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FISH AND WILDLIFE  
COMPENSATION PROGRAM

# STAVE WATERSHED *RIPARIAN AND WETLANDS* *ACTION PLAN* FINAL DRAFT

The FWCP is a partnership of:

**BC**hydro   
FOR GENERATIONS



**Canada**



Fisheries and Oceans  
Canada

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OCTOBER 2011

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# Stave River Riparian and Wetlands 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 original 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 the 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).

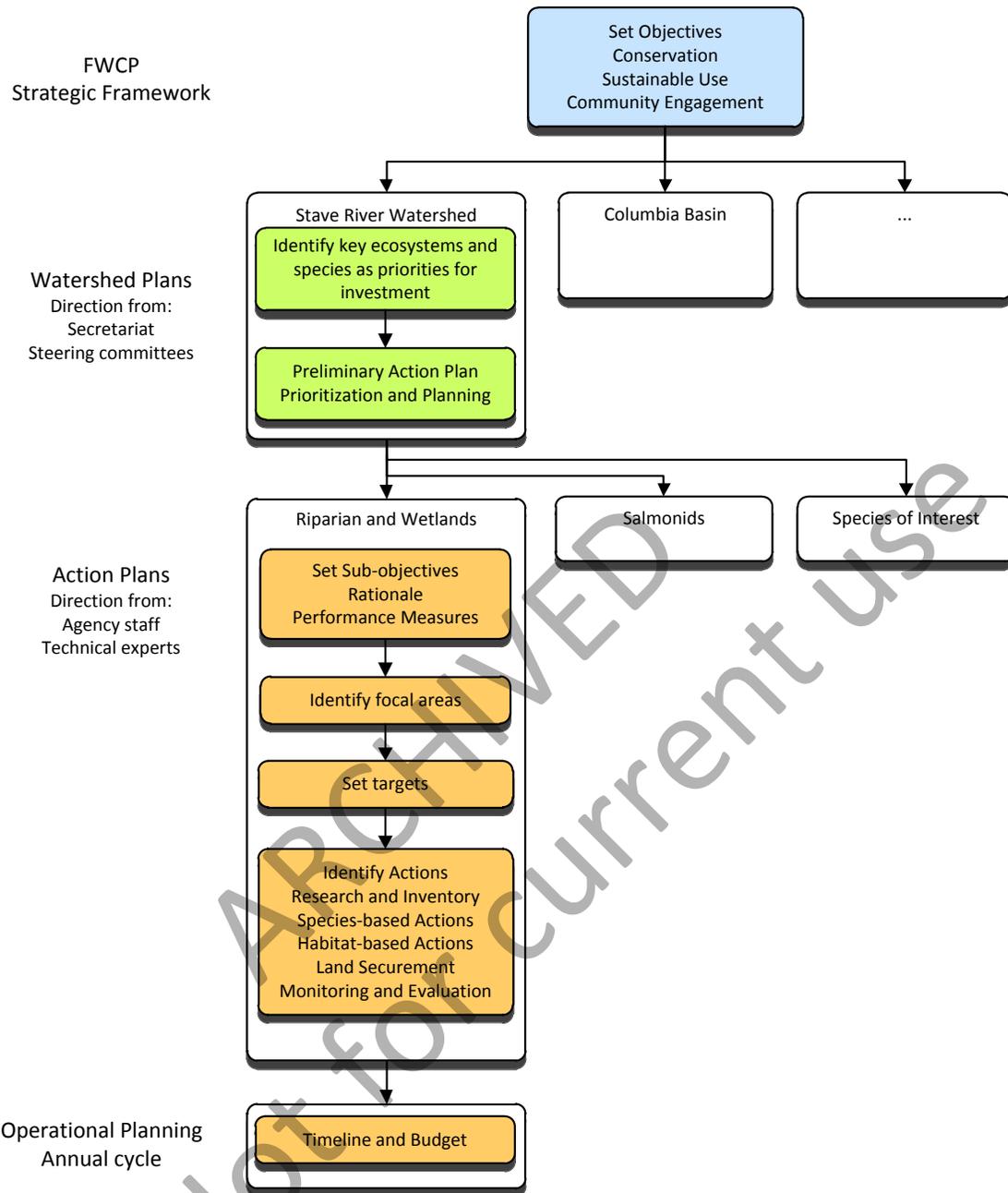
This Riparian and Wetlands Action Plan sets out priorities for the Fish and Wildlife Compensation Program to guide projects in the Stave River Watershed. The plan builds on the FWCP's strategic objectives and the Stave River Watershed Plan (FWCP, 2011). Action plans have also been developed for species of interest and salmonids; and some actions may be complementary across the different plans.

