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FISH AND WILDLIFE COMPENSATION PROGRAM

# STAVE WATERSHED

## *SALMONID ACTION PLAN*

FINAL DRAFT

The FWCP is a partnership of:

BC hydro FOR GENERATIONS

BRITISH COLUMBIA

Canada Fisheries and Oceans Canada Pêches et Océans Canada

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# Table of Contents



# Table of Figures and Tables

# Stave River Salmonid Action Plan

## 1. INTRODUCTION

The Fish and Wildlife Compensation Program (FWCP): Coastal Region evolved from its origin as the Bridge-Coastal Restoration Program (BCRP), a program initiated voluntarily by BC Hydro in 1999 to restore fish and wildlife resources that were adversely affected by the footprint of the development of hydroelectric facilities in the Bridge-Coastal generation area. Footprint impacts include historical effects on fish and wildlife that have occurred as a result of reservoir creation, watercourse diversions and construction of dam structures.

In 2009, the program developed a strategic framework that guides overall planning for compensation investments (MacDonald 2009). The framework has guided the development of strategic plans for each watershed within the FWCP program area, which are in turn informing action plans that focus on specific priorities within each watershed (Figure 1).

This Salmonid Action Plan sets out priorities for the Fish and Wildlife Compensation Program to guide projects in the Stave River project area. It identifies actions to be undertaken throughout the Stave River in support of salmonid fish species. The plan builds on the FWCP's strategic objectives and the Stave River Watershed Plan (FWCP 2011). Action plans have also been developed for riparian and wetland areas and species of interest; and some actions may be complementary across the different plans.

The actions and priorities outlined in this plan have been identified through a multi-stage process involving BC Hydro, Fisheries and Oceans Canada (DFO), Canadian Wildlife Service (CWS), Ministry of Environment (MOE), local First Nations, and local communities. Initial priorities were developed through consultation with agency staff. These priorities were then reviewed and discussed at a workshop[1] to allow First Nations, public stakeholders, and interested parties to comment and elaborate on the priorities.

It is important to understand, however, that planning priorities within action plans may not translate immediately into funded projects. Limited program funding requires that priority-setting has to also be developed across the program 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.



