Bulkley River Watershed Connectivity Remediation Plan: 2021 - 2031

Canadian Wildlife Federation

19-08-2024

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Acknowledgements

This plan represents the culmination of a collaborative planning process undertaken in the Bulkley River watershed over many months of work with a multi-partner planning team of individuals and groups passionate about the conservation and restoration of freshwater ecosystems and the species they support. Plan development was funded by the BC Salmon Restoration and Innovation Fund and the RBC Bluewater Project. We were fortunate to benefit from the feedback, guidance, and wisdom of many groups and individuals who volunteered their time throughout this process — this publication would not have been possible without the engagement of our partners and the planning team. (see Table 16).

We recognize the incredible fish passage and connectivity work that has occurred in the Bulkley River watershed to date, and we are excited to continue partnering with local groups and organizations to build up existing initiatives and provide a road map to push connectivity remediation forward over the next 10 years and beyond

The Canadian Wildlife Federation recognizes that the lands and waters that form the basis of this plan are the traditional unceded territory of the Wet'suwet'en and Gitxsan peoples. We are grateful for the opportunity to learn from the stewards of this land and work together to benefit Pacific Salmon and Steelhead. A special thank you to Dallas Nikal, Mike Ridsdale, and Elaine Sampson for sharing the traditional Witsuwit'en and Gitxsanimax names used in this plan.

Project Overview

Connectivity Plan Purpose and Approach

The following Watershed Connectivity Remediation Plan (WCRP) represents the culmination of a one-year collaborative planning effort for the Bulkley River watershed (excluding the Morice River, see Project Scope), the overall aim of which is to clarify and reduce the threat of aquatic barriers to anadromous salmonids and the livelihoods that they support, including the values and laws of First Nations, as well their continued sustenance, cultural, and ceremonial needs both now and into the future. This 10-year plan was developed to identify priority actions that the Bulkley River WCRP planning team (see Table 16 for a list of team members) will undertake between 2021-2031 to conserve and restore fish passage in the watershed through strategies aimed at barrier remediation, barrier prevention, and strengthening Indigenous connections to land and water.

WCRPs are long-term, actionable plans that blend local stakeholder and rightsholder knowledge with innovative GIS analyses to gain a shared understanding of where remediation efforts will have the greatest benefit for anadromous salmonids. The planning process is inspired by the Conservation Standards (v.4.0), which is a conservation planning framework that allows planning teams to systematically identify, implement, and monitor strategies to apply the most effective solutions to high priority conservation problems. There is a rich history of connectivity and fish passage planning and remediation work in the Bulkley River watershed that this WCRP builds upon, including the work undertaken by the BC Fish Passage Technical Working Group, the Skeena Fisheries Commission, the Office of the Wet'suwet'en, the Wet'suwet'en First Nation, and the Society for Ecosystem Restoration in Northern British Columbia (SERNbc) among others (Wilson and Rabnet. (2007), McCarthy and Fernando (2015), Smith (2018), Casselman and Stanley (2010), Irvine (2018)). The Canadian Wildlife Federation will continue to engage and coordinate with local partners and existing initiatives, in part through the Skeena Environmental Stewardship Initiative. SERNbc is also currently undertaking undertaking fish passage work in the Bulkley River watershed, with some overlap and some differences in scope compared to the work and processes described in this WCRP. The SERNbc project relies on expert knowledge and field assessments in both the Bulkley and Morice watersheds to improve passage for all fish, including fluvial and resident species, and focuses on stream crossings that act as barriers (Irvine (2021)). This WCRP focuses specifically on improving connectivity for anadromous salmonid species and uses consensus-based planning exercises and spatial model implementation to develop watershed-scale status assessments, goal setting, and prioritization for multiple barrier types. SERNbc and the WCRP

planning team are currently collaborating on the development of the bcfishpass connectivity model and will continue to work together to promote coordination and collaboration between the two initiatives moving forward.

The planning team compiled existing barrier location and assessment data, habitat data, and previously identified priorities, and combined this with local and Indigenous knowledge to create a strategic watershed-scale plan to improve connectivity. To expand on this work, the Bulkley River WCRP planning team applied the WCRP planning framework to define the "thematic" scope of freshwater connectivity and refine the "geographic" scope to identify those portions of the watershed where barrier prioritization will be conducted, and subsequent remediation efforts will take place. Additionally, the team selected target fish species, assessed their current connectivity status in the watershed, defined concrete goals for gains in connectivity, and developed a priority list of barriers for remediation to achieve those goals. During the 2021 field season, 28 barrier assessments and 21 habitat confirmations were completed. Seventeen barriers were added to the intermediate barrier list based on 2021 field assessments, and an additional 17 crossings were removed from the list, due to being passable, not existing, or having low quality habitat (see Table 10). The preliminary barriers list was further divided this year into an "intermediate barriers" list (see Table 11), which includes barriers that require further assessment, and a "priority barriers" list (see Table 12), which includes barriers that are actively being pursued for design and remediation. While the current version of this plan is based on the best-available information at the time of publishing, WCRPs are intended to be "living plans" that are updated regularly as new information becomes available, or if local priorities and contexts change. As such, this document should be interpreted as a current "snap-shot" in time, and future iterations of this WCRP will build upon the material presented in this plan to continuously improve aquatic barrier remediation for migratory fish in the Bulkley River watershed. For more information on how WCRPs are developed, see Mazany-Wright, Noseworthy, et al. (2021).

Vision Statement

Healthy, well-connected streams and rivers within the Bulkley River watershed support thriving populations of migratory and resident fish. In turn, these fish provide the continued sustenance, cultural, and ceremonial needs of the Wet'suwet'en and Gitxsan peoples, as they have since time immemorial. First Nations, residents, and visitors to the watershed work together for environmental stewardship to clarify, implement, and assess the effectiveness of actions to mitigate the negative effects of aquatic barriers, improving the resiliency of streams and rivers for the benefit and appreciation of all.

Project Scope

Connectivity is a critical component of freshwater ecosystems that encompasses a variety of factors related to ecosystem structure and function, such as the ability of aquatic organisms to disperse and/or migrate, the transportation of energy and matter (e.g., nutrient cycling and sediment flows), and temperature regulation (Seliger and Zeiringer (2018).). Though each of these factors are important when considering the health of a watershed, for the purposes of this WCRP the term "connectivity" is defined as the degree to which aquatic organisms can disperse and/or migrate freely through freshwater systems. Within this context, connectivity is primarily constrained by physical barriers including anthropogenic infrastructure such as dams, weirs, and stream crossings, and natural features such as waterfalls and debris flows. This plan is intended to focus on the direct remediation and prevention of localized, physical barriers instead of the broad land-use patterns that are causing chronic connectivity issues in the watershed. The planning team decided that the primary focus of this WCRP is addressing barriers to longitudinal connectivity (i.e., along the upstream-downstream plane) due to the magnitude of the threat posed by linear development (i.e., road and rail lines) in the watershed.

The primary geographic scope of this WCRP is the Bulkley River watershed, located in the mid-eastern portion of the Skeena River drainage basin in northwestern British Columbia (Figure 1). The scope constitutes the Bulkley River "watershed group" as defined by the British Columbia Freshwater Atlas (FWA). A consistent spatial framework was necessary to undertake a watershed-selection process at the provincial scale to identify target watersheds to improve connectivity for salmonids. The Bulkley River watershed was identified by the BC Fish Passage Restoration Initiative as one of four target watersheds for WCRP development Mazany-Wright, Norris, et al. (2021b). The Bulkley River watershed has a drainage area of 776,200 ha, spanning from Bulkley Lake in the southeast to the confluence with the Skeena River in the northwest. The watershed is generally divided into the "lower" Bulkley River and the "upper" Bulkley River by the confluence with the Morice River near the town of Houston. Culturally and economically important populations of Chinook Salmon (Oncorhynchus tshawytscha), Coho Salmon (Oncorhynchus kisutch), Sockeye Salmon (Oncorhynchus nerka), and Steelhead (Oncorhynchus mykiss) are all found in the watershed, which historically supported Indigenous sustenance and trading economies (Table 1; Irvine (2021)).

Table 1: Target fish species in the Bulkley River watershed. The Gitxsanimax, Witsuwit'en, and Western common and scientific species names are provided.

