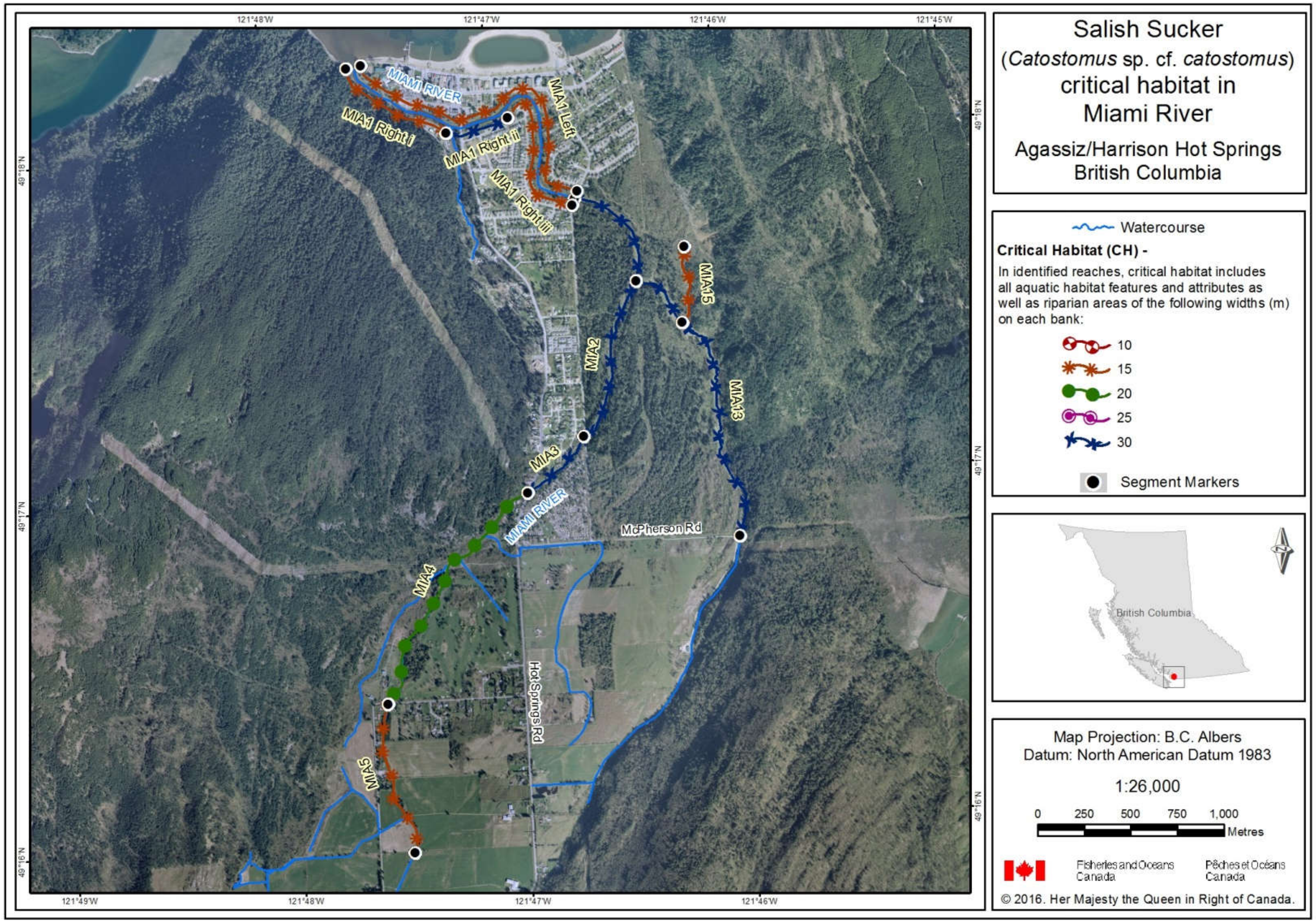

Figure E9. Map of critical habitat reaches for Miami River.

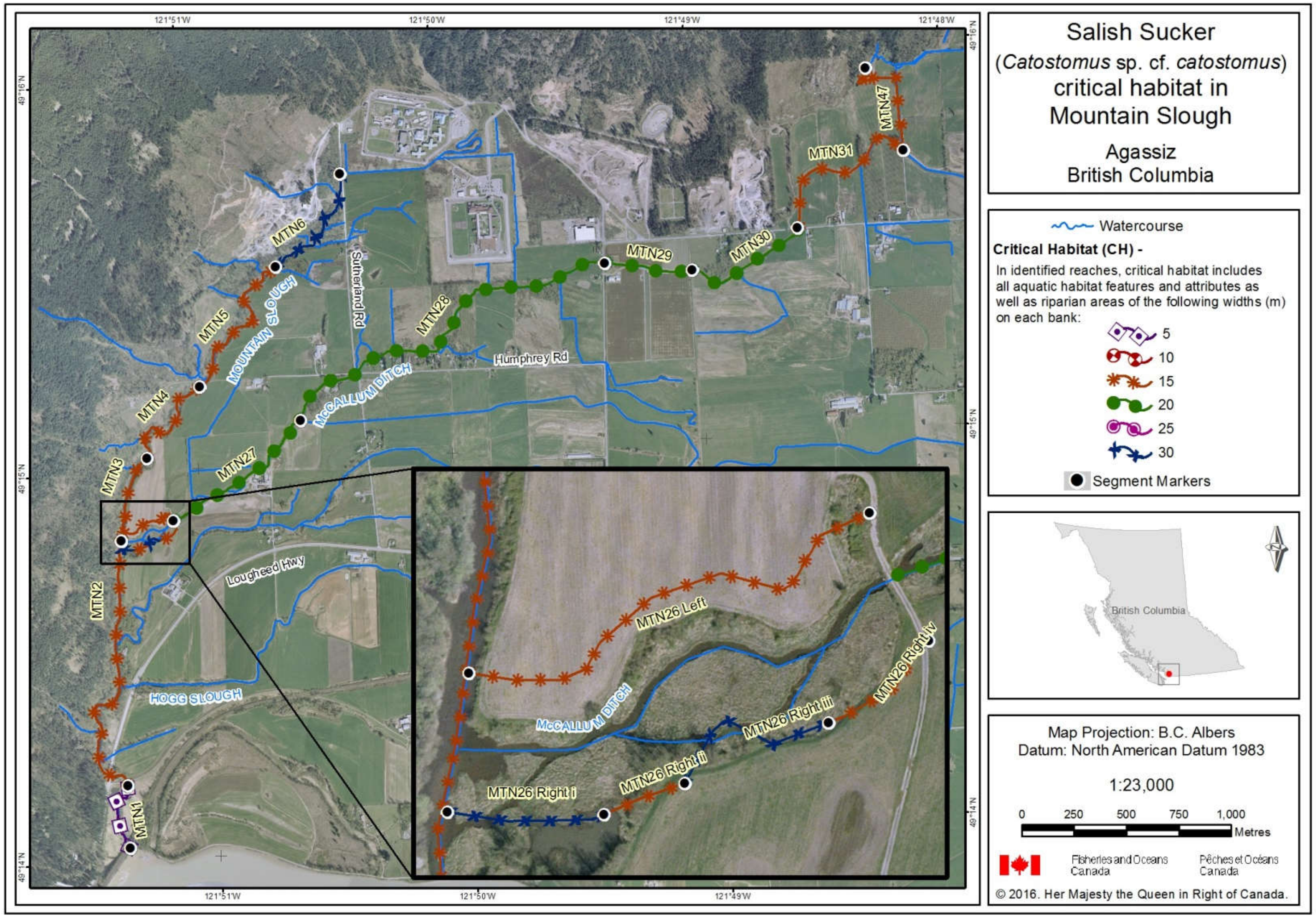

Figure E10. Map of critical habitat reaches for Mountain Slough.

