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FISH AND WILDLIFE
COMPENSATION PROGRAM

BRIDGE/SETON RIVER WATERSHED

SALMONID ACTION PLAN

FINAL DRAFT

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OCTOBER 2011

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Bridge-Seton Rivers 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 restoration projects in the Bridge-Seton project area, focussing on salmonid fish species. It identifies actions to be undertaken in the Bridge and Seton watersheds. The plan builds on the FWCP's strategic objectives and the Bride-Seton Rivers Watershed Plan (FWCP, 2011). A riparian and wetland action plan and a species of interest action plan are also being developed, 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 Lillooet (26 March 2009)

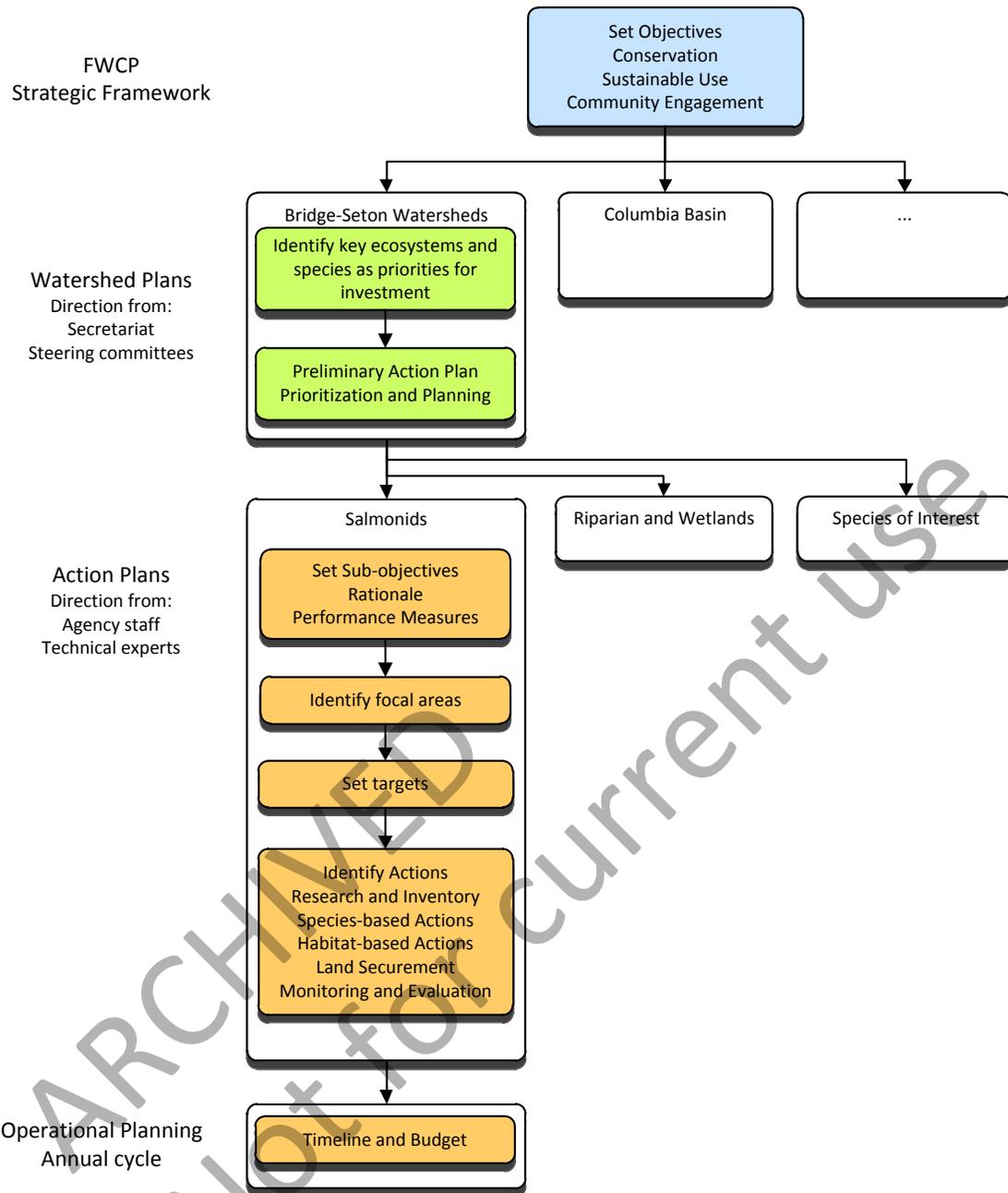


Figure 1. Relationship between the Salmonid Action Plan and higher level planning and objectives.

2. OVERVIEW CONTEXT

The Bridge and Seton watersheds are located in the rain shadow of the southern Coast Mountains, about 200 km northeast of Vancouver. The two watersheds are adjacent and separated by the Bendor Range and Mission Ridge. Together, they drain an area of approximately 3,700 km². Elevations range from 236 m at the confluence with the Fraser River to rugged peaks of about 3,000 m, and steep-sided slopes and broad lower valleys predominate. The Bridge River flows into the Fraser River just north of the town of Lillooet, and the Seton River meets the Fraser immediately south of the town (Figure 2).

The Bridge and Seton rivers are primarily affected by continental and modified maritime weather producing high snow pack in the winter and occasional short-duration rainfall between June and July. The hydrograph is dominated by snowmelt between May and August. Inflow is usually low from September to April, but autumn storm events result in occasional large inflows. The source of Bridge River is the Bridge Glacier covering 140 km² of the upper watershed.

The Bridge Seton watershed has a total human population of approximately 4,500, of which almost 3,000 are located near Lillooet. Other communities include Gold Bridge, near the La Joie Dam, and Yalakom on the lower Bridge River. It is within the traditional territory of the St'at'imc Nation and indigenous people from the majority of the population. The watersheds contain the Spruce Lake protected area.

