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FISH AND WILDLIFE
COMPENSATION PROGRAM

CAMPBELL RIVER WATERSHED *SALMONID ACTION PLAN* FINAL DRAFT

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Campbell 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 Campbell River project area. It identifies actions to be undertaken in the Campbell, Heber, Salmon and Quinsam watersheds, which are collectively referred to here as the Campbell system. The plan builds on the FWCP's strategic objectives and the Campbell 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 workshop¹ 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 Campbell River, 28 May 2009.

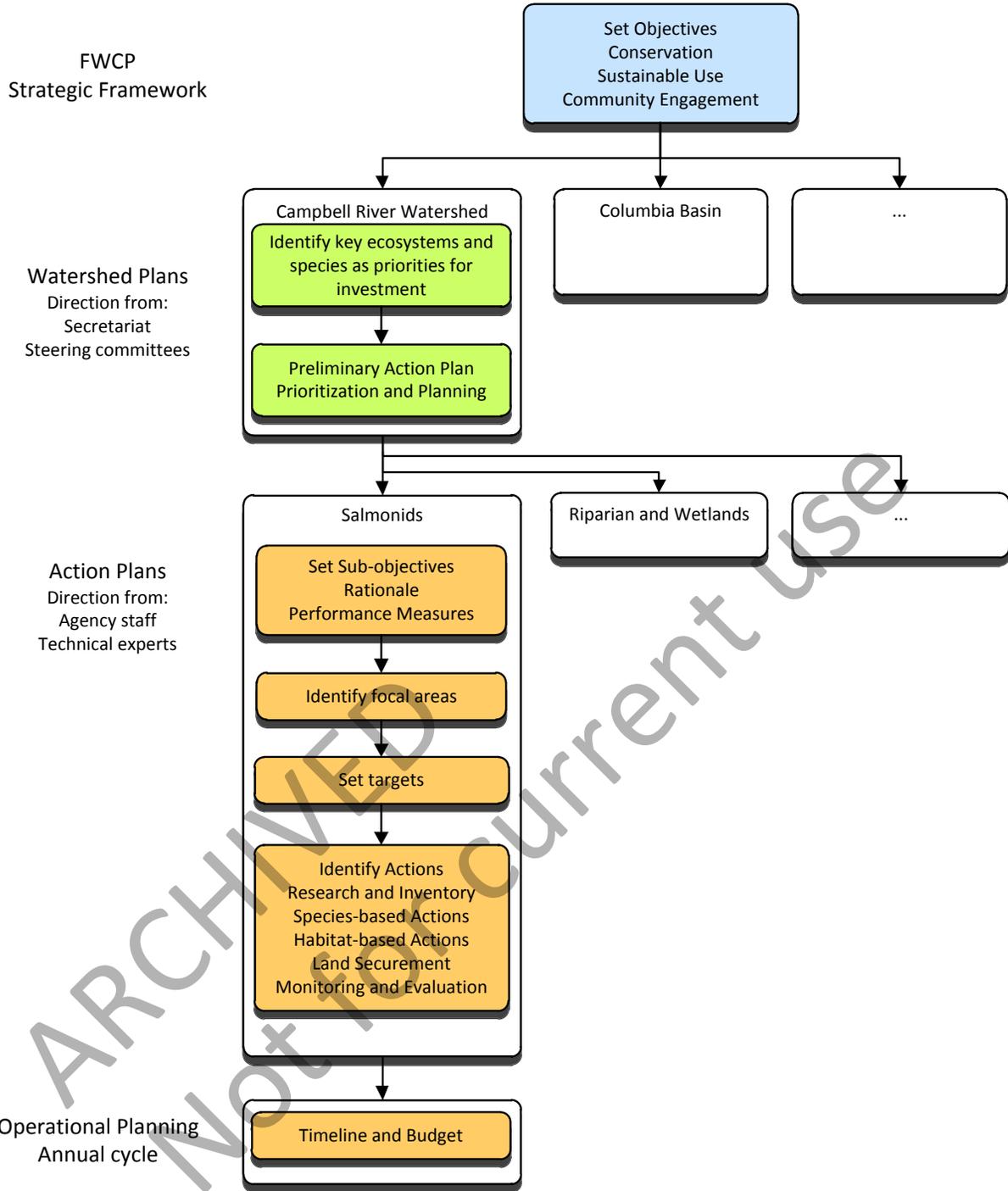


Figure 1. Relationship between the Salmonid Action Plan and higher level planning and objectives.