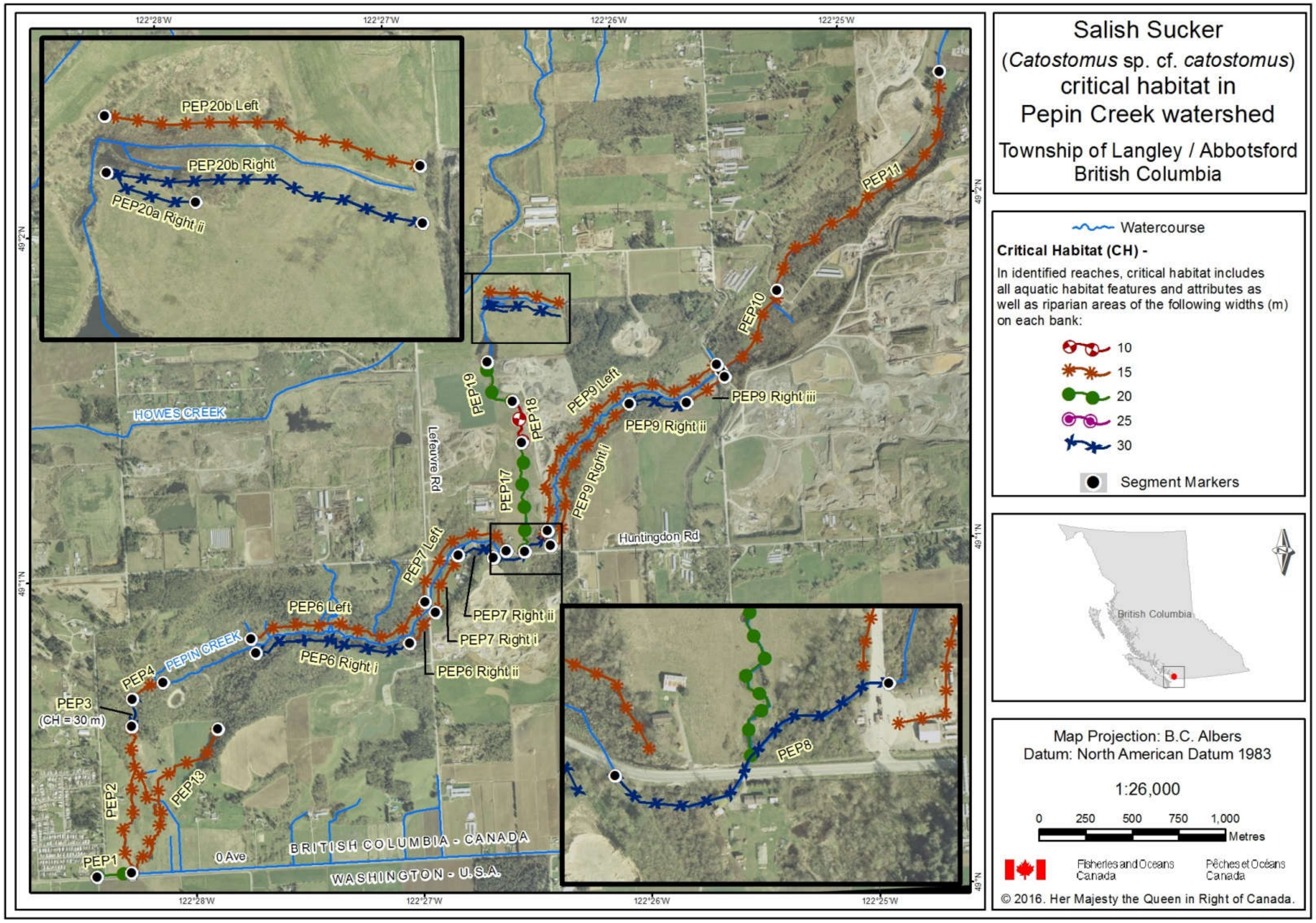

Figure E11. Map of critical habitat reaches for Pepin Creek.