The Bridge River project consists of La Joie Dam, which impounds Downton Reservoir, and Terzaghi Dam, which impounds Carpenter Reservoir. Water is diverted through tunnels and penstocks from Carpenter Reservoir to two powerhouses on the shore of Seton Lake Reservoir. Downton Reservoir has a total average inflow of 40 m³/s. Additional inflow to Carpenter Reservoir is 51 m³/s for a total diversion of about 91 m³/s into Seton Lake; the licensed diversion from Bridge River is 147 m³/s.

When Terzaghi Dam was completed in 1960 (and the Mission Dam before it in 1948), no continuous releases from Carpenter Reservoir were required, and any flows in the lower Bridge River derived exclusively from groundwater and inflow from tributaries. With the exception of occasional spills over the dam to manage unpredictable high inflows, a 4 km stretch of channel immediately below the dam was left essentially dry, and the other 15 km experienced a more than hundred-fold reduction in flow (Failing et al. 2004). In the late 1990s, Terzaghi Dam was modified to allow continuous flow release, and since August 2000 BC Hydro has implemented an average release of about 3 m³/s. The magnitude of the release is still managed under an adaptive management program. The dam remains impassable for fish.

The Seton project consists of Seton Dam at the outlet of Seton Lake, where water is diverted by canal then penstock to a powerhouse on the banks of the Fraser River downstream of the natural Seton-Fraser confluence. The Cayoosh Dam (owned and operated by Walden North) diverts water from Cayoosh Creek via

tunnel to Seton Lake near its outlet. About 80% of the total discharge through the Seton powerhouse comes from the Bridge River diversion. The Seton Dam incorporates fish passage structures, which allow anadromous salmon to ascend beyond the outlet of Seton Lake.

Seton Lake has a total average inflow of about 117 m³/s: 19 m³/s comes naturally from within the Seton basin, 16 m³/s from the Cayoosh Creek diversion, and 91 m³/s from the Bridge River diversion. The seasonal flow regime of the Bridge River watershed dominates the operation of Seton Lake Reservoir.

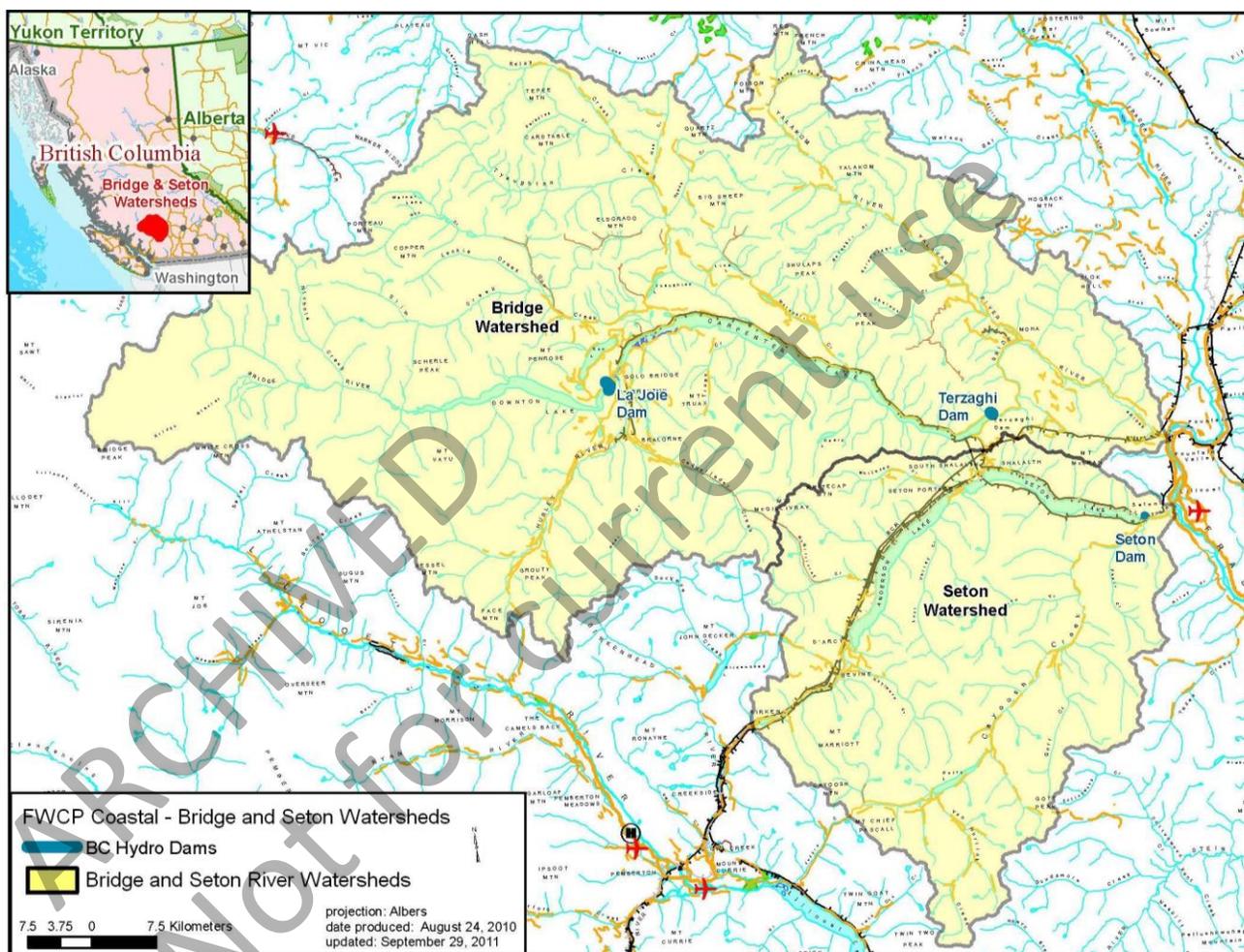


Figure 2. The Bridge Seton hydropower project.