2. OVERVIEW CONTEXT

The Campbell system, including the upper sub-basins of the Heber, Salmon and Quinsam, straddles the Vancouver Island mountain range near the town of Campbell River (Figure 2). Elevations range from sea level in the Campbell and Salmon river estuaries to rugged peaks with small areas of permanent snowpack over 2200 m. Inflows are typical of British Columbia coastal basins, with high inflows from snowmelt in May through July, low flows in August and September and high precipitation from October to March with mixtures of snow and heavy rain. The average precipitation in November is 420mm, but may reach 800mm. A more detailed explanation of the system and the hydro facilities can be found in BC Hydro (2000).

The Campbell River system lies within the traditional territory claimed by the Mowachaht/Muchalaht First Nation and Hamalta First Nations. The Lower Campbell River flows through the community of Campbell River before discharging into the Georgia Strait. The Upper Campbell River watershed lies within Strathcona Provincial Park.

The Campbell River hydro-electric development consists of three dams on the Campbell mainstem and one diversion on each of the Salmon, Quinsam and Heber rivers. On the mainstem, John Hart Dam (1953) is the lowermost facility, impounds John Hart Reservoir and diverts water to a powerhouse located 2km downstream of Elk Falls. This created an isolated diversion reach in Elk Falls Canyon. John Hart has the lowest discharge capacity ($124 \text{ m}^3/\text{s}$) of the mainstem facilities. The local basin area behind John Hart Dam is relatively small, only 24 km^2 , and inflows are dominated by upstream releases.

Ladore Dam (1958) is the middle facility, which impounds Lower Campbell Lake Reservoir, and has a powerhouse adjacent to the dam with a discharge capacity of $161.5 \text{ m}^3/\text{s}$. The terrain consists of rolling heavily forested hills, the mean basin elevation is 250 m and the local basin area behind Ladore Dam is 243 km^2 . Inflows are primarily influenced by upstream releases at Strathcona Dam, and from diversions from the Salmon and Quinsam rivers.

Strathcona Dam (1958) is the uppermost facility, impounds Upper Campbell Reservoir and Buttle Lake, and has a powerhouse located at the toe of the dam with a discharge capacity of $175.6 \text{ m}^3/\text{s}$. The upper most reservoir was formed by impounding Upper Campbell and Buttle lakes, and is about 50 km long and up to 5 km wide. The creeks feeding the reservoir tend to be short and steep. The Elk River sub-basin contains the longest watercourse, which is 24 km long and falls roughly 760 m. The mean basin elevation is 950 m and the basin area is 1192 km^2 . Natural hydraulic inflows from the basin are augmented by diverting water from the Heber River and Crest Creek. During periods of high inflow when it is necessary to control rising levels in Upper Campbell Lake, Strathcona discharges are often increased to $175.6 \text{ m}^3/\text{s}$ resulting in spills downstream at the Ladore and John Hart facilities.

The Salmon River Dam diverts water from the upper Salmon River into Brewster, Gray, Whympner and Fry lakes and then into Lower Campbell Lake. The Salmon

diversion contributes to power generation both at the Ladore and John Hart power stations.

The Quinsam project includes the Quinsam Dam at the outlet of Wokas Lake and a diversion dam downstream on the Quinsam River. Water is diverted through Gooseneck and Snakehead lakes, Miller Creek and into Lower Campbell Lake Reservoir. The Quinsam diversion contributes to power generation at both Ladore and John Hart power stations.

The Heber River Dam diverts water from the upper Heber River into Crest Lake then through the Drum lakes into the Elk River, which enters Upper Campbell Lake Reservoir. Crest Creek, a former tributary to Heber River, is also diverted into the Drum lakes. The Heber-Crest diversion contributes to power generation at all three power stations on the Campbell mainstem.



Figure 2. The Campbell River hydropower project.

