



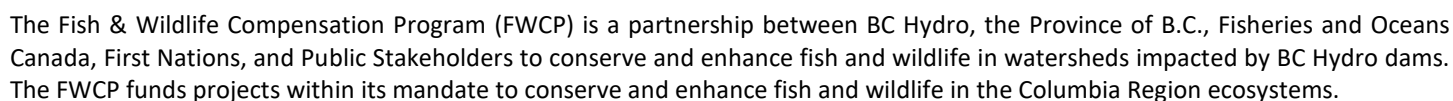
COLUMBIA REGION: RESERVOIRS & LARGE LAKES ACTION PLAN

August 21, 2019 (V1)

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 in watersheds impacted by BC Hydro dams.



Cover photos clockwise from left: Sturgeon, A. Glass; Common Loon, K. Tuttle; Kokanee, B. Meunier; Kinbasket Reservoir, L. Betts; Burbot, iStock-Scubaluna.



EXECUTIVE SUMMARY

Reservoirs & Large Lakes Action Plan

The Fish & Wildlife Compensation Program (FWCP) is a partnership between BC Hydro, the Province of B.C., Fisheries and Oceans Canada (DFO), First Nations, and Public Stakeholders to conserve and enhance fish and wildlife impacted by BC Hydro dams. This Action Plan builds on the FWCP's strategic objectives and is an update to the previous *FWCP Large Lakes Action Plan*. The Action Plan was developed with input from BC Hydro, DFO, the Province of B.C., participating First Nations, and local communities. It specifies Priority Actions that will conserve, restore, and enhance fish and wildlife species and their reservoir and large lake habitats in the Columbia Region.

Priority Actions are in the [Action Tables](#) at the end of this document. The Priority Actions are intended to support the FWCP's strategic objectives of conservation, sustainable use, and community engagement. Actions fall into one or more of the following Action Categories for reservoir and large lake ecosystems and associated species of interest:

- **Research and Information Acquisition** – These actions will collect information necessary to evaluate, review, and implement subsequent reservoir and large lake conservation, restoration, and enhancement actions. Examples include inventory, conservation, and restoration planning and other activities to address data gaps and fulfill information needs to complete other actions.
- **Habitat-based Actions** – These actions will conserve, restore, and enhance reservoir and large lake habitats. Examples include habitat creation, restoration, and enhancement; enhancing habitat connectivity; nutrient restoration; and invasive species prevention.
- **Monitoring and Evaluation** – These actions will monitor and evaluate reservoir and large lake projects supported by the FWCP to understand the effectiveness of habitat- or species-based actions.
- **Land Securement** – These actions will contribute to investigating and prioritizing land securement and stewardship opportunities for conservation purposes.
- **Species-based Actions** – These actions will alleviate limiting factors for reservoir and large lake species. Examples include restoration planning and species-specific habitat restoration and initiatives.

This Action Plan sets out Priority Actions for the FWCP that will guide funding decisions for FWCP projects in reservoirs and large lake habitats of the Columbia Region. The focus of the next five-year period will be Priority Actions identified for fish and aquatic habitats in six priority areas:

- Kootenay Lake
- Duncan Reservoir
- Arrow Lakes Reservoir
- Revelstoke Reservoir
- Kinbasket Reservoir
- other reservoirs and large lakes

Tributaries of these water bodies are also included in this Action Plan and are also eligible for Priority Actions in the Rivers & Riparian Areas Action Plan.

Priority species of interest for reservoir and large lake ecosystems includes one recovery species, White Sturgeon, as well as many focal and inventory species.

This Action Plan, and specifically the [Action Tables](#), sets out FWCP priorities for investments in compensation activities within reservoir and large lake habitats. However, actions may not translate into funded projects. FWCP funding limitations require priority-setting across the Columbia Region's ecosystems and species of interest. The process of selecting which actions will be implemented in any given year will occur during the annual grant intake and project selection cycle. See fwcp.ca for more information.



Introduction to the FWCP

The Fish & Wildlife Compensation Program (FWCP) 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 in watersheds impacted by construction of BC Hydro dams. The FWCP is funded annually by BC Hydro and directs those funds toward projects that address Priority Actions across its three regions. BC Hydro has water licence obligations in its Columbia and Peace Regions and has made voluntary commitments to address the impacts of dams in the Coastal Region. BC Hydro fulfills the applicable obligations through the work of the FWCP.

Introduction to this Action Plan

This Action Plan provides important background information about reservoir and large lake habitat in the Columbia Region, including hydro development projects by BC Hydro, and conservation and enhancement projects funded by the FWCP. This Action Plan outlines our Priority Actions for fish and wildlife eligible for an FWCP Grant.

Learn more about the FWCP, projects underway now, and how you can apply for a grant at fwcp.ca. Anyone interested in applying for an FWCP grant should review our Priority Actions (see [Action Tables](#)) 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](#) to our free email updates and annual newsletter at fwcp.ca/subscribe, and we will keep you posted about our grants and the projects we fund. Contact us anytime at fwcp@bchydro.com or learn more at fwcp.ca.

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INTRODUCTION AND BACKGROUND

FWCP Introduction

The FWCP Action Plans provide strategic direction for each region based on the unique priorities, compensation opportunities, and commitments in the region, and how they reflect the FWCP's vision and mission. The Action Plans describe the strategies and Priority Actions to support FWCP objectives of conservation, sustainable use, and community engagement. Please refer to the Columbia Region Overview & Action Plan document for more information on the process that was followed to develop Action Plans in 2018–2019. Action Plans have been developed for Reservoirs & Large Lakes; Small Lakes; Rivers & Riparian Areas; Wetlands & Riparian Areas; and Upland & Dryland; some actions may be complementary across the different plans.

This Reservoirs & Large Lakes Action Plan sets out priorities for the FWCP to guide projects within the FWCP Columbia geographic area in support of fish and wildlife. The plan builds on the FWCP's strategic objectives and the FWCP Columbia Region Overview and Action Plan document. The structure of this Reservoirs & Large Lakes Action Plan is shown in Figure 1.

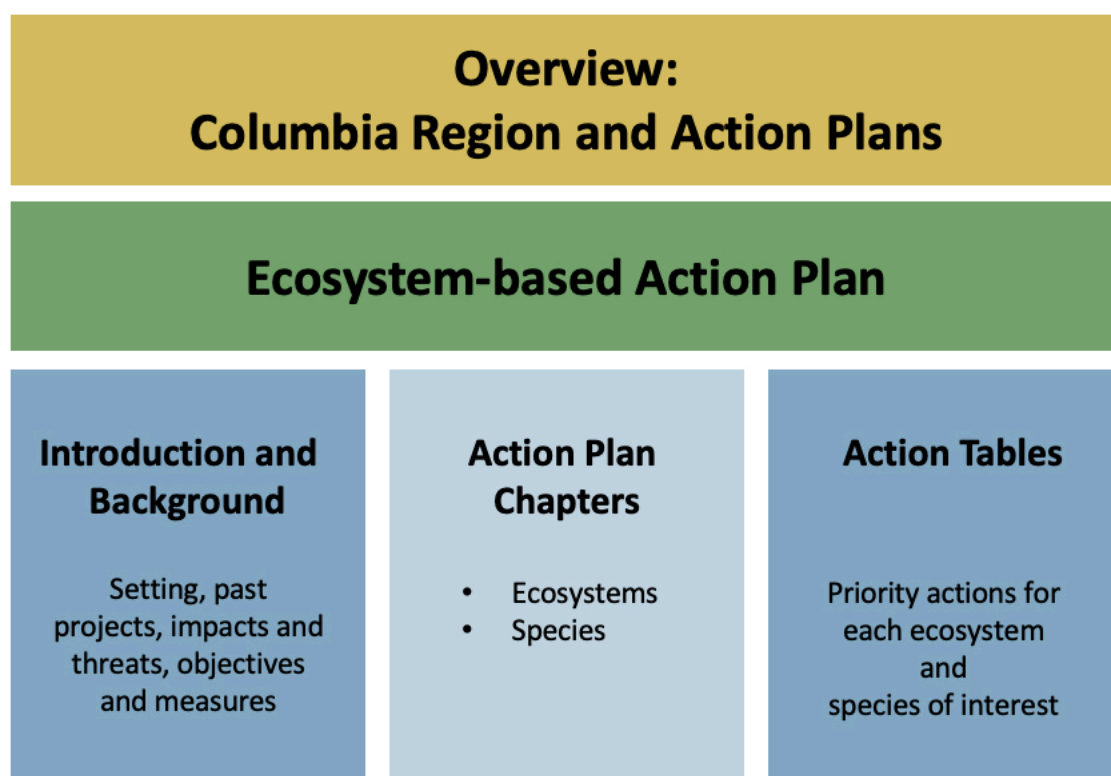


Figure 1: Overview and Action Plan document structure.

The objectives and Priority Actions described herein have been developed with input from the Province of B.C., Fisheries and Oceans Canada (DFO), BC Hydro, First Nations, and local stakeholders. See Overview document for details of the 2018–2019 engagement process.

It is important to understand; however, that planning priorities within Action Plans may not translate immediately into funded projects. Limited funding requires that priority-setting be developed across the FWCP as a whole, not just within Action Plans. The process of selecting which actions will be implemented in any given year will occur during the annual implementation planning cycle.

Reservoirs & Large Lakes Introduction

Early efforts by pre-cursors to the compensation program addressed dam-related impacts in reservoirs and large lakes by focusing mainly on losses of spawning habitat. These were addressed with hatchery production for Bull Trout and Rainbow Trout (e.g. Hill Creek Hatchery, Meadow Creek mini-hatchery) and spawning channels for Kokanee at Hill Creek and Meadow Creek. Hatchery funding by the FWCP has been discontinued due to poor survival of stocked fish, but spawning channels continue to be operated.

Another early attempt to address spawning habitat losses was the removal of an older dam on the Illecillewaet River in 1977 (under the auspices of an FWCP precursor). This re-established access to 38 km of the mainstem river, plus tributaries, for adfluvial Bull Trout spawning and rearing. Recent surveys have shown this work was very successful, as the Illecillewaet River is now the most important Bull Trout spawning stream for the Arrow Lakes Reservoir, supporting about half of all spawning (Decker and Hagen 2008).

Nutrient restoration programs were started in 1992 on Kootenay Lake and in 1999 on the Arrow Lakes Reservoir; these programs have successfully increased productivity at lower trophic levels and have increased Kokanee biomass by approximately 300% over pre-nutrient-addition levels. At higher trophic levels, the response of predators has been more variable, but also more difficult to assess given the lack of quantitative time series data on recruitment, abundance, and harvest. A future opportunity is to improve monitoring data to investigate relationships between trophic levels, so the potential benefits of the large spawning channel and nutrient projects may be more fully understood.

The Reservoirs & Large Lakes Action Plan does not preclude FWCP work on other reservoirs and large lakes, and in fact, some actions are proposed in these other reservoirs and lakes. The Action Plan may be expanded in the future to include additional detail for other reservoirs and large lakes, but for the moment it concentrates on those that have received the most attention from the FWCP.

Setting

Reservoirs and large lakes are defined as water bodies greater than 1,000 hectares and are typically complex ecosystems supporting a more diverse fish/aquatic community than that found in small lakes (B.C. Ministry of Environment 2007). Many have hydrologic regimes that are dominated by hydropower developments. Tributaries of these water bodies are also included in the Action Plan. This document provides a compensation Action Plan for reservoirs and large lakes within the Columbia geographic area, with a focus on fisheries resources in five high-priority areas: Kootenay Lake, Duncan Reservoir, Arrow Lakes Reservoir, Revelstoke Reservoir, and Kinbasket Reservoir (Figure 2 to Figure 6). Other reservoirs and lakes >1,000 hectares in the FWCP Columbia Region, including but not limited to Pend d'Oreille and Koocanusa Reservoirs, and Moose, Slocan, Columbia, and Windermere Lakes, also have relevant actions within the Action Plan. The monitoring programs associated with compensation projects have produced valuable long-term datasets that have great potential for informing improved management of reservoir and large lake ecosystems. On Arrow Lakes Reservoir, for example, there are angler catch data and Kokanee spawner counts going back to the 1970s, as well as lower trophic level sampling, which started in 1997. The potential for learning from these datasets has yet to be fully realized. Another recent contribution of the FWCP is an inventory and assessment of remaining Bull Trout spawning and rearing habitats for the Arrow Lakes Reservoir, which is valuable for habitat protection, restoration planning, and population monitoring.

Moody et al. (2007) discussed the lacustrine landscape in the Columbia Region, detailing the increase in pelagic habitat over historic values due to dams and reservoirs, the elimination of most large river and historic floodplain and wetland habitat, and losses to carbon production. Within the new footprint of the Columbia, compensation options are deemed limited; however, nutrient supplementation has helped to mitigate overall loss of carbon and has gained pre-eminence over other compensation options which were precluded due to low nutrient inputs or large drawdowns and a non-functional littoral zone within reservoir ecosystems.

