AN ADAPTIVE SCIENCE STRATEGY FOR THE COLUMBIA WETLANDS SYSTEM.

By: Science Committee
Columbia Wetlands Stewardship Partners

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EXECUTIVE SUMMARY

The objective of this document is to lay out a coordinated approach to science and monitoring for the Columbia Wetlands system. It is organized around three objectives and areas of action. These are the maintenance of the functional processes that drive the productivity of the river and wetland system, the maintenance of habitat quality and the maintenance of biodiversity. In each area we reviewed the critical factors involved, reviewed previous work, identified the present status of our knowledge and identified objectives and actions for future science and monitoring. A work plan and priorities for the next five years, based on this assessment is presented. This document will assist the Columbia Wetland Stewardship Partners is making long term decisions on the allocation of funds and time on science and monitoring concerns related to the management of the wetlands.

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1.0 INTRODUCTION

As part of overall management strategy for the Columbia Wetlands, the Science Committee of the Columbia Wetlands Stewardship Partners was asked to develop a ten year strategy for monitoring, inventory and science in the Columbia Wetlands system.

The Upper Columbia wetland/river floodplain system is a 180 km long complex that is unique to B.C. and uncommon in Western Canada and the world. The wetlands system is identified under the international RAMSAR treaty in recognition of this uniqueness. It is the largest intact floodplain river and wetland system in B.C. Many other similar systems have been seriously compromised due to human actions over the last century. The Bonner's Ferry to Creston floodplain system on the Kootenay River, the Peace Athabasca system on the Peace River and the Le Pas delta on the Saskatchewan River system are examples of similar systems in Canada; the Niger River delta in West Africa, the wetlands on the Euphrates and Tigris rivers in Iraq, and the Mekong and other river deltas in Asia are international examples. Multi-million dollar programs have been initiated in many of these areas to restore river and wetland systems processes (Bonners Ferry, the Danube and Tigris/Euphrates) in these systems. It would be money well spent to maintain this system before it is seriously compromised. To do so we have to understand the system.

The wetlands are primarily provincial lands in a Wildlife Management Area, smaller areas in a National Wildlife Area, some Provincial Park lands and some private land extending into the wetlands. A unique community of support for the wetlands has evolved in recent years. (See www.columbiawetlands.org). The objective of this paper is to provide solid science to assist the Wetland Partners in their deliberations.

There are a variety of perceived threats to the wetlands, the major of which are:

- Concern over potential decreasing water availability for the upper portion of the wetlands. Water demands for recreational home development in the Fairmont, Invermere and Radium Hot Springs area, at the top end of the wetland complex, is greatest where flows are relatively small.
- Increasing settlement along the wetlands and resultant impacts throughout the length of the river and wetlands.
- The loss of late season glacial flows, altered winter flow regimes, setback in peak flows, and an increase in major flood events as a result of climate change. (Mott and others 1999).

- Water quality issues related to ranches and cattle feeding, log mills, railway spills, farmsteads and communities.
- The loss of several important wetland species (salmon, steelhead, leopard frogs) and declines in other important species (swans).
- The invasion of alien species, many of which have entered aquatic and wetland systems in nearby watersheds in both Canada or the north west United States.

The wetlands presently operate in a close to natural manner. However, to date, we have lost three important river and wetland species, i.e. the Columbia River Chinook salmon and Columbia River Steelhead due to dam construction downstream and the Northern Leopard Frog, due to some combination of disease and habitat alteration across its range in Western Canada.

Relatively little academic science is available in this area since the wetlands are distant from major universities and funding opportunities are limited. This problem is compounded by the minimal management presence on the part of federal and provincial resource agencies in this area and system. This is balanced to some degree by support for the wetlands systems and its management by local communities, as expressed in the formation of the Columbia Wetlands Stewardship Partners.

Management actions to date have occurred as a result of concerns raised by people in the area, the availability of funding for specific projects and historic concerns that have been brought to the group. Discussions around these issues have been informed by science, but without any overall plan or direction. An overview of the projects initiated to date is provided in Appendix I.