2.1 SALMONIDS IN THE CAMPBELL RIVER SYSTEM

Anadromous fish were unable to access the Campbell watershed upstream of Elk Falls, a major barrier 5.6 km upstream of the ocean. Below Elk Falls canyon the lower river is inhabited by five salmon species (although sockeye are not plentiful), steelhead, anadromous cutthroat trout, Pacific lamprey, and resident fish species that are also found upstream. Campbell River is famous for its exceptionally large Chinook salmon known as *tyee*. Six resident fish species are currently found in the Campbell River watershed above and below Elk Falls, including the resident salmonid species, cutthroat and rainbow trout and Dolly Varden char.

The Heber River is used by five species of salmon and winter steelhead in the lowermost 0.9 km of the river, where there is a natural falls of about 2.5 to 3 m. Summer steelhead is the only anadromous stock able to ascend the falls, and they use the next 7.5 km of river up to another set of falls of about 4 m. Resident rainbow trout and Dolly Varden char occur throughout, above and below both sets of falls. For its size, the Heber River is one of the most productive wild steelhead streams on Vancouver Island.

The Quinsam River was used historically by pink, chum, Chinook and coho salmon, and steelhead trout, although they tended to be restricted to the lower reaches. Steelhead and coho have occasionally ascended the falls into Quinsam Lake. DFO has been active in enhancing Quinsam salmon production, including hatchery operations, outplanting programs, and other activities. Resident rainbow and cutthroat trout and Dolly Varden char occur throughout the watershed, and kokanee occur in Quinsam and Quinsam lakes, and spawn in the mainstem.

Historically, access for anadromous stocks to the upper Salmon River was blocked by a 5 m high falls/obstruction located about 12 km downstream of the current diversion dam. Remedial blasting in 1975 and 1976 made this barrier passable and the Salmon River above the diversion dam now supports wild steelhead and coho salmon. The lower reaches are an important fish-producing system used by chum, coho, and Chinook salmon and steelhead trout. Resident fish species are kokanee, rainbow and cutthroat trout, Dolly Varden char, and sculpins.

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 2: Campbell River (December 2000);
- Campbell River Water Use Plan Consultative Committee Report (August, 2004); and
- Findings in the Community Workshop (Campbell River, May 28, 2009).

Hydro-related Impacts — All dams in the Campbell system were constructed upstream of anadromous fish barriers, but construction affected habitats for resident stocks and operations affect both upstream and downstream habitats. Impacts are described here by location within the Campbell system. Area calculations are based on GIS analyses done for BC Hydro (2000).

Upstream of Strathcona Dam (Upper Campbell Reservoir and Buttle Lake).

1. The impoundment flooded:
 - 3583 ha of lake,
 - 3186 ha of land,
 - 252 ha of mainstem channel and 143 ha of adjacent riparian area,
 - 21 km of tributary habitat and 65 ha of adjacent riparian area, and
 - 695 ha of wetland.
2. Annual drawdowns reduce littoral productivity and affect the viability of spawning habitats in reservoir tributaries.

Upstream of Ladore Dam to Strathcona Dam (Lower Campbell Reservoir).

3. The impoundment flooded:
 - 934 ha of lake,
 - 1676 ha of land,
 - 81 ha of mainstem channel and 77 ha of adjacent riparian area,
 - 20 km of tributary habitat and 61 ha of adjacent riparian area, and
 - 241 ha of wetland.
4. Annual drawdowns reduce littoral productivity and affect the viability of spawning habitats in reservoir tributaries. Annual fluctuations are considerably less than in Upper Campbell Reservoir.
5. High flushing rate through Lower Campbell Reservoir reduces plankton and littoral productivity.

Upstream of John Hart dam to Ladore dam (John Hart Reservoir).

6. The impoundment flooded:
 - 346 ha of land,
 - 62 ha of mainstem channel and 60 ha of adjacent riparian area, and
 - 4 km of tributary habitat and 11 ha of adjacent riparian area.
7. High flushing rate through John Hart Reservoir reduces plankton and littoral productivity.

Lower Campbell River.

8. Water diversions and occasional spills alter habitat characteristics in this reach. The draft Campbell Water Use Plan assessed issues associated with operations, and some procedures have been altered to offset certain

impacts. The Water Use Plan has not yet been approved by the Water Comptroller.