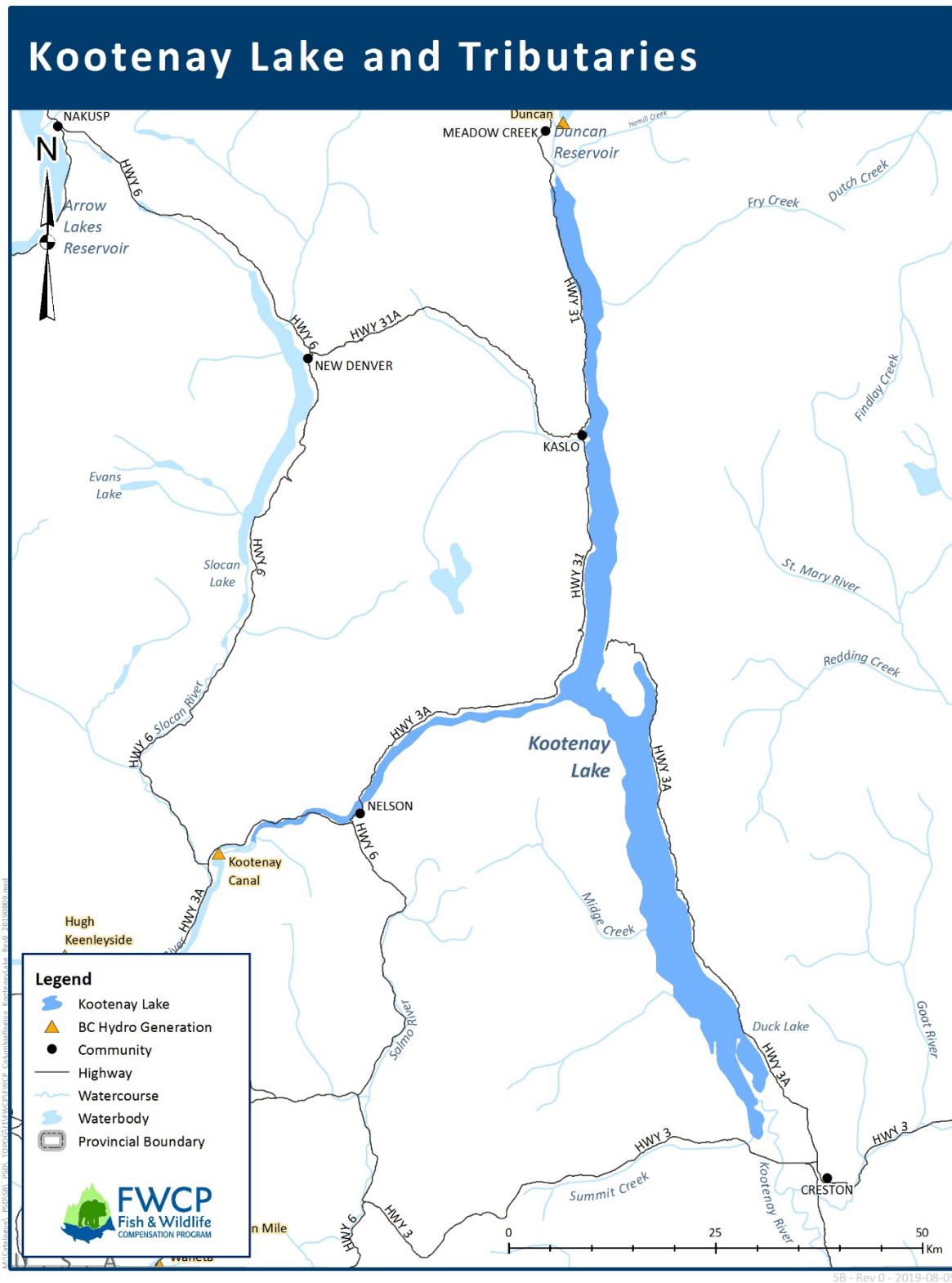


Figure 2: Kootenay Lake, a priority reservoir & large lake in the Columbia Region.

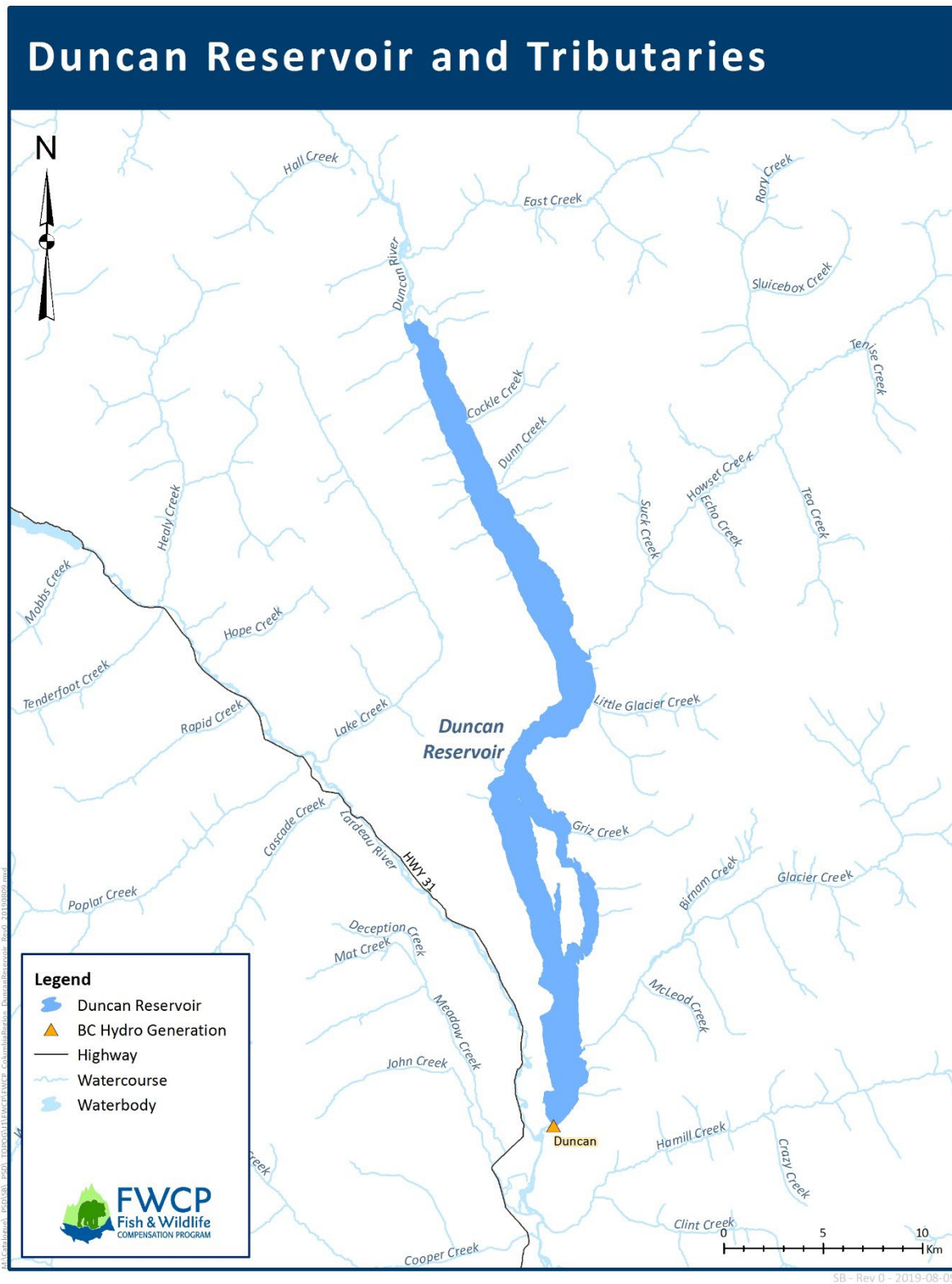


Figure 3: Duncan Reservoir, a priority reservoir & large lake in the Columbia Region.

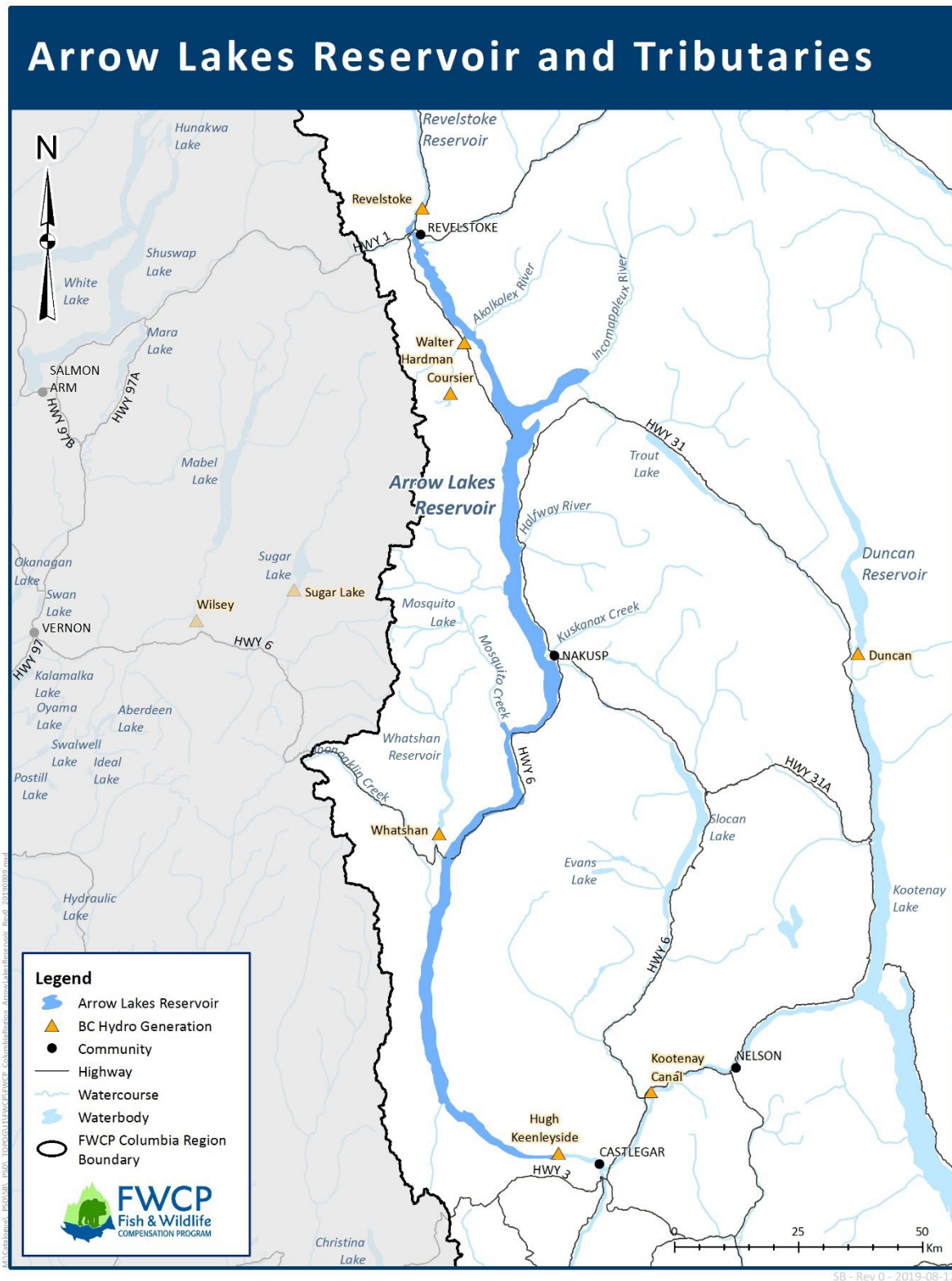


Figure 4: Arrow Lakes Reservoir, a priority reservoir & large lake in the Columbia Region.