2.1 SALMONIDS IN THE BRIDGE-SETON SYSTEM

There is little quantitative historical information on salmonid distribution and abundance in the Bridge River, and they are mostly inferred from historical photos and descriptions, current fish presence, and oral history. Anadromous salmon and steelhead likely accessed the Bridge River as far as La Joie and Zoltique Falls, near the current site of La Joie Dam. The lower Bridge was dominated by high velocity canyon habitat and much of the spawning and rearing occurred in the middle Bridge and its tributaries. There were substantial runs of species with strong swimming ability, like Chinook, coho, steelhead and to a lesser extent sockeye. Following construction of

Terzaghi Dam and the cessation of flows, the lower Bridge River became more hospitable as rearing and spawning habitat and pink and chum salmon now also use this area. Resident salmonids recorded in the Bridge system include bull trout, rainbow trout and mountain whitefish, as are non-salmonids like lamprey, sculpin and sucker.

Anadromous runs of sockeye, pink, Chinook and coho salmon and steelhead trout had access to the Seton system. Both Seton and Anderson lakes are sockeye nursery lakes and historically the system as a whole supported substantial runs of returning sockeye. The runs were affected by massive harvest in the lower Fraser, which peaked in the 1890s. Seton and Anderson lakes historically supported abundant kokanee, known as 'gwenis' by local First Nations. These fish spawned on the shore or shoal areas of the lakes. Spawning habitats for all salmonids occur in the Gates, Portage and lower Seton rivers, and a variety of tributaries.

Bridge River and Seton River fish stocks were substantially affected by two large slides in 1913 and 1914 at Hells Gate in the Fraser Canyon, which created a barrier to upstream fish migration. Fishways built in 1945 and extended in 1956 helped improve fish passage to the watersheds, but stocks took many years to rebuild. The effects of the Hells Gate slides are thought to have contributed to underestimating the productivity of Bridge-Seton fish stocks during evaluation of hydro-development in the watersheds.

2.2 IMPACTS AND THREATS

The following section deals with impacts throughout the Bridge-Seton system, based on the Community Workshop (Lillooet, 26 March, 2009), the WUP Consultative Committee Report (BC Hydro 2003) and the BCRP Strategic Plan (BC Hydro 2000a,b).

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 10: Bridge River and Chapter 11: Seton River (December 2000);
- Bridge River Water Use Plan Consultative Committee Report (December, 2003); and
- Findings in the Community Workshop (Lillooet, March 26, 2009).

Hydro-related Impacts — Footprint impacts of structures, reservoirs and their operations, have occurred throughout the system and are described as follows, based on location.

Upstream of La Joie Dam (Downton Reservoir and upper Bridge River).

1. The impoundment flooded:
 - 2234 ha of land, significant loss of valley bottoms, riparian and side habitat for bighorn sheep, other ungulates and carnivores,
 - 65 km of mainstem, 441 ha of side channels, and 390 ha of adjacent riparian areas,
 - 25 km of tributary habitat and 75 ha of adjacent riparian area, and
 - 237 ha of wetlands - feeding/breeding habitat for ducks and furbearers, and feeding habitat for bears & ungulates.
2. Construction of La Joie Dam sluiced a large volume of sediment that degraded downstream habitat in the Middle Bridge River.
3. Access roads reduced instream and riparian habitat.

4. Large annual drawdown (as much as 49m) in Downton Reservoir affects access to tributaries and the establishment of aquatic and riparian vegetation.
5. Flooding of mainstem and tributaries created a barrier to wildlife particularly bears and ungulates.
6. The creation of open water for osprey and waterfowl, as well as the flooding of forest areas created snags and nesting cavities.

Upstream of Terzaghi Dam to La Joie Dam (Carpenter Reservoir and middle Bridge River).

7. The impoundment flooded
 - 4996 ha of land, loss of valley side habitat for bighorn sheep, other ungulates and carnivores,
 - 92 km of mainstem, 761 ha of channels, and 552 ha of adjacent riparian areas,
 - 55 km of tributary habitat and 165 ha of adjacent riparian area, and
 - 46 ha of wetlands - feeding/breeding habitat for ducks and furbearers, and feeding habitat for bears & ungulates.
8. Terzaghi Dam blocked fish passage for anadromous and resident migratory fish.
9. Loss of salmon resource above the dam as a food source for grizzly bears, scavengers, and piscivorous birds feeding on fry and smolts.
10. Barriers to migration of mammals, particularly bears and ungulates.
11. Large annual drawdown (as much as 44m) in Downton Reservoir affects access to tributaries and the establishment of aquatic and riparian vegetation.
12. Change in flow regime of the remaining river has unknown effects on wildlife.
13. The creation of open water for osprey and waterfowl, as well as the flooding of forest areas created snags and nesting cavities.

Bridge River downstream of Terzaghi Dam.

14. Reduced flows downstream of Terzaghi Dam reduced wetted area and access to off-channel habitats. Despite the reduced flows, inflows from tributaries and groundwater provided a relatively productive area. Since August 2000, BC Hydro has provided a fish flow release of about 3 m³/s. The benefits of this release are currently under study.
15. Spills can strand and kill fish or displace them downstream
16. Terzaghi Dam has reduced gravel and LWD recruitment to the lower river.
17. Periodic spilling scours gravel and degrades downstream habitat, strands or displaces fish and may temporarily increase TGP.
18. Reduced flow has altered temperature in the river, potentially benefiting fish, particularly in the summer. Less cold water from the Bridge has likely increased water temperature below the Yalakom confluence. Conversely, in the winter the water from the Bridge system was warmer than Yalakom water and so the water temperature below the confluence is now colder.
19. Reduced flows in the 49.5 km of the lower Bridge River has unknown effects on aquatic wildlife such as American Dipper and Harelquin.

Upstream of Seton Dam (Seton Lake).