9. Upstream dams have reduced recruitment of gravel and large woody debris, which are important for spawning and rearing, respectively. Spills from John Hart have affected availability of spawning gravels downstream of the dam.
10. About 2 km of prime rearing habitat in Elk Falls canyon was dewatered as flows were diverted to the John Hart Generating Station. As part of the Water Use Plan, flows are now being released from the dam to make this habitat more functional.
11. Spills induce adult steelhead and salmon to move upstream into the canyon past the tail race and become stranded when spills cease. Flows now being released as part of the Water Use Plan may mitigate this effect.

Heber Diversion

12. The Heber Dam footprint led to losses of instream and riparian habitat.
13. Increased flows in the receiving channels changed channel hydraulics, with possible negative and positive effects.
14. The Crest diversion dewatered a tributary of the Heber River, with unknown effects.

Quinsam Diversion

15. The Quinsam Diversion Dam footprint led to losses of instream and riparian habitat, and some loss of spawning habitat.
16. The Diversion Dam reduced gravel and LWD recruitment to downstream habitats.
17. Increased flows in the receiving channels changed channel hydraulics, with possible negative and positive effects. Redds are dewatered when diversion ceases, but there would be a benefit if flow was maintained.
18. Decreased flows in the mainstem affect downstream fish populations.
19. The Quinsam Diversion Dam and Wokas Dam restrict movements of resident fish populations.

Salmon Diversion

20. The Salmon Diversion Dam footprint led to losses of instream and riparian habitat.
21. The dam reduced gravel and LWD recruitment to downstream habitats.
22. Increased flows in the receiving channels changed channel hydraulics, with possible negative and positive effects.
23. Decreased flows in the mainstem affect downstream fish populations.

24. Entrainment into the diversion leads to loss of juveniles and adults.

Non-Hydro Impacts — Other impacts on fish populations in the Campbell system include historic effects of logging, mining, linear developments, flood protection and urbanization. A significant portion of the upper watershed is protected within Strathcona Provincial Park. Historic logging in the Elk River watershed has increased the rate of sediment delivery to the main channel, and has contributed to channel instability. Logging is also implicated in increased debris and sediment delivery to the upper Salmon River. Activities at Western Mines near the head of Buttle Lake increased concentrations of toxic metals. Biological communities in Buttle Lake have returned to their former abundance after remedial measures were applied in the early 1980s.

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 drawdown and flooding, diversions, or dam and generating station operations; or from non-hydro sources. Urban encroachment along banks of the lower Campbell River and estuary has reduced off-channel, riparian and wetland areas.
2. **Habitat Quality:** Physical habitat below dams is altered by reduced recruitment of gravel and large woody debris. In particular, reduced gravel recruitment in the lower Campbell limits the quality of Chinook spawning habitat. In the Salmon River rearing habitat is limiting for coho.
3. **Access:** Dams block access to formerly useable habitat, and altered flow regimes affect passage conditions in some locations. This occurs particularly on the Salmon and Quinsam rivers, and in Elk Falls canyon.
4. **Diversions:** All three river diversions have reduced annual flow downstream of the diversion dams, and increased volumes in the receiving waterbodies. Altered flows have affected wetted area, seasonal temperatures and stream productivity in the Salmon, Quinsam and Heber rivers, though the magnitude of effect is variable and mostly unquantified. Loss of spawning and rearing area has occurred in Elk Falls canyon as a result of diversion from John Hart Dam to the generating station.
5. **Hatchery practices:** Intervention by the hatchery on Quinsam River has probably had positive and negative effects on wild salmonid stocks. Hatcheries typically increase overall abundance, but this may attract increased harvest, reduce genetic diversity, and increase competition for food and space. Under the DFO's Wild Salmon Policy the Salmon Enhancement Program takes steps to minimize these risks.

2.4 TRENDS AND KNOWLEDGE STATUS

HABITAT TRENDS

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

Changes in physical works and operations agreed to by BC Hydro as a part the Water Use Plan have likely improved habitat conditions downstream of diversions. (Note: the Water Use Plan has not been approved by the Water Comptroller, but BC Hydro has implemented some measures of the WUP.) FWCP (BCRP) habitat compensation projects have been conducted in the watershed since 1999 and have had a positive effect on habitat at many locations in the Campbell River watershed, for example:

- Salmon spawning gravel placements (e.g., Mainstem Campbell River, including Ebert Road, First Island, Elk Falls canyon)
- Development of side-channel or off-channel aquatic habitat (e.g., Elk Falls #3 side-channel upgrades, Salmon River/Big Tree Main side-channel)
- Salmon River nutrient enrichment, and
- Baikie Island Reserve purchase and reclamation.