The actions and priorities outlined in this plan have been identified through a multi-stage process involving BC Hydro, Fisheries and Oceans Canada (DFO), Canadian Wildlife Service (CWS), Ministry of Environment (MOE), local First Nations, and local communities. Initial priorities were developed through consultation with agency staff. These priorities were then reviewed and discussed at a workshop<sup>1</sup> 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.

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<sup>1</sup> Mission, B.C. (27 March, 2009)

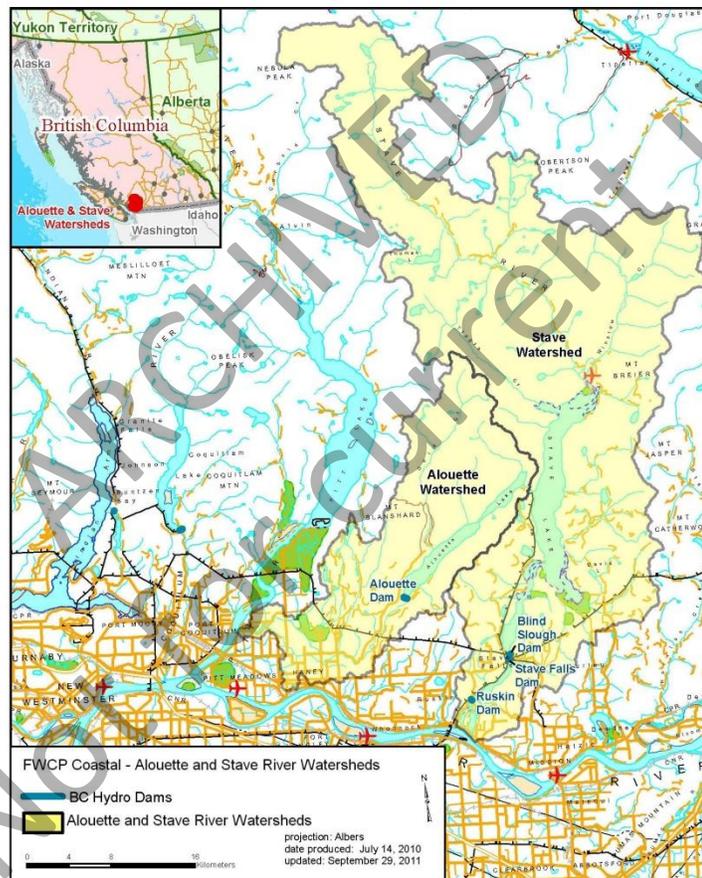


**Figure 1: Relationship between the Riparian and Wetlands Action Plan and higher level planning and objectives.**

## 2. OVERVIEW CONTEXT

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

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



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

The Alouette-Stave Falls-Ruskin generating complex includes four dams, a 1090 m long diversion tunnel and three powerhouses. About 94% of the annual inflow into Alouette Lake Reservoir is diverted into Stave Lake Reservoir through the diversion tunnel to the Alouette Generating Station on the shore of Stave Lake

Reservoir. At the south end of Stave Lake Reservoir are Blind Slough and Stave Falls dams, and Stave Falls Generating Station. Flows from Stave Falls Dam discharge into Hayward Reservoir. Outflow from Hayward Reservoir is controlled by Ruskin Dam, with power being generated at the Ruskin Generating Station. Water from Alouette Lake Reservoir is thus used for power generation at three separate generating stations.

## 2.1 IMPACTS AND THREATS

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

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

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

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

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

*Ruskin Dam and Upstream to Stave Falls.*

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

#### *Lower Stave River.*

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

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

## 2.2 LIMITING FACTORS

The limiting factors for wetland and riparian areas are predominantly related to extent of the available habitat, connectivity and distribution of the habitat, and its productivity.

### 1. Extent

The contribution of riparian and wetland habitats to broader ecological function is predominantly limited by the extent of the habitats on the land base. Habitats are lost through inundation and conversion to other land uses, and often detrimental fluctuations in water levels.