20. The impoundment flooded
 - 2503 ha of lake and 52km of shoreline, loss of coniferous forest,
 - 27 ha of land, and
 - 0.5 km of mainstem, 3 ha of channels, and 3 ha of adjacent riparian areas.
21. Diversion from Bridge River and the Seton Dam raised the level of Seton Lake, resulting in inundation of 27 ha land around the lake.
22. Adult pink salmon are impinged on screens at power canal intake structure.
23. Adult salmon are attracted to discharges greater than 60 m³/s through the radial gate and are delayed ascending the fish ladder.
24. The fish ladder does not accommodate large Chinook or sturgeon.
25. Dredging during construction caused a major loss of spawning habitat for pink salmon and other species.
26. Water chemistry, temperature, water clarity and nutrients have been altered significantly since the diversion of Bridge River water into the system.
27. Flooding of shoreline created snags and nesting sites.

Lower Seton River.

28. Larger spills since the Bridge River diversion has scoured gravel and reduced spawning and rearing habitat. Spills also cause the stranding of fish.
29. Cooler water from Bridge River may benefit upstream migration, however migrating fish are delayed at entrance to the spawning channels.
30. Present flow releases at Seton Dam restrict instream habitat and access to former off-channel habitat.
31. Seton Dam has reduced LWD recruitment to the river.
32. Reduced flows have unknown effect on aquatic wildlife.

Bridge to Seton Diversion

33. Anadromous salmon homing to the Bridge and Seton rivers are attracted to the tailrace at the Seton generating station on the Fraser River.
34. Potential temperature stress on Fraser upstream migrants trying to pass Bridge River Rapids due to loss of cool Bridge discharge.

Cayoosh Diversion

35. Partial mitigation is provided for Seton fish by diverting Cayoosh Creek water to Seton Lake.

36. Juvenile sockeye and pink salmon are impinged on trash racks and entrained into the Seton power canal.
37. Diversion of Cayoosh water from July to November assist sockeye to home to Seton River and not the tailrace discharge (positive effect).
38. Diversion diminishes available habitat area in the downstream channel.
39. Diversion has diminished gravel and LWD in downstream channel.
40. Reduced flows have unknown effect on aquatic wildlife.

Seton to Fraser Diversion

41. Juvenile sockeye and pink salmon are impinged on the penstock intake.
42. Seton adult spawners are attracted, delayed or injured at the tailrace before finding the Seton River. This is partially mitigated by controlling the % of Cayoosh Creek water diverted into Seton Lake.
43. Seton canal (4.6 km) is a hindrance to the movement of animals.

Non-Hydro Impacts — Other impacts in the Bridge-Seton watersheds include mining (particularly in the area of Gold Bridge around Ferguson Creek), forestry, and rail and road construction, in particular rail construction near Seton Lake likely filled limited shoal areas. Also, the slides in the Fraser River at Hell's Gate in 1913 and 1914 negatively affected anadromous fish passage into the Bridge-Seton watersheds. Fish passage at Hell's Gate was established in 1945 and extended in 1956; however, fish stocks took a long time to recover. The effects of the Hell's Gate slides are thought to have contributed to underestimating the productivity of Bridge-Seton fish stocks during evaluation of hydro-development in the watersheds. Urban development has not been a significant factor in the area.

2.3 LIMITING FACTORS

The limiting factors in the Bridge-Seton system 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. Disturbance and loss of riparian habitats in the lower Seton River and Cayoosh Creek is thought to play a role in limiting some species.
2. **Habitat Quality:** Physical habitat below dams is altered by reduced recruitment of gravel and large woody debris. Reduced gravel recruitment in the lower Bridge River is a concern, especially for Chinook.
3. **Access:** Dams block access to formerly useable habitat, and altered flow regimes affect passage conditions in some locations. Fish passage at Seton Dam is restricted for some species.
4. **Diversions:** The Bridge diversion has reduced annual flow downstream of Terzaghi Dam, and increased volumes in the receiving waterbodies. Altered flows have affected wetted area, seasonal temperatures and stream and lake productivity.
5. **Entrainment:** Entrainment in the Bridge River is limited to resident fish in Carpenter Reservoir and is variable in magnitude, timing and frequency. In the Seton River, it is

estimated that 10% of juvenile salmon out-migrating from areas above Seton Dam are entrained into the Seton power canal and generating station.²

2.4 TRENDS AND KNOWLEDGE STATUS

HABITAT TRENDS

A detailed account of habitat impacts from hydropower development is provided in BCRP (2000) and is summarized in Section 2.2. In addition to present and historic hydropower impacts there are diverse impacts in the watershed from forestry, mining and rail development.

Changes in operations agreed to by BC Hydro as a part the Water Use Plan (BC Hydro 2003) have improved habitat conditions in the watersheds (Hall,2007). FWCP (BCRP) habitat compensation projects have been conducted in the watershed since 1999 and have had a positive influence on habitat throughout many locations in the Bridge-Seton system. The low level outlet gates at Terzaghi Dam were modified to allow flow releases to the lower Bridge River, and since August 2000 BC Hydro has implemented an average release of about 3 m³/s. Prior to the flow release, FWCP partners and St'at'imc collaborated to rebuild habitat for coho, Chinook, steelhead, bull trout and rainbow trout in the upper 2.2 km of the river. These efforts rewatered 48,000 m² of stream channel, created 20,000 m² of in-channel habitat of which 16,000 m² is spawning habitat, created 5,000 m² of off-channel habitat, and 7,000 m² of riparian planting. There were additional increases in habitat further downstream, but the amount has not been quantified. Spawning salmon were observed in the channel within 10 days of the initial flow release.

Habitat in the Seton River system has been improving over the last decade. Work conducted by the FWCP includes complexing of 26,500 m² of Seton spawning channels, and opening them up to all fish species, whereas previously the channels had been used primarily for odd-year pink salmon. Additional habitat works include Seton River foreshore restoration, Gates Creek spawning channel gravel replacements, and purchase of Gates Creek properties for conservation and upgrading.

Gates Creek has been negatively affected by linear developments including transmission corridors, roads and railways and logging activity. Spawning channel weirs and rural development in the lower reach have altered stream morphology and this is believed to have impacted both bull trout and rainbow trout production. However, MOE has stated that Darcy Creek and other smaller tributaries have some restoration opportunities. Gates has areas of important groundwater influence.