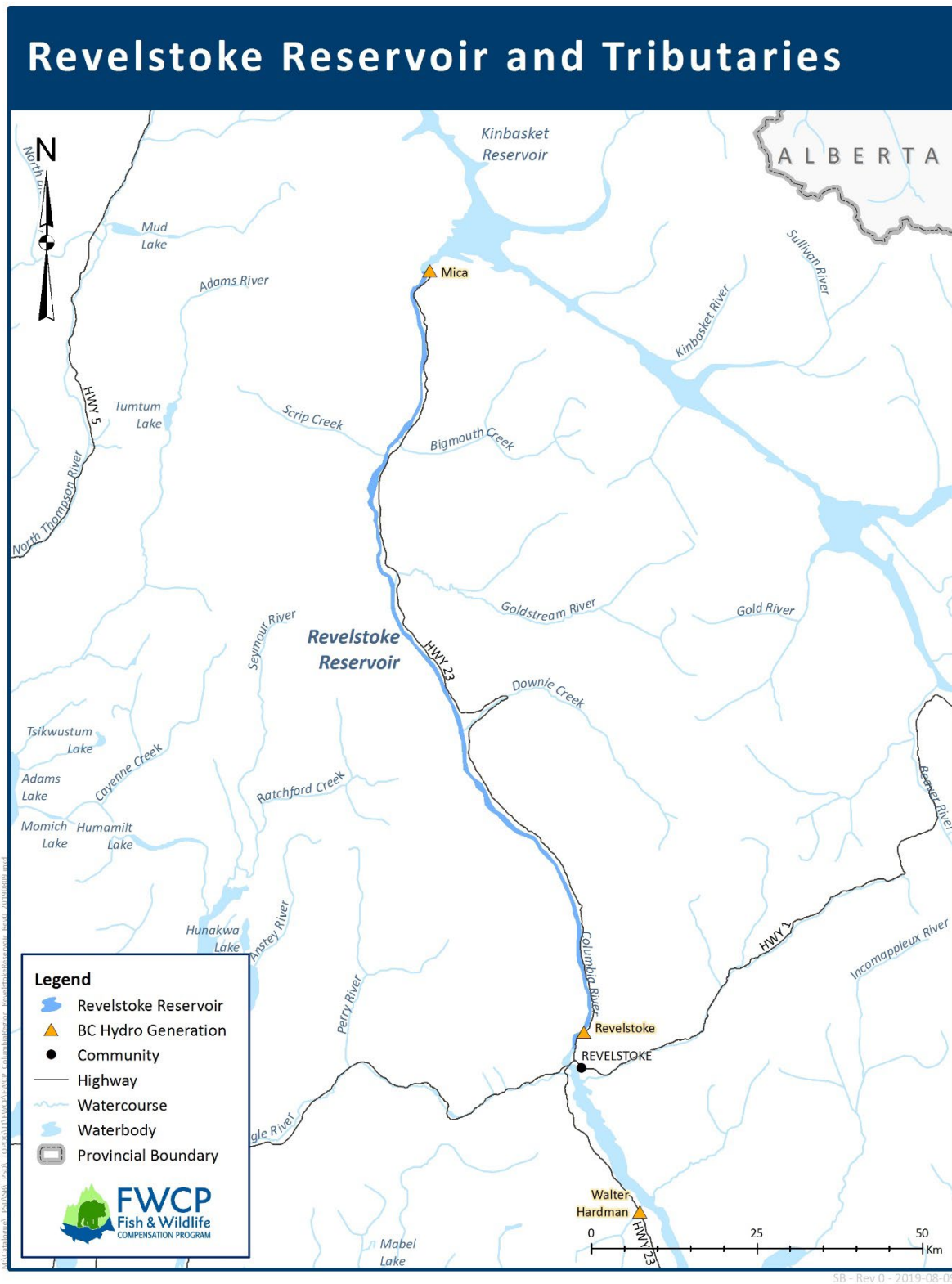


Figure 5: Revelstoke Reservoir, a priority reservoir & large lake in the Columbia Region.



Figure 6: Kinbasket Reservoir, a priority reservoir & large lake in the Columbia Region.

Footprint Impacts and Threats – Kootenay Lake

Hydro-related Impacts

Kootenay Lake inflows and outflows are primarily driven by the terms of the Columbia River Treaty, a joint agreement between the United States and Canada to optimize hydro-electric generation and coordinate flood control on both sides of the border. Corra Linn Dam has controlled the outlet of Kootenay Lake since 1939. Duncan Dam has controlled inflows from the Duncan River since 1967. Libby Dam in Montana has controlled inflows from the Kootenay River since 1973. Daley et al. (1981) estimated that the impoundments have reduced phosphorus inputs to Kootenay Lake by 45% and nitrogen inputs by 35%. Declines in overall productivity are thought to be related in part to this reduction in nutrient inputs. In addition to reduced nutrient inputs, lake levels have been regulated and altered the hydrograph, resulting in lower high-water levels during spring and summer and slightly higher low-water levels during the winter; the presence of upstream dams has also decreased turbidity levels in Kootenay Lake (Moody et al. 2007). In addition, there have been other habitat impacts as well, such as a barrier to upstream Kokanee migration.

Non-hydro Impacts

The introduction of mysid shrimp (*Mysis diluviana*) in 1949 is believed to have had a large and mostly negative effect on the ecology of Kootenay Lake, primarily by sequestering a large portion of carbon production in biomass that is unavailable to higher trophic levels, like fish. Mysids seek deep water refuge away from light during daytime and migrate through the water column at night, hence making them less available to fish as a food source due to the habitat of the lake. Due to unique bathymetry and flow patterns, this effect is much less pronounced in the West Arm. Another oft-cited effect is that of effluent discharges from the Cominco phosphate fertilizer plant from 1952 to 1975, which eutrophied the waterbody in this period. Other impacts include historic effects of logging, mining, flood protection, and land use changes from agriculture and urbanization. The threat of introduced and invasive species, such as Zebra and Quagga mussels, is a concern.

Limiting Factors

Kootenay Lake is naturally a low-productivity (oligotrophic) system. Other limiting factors for fish likely include habitat quantity and quality, access to habitats (i.e. passage), and predation. The limiting factors include natural and human-induced aspects, and the latter include both hydropower and other developments. Limiting factors likely vary among species and trophic levels. Overall productivity is limited by nutrient levels: productivity declined with the cessation of effluents from Cominco and the interception of nutrients in upstream reservoirs, and there is good evidence of a measurable response by lower trophic levels to nutrient additions from the lake nutrient restoration program. Historically, productivity was also related to the turbidity of Kootenay Lake, which has decreased due to the removal of suspended solids by upstream dams (Moody et al. 2007). Kokanee, as zooplankton grazers, have responded positively to increased nutrients in Kootenay Lake. The limiting factors for higher trophic levels are more uncertain, particularly for the highest level piscivores. The sequestration of carbon production in biomass (e.g. Mysids) that is unavailable to many fish, as well as the habitat preferences of Mysids themselves that result in their lack of availability as a food source, likely plays a role in limiting fish production. The historic alteration of rearing and spawning habitats in various tributaries may also limit some fish species, and the concentration of Kokanee spawning in spawning channels may have detrimental effects on contributions from other spawning streams.

Footprint Impacts and Threats – Duncan Reservoir

Hydro-related Impacts

Duncan Dam is located immediately upstream of the confluence of the Duncan and Lardeau Rivers, approximately 10 km upstream of Kootenay Lake. Duncan Dam was completed in 1967 and the reservoir is approximately 45 km in length at full pool; river, lake, wetland, and tributary habitat was impounded. The dam has no dedicated fish passage facilities, but the Low Level Operating Tunnel #2 is operated from the end of May to September annually for the purpose of providing upstream Bull Trout passage. At times, particularly during freshet, the reservoir can be turbid, which may limit aquatic

productivity. Annual drawdowns of the reservoir have likely affected reservoir productivity, and discharge patterns from the dam have likely affected the productivity and suitability of riverine habitat downstream of the dam. Changes in operations due to the Duncan Water Use Plan may have reduced some of these effects. The current monitoring program under the Water Licence Requirements is being implemented to address these uncertainties.

Historically, White Sturgeon occurred in the Duncan River, and a few still occur in Duncan Reservoir (Porto 2008). The area upstream of Duncan Dam was clearly part of White Sturgeon historic habitat, but it is not considered critical habitat and recovery actions are not planned for this area (National Recovery Team for White Sturgeon 2009). There have also been impacts to other fish species like Rainbow Trout (Arndt 2009a), Bull Trout (Hagen 2008), and Burbot (Cope 2008).

Non-hydro Impacts

Other impacts include historic and ongoing effects of logging, mining, and some linear development. The threat of introduced and invasive species, such as Zebra and Quagga mussels, is a concern.

Limiting Factors

Limiting factors for fish in Duncan Reservoir have not been well studied but likely include habitat quantity and quality, access to habitats (i.e. passage), predation, and potentially competition. Ongoing BC Hydro Water Use Plan studies are a start towards the long-term process of determining and understanding these factors. The limiting factors include natural and human-induced aspects, and the latter include both hydropower and other developments. Duncan Reservoir is a cold, seasonally turbid waterbody, which likely limits productivity at all trophic levels.

Footprint Impacts and Threats – Arrow Lakes Reservoir

Hydro-related Impacts

Hugh L. Keenleyside Dam (HLK) is located on the Columbia River about 8 km upstream of Castlegar. The facility was completed in 1968. The HLK raised maximum water levels by 14 m (Arndt 2009a), inundating the former Upper and Lower Arrow Lakes to form Arrow Lakes Reservoir. The reservoir is about 240 km in length and is licensed to operate between the normal full pool elevation of 440.1 m and minimum pool elevation of 418.64 m; annual drawdown is about 20 m (Hirst 1991). The increased water levels inundated high-quality spawning and rearing habitat in tributaries. Total stream habitat losses were estimated as 203 km (Thorley 2008), about 90% of this by area was low-gradient, high-quality habitat. Revelstoke Dam blocked access to spawning and rearing habitat in tributaries upstream of the reservoir, and both Mica and Revelstoke Dams caused long-term changes in light penetration and nutrients in the lentic habitat of Arrow Lakes Reservoir (Moody et al. 2007). Despite the habitat changes, potential total annual primary production was estimated to be 1.6 times higher after dams than before due to reduced turbidity and the greater area of the reservoir (Moody et al. 2007); however, not all of this habitat area is utilized. This estimate was also based only on in-lake processes (nutrient/turbidity interactions) and did not take into account possible effects of hydraulic changes resulting from dam operations (Matzinger et al. 2007), and possibly wetland losses upstream. Prior to Mica and Revelstoke Dams, soluble reactive phosphorus loading to Arrow Lakes was an average of 46.8 tonnes (1956 to 1973) and post-dam (1984 to 2018), the average soluble reactive phosphorus loading was 10.0 tonnes (E. Schindler, pers. comm.).

Non-hydro Impacts

A potentially significant impact for fish production was the introduction of mysid shrimp shortly after HLK was constructed. Mysids have become an important competitor with Kokanee and are believed to have had a large and mostly negative effect on the ecology of Arrow Lakes, primarily by sequestering a large portion of carbon production in biomass that is unavailable to higher trophic levels, like fish. Mysids seek deep water refuge away from light during daytime and migrate through the water column at night, hence making them less available to fish as a food source due to the habitat of the lake. Other impacts include historic and ongoing effects of logging. The threat of introduced and invasive species, such as Zebra and Quagga mussels, is a concern.

Limiting Factors

Limiting factors for fish in the Arrow Lakes likely include habitat quantity and quality, access to habitats (i.e. passage), and predation, though the extent to which each contribute to different species has not been determined. The limiting factors include natural and human-induced aspects, and the latter include effects from both dam construction and other developments. For Kokanee, the main limiting factor is productivity, and there is some evidence that operations such as reservoir fluctuations may reduce productivity capacity for Kokanee.

Footprint Impacts and Threats – Revelstoke Reservoir

Hydro-related Impacts

Revelstoke Dam is located on the Columbia River about 5 km upstream from the City of Revelstoke. The Revelstoke Project was completed in 1984 and impounded about 142 km of the Columbia River and the lower reaches of tributaries (Thorley 2008). At 115 km², Revelstoke Reservoir surface area is less than one-third of Kinbasket Reservoir and less than one-quarter of Arrow Lakes Reservoir (measured at full pool for each). Revelstoke Reservoir is operated as “run-of-the-river” based on storage in Kinbasket Reservoir; therefore, it has a very stable water level. This water-level stability has allowed for a small developing littoral zone; however, this also reduces residence time and limits pelagic production, the main driver of reservoir productivity.

The former riverine fish community has transformed into a lacustrine dominated fish assemblage with species such as Bull Trout, Kokanee, and Burbot benefitting and others, such as Mountain Whitefish, declining in abundance (Cope 2008; Hagen 2008; Arndt 2009b). The presence of White Sturgeon remains suspected, but unconfirmed. Revelstoke Dam has no fish passage facilities.

Non-hydro Impacts

Other impacts include historic and ongoing effects of logging. The threat of introduced and invasive species, such as Zebra and Quagga mussels, is a concern.

Limiting Factors

Limiting factors for fish in Revelstoke Reservoir could include habitat quantity and quality (productivity), entrainment, disease, competition, and predation, though the relative importance for many species other than Kokanee has not been fully determined. Pelagic production that supports Kokanee through zooplankton production is phosphorus limited and is strongly influenced by both outflow from Kinbasket Reservoir and climatic effects (Bray et al. 2018). The limiting factors include natural and human-induced aspects, and the latter include effects from both hydropower and other developments.

Footprint Impacts and Threats – Kinbasket Reservoir

Hydro-related Impacts

Mica Dam is located on the Columbia River about 135 km north of Revelstoke and was completed in 1973. Kinbasket Reservoir, formed by construction of Mica Dam, is 216 km long and the reservoir is operated under the terms of the Columbia River Treaty and other agreements. Kinbasket Reservoir inundated 539 km of mainstem Columbia River and the lower reaches of tributaries, 24 km² of small and medium lakes, 5.5 km² of shallow water habitat, and extensive flood plain and wetland habitat (Thorley 2008). While the maximum drawdown allowable is 47 m, the average annual drawdown (1977–2018) is 25.4 m. While eliminating the chance for developing littoral habitat, the reservoir refill cycle increases residence time.

As with Revelstoke Reservoir, the former riverine fish community has transformed into a lacustrine dominated fish assemblage with species such as Bull Trout, Kokanee, and Burbot benefitting and others, such as Mountain Whitefish,

declining in abundance (Cope 2008; Hagen 2008; Arndt 2009b). The presence of White Sturgeon remains suspected, but unconfirmed. Mica Dam has no fish passage facilities.

Non-hydro Impacts

Other impacts include historic and ongoing effects of logging. The threat of introduced and invasive species, such as Zebra and Quagga mussels, is a concern.