STOCK TRENDS

Chinook.— Campbell River is famous for its exceptionally large Chinook, known as *Tyee*. The river continues to support a world-class fishery; however, Chinook appear to be the species that has been most affected by dams and operations. Chinook are the highest priority for DFO in the lower Campbell River. Currently, the lower Campbell supports between 600-1500 spawners, but it is believed that habitat restoration could increase the capacity up to three times this amount.

In the Salmon River, Chinook were present mostly in the lower river before 1975, when selective blasting opened access to additional habitat. There is now a viable population in the river. Chinook salmon are a high management priority but a low priority for habitat restoration investment in the Salmon River.

There were few Chinook in the Quinsam River prior to enhancement. Quinsam River Hatchery used Campbell River Chinook for brood stock. Quinsam Chinook stocks are rated as a medium-high priority by DFO, particularly for habitat productivity assessments, as habitat factors may be the cause of low Chinook returns.

Coho.— There is a small population of coho in the lower Campbell River. Escapements have been fairly stable over the last couple of decades; usually in the low to mid hundreds, and occasionally over 1,000.

Trends indicate a stable population of coho in the Quinsam River, with escapements over the last two decades ranging from the low thousands to almost 40,000. Coho in the Quinsam are enhanced by the Quinsam Hatchery.

There is a robust population of coho in the Salmon River, and this is DFO's highest priority species in that river for habitat enhancement works. Availability of rearing habitat is considered a limiting factor.

Chum — Although escapements are variable, Chum salmon appear to be at (or near) their capacity population of 40,000 spawners in the lower Campbell River. However, there is interest in reducing stranding from outages at John Hart Generating Station.

The Quinsam River has a small population of chum, with escapements over the last two decades typically in the order of a few hundred fish.

Chum distribution in the Salmon River is likely restricted to areas downstream of the canyon and they were unlikely to have been significantly impacted by the diversion.

Cutthroat — Cutthroat trout are a priority conservation species for MOE in the lower Campbell River. Off channel habitats and increased connectivity could conceivably double existing capacity.

Cutthroat are of lower concern in the Salmon and Quinsam rivers.

Pink — Pink salmon have traditionally not done well in the lower Campbell River because spawning gravels are not suitable.

Conversely, pink salmon in the Quinsam River have done well in the last couple of decades. Improved access over the Quinsam Cascades has provided an additional 14 km of spawning area in the Quinsam River. Pinks are also enhanced at Quinsam Hatchery.

Salmon River pink distribution is likely restricted to areas downstream of the canyon and they were unlikely to have been significantly impacted by the diversion.

Sockeye — There are few sockeye present in the lower Campbell, Heber, Quinsam or Salmon rivers.

Steelhead.— Currently steelhead runs in the lower Campbell River do not appear to be viable, as wild fish are quasi-extinct with only 5-10 fish returning each year (1-2 fish/km). Based on existing habitat capacity, the Greater Georgia Basin Steelhead Recovery Plan (Lill 2002) suggests targets of 1,080 smolts and 140 adults. Despite the current stock status, there have been some steelhead returns in the lower Campbell River from the enhanced Tsitika River summer run. There appears to be an opportunity to enhance the Campbell population with culture augmentation. MOE considers this a high priority.

Steelhead are also a conservation concern in the Quinsam River, where escapement data suggest current populations are less than 187 adults. Moreover,

the population is heavily skewed to areas downstream of the Quinsam Hatchery counting fence where habitats are degraded. Habitats above the fence (approximately 15 km to Iron River) may not be used to capacity.

Steelhead populations in the Heber and Salmon rivers are relatively healthy.

Other salmonids — other salmonids include Dolly Varden, kokanee, and rainbow trout. These are considered lower priority within anadromous reaches, but MOE is interested in opportunities to enhance cutthroat and Dolly Varden within areas used by resident species.