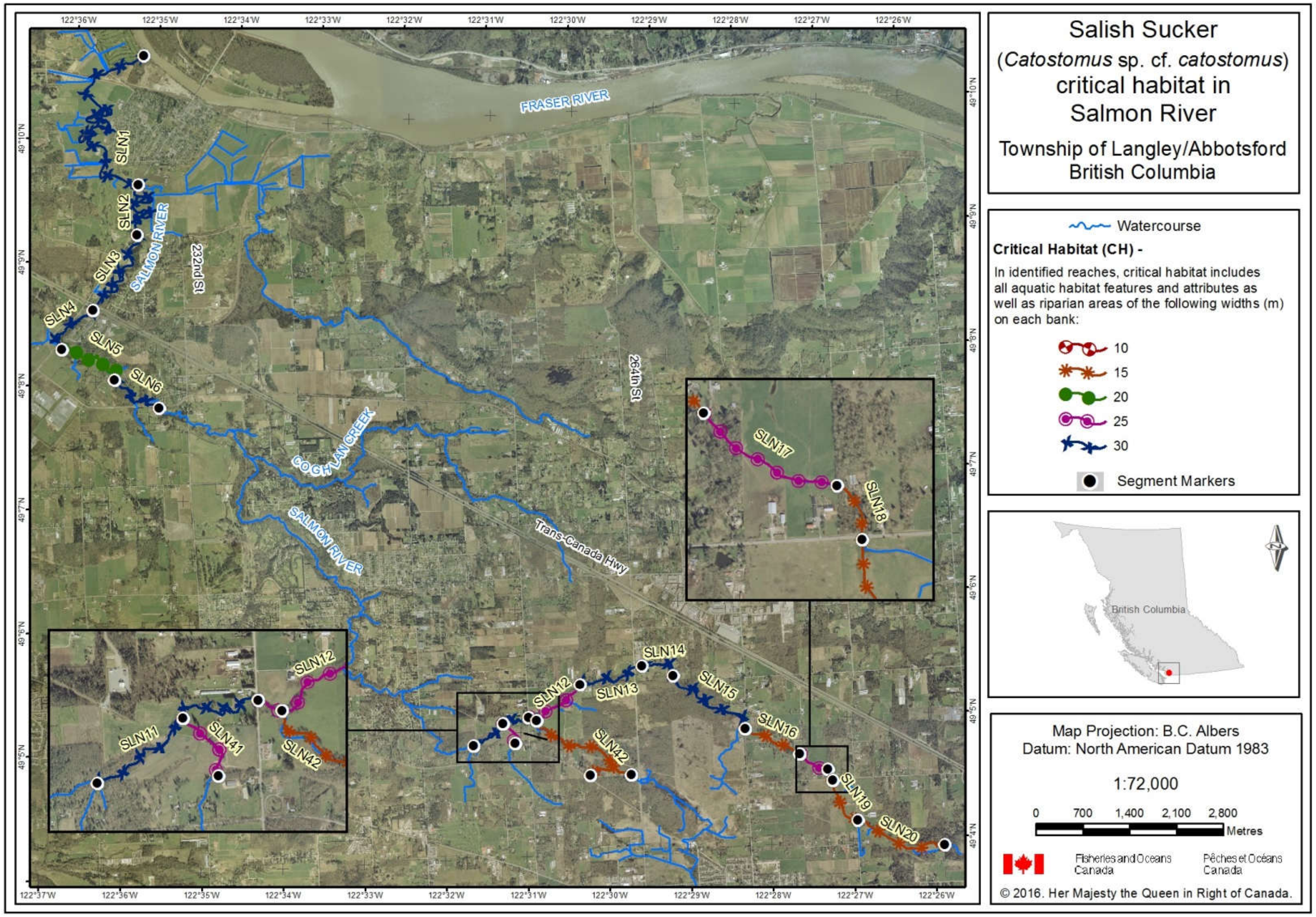

Figure E12. Map of critical habitat reaches for Salmon River.

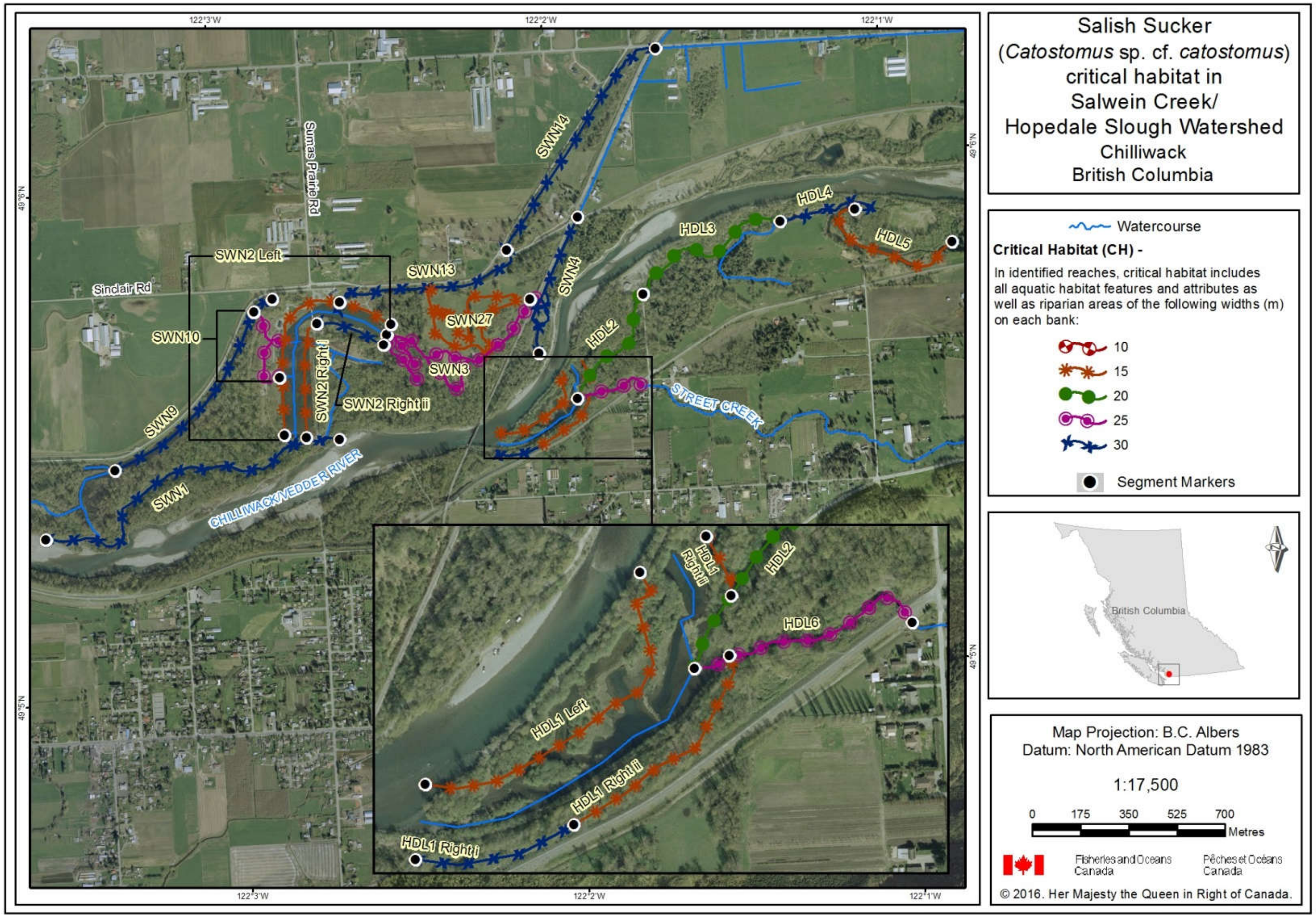

Figure E13. Map of critical habitat reaches for Salwein Creek / Hopedale Slough.

Appendix F: geographic coordinates of critical habitat

Watershed	Reach code	Approximate reach length (m)	Reach start point (dms)[110] latitude	Longitude start	Latitude end [111]	Longitude end	Riparian critical habitat width on each bank for entire reach length (m)	Area of riparian critical habitat associated with the reach (ha)
Agassiz Slough	AGZ1 Left i	661	49° 13' 11" N	121° 48' 2" W	49° 13' 15" N	121° 47' 36" W	15	1.0
Agassiz Slough	AGZ1 Left ii	645	49° 13' 15" N	121° 47' 36" W	49° 13' 10" N	121° 47' 10" W	15	1.0
Agassiz Slough	AGZ1 Left iii	363	49° 13' 15" N	121° 47' 36" W	49° 13' 8" N	121° 47' 15" W	15	0.5
Agassiz Slough	AGZ1 Right i	134	49° 13' 11" N	121° 48' 2" W	49° 13' 14" N	121° 47' 58" W	15	0.2
Agassiz Slough	AGZ1 Right ii	870	49° 13' 14" N	121° 47' 58" W	49° 13' 15" N	121° 47' 15" W	30	2.6
Agassiz Slough	AGZ1 Right iii	160	49° 13' 15" N	121° 47' 15" W	49° 13' 10" N	121° 47' 10" W	15	0.2
Agassiz Slough	AGZ1 Right iv	336	49° 13' 15" N	121° 47' 36" W	49° 13' 11" N	121° 47' 22" W	30	1.0
Agassiz Slough	AGZ1 Right v	145	49° 13' 11" N	121° 47' 22" W	49° 13' 8" N	121° 47' 15" W	15	0.2
Agassiz Slough	AGZ2 Left	1488	49° 13' 10" N	121° 47' 10" W	49° 12' 49" N	121° 46' 30" W	15	2.2
Agassiz Slough	AGZ2 Right i	919	49° 13' 10" N	121° 47' 10" W	49° 12' 43" N	121° 47' 4" W	15	1.4
Agassiz Slough	AGZ2 Right ii	829	49° 12' 43" N	121° 47' 4" W	49° 12' 49" N	121° 46' 30" W	30	2.5
Agassiz Slough	AGZ4 Left	454	49° 13' 10" N	121° 47' 10" W	49° 13' 13" N	121° 46' 47" W	15	0.7
Agassiz Slough	AGZ4 Right i	348	49° 13' 10" N	121° 47' 10" W	49° 13' 11" N	121° 46' 51" W	30	1.0
Agassiz Slough	AGZ4 Right ii	159	49° 13' 11" N	121° 46' 51" W	49° 13' 13" N	121° 46' 47" W	15	0.2
Agassiz Slough	AGZ5	2094	49° 13' 13" N	121° 46' 47" W	49° 13' 41" N	121° 46' 3" W	30	12.6
Agassiz Slough	AGZ6	1686	49° 13' 41" N	121° 46' 3" W	49° 13' 43" N	121° 44' 50" W	30	10.1
Bertrand Creek	BTD5	651	49° 2' 15" N	122° 32' 3" W	49° 2' 16" N	122° 31' 32" W	30	3.9
Bertrand Creek	BTD6	352	49° 2' 16" N	122° 31' 33" W	49° 2' 23" N	122° 31' 20" W	30	2.1
Bertrand Creek	BTD7	450	49° 2' 23" N	122° 31' 20" W	49° 2' 28" N	122° 31' 2" W	20	1.8
Bertrand Creek	BTD8	1137	49° 2' 28" N	122° 31' 2" W	49° 2' 31" N	122° 30' 13" W	25	5.7