2.0 GOALS AND OBJECTIVES

The vision statement of the Columbia Wetland Stewardship Partners is:

> "The Upper Columbia River and the adjacent Columbia Wetlands will continue to function as a healthy flood-plain ecosystem with a complex biological community governed by natural fluvial and ecological processes. Human communities will continue to benefit socially, environmentally and economically from this naturally functioning ecosystem and in turn the wetlands will contribute to the health and vitality of the communities in the upper Columbia River Basin. Residents in these communities will become engaged and motivated to adopt a stewardship ethic and will work collectively to demonstrate the benefits of a shared stewardship model for this important resource".

The primary objectives of the Columbia Wetland Stewardship Partners and the responsible agencies is to maintain the functional processes that drive the system, all the present habitat elements in the system and the entire range of historically present species in the wetlands and the river system. **The role of the Science Committee is to provide the best possible science to inform decisions made by the wetlands group,** in concert with the various agencies, concerning the long term maintenance of the wetland system. The challenge is to do so in the

face of minimal funding for research and staff. Actions to date by the science committee have been ad hoc responses to issues. In the future we would like to identify priorities and address issues on the basis of an overarching view of issues in the wetlands, as provided here.

The specific overall objectives are to:

- **Maintain System Function**
- **Maintain Habitat Quality**
- **Maintain Biodiversity in the system**

In addition, we need to develop a strategy for responding to issues as they arise and develop strategies for the inclusion of traditional and local knowledge into our understanding of issues and processes. It is also important for the CWSP and agencies to have a knowledge of the natural range of variation of natural processes, so that they can detect changes that may be affecting the ecosystem, especially those changes that can be influenced by management actions.

3.0 APPROACH

This is a very complex aquatic/terrestrial system with multiple factors driving the system. Our discussion of these factors is approached as below.

For each objective we have discussed:

1. The critical factors in the system related to system function, habitat quality and the maintenance of biodiversity.
2. Prior work completed in each area of concern.
3. The present status of science related to each area of concern.
4. Objectives for adaptive science in each area of concern.
5. Proposed actions.

In each case we have attempted to identify clear action items (identified with red font).

4.0 AREAS OF ACTION

4.1. MAINTAIN SYSTEM FUNCTION

The critical process driving the system are:

- Geomorphological processes of ongoing sediment erosion and deposition.
- Climate, especially in terms of how it drives water flows and vegetation development.
- Hydrology, which drives the annual hydrograph and spring freshette, upon which the wetlands depend.
- Nutrient levels and flows downstream, through erosion, and transport of nutrients back upstream by kokanee and other fish.
- Fire, as a periodic disturbance event in the wetlands.
- Beaver activity as an agent for vegetation change in riparian areas and as an agent of change in levee breaks.
- Muskrat as an agent of vegetation change in the wetlands.

Prior work

Dr. Derald Smith (Univ. of Calgary) and Dr. Bart Makaske (Univ. of Utrecht) have had a series of graduate students researching post glacial sedimentation and geomorphic process in the wetlands for over two decades. Bonneville Power Corporation commissioned extensive work on climate change impacts on the entire Columbia Basin that provides a good overview of climate shift implications for the landscape and for the watershed (Mott 1999, Hamlett and Lettenmaier 1999). A recent report (MacDonald and Berzins, 2009) has reviewed the available climate, water flow, water quality, groundwater data, relative to climate change, for the Upper Columbia watershed. Oliver 1995 reviewed the available water quality to that date. Wildsight, a local NGO, has carried out a water quality monitoring program on Windermere Lake for the last five years. Chris Carli, a graduate student working with Dr. Suzanne Bayley of the Univ. of Alberta will be competing a thesis on the impact of levee breaks on wetland health in April 2011.

Present Status

Climate is reasonably well monitored at lower elevations but there are a lack of stations at higher elevations in the watershed (MacDonald and Berzins 2009). Water flows are poorly monitored in the system, with presently operating stations located well downstream in the wetlands (Nicholson Bridge) and on the major tributaries in the lower end of the system, for BC Hydro's purposes. Water quality monitoring has been maintained over time at only one site (Nicholson Bridge). The best present data of water quality is for Windermere Lake, with some data associated with municipal sewage operations. There is little information on ground water dynamics in the system overall, with some work in the Invermere and Athalmere areas (MacDonald and Berzins 2009). Nutrient flows, and the role of fire, beaver and muskrat impacts on the system have not been worked on.