Gitxsanimax	Witsuwit'en	Common Name	Scientific Name
Ya'aa	Ggïs	Chinook Salmon	Oncorhynchus tshawytscha
Eek	Deedzex	Coho Salmon	Oncorhynchus kisutch
Mi'soo	Taalook	Sockeye Salmon	Oncorhynchus nerka
Milit	Tësdlï	Steelhead	Oncorhynchus mykiss

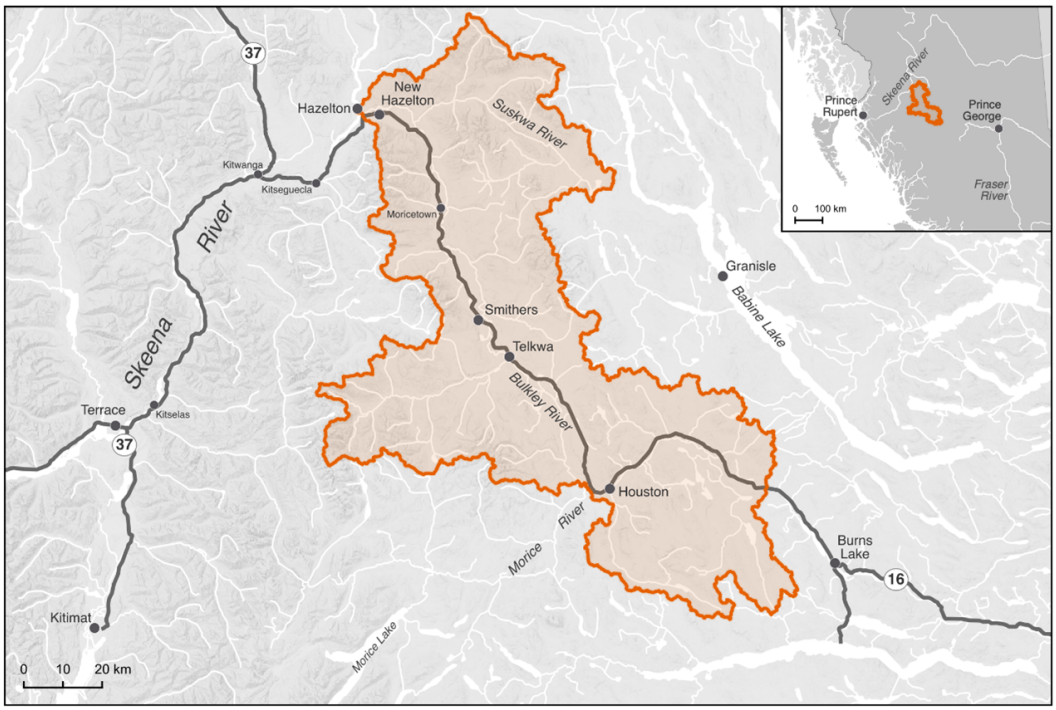

Figure 1: The primary geographic scope — the Bulkley River watershed, excluding the Morice River drainage.

The Bulkley River watershed comprises parts of the traditional territories of two matrilineal nations:

- Gitxsan peoples– the traditional Gitxsan Laxyip spans the northern portion of the watershed, including the Suskwa River, and is governed by a hereditary system of 60 Wilps or House Groups who are represented by Simgigyat (hereditary chiefs). Each Wilp has jurisdiction over several Anaat, or fishing sites. The Wilp groups that have territory coinciding with the Bulkley River watershed include Djogaslee, Gyet'm Galdo'o, Luutkudziiwas, Axtii Tsex, Yagosip, and Spookw (G. Sebastian pers. comm.). The Gitxsan steward the land and waters based on Ayookw (Gitxsan law) and Adaakw (oral histories; Government (2019), Irvine (2021)). It is necessary to receive permission from the individual Wilp chief for any work to occur on their territory.
- Wet'suwet'en peoples– the Wedzin Kwah (Bulkley River watershed) is part of the larger Wet'suwet'en traditional territory. The hereditary territory is governed by a system made up of five clans – Gilseyhu (Big Frog), Laksilyu (Small Frog), Tsayu (Beaver), Gitdumden (Wolf/Bear) and Laksamshu (Fireweed) – each of which comprises multiple Yikhs (House Groups) represented by hereditary chiefs. The Wet'suwet'en steward the land based on Inuk Nu'at'en (Wet'suwet'en law), and the principle of Yintahk, meaning everything is connected to the land (Office of the Wet'suwet'en (2013), Irvine (2021)). It is necessary to receive permission from the appropriate bands (Witset First Nation or Wet'suwet'en first Nation, Skin Tyee, Nee Tahi Buhn, or Burns Lake Band), nation representatives (Office of the Wet'suwet'en (2013)), and the individual Yikh chiefs for any work to occur on their territory.

The geographic scope of this WCRP was further refined by identifying "potentially accessible" stream segments, which are defined as streams that target species should be able to access in the absence of anthropogenic barriers (Figure 2). Potentially accessible stream segments were spatially delineated using fish species observation and distribution data, as well as data on "exclusionary points", which are waterfalls greater than 5 m in height and gradient barriers based on species-specific swimming abilities. These maps were explored by the planning team to incorporate additional local knowledge, ensure accuracy, and finalize the constraints on potentially accessible stream segments. All other stream segments were removed from the scope for further consideration. The "constrained geographic scope" formed the foundation for all subsequent analyses and planning steps, including mapping and modelling useable habitat types, quantifying the current connectivity status, goal setting, and action planning Mazany-Wright, Norris, et al. (2021a).

Target Species

Target species represent the ecologically and culturally important species for which habitat connectivity is being conserved and/or restored in the watershed. In the Bulkley River watershed,

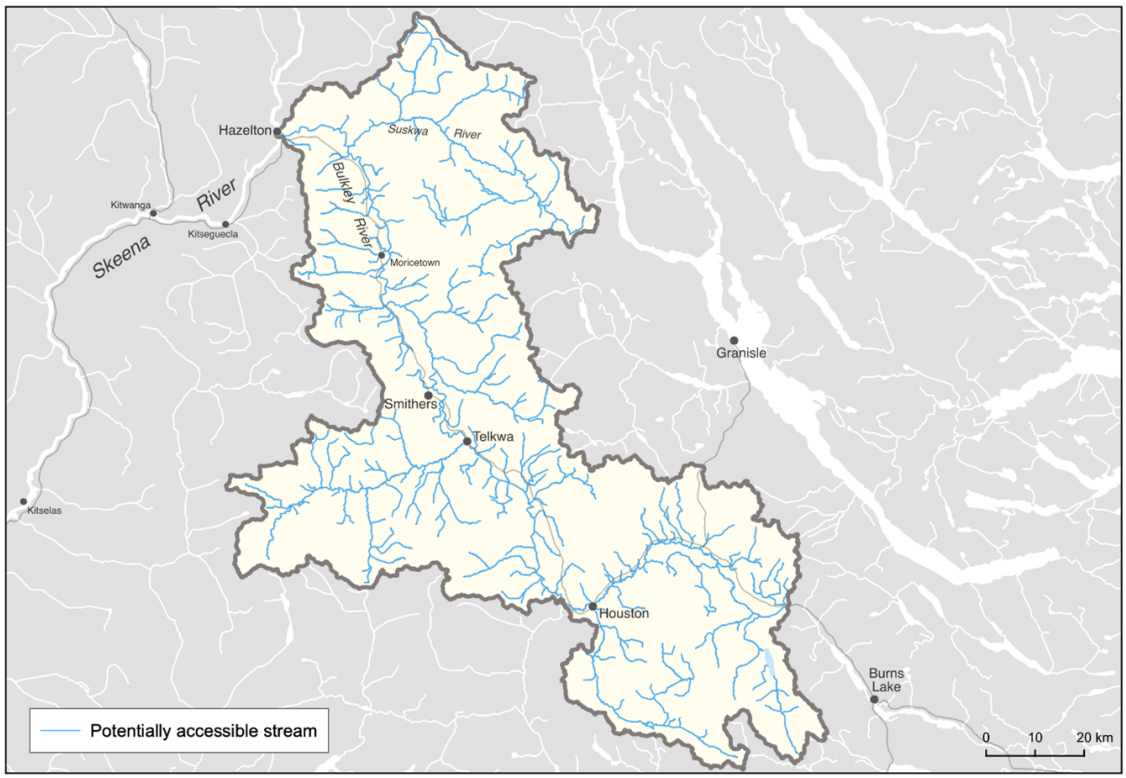

Figure 2: Potentially accessible stream segments within the Bulkley River watershed. These do not represent useable habitat types, but rather identifies the stream segments within which habitat modelling and barrier mapping and prioritization was undertaken.

the planning team selected Anadromous Salmonids as the target species group, which comprises Chinook Salmon, Coho Salmon, Sockeye Salmon, and Steelhead. Anadromous salmonids also include Pink Salmon (Oncorhynchus gorbuscha) and Chum Salmon (Oncorhynchus keta) as beneficiary species (i.e., species that are not actively targeted through the planning process but will also benefit from connectivity improvements for target anadromous species in the watershed). The selection of these target species was driven primarily by the target species of the primary fund supporting this planning work. The planning team also identified other culturally and ecologically important species within the watershed to consider for inclusion in future iterations of the WCRP, including Pacific Lamprey (Entosphenus tridentatus) and Bull Trout (Salvelinus confluentus).