110 Reach start point indicates the location of the beginning of the reach in question along the watercourse.
111 Reach end point indicates the location of the end of the reach in question along the watercourse.

Watershed	Reach code	Approximate reach length (m)	Reach start point (dms)[110] latitude	Longitude start	Latitude end [111]	Longitude end	Riparian critical habitat width on each bank for entire reach length (m)	Area of riparian critical habitat associated with the reach (ha)
Bertrand Creek	BTD9	1105	49° 2' 31" N	122° 30' 13" W	49° 2' 13" N	122° 29' 33" W	20	4.4
Bertrand Creek	BTD10	968	49° 2' 13" N	122° 29' 33" W	49° 2' 7" N	122° 28' 54" W	20	3.9
Bertrand Creek	BTD11	1134	49° 2' 7" N	122° 28' 54" W	49° 2' 11" N	122° 28' 14" W	25	5.7
Bertrand Creek	BTD12	395	49° 2' 11" N	122° 28' 14" W	49° 2' 19" N	122° 28' 2" W	25	2.0
Bertrand Creek	BTD13	356	49° 2' 19" N	122° 28' 2" W	49° 2' 29" N	122° 27' 57" W	25	1.8
Bertrand Creek	BTD14	527	49° 2' 29" N	122° 27' 57" W	49° 2' 43" N	122° 27' 49" W	20	2.1
Bertrand Creek	BTD15	716	49° 2' 43" N	122° 27' 49" W	49° 3' 3" N	122° 27' 47" W	15	2.1
Bertrand Creek	BTD16	285	49° 3' 3" N	122° 27' 47" W	49° 3' 11" N	122° 27' 49" W	30	1.7
Bertrand Creek	BTD17	616	49° 3' 11" N	122° 27' 49" W	49° 3' 29" N	122° 27' 59" W	15	1.8
Bertrand Creek	BTD18	638	49° 3' 29" N	122° 27' 59" W	49° 3' 34" N	122° 28' 23" W	20	2.6
Bertrand Creek	BTD19	918	49° 3' 34" N	122° 28' 23" W	49° 3' 43" N	122° 28' 57" W	15	2.8
Bertrand Creek	BTD20	927	49° 3' 43" N	122° 28' 57" W	49° 3' 58" N	122° 29' 34" W	15	2.8
Bertrand Creek	BTD34	657	49° 2' 10" N	122° 29' 27" W	49° 1' 52" N	122° 29' 16" W	30	3.9
Bertrand Creek	BTD35	1899	49° 1' 52" N	122° 29' 16" W	49° 1' 24" N	122° 28' 13" W	10	3.8
Bertrand Creek	BTD36	1477	49° 1' 24" N	122° 28' 13" W	49° 1' 34" N	122° 27' 7" W	10	3.0
Bertrand Creek	BTD37	908	49° 1' 34" N	122° 27' 7" W	49° 1' 52" N	122° 26' 34" W	20	3.6
Bertrand Creek	BTD38a	5204	49° 1' 52" N	122° 26' 34" W	49° 2' 18" N	122° 26' 4" W	15	15.6
Bertrand Creek	BTD38b	5204	49° 1' 52" N	122° 26' 34" W	49° 2' 45" N	122° 25' 35" W	15	15.6
Bertrand Creek	BTD38c	5204	49° 1' 52" N	122° 26' 34" W	49° 2' 51" N	122° 26' 11" W	15	15.6
Bertrand Creek	BTD38d	5204	49° 1' 52" N	122° 26' 34" W	49° 2' 55" N	122° 25' 47" W	15	15.6
Bertrand Creek	BTD38e	5204	49° 1' 52" N	122° 26' 34" W	49° 2' 58" N	122° 25' 53" W	15	15.6
Bertrand Creek	BTD38f	5204	49° 1' 52" N	122° 26' 34" W	49° 2' 56" N	122° 25' 59" W	15	15.6
Bertrand Creek	BTD43 i	392	49° 3' 49" N	122° 29' 1" W	49° 4' 5" N	122° 29' 5" W	15	1.2
Bertrand Creek	BTD43 ii	873	49° 4' 5" N	122° 29' 5" W	49° 4' 14" N	122° 28' 49" W	30	5.2
Bertrand Creek	BTD43 iii	1018	49° 4' 14" N	122° 28' 49" W	49° 4' 18" N	122° 29' 3" W	15	3.1