KNOWLEDGE GAPS

Several knowledge gaps have been highlighted by agencies and stakeholders:

- Understanding the effects of previous restoration efforts,
- Feasibility and effects of increased fish passage and decreased entrainment at the Salmon River diversion. For example, it is not known how facilitating passage for other species around the Salmon River diversion would affect steelhead production. Evaluating the feasibility of fish passage should consider this issue carefully.
- To help set priorities for restoration, the program needs a better understanding of limiting factors that can be addressed by restoration initiatives
- Assessing effects of increased access for pink salmon over Quinsam River cascades. DFO views continued monitoring as a high priority to better understand relationships for future restoration efforts with pink salmon, and the possible benefits to other species and the ecosystem with increased pink access
- Information on cutthroat populations, habitat limitations and opportunities for restoration.
- The effects of existing gravel placement should be monitored for Chinook and other species in the lower Campbell River to better understand the benefit to fish populations, and in particular determine preferential size distribution of gravels.
- Further restoration opportunities for coho and Chinook in the Quinsam River should be evaluated to guide restoration opportunities.
- Effects on Campbell River salmonids from altered temperature regimes (e.g., delayed rearing, accelerated incubation)

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 CAMPBELL SYSTEM

Management objectives are common to all locations in the Campbell system, although the species of interest vary somewhat among the different watersheds 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 salmonid management objectives for the Campbell system:

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 Campbell system.

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

Each sub-objective is supported by the following status indicators:

1. Anadromous salmon and steelhead
 - a. Chinook salmon
 - b. coho salmon
 - c. chum salmon
 - d. pink salmon
 - e. steelhead trout
2. Resident salmonids
 - a. cutthroat trout
 - b. rainbow trout
 - c. Dolly Varden char

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 Campbell system. Projects need not focus solely on these species, but they are the species of greatest interest to most stakeholders. From a conservation perspective, priorities in each river system are:

Lower Campbell River: Chinook and steelhead are the highest priority species in the Lower Campbell, with chum, coho and cutthroat being the next most important species. The steelhead population in the Lower Campbell is in decline and the Wild Stock Status is rated Extreme Conservation Concern (Lill 2002). Cutthroat trout are also a conservation concern and it is believed that restoration work could increase the existing capacity.

Quinsam River: Both steelhead and cutthroat trout are a conservation concern in the Quinsam. Pink, coho and Chinook are DFO's highest priorities.

Salmon River: Chinook were restricted mostly to the lower Salmon River prior to selective blasting of falls in 1975. Steelhead are the primary species of conservation concern, as this is a viable population currently and limiting habitats should be enhanced where possible. DFO's highest priority in the Salmon River is coho. Lower priority salmonid species in the system include chum and sockeye salmon, and Dolly Varden.

Heber River: Steelhead are the primary species of management interest in the Heber, but the stock is healthy and no restoration activities are identified at present.

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, escapements at the hatchery, 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 the Table 1.

Table 1: Species management targets for each location in the Campbell River system.

Location	Species	Target (5-year average)
Lower Campbell River	Chinook	4,000 spawners
	Chum	40,000 spawners
	Coho	300 spawners
	Steelhead	increase in wild steelhead
	Cutthroat	1,000 smolts
Quinsam	Chinook	4,000 spawners
	Chum	1,000 spawners
	Coho	10,000 spawners
	Pink	100,000 spawners
	Steelhead	4,800 smolts and 624 adults
Salmon	Chinook	to be determined
	Coho	20,000 spawners (for the entire river, including above the diversion)
	Steelhead	20 adults/km
Heber	Steelhead	no target
all	Dolly Varden	no target
	Rainbow	no target
	Cutthroat	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 the above objective also support this sustainable use objective. Although there are no direct actions aimed at 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, priorities in each river system are:

Campbell River: Chinook are the most highly sought-after sport fish and the river is famous for producing exceptionally large fish. The chum fishery is stable but might be improved through reduced stranding. There may be opportunities to develop a steelhead sport fishery from Tsitika River stock.

Quinsam River: Pink salmon are a high priority species in the river for angling, and the population is currently considered healthy. Coho have a variable population in the Quinsam River and opportunities for increasing the population could be explored. Other species, including rainbow, cutthroat, Dolly Varden and kokanee are considered lower priorities at this time.

Salmon River: Coho salmon are a high priority for angling and there appear to be opportunities for enhancement both above and below the diversion. Chinook are also important from a management perspective, but there may be fewer restoration opportunities. Steelhead are an important species in this river.

