



JONES CREEK - WAHLEACH LAKE WATERSHED ACTION PLAN

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The Fish & Wildlife Compensation Program is a partnership between BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams.



From left: Wahleach Dam, Wahleach Dam and Reservoir (Credit BC Hydro). Cover photos: Black Bear caught on trail camera as part of 2016-17 project (Credit: Quercus Ecological), Western Toad (Credit: Quercus Ecological).



The Fish & Wildlife Compensation Program (FWCP) is a partnership between BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams. The FWCP funds projects within its mandate to conserve and enhance fish and wildlife in 14 watersheds that make up its Coastal Region.

Learn more about the Fish & Wildlife Compensation Program, projects underway now, and how you can apply for a grant at fwcp.ca. Subscribe to our free email updates and annual newsletter at www.fwcp.ca/subscribe. Contact us anytime at fwcp@bchydro.com.

EXECUTIVE SUMMARY: WAHLEACH WATERSHED

The Fish & Wildlife Compensation Program is partnership between BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams.

This Action Plan builds on the Fish & Wildlife Compensation Program's (FWCP's) strategic objectives, and is an update to the previous *FWCP Watershed and Action Plans*. The Action Plan was developed with input from BC Hydro, Fisheries and Oceans Canada (DFO), Canadian Wildlife Service (CWS), Ministry of Environment (MOE), Ministry of Forests, Lands and Natural Resource Operations (FLNRO), participating First Nations, and local communities. It specifies actions that will conserve, restore and enhance fish and wildlife species and their habitats.

This Action Plan sets out Priority Actions for the FWCP that will guide funding decisions for FWCP projects in the Wahleach watershed. The focus of the next five-year period will be Priority Actions identified for fish, wildlife and habitats in three broad ecosystem categories:

1. [Rivers, Lakes & Reservoirs](#);
2. [Wetland & Riparian Areas](#); and
3. [Upland & Dryland](#).

These ecosystem categories are described in the Ecosystem Chapters, and proposed Priority Actions are captured in the [Action Table](#) at the end of this document. The Priority Actions are intended to support FWCP's strategic objectives of conservation, sustainable use, and community engagement. Priority Actions eligible for FWCP funding fall into one or more of the following action types:

- **Research and Information Acquisition** – These actions will collect information necessary to evaluate, review and implement subsequent conservation, restoration and enhancement actions. Examples include inventory, limiting factor assessments and other activities to address data gaps and information needs to complete other actions.
- **Habitat-based Actions** – These actions will conserve, restore, and enhance habitats. Examples include habitat creation, restoration, and enhancement, enhancing habitat connectivity, and invasive species management.
- **Land Securement** – These actions will contribute to the establishment of easements or covenants or the purchase of private land for conservation purposes.
- **Species-based Actions** – These actions will alleviate limiting factors for a species. Examples include restoration planning, captive breeding/rearing and reintroduction.
- **Monitoring and Evaluation** – These actions will monitor and evaluate projects supported by FWCP to understand the effectiveness of habitat- or species-based actions.

This Action Plan, and specifically the [Action Table](#), sets FWCP priorities for investments in compensation activities within the watershed. However, actions may not translate into funded projects. FWCP funding limitations require priority setting across the Coastal Region's 14 watersheds. The process of selecting which actions will be implemented in any given year will occur during the annual grant intake and project cycle. See fwcp.ca for more.

About our Action Plan

This Action Plan provides important background information about the watershed, including hydro development projects by BC Hydro, and conservation and enhancement projects funded by the Fish & Wildlife Compensation Program (FWCP). This Action Plan outlines our Priority Actions for fish and wildlife eligible for an FWCP grant.

Anyone interested in applying for an FWCP grant should review our Priority Actions (see [Action Table](#)) and develop a grant application that aligns with a priority action(s).

[Contact us](#) to discuss our grants, Priority Actions and how we can help you develop your grant application. [Subscribe](#) and we will keep you posted about our grants and the projects we fund. Learn more at fwcp.ca

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WAHLEACH WATERSHED BACKGROUND

Introduction

The FWCP Action Plans provide strategic direction for each region based on the unique priorities, compensation opportunities, and commitments in the region and they reflect FWCP's vision and mission. The Action Plans describe the strategies and Priority Actions to support FWCP objectives. Please refer to the Action Plan Overview for more information on the process that was followed to develop Action Plans. The structure of this Action Plan is shown in Figure 1.

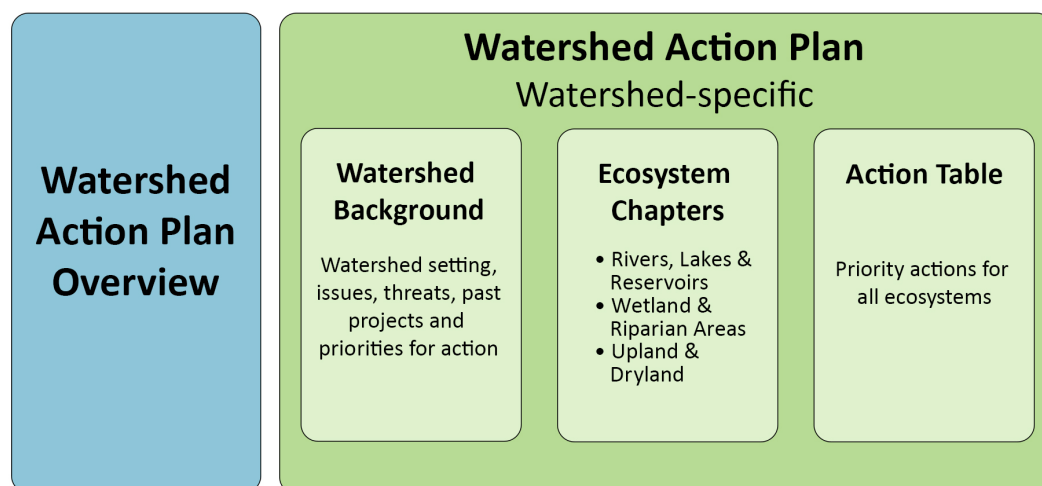


Figure 1: Structure of FWCP Action Plan Overview and Action Plan components.

Setting

The Wahleach facility is situated in the Jones Creek Wahleach Lake watershed approximately 25 km west of Hope and 100 km east of Vancouver (Figure 2). Wahleach Dam is situated at the outlet of Wahleach (Jones) Lake Reservoir,¹ and expanded a previously existing lake. Although the lake existed before the hydroelectric facility, the Wahleach Dam has raised its level. Water from the reservoir is diverted to a powerhouse on the south side of the Fraser River and is discharged into a creek, which flows into the Herrling Island side channel. The drainage area upstream of Wahleach dam is 93 km². It is steep sided terrain with short tributary streams. The watershed is dominated by Pacific air masses moving up the Fraser Valley. The largest storms occur during the winter months, with almost 400mm of precipitation on average in November. Elevations in the basin range from 640 to 2300m. Inflow is governed by snow melt between April and July and by winter storms.