Anadromous Salmonids

Anadromous salmonids are cultural and ecological keystone species that contribute to productive ecosystems by contributing marine-derived nutrients to the watershed and forming an important food source for grizzly bears and other species Schindler and Quay (2003). Salmon have enduring food, social, and ceremonial value for the Gitxsan and Wet'suwet'en peoples and contribute significant economic value for recreational and commercial fisheries. Salmon have sustained the culture and economies of Indigenous peoples in the watershed since time immemorial – providing the primary food source for communities, supporting wide-ranging trade systems, and helping pass knowledge and ceremony to future generations through fishing and fish processing (SSAF (2021), Office of the Wet'suwet'en (2013), Rescan (2012)).

Anadromous salmonid populations in the Bulkley River watershed have declined significantly in recent decades, leading both the Gitxsan and Wet'suwet'en nations to declare harvest moratoriums or fishing bans in their territories (Office of the Wet'suwet'en (2013), Government (2019)). The stewardship of these resources in their territories are imbued in the spirit and culture of these nations through a symbiotic relationship with these fish species – threats to the fish are threats to the well-being of the Wet'suwet'en and Gitxsan peoples (SSAF (2021)). The stewardship of their waters continues through the work of the Gitksan Watershed Authorities and the Wet'suwet'en Fisheries Program, as well as collaborative initiatives like the Skeena Environment Stewardship Initiative.

For the purposes of this WCRP, anadromous salmonid populations are defined using Fisheries and Oceans Canada's Conservation Units. A Conservation Unit (CU) is a group of wild Pacific salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable timeframe, such as a human lifetime or a specified number of salmon generations. Conservation Units are not defined for Steelhead, as such there is no assessment information to provide for the Bulkley River watershed population. See Appendix A for maps of modelled anadromous salmonid spawning and rearing habitat in the Bulkley River watershed.

Chinook Salmon | Ya'aa | Ggïs| Oncorhynchus tshawytscha

Table 2: Chinook Salmon Conservation Units assessments in the Bul
sessments undertaken by the Pacific Salmon Foundation (2

Conservation Unit	Biological Status	Run timing	Trend in spawner abundance (al
Middle Skeena – Mainstem Tributaries	Good	July-September	575%
Upper Bulkley River	Data Deficient	Data Deficient	Data Deficient

The Middle Skeena – Mainstem Tributaries Chinook Salmon spawn in the mainstem Bulkley River (downstream of the confluence with the Morice River) and in key tributaries, including Telkwa River, Goathorn Creek, Howson Creek, Kathlyn Creek, Suskwa River, Harold Price Creek, and Natlan Creek. The Middle Skeena Chinook Salmon stocks have seen a decline in recent years, particularly over the last three generations of spawners Pacific Salmon Explorer. The upper Bulkley River Chinook Salmon (upstream of the confluence with the Morice River) are the first salmon to return in the year, usually early-to-mid June, marking the start of the salmon fishery in the watershed Office of the Wet'suwet'en (2013). The upper Bulkley River population is known to spawn in the mainstem and tributaries of the Bulkley River, including Buck Creek, Byman Creek, Richfield Creek, Maxan Creek, and Foxy Creek. In some years, low water flows prevent adult Chinook Salmon from migrating past Bulkley Falls. The upper Bulkley Chinook Salmon stocks have been observed to be in decline and are threatened, in part, by habitat degradation, including linear development (e.g., highway, rail, and road infrastructure) that fragments tributaries (Office of the Wet'suwet'en (2013), Pacific Salmon Explorer).

Coho Salmon | Eek | Deedzex | Oncorhynchus kisutch

Table 3: Coho Salmon Conservation Unit assessment in the Bulkley River Wa
ments undertaken by the Pacific Salmon Foundation (2020).

Conservation Unit	Biological Status	Run timing	Trend in spawner abundance (all available data)	T
Middle Skeena	Good	July-September	82%	-2

Coho Salmon are the most widely dispersed anadromous salmonid species in the Bulkley River watershed due to their ability to move into smaller tributaries, including headwater streams. Coho Salmon spawning migration peaks in early-to-mid August, though traditionally the main Coho Salmon fishery occurs later in the season (Office of the Wet'suwet'en (2013)). Spawning and rearing of the Middle Skeena population is known to occur within the watershed in the mainstem channels of the Bulkley, Telkwa, and Suskwa Rivers, and key tributaries, including

Buck Creek, Aitken Creek, McQuarrie Creek, Byman Creek, Richfield Creek, Ailport Creek, and Maxan Creek. In recent decades, Coho Salmon distribution has often been limited to areas downstream of Bulkley Falls, but in years with sufficient flow, tributaries upstream of the falls are well-used by rearing juveniles (M. Risdale pers. comm.). The Coho Salmon population in the watershed appeared to begin recovering around 1998 but has since declined over the last three generations of spawners (Office of the Wet'suwet'en (2013), PSF 2014). Additionally, since 1989, tens of thousands of Coho Salmon fry have been released into the upper Bulkley River mainstem from the Toboggan Hatchery on Toboggan Creek (Office of the Wet'suwet'en (2013)).

Sockeye Salmon | Mi'soo | Taalook | Oncorhynchus nerka

Table 4: Sockeye Salmon Conservation Unit Assessments in the Bulkle
There were not enough data to support assessments for Sockeye S
at the time of analysis. Assessments undertaken by the Pacific S
(2020).

Conservation Unit	Biological Status	Run timing	Trend in spawner abundance (all available d
Bulkley/Maxan (Lake type)	Data Deficient	Data Deficient	Data Deficient
Skeena River (River-type)	Data Deficient	Data Deficient	Data Deficient

Sockeye Salmon have cultural and commercial importance within the watershed, especially for First Nations communities, in part due to their fat content which is optimal for the smoke-drying process. Limitations on the Sockeye Salmon harvest in the watershed have hindered the ability of the Wet'suwet'en and Gitxsan to practice important cultural activities and the associated sharing of oral traditions and histories (SSAF (2021), Office of the Wet'suwet'en (2013)). The Sockeye Salmon runs generally follow the spring Chinook Salmon migrations in the Bulkley River system, but Bulkley Falls and flows in some parts of Maxan Creek can limit migration during low-flow years. Data are insufficient for population assessments; however, it is believed that the Bulkley/Maxan populations are at risk of extirpation. There are two Sockeye Salmon populations present in the watershed with distinct life histories – the lake-type and the river-type (Office of the Wet'suwet'en (2013), PSF 2014). Two lake-type Sockeye Salmon sub-populations spawn and rear in and around Bulkley Lake and Maxan Lake, and a third lake-type sub-population was extirpated from Toboggan Lake. River-type Sockeye distribution and habitat use within the Bulkley River watershed is not well documented; however, there are records of Sockeye Salmon river spawners in the mainstem Bulkley River around Richfield Creek, McQuarrie Creek, the Morice River confluence, and the Suskwa River mainstem near Natlan Creek.

Steelhead | Milit | Tësdlï | Oncorhynchus mykiss

Steelhead migrations coincide with the arrival of Coho Salmon in the watershed and are an important traditional food source to augment winter stores (Office of the Wet'suwet'en (2013)). Steelhead are known to spawn and rear in the mainstem Bulkley River and important tributaries, including the Telkwa River, Hubert Creek, Buck Creek, McQuarrie Creek, Byman Creek, Richfield Creek, Ailport Creek, Johnny David Creek, and Robert Hatch Creek. In the lower part of the watershed, Steelhead are known to spawn and rear throughout the Suskwa River system, all the way up through Harold Price Creek and Blunt Creek. Local knowledge indicates that Steelhead populations have been declining in recent decades and are currently in poor condition throughout the entire watershed. In response, some stocking enhancement actions have been undertaken in an attempt to increase the population in the watershed (Office of the Wet'suwet'en (2013), Chudyk (1979)).

Barrier Types

The following table highlights which barrier types pose the greatest threat to anadromous salmon in the watershed. The results of this assessment were used to inform the subsequent planning steps, as well as to identify knowledge gaps where there is little spatial data to inform the assessment for a specific barrier type.

Table 5: Barrier Types in the Bulkley River watershed and barrier rating assessment results. For each barrier type listed, Extent refers to the proportion of anadromous salmonid habitat that is being blocked by that barrier type, Severity is the proportion of structures for each barrier type that are known to block passage for target species based on field assessments, and Irreversibility is the degree to which the effects of a barrier type can be reversed and connectivity restored. The amount of habitat blocked used in this exercise is a representation of total amount of combined spawning and rearing habitat.