Limiting Factors

Limiting factors for fish in Kinbasket Reservoir could include habitat quantity and quality (productivity), disease, competition, and predation, though the relative importance for many species other than Kokanee has not been fully determined. Although Kinbasket Reservoir is naturally low in productivity, Kokanee, and likely species that they support, have done relatively well in the reservoir, benefitting from the pelagic habitat and extensive spawning areas. Pelagic production that supports Kokanee through zooplankton production is phosphorus limited and strongly influenced by climatic effects (Bray et al. 2018). The limiting factors include natural and human-induced aspects, and the latter include effects from both hydropower and other developments.

Knowledge Status and Gaps

The Reservoirs & Large Lakes Action Plan re-affirms the importance of the nutrient restoration program as the primary near-term means to offset the losses of overall aquatic productivity in Kootenay Lake and Arrow Lakes Reservoir due to impoundment, upstream dams, and flooded wetlands. Models for Kootenay Lake and Arrow Lakes Reservoir that synthesize available data, reveal knowledge gaps, and allow exploration of different management alternatives, such as the predicted response of different ecological units to aquatic productivity affected by nutrients, climate (light, flow, temperature), or changes in Kokanee escapement, are gaps that can be addressed for the five main reservoirs and large lakes.

In Duncan, Revelstoke, and Kinbasket Reservoirs, long-term trends in status of the main fish species of interest – like Bull Trout, Burbot, Kokanee, and Rainbow Trout in Duncan Reservoir – have been lacking; the only long-term trend data that exists is for Kokanee in Revelstoke and Kinbasket Reservoirs. In recent years, BC Hydro Water Use Plan studies have been addressing some of these gaps, primarily for Burbot and Kokanee in Duncan Reservoir and Bull Trout and Burbot in Kinbasket Reservoir.

Previously Implemented FWCP Projects

The FWCP has supported projects in reservoir and large lake ecosystems within the Columbia Region since its inception. A full list of the reports from projects undertaken to date is available online at fwcp.ca/results. Below is a brief summary of the work undertaken during recent project years (2013–2017), since the last round of Action Plan updates.

- Nutrient restoration programs;
- Spawning channel operation and maintenance;
- Habitat- and species-based studies regarding Bull Trout, Kokanee and piscivorous Rainbow Trout; and
- Habitat creation and restoration for focal species.

A total of 177 projects primarily addressed large lake actions, which amounted to over \$9.5 million of FWCP investments. High-priority reservoirs and large lakes addressed by these projects included Kootenay Lake, Arrow Lakes Reservoir, and other large lakes for both fish (95%) and wildlife (5%) projects. Annual and ongoing projects within the Arrow Lakes Nutrient Restoration Program, Kootenay Lake Restoration Program, Meadow Creek Spawning Channel, and Hill Creek Spawning Channel were the most numerous activities addressed under this Action Plan. Several Grant projects were conducted, including research and information-acquisition projects such as exploring the history of fish-derived nutrient supplies in Arrow Lakes Reservoir (FY15), determination of Gerrard Rainbow Trout Parr Productivity and Capacity (FY14-FY15), and the Meadow Creek Bear Education and Management Project (FY16-FY17). Habitat-based projects, such

as the Slocan Lake Bull Trout Redd Counts (FY16) and Whatshan Reservoir Nutrient Addition Restoration Feasibility (FY16), were also supported through the grant intake process.

Bull Trout, Kokanee, piscivorous Rainbow Trout, White Sturgeon, Grizzly Bear, and Common Loon were all species of interest that were addressed by projects within this Action Plan. Key knowledge gaps include the fact that three of five priority reservoirs and large lakes were not addressed (i.e. Duncan, Kinbasket, and Revelstoke Reservoirs), plus the majority of projects were in the West Kootenay sub-region (97%). Several actions of various priority ratings were not addressed in the suite of projects reviewed, including all actions for Burbot.

RESERVOIRS & LARGE LAKES ACTION PLAN OBJECTIVES

Clear and realistic objectives are necessary to guide information acquisition and prioritize actions. Priority Actions and information needs will change as both improvements to the system are realized and information is gained. The current Action Plan reflects the information available and values expressed by FWCP partners.

The Reservoirs & Large Lakes Action Plan has four objectives, which are high-level statements of desired future conditions (outcomes) consistent with FWCP strategic objectives, partner mandates, and policies. Each objective has associated sub-objectives, which provide more specific direction on desired future conditions, including detailed performance measures that can direct specific projects. Priority Actions in the [Action Tables](#) align with the objectives and sub-objectives.

Objectives and Measures

The following objectives have been developed to define the scope of the Reservoirs & Large Lakes Action Plan (Figure 7). While the objectives are expected to remain stable over time, the projects funded may evolve as priorities shift, or new information becomes available.

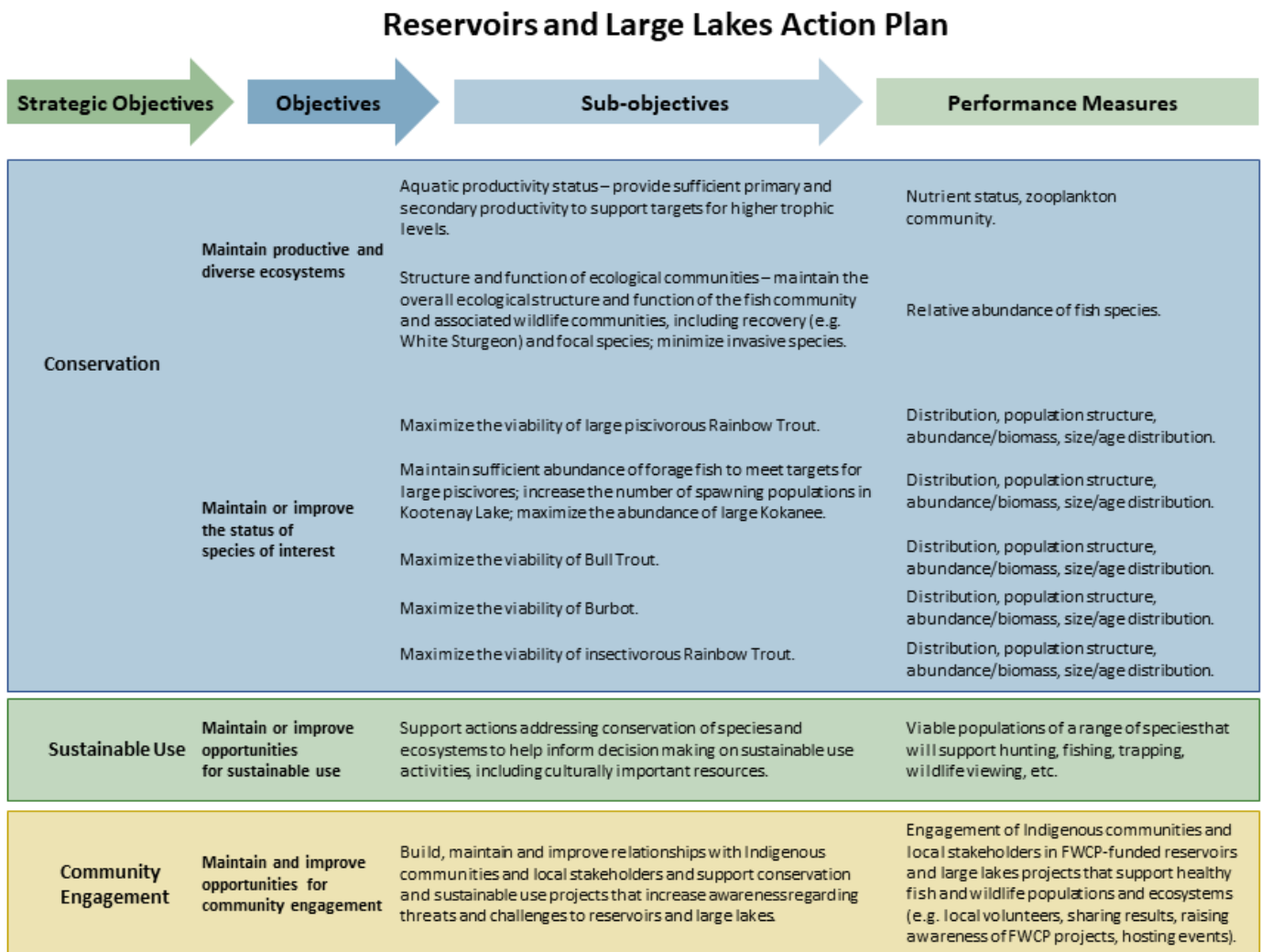


Figure 7: Reservoirs & Large Lakes Action Plan objectives and measures.

ACTION PLAN CHAPTERS

The [Action Tables](#) in this document identify FWCP Priority Actions to conserve and enhance fish and wildlife in reservoir and large lake ecosystems in the Columbia Region. See Overview document for additional information on Action Table format and the funding application process.

Priority Actions are organized by cross plan actions, ecosystem, and species, and by action type: Research and Information Acquisition, Habitat-based Actions, Monitoring and Evaluation Actions, Land Securement, and Species-based Actions are assigned a priority ranking from 1 (highest priority) to 3 (lowest priority).

There are six priority areas in the Reservoirs & Large Lakes Action Plan:

- Kootenay Lake
- Duncan Reservoir
- Arrow Lakes Reservoir
- Revelstoke Reservoir
- Kinbasket Reservoir
- other reservoirs and lakes >1,000 hectares in the FWCP Columbia Region

Species of interest for reservoirs and large lakes are outlined in this Action Plan. There is one priority recovery species of interest in the Reservoirs & Large Lakes Action Plan, White Sturgeon, as well as focal and inventory species of interest associated with reservoir and large lake ecosystems for the Columbia Region.

Cross Plan Actions

Several broad cross plan actions are relevant to all terrestrial and aquatic Action Plans but are not readily nested under any particular sub-objective. Projects that address these actions will require the consideration of multiple ecosystems.

Reservoir & Large Lake Ecosystems

Reservoirs and large lakes are defined as those bigger than 1,000 hectares and are typically complex ecosystems supporting a more diverse fish/aquatic community than that found in small lakes (B.C. Ministry of Environment 2007). These ecosystems are also of importance in the Columbia Region as they support fisheries for large Rainbow Trout, Bull Trout, and Kokanee. Reservoirs have inundated extensive areas of lakes, riverine, riparian, and wetland/floodplain habitats resulting in impacts to both fish and wildlife species. Some of the most limiting factors in the reservoir and large lake aquatic ecosystems include a decline in nutrient inputs due to dam impoundments, alteration of flow due to dam operations, a loss of high-quality spawning and rearing habitat in stream tributaries, a loss of effective littoral habitat due to reservoir fluctuations, and reservoir aging phenomenon (initial nutrient spike with long term decline after). Connectivity among lakes, and between lakes and streams, which is important for seasonal movement of some species and for spawning fish, has also been impacted by the creation of large reservoirs.

Priority Habitats

The Reservoirs & Large Lakes Action Plan presents a strategy to address compensation for five priority reservoir and large lake systems within the Columbia geographic area, as well as other large reservoirs and lakes within the region (tributaries of these water bodies are also included in this Action Plan). The Action Plan describes objectives, sub-objectives, and performance measures, and the actions are required to address these over time.

- **Kootenay Lake** – The annual pattern of lake level fluctuations of Kootenay Lake has changed from historical patterns due to hydropower development, but the quantity of in-lake physical habitat has not changed markedly (Thorley 2008). Water quality in Kootenay Lake has changed through time, as nutrient concentrations and water clarity have been affected by upstream dams and industrial effluent discharges (Moody et al. 2007). The most notable effect on habitat from these changes is a decline in aquatic productivity. Tributary habitats have been

affected by dams and altered discharge regimes on the two largest in-flowing rivers, Duncan and Kootenay Rivers, affecting availability of spawning and rearing habitat.

- **Duncan Reservoir** – The annual reservoir operations result in a drawdown of approximately 30 m, which dewateres an area of over 5,000 hectares (Cope 2008). While operational changes associated with the Duncan Water Use Plan (BC Hydro 2007) have likely improved habitat downstream of Duncan Reservoir, this effect has not been quantified. Further, reservoir aging may have caused a decline in pelagic productivity over time (Moody et al. 2007). Long-term trends in status of the main fish species of interest within the Duncan Reservoir, including Burbot, Bull Trout, Kokanee, and Rainbow Trout remain relatively unknown; however, BC Hydro Water Use Plan studies have addressed some information gaps for Burbot and Kokanee in recent years. General limnological information is also a key data gap.
- **Arrow Lakes Reservoir** – As a result of dam construction, Arrow Lakes have switched from light limitation during pre-dam conditions, to nutrient limitation today (Moody et al. 2007), which has been the primary motivation for compensation through nutrient restoration. Fish stocks have been monitored fairly consistently through time and, in general, the reservoir has provided a self-sustaining population of piscivorous Rainbow Trout. Burbot are also widely distributed throughout the reservoir (Arndt and Baxter 2006). However, Kokanee stocks declined substantially by the mid-1990s, but nutrient additions in combination with use of the Hill Creek Spawning Channel appear to have been successful at restoring Kokanee escapement to pre-impoundment levels (Hagen 2008). Likewise, Bull Trout growth and survival conditions (linked to improved Kokanee populations) appear to have been enhanced from reservoir fertilization (Hagen 2008).
- **Revelstoke Reservoir** – Revelstoke Reservoir transformed a former free-flowing section of the Columbia River into an oligotrophic reservoir with low residence time (Moody et al. 2007). While several studies have been conducted on fish resources in the reservoir over the years, the only long-term trend data exist for Kokanee. Recent data indicate Kokanee populations in Revelstoke Reservoir are at low levels, likely due to a combination of climatic and operational conditions that affect pelagic production (Bray et al. 2018).
- **Kinbasket Reservoir** – Kinbasket Reservoir flooded the largest amount of aquatic and terrestrial habitat of any of the Columbia reservoirs in BC (Arndt 2009a). The reservoir itself is oligotrophic (Bray et al. 2018). While some life history studies have been conducted on fish resources in the reservoir in recent years, the only long-term trend data exist for Kokanee (Sebastian and Weir 2017). Recent data indicate Kokanee populations in Kinbasket Reservoir were stable for many years and have recently declined partly as a result of a large die-off in 2016. Climatic factors exert a strong influence on zooplankton productivity that affect Kokanee (Bray et al. 2018).
- **Other Reservoirs and Large Lakes** – This includes water bodies >1,000 hectares in the FWCP Columbia Region (including but not limited to Pend d'Oreille and Koocanusa Reservoirs, and Moose, Slokan, Columbia, and Windermere Lakes).