The Wahleach hydroelectric facility is part of the BC Hydro Coastal Region. The facility came into service in 1952. Water is drawn from Wahleach Lake reservoir (489 ha) through the Four Brothers Mountain via a 4.2 km tunnel and a 500 m penstock. The penstock connects to a single 60 MW nameplate generator located in a powerhouse on the south bank of the Fraser River. Additional water is supplied by the diversion of Boulder Creek into Jones Creek.

As well as BC Hydro activities, an Independent Power Producer may be applying for a water licence in the watershed.

¹ Some sources refer to the old lake as Jones Lake and the new reservoir as Wahleach Lake. FWCP refers to the reservoir as the Wahleach Lake Reservoir.

The watershed has a diverse group of users. The Wahleach Watershed lies within the traditional territories of the Peters First Nation and is of interest to Coldwater Indian Band, Cook's Ferry Indian Band, Nooaitch Indian Band, Siska Indian Band, Chawathil First Nation, Cheam First Nation, Lyackson First Nation, Penelakut Tribe, Peters First Nation, Popkum First Nation, Seabird Island Band, Shxw'ow'hamel First Nation, Skawahlook First Nation, Skwah First Nation, Soowahlie First Nation, Stz'uminus First Nation and Union Bar First Nation. The northern portion of Wahleach Lake Reservoir is a BC Hydro recreational area. As the watershed is in the eastern portion of the Fraser Valley it lies close to several sizable communities including Hope and Chilliwack.

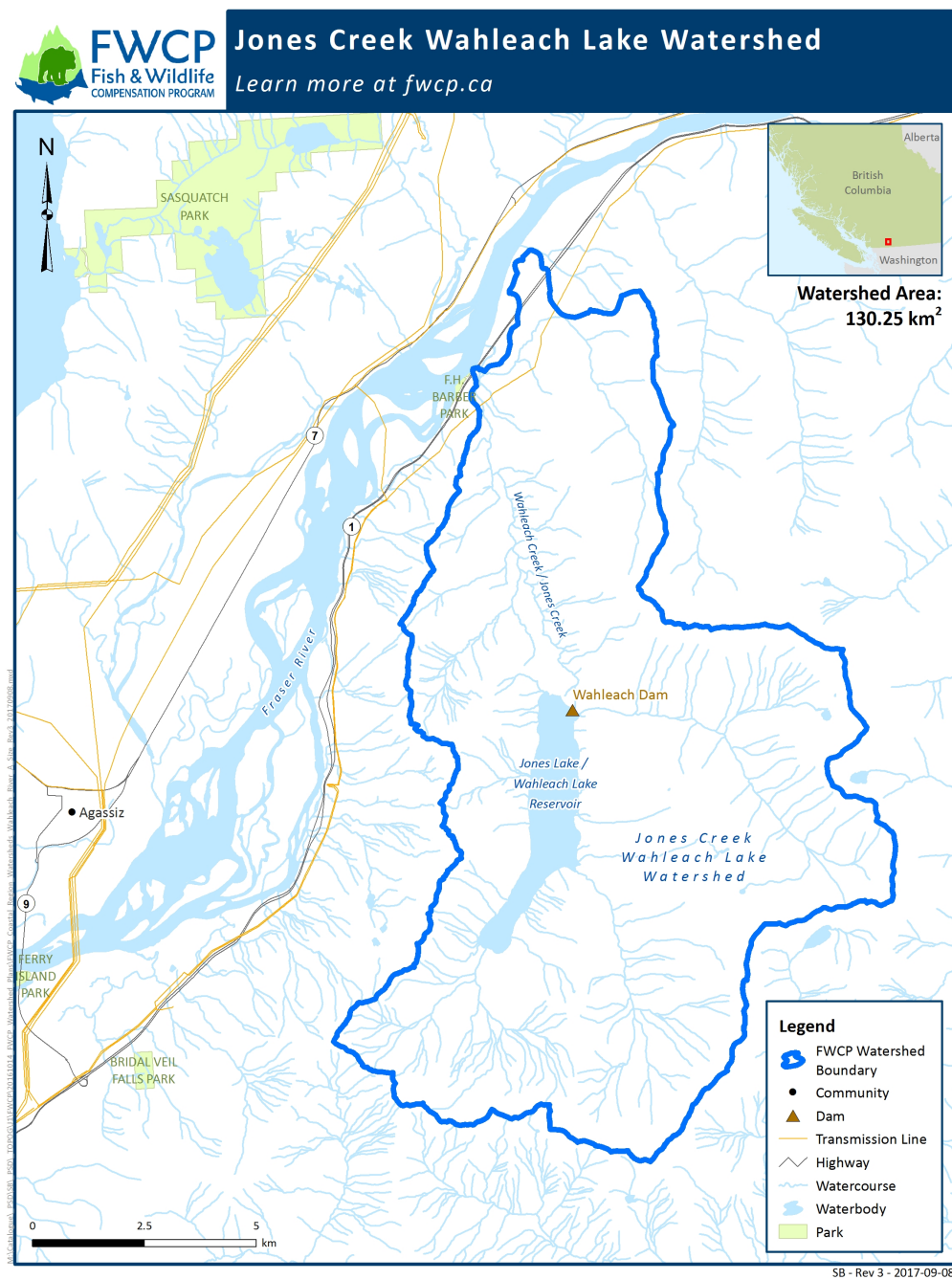


Figure 2: The FWCP Jones Creek - Wahleach Lake Watershed boundary.

Land Ownership in the Wahleach Watershed

Most of the Wahleach Watershed is Crown land but there is some private land. BC Hydro owns property on the north end of the reservoir around where the Wahleach Dam is located. BC Hydro recreation areas within this property include the Jones Lake Main Recreation Area and the Jones Lake West Recreation Area. Private cabins exist on the eastern shore of the reservoir.

Footprint Impacts and Threats

Dam construction, hydro-electric operation, and associated alterations in the hydrologic regime of the system have resulted in considerable changes to habitats and the fish and wildlife populations that rely on them.

Hydro-related Impacts

Inundation: The original lake was inundated and lake levels were raised from 619 m to 641 m, resulting in the loss of 211 ha of land.