Objectives for understanding system process
We need to:

- Develop a better understanding of the critical geomorphic and hydrologic processes that drive the system.
- Identify potential alterations to process that may result from climate change.
- Identify actions around water management that will allow us to maintain the spring freshette and natural flows to maintain the wetlands.
- Identify specific fish and wildlife species (beaver, muskrat, kokanee) that play a critical role in to maintaining functional processes in the system by altering habitat elements within the system or contributing to nutrient flows.

Potential Actions:

1. Improve our knowledge of long term geomorphic processes.
Action: Encourage further work by students and university researchers.

2. Improve our understanding of climate issues, water flows and water quality.
In this watershed, our understanding is limited by the lack of monitoring data. Recent work by the Canadian Rockies Snow and Ice Initiative is attempting to address this weakness for the Rockies portion of the basin. This group is also looking at the issue of glacial ice storage, the loss of glacial mass and its impact on river hydrographs in the Rockies. Discussions have taken place with BC Hydro and provincial representatives to look at options for improving monitoring on watersheds such as Dutch Creek and Toby Creek at the upper end of the watershed. Several groups, including municipalities need to play a larger role in advocating for better monitoring. Wildsight's program of monitoring water quality is being expanded, subject to funding, to sites upstream of Windermere Lake, potentially Columbia Lake and sites along the Columbia River in the wetlands.

Action: Maintain a watching brief on these issues. In the future the Wetland Partners should participate in a community driven exercise to identify minimal flow requirements for the wetland system, especially in the upper end of the system. This would involve developing management objectives primarily for the Dutch Creek, Toby Creek and Horsethief Creek drainages which are the major contributors to flows to the upper portion of the Columbia wetlands system.

3. Improve our knowledge of impacts of fire on the wetland system.
Although there have been few fires in the wetlands in recent years, fire has played a major role in the wetlands in previous decades. We need to develop a better understanding of the role of fire in such systems and need to map previous fires where they can be detected now.

Action: Encourage a student to take on this issue as a thesis topic (see Habitat Section). This could include interviews with older residents along the system, and with BC Vorest Service staff, to identify those portions of the wetland system that have been burned int eh past.

4. Improve our knowledge of impacts of beaver and muskrat activities on functional processes in the wetland system.
These species can have a major impact on habitat elements in the wetlands and on basic process in the wetland system. The more specific elements of these processes are discussed in the following sections.

Action: Encourage a student to take on this issue as a thesis topic. (See Habitat Section).

5. Improve our knowledge of nutrient cycling in the wetland system.
The productivity of the river system and the wetlands was maintained in pre-settlement times by inputs of organic nitrogen, potassium and other nutrients in the form of salmon carcasses. These inputs began to decline in the early 1900s when overfishing lower in the system reduced salmon numbers on the spawning beds and ended in 1937 when Grand Coulee dam was built and runs into the upper end of the Columbia system came to an end. Historic references suggest that several hundred thousand large Chinook salmon (and Steelhead perhaps) made it up to the wetlands area to spawn (Green 1995). This input of oceanic nutrients was an important part of the nutrient cycling in the river in the pre-settlement era. However, the nutrients that originally flowed downstream into the lower system are now trapped in the Mica Reservoir and as a result, a significant kokanee salmon population of 700,000 to 1 million fish (Oliver 1995) has established itself, based on the nutrients trapped in the Mica Reservoir. This has, to a minor degree, re-started this nutrient pump in the upper system, bringing nutrients, in the form of kokanee salmon carcasses, (much smaller fish than the original salmon), back to the spawning beds in the upper portion of the river.

Action: Encourage a student to consider a review of the loss of nutrient flow due to the loss of salmon in the system as a thesis topic.

6. Improve our knowledge of carbon sequestration and methane release processes in this wetland system.
There is little information available on these issues for this system or for floodplain wetland systems in general. The focus of work in this area, in Canada, is on peat bogs and wetlands in the boreal zone and in tropical wetland systems. Discussions with R. Dalon and others would suggest that there are few options for involving wetland conservation in the West Coast carbon trading scheme that is evolving.

Action: Encourage a student to look at the issue of carbon and methane flux in floodplain wetland systems and review the options provided by the West Coast carbon credit scheme, for wetlands.