STOCK TRENDS

There is little historic information on Bridge-Seton fish stocks prior to 1913 and 1914 when two large slides created a barrier at Hells Gate in the Fraser Canyon. The slides seriously affected fish stocks in the Bridge-Seton watersheds. Fishways built in 1945 and extended in 1956 helped improve fish passage to the watersheds.

Coho — Coho likely had historic access to the Bridge River above Terzaghi Dam, and they are found in both the Bridge and Seton rivers. Currently, Bridge River and Seton River coho are not considered genetically distinct from other Interior Fraser coho and are part of the Interior Conservation Unit. As Interior Fraser coho they are of great conservation concern and DFO is

² Bridge-Coastal Restoration Program. 2000 Strategic Plan, Volume 2, Watershed Plans, Chapter10: Bridge River and Chapter 11: Seton River. Available at: http://www.bchydro.com/bcrp/about/strategic_plan.html

currently working on an Interior Fraser Coho Recovery Plan. They are DFO's main priority in the Bridge-Seton system.

Steelhead — Steelhead occur in both the Bridge and Seton systems and are a priority species for MOE. Bridge River steelhead are part of an important catch and release fishery in the Fraser system. Current populations are considered to be 160-370 spawners. MOE staff advise that habitat is not currently limiting and sufficient habitat is available to support at least twice current escapements, but is insufficient to support the high end of the target escapement.

Steelhead spawn and rear in the Seton and Cayoosh rivers; however, their habitat has been degraded due to spills, scouring and lack of gravel recruitment. While access to former pink spawning channels has likely enhanced the population, the extent of this benefit is not known. MOE has identified slow development of riparian habitats in the Seton and Cayoosh channels as an additional limiting factor to steelhead.

Chinook — Chinook were present in the middle Bridge river and in tributaries such as Ferguson and Tyaughton creeks, where estimates ranged from 300 to 2,000 fish spawning in the accessible lower 1.6 km section of Tyaughton Creek. Production in Ferguson was estimated to be much less, ranging from 1 to 300. Chinook are now restricted to the lower river, and are a moderate priority for DFO. Current escapements are estimated at approximately 500 spawners, with a target of 1,000 spawners. DFO does not consider habitat to be limiting, but there is concern over the quality of the habitat, particularly for spawning. Specifically, the channel area immediately downstream of Terzaghi Dam was restored with clean washed gravel, but current design calls for gravels to include a fraction of finer material. A fraction of finer material tends to reduce the intrusion of fine organic matter leading to reduced flushing, overall gravel health and less predation of eggs by other fish such as sculpins.

Historically, Chinook spawning occurred in the Seton and Seton Portage; however, the habitat below Seton Dam has been degraded and is likely limiting. Despite this, Chinook utilize the Seton spawning channels and there is a viable population in the lower Seton River. Although Chinook were transplanted from Seton-Portage to the Gates River in the 1940s the population does not appear to be viable.

Bull trout — MOE staff identified that bull trout escapements in the lower Bridge and Yalakom rivers are likely less than 200. The Yalakom River spawning population is considered critical to the overall Bridge population. MOE staff stated that escapement numbers are likely low compared to habitat availability and proposed an interim target in the Yalakom River of several hundred spawners. Bull trout are considered a medium priority in the lower Bridge River, and no specific targets have been set. Current bull trout escapements are believed to be very low.

MOE staff identified that bull trout are present in the lower Seton River; however, they spawn in headwater streams throughout the watershed rather than in this reach of the river. Current escapement estimates for bull trout in Anderson Lake are in the order of 200-300.

Sockeye — DFO recognizes that sockeye are present in the Bridge each year, but currently identify these fish as strays citing the fact that in years where spawners seem more abundant there are usually stressful conditions in the Fraser River.

Most sockeye spawning occurs in the Gates River spawning channel. The Gates River sockeye spawning channel is a facility operated under international agreement and its successful operation is a high priority for DFO.

Pink — Pink salmon were not reported in the Bridge River until 1959 after the Hells Gate fishway was extended. Pinks have generally done well and they are not currently a management priority in either the Bridge or the Seton rivers. Pinks have been able to ascend to all reaches of the lower Bridge with reduced flows associated with the dams. DFO has reported that pink salmon escapements on the Bridge have been in the order of 60,000 – 104,000 spawners over the past several years. The populations are stable and sustainable, and the spawning channels habitats are fully utilized and have been redesigned for multi-species use.

Kokanee — Kokanee in the Seton system are known as 'gwenis' by First Nations. Recent population estimates for Seton Lake are 67,700 for all life stages combined, and 3 million in Anderson Lake. The Seton Lake population is generally considered limited by spawning habitat availability, and few active spawning sites have been identified. MOE staff advise that diversion of flows from Bridge has resulted in increased sedimentation to Seton Lake and this may be limiting kokanee spawning production in the lake. Conversely, the Anderson kokanee population is considered viable and well distributed in the lake for spawning and rearing. Kokanee are not found in Gates creek.

Rainbow trout — Rainbow trout occur in all parts of both systems. MOE staff note that rainbow trout spawning populations appear to be stable in the lower Bridge River and there are no specific restoration opportunities for them.

In the lower Seton River, rainbow trout along with steelhead are high priorities for MOE. They spawn and rear in both Seton River and Cayoosh Creek. Spawning habitat for rainbow trout has been degraded by spills, scouring and a lack of gravel recruitment, but access to the Seton spawning channels has provided new options for both spawning and rearing. There is, however, a limited understanding of how the Seton spawning channels are being used by rainbow trout. Although rainbow trout are a management priority in Seton Lake, there are limited restoration opportunities.

Other salmonids — Mountain whitefish occur in both the Bridge and Seton rivers, and lake whitefish have been reported in both watersheds. Contrary to BC Hydro (2000a,b) cutthroat trout are not found in the Bridge-Seton system.