Habitat loss: Loss of 30 ha of riparian habitat, 8 km of river habitat, and 11 km of natural shoreline. Access problems for fish to tributaries off Jones Lake may occur in the spring if lake levels are too low. Fluctuating reservoir levels negatively affect shallow littoral habitats. The dam has reduced large woody debris (LWD) into Jones Creek.

New habitat: Reservoir impoundment raised elevation of the original Jones Lake by 18 m to create a reservoir area of 489 ha following the flooding of 211 ha of land. This represents a net gain of 211 ha in reservoir habitat. The Jones Creek spawning channel, constructed in 1954 to mitigate impacts of reduced flows, was damaged beyond repair by debris torrents in 1993 and 1995, and was completely removed by 2004. In 2006, BC Hydro constructed a rearing channel and spawning platform at the confluence of Lower Jones and Lorenzetta Creeks as a requirement of the Wahleach Water Use Plan (WUP).

Altered flow regime: Lower Jones Creek flow has been reduced through water diversion for power generation. There is also an altered flow regime in the Herrling Island side channel as a result of flows diverted to and released from the powerhouse. The altered flow allows the Herrling Island side channel to be wetted during the late summer through late winter when the channel would be historically dry. In addition, the reservoir's hydrograph has been altered, impacting littoral productivity.

Diversions: Diversion of water out of Jones Lake has diminished the habitat capacity in Jones Creek downstream, in particular the lower sections with coho, pink and steelhead habitat.

Entrainment: Entrainment is known to occur through Wahleach Generating Station, Boulder Diversion and dam release facilities. However, the magnitude of entrainment mortality and injury on reservoir fish is unknown.

Non-hydro Impacts

Impacts to wildlife and habitats in the watershed are mostly from forestry operations, associated roads and recreational access. These activities have altered the distribution of forest age classes and structure, increased erosion and siltation, and increases levels of human use and related impacts.

Objectives for the Wahleach Watershed

Clear management objectives are needed to guide information gathering and effective prioritizing of management actions. Each Ecosystem Chapter has three objectives, which are high-level statements of desired future conditions (outcomes), consistent with FWCP strategic objectives, partner mandates and policies. Each Ecosystem Chapter also has more detailed sub-objectives, which provide more specific direction on desired future conditions. Priority Actions in the [Action Table](#) align with the objectives and sub-objectives, summarized in Table 1.

Table 1: Summary of objectives and sub-objectives in each Ecosystem Chapter.

Objectives	Sub-objectives		
	Rivers, Lakes & Reservoirs	Wetland & Riparian Areas	Upland & Dryland
Ensure a productive and diverse ecosystem	Conserve and restore habitat capacity and diversity for fish and other aquatic organisms.	Protect, enhance and create new wetland and riparian habitat.	Protect and enhance rare and ecologically significant upland/dryland habitat.
Maintain or improve the status of species of interest	Sustain and increase the population viability of: (a) Anadromous salmon (Chum, Pink and Coho Salmon) and Steelhead; (b) Resident salmonids (Kokanee and Rainbow Trout); and, (c) White Sturgeon.	Maintain and, where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk and species identified through government, community, and First Nations engagement). See Action Table for specific species.	Maintain and, where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk and species identified through government, community, and First Nations engagement). See Action Table for specific species.
Maintain or improve opportunities for sustainable use	Maintain or improve opportunities for sustainable use, including for food, social, ceremonial, recreational, or commercial purposes.		

FWCP Projects Implemented: Wahleach Watershed

FWCP has been funding projects in the Wahleach Watershed since 1999 under the Bridge-Coastal Restoration Program (BCRP) and subsequently under the Fish & Wildlife Compensation Program² Coastal Region. A full list of the reports from projects undertaken to date is available online at www.fwcp.ca. Below is a brief summary of the work undertaken under each Ecosystem Chapter during the 2010/2011 to 2015/2016 FWCP project years.

Rivers, Lakes & Reservoirs

No projects were undertaken during the 2010/2011 to 2015/2016 FWCP project years that addressed Rivers, Lakes & Reservoirs species or habitats in the Wahleach Watershed.

² The Program changed its name in 2011 from the BCRP to the FWCP.

Wetland & Riparian Areas

One Wetland & Riparian Areas seed project was undertaken during the 2010/2011 to 2015/2016 FWCP project years with \$4,400 of FWCP funding. The objective of this project was to develop a proposal for wetland and riparian ecosystem mapping and habitat suitability mapping for seven Wetland & Riparian Areas species at risk (Pacific Water Shrew, Northern Red-legged Frog, Oregon Spotted Frog, Western Toad, Coastal Tailed Frog, Coastal Giant Salamander, Western Painted Turtle).

Upland & Dryland

One Upland/Dryland seed project was undertaken during the 2010/2011 to 2015/2016 FWCP project years with \$4,400 of FWCP funding. This project was the same as that which developed a proposal for Wetland & Riparian Areas ecosystem mapping and habitat suitability mapping for species at risk (see above). Although it was almost exclusively focused on wetland and riparian species, it also targeted one upland and dryland species, the Mountain Beaver.

Interactions with Other Ongoing Processes

Water Use Plan (WUP) – BC Hydro undertook Water Use Planning on the Wahleach to find a better balance of power and non-power interests (such as fish, wildlife and recreation) when operating the system. The resulting WUP Order directed incremental operational changes and monitoring studies to determine the effectiveness of the operational changes. FWCP partners support and coordinate with the WUP ordered monitoring studies, however FWCP does not fund the monitoring associated with operations.

Fish Passage Decision Framework – Any studies to assess the feasibility of restoring fish passage at existing BC Hydro facilities must adhere to the [Fish Passage Decision Framework](#) (BC Hydro 2016) to be funded by the FWCP.

Fish Entrainment Strategy – Fish entrainment issues are addressed through BC Hydro's Fish Entrainment Strategy (BC Hydro 2006). Grant applications to study or mitigate entrainment issues are not eligible for FWCP funding.

ECOSYSTEM CHAPTERS

WAHLEACH WATERSHED

ECOSYSTEM CHAPTER: RIVERS, LAKES & RESERVOIRS

Actions for Rivers, Lakes & Reservoirs

The [Action Table](#) in this document (see page 18) identifies our Priority Actions to conserve and enhance fish & wildlife in this watershed. Priority Actions are organized by Action type: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Actions are assigned a priority ranking from 1 (highest priority) to 3 (lowest priority).