The nutrient restoration program is the primary means currently being used to offset losses of aquatic productivity in Kootenay Lake and Arrow Lakes Reservoir due to impoundment, upstream dams, and flooded wetlands. The nutrients support phytoplankton, which feeds the zooplankton, which in turn feed the Kokanee. Kokanee are the fish species most preyed on by piscivorous fish (like piscivorous Rainbow Trout and Bull Trout) and wildlife (like birds and bears). The nutrient restoration program is therefore critical to meeting many of the program objectives and sub-objectives. A detailed review of the overall effectiveness of the nutrient restoration program should be completed on a regular basis as proposed in the Reservoirs & Large Lakes Action Tables.

All species are important, but it is possible to identify a subset that can be used as indicators for the status of the broader community. Managing for and tracking the status of these species provides a good overall picture of progress towards fish and wildlife management goals. This Action Plan focuses on specific species, depending on the waterbody, with the assumption that funded projects for these will support conservation of other fish species not in this list.

Species of Interest in Reservoir & Large Lake Ecosystems

Species of interest in reservoir and large lake ecosystems are species or guilds that are important to communities or are of conservation concern but may not be adequately addressed by ecosystem-based actions. These include some species at risk (SAR) or species used for food or cultural purposes.

The FWCP uses three general categories of species of interest: recovery, focal, and inventory.

Recovery Species	Recovery species are those of highest priority and conservation concern that have been adversely impacted by dam construction and/or operation. These species have formally been classified as either threatened or endangered by Canada or B.C., and recovery and/or management plans are either in place or under development by Federal or Provincial management agencies. Actions for recovery species are directly coordinated with recovery strategies and plans.
Focal Species	Focal species have a strong linkage to dam footprint impacts and are of regional interest. Actions proposed for species in this category should be developed in the context of restoring/improving/enhancing suitable habitats in the relevant ecosystems. Focal species with a high conservation concern (i.e. species at risk) may be considered a higher priority for actions.
Inventory Species	Inventory species have also been affected by dams, but detailed inventory and/or trend monitoring is required to support the development of more detailed actions. Actions proposed for species in this category should aim to provide the basis for future compensation actions. Inventory species with a high conservation concern (i.e. species at risk) may be considered a higher priority for actions.

Species of interest may benefit from general improvements in reservoir and large lake habitat, but often there are specific factors that may be limiting the abundance and distribution of priority species. Species that would benefit most from FWCP investment and that also depend on reservoirs and large lakes more than any other type of habitat are presented below. Actions are presented that will directly benefit species that utilize reservoirs and large lakes. In addition, reservoirs and large lakes may also represent supporting habitat; that is, these species occur in reservoirs and large lakes, but they occur more often or are more dependent on one or more other habitat types. Actions taken on reservoirs and large lakes may benefit these species, but actions on their primary habitat are likely to provide greater benefit.

Recovery Species

There is one recovery species of interest (Table 1) associated with reservoir and large lake habitats for the Columbia Region. Actions for this species align with Federal and/or Provincial recovery strategies and management plans.

White Sturgeon (*Acipenser transmontanus*)

White Sturgeon is the largest, longest-lived freshwater fish species in North America (Scott and Crossman 1973). Within Canada, White Sturgeon occur only in British Columbia and are divided into six populations, based on geography and genetics: the lower, mid, and upper Fraser River, Nechako River, Columbia River, and Kootenay River. All populations were assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), but only the latter four are legally listed under the Federal Species at Risk Act. In the Columbia Region, White Sturgeon occur in the Kootenay and Columbia Rivers.

Kootenay River — The Kootenay River population of White Sturgeon extends from Kootenai Falls, Montana, located 50 km below Libby Dam, downstream through Kootenay Lake to Corra Linn Dam on the lower West Arm of Kootenay Lake, British Columbia. A natural barrier at Bonnington Falls downstream of Kootenay Lake has isolated the Kootenay River White Sturgeon from other populations in the Columbia River basin since the end of the Pleistocene, approximately 10,000 years ago (Northcote 1973). Spawning habitat is located in the US, whereas much of the adult and juvenile rearing habitat is located in the Canadian portion of Kootenay River plus Kootenay Lake (e.g. Kootenay delta and tributary creek mouths).

Small remnant populations of White Sturgeon are known to occur upstream of Duncan Dam and in Slocan Lake; however, recovery of these populations has been deemed infeasible and the Federal White Sturgeon Recovery Strategy does not consider those demographically isolated population components (Fisheries and Oceans Canada 2014).

Columbia River — White Sturgeon historically had access from the ocean all the way to Columbia Lake in the upper Columbia and Shoshone Falls in the upper Snake River. Distribution was probably concentrated in areas of favourable habitat. Significant concentrations of White Sturgeon were reported during the early 1900s in the mainstem downstream from Castlegar, the lower Kootenay River, Arrow Lakes, Big Eddy near Revelstoke, and the present site of Mica Dam (Prince 2001). At least two significant populations remain in the upper Columbia River and other remnant populations consisting of a few individuals occur, or are suspected, throughout other portions of the historic range. The largest population resides in the free-flowing transboundary reach between Hugh L. Keenleyside Dam (HLK) and Roosevelt Reservoir (FDR). A second significant subpopulation of White Sturgeon currently inhabits Arrow Lakes Reservoir (ALR), upstream of HLK. The occurrence of this subpopulation may simply reflect splitting of a larger population by the construction of HLK. Abundance in this subpopulation is substantially lower than in the reach from HLK to FDR. Adult sturgeon have not been collected during investigations in Kinbasket Reservoir, Revelstoke Reservoir, or Trout Lake (RL&L Environmental Services Ltd. 1996a, 1996b, 2000), despite repeated efforts.

The FWCP has supported White Sturgeon aquaculture in the Upper Columbia River. One action is presented for White Sturgeon to support strategies and initiatives outlined in the Federal recovery strategy and draft Action Plan for the species in Canada.

Focal Species

Focal species have been identified and prioritized by the FWCP Columbia Region using the Species Rating and Database Tool (Fish & Wildlife Compensation Program 2011) and the following steps:

1. Identifying species that have known habitat-based or species-based actions that could be implemented immediately (i.e. where the species distribution, abundance, and limiting factors are sufficiently understood); and
2. Removing species that are not of a high local or conservation concern, as defined by consultation and by the British Columbia Conservation Framework, and/or those that were not ranked high in the Columbia Basin dam impacts studies (e.g. Manley and Krebs 2009).

Table 2 lists the focal species cross-referenced with the priority (dark green) and supporting (light green) ecosystem Action Plans. The FWCP considers projects targeting focal species and their habitats as priorities for consideration where clear habitat-, land-, or species-based actions are available for implementation.

Inventory Species

Inventory species are those for which inventory/data acquisition is the primary compensation action identified by the FWCP and in the Columbia Basin dam impacts reports (e.g. Manley and Krebs 2009). Table 3 lists the inventory species that are primarily associated with reservoirs and large lakes and that have been identified as highly impacted by dam construction or operation. Before further actions are developed and implemented for these species, some baseline inventory work is required to determine their distribution and abundance and/or trend within the Columbia Region.

The FWCP considers projects targeting inventory species as priorities for consideration where clear outcomes leading to habitat-, land-, or species-based actions are practically achievable. Projects are prioritized during the annual operational planning cycle.

Culturally Important Species

Culturally important plant and animal species occur in the Columbia Region and are a recognized component of reservoir and large lake ecosystem function and resiliency, as well as a part of a holistic approach to current and future fish and wildlife compensation actions. First Nations should be consulted where projects overlap with identified culturally important species. FWCP-funded work for culturally important reservoir and large lake species may occur under cross plan actions, or as part of other ecosystem or species actions in this plan.

Invasive Species

The FWCP Columbia Region supports work that prevents and/or controls the spread and effects of invasive species that have the potential to negatively impact projects previously supported by the FWCP, such as restoration sites and/or conservation properties. Any work to address invasive species should be completed in collaboration with the Province of B.C. and regional invasive species councils and societies as appropriate. Invasive species priority and watch lists vary by region, location, and year; therefore, grant applicants should refer to the appropriate regional and/or Provincial organization when developing funding applications.

Table 1: Recovery species of interest associated with reservoirs & large lake habitats in the Columbia Region. This list is based on species that are of highest priority and conservation concern and have been adversely impacted by dam construction and/or operation. Coloured cells represent the ordered relationship between species and the ecosystem-based Action Plans: ✓ with dark green = primary habitat, light green = supporting habitat.

Fish Wildlife	Guild	Common Name	Species Name	Federal	Provincial	Reservoirs & Large Lakes	Small Lakes	Rivers & Riparian	Wetlands & Riparian	Upland & Dryland
Fish	Fish - Sturgeon	White Sturgeon	<i>Acipenser transmontanus</i>	Endangered	Red-listed	✓		✓		
Wildlife	Mammal - Ungulate	Mountain Caribou	<i>Rangifer tarandus caribou</i>	Endangered	Red-listed					✓

Table 2: Focal species of interest associated with reservoirs & large lake habitats in the Columbia Region. The list is based on species for which there are habitat-based or species-based actions that can be implemented immediately (i.e. where the species distribution, abundance, and limiting factors are sufficiently understood) and dam impacts are known to be high. Coloured cells represent the ordered relationship between species and the ecosystem-based Action Plans: ✓ with dark green = primary habitat, light green = supporting habitat.

Fish Wildlife	Guild	Common Name	Species Name	Federal	Provincial	Reservoirs & Large Lakes	Small Lakes	Rivers & Riparian	Wetlands & Riparian	Upland & Dryland
Fish	Fish - Benthic	Burbot	<i>Lota lota</i>		Yellow-listed	✓				
Fish	Fish - Benthic	Burbot (Kootenay Lake)	<i>Lota lota</i> , pop 1.		Red-listed	✓				
Fish	Fish - Benthic	Mountain Sucker	<i>Catostomus platyrhynchus</i>	Special Concern	Blue-listed			✓		
Fish	Fish - Insectivorous	Rainbow Trout (insectivorous-Fluvial)	<i>Oncorhynchus mykiss</i>		Yellow-listed			✓		
Fish	Fish - Insectivorous	Rainbow Trout (insectivorous-LL)	<i>Oncorhynchus mykiss</i>		Yellow-listed	✓				
Fish	Fish - Insectivorous	Westslope Cutthroat Trout	<i>Oncorhynchus clarkii lewisi</i>	Special Concern	Blue-listed			✓		
Fish	Fish - Piscivorous	Bull Trout	<i>Salvelinus confluentus</i>	Special Concern	Blue-listed	✓				
Fish	Fish - Piscivorous	Rainbow Trout (piscivorous-LL)	<i>Oncorhynchus mykiss</i>		Yellow-listed	✓				
Fish	Fish - Plankton	Kokanee	<i>Oncorhynchus nerka</i>		No Status	✓				
Wildlife	Bird - Raptor	Osprey	<i>Pandion haliaetus</i>		Yellow-listed				✓	
Wildlife	Bird - Shorebird	Spotted Sandpiper	<i>Actitis macularius</i>		Yellow-listed		✓			
Wildlife	Bird - Wader	Great Blue Heron	<i>Ardea herodias herodias</i>		Blue-listed				✓	
Wildlife	Bird - Water	American White Pelican	<i>Pelecanus erythrorhynchos</i>		Red-listed		✓			
Wildlife	Bird - Water	Common Loon	<i>Gavia immer</i>	Not at Risk	Yellow-listed		✓			
Wildlife	Bird - Water	Western Grebe	<i>Aechmophorus occidentalis</i>	Special Concern	Red-listed		✓			
Wildlife	Mammal - Bat	Northern Myotis	<i>Myotis septentrionalis</i>	Endangered	Blue-listed					✓
Wildlife	Mammal - Bat	Silver-haired Bat	<i>Lasiurus noctivagans</i>		Yellow-listed					✓
Wildlife	Mammal - Carnivore	Grizzly Bear	<i>Ursus arctos</i>	Special Concern	Blue-listed					✓

Table 3: Inventory species of interest associated with reservoirs & large lake habitats in the Columbia Region. The list is based on species for which dam impacts are known to be high, but baseline information is required before habitat- or species-based action can be implemented. Coloured cells represent the ordered relationship between species and the ecosystem-based Action Plans: ✓ with dark green = primary habitat, light green = supporting habitat.