Barrier Types	Extent	Severity	Irreversibility	Overall Threat Rating:
Road-Stream Crossings	High	Very High	Medium	High
Rail-stream Crossings	Low	Low	Medium	High
Natural Barriers	Medium	Very High	Medium	Medium
Lateral Barriers	Medium	High	Medium	Medium
Large Dams(>3m height)	Low	Very High	High	Low
Small Dams(<3m height)	Low	Very High	Medium	Low
Trail-stream Crossings	Medium	Medium	Low	Low

Road-stream Crossings

Road-stream crossings are the most abundant barrier type in the watershed, with 48 assessed and modelled crossings located on stream segments with modelled habitat. Demographic road crossings (highways, municipal, and paved roads) block 4.84 of habitat (1% of the total blocked habitat), with 0% of assessed crossings having been identified as barriers to fish passage. Resource roads block 4.84 km of habitat (1%), with 0% of assessed crossings have been identified as barriers. Significant land use and linear development throughout the valley bottom has disconnected the Bulkley River from important habitat in many tributaries, including Highway 16 which represents one of the main drivers of fragmentation in the watershed (see Table 9). The collective experience and input from the planning team resulted in a Medium irreversibility rating due to the technical complexity and resources required to remediate road-stream crossings, though it was noted that this differs considerably between resource roads and highway crossings.

Rail-stream crossings

There are relatively few rail-stream crossings in the watershed (24 crossings on "potentially accessible" streams), but those that exist block significant amounts of habitat (4.84 km or 1% of the total habitat blocked), with more than half of assessed crossings (0%) acting as barriers to anadromous salmonids. All rail-stream crossings in the watershed are associated with the Canadian National (CN) railway running along the Bulkley River. With significant financial costs, technical challenges, and stakeholder engagement required with CN to remediate these barriers, the planning team decided on an overall pressure rating of High for this barrier type.

Lateral Barriers

There are numerous types of lateral barriers that potentially occur in the watershed, including dykes, berms, and linear development (i.e., road and rail lines), all of which can restrict the ability of anadromous salmonids to move into floodplains, riparian wetlands, and other off-channel habitats. No comprehensive lateral barrier data exists within the watershed, so pressure ratings were based on qualitative local knowledge. Lateral barriers are not thought to be as prevalent as road- or rail-stream crossings but are likely very severe where they do exist. Highway 16 and the CN rail line that run along a significant stretch of the Bulkley River were identified as major lateral barriers that disconnect the mainstem river from its historic floodplain and off-channel habitat. Overall, the planning team decided that a Medium pressure rating adequately captured the effect that lateral barriers are having on connectivity in the watershed, while recognizing that the lack of data on lateral barriers in the watershed is an important knowledge gap to fill.

Natural Barriers

Natural barriers to fish passage can include debris flows, log jams, sediment deposits, etc., but natural features that have always restricted fish passage (e.g., waterfalls) are not considered under this barrier type. Natural barriers are difficult to include in a spatial prioritization framework due to their transient nature. The planning team felt that the extent of natural barriers in the watershed is seasonal and fluctuates with freshet flow levels. Both current and historic land-use practices, including historic mining and current forest-harvesting impacts, have created sediment wedges that can act as significant barriers to anadromous salmonids. Due to the nature of these land-use practices, the severity of natural barriers was rated as High and the irreversibility as Medium, the latter due to the nature of what would be required to rectify poor land-use practices at a watershed scale. Overall, the planning team felt that a pressure rating of Medium adequately captured the effects of natural barriers.

Large Dams (>3m height) and Small Dams (<3m height)

There are 24 mapped large and small dams on "potentially accessible" stream segments in the watershed, blocking 4.84 km (1.26% of the total blocked habitat) of modelled spawning and rearing habitat, resulting in a Low extent. The extent rating of these structures was confirmed by the planning team. There is only one known fish passage structure in the watershed and the remaining dams likely block passage for anadromous salmonids. Remediating these dams will require significant resources; however, due to the Low extent of dams in the watershed, a final pressure rating of Low was assigned.

Trail-stream crossings

There is very little spatial data available on trail-stream crossings in the watershed, so the planning team was unable to quantify the true Extent and Severity of this barrier type. However, the planning team felt that trail-stream crossings are not prevalent within the watershed and that where they do exist, they rarely significantly block passage for anadromous salmonids. Given that most crossings will likely be fords or similar structures, the remediation costs associated with these barriers would be quite low. Overall, the planning team felt that the pressure rating for trail-stream crossings was likely Low.

Connectivity Status Assessment and Goals

Key Ecological Attributes and Current Connectivity Status

The planning team devised two Key Ecological Attributes (KEAs) and associated indicators to assess the current connectivity status of the watershed – Accessible Spawning Habitat and Accessible Rearing Habitat (Table 6). KEAs are the key aspects of anadromous salmonid ecology that are being targeted by this WCRP. The connectivity status for the Anadromous Salmonid KEAs were used to establish goals to improve habitat connectivity in the watershed and will be the baseline against which progress is tracked over time.

The current connectivity status assessment relies on GIS analyses to map known and modelled barriers to fish passage, identify stream reaches that have potential spawning and rearing habitat, estimate the proportion of habitat that is currently accessible to target species, and prioritize barriers for field assessment that would provide the greatest gains in connectivity. To support a flexible prioritization framework to identify priority barriers in the watershed, two assumptions are made: 1) any modelled (i.e., passability status is unknown) or partial barriers are treated as complete barriers to passage and 2) the habitat modelling is binary, it does not assign any habitat quality values. As such, the current connectivity status will be refined over time as more data on habitat and barriers are collected. For more detail on how the connectivity status assessments were conducted, see Appendix B.

Table 6: Connectivity status assessment for spawning (a) and rearing (b) habitat in the Bulkley River watershed. The two KEAs - Accessible Spawning Habitat and Accessible Rearing Habitat - are evaluated by dividing the length of linear habitat (of each type) that is currently accessible to target species by the total length of all linear habitat (of each type) in the watershed.

Target Species	KEA	Indicator	Poor	Fair	Good
Andromous Salmon	Available Spawning Habitat	% of total spawning habitat Current Status:	<50%	51-75%	76-90% 88

Comments: Indicator rating definitions are based on the consensus decisions of the planning team. The current status is based on the CWF Barrier Prioritization Model output, which is current as of October 2022.

Table 7

Target Species	KEA	Indicator	Poor	Fair	Good	Very
Andromous Salmon	Available Rearing Habitat	% of total rearing habitat Current Status:	<50%	51-75% 52	76-90%	>90

Comments: Indicator rating definitions are based on the consensus decisions of the planning team. The current status is based on the CWF Barrier Prioritization Model output, which is current as of October 2022.

Goals

Table 8: Goals to improve spawning (1) and r
in the Bulkley River watershed ove
goals were established through disc
the resulting desired state of connect
change as more information and data
(e.g., the current connectivity status

Goal #	Goal
1	By 2031, the percent (%) of total linear spawning habitat accessible to anadromous salmonids will in
2	By 2031, the percent (%) of total linear rearing habitat accessible to anadromous salmonids will incr

Barrier Prioritization

Bulkley River Watershed Barrier Prioritization Summary

The primary conservation outcome of the WCRP is the remediation of barriers to connectivity in the Bulkley River watershed. To achieve Goals 1 and 2 in this plan, it is necessary to prioritize and identify a suite of barriers that, if remediated, will provide access to a minimum of 86 km of spawning habitat and 211 km of rearing habitat (Table 9):

Table 9: Spawning and rearing habitat connectivity gain requirements to meet WCRP goals in the Bulkley River watershed. The measures of currently accessible and total habitat values are derived from the Intrinsic Potential habitat model described in Appendix B.

Habitat Type	Currently accessible (km)	Total	Current Connectivity Status	Goal	Gain required (km)
Spawning	249.9	284.62	88%	95%	62.43
Rearing	54.91	105.34	52%	80%	62.43

The barrier prioritization process comprises three stages:

- Stage 1: preliminary barrier list
- Stage 2: intermediate barrier list
- Stage 3: priority barrier list

Initially, the barrier prioritization analysis ranked all barriers in the watershed by the amount of habitat blocked to produce a "preliminary barrier list", which also accounted for assessing "sets" of barriers for which remediation could be coordinated to maximize connectivity gains. From this list, the top-ranking subset of barriers - comprising more barriers than are needed to achieve the goals - is selected to produce an "intermediate barrier list". Barriers that did not rank highly in the model results, but were identified as priority barriers by the local partners were also added to the intermediate barrier list. A longer list of barriers is needed due to the inherent assumptions and uncertainty in the connectivity and habitat models and gaps in available data. Barriers that have been modelled (i.e., points where streams and road/rail networks intersect) are assumed to be barriers until field verification is undertaken and structures that have been assessed as "potential" barriers (e.g., may be passable at certain flow levels

or for certain life history stages) require further investigation before a definitive remediation decision is made. Additionally, the habitat model identifies stream segments that have the potential to support spawning or rearing habitat for target species but does not attempt to quantify habitat quality or suitability (see Appendix B), which will require additional field verification once barrier assessments have completed. As such, the intermediate barrier list below (Table 11) should be considered as a starting point in the prioritization process and represents structures that are a priority to evaluate further through barrier assessment and habitat confirmations because some structures will likely be passable, others will not be associated with usable habitat, and others may not be feasible to remediate because of logistic considerations.The intermediate barrier list was updated following the barrier assessments and habitat confirmations that were undertaken during the 2021 field season - some barriers were moved forward to the "priority barrier list" (see Table 12) and others were eliminated from consideration due to one or more of the considerations discussed above (see Table 10). The priority barrier list represents structures that were confirmed to be partial or full barriers to fish passage and that block access to confirmed habitat. Barriers on the priority list were reviewed by planning team members and selected for inclusion for proactive pursual of remediation. For more details on the barrier prioritization model, please see Mazany-Wright, Norris, et al. (2021a).