Aquatic Habitat in the Wahleach Watershed

The Wahleach Watershed is a relatively small watershed that originates at the northeast end of the Cheam Mountains. Fish habitat is present in the reservoir and tributaries for resident salmonids (Kokanee, Rainbow Trout and Cutthroat Trout), in Jones Creek downstream of the dam for anadromous salmonids (Coho, Chum, and Pink Salmon and Steelhead), and in the Herrling Island Sidechannel for anadromous salmonids and White Sturgeon. The original Jones (Wahleach) Lake did not contain either Rainbow or Kokanee; these were introduced starting in 1924. Sterile Cutthroat Trout are also stocked annually to help control the illegally introduced Threespine Stickleback population. Kokanee are known to spawn in several reservoir tributaries including Upper Jones Creek, the Glacier Creeks, Flat Creek and Boulder Creek.

Lower Jones Creek has seen a number of enhancement initiatives starting with the development of a spawning channel in 1954 (Hartman and Miles 1997). The spawning channel was installed to help sustain the pink and chum salmon populations in lower Jones Creek following a reduction in creek flows by impoundment and diversion (Hirst 1991). The spawning channel is no longer in operation and fish access has been re-established through the provision of a minimum flow and a series of channel enhancements conducted through the Water Use Plan (Bruce and Greenbank 2016).

The Wahleach generation station discharges into the Herrling Island Sidechannel of the Fraser River. The side-channel supports Pink and Chum Salmon spawners and White Sturgeon. During most of the year, when Fraser River flows are low, the side-channel does not receive water from the Fraser River at the upstream end and operation of the Wahleach generation station has a large influence on downstream habitat quality by fluctuating flows through spawning and incubation periods (Bruce and Greenbank 2016).

Limiting Factors

Limiting factors vary among species and need to be further assessed. They are expected to include:

- **Habitat area:** Former spawning, rearing and overwintering areas are reduced by dam footprint, reservoir drawdown and flooding, diversions, or dam and generating station operations.
- **Habitat quality:** Physical habitat below dams in Lower Jones Creek and in the Herrling Island side channel is altered by highly variable flows, which can result in stranding and low egg-to-fry survival. Forestry activities in the upper Wahleach Watershed may reduce habitat quality in some of the reservoir tributaries. Disruption to littoral productivity also impacts habitat quality.
- **Nutrient limitations:** Wahleach Lake Reservoir is ultra-oligotrophic. A fertilization program operated by the Ministry of Environment as a part of the Water Use Plan activities increases lake productivity and aims to restore and maintain Kokanee abundance in Wahleach Lake Reservoir.

Knowledge Status

Habitat

Water Use Plan activities were designed to improve habitat conditions for fish species. These include increased Kokanee habitat in the reservoir through minimum reservoir elevation levels and a reservoir fertilization program, increased salmon habitat in Jones Creek through the provision of a minimum flow and a habitat enhancement project, and increased spawning success at Herrling Island Sidechannel through periods of no generation through the Wahleach Generating Station.

Knowledge Gaps

The following knowledge gaps have been highlighted by agencies, First Nations and stakeholders:

- To help set priorities for restoration, the program needs a better understanding of limiting factors that can be addressed by restoration initiatives
- Understanding the effectiveness of previous restoration efforts and a need to develop detailed restoration plans to achieve long-term conservation objectives

Objectives and Measures

The following objectives have been developed to define the scope of the Rivers, Lakes & Reservoirs Ecosystem Chapter. While the objectives are expected to remain stable over time, the projects funded may evolve as management priorities shift, or new information becomes available.

Objective 1: Ensure a productive and diverse aquatic ecosystem.

This objective addresses overall ecosystem integrity and productivity and directs compensation activities to develop productive, useable aquatic habitats. Where cost-effective opportunities exist, compensation works will be aimed at aiding multiple aquatic species to conserve and restore habitat capacity and diversity for fish and other aquatic organisms.

Measures — Measures will be ecosystem- and project-specific.

Objective 2: Maintain or improve the status of species of interest

This objective is supported by two sub-objectives:

1. Sustain and increase the population viability of anadromous salmon, Steelhead, and White Sturgeon.

Efforts are underway to restore anadromous salmon (i.e., Coho, Chum, Pink Salmon), Steelhead, and White Sturgeon spawning and rearing habitat in the Wahleach system to rebuild natural populations.

Measures — Measures will be species- and project-specific.

2. Sustain and increase the population viability of resident salmonids.

Measures — Measures will be species- and project-specific.

Objective 3: Maintain or improve opportunities for sustainable use.

This objective reflects the important sustainable use benefits that can be derived from healthy fish populations. Many salmonid species are the focus of First Nations, commercial and recreational fisheries. Consequently, any actions aimed at achieving the above objective also support this sustainable use objective.

Measures — There are no specific measures required at this time, aside from those associated with Objective 1 and 2.

ECOSYSTEM CHAPTER: WETLAND & RIPARIAN AREAS

Actions for Wetland & Riparian Areas

The [Action Table](#) in this document (see page 18) identifies our Priority Actions to conserve and enhance fish & wildlife in this watershed. Priority Actions are organized by Action type: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Actions are assigned a priority ranking from 1 (highest priority) to 3 (lowest priority).

Wetland and Riparian Areas in the Wahleach Watershed

Wetland and riparian areas are the most diverse and biologically rich terrestrial ecosystems in BC and are considered highly valuable from an ecological standpoint. Riparian areas are the areas bordering on streams, lakes, and wetlands that link water to land. The blend of streambed, water, trees, shrubs and grasses directly influences and provides habitat for fish and wildlife. The abundance, distribution and condition of wetland and riparian habitats may be limiting factors for many species, especially amphibians, which depend upon them either for the majority of their lifecycles or for key periods such as breeding. Riparian and wetland habitats are often critical in terms of maintaining function and structure for natural systems, including helping to support trophic level functioning and genetic diversity, as well as providing key ecological services such as erosion control, flood control, assimilation of nutrients and water purification. Furthermore, many wetland and riparian species are the focus of sustainable use activities by First Nations and non-First Nations people. Riparian and wetland areas are commonly inundated by impoundments or adversely affected by changes in hydrological regimes that result from water management for power generation. Loss and alteration can significantly affect the services provided by these ecosystems.