Fish Wildlife	Guild	Common Name	Species Name	Federal	Provincial	Reservoirs & Large Lakes	Small Lakes	Rivers & Riparian	Wetlands & Riparian	Upland & Dryland
Fish	Fish - Benthic	Columbia (Mottled) Sculpin	<i>Cottus hubbsi</i>	Special Concern	Blue-listed			✓		
Fish	Fish - Benthic	Leopard Dace	<i>Rhinichthys falcatus</i>		Yellow-listed			✓		
Fish	Fish - Benthic	Shorthead Sculpin	<i>Cottus confusus</i>	Special Concern	Blue-listed			✓		
Fish	Fish - Benthic	Slimy Sculpin	<i>Cottus cognatus</i>		Yellow-listed			✓		
Fish	Fish - Benthic	Torrent Sculpin	<i>Cottus rhotheus</i>		Yellow-listed			✓		
Fish	Fish - Benthic	Prickly Sculpin	<i>Cottus asper</i>		Yellow-listed	✓				
Fish	Fish - Benthic	Umatilla Dace	<i>Rhinichthys umatilla</i>	Threatened	Red-listed			✓		
Fish	Fish - Insectivorous	Mountain Whitefish	<i>Prosopium williamsoni</i>		Yellow-listed	✓				
Fish	Fish - Insectivorous	Pygmy Whitefish	<i>Prosopium coulterii</i>	Not at Risk	Yellow-listed	✓				
Wildlife	Bird - Aerial Insectivore	Bank Swallow	<i>Riparia riparia</i>	Threatened	Yellow-listed			✓		
Wildlife	Bird - Aerial Insectivore	Cliff Swallow	<i>Petrochelidon pyrrhonota</i>		Yellow-listed				✓	
Wildlife	Bird - Aerial Insectivore	Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>		Yellow-listed				✓	
Wildlife	Bird - Aerial Insectivore	Tree Swallow	<i>Tachycineta bicolor</i>		Yellow-listed				✓	
Wildlife	Bird - Gull	Ring-billed Gull	<i>Larus delawarensis</i>		Yellow-listed		✓			
Wildlife	Bird - Raptor	Bald Eagle	<i>Haliaeetus leucocephalus</i>	Not at Risk	Yellow-listed	✓				
Wildlife	Bird - Shorebird	Forster's Tern	<i>Sterna forsteri</i>	Data Deficient	Red-listed		✓			
Wildlife	Bird - Shorebird	Herring Gull	<i>Larus argentatus</i>		Yellow-listed				✓	
Wildlife	Bird - Shorebird	Killdeer	<i>Charadrius vociferus</i>		Yellow-listed	✓				
Wildlife	Bird - Water	Barrow's Goldeneye	<i>Bucephala islandica</i>		Yellow-listed		✓			
Wildlife	Bird - Water	Blue-winged Teal	<i>Spatula discors</i>		Yellow-listed				✓	
Wildlife	Bird - Water	Bufflehead	<i>Bucephala albeola</i>		Yellow-listed		✓			
Wildlife	Bird - Water	Canvasback	<i>Aythya valisineria</i>		Yellow-listed				✓	
Wildlife	Bird - Water	Common Goldeneye	<i>Bucephala clangula</i>		Yellow-listed		✓			
Wildlife	Bird - Water	Hooded Merganser	<i>Lophodytes cucullatus</i>		Yellow-listed				✓	
Wildlife	Bird - Water	Lesser Scaup	<i>Aythya affinis</i>		Yellow-listed				✓	
Wildlife	Bird - Water	Northern Pintail	<i>Anas acuta</i>		Yellow-listed				✓	
Wildlife	Bird - Water	Redhead	<i>Aythya americana</i>		Yellow-listed				✓	
Wildlife	Bird - Water	Red-necked Grebe	<i>Podiceps grisegena</i>	Not at Risk	Yellow-listed				✓	
Wildlife	Bird - Water	Ring-necked Duck	<i>Aythya collaris</i>		Yellow-listed				✓	
Wildlife	Bird - Water	Wood Duck	<i>Aix sponsa</i>		Yellow-listed				✓	
Wildlife	Mammal - Bat	Long-eared Myotis	<i>Myotis evotis</i>		Yellow-listed					✓
Wildlife	Mammal - Bat	Long-legged Myotis	<i>Myotis volans</i>		Yellow-listed					✓
Wildlife	Mammal - Carnivore	North American River Otter	<i>Lontra canadensis</i>		Yellow-listed			✓		

ACTION TABLES

These Action Tables identify the FWCP's Priority Actions to conserve and enhance fish and wildlife in watersheds impacted by BC Hydro dams in reservoir and large lake ecosystems in the Columbia Region. 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. Actions identified as **DIRECTED only** are not eligible for a grant. These are projects that our Regional Boards will direct through the appropriate procurement process (e.g. a request for proposal). Please **do not** submit a grant application for a **DIRECTED only** project. Actions identified as **DIRECTED / OPEN are eligible for a grant** or may be projects that our Regional Boards will direct through the appropriate procurement process. Contact us if you are unsure.

Cross Plan Actions

Several broad cross plan actions are relevant to all Action Plans and will require the consideration of multiple ecosystems.

CROSS ECOSYSTEM PLAN ACTIONS							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
1	Research and Information Acquisition	COLRLL.CXP.RI.01.01 Indigenous knowledge and values, develop framework-P1	1	All Action Plan Priority Areas	Fish and Wildlife	Develop a framework for incorporating Indigenous knowledge and values into FWCP projects.	Collaboration with Indigenous peoples relating to FWCP projects.	Directed
2	Habitat-based	COLRLL.CXP.HB.02.01 Indigenous knowledge and values, incorporate based on framework-P1				Incorporate Indigenous knowledge and values into FWCP projects based on framework developed in Action #1.		Directed / Open
3	Research and Information Acquisition	COLRLL.CXP.RI.03.01 Climate change strategy-P1	1	All Action Plan Priority Areas	Fish and Wildlife	Develop a framework for the FWCP Columbia Region to incorporate elements of climate change into actions (e.g. research, habitat restoration, land securement and/or monitoring of fish and wildlife populations, ecosystems or habitats).	Increased understanding of climate change impacts on fish and wildlife in the Columbia Region and how FWCP can help support on-the-ground action (e.g. development and implementation of resiliency plans, land securement initiatives, restoration).	Directed
4	Research and Information Acquisition	COLRLL.CXP.RI.04.01 Responding to emergent issues-P2	2	All Action Plan Priority Areas	Fish and Wildlife	Support project work relating to urgent and emerging issues for the Columbia Region (e.g. emergent diseases, cumulative effects, imminent species declines).	Allows the FWCP to support appropriate organizations and/or support initiatives aimed at emergent issues.	Directed

Continued: Cross Ecosystem Plan Actions

CROSS ECOSYSTEM PLAN ACTIONS							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
5	Research and Information Acquisition	COLRLL.CXP.RI.05.01 Culturally important resources-P1	1	All Action Plan Priority Areas	Fish and Wildlife	Work with appropriate Indigenous groups and organizations to conduct research and inventory to improve the understanding of culturally important plants and animals.	Conservation and increased understanding of culturally important species.	Directed / Open
6	Habitat-based	COLRLL.CXP.HB.06.01 Connectivity habitat-P1	1	All Action Plan Priority Areas	Fish and Wildlife	Support work towards conservation, improvement of important connectivity habitat and land securement (i.e. linkage areas, including high elevation) both within an ecosystem type (i.e. reservoirs and spawning tributaries, riparian areas) and across ecosystem types (i.e. valley bottoms to montane habitats) for fish and wildlife species (e.g. wide-ranging species, transboundary species, rare species).	Conservation and improvement of connectivity habitats.	Directed / Open

Reservoir & Large Lake Ecosystem Actions

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (AQUATIC PRODUCTIVITY)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
7	Research and Information Acquisition	COLRLL.ECO.RI.07.01 Food web and trophic dynamics-P1	1	Kootenay Lake Arrow Lakes Duncan Kinbasket Revelstoke	Fish	Contribute to the understanding of food web and trophic dynamics in reservoir and large lake ecosystems.	<ul style="list-style-type: none"> Greater understanding of dynamics will aid in adaptive management. Increased knowledge for nutrient restoration programs. 	Directed
8	Habitat-based	COLRLL.ECO.HB.08.01 Implementation of Kootenay Lake and Arrow Lakes Nutrient Restoration Programs-P1	1	Kootenay Lake Arrow Lakes	Fish	Implement and adaptively manage nutrient restoration programs in Kootenay Lake and Arrow Lakes Reservoir to sustain in-lake productivity at levels sufficient to support secondary productivity (forage for Kokanee).	Successfully demonstrate improved health and productivity of reservoirs.	Directed
9	Habitat-based	COLRLL.ECO.HB.09.01 Operation of Meadow Creek and Hill Creek spawning channels-P1	1	Kootenay Lake Arrow Lakes	Fish	Support the maintenance and operation of the Meadow Creek and Hill Creek spawning channels to ensure sufficient kokanee production in Kootenay Lake and Arrow Lakes Reservoir.	Improved Kokanee productivity to support a healthy and resilient reservoir ecosystem.	Directed
10	Monitoring and Evaluation	COLRLL.ECO.ME.10.01 In-season-Monitoring of Kootenay Lake and Arrow Lakes Nutrient Restoration Programs-P1	1	Kootenay Lake Arrow Lakes	Fish	Implement in-season monitoring and evaluation of indicators and trends in ecosystem components (e.g. water chemistry, plankton, Kokanee) related to the Kootenay Lake and Arrow Lakes Reservoir nutrient restoration programs.	Improved understanding of indicators and annual trends of in lake productivity.	Directed
11	Monitoring and Evaluation	COLRLL.ECO.ME.11.01 Detailed Review of Kootenay Lake and Arrow Lakes Nutrient Restoration Programs-P1	1	Kootenay Lake Arrow Lakes	Fish	Undertake a detailed review of the overall effectiveness of the Kootenay Lake and Arrow Lakes Reservoir nutrient restoration programs. The review should include a review of the stated objectives of the program in consultation with program partners and must include recommendation of frequency of trend monitoring per ecosystem components outlined in Action #10.	<ul style="list-style-type: none"> Determination of the overall effectiveness of the nutrient restoration programs against stated program objectives to be done every five years. Implementation of opportunities for improvements identified through ongoing adaptive management. 	Directed

Continued: Ecosystems Action Tables

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (STRUCTURE AND FUNCTION OF ECOLOGICAL COMMUNITIES)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
12	Research and Information Acquisition	COLRLL.ECO.RI.12.01 Status of fish communities-P3	3	Kootenay Lake Arrow Lakes Duncan Kinbasket Revelstoke Other	Fish	Assess status and trends of fish communities related to dam impacts and compensation actions. Include factors affecting the function and sustainability of these ecosystems as well as identification of current and future threats.	Maintenance of the overall ecological structure and function of the fish community.	Directed / Open
13	Habitat-based	COLRLL.ECO.HB.13.01 Prevention & control of invasive species in Kootenay, Arrow, Pend d'Oreille, Koocanusa-P1	1	Kootenay Lake, Arrow Lakes Pend d'Oreille Koocanusa	Aquatic Invasive Species	Contribute to the prevention and control of high priority aquatic invasive species that have the potential to negatively impact FWCP project investments in collaboration with the Province of BC and regional invasive species councils and societies as appropriate.	<ul style="list-style-type: none"> Protection of FWCP investments against invasive species establishment and spread. Prevent the introduction and spread of aquatic invasive species. 	Directed / Open
		COLRLL.ECO.HB.13.02 Prevention & control of invasive species in Duncan, Kinbasket, Revelstoke-P3	3	Duncan Kinbasket Revelstoke				

Continued: Ecosystems Action Tables

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (PISCIVOROUS RAINBOW TROUT)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
14	Research and Information Acquisition	COLRLL.ECO.RI.14.01 Inventory Arrow Lakes Reservoir spawning tributaries for piscivorous Rainbow Trout-P2	2	Arrow Lakes	Piscivorous Rainbow Trout	Inventory existing spawning tributaries (Mosquito Creek already completed) used by piscivorous Rainbow Trout in Arrow Lakes Reservoir.	Acquisition of data and information on piscivorous Rainbow Trout population distribution.	Directed
15	Research and Information Acquisition	COLRLL.ECO.RI.15.01 Develop habitat-based planning for piscivorous Rainbow Trout in Kootenay, Arrow-P1	1	Kootenay Lake Arrow Lakes	Piscivorous Rainbow Trout	Based on known limiting factors, develop habitat-based conservation, enhancement or restoration planning to address compensation options for piscivorous Rainbow Trout.	Detailed habitat-based plan which can guide opportunities for future conservation, enhancement or restoration work.	Directed / Open
		COLRLL.ECO.RI.15.02 Develop habitat-based planning for piscivorous Rainbow Trout in Duncan, Kinbasket-P2	2	Duncan Kinbasket				
16	Habitat-based	COLRLL.ECO.HB.16.01 Conservation, enhancement or restoration of piscivorous Rainbow Trout habitat in Kootenay, Arrow-P1	1	Kootenay Lake Arrow Lakes	Piscivorous Rainbow Trout	Where deemed limiting to piscivorous Rainbow Trout populations, conserve, enhance or restore spawning, rearing, overwintering and foraging habitats. Habitat-based actions may include but not be limited to recommendations determined from detailed planning efforts following Action #15.	Conservation, restoration and/or enhancement of spawning, rearing, overwintering and foraging habitat for piscivorous Rainbow Trout.	Directed / Open
		COLRLL.ECO.HB.16.02 Conservation, enhancement or restoration of piscivorous Rainbow Trout habitat in Duncan, Kinbasket-P2	2	Duncan Kinbasket				