Table 10: List of cro
assessmen
intermedi
removed
existing,
feasible to

ID	Stream name	Reason for removal from prioritization	Comme
1001805665	Canyon Creek	Structure doesn't exist	Adjacen
197957 (1001801969)	Tributary to Bulkley River	Passable	ATV br
197905 (1001803682)	Crow Creek	Passable	Bridge
197900 (1001805532)	Crow Creek	Passable	Bridge
198041 (1001802760)	Deep Creek	Passable	Bridge
1001802820	Deep Creek	Structure doesn't exist	Crossing
123776	Corya Creek	Passable	Bridge,
1001802044	Ailport Creek	Passable	Bridge c
197955 (1001800422)	Ailport Creek	Passable	Ford
197914 (1001802089)	Johnny David Creek	Passable	Ford cro

ID	Stream name	Reason for removal from prioritization	Comme
197910 (1001804694)	Tributary to Maxan Lake	Passable	Bridge
197964 (1001805529)	Bulkley River	Passable	Embedd
197913 (1001802088)	Robert Hatch Creek	Passable	Ford cr
198042 (1001805553)	Glass Creek	Passable	Likely c
198047 (1001801773)	Boulder Creek	Structure doesn't exist	
197956 (1001801133)	Tributary to Bulkley River	Structure doesn't exist	No cross
123375 (1001800131)	Trib to Thompson Creek	Not suitable habitat	Barrier,
123775 (1001800161)	Witset Creek	Not suitable habitat	Noted a
197903 (1001800180)	Trib to Bulkley River	Not suitable habitat	Low qua
197902 (1001800360)	Trib to Bulkley River	Not suitable habitat	Low qua
197904 (1001800372)	Trib to Bulkley River	Not suitable habitat	Low qua
1001800752	Trib to Elwin	Not suitable habitat	Could n
197972 (1001802040)	Trib to Broman Lake	Not suitable habitat	Low qua
197970 (1001803813)	Trib to Broman Lake	Not suitable habitat	Low qua
197907 (1001802611)	Trib to Maxan Creek	Not suitable habitat	Low qua
197908 (1001803697)	Trib to Maxan Creek	Not suitable habitat	Low qua
197906 (1001803706)	Trib to Maxan Creek	Not suitable habitat	Low qua
197963 (1001805531)	Trib to Bulkley River	Not suitable habitat	Low qua
198044 (1001805573)	Trib to Toboggan Creek	Not suitable habitat	Low qua
197969 (1001800583)	Bulkley River (Conrad Lake)	Passable	Bridge
1001802374	Causqua Creek	Structure doesn't exist	
1001804408	Trib to Klo Creek	Not suitable habitat	Unlikely
1001806000		Not suitable habitat	Unlikely

ID	Stream name	Data source	Assessment Status
124422	Trib to Waterfall Cr	Municipal road crossing	Habitat confirmatio
1001803294	Waterfall Cr	Resource Road	Modelled
198066 (1001802488)	Thompson Cr	Resource road crossing	Habitat confirmatio
198048 (1001800048)	Cesford Creek	Highway crossing	Habitat confirmatio
198090	Cesford Creek	Railway	Barrier Assessment
123446	Tyhee Creek	Demographic road crossing	Habitat confirmatio
58158	McDowell Creek	Highway crossing	Assessed
57944	Toboggan Creek	Highway crossing	Habitat confirmatio
-1001800355	Ailport Creek	Highway crossing	Habitat confirmatio
197967 (1001800050)	Taman Creek/Bulkley River	Highway crossing	Habitat confirmatio
123770	John Brown Creek	Highway crossing	Habitat confirmatio
197663	Johnny David Creek	Highway crossing	Habitat confirmatio
198065 (1001800191)	Watson Creek	Demographic road crossing	Assess 1001800255
197974 (1001800356)	Watson Creek	Highway crossing	Assessed
1100001493	Coffin Creek	Dam	Modelled
123392	Lemieux Creek	Demographic road crossing	Assessed
57793	Vallee Creek	Demographic road crossing	Assessed
57978		Resource road crossing	Assessed
195288	Gibson Creek	Demographic road crossing	Assessed
58242	Kathlyn Creek	Demographic road crossing	Assessed

ID	Stream name	Data source	Assessment Status
58067	Gramophone Creek	Demographic road crossing	Assessed
195559	Four Creek	Resource road crossing	Assessed
123699	Driftwood Creek	Resource road crossing	Assessed
124504	Coffin Creek	Demographic road crossing	Assessed
123426	Robin Creek	Demographic road crossing	Assessed
195290	Gibson Creek	Demographic road crossing	Assessed
195943	Stock Creek	Demographic road crossing	Assessed
197653	Perow Creek	Demographic road crossing	Assessed
123393	Lemieux Creek	Demographic road crossing	Assessed
195944	Stock Creek	Resource road crossing	Assessed
197668	Coffin Creek	Railway crossing	Assessed
1001800865		Resource road crossing	Modelled
123697	Driftwood Creek	Resource road crossing	Assessed
1001801115	Watson Creek	Resource road crossing	Modelled
1001800255	Stock Creek	Demographic road crossing	Modelled
1001801071	Perow Creek	Resource road crossing	Modelled
1001801328	Robin Creek	Resource road crossing	Modelled
1001802047	Bulkley River	Resource road crossing	Modelled
1001804538		Resource road crossing	Modelled
1001801123	Watson Creek	Resource road crossing	Modelled
1001802069	Johnny David Creek	Resource road crossing	Modelled
1001806259	Maish Creek	Resource road crossing	Modelled
1001800670	Vanderven Creek	Resource road crossing	Modelled
1001800403		Demographic road crossing	Modelled
1001802798	Coffin Creek	Resource road crossing	Modelled
1001805019		Resource road crossing	Modelled
1001803607		Resource road crossing	Modelled

ID	Stream name	Data source	Assessment Status
1001802239		Resource road crossing	Modelled
1001801039		Resource road crossing	Modelled
1001805507	Stock Creek	Railway crossing	Modelled
1001802482	Vallee Creek	Resource road crossing	Modelled
1001800067	Perow Creek	Demographic road crossing	Modelled

Aggregated Crossing ID	Stream Name	Road Name	Barrier Owner	PSCIS St
197912 (1001802106)	Robert Hatch	Private	Private	Design
123445	Tyhee Creek	Hwy 16 E	MOTI	Design
124500	Helps Creek	Lawson Rd	MOTI	Design
197640	Trib to Buck Cr	Buck Flats Rd	MOTI	Design
58159	McDowell Creek	Woodmere Nursery	Woodmere Nursery	Design
197665	Barren Creek	Railway	CN Rail	Design
197664	Barren Creek	Hwy 16	MOTI	Design
124420	Station Creek	Hwy 16	MOTI	Design
124424	Trib to Waterfall Cr	Railway Crossing	CN Rail	Assessed
197975 (1001801122)	Ailport Creek	Private	Private	Habitat c
197960 (1024704566)	Corya Creek	Railway	CN Rail	Habitat c
124421	Station Creek	11th Ave	Hazelton	Habitat c
124487	Porphyry Creek	Hwy 16	MOTI	Habitat c
197658	Byman Creek	Hwy 16 E	MOTI	Habitat c
197662	Richfield Cr	Hwy 16 E	MOTI	Habitat c
123377	Thompson Cr	Walcott Rd	MOTI?	Habitat c

Aggregated Crossing ID	Stream Name	Road Name	Barrier Owner	PSCIS St
123544	McDowell Creek	Unnamed	Private	Assessed
1001800193 (198049)	Cesford Creek	Hwy 118	MOTI	Habitat c
58151	McDowell Creek	Woodmere Rd	MOTI?	Habitat c

Thirty barriers on the intermediate list require short-term field assessments before selection as a final barrier to pursue for remediation:

Table 13: Field assessment requirements for the intermediate barrier list in the Bulkley River watershed. The cost per barrier values are estimates based on previously completed field work. The habitat confirmation count is based on the assumption that the 23 barriers requiring barrier assessments will also require a subsequent confirmation. In the case that some barriers are identified as unsuitable candidates for habitat confirmations, the total cost will be reduced.