Limiting Factors

The limiting factors for wetland and riparian areas are predominantly related to extent of the available habitat, connectivity and distribution of the habitat, and its productivity. Limiting factors need to be further assessed and are expected to include:

- **Extent:** The contribution of riparian and wetland habitats to broader ecological function is predominantly limited by the extent of the habitats on the land base. Habitats are lost through inundation and conversion to other land uses.
- **Distribution:** Connectivity among riparian and wetland habitats, and between these habitats and other habitats and features, are important for dispersal of plants and animals and for seasonal movements of some species. Wetland and riparian habitats that are isolated will likely have decreased diversity compared to those which experience a healthy connectivity between areas. Distribution is therefore related not only to the extent of healthy riparian and wetland habitats, but also to adjacent land uses.
- **Productivity:** Even where riparian and wetland habitats are adequately represented and connected, there are several factors that can affect their productivity:
 - Hydrologic conditions such as water level variability and flow rates are among the most important variables driving riparian and wetland habitat development, structure, functioning and persistence (National Research Council 2001). Wetlands and riparian ecosystems require dynamic water regimes to maintain their productivity, but managed systems can result in unnatural cycles of stability and de-watering that can impair function or result in succession to different habitat types (e.g., forest, mudflats).
 - Stressors such as invasive species or disruptive human access can affect community structure and function.

- Loss of specific habitat features can affect life requisites of specific species, e.g., dense nesting cover for waterfowl, suitable tree cavities for nesting owls or waterfowl, basking sites to turtles.
- Poorly understood factors limit the productivity of created wetlands. These are generally thought to be related to unnatural hydrologic regimes, soil conditions, and/or cattle grazing (e.g., Atkinson et al. 2010).

Knowledge Status

Habitat

Basin-wide trends in the abundance, distribution and productivity of riparian and wetland habitats have not been compiled, but inundation following dam construction was likely the most significant source of habitat loss (see *Footprint Impacts and Threats* above). The area of inundation has not increased since construction of the last dam, but the productivity of adjacent habitats has continued to be affected, either directly or indirectly as a result of BC Hydro operations.

Knowledge Gaps

A full inventory of species utilizing wetlands and riparian habitats has not taken place in the Wahleach Watershed, and opportunities for riparian and wetland habitat enhancement or creation have not been determined. FWCP funded an assessment of riparian habitats and species-at-risk in the Wahleach Watershed, but results were not available for development of this plan.

Objectives and Measures

The following objectives have been developed to define the scope of the Wetland & Riparian Areas Ecosystem Chapter. While the objectives are expected to remain stable over time, the projects funded may evolve as management priorities shift, or as new information becomes available.

Objective 1: Ensure productive and diverse wetland and riparian ecosystems.

This objective addresses overall ecosystem integrity and directs compensation activities to maintain ecosystem productivity by protecting, enhancing or creating new wetland and riparian habitat.

Measures — Measures will be ecosystem- and project-specific.

Objective 2: Maintain or improve the status of species of interest.

Actions under this objective focus on addressing limiting factors that are not otherwise addressed by general improvements to ecosystem function under Objective 1. The intent is to maintain, or where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk or species identified through government, industry, public and First Nations engagement).

Measures — Measures will be species- and project-specific.

Objective 3: Maintain or improve opportunities for sustainable use.

Many wetland and riparian species are the focus of sustainable use activities by First Nations and non-First Nations people (e.g., duck hunting, medicinal plants, wildlife viewing). Actions addressing Objectives 1 and 2 will often support this sustainable use objective.

Measures — Measures will be species- and project-specific.

ECOSYSTEM CHAPTER: UPLAND & DRYLAND

Actions for Upland and Dryland Areas

The [Action Table](#) in this document (see page 18) identifies our Priority Actions to conserve and enhance fish & wildlife in this watershed. Priority Actions are organized by Action type: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Actions are assigned a priority ranking from 1 (highest priority) to 3 (lowest priority).

Upland and Dryland in the Wahleach Watershed

Upland and dryland habitats are those that occur above areas of permanent inundation or periodic flooding. They are usually the habitats least affected by hydroelectric generating infrastructure or operation; however, footprint impacts have occurred and they contribute to the cumulative effects of human-related activities in these habitats.

Upland/dryland habitats are diverse and can range from unvegetated areas to grasslands, forests, and alpine ecosystems. Different habitats are associated with distinct species assemblages that react to direct or indirect stressors in their distinct habitat niches.

The lower elevations at the northern end of the Wahleach Watershed lie within the Southern Dry Submaritime Coastal Western Hemlock Variant (CWHds1). Above and south of the CWHds1 is in the Southern Moist Submaritime Coastal Western Hemlock Variant (CWHms1). Above the CWHms1, the Leeward Moist Maritime Mountain Hemlock Variant (MHmm2) occurs. Upper elevations are within the Coastal Mountain-heather alpine (undifferentiated and parkland; CMAunp) subzone.

Limiting Factors

Limiting factors vary among species and need to be further assessed. They are generally associated with:

- **Habitat loss and alteration:** The cumulative effects of forest harvesting and hydro-electric development have resulted in substantial losses and alterations to habitat and habitat connectivity.
- **Habitat connectivity:** Habitat loss and road development have resulted in lost connectivity between habitats, which alter wildlife movement.

Knowledge Status

Habitat

The Wahleach Watershed has a long history of forest operations. This has altered the distribution of forest ages and species composition, and has resulted in an extensive road network and associated direct and indirect impacts. The extent of these landscape changes has not been specifically quantified. Slope stability and landslides associated with logging have been an issue of concern in the watershed (Hartman and Miles 1997). Natural disturbance has also contributed to changes in the watershed as a result of the large Sayward fire in 1938 (BC Ministry of Forests, 1997).

Knowledge Gaps

Knowledge of species and ecosystems in the Wahleach Watershed is limited. There have not been extensive inventories specifically targeting the Wahleach.

Objectives and Measures

The following objectives have been developed to define the scope of the Upland & Dryland Ecosystem Chapter. While the objectives are expected to remain stable over time, the projects funded may evolve as management priorities shift, or as new information becomes available.

Objective 1: Ensure productive and diverse upland and dryland ecosystems.

Actions under this objective are aimed at protecting/enhancing rare or ecologically significant features.

Measures — Measures will be ecosystem- and project-specific.

Objective 2: Maintain or improve the status of species of interest.

Actions under this objective focus on addressing limiting factors that are not otherwise addressed by general improvements to ecosystem function under Objective 1. The intent is to maintain, or where feasible, increase the abundance of species of interest (e.g., federally listed species-at-risk or species identified through government and First Nations engagement).

Measures — Measures will be species- and project-specific.

Objective 3: Maintain or improve opportunities for sustainable use.

Many wetland and riparian species are the focus of sustainable use activities by First Nations and non-First Nations people (e.g., hunting, country foods and medicinal plant collection, wildlife viewing). Actions addressing Objectives 1 and 2 will often support this sustainable use objective.

Measures — Measures will be species- and project-specific.