Continued: Ecosystems Action Tables (Piscivorous Rainbow Trout)

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (PISCIVOROUS RAINBOW TROUT)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
17	Monitoring and Evaluation	COLRLL.ECO.ME.17.01 Effectiveness monitoring of past piscivorous Rainbow Trout projects in Kootenay, Arrow-P1	1	Kootenay Lake Arrow Lakes	Piscivorous Rainbow Trout	Monitor and evaluate the effectiveness of previous FWCP piscivorous Rainbow Trout habitat-based projects. Include an approach for adaptive management, information sharing and collaboration among agencies and the public stakeholders to increase the efficacy of conservation action.	Ensuring habitat-based actions are functioning as intended.	Directed / Open
		COLRLL.ECO.ME.17.02 Effectiveness monitoring of past piscivorous Rainbow Trout projects in Duncan, Kinbasket-P2	2	Duncan Kinbasket				

Continued: Ecosystems Action Tables

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (KOKANEE)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
18	Research and Information Acquisition	COLRLL.ECO.RI.18.01 Develop habitat-based planning for Kokanee-P3	3	Kootenay Lake Arrow Lakes Duncan Kinbasket Revelstoke	Kokanee	Based on known limiting factors, develop habitat-based conservation, enhancement or restoration planning to address compensation options for Kokanee.	<ul style="list-style-type: none"> Acquisition of information needed for habitat-based compensation options. Detailed habitat-based plan which can guide opportunities for future conservation, enhancement or restoration work. 	Directed / Open
19	Habitat-based	COLRLL.ECO.HB.19.01 Conservation, enhancement or restoration of Kokanee habitat-P3	3	Kootenay Lake Arrow Lakes Duncan Kinbasket Revelstoke	Kokanee	Where deemed limiting to Kokanee populations, conserve, enhance or restore spawning, rearing, overwintering and foraging habitats. Habitat-based actions may include but not be limited to recommendations determined from detailed planning efforts following Action #18.	Conservation, restoration and/or enhancement of spawning, rearing, overwintering and foraging habitat for Kokanee.	Directed / Open
20	Land securement	COLRLL.ECO.LS.20.01 Conservation and protection of natural spawning tributaries of Kokanee-P2	2	Kootenay Lake Arrow Lakes Reservoir	Kokanee	Conservation and protection (i.e. land securement) of spawning habitat in tributaries other than Meadow Creek and Hill Creek spawning channels.	Expansion of conservation and protection of Kokanee habitats throughout the Columbia Region.	Directed / Open
21	Monitoring and Evaluation	COLRLL.ECO.ME.21.01 Effectiveness monitoring of past Kokanee projects-P3	3	Kootenay Lake Arrow Lakes Duncan Kinbasket Revelstoke	Kokanee	Monitor and evaluate the effectiveness of previous FWCP Kokanee habitat-based projects. Include an approach for adaptive management, information sharing and collaboration among agencies and the public stakeholders to increase the efficacy of conservation action.	Ensuring habitat-based actions are functioning as intended.	Directed / Open

Continued: Ecosystems Action Tables

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (BULL TROUT)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
22	Research and Information Acquisition	COLRLL.ECO.RI.22.01 Develop habitat-based planning for Bull Trout in Kootenay, Arrow-P2	2	Kootenay Lake Arrow Lakes	Bull Trout	Based on known limiting factors, develop habitat-based conservation, enhancement or restoration planning to address compensation options for Bull Trout.	Detailed habitat-based plan which can guide opportunities for future conservation, enhancement or restoration work.	Directed / Open
		COLRLL.ECO.RI.22.02 Develop habitat-based planning for Bull Trout in Duncan, Kinbasket, Revelstoke-P3	3	Duncan Kinbasket Revelstoke				
23	Habitat-based	COLRLL.ECO.HB.23.01 Conservation, enhancement or restoration of Bull Trout habitat in Kootenay, Arrow-P2	2	Kootenay Lake Arrow Lakes	Bull Trout	Where deemed limiting to Bull Trout populations, conserve, enhance or restore spawning, rearing, overwintering and foraging habitats. Habitat-based actions may include but not be limited to recommendations determined from detailed planning efforts following Action #22.	Conservation, restoration and/or enhancement of spawning, rearing, overwintering and foraging habitat for Bull Trout.	Directed / Open
		COLRLL.ECO.HB.23.02 Conservation, enhancement or restoration of Bull Trout habitat in Duncan, Kinbasket, Revelstoke-P3	3	Duncan Kinbasket Revelstoke				
24	Monitoring and Evaluation	COLRLL.ECO.ME.24.01 Effectiveness monitoring of past Bull Trout projects in Kootenay, Arrow-P2	2	Kootenay Lake Arrow Lakes	Bull Trout	Monitor and evaluate the effectiveness of previous FWCP Bull Trout habitat-based projects. Include an approach for adaptive management, information sharing and collaboration among agencies and the public stakeholders to increase the efficacy of conservation action.	Ensuring habitat-based actions are functioning as intended.	Directed / Open
		COLRLL.ECO.ME.24.02 Effectiveness monitoring of past Bull Trout projects in Duncan, Kinbasket, Revelstoke-P3	3	Duncan Kinbasket Revelstoke				

Continued: Ecosystems Action Tables

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (BURBOT STATUS)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
25	Research and Information Acquisition	COLRLL.ECO.RI.25.01 Develop habitat-based planning for Burbot in Kootenay, Koocanusa-P1	1	Kootenay Lake Koocanusa	Burbot	Based on known limiting factors, develop habitat-based conservation, enhancement or restoration planning to address compensation options for Burbot.	Detailed habitat-based plan which can guide opportunities for future conservation, enhancement or restoration work.	Directed / Open
		COLRLL.ECO.RI.25.02 Develop habitat-based planning for Burbot in Duncan, Kinbasket, Revelstoke-P2	2	Duncan Kinbasket Revelstoke				
26	Habitat-based	COLRLL.ECO.HB.26.01 Conservation, enhancement or restoration of Burbot habitat in Kootenay, Koocanusa-P1	1	Kootenay Lake Koocanusa	Burbot	Where deemed limiting to Burbot populations, conserve, enhance or restore spawning, rearing, overwintering and foraging habitats. Habitat-based actions may include but not be limited to recommendations determined from detailed planning efforts following Action #25.	Conservation, restoration and/or enhancement of spawning, rearing, overwintering and foraging habitat for Burbot.	Directed / Open
		COLRLL.ECO.HB.26.02 Conservation, enhancement or restoration of Burbot habitat in Duncan, Kinbasket, Revelstoke-P2	2	Duncan Kinbasket Revelstoke				
27	Monitoring and Evaluation	COLRLL.ECO.ME.27.01 Effectiveness monitoring of past Burbot projects in Kootenay, Koocanusa-P1	1	Kootenay Lake Koocanusa	Burbot	Monitor and evaluate the effectiveness of previous FWCP Burbot habitat-based projects. Include an approach for adaptive management, information sharing and collaboration among agencies and the public stakeholders to increase the efficacy of conservation action.	Ensuring habitat-based actions are functioning as intended.	Directed / Open
		COLRLL.ECO.ME.27.02 Effectiveness monitoring of past Burbot projects in Duncan, Kinbasket, Revelstoke-P2	2	Duncan Kinbasket Revelstoke				

Continued: Ecosystems Action Tables

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (INSECTIVOROUS RAINBOW TROUT)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
28	Research and Information Acquisition	COLRLL.ECO.RI.28.01 Develop habitat-based planning for insectivorous Rainbow Trout in Kootenay, Arrow-P2	2	Kootenay Lake Arrow Lakes	Insectivorous Rainbow Trout	Based on known limiting factors, develop habitat-based conservation, enhancement or restoration planning to address compensation options for insectivorous Rainbow Trout.	Detailed habitat-based plan which can guide opportunities for future conservation, enhancement or restoration work.	Directed / Open
		COLRLL.ECO.RI.28.02 Develop habitat-based planning for insectivorous Rainbow Trout in Duncan, Kinbasket, Revelstoke-P3	3	Duncan Kinbasket Revelstoke				
29	Habitat-based	COLRLL.ECO.HB.29.01 Conservation, enhancement or restoration of insectivorous Rainbow Trout habitat in Kootenay, Arrow-P2	2	Kootenay Lake Arrow Lakes	Insectivorous Rainbow Trout	Where deemed limiting to insectivorous Rainbow Trout populations, conserve, enhance or restore spawning, rearing, overwintering and foraging habitats. Habitat-based actions may include but not be limited to recommendations determined from detailed planning efforts following Action #28.	Conservation, restoration and/or enhancement of spawning, rearing, overwintering and foraging habitat for insectivorous Rainbow Trout.	Directed / Open
		COLRLL.ECO.HB.29.02 Conservation, enhancement or restoration of insectivorous Rainbow Trout habitat in Duncan, Kinbasket, Revelstoke-P3	3	Duncan Kinbasket Revelstoke				

Continued: Ecosystems Action Tables (Insectivorous Rainbow Trout)

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (INSECTIVOROUS RAINBOW TROUT)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
30	Monitoring and Evaluation	COLRLL.ECO.ME.30.01 Effectiveness monitoring of past insectivorous Rainbow Trout projects in Kootenay, Arrow-P2	2	Kootenay Lake Arrow Lakes	Insectivorous Rainbow Trout	Monitor and evaluate the effectiveness of previous FWCP insectivorous Rainbow Trout habitat-based projects. Include an approach for adaptive management, information sharing and collaboration among agencies and the public stakeholders to increase the efficacy of conservation action.	Ensuring habitat-based actions are functioning as intended.	Directed / Open
		COLRLL.ECO.ME.30.02 Effectiveness monitoring of past insectivorous Rainbow Trout projects in Duncan, Kinbasket, Revelstoke-P3	3	Duncan Kinbasket Revelstoke				

Continued: Ecosystems Action Tables

RESERVOIRS AND LARGE LAKES ACTION TABLE - ECOSYSTEMS (OTHER RESERVOIRS AND LARGE LAKES)							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
31	Research and Information Acquisition	COLRLL.ECO.RI.31.01 Other Reservoirs and Large Lakes planning-P3	3	Other Reservoirs and Large Lakes	Fish and Wildlife	Undertake additional investigation/assessment/planning for the other reservoirs and large lakes not already addressed in detail in the reservoirs and large lakes action plan. May include assessing feasibility of nutrient additions to waterbodies or other habitat based actions. This additional information will follow the approach used for the five reservoirs and large lakes currently discussed in detail, and will describe opportunities for FWCP investment and describe how results should be monitored.	Identification of compensation options for other reservoirs and large lakes.	Directed
32	Habitat-based	COLRLL.ECO.HB.32.01 Conservation and restoration of fish and wildlife species' habitat-P3	3	Other Reservoirs and Large Lakes	Fish and Wildlife	Protect, conserve, restore and/or create habitat elements for focal fish and wildlife species. Actions may include: enhance fish spawning and rearing habitat, provide nesting islands for loons and waterfowl, create emergent aquatic vegetation with slightly submerged floating islands, build nesting islands for turtles, create wildlife trees on shorelines, install nesting boxes on shorelines.	Contribution to maintenance of the overall ecological structure and function of the fish and wildlife communities associated with other reservoirs and large lakes.	Directed / Open
33	Monitoring and Evaluation	COLRLL.ECO.ME.33.01 Monitoring of FWCP Reservoirs and Large Lakes projects-P1	1	Other Reservoirs and Large Lakes	Fish and Wildlife	Conduct effectiveness monitoring and evaluation of FWCP habitat-based projects conducted under Action #32.	Ensuring habitat-based actions are functioning as intended. Provide information and knowledge learned for informing decisions on future projects.	Directed
34	Land Securement	COLRLL.ECO.LS.34.01 Land securement and stewardship opportunities-P1	1	Other Reservoirs and Large Lakes	Fish and Wildlife	Investigate and prioritize land securement and stewardship opportunities to conserve and protect large lake habitats. Collaborate with existing stewardship programs.	Protection of large lake habitat (including aquatic habitat when feasible).	Directed / Open