[1] Mission, 27 March, 2009

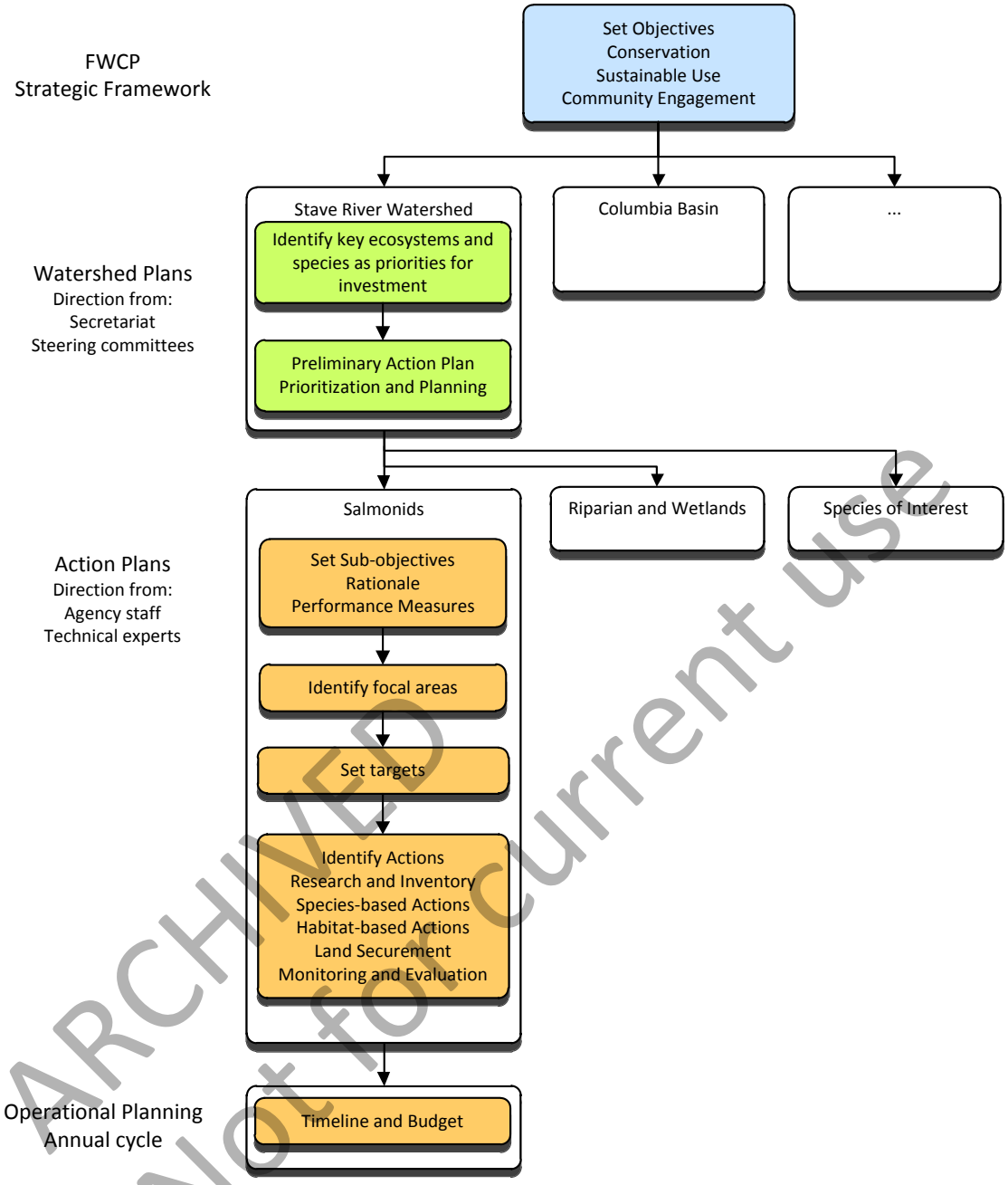




**Figure 1. Relationship between the Salmonid Action Plan and higher level planning and objectives.**

# 2. OVERVIEW CONTEXT

The Stave watershed is located approximately 70 km east of Vancouver, next to the Alouette watershed on the north side of the Fraser Valley (Figure 2). The Stave River flows predominantly south and discharges directly into the Fraser River. Inflows to Stave Lake Reservoir come primarily from two weather patterns: heavy rain in the fall from Pacific frontal systems and snowmelt in the spring.

The Stave River system lies within the traditional territory claimed by the Katzie and Kwantlen First Nations. The lower Stave River is between the communities of Maple Ridge and Mission. The northern part of Stave Reservoir borders Golden Ears Provincial Park.

The Alouette-Stave Falls-Ruskin generating complex includes four dams, a 1090 m long diversion tunnel and three powerhouses. About 94% of the annual inflow into Alouette Lake Reservoir is diverted into Stave Lake Reservoir through the diversion tunnel to the Alouette Generating Station on the shore of Stave Lake Reservoir. At the south end of Stave Lake Reservoir are Blind Slough and Stave Falls dams, and Stave Falls Generating Station. Flows from Stave Falls Dam discharge into Hayward Reservoir. Outflow from Hayward Reservoir is controlled by Ruskin Dam, with power being generated at the Ruskin Generating Station. Water from Alouette Lake Reservoir is thus used for power generation at three separate generating stations.