Watershed	Reach code	Appro-ximate reach length (m)	Reach start point (dms)[110] latitude	Longitude start	Latitude end [111]	Longitude end	Riparian critical habitat width on each bank for entire reach length (m)	Area of riparian critical habitat associated with the reach (ha)
Bertrand Creek	CAV2 Left i	301	49° 0' 26" N	122° 32' 21" W	49° 0' 25" N	122° 32' 30" W	30	0.9
Bertrand Creek	CAV2 Left ii	81	49° 0' 25" N	122° 32' 30" W	49° 0' 27" N	122° 32' 34" W	15	0.1
Bertrand Creek	CAV2 Right	229	49° 0' 26" N	122° 32' 21" W	49° 0' 27" N	122° 32' 34" W	15	0.3
Bertrand Creek	PHS2 Left	2700	49° 0' 44" N	122° 30' 22" W	49° 0' 52" N	122° 28' 56" W	15	4.1
Bertrand Creek	PHS2 Right i	697	49° 0' 44" N	122° 30' 22" W	49° 1' 2" N	122° 30' 7" W	15	1.0
Bertrand Creek	PHS2 Right ii	441	49° 1' 2" N	122° 30' 7" W	49° 1' 3" N	122° 29' 45" W	30	1.3
Bertrand Creek	PHS2 Right iii	869	49° 1' 3" N	122° 29' 45" W	49° 0' 44" N	122° 29' 20" W	15	1.3
Bertrand Creek	PHS2 Right iv	119	49° 0' 44" N	122° 29' 20" W	49° 0' 45" N	122° 29' 14" W	30	0.4
Bertrand Creek	PHS2 Right v	507	49° 0' 45" N	122° 29' 14" W	49° 0' 52" N	122° 28' 56" W	15	0.8
Chilliwack Delta	ATZ4	1397	49° 9' 15" N	121° 58' 56" W	49° 9' 2" N	121° 57' 50" W	30	8.4
Chilliwack Delta	ATZ6	1391	49° 9' 2" N	121° 57' 50" W	49° 9' 5" N	121° 57' 3" W	30	8.3
Chilliwack Delta	ATZ7	679	49° 9' 5" N	121° 57' 3" W	49° 8' 50" N	121° 56' 44" W	25	3.4
Chilliwack Delta	ATZ8	987	49° 8' 50" N	121° 56' 44" W	49° 8' 24" N	121° 56' 33" W	20	3.9
Chilliwack Delta	ATZ9	1431	49° 8' 24" N	121° 56' 33" W	49° 7' 58" N	121° 55' 39" W	30	8.6
Chilliwack Delta	ATZ10	2656	49° 7' 58" N	121° 55' 39" W	49° 7' 21" N	121° 53' 48" W	25	13.3
Chilliwack Delta	ATZ12	883	49° 8' 25" N	121° 56' 33" W	49° 8' 8" N	121° 56' 51" W	20	3.5
Chilliwack Delta	ATZ16	1697	49° 9' 11" N	121° 57' 21" W	49° 9' 22" N	121° 56' 24" W	15	5.1
Chilliwack Delta	ATZ18	2171	49° 9' 22" N	121° 56' 24" W	49° 8' 50" N	121° 55' 44" W	15	6.5
Chilliwack Delta	ATZ19	1348	49° 9' 5" N	121° 57' 0" W	49° 9' 11" N	121° 56' 8" W	15	4.0
Chilliwack Delta	ATZ20	1192	49° 8' 50" N	121° 56' 44" W	49° 8' 50" N	121° 55' 45" W	30	7.2
Chilliwack Delta	ATZ23	3332	49° 8' 50" N	121° 55' 45" W	49° 7' 59" N	121° 53' 52" W	25	16.7
Chilliwack Delta	ATZ24	1712	49° 7' 59" N	121° 53' 52" W	49° 7' 58" N	121° 52' 28" W	20	6.8
Chilliwack Delta	ATZ26	858	49° 9' 2" N	121° 58' 28" W	49° 8' 36" N	121° 58' 34" W	20	3.4
Chilliwack Delta	ATZ27	1848	49° 8' 36" N	121° 58' 34" W	49° 7' 57" N	121° 57' 43" W	25	9.2
Chilliwack Delta	ATZ28	1745	49° 7' 57" N	121° 57' 43" W	49° 7' 29" N	121° 57' 39" W	15	5.2

Watershed	Reach code	Appro-ximate reach length (m)	Reach start point (dms)[110] latitude	Longitude start	Latitude end [111]	Longitude end	Riparian critical habitat width on each bank for entire reach length (m)	Area of riparian critical habitat associated with the reach (ha)
Chilliwack Delta	ATZ33	1646	49° 8' 38" N	121° 59' 59" W	49° 8' 21" N	121° 59' 48" W	30	9.9
Chilliwack Delta	ATZ34	1510	49° 8' 20" N	121° 59' 47" W	49° 7' 58" N	121° 59' 48" W	20	6.0
Chilliwack Delta	ATZ2 Left	2960	49° 9' 44" N	121° 59' 38" W	49° 8' 49" N	121° 59' 7" W	15	4.4
Chilliwack Delta	ATZ2 Right i	531	49° 9' 44" N	121° 59' 38" W	49° 9' 30" N	121° 59' 34" W	15	0.8
Chilliwack Delta	ATZ2 Right ii	253	49° 9' 30" N	121° 59' 34" W	49° 9' 30" N	121° 59' 24" W	30	0.8
Chilliwack Delta	ATZ2 Right iii	113	49° 9' 30" N	121° 59' 24" W	49° 9' 32" N	121° 59' 20" W	15	0.2
Chilliwack Delta	ATZ2 Right iv	247	49° 9' 32" N	121° 59' 20" W	49° 9' 35" N	121° 59' 7" W	30	0.7
Chilliwack Delta	ATZ2 Right v	590	49° 9' 35" N	121° 59' 7" W	49° 9' 17" N	121° 59' 7" W	15	0.9
Chilliwack Delta	ATZ2 Right vi	218	49° 9' 17" N	121° 59' 7" W	49° 9' 14" N	121° 58' 56" W	30	0.7
Chilliwack Delta	ATZ2 Right vii	989	49° 9' 14" N	121° 58' 56" W	49° 8' 49" N	121° 59' 7" W	15	1.5
Chilliwack Delta	ATZ3 Left	1365	49° 8' 49" N	121° 59' 7" W	49° 9' 8" N	121° 58' 37" W	15	2.0
Chilliwack Delta	ATZ3 Right i	630	49° 8' 49" N	121° 59' 7" W	49° 8' 59" N	121° 58' 53" W	15	0.9
Chilliwack Delta	ATZ3 Right ii	545	49° 8' 59" N	121° 58' 53" W	49° 9' 1" N	121° 58' 29" W	30	1.6
Chilliwack Delta	ATZ3 Right iii	407	49° 9' 1" N	121° 58' 29" W	49° 9' 8" N	121° 58' 37" W	15	0.6
Chilliwack Delta	ATZ5 Left	2217	49° 9' 16" N	121° 58' 37" W	49° 9' 3" N	121° 57' 54" W	15	3.3
Chilliwack Delta	ATZ5 Right i	300	49° 9' 16" N	121° 58' 37" W	49° 9' 13" N	121° 58' 22" W	30	0.9
Chilliwack Delta	ATZ5 Right ii	923	49° 9' 13" N	121° 58' 22" W	49° 9' 25" N	121° 58' 5" W	15	1.4
Chilliwack Delta	ATZ5 Right iii	203	49° 9' 25" N	121° 58' 5" W	49° 9' 23" N	121° 57' 54" W	30	0.6
Chilliwack Delta	ATZ5 Right iv	664	49° 9' 23" N	121° 57' 54" W	49° 9' 3" N	121° 57' 54" W	15	1.0
Chilliwack Delta	ATZ32 Left i	1500	49° 9' 29" N	121° 59' 32" W	49° 8' 53" N	121° 59' 18" W	15	2.3
Chilliwack Delta	ATZ32 Left ii	367	49° 8' 53" N	121° 59' 18" W	49° 8' 52" N	121° 59' 35" W	30	1.1
Chilliwack Delta	ATZ32 Left iii	482	49° 8' 52" N	121° 59' 35" W	49° 8' 49" N	121° 59' 48" W	15	0.7
Chilliwack Delta	ATZ32 Left iv	168	49° 8' 49" N	121° 59' 48" W	49° 8' 47" N	121° 59' 57" W	30	0.5
Chilliwack Delta	ATZ32 Left v	315	49° 8' 47" N	121° 59' 57" W	49° 8' 38" N	121° 59' 59" W	15	0.5
Chilliwack Delta	ATZ32 Right i	272	49° 9' 29" N	121° 59' 32" W	49° 9' 22" N	121° 59' 27" W	15	0.4