ACTION TABLE

This Action Table identifies the FWCP's Priority Actions to conserve and enhance fish and wildlife impacted by BC Hydro dams in this watershed. Actions identified as OPEN (see Delivery Approach column) are eligible for a grant. When completing your online grant application, you will be required to identify a Priority Action(s) that best aligns with your project idea. A high-quality grant application will clearly demonstrate alignment with Priority Action(s) in an Action Table.

JONES CREEK-WAHLEACH LAKE WATERSHED ACTION TABLE								Version: 28August2020	
Action #	Ecosystem Chapter	Action Type	Priority Action Short Description	Priority	Target Species	Priority Action	Intended Outcome	Delivery Approach	Location
1	All	Research & Information Acquisition	WAH.ALL.RI.01.01 Develop a current habitat assessment map-P1	1	Fish & Wildlife	Develop a current habitat assessment map for priority fish & wildlife species in the Wahleach watershed. Habitats to be assessed & mapped include: • Wetlands • Riparian Areas • Stream Habitats • Estuary • Connectivity Corridors • Forested Ecosystems (e.g., seral stage distribution) • Over-wintering habitat for species that utilize talus or rock features (e.g., bats, snakes) • Culturally Important Areas Mapping is to include as much on-the-ground information as possible relevant to the subject wildlife species. The assessment should focus on practical conservation and restoration opportunities. For fish, this work should inform development of habitat restoration and protection plans for priority species and habitats. Consideration should be given to potential impacts from available climate change predictions relevant to the specific habitats (i.e., potential changes to vegetation communities, precipitation, wetland hydro-periods, snowpack, wildfire risk, wildlife movements, etc.). Recommendations should be made through this work for future management actions and assessments.	Improved strategic planning for restoration opportunities.	Directed	Throughout
2	All	Research & Information Acquisition	WAH.ALL.RI.02.01 Conduct a limiting factors analysis-Herrling Island Side Channel-P1	1	Fish & Wildlife	Conduct a limiting factors analysis for priority fish and/or wildlife in the Wahleach watershed or sub-basins to support prioritization of future projects. This will include an assessment of population status, habitat status or habitat capacity and/or a cost-benefit analysis of any habitat-based actions proposed by the program, and should be considerate of the root causes of degraded habitats and limitations to productive potential. For fish, sub-basins for assessment include the Herrling Island Side Channel (Priority 1), the lower Jones Creek (Priority 3), and the Upper Wahleach including Wahleach Lake Reservoir and tributaries	To determine cost-benefit of potential FWCP actions and support prioritization of future projects. Leads to the creation of	Directed	Throughout
		WAH.ALL.RI.02.02 Conduct a limiting factors analysis-lower Jones Creek-P3	3						

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Action #	Ecosystem Chapter	Action Type	Priority Action Short Description	Priority	Target Species	Priority Action	Intended Outcome	Delivery Approach	Location
2 cont.			WAH.ALL.RI.02.03 Conduct a limiting factors analysis- Upper Wahleach incl. Wahleach Lk Reservoir&tributarie s-P3	3		(Priority 3). Analyses should build upon previous and ongoing assessments, including the Water Use Plan studies (e.g., Bruce and Greenbank 2016) and any existing restoration plans, in association with local agency, First Nation and BC Hydro staff, private landowners and other land managers. A limiting factors analysis for the Lower or Upper Wahleach should include a watershed assessment of hydraulic stability that can prioritize sites for restoration.	robust habitat or species-based restoration plans for the watershed or sub-basins.		
			WAH.ALL.RI.02.04 Conduct a limiting factors analysis- Wahleach Watershed-P3	3		*Please note that the FWCP may develop templates for this work. Please check with FWCP to see if these templates are available.			
3	All	Research & Information Acquisition	WAH.ALL.RI.03.01 Develop a comprehensive restoration&protecti on Plan-Herrling Island Side Channel-P1	1	Fish & Wildlife	Develop a comprehensive restoration and protection plan for fish and/or wildlife in the Wahleach watershed or sub-basins in relation to limiting factors analyses and assessment of population status/habitat capacity. Restoration refers to habitat or species-based actions that restore habitat capacity or population viability, while protection includes habitat-based actions or land securement that protect important habitat from further degradation. Plans must include: • Baseline description of the watershed (hydrology, climate, topography); • Priorities of local First Nations for conservation and restoration; • Previous assessment and restoration works; • Distribution, timing, biological and critical habitat requirements and status of species in the watershed; • Clear goals and objectives based on a desired future condition; • Summary of habitat indicators and limiting factors (based on analyses of habitat pressure indicators, habitat state indicators, limiting factors analysis); • Knowledge gaps and recommended research and/or assessment priorities; • Restoration priorities with rationale/discussion; • Selected indicators and performance standards for effectiveness monitoring program; and, • Monitoring protocol and schedule. Plans may be multi-species and habitat-based or they may be focused on individual high priority species in the watershed. At this time the highest priority species is White Sturgeon and a species-based protection and restoration plan could be considered for Sturgeon in Herrling Island side channel. Additional priority species include Pink,	To determine high priority, cost-effective habitat and/or species-based actions that can be supported by the FWCP.	Directed	Throughout
			WAH.ALL.RI.03.02 Develop a comprehensive restoration&protecti on Plan-lower Jones Creek-P3	3					
			WAH.ALL.RI.03.03 Develop a comprehensive restoration&protecti on Plan-Upper Wahleach incl. Wahleach Lk Reservoir&tributarie s-P3	3					

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Action #	Ecosystem Chapter	Action Type	Priority Action Short Description	Priority	Target Species	Priority Action	Intended Outcome	Delivery Approach	Location
3 cont.			WAH.ALL.RI.03.04 Develop a comprehensive restoration&protection Plan-Wahleach Watershed-P3	3		Chum and Coho Salmon, Kokanee and Rainbow Trout. High priority wildlife include bats, amphibians, and riparian-associated mammals and birds. Note that all estuary, riparian and wetland projects should include inventory of rare plants and invertebrates to prevent the destruction of at-risk habitats while carrying out other projects. Plans should be developed in association with local agency, First Nation and BC Hydro staff, landowners and other land managers. Sub-basins for fish plans include the Herrling Island Side Channel (Priority 1), the lower Jones Creek (Priority 3), and the upper Wahleach including Wahleach Lake Reservoir and tributaries (Priority 3). Restoration plans are best developed as 'living documents' so that they can be updated over time. A number of Priority Actions have been developed already and are described in this Action Table, but further development of restoration actions would be beneficial. *Please note that the FWCP may develop templates for this work. Please check with FWCP to see if these templates are available.			
4	All	Habitat-based Actions	WAH.ALL.HB.04.01 Implement high priority habitat-based actions for fish and/or wildlife-P1	1	Fish & Wildlife	Implement high priority habitat and/or species-based actions for fish and/or wildlife as recommended by mapping activities (Action 1), inventory (Action 12), or by the restoration and protection plan (Action 3), or other similar plans already developed in the watershed. Note that a number of priority habitat and/or species-based actions have been developed already and are described in this Action Table, but further development of restoration actions would be beneficial.	Implement high priority, cost-effective habitat and/or species-based actions that can be supported by the FWCP.	Open	Throughout
		Species-based Actions	WAH.ALL.SB.04.02 Implement high priority habitat-based actions for fish and/or wildlife-P1	1					
5	All	Land Securement	WAH.ALL.LS.05.01 Conduct an options assessment for land securement -P2	2	Fish & Wildlife	Considering ecosystem, conservation and/or local management objectives, conduct an options assessment for land securement that establishes priority area to be protected through and land securement and identifies feasible mechanisms (e.g., fee-simple purchase, covenants, WHAs, etc.). In particular, identify opportunities to secure category 1 areas in the Wahleach watershed, or off-site category 1 areas, in partnership with other organizations.	Prioritize locations and secure partnerships for land securement.	Open	Throughout