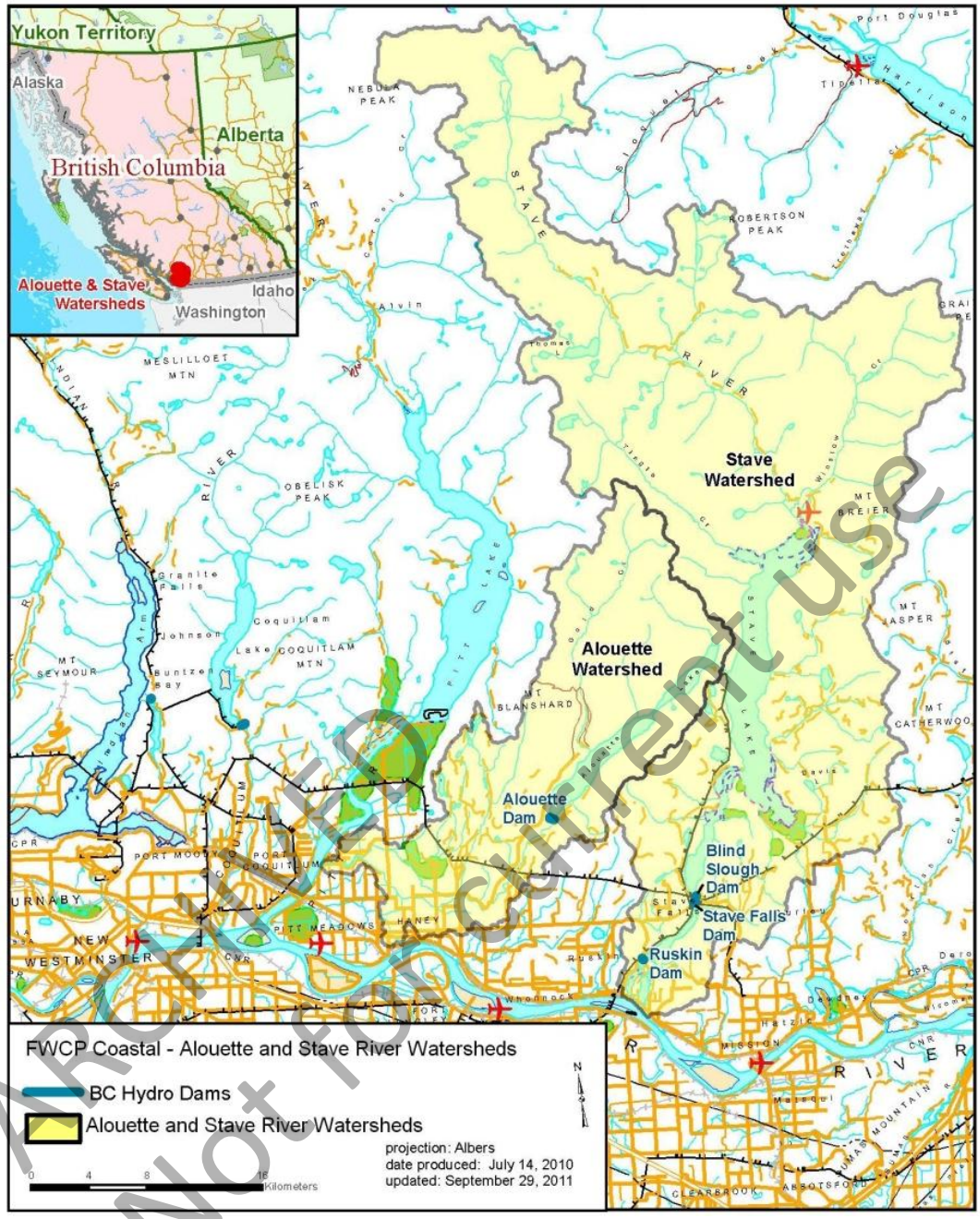




**Figure 2. The Stave River hydropower project.**

## 2.1. FISH AND FISH HABITAT IN THE STAVE RIVER

Descriptions of fish and fish habitat come primarily from BCRP (2000). The Stave River downstream of Ruskin Dam is less than 3 km in length. It crosses the Fraser River floodplain and has low banks composed of sands and fine sediments. Water levels in this reach are influenced by tides and Fraser River discharge, as well as Ruskin operations. Coho, pink, chum, Chinook, sockeye and steelhead occur in this section. Chum are by far the most numerous and are the highest priority for

DFO, whereas steelhead are the highest priority for MOE. In 1991, DFO constructed a 360 m spawning channel on the left bank below the tailrace, which is mostly used by chum salmon though likely benefits others species, too.

Hayward Reservoir flooded a river channel that was 6 km in length, of which the lower 2 km provided spawning habitats for all salmonid species. The upstream portions of this section were likely suitable for rearing by steelhead parr. As a whole, this section was described as a series of rapids that emptied through a narrow granite gorge, which was reported passable at high water. Hayward Reservoir now has generally low sportfish populations, due to high turnover, low nutrient levels and scarce tributary habitat.

Resident fish species like rainbow trout, cutthroat trout, bull trout, and kokanee occur above Stave Falls, but there is disagreement about whether anadromous salmonids were able to ascend Stave Falls prior to construction of the dam. Largescale sucker, northern pikeminnow, peamouth chub, redside shiner, prickly sculpin, coastrange sculpin, and lamprey are also recorded above Stave Falls. Most tributaries to the reservoir are steep with widely fluctuating discharge.

There are unconfirmed reports of Salish sucker in Davis Lake, which is tributary to Stave Lake Reservoir (M. Pearson, Pearson Ecological, personal communication). This species is listed as Endangered under the Species at Risk Act, and it is a priority 1 species under the BC Conservation Framework. Determining whether the species occurs in the Stave watershed is a high priority. The primary actions at this time are to complete inventory and genetic analyses.

There is taxonomic uncertainty about the char that occur in the Coquitlam system, and it is possible they are bull trout, Dolly Varden, or both. The two species are difficult to distinguish in the field and both occur in this region. Various documents refer to both bull trout and Dolly Varden in the Coquitlam watershed, but there have been no definitive surveys or studies. Typically, the char that occur in large lakes in this region are bull trout, but Dolly Varden also occur, particularly in smaller tributaries and in headwaters (Rick Taylor, UBC, personal communication). For convenience we refer to char in this report as bull trout, but acknowledge the considerable uncertainty regarding proper identification.



## 2.2. IMPACTS AND THREATS

Fish and Wildlife habitat and species have been significantly altered due to the construction of the dams, the development of hydro-power, and alterations in the hydraulic regimes of the systems. The following summary of the primary footprint impacts is derived from:

- Bridge-Coastal Restoration Program: Strategic Plan, Volume 2: Watershed Plans, Chapter 7: Stave River (December 2000);
- Stave River Water Use Plan Consultative Committee Report (October, 1999); and
- Findings in the Community Workshop (Mission, 27 March, 2009).

***Hydro-related Impacts —*** The impacts that occurred are based on location in the watershed as follows:

*Stave Falls Dam, Blind Slough Dam, and Upstream of Stave Falls.*

1. The reservoir flooded 22.4 km of mainstem and 32 km of tributary channels and their associated riparian zones, 1676 ha of forest and 241 ha of wetland.
2. Drawdown of the reservoir reduces littoral productivity, strands fish and reduces access for resident fish to historic tributaries.
3. Attraction of fish to Alouette powerhouse increases susceptibility to angling harvest.
4. Dam footprint caused loss of instream, riparian and upland habitat. Initial construction likely sluiced a large volume of sediment that degraded downstream habitat.
5. The dam has reduced LWD and gravel recruitment to downstream reaches.
6. Blind Slough Dam cut off flows to 1 km of downstream channel.
7. Entrainment mortality occurs but is not quantified. Entrainment is limited to reservoir species as there is no fish passage at Ruskin or Stave Falls dams.