Field assessment	Cost per barrier	Count	Total costs
Barrier Assessment	$230	23	$5,290
Habitat Confirmation	$3,000	30	$90,000
Total:		53	$95,290

Based on the results of the prioritization analysis, 30 barriers from the intermediate barrier list are required to be remediated to achieve the connectivity goals in this plan:

Table 14: Preliminary barrier remediation cost estimate to reach connectivity goals in the Bulkley River watershed. Cost per barrier values are estimated based on the average cost of previously completed projects. Barrier counts and total costs are subject to change as more information is collected through the implementation of this plan.

Barrier Type	Cost per barrier	Count	Total Cost
Rail	$1,700,000	4	$6,800,000
Highway	$5,200,000	9	$46,800,000
Municipal/paved road	$1,500,000	3	$4,500,000
Resource road	$500,000	15	$7,500,000

Barrier Type	Cost per barrier	Count	Total Cost
Total:		30	$65,600,000

Work Planning

Annual Progress Report

One priority barrier in the Bulkley watershed was removed on McDowell Creek at Woodmere Nursery in summer 2023. This crossing was replaced with a clearspan bridge and opens up approximately 200 m of seasonal off-channel habitat for salmonids during periods of high flow. The Ministry of Transportation and Infrastructure has been working with local partners to advance designs for barriers on Trib to Buck Creek, Helps Creek, Thompson Creek and Gramophone Creek. The Office of the Wet'suwet'en has hired a part-time staff to help with fish passage coordination in the Bulkley watershed. In addition, efforts have been made by CWF and local partners to build a campaign around Station Creek, to convince the BC government to invest in an appropriate crossing at Highway 16.

Operational Plan

The operational plan represents a preliminary exercise undertaken by the planning team to identify the potential leads, potential participants, and estimated cost for the implementation of each action in the Bulkley River watershed. The table below summarizes individuals, groups, or organizations that the planning team felt could lead or participate in the implementation of the plan and should be interpreted as the first step in on-going planning and engagement to develop more detailed and sophisticated action plans for each entry in the table. The individuals, groups, and organizations listed under the "Lead(s)" or "Potential Participants" columns are those that provisionally expressed interest in participating in one of those roles or were suggested by the planning team for further engagement (denoted in bold), for those that are not members of the planning team. The leads, participants, and estimated costs in the operational plan are not binding nor an official commitment of resources, but rather provide a roadmap for future coordination and engagement to work towards implementation of the WCRP.

Strategy / Actions
Strategy 1: Barrier Remediation
1.1 – Remove and decommission barriers
1.2 – Upgrade and resize crossings
1.3 – Install temporary mitigation
1.4 – Raise funds to remediate barriers
1.5 – Request regulatory action for non-compliant crossings
1.6 – Engage with CN to address their barriers
1.7 – Knowledge Gap: Continue updating the barrier prioritization model
1.8 - Knowledge Gap: Adapt the provincial fish passage framework to account for adult fish and low flow cond
1.9 – Knowledge Gap: Assess barriers by applying adapted version of the provincial fish passage framework
Strategy 2: Barrier Prevention
2.1 – Work with forestry licensees to improve their aquatic connectivity practices
2.2 – Monitor new crossing installation compliance with regulations regarding fish passage
Strategy 3: Strengthen Indigenous Connections to Land and Water
3.1 – Develop a First Nations Youth Mentorship capacity building program
3.2 – Engage with Wilp/House Groups for work to occur in their territory
3.3 – First Nations guardianship program to monitor fish passage in the watershed
3.4 – Knowledge Gap: Identify traditional use areas to help inform where to improve connectivity
Strategy 4: Progress Tracking Plan
4.1– Implement the WCRP Progress Tracking Plan
4.2 – Develop a data catalogue on all current information related to aquatic connectivity in the Bulkley Water
4.3 – Expand this WCRP to include the Morice River Watershed
Total:
Fundraising total:
Proponent/government contribution total:

Funding Sources

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Version History

v.1.0 – May 2024

Project Partners

Planning Team

Table 16: Bulkley River watershed WCRP planning team members. Planning team members contributed to the development of this plan by participating in a series of workshops and document and data review. The plan was generated based on the input and feedback of the local groups and organizations list in this table.

Name	Organization
Betty Rebellato	Canadian Wildlife Federation
Nick Mazany-Wright	Canadian Wildlife Federation
Justin Duncan	Canadian Wildlife Federation
Nicolas Lapointe	Canadian Wildlife Federation
Sarah Sra	Canadian Wildlife Federation
Simon Norris	Hillcrest Geographics
Natalie Newman	Department of Fisheries and Oceans Canada
Peter Dekoning	Department of Fisheries and Oceans Canada
Sandra Devcic	Department of Fisheries and Oceans Canada
Brian Williams	Gitxsan Nation
Elaine Sampson	Gitxsan Nation
Gordon Sebastian	Gitxsan Nation
John Degagne	Ministry of Forests, Lands and Natural Resource Operations
Al Irvine	Society for Ecosystem Restoration in Northern BC
Sean Mitchell	Skeena Sustainability Assessment Forum
Jesse Stoeppler	Skeena Watershed Conservation Coalition
David Dewit	Office of the Wet'suwet'en

Name	Organization
Mike Ridsdale	Office of the Wet'suwet'en
Dallas Nikal	Witset First Nation

Key Actors

Individual or Organization Name
B.C. Fish Passage Technical Working Group
Cindy Verbeek/ A Rocha Canada, Upper Bulkley Streamkeepers
Canadian National Rail (CN Rail)
David Wilford – Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRO)
Gitksan Watershed Authorities
Jeff Anderson
Skeena Knowledge Trust
Ken Rabnett
Ministry of Transportation and Infrastructure (MOTI)
Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD)
Environmental Stewardship Initiative – Skeena Sustainability Assessment Forum (ESI:SSAF)
SkeenaWild Conservation Trust
Stu Barns/Skeena Fisheries Commission

Supplementary Information

Situation Analysis

The following situation model was developed by the WCRP partnership to "map" the project context and brainstorm potential actions for implementation. Green text is used to identify actions that were selected for implementation (see 'Strategies & Actions'), and red text is used to identify actions that the project team has decided to exclude from the current iteration of the plan, given that they were either outside of the project scope or were deemed to be ineffective by the planning team.

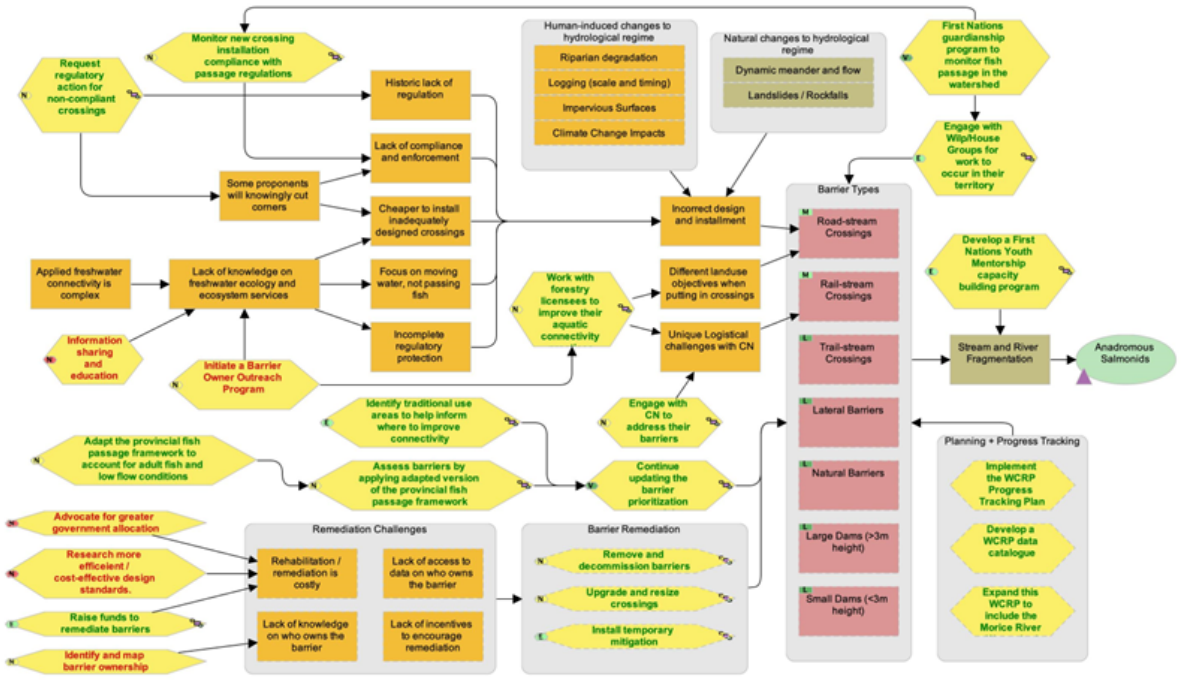

Figure 3: Situation analysis developed by the planning team to identify factors that contribute to fragmentation (orange boxes), biophysical results (brown boxes), and potential strategies/actions to improve connectivity (yellow hexagons) for target species in the Bulkley River watershed.