Heber River: The Heber River is one of the most productive wild steelhead streams on Vancouver Island, and this is a clear management priority. Salmon and winter steelhead are restricted to the lowermost 0.9 km of the river by a natural barrier.

Salmonids from all of these systems are also caught in commercial fisheries.

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.

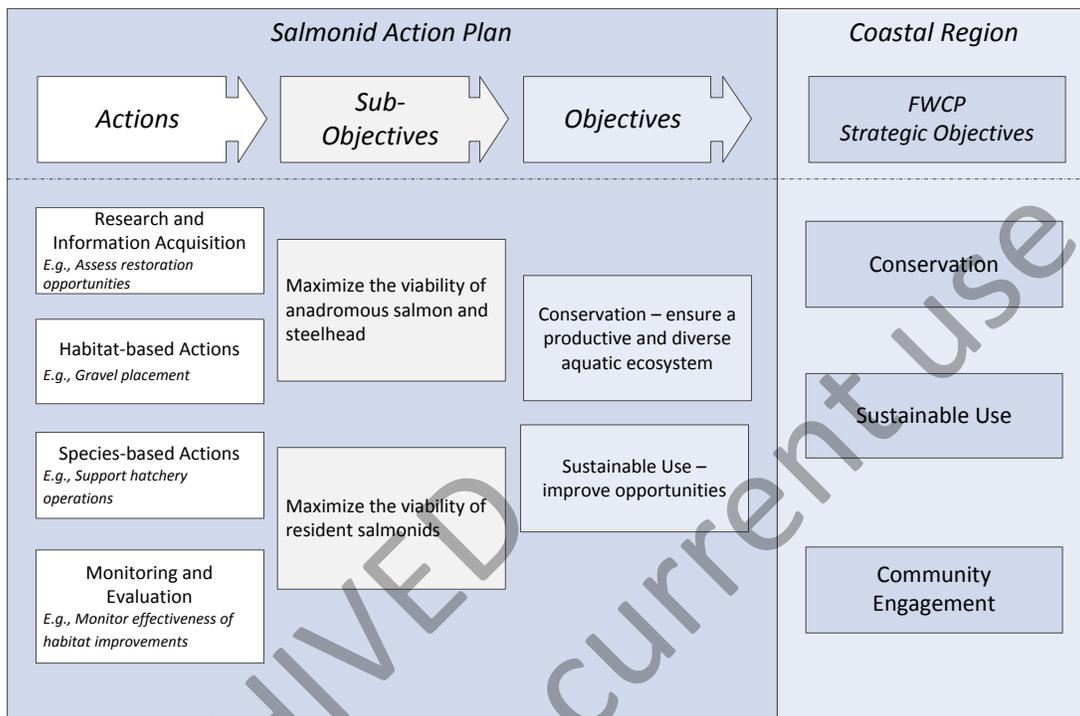


Figure 3: Relationship between actions, sub-objectives and objectives in this Salmonid Action Plan and the FWCP strategic objectives in the Campbell River Watershed Plan.

4.2 COMPONENTS

This section presents the main actions identified under each sub-objective 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 (Tables 2 and 3). Actions are assigned priorities from 1-3. Note that low priority actions are not included in the table.