### 2. Distribution

Connectivity among riparian and wetland habitats, and between these habitats and other habitats and features, are important for dispersal of plants and animals and for seasonal movements of some species. Wetland and riparian habitats that are isolated will likely have decreased diversity to those which experience a healthy connectivity between areas. Distribution is therefore related not only to the extent of healthy riparian and wetland habitats, but also to adjacent land uses.

### 3. Productivity

Even where riparian and wetland habitats are adequately represented and connected, there are several factors that can affect their productivity:

- Hydrologic conditions such as water level variability and flow rates are among the most important variables driving riparian and wetland habitat development, structure, functioning and persistence (National Research Council 2001). Hydrologic conditions also influence the extent and distribution of habitats. For example reduced peak flows in a river, due to regulation, result in succession to upland habitat types. Also, Extreme fluctuations both in timing and extend, such as in a drawdown zone of reservoirs, can reduce the ability of plant communities to be established and thus the establishment of wetlands.
- Stressors such as invasive species or disruptive human access can affect community structure and function.
- Loss of specific habitat features can affect life requisites of specific species, e.g., dense nesting cover for waterfowl, suitable tree cavities for nesting owls or waterfowl, loafing sites to turtles.
- Poorly understood factors limit the productivity of created wetlands. These are generally thought to be related to unnatural hydrologic regimes, soil conditions, and/or cattle grazing (e.g., Atkinson et al. 2010).

## 2.3 TRENDS AND KNOWLEDGE STATUS

### HABITAT TRENDS

Basin-wide trends in the abundance, distribution and productivity of riparian and wetland habitats have not been compiled (other than direct BC Hydro footprint impacts). The area of inundation has not increased since dam construction, but the productivity of adjacent habitats has continued to be affected, either directly or indirectly as a result of BC Hydro operations.

In particular agricultural practices and urban encroachment has negatively affected wetland and riparian areas in the Lower Stave.

Significant changes include:

- Unknown loss of habitat from conversion to other land uses or succession to different habitat types; and,
- Deterioration in productivity from hydrology changes and stressors such as invasive species (canary grass is pervasive in the area).

Potential areas for wetland and riparian habitat restoration include:

- Silvermere Lake, the area adjacent to Fraser River (on the south side of Lougheed Highway) and the area east of Stave River.
- The tidal wetland adjacent to the Fraser (on the south side of Lougheed Highway, east of Sate River and Silvermere).
- Silverdale area and areas to the east of footprint areas
- Chester Creek.

Riparian and wetland habitat losses can be monitored via remote sensing, air photo interpretation or ground reconnaissance. Assessing deterioration in habitat productivity is more difficult.

### KNOWLEDGE GAPS

Some habitat mapping has been completed for species specific activities, including Red-legged frogs. There have been several potential areas noted, but in most cases there is limited knowledge regarding the abundance, location, quality and productivity of either riparian areas or wetlands in the Stave River Area.

### 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 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 riparian and wetland species and habitats. Complementary actions may also be identified in the separate Species of Interest Action Plan.

There are three general categories of riparian and wetland habitats defined for setting objectives:

<b>Category 1</b> Natural riparian or wetland habitat:	Largely intact ecosystems with natural disturbances sufficient to maintain subclimax communities and processes characteristics of wetlands and riparian ecosystems.
<b>Category 2</b> Disclimax or degraded wetland or riparian habitat, or creation of habitat	Formerly natural wetland or riparian ecosystems that have lost most or all of their natural disturbance regime and are no longer functioning effectively as wetland or riparian habitat. These areas are candidates for restoration or creation of wetlands.
<b>Category 3</b> Restored or created riparian or wetland habitat:	Ecosystems resulting from water impoundments, diversions or other artificial disturbances that require active management to maintain productivity and function.

The categories contrast different levels of ecosystem function that require different management approaches. Note that there are no category 3 wetlands in the Stave Watershed system at this time.

### 3.2 OBJECTIVES, MEASURES AND TARGETS

There are two riparian and wetlands management objectives for the Stave River system as a whole.