Strategies & Actions

Effectiveness evaluation of identified conservation strategies and associated actions to improve connectivity for target species in the Bulkley River watershed. The planning team identified four broad strategies to implement through this WCRP, 1) barrier remediation, 2) barrier prevention, 3) strengthen Indigenous connections to land and water, and 4) planning and progress tracking. Individual actions were qualitatively evaluated based on the anticipated effect each action will have on realizing on-the-ground gains in connectivity. Effectiveness ratings are based on a combination of "Feasibility and"Impact", Feasibility is defined as the degree to which the project team can implement the action within realistic constraints (financial, time, ethical, etc.) and Impact is the degree to which the action is likely to contribute to achieving one or more of the goals established in this plan.

Strategy 1: Barrier Remediation

ID	Actions
1.1	Remove and decommission barriers
1.2	Upgrade and resize crossings
1.3	Install temporary mitigation
1.4	Raise funds to remediate barriers
1.5	Request regulatory action for non-compliant crossings
1.6	Engage with CN to address their barriers
1.7	Knowledge Gap: Continue updating the barrier prioritization model
1.8	Knowledge Gap: Adapt the provincial fish passage framework to account for adult fish and low-flow cond
1.9	Knowledge Gap: Assess barriers by applying adapted version of the provincial fish passage framework

Strategy 2: Barrier Prevention

ID	Actions	Details
2.1	Work with forestry licensees to improve their aquatic connectivity practices	This should includ
2.2	Monitor new crossing installation compliance with regulations regarding fish passage	This action could

Strategy 3: Strengthen Indigenous Connections to Land and Water

ID	Actions	Details
3.1	Develop a First Nations Youth Mentorship capacity building program	The progra
3.2	Engage with Wilp/Yikh for work to occur in their territory	Obtain per
3.3	First Nations guardianship program to monitor fish passage in the watershed	
3.4	Knowledge Gap: Identify traditional use areas to help inform where to improve connectivity	Used as de

Strategy 4: Planning and Progress Tracking

Ta

ID	Actions
4.1	Implement the WCRP Progress Tracking Plan
4.2	Develop a data catalogue on all current information related to aquatic connectivity in the Bulkley Water
4.3	Explore expanding this WCRP to include the Morice River Watershed

Theories of Change & Objectives

Theories of Change are explicit assumptions around how the identified actions will achieve gains in connectivity and contribute towards reaching the goals of the plan. To develop Theories of Change, the planning team developed explicit assumptions for each strategy which helped to clarify the rationale used for undertaking actions and provided an opportunity for feedback on invalid assumptions or missing opportunities. The Theories of Change are results oriented and clearly define the expected outcome. The following theory of change models were developed by the WCRP planning team to "map" the causal ("if-then") progression of assumptions of how the actions within a strategy work together to achieve project goals.

Operational Plan

The operational plan represents a preliminary exercise undertaken by the planning team to identify the potential leads, potential participants, and estimated cost for the implementation of each action in the Bulkley River watershed. The table below summarizes individuals, groups, or organizations that the planning team felt could lead or participate in the implementation

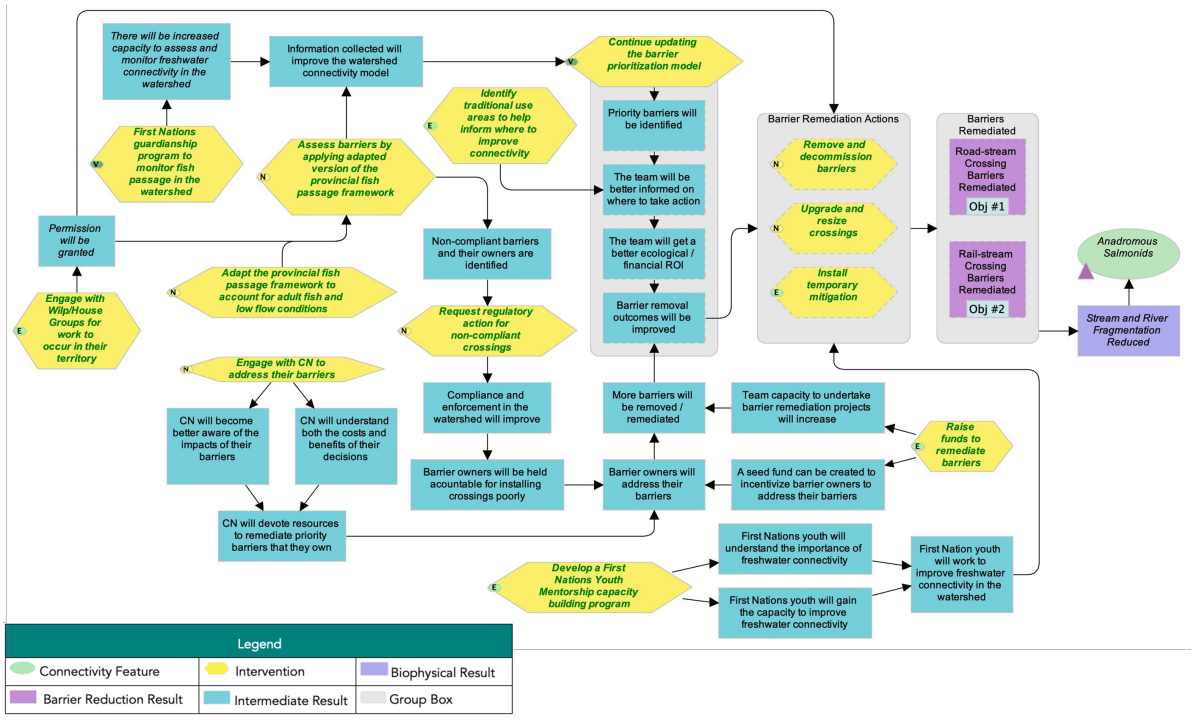

Figure 4: Theory of change developed by the planning team for the actions identified under Strategy 1: Barrier Remediation in the Bulkley River watershed.

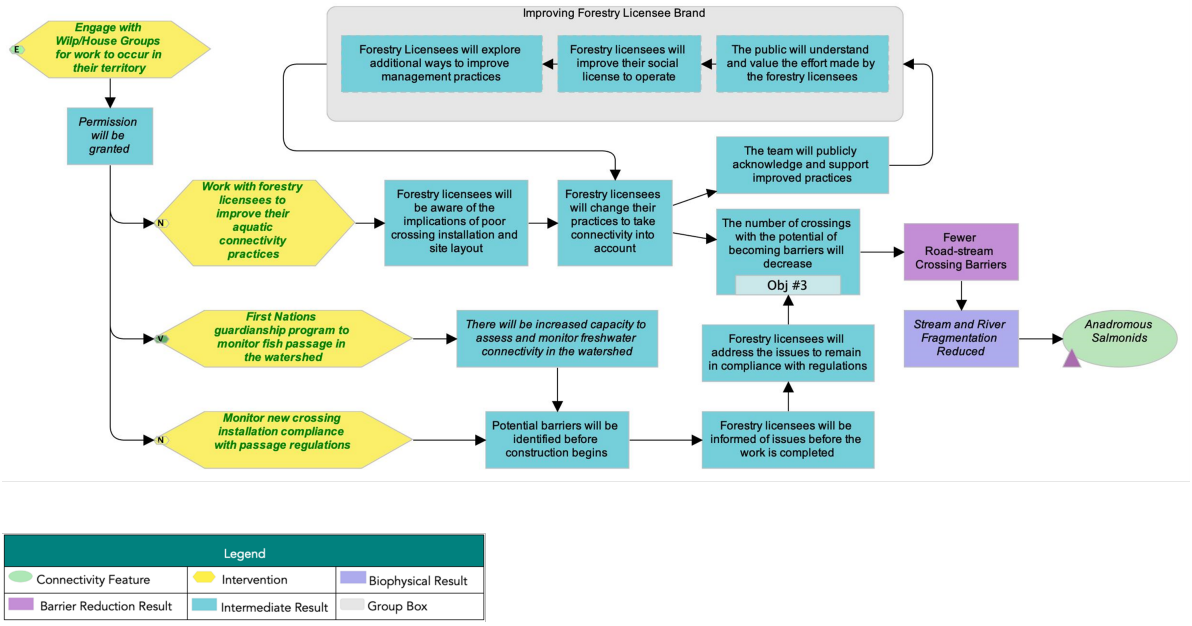

Figure 5: Theory of change developed by the planning team for the actions identified under Strategy 2: Barrier Prevention in the Bulkley River watershed.

of the plan and should be interpreted as the first step in on-going planning and engagement to develop more detailed and sophisticated action plans for each entry in the table. The individuals, groups, and organizations listed under the "Lead(s)" or "Potential Participants" columns are those that provisionally expressed interest in participating in one of those roles or were suggested by the planning team for further engagement (denoted in bold), for those that are not members of the planning team. The leads, participants, and estimated costs in the operational plan are not binding nor an official commitment of resources, but rather provide a roadmap for future coordination and engagement to work towards implementation of the WCRP.