Sub-objective 1: Maximize the viability of anadromous salmonids

Table 2: Actions with associated priorities for anadromous species

Actions	Lower Campbell River	Quinsam	Salmon	Heber	Upper Campbell Reservoir	Lower Campbell Reservoir	Salmon diversion lakes	other	multiple species	Anadromous				Resident			
										Chinook	Coho	Chum	Pink	Steelhead	Cutthroat	Dolly Varden	Rainbow
Research & Information Acquisition																	
Channel assessment of mainstem, off-channel habitat, and tributaries in Lower Campbell River to assess the effectiveness of existing channels and the feasibility of new channels for rearing, including an assessment of connectivity.	1								x								
Assess opportunities for improving Chinook and chum rearing habitat in the estuary. Any actions would likely also benefit Quinsam River pink salmon.	1	1								x		x	x				
Assess restoration opportunities in the Quinsam watershed for coho and Chinook. Actions would likely also benefit pink salmon and other species.		1							x	x	x		x				
Assess benefits and costs of increased fish passage in the Salmon River, particularly for steelhead and coho. Any assessment must adhere to the Fish Passage Decision Framework.			1						x								
Assess efficacy of fish culture augmentation, using Tsitika River steelhead to enhance Campbell River steelhead in support of targets.	1														x		
Assess the anadromous fish use of access to the Middle and Upper Quinsam River, and identify possibilities for steelhead out-planting programs.		1													x		
Develop integrated habitat restoration plan for the Campbell system, and ensure compatibility with WUP implementation and monitoring. Proponent should discuss project scope with program staff before submitting a proposal.	1	1	1	1	1	1	1	1	x								
Assess benefits and costs of increased fish passage above DFO fence on Quinsam, particularly for steelhead. Any assessment must adhere to the Fish Passage Decision Framework.		2							x						x		
Assess benefits and costs of increased fish passage above falls downstream of Quinsam Lake. This is a long term goal. Any assessment must adhere to the Fish Passage Decision Framework.		3							x								
Habitat Based Actions																	
Continue augmentation of gravels in Elk Falls Canyon.	1								x								
Gravel placement in the Lower Campbell to improve egg to fry survival (primarily for Chinook). Possible locations include, extension of First Island Mainstem project, and gravel pads in the mainstem upstream of Second Island.	1									x							
Additional complexing of Elk Falls canyon and other areas (e.g., 2 nd Island channel) for the benefit of all salmonids.	1								x								
Improve existing side channels and off channel areas for all salmonids.	1								x								
Enhance Second Island side channel to reduce stranding of chum in Lower Campbell.	1										x						
Habitat complexing in the lower Quinsam River. The focus is rearing habitat for steelhead, but other species such as coho would benefit.		1							x		x			x			
Implement recommendations from Wokas Lake storage feasibility study.		1							x								
Continued nutrient augmentation upstream of the Salmon River Diversion.		1							x								
Side channel development in Salmon River (e.g., Big Tree side channel).		1							x								
Maintain existing constructed habitat enhancements for all salmonids.	1	1	1	1	1	1	1	1									
Installation of a fish-way into Beaver Pond in Lower Campbell for coho.	2										x						
Continued restoration and protection activities for estuary habitats in Lower Campbell.	2								x								
Species Based Actions																	
Support hatchery incubation of Chinook for out-planting to Campbell mainstem upstream of Quinsam confluence in support of targets.	1									x							
Land Securement																	
There are possible opportunities where land securement may address fisheries management objectives.	2								x								
Monitoring & Evaluation																	
Maintenance and monitoring of existing gravel pads in Elk Falls canyon and the lower Campbell River.	1								x								
Monitor the effectiveness of the fishway over Quinsam Cascade for pink salmon, coho and steelhead smolts.		1							x								
Assess efficacy of nutrient augmentation programs on adult returns.	2	2	2	2	2	2	2	2	x								
Assess efficacy of habitat enhancements undertaken by the program.	2	2	2	2	2	2	2	2	x								
Assess adult returns and out-migrating smolts as a measure of overall fish production in relation to specified targets.	2	2	2	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 assessment 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 Campbell system.

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 2: Maximize the viability of resident salmonids.

Table 3: Actions with associated priorities for resident species

Actions	Lower Campbell River	Quinsam	Salmon	Heber	Upper Campbell Reservoir	Lower Campbell Reservoir	Salmon diversion lakes	other	multiple species	Anadromous				Resident			
										Chinook	Coho	Chum	Pink	Steelhead	Cutthroat	Dolly Varden	Rainbow
Research & Information Acquisition																	
Develop a detailed inventory of potential restoration projects directed at resident salmonids in mainstem rivers and reservoirs, and tributaries.	2	2	2	2	1	1	1	2							x	x	x
Channel and bank stabilization, habitat restoration and nutrient enrichment in the chain of lakes and creeks associated with the Salmon River diversion.							2		x								
Instream complexing in Drum Creek.								3	x								

Rationale.— The rationale for the proposed actions related to resident salmonids are similar to those discussed earlier for anadromous salmon and steelhead. The actions are separated to highlight different locations within the Campbell system and the complementary roles of DFO and MOE.

4.3 UNSUPPORTABLE PROJECTS

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

- BC Hydro has implemented operational changes under the Campbell River Water Use Plan, which are expected 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.

ARCHIVED
Not for current use

5. REFERENCES

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