Reservoir & Large Lakes Species of Interest Actions

RESERVOIRS AND LARGE LAKES ACTION TABLE - SPECIES OF INTEREST							Version:AUG2019	
Action #	Action Type	Priority Action Short Description	Priority	Priority Area	Target Species	Priority Action	Intended Outcome	Delivery Approach
35	Species-based	COLRLL.SOI.SB.35.01 White Sturgeon Conservation-P1	1	Kootenay Lake Arrow Lakes	White Sturgeon	Support strategies and initiatives outlined in the SARA Recovery Strategy for White Sturgeon that relate to compensation for dam impacts. Where possible, link project work to the connectivity of this species across ecosystems and collaborate with recovery team specialists.	Recovery of White Sturgeon.	Directed / Open
36	Species-based	COLRLL.SOI.SB.36.01 Focal and Inventory species projects for species at risk-P2	2	All Priority Reservoirs and Large Lakes	Species at Risk	Support surveys, restoration and/or other compensation-related activities for 'focal' and 'inventory' species not covered in other Actions. A clear link must be made between dam impacts and proposed projects.	<ul style="list-style-type: none"> Changes to species presence are monitored and inform future conservation/compensation actions. Improved habitat for fish and wildlife species. 	Directed / Open
		COLRLL.SOI.SB.36.02 Focal and Inventory species projects for other fish & wildlife-P3	3		Other Fish and Wildlife			
37	Species-based	COLRLL.SOI.SB.37.01 Ungulate connectivity and enhancement-P2	2	All Priority Reservoirs and Large Lakes	Ungulates	Implement habitat enhancement projects that are informed by ungulate research (e.g. inventories) for priority reservoirs and large lakes to improve habitat connectivity. Integrate with historic information including movement routes, timing of movement and sources of mortality.	Improved habitat connectivity for ungulates.	Open
38	Monitoring and Evaluation	COLRLL.SOI.ME.38.01 Invertebrate monitoring for native mussels-P2	2	All Priority Reservoirs and Large Lakes	Native Mussels	Support inventory/monitoring of reservoir and large lake-associated invertebrate groups to increase knowledge of community structure and act as an indicator of productivity and ecosystem health/function in areas related to FWCP compensation activities.	Evaluation of the effect of restoration activities on invertebrate community structure.	Open
		COLRLL.SOI.ME.38.02 Invertebrate monitoring for invertebrates-P3	3		Invertebrates			

REFERENCES

- Arndt, S. 2009a. Footprint impacts of BC Hydro dams on Rainbow Trout in the Columbia River basin, British Columbia. Prepared by Fish & Wildlife Compensation Program – Columbia Basin, Nelson, BC.
- Arndt, S. 2009b. Footprint impacts of BC Hydro dams on Kokanee populations in the Columbia River basin, British Columbia. Prepared by Fish & Wildlife Compensation Program – Columbia Basin, Nelson, BC.
- Arndt, S., and J. Baxter. 2006. Status of Burbot (*Lota lota*) in Arrow Lakes Reservoir. Report for Columbia Basin Fish & Wildlife Compensation Program, Nelson, B.C., and BC Hydro, Castlegar, BC.
- B.C. Ministry of Environment. 2007. Freshwater fisheries program plan, Province of British Columbia, Ministry of Environment. Available at: env.gov.bc.ca/esd.
- BC Hydro. 2007. Duncan Dam Project Water Use Plan. Revised for acceptance by the Comptroller of Water Rights. December 20, 2007. Available: www.bchydro.com/content/dam/hydro/medialib/internet/documents/environment/pdf/wup_duncan_dam_project_water_use_plan_december_2007.pdf (accessed August 20, 2019).
- Bray, K., T. Weir, R. Pieters, S. Harris, D. Brandt, D. Sebastian, and L. Vidmanic. 2018. Kinbasket and Revelstoke Reservoirs ecological productivity and Kokanee population monitoring – 2008-2016 (Years 1 to 9) Synthesis Report. Prepared for BC Hydro under the Columbia River Water Use Plan, Water Licence Requirements Study Nos. CLBMON-2, CLBMON-3, CLBMON-56. 112 pp + appendices.
- Cope, S. 2008. Footprint impacts of BC Hydro dams on Burbot populations in the Columbia River basin, British Columbia. Prepared for: Fish & Wildlife Compensation Program – Columbia Basin, Nelson, BC.
- Daley, R. J., E. C. Carmack, C. B. J. Gray, C. H. Pharo, S. Jasper, and R. C. Wiegand. 1981. The effects of upstream impoundments on the limnology of Kootenay Lake, B.C. Environment Canada, National Water Research Institute, Inland Waters Directorate, Scientific Series 117, Vancouver, BC.
- Decker, S., and J. Hagen. 2008. Adfluvial Bull Trout spawner abundance in tributaries of the Arrow Lakes Reservoir. Prepared for: Fish & Wildlife Compensation Program – Columbia Basin, Nelson, BC.
- Fish & Wildlife Compensation Program. 2011. FWCP: Columbia Species Rating and Database Tool. Background report to accompany the Excel™-based tool.
- Fisheries and Oceans Canada. 2014. Recovery strategy for White Sturgeon (*Acipenser transmontanus*) in Canada [Final]. In Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. 252 pp.
- Hagen, J. 2008. Impacts of dam construction in the upper Columbia Basin, British Columbia, on Bull Trout (*Salvelinus confluentus*) production, fisheries, and conservation status. Prepared for: Fish & Wildlife Compensation Program – Columbia Basin, Nelson, BC.
- Hirst, S. M. 1991. Impacts of the operation of existing hydroelectric developments on fishery resources in British Columbia. Volume 2. Inland fisheries. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2093.
- Manley, I., and J. Krebs. 2009. Wildlife impacts due to BC Hydro dams in the Columbia basin. Fish & Wildlife Compensation Program, Nelson, BC.
- Matzinger, A., R. Pieters, K. I. Ashley, G. A. Lawrence, and A. Wüest. 2007. Effects of impoundment on nutrient availability and productivity in lakes. Limnology and Oceanography 52:2629–2640.
- Moody, A., P. Slaney, and J. Stockner. 2007. Footprint impact of BC Hydro dams on aquatic and wetland primary productivity in the Columbia Basin. Prepared for: Columbia Basin Fish & Wildlife Compensation Program. Final Draft – April 2007.
- National Recovery Team for White Sturgeon. 2009. Recovery strategy for White Sturgeon (*Acipenser transmontanus*) in Canada [Proposed]. In Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. Draft.

- Northcote, T. C. 1973. Some impacts of man on Kootenay Lake and its salmonids. Great Lakes Fishery Commission, Technical Report 2, Ann Arbor, MI.
- Porto, L. 2008. White Sturgeon populations in the BC Hydro dam footprint impacts area. Prepared for: Fish & Wildlife Compensation Program – Columbia Basin, Nelson, BC.
- Prince, A. 2001. Local knowledge of Columbia River fisheries in British Columbia, Canada. Prepared for: Columbia – Kootenay Fisheries Renewal Partnership, Cranbrook, BC, by Westslope Fisheries, Cranbrook, BC. 50 p. + 1 app.
- RL&L Environmental Services Ltd. 1996a. The distribution and status of White Sturgeon in isolated waterbodies within the Columbia River Basin in B.C. 1995 Study Results. Report to: B.C. Ministry of Environment, Lands and Parks.
- RL&L Environmental Services Ltd. 1996b. Columbia River White Sturgeon investigations – 1995 study results. Prepared for: BC Hydro, Kootenay Generation, Vancouver, BC, and B.C. Ministry of Environment, Lands and Parks, Nelson Region, Nelson, BC. RL&L Report No. 377F: 94 p. + 6 app.
- RL&L Environmental Services Ltd. 2000. A summary of White Sturgeon investigations in isolated water bodies within the Columbia River Basin in B.C. 1995 to 1999. Report to: B.C. Ministry of Environment, Lands and Parks.
- Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. Bulletin of the Fisheries Research Board of Canada 184.
- Sebastian, D. and T. Weir. 2017. Kinbasket and Revelstoke Reservoirs Kokanee population monitoring - Year 9 (2016). Prepared for BC Hydro under the Columbia River Water Use Plan, Water Licence Requirements Study No. CLBMON-2. 56 pp.
- Thorley, J. L. 2008. Aquatic habitat losses and gains due to BC Hydro dams in the Columbia Basin. Prepared for: Fish & Wildlife Compensation Program – Columbia Basin, Nelson, BC.

GLOSSARY

Action Plan: The Fish & Wildlife Compensation Program has identified conservation priorities for fish and wildlife in each of its three regions and these are reflected in a series of Action Plans. The priorities and plans vary by region.

Blue List Species: Any species that is of special concern.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): An independent advisory panel to the Minister of Environment and Climate Change Canada that meets twice a year to identify and assess the status of wildlife species at risk of extinction. Members are wildlife biology experts from academia, government, non-governmental organizations, and the private sector responsible for designating wildlife species in danger of disappearing from Canada.

Cross Plan Action: An action that is relevant to two or more Action Plans and requires the consideration of multiple ecosystems.

Delivery Approach: Priority Actions identified as “Open” are eligible for a grant. Actions identified as “Directed” are not eligible for a grant. These are projects that the FWCP Regional Boards will direct through the appropriate procurement process (e.g. a request for proposal). Actions identified as “Directed / Open” are eligible for a grant or may be projects directed by the FWCP Regional Boards through the appropriate procurement process.

Endangered Species: A fish or wildlife species that is facing imminent extirpation or extinction.

Entrainment: Fish entrainment can be defined as fish being transported along with the flow of water and out of their normal river, lake, or reservoir habitat into unnatural or potentially harmful environments.

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

Floodplain: An area of low-lying ground adjacent to a river, formed mainly of river sediments and subject to flooding.

Focal Species: Defined by the FWCP Columbia Region as species that have strong linkages to dam footprint impacts and are of regional interest.

Footprint Impacts: The permanent loss of habitat associated with the dam and related infrastructure, including the permanently flooded habitat (below the drawdown zone) resulting from reservoir creation.

Indigenous Knowledge (IK): The United Nations Educational, Scientific and Cultural Organization (UNESCO) refers to IK as the “understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings.”

Invasive Species: An organism (plant, animal, fungus, or bacterium) that is not native and has negative effects on our economy, our environment, or our health. Invasive species can spread rapidly to new areas and will often out-compete native species as there are no predators or diseases to keep them under control.

Inventory Species: Defined by the FWCP Columbia Region as species that have been affected by dams, but detailed inventory and/or trend monitoring is still required.

Lacustrine: Relating to or associated with lakes.

Lake: A naturally occurring body of water deeper than 2 m, classified by FWCP Columbia as small (less than 1,000 hectares) or large (greater than 1,000 hectares).

Littoral: Part of a lake or river that is close to the shore. The littoral zone typically extends from the high water mark, which is rarely inundated, to shoreline areas that are permanently submerged.

Oligotrophic: Having a deficiency of plant nutrients that is usually accompanied by an abundance of dissolved oxygen.

Pelagic: The open water area of lakes, neither close to the bottom nor the shore.

Priority Areas: Habitats, areas, or ecosystems that have been outlined for each Action Plan and include areas that are deemed as a priority for FWCP Open or Directed projects.

Recovery Species: Defined by the FWCP Columbia Region as species of highest priority and conservation concern that have been adversely impacted by dam construction and/or operation. These species have formally been classified as either threatened or endangered by Canada or B.C., and recovery and/or management plans are either in place or under development by Federal or Provincial management agencies.

Red List Species: Any species that is at risk of being lost (extirpated, endangered, or threatened).

Reservoir: A body of water formed by damming a river or stream. Water is held back by the dam and is allowed to fall to generate electricity when it is needed.

Riparian Habitat: Defined as an area adjacent to a river, stream, wetland, or lake that differs from the surrounding uplands in the diversity of plant and animals found and in the overall productivity of the site.

Riverine: Relating to or situated on a river or riverbank.

Species of Interest: Defined by the FWCP as a specific fish and wildlife species of conservation concern (including species at risk) or other regionally important species for compensation or conservation planning process that have been affected by hydro-power development footprint impacts.

Species at Risk (SAR): Specific fish and wildlife species that have been listed by the Provincial (B.C. Conservation Data Centre) or Federal authorities (COSEWIC, SARA) to be of conservation concern for the Columbia Region.

Species at Risk Act (SARA): Proclaimed in 2003, SARA is Government of Canada legislation designed to prevent wildlife species in Canada from disappearing; to provide for the recovery of wildlife species that are extirpated (no longer exist in the wild in Canada), endangered, or threatened as a result of human activity; and to manage species of special concern to prevent them from becoming endangered or threatened.

Species of Special Concern: A fish or wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Strategic Objectives: These objectives support meeting both BC Hydro's water licence conditions in the Peace and Columbia Regions, and its commitment and intent when voluntarily establishing the program in the Coastal Region in partnership with the Province of B.C. and DFO. The strategic objectives address conservation, sustainable use and community engagement goals.

Threatened Species: A fish or wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.

Tributary: A stream or river that flows into a larger stream or mainstem of a river or a lake. Tributaries and the mainstem river drain the surrounding drainage basin of its surface water and groundwater.

Wetland: An area of land where the soil is saturated with moisture either permanently or seasonally and where water occurs on the surface (e.g. in marshes, bogs, and swamps).

Wildlife Extension Area (WEA): The FWCP recognizes that opportunities for fish and wildlife habitat enhancement within the Canoe Arm drainage of the Kinbasket Reservoir are extremely limited and better opportunities may exist in the upper drainage of the Fraser River near Valemound. The Columbia Region boundary includes a portion of the Fraser River drainage (i.e. the wildlife extension area) for wildlife projects only. The Policy Committee approved the WEA in 1996. The Wildlife Extension Area includes the area north of Valemound, extending east to the Alberta border, including Mount Robson Provincial Park, and west to north of McBride.

Yellow List Species: Any species that are apparently secure and not at risk of extinction.