*Ruskin Dam and Upstream to Stave Falls.*

8. Hayward Reservoir flooded 6 km of mainstem and 2.7 km of tributary channels and their associated riparian zones. The biological community was changed from river-type to lake-type.
9. Drawdown of the reservoir reduces littoral productivity and reduces access for fish to historic tributaries. Its high flushing rate also affects productivity.
10. The dam blocked migration of anadromous salmon and migration of resident fish.
11. Entrainment mortality occurs but is not quantified. Entrainment is limited to reservoir species as there is no fish passage at Ruskin or Stave Falls dams.

*Lower Stave River.*

12. Water diversions from Alouette and occasional spills at Ruskin Dam alter habitat characteristics in this reach.
13. The Alouette diversion and water storage have altered the flow regime and affected habitat availability and morphology of this river reach.
14. Ramping rates have historically stranded fish.

***Non-Hydro Impacts —*** Other impacts on fish populations in the Stave watershed include historic effects of logging, flood protection and urbanization.

## 2.3. LIMITING FACTORS

Limiting factors vary among species and include availability of useable habitat, access to habitats (e.g., passage) and nutrient limitations. There are both natural and human-induced aspects, and the latter include effects from hydropower and other developments. The factors are summarized here.

1. **Habitat area**: Former spawning, rearing and overwintering areas are permanently lost or seasonally reduced by dam footprint, reservoir flooding, flow diversions, or operating flows; or from non-hydro sources, such as urban encroachment along banks of the lower river. There is limited parr habitat for steelhead, and off-channel rearing habitat for coho.
2. **Habitat quality**: Physical habitat below dams has been altered by reduced gravel and wood recruitment, particularly in the lower river. Chum currently utilize all available habitat, but the habitat needs to be maintained every 10-15 years to keep it productive. Lakes and streams in this region have naturally low nutrient levels.
3. **Access**: Anadromous and migratory resident stocks have been excluded from river habitats now occupied by Hayward Reservoir. Access has been reduced through the creation of dykes and diversions, as well as the alteration of the natural flow regime.
4. **Diversions**: The Alouette diversion has increased annual flow volume in the lower Stave River, which has affected habitat quantity and quality.
5. **Hatchery practices**: Chinook, coho and steelhead populations are augmented by hatchery production, which may have positive and negative effects on wild salmonid stocks. The hatchery increases the fish population, which at times is necessary for maintaining runs. At the same time, wild populations may be harvested along with hatchery fish. Genetic diversity of wild salmon can be altered by hatchery practices and hatchery-raised fish compete for food and habitat with wild salmon. Under the Wild Salmon Policy, the Salmon Enhancement Program takes steps to minimize these risks.



## 2.4. TRENDS AND KNOWLEDGE STATUS

### HABITAT TRENDS

A detailed account of habitat alterations from hydropower development is provided in BCRP (2000). In addition to present and historic hydropower impacts there are impacts in the watershed from forestry and urbanization.

Changes in operations as part the Stave River Water Use Plan have been implemented to improve habitat conditions (BC Hydro 2003). The expected benefits of the WUP are an improvement in rearing habitat downstream of Ruskin Dam, reduced stranding of eggs and emerging fry, and increased carbon production in Stave Lake Reservoir. Monitoring is underway to assess the effects of the operational changes.

In the early 1990s, spawning area was enhanced and created in the mainstem below Ruskin Dam, primarily for chum; however, pink and Chinook also benefited. Work included scalping island bars to provide gravel replenishment. Further work has been undertaken by FWCP (BCRP), DFO and other partners (e.g., Stave River Enhancement Society, Forest Renewal BC). In 1999 a side channel on the left bank was further improved with excavation to provide 5100 $m^2$ of coho rearing habitat. Under the Water Use Plan re-grading and improving spawning areas of the mainstem resulted in the restoration of 118,000 $m^2$ of habitat for chum, pink and Chinook.

## STOCK TRENDS

***Chum —*** The chum population is stable and likely near capacity. Escapements range from 200,000 to 600,000 spawners each year. They have a healthy distribution throughout the mainstem. Chum are the highest priority for DFO.

***Chinook —*** There is a small population of wild Chinook, which is augmented by hatchery operations. Potential for additional habitat restoration is limited. Chinook salmon are likely limited by spawning areas and competition with chum.

***Coho —*** Coho have a limited wild population and are augmented through hatchery operations. Natural production is mostly limited to Thompson Creek. DFO has not set targets for coho; nevertheless, it is a high priority species in the Stave system.

***Pink —*** The population of pink salmon is increasing, though it will likely become limited by the chum population. Pink salmon are likely limited by spawning areas and competition with chum.

***Sockeye —*** Sockeye are observed annually in the Stave; however, it is not known whether these are stray fish, or adults returning from entrainment of kokanee in the reservoir.