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Chilliwack Delta	ATZ32 Right ii	95	49° 9' 22" N	121° 59' 27" W	49° 9' 21" N	121° 59' 22" W	30	0.3
Chilliwack Delta	ATZ32 Right iii	865	49° 9' 21" N	121° 59' 22" W	49° 8' 57" N	121° 59' 25" W	15	1.3
Chilliwack Delta	ATZ32 Right iv	115	49° 8' 57" N	121° 59' 25" W	49° 8' 57" N	121° 59' 18" W	30	0.3
Chilliwack Delta	ATZ32 Right v	1478	49° 8' 57" N	121° 59' 18" W	49° 8' 38" N	121° 59' 59" W	15	2.2
Elk Creek / Hope Slough	ELK2	1906	49° 10' 46" N	121° 58' 52" W	49° 11' 29" N	121° 58' 16" W	15	5.7
Elk Creek / Hope Slough	ELK4	2489	49° 10' 57" N	121° 57' 13" W	49° 10' 46" N	121° 58' 52" W	30	14.9
Elk Creek / Hope Slough	ELK5 Left	2994	49° 11' 14" N	121° 54' 54" W	49° 10' 57" N	121° 57' 13" W	15	4.5
Elk Creek / Hope Slough	ELK5 Right	3052	49° 11' 14" N	121° 54' 54" W	49° 10' 57" N	121° 57' 13" W	30	9.2
Elk Creek / Hope Slough	ELK6	1409	49° 11' 43" N	121° 54' 7" W	49° 11' 14" N	121° 54' 54" W	15	4.2
Elk Creek / Hope Slough	ELK6b	1716	49° 11' 43" N	121° 54' 7" W	49° 11' 0" N	121° 53' 55" W	15	5.1
Elk Creek / Hope Slough	ELK7	4843	49° 11' 0" N	121° 53' 55" W	49° 10' 37" N	121° 51' 7" W	30	29.1
Elk Creek / Hope Slough	ELK8	2137	49° 10' 37" N	121° 51' 7" W	49° 10' 17" N	121° 49' 41" W	30	12.8
Elk Creek / Hope Slough	ELK14	1474	49° 10' 37" N	121° 51' 7" W	49° 9' 50" N	121° 51' 7" W	15	4.4
Elk Creek / Hope Slough	ELK15	1838	49° 9' 49" N	121° 51' 7" W	49° 8' 49" N	121° 51' 8" W	15	5.5
Elk Creek / Hope Slough	ELK17	2613	49° 9' 50" N	121° 51' 7" W	49° 8' 48" N	121° 50' 5" W	15	7.8

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Elk Creek / Hope Slough	ELK24	2078	49° 10' 17" N	121° 49' 41" W	49° 10' 33" N	121° 48' 22" W	15	6.2
Fishtrap Creek	FTP1	1989	49° 0' 8" N	122° 24' 25" W	49° 1' 3" N	122° 24' 15" W	30	11.9
Fishtrap Creek	FTP2	1239	49° 1' 3" N	122° 24' 15" W	49° 1' 29" N	122° 23' 42" W	30	7.4
Fishtrap Creek	FTP4	459	49° 1' 28" N	122° 23' 4" W	49° 1' 40" N	122° 22' 58" W	20	1.8
Fishtrap Creek	FTP7	472	49° 2' 34" N	122° 22' 45" W	49° 2' 47" N	122° 22' 32" W	15	1.4
Fishtrap Creek	FTP27a	420	49° 3' 6" N	122° 21' 55" W	49° 2' 59" N	122° 21' 37" W	30	2.5
Fishtrap Creek	FTP27b	430	49° 3' 5" N	122° 21' 55" W	49° 2' 59" N	122° 21' 37" W	30	2.6
Fishtrap Creek	FTP28	1478	49° 2' 59" N	122° 21' 37" W	49° 3' 26" N	122° 20' 45" W	15	4.4
Little Campbell River	LCR4	429	49° 0' 47" N	122° 44' 45" W	49° 0' 47" N	122° 44' 32" W	30	2.6
Little Campbell River	LCR5	669	49° 0' 47" N	122° 44' 32" W	49° 0' 43" N	122° 44' 8" W	30	4.0
Little Campbell River	LCR6	812	49° 0' 43" N	122° 44' 8" W	49° 0' 39" N	122° 43' 39" W	25	4.1
Little Campbell River	LCR7	517	49° 0' 39" N	122° 43' 39" W	49° 0' 50" N	122° 43' 27" W	20	2.1
Little Campbell River	LCR8	390	49° 0' 50" N	122° 43' 27" W	49° 1' 0" N	122° 43' 27" W	30	2.3
Little Campbell River	LCR14	1646	49° 1' 19" N	122° 41' 39" W	49° 1' 52" N	122° 41' 14" W	25	8.2
Little Campbell River	LCR15	700	49° 1' 52" N	122° 41' 14" W	49° 2' 7" N	122° 40' 56" W	25	3.5
Little Campbell River	LCR16	806	49° 2' 7" N	122° 40' 56" W	49° 2' 26" N	122° 40' 43" W	30	4.8
Little Campbell River	LCR17	715	49° 2' 26" N	122° 40' 43" W	49° 2' 44" N	122° 40' 37" W	30	4.3

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Little Campbell River	LCR18	1030	49° 2' 44" N	122° 40' 37" W	49° 2' 59" N	122° 40' 9" W	30	6.2
Little Campbell River	LCR20	807	49° 2' 50" N	122° 39' 31" W	49° 2' 26" N	122° 39' 33" W	30	4.8
Little Campbell River	LCR21	1084	49° 2' 26" N	122° 39' 33" W	49° 1' 52" N	122° 39' 27" W	15	3.3
Little Campbell River	LCR22	1101	49° 1' 52" N	122° 39' 27" W	49° 1' 20" N	122° 39' 18" W	15	3.3
Little Campbell River	LCR23	2116	49° 1' 20" N	122° 39' 18" W	49° 0' 50" N	122° 37' 58" W	15	6.3
Little Campbell River	LCR24	1593	49° 0' 50" N	122° 37' 58" W	49° 0' 43" N	122° 36' 51" W	15	4.8
Little Campbell River	LCR25	1632	49° 0' 43" N	122° 36' 51" W	49° 0' 33" N	122° 35' 48" W	15	4.9
Little Campbell River	LCR26	1042	49° 0' 33" N	122° 35' 48" W	49° 0' 36" N	122° 35' 18" W	30	6.3
Little Campbell River	LCR27	2137	49° 0' 36" N	122° 35' 18" W	49° 1' 23" N	122° 34' 11" W	30	12.8
Little Campbell River	LCR50	588	49° 1' 19" N	122° 41' 39" W	49° 1' 24" N	122° 41' 15" W	10	1.2
Little Campbell River	LCR51	437	49° 1' 24" N	122° 41' 15" W	49° 1' 28" N	122° 40' 57" W	15	1.3
Little Campbell River	LCR63	509	49° 2' 49" N	122° 40' 30" W	49° 3' 2" N	122° 40' 20" W	15	1.5
Little Campbell River	LCR76	535	49° 0' 36" N	122° 35' 18" W	49° 0' 38" N	122° 34' 53" W	15	1.6
Little Campbell River	LCR82	202	49° 1' 53" N	122° 41' 13" W	49° 1' 56" N	122° 41' 6" W	15	0.6