Non-salmonids — The following non-salmonid fishes have been reported in the Bridge-Seton system: lamprey, longnose sucker, bridgelip sucker, peamouth chub, redbelly darter, prickly sculpin, slimy sculpin and coastrange sculpin. There are unconfirmed reports of sturgeon from divers investigating train derailments in both Seton and Anderson lakes.

KNOWLEDGE GAPS

Several knowledge gaps have been highlighted by agencies and stakeholders:

- Information on habitat limitations and restoration opportunities for anadromous and resident fish populations
- Better understanding the relative benefits of different restoration initiatives to help set priorities
- Feasibility and effects of increased fish passage and decreased entrainment at Seton Dam
- Understanding the effects of previous restoration efforts.

The key knowledge gaps are addressed as part of the Action Plan in section 4.2 under Research and Information Acquisition.

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 BRIDGE-SETON SYSTEM

Management objectives are common to all locations in the Bridge-Seton system, although the species of interest vary somewhat among the different watersheds and thus the list of indicators and measures may differ. This section briefly summarizes the objectives, sub-objectives and status indicators.

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 three fisheries management objectives for the Bridge-Seton system:

1. Conservation – Ensure a productive and diverse aquatic ecosystem,
2. Conservation – Improve the status of species of conservation concern
3. Sustainable Use – Maintain or improve opportunities for sustainable use.

Supporting these objectives are sub-objectives that break each into its key components and provide clarity about what exactly is meant by the objective.

Objective 1. Ensure a productive and diverse ecosystem.

The 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 Bridge-Seton 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. coho salmon
 - b. Chinook salmon
 - c. pink salmon
 - d. sockeye salmon
 - e. steelhead trout
2. Resident salmonids
 - a. bull trout
 - b. rainbow trout
 - c. kokanee (gwenis)

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 not in these lists. There are different priority species in different parts of the Bridge-Seton system. Projects need not focus solely on these species, but they are the species of greatest interest to most stakeholders.

LOWER BRIDGE RIVER

Fish passage. Fish Passage at Terzaghi Dam is not considered a priority by DFO or MOE.

Coho. DFO is concerned about the current status of Interior Fraser coho and has identified coho salmon as the main restoration priority in the lower Bridge River. Off-channel spawning and rearing habitats are thought to be limiting for coho, and good restoration opportunities have been identified predominantly downstream of the Yalakom River.

Chinook. DFO has identified Chinook as the next priority after coho, in the lower Bridge River. Chinook habitat is not thought to be limiting in terms of available area, but there appear to be opportunities to improve habitat quality, particularly for spawning. A partial barrier on the Yalakom River has also been identified as a possible restoration opportunity.

Pink and sockeye. Pink and sockeye salmon are low priorities for DFO in the lower Bridge River.

Steelhead. MOE identified steelhead as the top priority in the lower Bridge River because they are part of an important catch and release fishery in the Fraser River. Sufficient habitat is thought to be available to support at least twice current escapements. Potential opportunities have been identified for off-channel sites that could provide multi-species spawning and rearing habitat.

Bull trout. Bull trout are considered a medium priority in the lower Bridge River. The Yalakom spawning population is thought to be critical to the overall population in the lower Bridge. No specific restoration projects have been identified for bull trout in the lower Bridge River.

Rainbow trout. Rainbow trout are considered to be a medium priority in the lower Bridge River, and the populations appear to be stable. No specific restoration opportunities were identified.

MIDDLE AND UPPER BRIDGE RIVER

Bull trout and rainbow trout. Bull trout is a priority in the middle upper Bridge watershed. Rainbow trout are a prized recreational fishery species and MOE is interested in enhancing the recreational fishing experience in this area. MOE staff identified both bull trout and rainbow as the highest priority species in the Bridge River upstream of Carpenter Reservoir. Hurley River and Cadwallader Creek have been identified as systems with specific limitations and potential restoration opportunities, and identifying the limiting factors for other tributaries such as Gun and Tyaughton are a high priority. Numerous lakes and streams upstream of falls also offer restoration opportunities.

Kokanee. Kokanee are considered a medium management priority at this time although MOE staff view kokanee as a very important component of the ecosystem and an important prey species for both bull trout and rainbow trout.

Other species. Mountain whitefish are considered a lower priority at this time.

SETON RIVER

Fish passage. Upstream fish passage at Seton Dam is provided through a fishway and an intricate flow release strategy. DFO believes that it may be possible to improve passage and considers the assessment of options a high priority. MOE also believes that improvements may be possible.

Coho. DFO has identified coho salmon as the main restoration priority in the Seton watershed, linked to a general concern with the status of Interior Fraser coho. Off-channel habitat for spawning and rearing is thought to be limiting and should be the focus of restoration efforts, and several opportunities have been identified. The best opportunities appear to be in Gates River. Limited restoration opportunities exist in Seton-Portage for coho and projects in this area are a low priority.

Chinook. Chinook are a medium priority in the lower Seton and Seton-Portage, and a low priority in Gates River. The quality of Chinook spawning habitat just below Seton Dam may be limiting, and evaluating options to improve this habitat should be a high priority.

Sockeye. DFO recognizes that sockeye are present in the Bridge each year but currently identify these fish as strays citing the fact that in years where spawners seem to be in larger numbers there are usually stressful conditions in the Fraser River.

Most sockeye spawning in the Seton watershed occurs in the Gates River spawning channel. DFO has requested that any projects undertaken in Gates River be designed to not impact this facility. Additional efforts directed at sockeye are considered low priority.

Pink. Restoration projects directed at pink salmon are low priority. All suitable habitats are fully utilized and the population is healthy.

Steelhead. Steelhead and rainbow trout are MOE's highest priority for the lower Seton River. Several potential restoration opportunities exist in the lower Seton. Opportunities to develop spawning platforms for steelhead and other species may exist in the Seton mainstem.