***Steelhead —*** The steelhead population is augmented through hatchery operations. There have been increases of wild fish and MOE is now taking brood stock from the Stave for hatchery operations.

***Cutthroat trout —*** There is limited knowledge of the cutthroat trout population in the system, however, it is thought that production is likely confined to Thompson Creek. MOE does not have population data, but they are a conservation concern and are a high priority for restoration.

***Rainbow trout —*** There is limited knowledge of the rainbow population in the Stave, but they occur throughout the system and there is a desire for additional information.

***Bull Trout —*** There is a small population of bull trout in the upper watershed, though little is known about its status and it is currently not a management priority.

***Other fish —*** Bass and possibly white sturgeon utilize the lower river; however, there is only limited information. Bass is an invasive species that competes for food and preys on salmonid fry.

## KNOWLEDGE GAPS

Several knowledge gaps have been highlighted by agencies and stakeholders:

- There remain uncertainties about the historical range of anadromous salmonids, and whether they were able to regularly ascend above Stave Falls.
- There is interest in obtaining more information about the effect of block flows, particularly in relation to salmon spawning and incubation. Current monitoring is helping to address this knowledge gap.
- To help set priorities for restoration, the program needs a better understanding of limiting factors that can be addressed by restoration initiatives, and a better understanding of the effects of previous restoration efforts.
- Information on rainbow trout and cutthroat trout populations is limited, as is the understanding of habitat limitations and opportunities for restoration for these species.
- There are knowledge gaps with respect to interactions with invasive species like bass, possible utilization of Stave River by white sturgeon, and determination of the source of sockeye in the lower Stave.

# 3. ACTION PLAN OBJECTIVES, MEASURES AND TARGETS

Clear and realistic management objectives are necessary to guide information acquisition and prioritize management actions. Priority actions and information needs will change as both improvements to the system are realized and information is gained. The current plan reflects the information available and values expressed by stakeholders (FWCP partners, First Nations and local communities) through reports, interviews and regional workshops held between 2009 and 2011.

## 3.1. OBJECTIVE AND TARGET SETTING

The following terminology is used in this report.

| | |
|---|---|
| Objectives: | Objectives are high-level statements of desired future conditions (outcomes), consistent with FWCP partner mandates and policies. |
| Sub-objectives and Status Indicators: | Sub-objectives are detailed statements of desired future conditions within objectives, from which status indicators can be derived and alternative management actions evaluated. Sub-objectives and indicators provide the details necessary to translate policy into actions and to evaluate their consequences. They may be arranged hierarchically within objectives, and usually indicate conditions necessary to attain the objective to which they refer. |
| Measures: | Measures are specific metrics whose values indicate the degree to which desired future conditions have been achieved. They can be either qualitative or quantitative. There is a preference to develop the latter where possible for ease of monitoring. |
| Targets: | Targets are the values of measurable items that indicate the attainment of a desired condition. In the current context these may be expressed as a single value or as a range to acknowledge the inherent variability of ecosystems. |
| Actions: | Management actions, plans or policies for achieving the objectives. |

Objectives are the “ends” or the outcomes we ultimately care about. Actions are the “means,” or the things we do to achieve them. This report focuses on describing the actions required to achieve the objectives in relation to Salmonid species and fish in general. Actions relating to specific species or habitats may also be related to actions in other Action Planning documents such as the Riparian and Wetlands or Species of Interest plans.

## 3.2. OBJECTIVES FOR THE STAVE RIVER

Management objectives are common to all locations in the Stave watershed, although the species of interest vary between the upper and lower watershed and thus the list of indicators and targets may differ.

This section briefly summarizes the objectives, sub-objectives and status indicators. While the objectives are expected to remain stable over time, the indicators and targets may evolve as management priorities for agencies shift, or new information becomes available.

There are two management objectives for salmonids in the Stave River:

1. Conservation – Ensure a productive and diverse aquatic ecosystem,

2. Sustainable Use – Maintain or improve opportunities for sustainable use.

Supporting these objectives are sub-objectives that break each into its key components and provide further clarity.

***Objective 1.* Ensure a productive and diverse aquatic ecosystem.**

***Rationale —*** This objective addresses overall ecosystem integrity and productivity and directs compensation activities to developing productive, useable aquatic habitats. Where cost-effective opportunities exist, compensation works will be aimed at aiding multiple fish species.

There are two sub-objectives, which divide salmonids into anadromous and resident species, since priorities tend to fall along these lines in different locations in the Stave watershed.

1. Maximize the viability of anadromous salmon and steelhead,
2. Maximize the viability of resident salmonids.

The sub-objectives are supported by the following status indicators:

1. Anadromous salmon and steelhead
    a. chum salmon
    b. coho salmon
    c. Chinook salmon
    d. steelhead trout

2. Resident salmonids
    a. cutthroat trout
    b. rainbow trout

The indicators focus on species of greatest management concern. There is a tacit assumption that these are to some extent true indicator species and that meeting targets for these species will support conservation of other fish species.

There are different priority species in different parts of the Stave watershed. Projects need not focus solely on these species, but they are the species of greatest interest to most stakeholders. From a conservation perspective, the priorities are as follows.