Strategy / Actions
Strategy 1: Barrier Remediation
1.1 – Remove and decommission barriers
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1.6 – Engage with CN to address their barriers

Strategy / Actions
1.7 – Knowledge Gap: Continue updating the barrier prioritization model
1.8 - Knowledge Gap: Adapt the provincial fish passage framework to account for adult fish and low flow cond
1.9 – Knowledge Gap: Assess barriers by applying adapted version of the provincial fish passage framework
Strategy 2: Barrier Prevention
2.1 – Work with forestry licensees to improve their aquatic connectivity practices
2.2 – Monitor new crossing installation compliance with regulations regarding fish passage
Strategy 3: Strengthen Indigenous Connections to Land and Water
3.1 – Develop a First Nations Youth Mentorship capacity building program
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Strategy 4: Progress Tracking Plan
4.1– Implement the WCRP Progress Tracking Plan
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4.3 – Expand this WCRP to include the Morice River Watershed
Total:
Fundraising total:
Proponent/government contribution total:

Funding Sources

Funding Source	Spending Restrictions and C
Land Based Investment Strategy	Assessment and remediation
Environmental Enhancement Fund	Fish and wildlife passage im
Community Salmon Program	For projects supporting the
Southern Boundary Restoration and Enhancement Fund	Supports 3 activities: (1) de
Habitat Conservation Trust Foundation Enhancement and Restoration Grants	Projects that focus on freshv
Environmental Damages Fund	Direct funds received from f
Habitat Stewardship Program for Aquatic Species at Risk	Program for non-profits, Inc
Canada Nature Fund for Aquatic Species at Risk	Funding program aimed at a

Funding Source	Spending Restrictions and C
BC Salmon Restoration and Innovation Fund	Funding for Indigenous ente
Aboriginal Fund for Species at Risk	Program for Indigenous grou
Federal Gas Tax Fund - Community Works Fund	Funding available to local g
Disaster Mitigation and Adaptation Fund	For those projects where flo
Community Gaming Grants	Funding for non-profit orga
Sitka Foundation	Funding for registered chari
TULA Foundation	Supports various environme
Vancouver Foundation	Granting agency for commu
BC Conservation Foundation Small Project Fund	Funding available to Non-pr
Real Estate Foundation of BC General Grants	Funding for First Nations, c

Data Download and Methods

Appendix A: Modelled Anadromous Salmon Habitat Maps

High-resolution PDF maps of the Bulkley River watershed and model results can be accessed here. The watershed is divided into multiple maps sheets to allow for detailed examination of modelled spawning and rearing habitat and priority barriers identified through this planning process. The locations of WCRP priority barriers and associated map sheet numbers are shown below. In each individual map sheet, priority barriers are symbolized using the following notation:

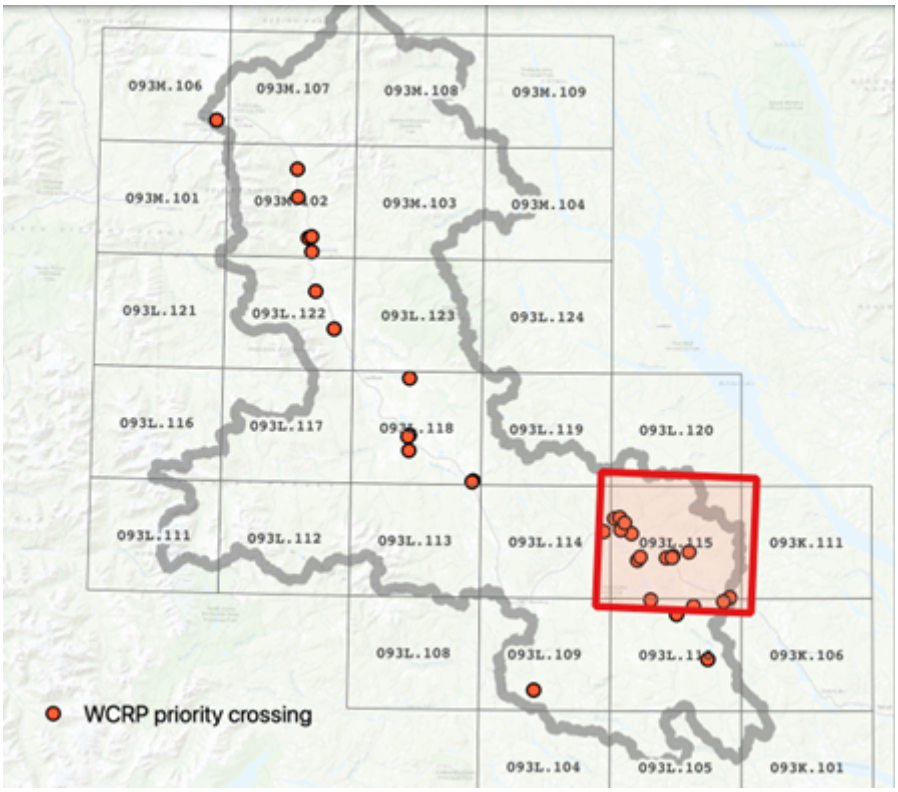

Figure 6: Bulkley River watershed overview map identifying the portions of the watershed covered by each map sheet (grey squares) and the prioritized barriers on the intermediate barrier list (orange points; see Appendix C).

Appendix B: Connectivity Status Assessment Methods

The connectivity status assessment for anadromous salmonids in the Bulkley River watershed builds on existing connectivity modelling work undertaken by the BC Fish Passage Technical Working Group, resulting in a flexible, customizable open-source spatial model called "bc-fishpass". The model spatially locates known and modelled barriers to fish passage, identifies potential spawning and rearing habitat for target species, and estimates the amount of habitat that is currently accessible to target species. The model uses an adapted version of the Intrinsic Potential (IP) fish habitat modelling framework (see Sheer et al. (2009) for an overview of the IP framework). The habitat model uses two geomorphic characteristics of the stream network — channel gradient and mean annual discharge — to identify potential spawning habitat and rearing habitat for each target species. The habitat model does not attempt to definitively map each habitat type nor estimate habitat quality, but rather identifies stream segments that have high potential to support spawning or rearing habitat for each species based on the geomorphic characteristics of the segment. For more details on the connectivity and habitat model structure and parameters, please see Mazany-Wright, Norris, et al. (2021a). The variables and thresholds used to model potential spawning and rearing habitat for each target species are summarized in Table 15. The quantity of modelled habitat for each species was aggregated for each habitat type to inform the two KEAs — Accessible Spawning Habitat and Accessible Rearing Habitat — and represents a linear measure of potential habitat. To recognize the rearing value provided by features represented by polygons for certain species (e.g., wetlands for Coho Salmon and lakes for Sockeye Salmon) a multiplier of 1.5x the length of the stream segments flowing through the polygons was applied.

Tab

Species	Channel Gradient (%) (Spawning Habitat)	Mean annual discharge (m3/s) (Spawning
Chinook Salmon	0-3 [1] [2]	0.46-322.5 [3][4][5][6][7]
Coho Salmon	0-5 [6][10]	0.164-59.15 [3][4][5][10][11]
Sockeye Salmon	0-2 [14][15]	0.175-65 [3][4][5][6]
Steelhead	0-4 [2][16]	0.447-75 [3][4][6]

References: [1] Busch et al. (2011). [2] Cooney and Holzer (2006). [3] Bjornn and Reiser (1991). [4] Neuman and Newcombe (1977). [5] Woll, Albert, and Whited (2017). [6] Roberge et al. (2002). [7] Raleigh and Miller (1986). [8] Porter et al. (2008). [9] Agrawal et al. (2005). [10] Sloat, Reeves, and Christiansen (2017). [11] Mcmahon (1983). [12] Rosenfeld, Porter, and Parkinson (2000). [13] Burnett et al. (2007). [14] Lake (1999). [15] Hoopes (1972). [16] Sheer and Steel (2003).