Kokanee. Seton Lake kokanee (gwenis) have been identified as a high priority and appear to provide considerable opportunity for restoration. In particular, evaluating options to improve spawning success has been identified as a high priority. Kokanee (gwenis) is considered a critical ecosystem component in Anderson Lake, and therefore a high management priority, but MOE staff indicated that the population appears healthy and sustainable and is therefore a lower priority for restoration.

Bull trout. MOE staff identified Gates Creek bull trout as a high priority. Darcy Creek and other smaller tributaries appear to have restoration opportunities, and feasibility studies to restore access to tributaries and identify habitat improvement options are a high priority. Feasibility studies are also required to assess restoration opportunities in Gates River mainstem.

MOE identified bull trout as a top management priority in the Portage River. The best opportunities for bull trout restoration exist in tributaries to Portage (Spyder and Whitecap). Bull trout are present in the lower Seton River; however, they spawn in headwater streams throughout the watershed rather than in this reach of the river, so restoration in this area is a low priority.

MOE indicated that stream habitat is limiting for bull trout and rainbow trout in Anderson Lake and Portage River due to short stream length and competition from other salmonids. Nevertheless, there are limited restoration options in Anderson Lake and its tributaries and MOE considers this a low priority area for restoration.

Rainbow trout. Rainbow are a top priority for MOE at Seton-Portage. MOE has identified a potential off-channel habitat development for rainbow trout on reserve land, and feasibility studies are a medium priority. MOE staff identified Gates Creek rainbow trout as a high priority, and indicated that assessing and implementing restoration opportunities in the Gates River watershed should consider rainbow and bull trout together.

Dolly Varden and mountain whitefish. MOE consider Dolly Varden and mountain whitefish low priority for restoration activities.

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 (See monitoring and evaluation under Section 4.2). To the extent feasible, a quantitative measure will be used.

Targets.— Abundance targets have been set for a number of species and locations, but several targets remain to be determined – see Table 1.

Table 1: Species management targets for each location in the Bridge-Seton system.

Location	Species	Target (5 year average)
Bridge	Coho	1500 - 2000 spawners
	Chinook	1000 spawners
	Steelhead	Several hundred to just over 1000 spawners
	Bull trout	400 mature adults in lower Bridge
	Rainbow	4000 spawners in Downton Reservoir and tributaries no targets elsewhere
	Sockeye	no target
	Pink	no target
	Kokanee	no target
Seton	Coho	500 spawners in Seton River 2500 spawners in Gates River 200 spawners in Seton-Portage
	Chinook	500 spawners in Seton River 250-500 spawners in Seton-Portage no target in Gates River
	Steelhead	no target
	Bull trout	interim target of 400-600 spawners in Anderson Lake no target for elsewhere in Seton system
	Sockeye	no target, but Gates River spawning channel is important
	Pink	no target, Seton spawning channels are used to capacity
	Rainbow	400 – 600 spawners in Anderson Lake and Seton-Portage no targets elsewhere
	Kokanee	no target

Objective 2. Improve the status of species of conservation concern.—This objective refers explicitly to responsibilities for species that are listed under the Species at Risk Act (SARA), assigned endangered, threatened or special concern status by COSEWIC, or identified as priority 1 under the province’s Conservation Framework. At this time, there are no fish species identified within the Bridge-Seton system that need to be addressed by this objective. [The objective is nevertheless listed here for consistency with other action plans.]

Coastal cutthroat trout populations are considered vulnerable and are therefore on the Conservation Data Centre’s (CDC) blue list, and are identified as priority 2 by the Conservation Framework. They have not been assessed by COSEWIC and are not listed under SARA. Bull trout are on the CDC blue list and are identified as priority 2 by the Conservation Framework. COSEWIC assigned endangered status to Interior Fraser coho (COSEWIC 2002). Coho in the Bridge-Seton system belong to the Upper Fraser population, one of five Fraser River sub-populations assessed. The Government of Canada decided not to list Interior Fraser coho under SARA, “based on uncertainties associated with changes in the marine environment and potential future socio-economic impacts on users” (Government of Canada 2006).

Coastal cutthroat trout, bull trout and coho salmon are discussed in relation to objective 1.

Objective 3. Maintain or improve opportunities for sustainable use.— This objective reflects the important sustainable use benefits that can be derived from healthy fish populations. Many salmonid species are the focus of First Nations, commercial and recreation fisheries. Consequently, any actions aimed at achieving the above objectives indirectly 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 the above objectives.

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:

Bridge River: Adult Chinook and coho are the most highly sought-after salmonids and there are ongoing efforts to improve habitat and abundance.

Seton River: Pink salmon are the most abundant species in the lower river, and the population is currently considered healthy. There are large runs of sockeye upstream of Seton Dam and there is interest in improving upstream and downstream passage for these and other fish species. There is interest in improving spawning and rearing conditions for other anadromous and resident salmonids.

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.