The chum salmon population is currently healthy and maintaining that status is the primary priority for DFO. In many cases, restoration activities that are directed at chum will likely benefit pink, coho and Chinook, and possibly benefit steelhead (spawning), rainbow trout and perhaps white sturgeon.

Coho and Chinook have relatively modest populations, which are augmented by hatchery operations. Overall, these are high priority species for DFO. There are limited opportunities to enhance Chinook and coho habitat in the lower Stave, but there may be some opportunities in Thompson Creek through improving access.

Cutthroat and steelhead are conservation concerns in the Stave watershed. The steelhead population currently requires augmentation and is limited by parr rearing habitat in the lower river. Relatively little is known about cutthroat and rainbow population status, distribution and opportunities for restoration.

Invasive species such as bass are a concern with respect to effects on native species; however, no specific projects have been identified at this time to address these species.

***Measures —*** Measures for the sub-objectives relate to the long-term viability of indicator fish populations, and may include distribution, population structure, abundance, and size or age distribution. At this time, the focus will be on abundance. Compensation activities may focus on improving habitat, but success will ultimately be assessed with measures of abundance. Abundance is currently measured through escapement estimates, snorkel swims, and Water Use Plan monitoring activities. Where necessary, additional monitoring may be required for the compensation program to assess progress under this objective.

***Targets —*** Species targets were determined by DFO and MOE and are indicated in Table 1.

**Table 1: Species management targets for the Stave watershed.**

| Location | Species | Target (5 year average) |
|---|---|---|
| Lower Stave | Chum | No target has been set, but chum salmon habitat is currently used to capacity or near capacity, with escapements ranging between 200,000 and 600,000 annually. |
| | Coho | 500 spawners |
| | Chinook | 500 wild spawners |
| | Steelhead | no specific target - an increase in steelhead abundance |
| | Sockeye | no target |
| | Pink | interim target of 15,000 spawners |
| | Cutthroat | no target |
| | Rainbow | no target |
| Stave Reservoir and Upper Stave | Cutthroat | no target |
| | Rainbow | no target |
| | Bull trout | no target |
| | Kokanee | no target |

***Objective 2. Maintain or improve opportunities for sustainable use.***

***Rationale —*** This objective reflects the important sustainable use benefits that can be derived from healthy fish populations. Many salmonid species are the focus of First Nations, commercial and recreation fisheries. Consequently, any actions aimed at achieving objective 1 also support this sustainable use objective. Although there are no direct actions for improving sustainable use at this time, it is conceivable that projects aimed at generally improving opportunities or increasing the participation in the fisheries could be identified by the program partners in the future.

As additional context, it should be noted that fisheries management agencies have an overall responsibility to manage the fisheries resource at a level of abundance and distribution to support First Nations' traditional uses and rights. These responsibilities are dealt with through the ongoing process of decision-making, which is not a formal part of this FWCP plan. In addition to this, First Nations' interests in overall conservation and sustainable use benefits have been incorporated into the development of this plan.

***Measures and Targets —*** There are no specific measures or targets required at this time, aside from those associated with objective 1.

As part of their overall management responsibilities, DFO uses information such as abundance trends and escapement estimates to regulate angling and commercial harvest. MOE collects information on angler days, catch per unit effort,

and number of fishing licences sold in the region, which informs decisions related to angling regulations.

From a fisheries management perspective, the highest priorities are chum and steelhead in the lower river, and cutthroat trout and rainbow trout in the upper Stave.

# 4. ACTION PLAN

## 4.1. OVERVIEW

The Action Plan has many individual actions, which are presented in Section 4.2. Some actions support multiple sub-objectives, which in turn support multiple objectives. Figure 3 provides an overview of the link between actions and objectives.