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6	All	Land Securement	WAH.ALL.LS.06.01 Land securement-P2	2	Fish & Wildlife	Land securement in association with partner organizations to address fish and wildlife management objectives or to support habitat-based actions proposed by the FWCP. Land securement could address ecosystem function objectives across the watershed plan chapters of Rivers, Lakes & Reservoirs, Riparian/Wetland, and Upland/Dryland.	Conserve, protect and restore ecosystem function and resilience through land securement.	Open	Throughout
7	All	Monitoring & Evaluation	WAH.ALL.ME.07.01 Develop and implement an integrated monitoring plan-P2	2	Fish & Wildlife	Develop and implement an integrated monitoring plan for fish and/or wildlife in the Wahleach watershed or sub-basins in relation to existing agency monitoring programs, limiting factors analyses (Action 2), restoration plans (Action 3) and/or habitat or species-based actions supported by the FWCP. Monitoring should inform limiting factors analyses and/or habitat restoration and should be compatible with existing programs.	Support prioritization of monitoring associated with actions to sustain and restore habitat capacity and population viability of fish & wildlife.	Open	Throughout
8	All	Monitoring & Evaluation	WAH.ALL.ME.08.01 Assess success of habitat-based actions supported by FWCP-P2	2	Fish & Wildlife	Assess success of habitat-based actions supported by the FWCP. Success could be assessed through monitoring of biological and/or physical habitat responses. Success could be assessed on a graduated schedule such as every 1, 3, 5 and 10 years or based on high flow events or other natural or human-caused disturbances.	Assess success of habitat-based actions and support future planning and prioritization.	Open	Throughout
9	All	Monitoring & Evaluation	WAH.ALL.ME.09.01 Conduct condition assessments and/or maintenance on habitat enhancements-P2	2	Fish & Wildlife	Conduct condition assessments and/or maintenance on habitat enhancements supported by the FWCP. This could include the development of an inspection and maintenance schedule if required.	Maintain functioning of habitat enhancements supported by the FWCP.	Open	Throughout
10	Rivers, Lakes & Reservoirs	Habitat-based Actions	WAH.RLR.HB.10.01 Implement habitat restoration,... within the Herrling Island side channel for White Sturgeon-P1	1	White Sturgeon	Implement habitat restoration, enhancement and/or protective measures within the Herrling Island side channel to support and improve spawning areas for White Sturgeon. If a restoration plan has been completed under Action 3 , please reference that plan for more information.	Sustain and restore habitat capacity and population viability of White Sturgeon	Open	Herrling Island side channel

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Action #	Ecosystem Chapter	Action Type	Priority Action Short Description	Priority	Target Species	Priority Action	Intended Outcome	Delivery Approach	Location
11	Rivers, Lakes & Reservoirs	Habitat-based Actions	WAH.RLR.HB.11.01 Implement habitat restoration, enhancement...within tributaries of Wahleach Lk Reservoir-P3	3	Kokanee, Rainbow Trout	Implement habitat restoration, enhancement and/or protective measures within tributaries of Jones Lake to improve salmonid migration, spawning, incubation or rearing habitat. Tributaries include Boulder Creek, Upper Jones Creek, Flat Creek and Glacier creeks. Restoration actions in the Upper Wahleach should consider local hydraulic stability and the Water Use Plan nutrient enrichment program and should also be accompanied by community engagement activities. If a restoration plan has been completed under Action 3 , please reference that plan for more information.	Sustain and restore habitat capacity and population viability of resident salmonids.	Open	Upper Wahleach
12	Wetland & Riparian, Upland & Dryland	Research & Information Acquisition	WAH.WAR.RI.12.01 Inventory for species of interest that are likely in the watershed-P2	2	Wildlife	Inventory for species of interest that are likely in the watershed. Inventory actions must meet the following criteria: • The data collected will clearly inform a specific natural resource management decision or conservation action; this includes a clear understanding of: - The data or knowledge gap that is currently limiting a decision-maker or party(ies) from making a conservation decision or undertaking a conservation action; - How the inventory has been specifically designed to fill the above-noted data/knowledge gap; and - The decision-makers' commitment to using the data or information to support a specific decision. • The data collection is well informed by a clear and specific management objective (land use plan, recovery plan etc.) that also informs the management decision or conservation action; this includes clarity of: - How the inventory work has been designed to specifically assess the status or condition of the objective; and, - How the data will be used to inform/improve/clarify the management objective. Species of interest reflect engagement from FWCP partners and include, but are not limited to:	Maintain or, where feasible, increase the abundance of species of interest.	Open	Throughout