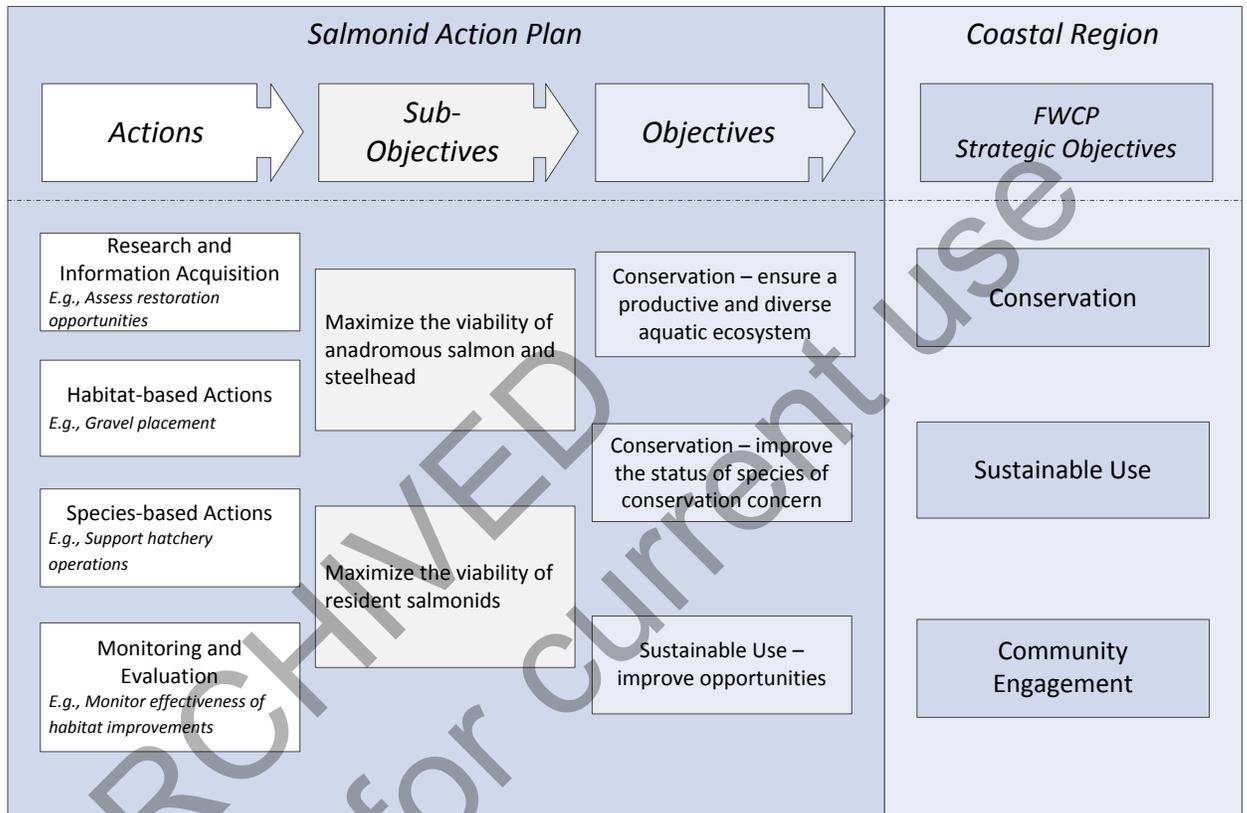


Figure 3: A “means-ends” diagram that summarizes the actions described in the action plan and how they support fisheries objectives and FWCP program goals.

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. 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 for anadromous species.

Actions	Lower Bridge	Middle Bridge	Upper Bridge	Lower Seton	Seton Lake	Seton-Portage	Gates	other	multiple species	Anadromous					Resident			
									Chinook	Coho	Chum	Pink	Sockeye	Steelhead	Bull trout	Rainbow	Kokanee	
Research & Information Acquisition																		
Assessment of gravel immediately downstream of Terzaghi Dam to determine if it functioning effectively to maximize egg to fry success	1								x									
Develop options to improve habitat quality in Gates Creek and its tributaries for coho, bull trout, rainbow trout, and other species. Possible activities include: i) Overview flights in winter to identify possible off channel projects. ii) Determination of coho (and other species) distribution etc. iii) Smolt estimates. iv) Opportunistic Chinook DNA sampling to assess whether this is a separate run or straying individuals.							1		x									
Assess the use of Seton spawning channels by all species				1					x									
An evaluation and feasibility assessment of increased fish passage at Seton Dam. Any assessment must adhere to the Fish Passage Decision Framework.				1					x									
Assess the feasibility for channel habitat work in the Bridge River upstream of the Yalakom, to benefit multiple species	2								x									
Determine the extent of river run populations versus strays, by conducting a genetic study	2												x					
Assess opportunities to develop spawning platforms for steelhead, Chinook, coho and other species in the Seton mainstem.				2					x									
Sampling in Portage Creek in conjunction with Gates Creek to be done in partnership with N'Quatqua Band and St's't'im First Nation. Includes mark/capture project using rotary screw trap to determine population of out-migrating fry.						3	3		x									
Determine coho run in D'Arcy Creek.								3		x								
Develop an integrated habitat restoration plan for the Bridge-Seton system, and ensure compatibility with WUP implementation and monitoring. Proponent should discuss project scope with program staff before submitting a proposal.	3	3	3	3	3	3	3	3	x									
Assess benefits and costs of increased fish passage in the Bridge-Seton system (e.g., Yalakom River), and develop plans as necessary. Any assessment must adhere to the Fish Passage Decision Framework.	3	3	3	3	3	3	3	3	x									
Habitat Based Actions																		
Develop off channel sites to provide spawning and rearing habitat for coho, steelhead and other salmonids. Possible locations include Apple Springs and Horseshoe Bend.	1			3			3		x									
Gravel placement and maintenance for spawning. Potential locations include platforms in the lower Bridge River above the confluence of the Yalakom, areas upstream of Yalakom that were affected by a spill event in 1982, and Seton-Portage.	1			3		3	3		x									
Removal of a partial barrier on the Yalakom, 15km upstream of its confluence with the Bridge River. (Note that recent fires may have led to other watershed instabilities of perhaps other partial barrier problems.)	2									x								
Maintain and assess previously completed habitat enhancement projects (e.g., Seton spawning/rearing channels).	2	2	2	2	2	2	2	2	x									
Following assessment of pink salmon spawning channels undertake the advised enhancement work (e.g., additional complexing, riparian planting, maintenance of siphons, etc), first in the lower channel and then in the upper.				1						x								
Improve fish counter at Seton dam and coordinate efforts with Gates Creek fish counter. (Proponents are advised to contact FWCP staff and WLR before completing a proposal for this project since this project is being implemented by WLR as part of the WUP process.)					3					x								
Riparian planting in Portage Creek.						3				x								
Land Securement																		
There are possible opportunities where land securement may address fisheries management objectives.	2	2	2	2	2	2	2	2										
Monitoring & Evaluation																		
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	2	2	x									

4.3 UNSUPPORTABLE PROJECTS

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

- BC Hydro has implemented operational changes under the Bridge-Seton 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.

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