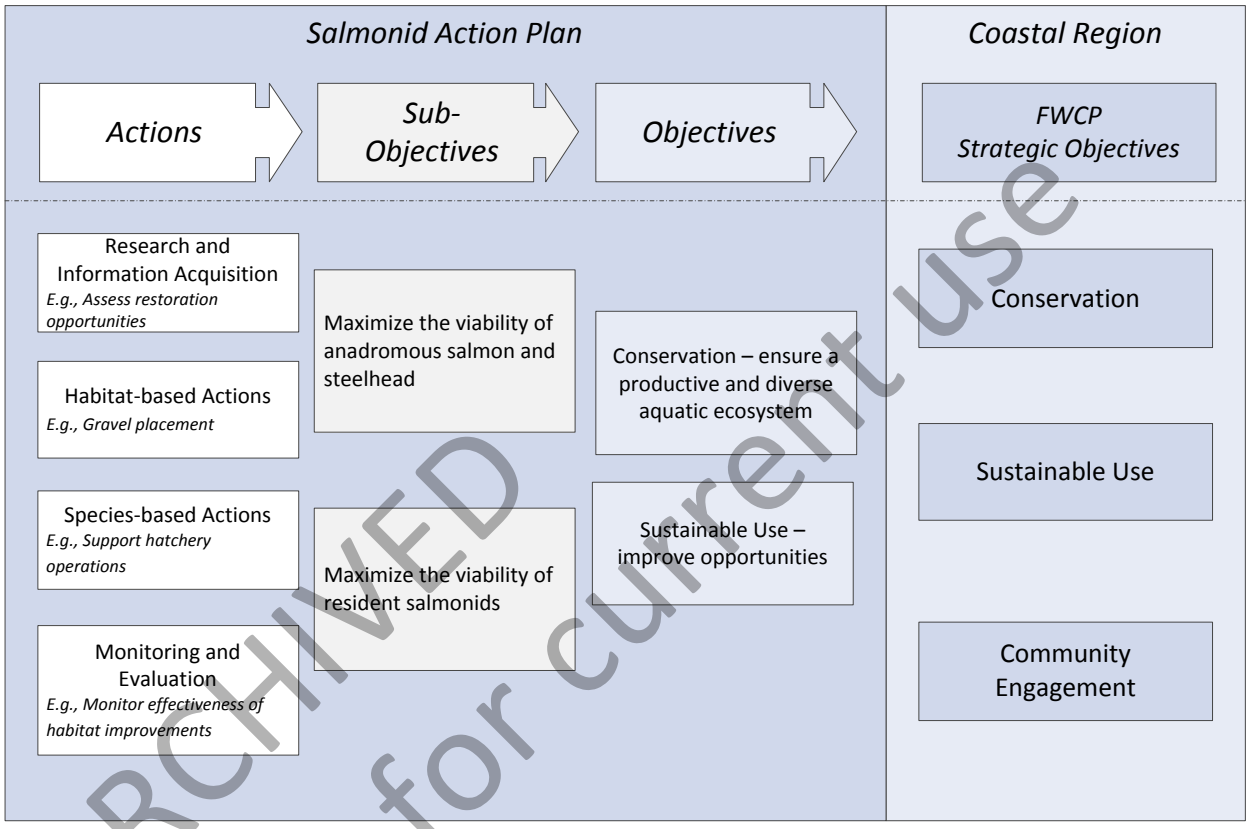


**Figure 3: Relationship between actions, sub-objectives and objectives in this Salmonid Action Plan and the FWCP strategic objectives in the Stave River Watershed Plan.**



## 4.2. COMPONENTS

This section presents the main actions identified under each sub-objective (Tables 2 and 3) along with the supporting rationale for why the action is required and what it will achieve. Actions are organized under five broad categories: Research and Information Acquisition, Habitat-based Actions, Species-based Actions, Land Securement and Monitoring and Evaluation. Also provided are priority ratings to guide investment planning efforts. Actions are assigned priorities from 1-3. Note that low priority actions are not included in the table.

## Sub-objective: Maximize the viability of anadromous salmonids.

**Table 2: Actions with associated priorities and target species in the Stave River.**

| Actions | Lower Stave | Stave Lake Reservoir | Upper Stave | multiple species | Anadromous | | | | | Resident | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Chum | Coho | Chinook | Steelhead | Sockeye | Cutthroat | Rainbow | Kokanee |
| **Research & Information Acquisition** | | | | | | | | | | | | |
| Assess restoration opportunities and feasibility of improving steelhead parr habitat. | 2 | | | | | | | x | | | | |
| Use genetic analysis to determine the origin of sockeye and Chinook adults returning to Stave River. | 2 | | | | | | x | | x | | | |
| Identify additional opportunities for enhancement of coho habitat. | 2 | | | | | x | | | | | | |
| Identify methods to control invasive species, in particular bass. | 2 | | | x | | | | | | | | |
| Identify stock origin of early Chinook run, potentially through an angler survey. | 2 | | | | | | x | | | | | |
| Assess use of the lower Stave River by white sturgeon, particularly for spawning and juvenile rearing. | 2 | | | | | | | | | | | |
| Develop an integrated habitat restoration plan for the Stave system, and ensure compatibility with WUP implementation and monitoring. Proponent should discuss project scope with program staff before submitting a proposal. | 3 | | | x | | | | | | | | |
| **Habitat Based Actions** | | | | | | | | | | | | |
| On-going gravel replenishment and upgrading of existing spawning areas for chum, which will also benefit pink, Chinook, and possibly steelhead, rainbow and cutthroat. | 1 | | | x | | | | | | | | |
| Improve access to suitable tributaries and off-channel habitats for coho, Chinook and cutthroat, and maintain and improve habitat in areas such as Thompson Creek and Thompson Creek wetlands. | 1 | | | | | x | x | | | x | | |
| Maintain existing constructed habitat enhancements for all salmonids. | 1 | | | x | | | | | | | | |
| **Species Based Actions** | | | | | | | | | | | | |
| Support hatchery operations for steelhead in support of achieving targets. | 1 | | | | | | | x | | | | |
| Support hatchery operations for Chinook and coho in support of achieving targets. | 2 | | | | | x | x | | | | | |
| **Land Securement** | | | | | | | | | | | | |
| There are possible opportunities in the lower Stave where land securement may address fisheries management objectives. | 2 | | | | x | | | | | | | |
| **Monitoring & Evaluation** | | | | | | | | | | | | |
| Assess adult returns and outmigrating smolts as a measure of overall fish production in relation to targets. | 2 | | | x | | | | | | | | |
| Assess efficacy of habitat enhancements undertaken by the program. | 2 | | | x | | | | | | | | |



***Rationale.—*** To support targets for anadromous salmon and steelhead a number of actions are proposed. Many actions focus on improving habitat for different species and life stages, but there is much we don't know biologically and physically about the species and habitats of interest, so actions also include collecting information to help evaluate and implement compensation options and assessing performance of implemented restoration activities.