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

**Rationale** — This objective addresses overall ecosystem integrity and directs compensation activities to develop productive, useable habitats. Riparian and wetland areas have been heavily impacted by the creation of dams, and continue to be severely degraded in the remaining areas. They may be the limiting factor for many species, including fish, which depend upon them, either for the majority of their lifecycles or for key periods such breeding. Riparian and wetland areas are the most diverse and biologically rich terrestrial ecosystems in BC and are considered as highly valuable from an ecological standpoint. They are often critical in terms of maintaining function and structure for natural system, including helping to support trophic level functioning, genetic diversity, as well as providing key ecological services such as erosion control, flood control and assimilation of nutrients.

To date, FWCP has not significantly funded restoration of riparian areas or wetlands in the Stave watershed. However, these areas have a high restoration potential and would benefit from restoration activities.

This objective is supported by three sub-objectives:

***Sub-objective 1: Secure remaining Category 1 riparian and wetland habitat.***

**Rationale** — Wetland and riparian areas can be heavily impacted by conversion to other lands uses, such as agriculture development or forestry, amongst others. Securing remaining habitat to prevent loss is very important. Habitat is considered secure if it is protected from conversion to other land use, for example by purchasing the land or negotiating a covenant agreement.

As opportunities in the Stave system may be limited, consideration could also be given to secure off-site category 1 wetlands that would help compensate losses in the Stave system. In dollar terms and effort there may be more effective opportunities off-site to provide compensation for habitat losses.

**Measure** — Hectares (or percentage) of Category 1 riparian and wetland habitat secured or conserved over a 5 year period.

**Targets** — Specific targets will be developed as part of the action plan implementation as current areas are not known.

***Sub-objective 2: Reduce threats to Category 1 riparian and wetland habitat.***

**Rationale** — Wetlands and riparian areas are subject to a variety of threats both internally and externally. Many naturally functioning riparian and wetland habitats (Category 1) can benefit from management actions that reduce specific threats (e.g., treatment for invasive species, access control, forestry in adjacent areas etc.).

**Measure** — Hectares (or percentage) of Category 1 riparian and wetland habitat improved annually.

**Targets** — Specific targets will be developed as part of the action plan implementation as current areas are not known.

***Sub-objective 3: Restore degraded or create new riparian and wetland habitat (Category 2).***

**Rationale** — While conservation of existing high quality habitat is always preferable, category 1 habitat may be limited or the opportunities for conservation are difficult. Restoration opportunities may be more available in areas where changes in water regime have altered successional pathways in pre-existing riparian and wetland ecosystems. Typically the regime in managed watersheds becomes more stable. Riparian and wetland ecosystems require the disturbances caused by fluctuating water levels to maintain their productivity. When these disturbances are reduced or eliminated, riparian and wetland ecosystems transition to other ecosystem types. Projects can be designed to restore the

original ecological function of these areas, or to create new riparian or wetland habitats that differ from what was present historically, but still represent an improvement in function.

**Measures** — Hectares of riparian and wetland habitat that are restored or created over 5 year period.

**Targets** — Specific targets will be developed as part of the action plan implementation as current areas are not known.

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

**Rationale** — Many wetland and riparian species are the focus of sustainable use activities by First Nations and non-first nations people. For example some riparian and wetland dependant species are hunted, while bird and wildlife viewing is also a popular recreational use in the watershed. 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 for sustainable use activities could be identified by the program partners in the future.