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Miami River	MIA1 Left	1783	49° 18' 15" N	121° 47' 35" W	49° 17' 50" N	121° 46' 38" W	15	2.7
Miami River	MIA1 Right i	673	49° 18' 15" N	121° 47' 35" W	49° 18' 3" N	121° 47' 10" W	15	1.0
Miami River	MIA1 Right ii	358	49° 18' 3" N	121° 47' 10" W	49° 18' 5" N	121° 46' 56" W	30	1.1
Miami River	MIA1 Right iii	837	49° 18' 5" N	121° 46' 56" W	49° 17' 50" N	121° 46' 38" W	15	1.3
Miami River	MIA2	1564	49° 17' 50" N	121° 46' 38" W	49° 17' 8" N	121° 46' 39" W	30	9.4
Miami River	MIA3	446	49° 17' 8" N	121° 46' 39" W	49° 16' 59" N	121° 46' 55" W	30	2.7
Miami River	MIA4	1446	49° 16' 59" N	121° 46' 55" W	49° 16' 24" N	121° 47' 35" W	20	5.8
Miami River	MIA5	853	49° 16' 24" N	121° 47' 35" W	49° 15' 58" N	121° 47' 31" W	15	2.6
Miami River	MIA13	1699	49° 17' 35" N	121° 46' 23" W	49° 16' 49" N	121° 46' 0" W	30	10.2
Mountain Slough	MTN1	382	49° 14' 2" N	121° 51' 21" W	49° 14' 12" N	121° 51' 21" W	5	0.4
Mountain Slough	MTN2	1370	49° 14' 12" N	121° 51' 21" W	49° 14' 50" N	121° 51' 19" W	15	4.1
Mountain Slough	MTN3	425	49° 14' 50" N	121° 51' 19" W	49° 15' 2" N	121° 51' 12" W	15	1.3
Mountain Slough	MTN4	590	49° 15' 2" N	121° 51' 12" W	49° 15' 13" N	121° 50' 59" W	15	1.8
Mountain Slough	MTN5	836	49° 15' 13" N	121° 50' 59" W	49° 15' 30" N	121° 50' 39" W	15	2.5
Mountain Slough	MTN6	630	49° 15' 30" N	121° 50' 39" W	49° 15' 44" N	121° 50' 23" W	30	3.8
Mountain Slough	MTN26 Left	278	49° 14' 50" N	121° 51' 19" W	49° 14' 52" N	121° 51' 7" W	15	0.4
Mountain Slough	MTN26 Right i	90	49° 14' 50" N	121° 51' 19" W	49° 14' 49" N	121° 51' 16" W	30	0.3
Mountain Slough	MTN26 Right ii	49	49° 14' 49" N	121° 51' 16" W	49° 14' 50" N	121° 51' 14" W	15	0.1
Mountain Slough	MTN26 Right iii	107	49° 14' 50" N	121° 51' 14" W	49° 14' 51" N	121° 51' 9" W	30	0.3
Mountain Slough	MTN26 Right iv	77	49° 14' 51" N	121° 51' 9" W	49° 14' 52" N	121° 51' 7" W	15	0.1
Mountain Slough	MTN27	824	49° 14' 52" N	121° 51' 7" W	49° 15' 6" N	121° 50' 35" W	20	3.3
Mountain Slough	MTN28	1822	49° 15' 7" N	121° 50' 35" W	49° 15' 28" N	121° 49' 21" W	20	7.3
Mountain Slough	MTN29	425	49° 15' 28" N	121° 49' 21" W	49° 15' 26" N	121° 49' 1" W	20	1.7
Mountain Slough	MTN30	621	49° 15' 26" N	121° 49' 1" W	49° 15' 32" N	121° 48' 36" W	20	2.5
Mountain Slough	MTN31	847	49° 15' 32" N	121° 48' 36" W	49° 15' 43" N	121° 48' 10" W	15	2.5

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Mountain Slough	MTN47	630	49° 15' 43" N	121° 48' 10" W	49° 15' 56" N	121° 48' 17" W	15	1.9
Pepin Creek	PEP1	191	49° 0' 8" N	122° 28' 26" W	49° 0' 9" N	122° 28' 17" W	20	0.8
Pepin Creek	PEP2	926	49° 0' 9" N	122° 28' 17" W	49° 0' 34" N	122° 28' 15" W	15	2.8
Pepin Creek	PEP3	156	49° 0' 34" N	122° 28' 15" W	49° 0' 39" N	122° 28' 15" W	30	0.9
Pepin Creek	PEP4	205	49° 0' 39" N	122° 28' 15" W	49° 0' 42" N	122° 28' 6" W	15	0.6
Pepin Creek	PEP6 Left	1102	49° 0' 47" N	122° 27' 42" W	49° 0' 52" N	122° 26' 55" W	15	1.7
Pepin Creek	PEP6 Right i	949	49° 0' 47" N	122° 27' 42" W	49° 0' 48" N	122° 27' 1" W	30	2.8
Pepin Creek	PEP6 Right ii	225	49° 0' 48" N	122° 27' 1" W	49° 0' 52" N	122° 26' 55" W	15	0.3
Pepin Creek	PEP7 Left	745	49° 0' 52" N	122° 26' 55" W	49° 1' 1" N	122° 26' 36" W	15	1.1
Pepin Creek	PEP7 Right i	325	49° 0' 52" N	122° 26' 55" W	49° 1' 2" N	122° 26' 48" W	15	0.5
Pepin Creek	PEP7 Right ii	225	49° 1' 2" N	122° 26' 48" W	49° 1' 1" N	122° 26' 36" W	30	0.7
Pepin Creek	PEP8	327	49° 1' 1" N	122° 26' 36" W	49° 1' 3" N	122° 26' 22" W	30	2.0
Pepin Creek	PEP9 Left	1697	49° 1' 3" N	122° 26' 22" W	49° 1' 31" N	122° 25' 35" W	15	2.5
Pepin Creek	PEP9 Right i	1016	49° 1' 3" N	122° 26' 22" W	49° 1' 27" N	122° 26' 1" W	15	1.5
Pepin Creek	PEP9 Right ii	338	49° 1' 27" N	122° 26' 1" W	49° 1' 27" N	122° 25' 45" W	30	1.0
Pepin Creek	PEP9 Right iii	249	49° 1' 27" N	122° 25' 45" W	49° 1' 31" N	122° 25' 35" W	15	0.4
Pepin Creek	PEP10	560	49° 1' 31" N	122° 25' 35" W	49° 1' 44" N	122° 25' 19" W	15	1.7
Pepin Creek	PEP11	1633	49° 1' 44" N	122° 25' 19" W	49° 2' 21" N	122° 24' 33" W	15	4.9
Pepin Creek	PEP13	1708	49° 0' 9" N	122° 28' 17" W	49° 0' 33" N	122° 27' 52" W	15	5.1
Pepin Creek	PEP17	670	49° 1' 1" N	122° 26' 29" W	49° 1' 20" N	122° 26' 29" W	20	2.7
Pepin Creek	PEP18	263	49° 1' 20" N	122° 26' 29" W	49° 1' 27" N	122° 26' 30" W	10	0.5
Pepin Creek	PEP19	345	49° 1' 27" N	122° 26' 30" W	49° 1' 35" N	122° 26' 36" W	20	1.4
Pepin Creek	PEP20a Left	494	49° 1' 35" N	122° 26' 36" W	49° 1' 45" N	122° 26' 31" W	15	0.7
Pepin Creek	PEP20a Right i	377	49° 1' 35" N	122° 26' 36" W	49° 1' 46" N	122° 26' 36" W	15	0.6