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Action #	Ecosystem Chapter	Action Type	Priority Action Short Description	Priority	Target Species	Priority Action	Intended Outcome	Delivery Approach	Location
12 cont.						• Mesocarnivores. Conduct risk assessment and evaluate population sustainability in disturbed watersheds through monitoring program as part of multi-carnivore surveys in the watershed. Species of interest include Western Spotted Skunk, Pacific Marten but especially Long-tailed Weasel, <i>altifrontalis</i> subspecies. Inventory required to assess if Long-tailed Weasel subspecies still occur in Lower Mainland watersheds. Coordinate with US Fish and Wildlife. If necessary, implement enhancement strategies to maintain sustainable populations. If part of a multi-year study, provide information about future objectives and actions. • Snowshoe Hare. Inventory required to evaluate occurrences of <i>washingtonii</i> subspecies in watershed. • Olympic Water Shrew. Inventory of forested habitats to determine range extent and habitat associations. Trowbridge's Shrew does not warrant a species specific survey but opportunistic data should be collected as part of any small mammal inventories. • Western Screech-owl, <i>kennicottii</i> subspecies. Inventory is necessary, newly detected in watershed in 2015. If found, refer to the Recovery plan for the Western Screech-owl, <i>kennicottii</i> subspecies (<i>Megascops kennicottii kennicottii</i>) in British Columbia for priority species- and habitat-related conservation actions within the Wahleach watershed. • Coastal Giant Salamander. Conduct inventory to determine presence and thus whether any habitat mitigation or enhancements should be conducted. They occur in nearby watersheds (within 1.5 km). If found, refer to the Recovery strategy for the Pacific Giant Salamander (<i>Dicamptodon tenebrosus</i>) in British Columbia (Pacific Giant Salamander Recovery Team 2010) for priority species- and habitat-related conservation actions within the Wahleach watershed. • Oregon Forestsnail. Inventory required, if found refer to the Recovery Strategy for the Oregon Forestsnail (<i>Allogona townsendiana</i>) in Canada (Environment Canada 2016) for priority species- and habitat-related conservation actions within the Wahleach watershed.			
13	Wetland & Riparian	Habitat-based Actions	WAH.WAR.HB.13.01 Implement priority species- and habitat-related conservation actions....-P1	1	Wildlife Species at Risk	Implement priority species- and habitat-related conservation actions in the following (or most recent) Recovery Strategies and Management Plans for species at risk that are known to be in the watershed. Conservation actions must be well informed by a clear and specific management objective and must be well informed by previous inventory in the watershed.	Stable or increasing population of at-risk species. Habitat enhancement opportunities.	Open	Throughout

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Action #	Ecosystem Chapter	Action Type	Priority Action Short Description	Priority	Target Species	Priority Action	Intended Outcome	Delivery Approach	Location
13 cont.	Upland & Dryland	Habitat-based Actions	WAH.UAD.HB.13.02 Implement priority species- and habitat-related conservation actions...-P1	1		• Management Plan for the Mountain Goat (<i>Oreamnos americanus</i>) in British Columbia (B.C. Ministry of Environment 2010). • Recovery Strategy for the Pacific Water Shrew (<i>Sorex bendirii</i>) in Canada (Environment Canada 2014). Build upon the pilot surveys conducted in project COA-F17-W-1211 Riparian Habitats and Species-at-Risk in Wahleach Watershed. • Management Plan for the Northern Goshawk, <i>laingi</i> subspecies (<i>Accipiter gentilis laingi</i>) in British Columbia (Ministry of Forests, Lands, and Natural Resource Operations and Ministry of Environment 2013). Work collaboratively with the province. • Management Plan for the Coastal Tailed Frog (<i>Ascaphus truei</i>) in British Columbia (B.C. Ministry of Environment 2015). • Management Plan for the Western Toad (<i>Anaxyrus boreas</i>) in British Columbia (Provincial Western Toad Working Group 2014). • Management Plan for the Northern Red-legged Frog (<i>Rana aurora</i>) in Canada [Proposed] (Environment Canada 2016).			
14	Wetland & Riparian	Habitat-based Actions	WAH.WAR.HB.14.01 Determine presence, identify/protect bat Maternity roosts & winter hibernacula-P1	1	Bats	1) Determine presence of bat species , especially those species potentially vulnerable to White Nose Syndrome; 2) Through acoustic monitoring or other methods (e.g., radio-tracking, DNA), identify maternity roosts and winter hibernacula ; 3) Pursue protection of hibernacula and maternity roosts (e.g., critical habitat, WHAs or wildlife habitat feature designations). Build upon bat acoustic and mist-netting surveys conducted in project COA-F17-W-1211 Riparian Habitats and Species-at-Risk in Wahleach Watershed.	Increased knowledge of species' habitat requirements and habitat protection opportunities.	Open	Throughout
	Upland & Dryland	Habitat-based Actions	WAH.UAD.HB.14.02 Determine presence, identify/protect bat Maternity roosts & winter hibernacula-P1	1					
15	Wetland & Riparian	Habitat-based Actions	WAH.WAR.HB.15.01 Conserve or enhance important habitats or mitigate habitat threats for priority bird species-P2	2	High priority birds	Conserve or enhance important habitats or mitigate habitat threats for priority bird species in the watershed. This watershed is within Bird Conservation Region 9 and falls under the Canadian Intermountain Joint Venture. See the lists of priority species for wetlands, lakes and rivers, riparian habitat and grasslands and shrub-steppe at http://cijv.ca/where-we-work/ . Proposed projects should refer to the priority lists and recommended conservation actions/guidance in the implementation plans (http://cijv.ca/resources/ ; to be posted January 2017). Build upon bird surveys conducted in project COA-F17-W-1211 Riparian Habitats and Species-at-Risk in Wahleach Watershed.	Varied types of species and habitat conservation, protection and enhancement opportunities.	Open	Throughout
	Upland & Dryland	Habitat-based Actions	WAH.UAD.HB.15.02 Conserve or enhance important habitats or mitigate habitat threats for priority bird species-P2	2					

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16	Upland & Dryland	Habitat-based Actions	WAH.UAD.HB.16.01 Restore and enhance the supply of cavities in trees for large cavity users-P3	3	Northern Flying Squirrel, Pacific Marten	Restore and enhance the supply of cavities in trees for large cavity users (e.g., Pacific marten, flying squirrels) after mesocarnivore surveys have been completed (under action 11).	Protect and/or restore rare and ecologically significant upland/dryland habitat.	Open	Throughout
17	Wetland & Riparian	Habitat-based Actions	WAH.WAR.HB.17.01 Implement wetland and riparian restoration projects-P1	1	Wildlife	Implement wetland and riparian restoration projects that are identified as high priorities through inventory, mapping or assessment in the Wahleach watershed. If a restoration plan has been completed under action 3, please reference that plan for more information. This can include managing invasive plants as needed.	Protect, restore and/or create new wetland and riparian habitat.	Open	Throughout
18	Wetland & Riparian	Habitat-based Actions	WAH.WAR.HB.18.01 Inventory & restoration for at-risk...and/or culturally important plant species-P3	3	At-risk Plants	Inventory and restoration for at-risk (e.g., SARA-listed, red- and blue-listed) and/or culturally important plant species and ecological communities. Potential species of interest: Cliff Paintbrush.	Habitat restoration opportunities.	Open	Throughout
	Upland & Dryland	Habitat-based Actions	WAH.UAD.HB.18.02 Inventory & restoration for at-risk...and/or culturally important plant species-P3	3					

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