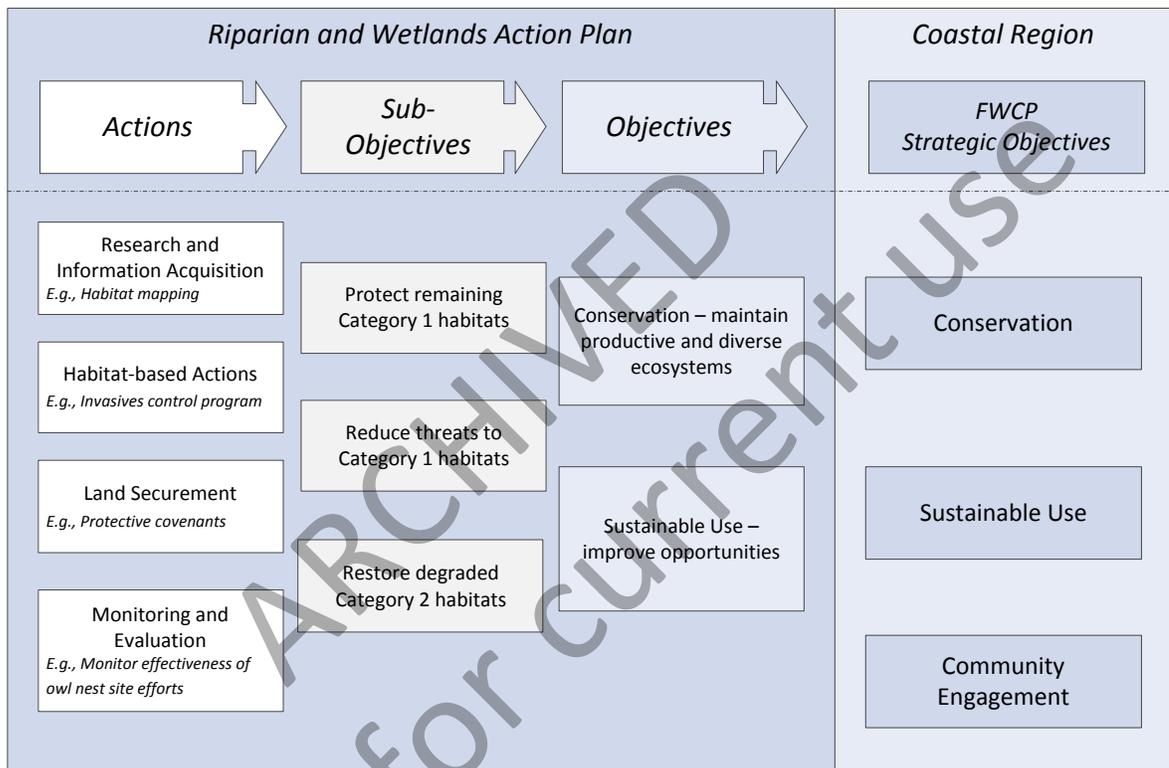
**Measures and Targets** — There are no specific measures or targets required at this time aside from those associated with the above objectives.

As part of their overall management responsibilities, MOE periodically collects information regarding abundance trends, hunter reports, catch per unit effort (CPUE) and number of hunting licences sold in the region.

## 4. ACTION PLAN

### 4.1 OVERVIEW

The Action Plan has several 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 Riparian and Wetlands Action Plan and the FWCP strategic objectives in the Stave River Watershed Plan.**

### 4.2 COMPONENTS

This section presents the main actions identified for riparian and wetland areas in the Stave River system along with the supporting rationale for why the action is required and what it will achieve (Table 1 below). Currently, there is a dearth of information regarding the extent and distribution of wetlands and riparian areas, as well as the specific species which may utilise them in the Stave River watershed. Consequently, the initial focus of this action plan is solely on research and information acquisition. At such time as enough information is collected, the action plan should be revisited and updated with opportunities for habitat-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.

**Table 1: Actions for wetlands and riparian areas in the Stave River Watershed**

#	Action	Rationale	Priority
Research and information acquisition			
1	Conduct mapping to determine abundance, distribution, and category of riparian and wetland habitat,	<p>Riparian and wetland habitat is poorly mapped throughout the basin and developing a habitat map is necessary to establish targets for securement and compensation. Focus should be given to:</p> <ul style="list-style-type: none"> <li>• Silvermere Lake, the area adjacent to Fraser River (on the south side of Lougheed Highway) and the area east of Stave River.</li> <li>• The tidal wetland adjacent to the Fraser (on the south side of Lougheed Highway, east of Sate River and Silvermere).</li> <li>• Silverdale area and areas to the east of footprint areas</li> <li>• Chester Creek.</li> </ul>	1
2	Identify opportunities to secure category 1 areas in the Stave system.	Once Category 1 areas have been identified, coherent plans need to be made to secure them. Legal status of different lands must be known to determine appropriate actions for protection.	2
3	Identify opportunities to secure off-site category 1 areas.	There may be more cost effective opportunities off-site.	3
4	Determine threats and potential mitigation strategies to improve category 1 areas	There may be potential threats reducing category 1 area productivity	2
5	Identify opportunities for restoration or creation of category 2 areas.	The Stave River has been highly regulated and there is likely potential for restoration of degraded areas.	2

#	Action	Rationale	Priority
Habitat-based actions			
6	Implement riparian and wetland restoration projects that are identified as high priorities through inventory, mapping or assessment.	Primary target is Category 2 areas.	2
Land securement			
Monitoring and adaptive management			

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