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Pepin Creek	PEP20a Right ii	117	49° 1' 46" N	122° 26' 36" W	49° 1' 45" N	122° 26' 31" W	30	0.4
Pepin Creek	PEP20b Left	376	49° 1' 46" N	122° 26' 35" W	49° 1' 43" N	122° 26' 17" W	15	0.6
Pepin Creek	PEP20b Right	376	49° 1' 46" N	122° 26' 35" W	49° 1' 43" N	122° 26' 17" W	30	1.1
Salmon River	SLN1	5102	49° 10' 37" N	122° 35' 13" W	49° 9' 35" N	122° 35' 22" W	30	30.6
Salmon River	SLN2	1905	49° 9' 35" N	122° 35' 22" W	49° 9' 11" N	122° 35' 25" W	30	11.4
Salmon River	SLN3	1832	49° 9' 11" N	122° 35' 25" W	49° 8' 35" N	122° 35' 59" W	30	11.0
Salmon River	SLN4	1019	49° 8' 35" N	122° 35' 59" W	49° 8' 17" N	122° 36' 24" W	30	6.1
Salmon River	SLN5	1749	49° 8' 17" N	122° 36' 24" W	49° 8' 1" N	122° 35' 46" W	20	7.0
Salmon River	SLN6	1081	49° 8' 1" N	122° 35' 46" W	49° 7' 46" N	122° 35' 14" W	30	6.5
Salmon River	SLN11	1164	49° 4' 55" N	122° 31' 35" W	49° 5' 7" N	122° 30' 54" W	30	7.0
Salmon River	SLN12	1063	49° 5' 7" N	122° 30' 54" W	49° 5' 22" N	122° 30' 15" W	25	5.3
Salmon River	SLN13	1078	49° 5' 22" N	122° 30' 15" W	49° 5' 30" N	122° 29' 29" W	30	6.5
Salmon River	SLN14	606	49° 5' 30" N	122° 29' 29" W	49° 5' 24" N	122° 29' 6" W	30	3.6
Salmon River	SLN15	1725	49° 5' 24" N	122° 29' 6" W	49° 4' 57" N	122° 28' 15" W	30	10.3
Salmon River	SLN16	1014	49° 4' 57" N	122° 28' 15" W	49° 4' 43" N	122° 27' 36" W	15	3.0
Salmon River	SLN17	493	49° 4' 43" N	122° 27' 36" W	49° 4' 35" N	122° 27' 16" W	25	2.5
Salmon River	SLN41	401	49° 5' 5" N	122° 31' 13" W	49° 4' 55" N	122° 31' 5" W	25	2.0
Salmon River	SLN42a	2270	49° 4' 37" N	122° 30' 10" W	49° 4' 37" N	122° 29' 40" W	15	6.8
Salmon River	SLN42b	2270	49° 4' 37" N	122° 30' 10" W	49° 5' 5" N	122° 30' 47" W	15	6.8
Salwein Creek / Hopedale Slough	HDL1 Left	402	49° 5' 28" N	122° 2' 12" W	49° 5' 37" N	122° 1' 58" W	15	0.6
Salwein Creek / Hopedale Slough	HDL1 Right i	177	49° 5' 28" N	122° 2' 12" W	49° 5' 29" N	122° 2' 5" W	30	0.5
Salwein Creek / Hopedale Slough	HDL1 Right ii	331	49° 5' 29" N	122° 2' 5" W	49° 5' 37" N	122° 1' 58" W	15	0.5

Watershed	Reach code	Approximate reach length (m)	Reach start point (dms)[110] latitude	Longitude start	Latitude end [111]	Longitude end	Riparian critical habitat width on each bank for entire reach length (m)	Area of riparian critical habitat associated with the reach (ha)
Salwein Creek / Hopedale Slough	HDL2	481	49° 5' 33" N	122° 1' 57" W	49° 5' 45" N	122° 1' 44" W	20	1.9
Salwein Creek / Hopedale Slough	HDL3	652	49° 5' 45" N	122° 1' 44" W	49° 5' 52" N	122° 1' 19" W	20	2.6
Salwein Creek / Hopedale Slough	HDL4	437	49° 5' 52" N	122° 1' 19" W	49° 5' 53" N	122° 1' 6" W	30	2.6
Salwein Creek / Hopedale Slough	HDL5	604	49° 5' 53" N	122° 1' 6" W	49° 5' 49" N	122° 0' 49" W	15	1.8
Salwein Creek / Hopedale Slough	HDL6	266	49° 5' 33" N	122° 1' 57" W	49° 5' 34" N	122° 1' 46" W	25	1.3
Salwein Creek / Hopedale Slough	SWN1	1380	49° 5' 20" N	122° 3' 34" W	49° 5' 30" N	122° 2' 40" W	30	8.3
Salwein Creek / Hopedale Slough	SWN2 Left	844	49° 5' 30" N	122° 2' 48" W	49° 5' 42" N	122° 2' 31" W	15	1.3
Salwein Creek / Hopedale Slough	SWN2 Right i	436	49° 5' 30" N	122° 2' 48" W	49° 5' 45" N	122° 2' 44" W	15	0.7
Salwein Creek / Hopedale Slough	SWN2 Right ii	261	49° 5' 45" N	122° 2' 44" W	49° 5' 42" N	122° 2' 31" W	30	0.8
Salwein Creek / Hopedale Slough	SWN3	1404	49° 5' 42" N	122° 2' 31" W	49° 5' 45" N	122° 2' 3" W	25	7.0
Salwein Creek / Hopedale Slough	SWN4	720	49° 5' 38" N	122° 2' 4" W	49° 5' 54" N	122° 1' 55" W	30	4.3
Salwein Creek / Hopedale Slough	SWN9	877	49° 5' 27" N	122° 3' 20" W	49° 5' 47" N	122° 2' 51" W	30	5.3
Salwein Creek / Hopedale Slough	SWN10	412	49° 5' 37" N	122° 2' 50" W	49° 5' 45" N	122° 2' 54" W	25	2.1
Salwein Creek / Hopedale Slough	SWN13	755	49° 5' 46" N	122° 2' 39" W	49° 5' 51" N	122° 2' 8" W	30	4.5

Watershed	Reach code	Appro-ximate reach length (m)	Reach start point (dms)[110] latitude	Longitude start	Latitude end [111]	Longitude end	Riparian critical habitat width on each bank for entire reach length (m)	Area of riparian critical habitat associated with the reach (ha)
Salwein Creek / Hopedale Slough	SWN14	945	49° 5' 51" N	122° 2' 8" W	49° 6' 13" N	122° 1' 40" W	30	5.7
Salwein Creek / Hopedale Slough	SWN27a	1384	49° 5' 38" N	122° 2' 12" W	49° 5' 39" N	122° 2' 11" W	15	4.2
Salwein Creek / Hopedale Slough	SWN27b	1384	49° 5' 38" N	122° 2' 12" W	49° 5' 46" N	122° 2' 22" W	15	4.2