Compensation requires increasing present biological productivity to offset hydro development-related declines in productivity. There are myriad ways to compensate for fisheries impacts, and some work better for some species than others and some may be more suited to certain physical settings. To make informed choices on implementing the most cost-effective projects requires understanding what is possible and the costs and benefits of different approaches. More detailed options assessments are required in some circumstances so that costs and projected benefits can be better understood when prioritizing among potential projects. This would aid priority setting both within and among waterbodies within the Stave system.

There appear to be relatively limited opportunities in the Lower Stave to enhance fish habitat. As noted earlier, FWCP (BCRP) and other programs have completed a number of habitat enhancements in the lower Stave, including construction of approximately 118,000 $m^2$ of chum spawning habitat, which may also benefit other species. This habitat needs regular maintenance for continued benefit, and potentially could be modified to provide benefits to other species such as cutthroat and coho. Efforts for steelhead should focus on improving parr habitat and the needs for this species should be considered when designing all habitat modifications in the lower Stave.

Invasive species, such as bass, are a substantial concern, but no specific activities have been identified for their control. In general, care should be taken to ensure that restoration projects do not benefit bass, sunfish, bullfrog or canary grasses.

Enhancement of sustainable fisheries will support First Nations and recreational fisheries. Clearly, many of the activities which enhance the ecological integrity and the status of certain species will also benefit a sustainable fishery.

Monitoring is a cornerstone of good resource management because it provides information on present status and trends and allows post-implementation assessment of management decisions and programs. Fundamentally, monitoring provides direction on adjustments that may be necessary. There are multiple elements related to anadromous salmon and steelhead that require monitoring. Realistically, monitoring will likely focus on abundance of different life stages of sportfish and species of concern, and the level of effort will likely vary among locations and species. Results of monitoring should feed directly into compensation program evaluation and help revise objectives and targets, where necessary. Special care will be required to ensure that implementation and monitoring of FWCP: Coastal projects complements that of the Water Use Plan.

**Sub-objective: Maximize the viability of resident salmonids.**

**Table 3: Actions with associated priorities and target species in the Stave River.**

| Actions | Lower Stave | Stave Lake Reservoir | Upper Stave | multiple species | Anadromous | | | | | Resident | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Chum | Coho | Chinook | Steelhead | Sockeye | Cutthroat | Rainbow | Kokanee |
| Research & Information Acquisition | | | | | | | | | | | | |
| Undertake stream habitat evaluations and determine stock status and habitat capacity for resident species, and to identify restoration opportunities. | | 1 | 1 | x | | | | | | | | |
| Support inventory efforts for Salish sucker. Identify appropriate restoration opportunities. | 1 | 1 | | | | | | | | | | |
| Assess opportunity for "put and take" fishery in Hayward Reservoir for rainbow trout. | 2 | | | | | | | | | | x | |
| Assess the status of kokanee and opportunities for habitat improvements. | | 2 | 2 | | | | | | | | | x |
| Assess opportunity for improving littoral productivity, especially the establishment of macrophytes. | | 2 | | x | | | | | | | | |

***Rationale.—*** The rationale for the proposed actions related to resident salmonids is similar to that discussed above for anadromous salmon and steelhead, and some of those proposed projects will benefit resident fish also. The primary actions required for resident salmonids are to develop a better understanding of present stock status and possible restoration options for different species. For example, population status and opportunities for habitat improvements require assessments of rainbow trout, cutthroat trout, kokanee and white sturgeon.

Salish sucker may occur in the Stave watershed, and information is needed regarding their presence and distribution to determine if appropriate restoration actions are required. Until more information is available to confirm presence or absence, restoration projects should carefully consider whether there may be detrimental effects on these species.



## 4.3. UNSUPPORTABLE PROJECTS

DFO and MOE have indicated they would not support the following projects.

- The Stave River Water Use Plan has implemented a number of operational changes to improve conditions for fish and other resources. There are concerns that some restoration works could confound results from studies underway to evaluate aspects of the WUP. FWCP partners support the WUP and its associated monitoring studies and recognize the need to avoid confounding WUP monitoring results.
- Projects related to fish passage at BC Hydro facilities must adhere to the Fish Passage Decision Framework for BC Hydro Facilities (BC Hydro 2008), including requirements for evaluation of specific prerequisite biological studies.

- Habitat enhancement projects (e.g., improving fish passage at natural barriers, modifications to specific habitats) may require agency review, and in some cases prerequisite biological studies, to evaluate risks and benefits.

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**Personal Communication**


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