OBJECTIVE 2. MAINTAIN HABITAT QUALITY

There are several habitat types present in the system. The most important of these habitats are:

- The Columbia River and its' channels, with a silt or sand river bed.
- The major tributary streams generally with low gradients in the floodplain, with a gravel river bed.
- The two large lakes in the system, Columbia and Windermere Lakes.
- Several open water lakes and ponds in the wetlands.
- Several thousand marshes, spanning a gradient of large to small annual hydrologic inputs from the main river. On one end of the gradient are those that are flooded fully by the river every year, while on the other end of the gradient are those that are "perched" above the river flooding and are seldom flooded by the river. Most marshes fall between these extremes and are flooded at different levels depending on channel connections and levee heights.
- Shrub thickets and sedge meadow areas.
- Levees along the main river channels with a mix of deciduous forests and shrubs
- Mixed forest types on the alluvial fans along the edge of the wetlands.

All of these various habitat types support very different vegetative communities and faunal communities. And each have been affected by human activities in different ways. It is important to note that what we see today is not an "unaltered natural" system, but a system that has evolved from a system that was heavily altered by human actions early in the century when the main channel was dredged to allow the use of the river by sternwheeler boats that were the main mode of access up and down the valley in that era.

Prior work

Very little work has been done on habitat elements within the wetlands. The best habitat work to date was completed in 1978 (Pelology Consultants 1978), using air photo interpretation, as part of the data collection for the proposed Kootenay Diversion project. Provincial habitat and forest type mapping is also available for most of the area. The Columbia Valley Greenways Alliance commissioned an overview of the mapping and data available in 2004 (Worgan, 2004). Concerns over the status of cottonwoods on the levees resulted in a short study on cottonwood status (Ohanjanian and Teske 2001). Background science on floodplain and willow/cottonwood systems is available for several similar systems (Jamieson and Braatne 2001, Jamieson et al. 2001). Fisheries habitat surveys have been completed on several tributaries but little work has been done on the main stem.

Present Status

Most of the aquatic habitats in the system seem to be in good condition, as expressed by the healthy fish populations in the river. The large lakes in the system are of concern. A report on water quality issues in Windermere Lake was recently completed. Planning for the foreshore has been developed over the last few years by the EK Integrated Lake Management Partnership. Concerns have been raised about the impacts on breaks in the river levees on adjacent wetlands. Dr. S. Bayley and her student, Chris Carli, are working on this issue. Chris Carli (MSc student of Dr. Suzanne Bayley) is mapping eight vegetation zones in the region from Invermere to Nicholson and determining the change in vegeation from 1946 to 2004. He is also identifying

and quantifying the abundance of species in the open water areas to determine the natural range of variation in plant communities in the system and the impacts of human activities on the vegetation communities. Most wetland habitats appear to be in good condition at present, but we have no data to support that supposition. There is an apparent loss of cottonwood and lack of recruitment of cottonwood on the river levees in many parts of the system. This is a complex issue that relates to the history of the system and the impact of beaver on cottonwood trees. There are several alluvial fans adjacent to the system that support stands of cottonwood and conifers, these areas also face problems from development and grazing, in addition to the impacts of beaver and other natural processes. Cottonwood dominated vegetation types are listed as a vegetation type of concern provincially.

There are serious concerns relative to invasive species in the system. The Wetland Partners have helped to support an inventory and control program that is being carried out by Wildsight Golden (a local NGO) and other agencies.

Objectives for understanding habitat issues
We need to:

- Develop a better understanding of the critical processes that drive habitat presence and their quality as wildlife and fisheries habitat.
- Identify actions around habitat management that will allow us to maintain the present mix of habitat types in the wetlands.
- Identify potential alterations to habitat that may result from climate change.
- Document the status specific fish and wildlife species that are critical to maintaining habitat (beaver, muskrat, kokanee).

Potential Actions

1. Habitat Inventory
An overview of the kinds of habitat types that occur, and a summary of the area of each type is needed.

Action: Complete a survey of habitat types for the entire wetlands, using scanned air photos. Focus especially on the areas south of Invermere and north of Nicholson since these regions were not included in the current mapping being completed by Chris Carli and Dr. Suzanne Bayley.

2. Ongoing monitoring
Effective scientific monitoring of habitat is difficult and expensive in such a complex system.

Action: We have budgeted for a simple photo plot survey approach that is in it's first stage in 2010. Further work will be carried out in future years.

3. Invasive plants and animals
Invasive species alter habitat and compete with native species. To date the Wildsight invasive plants program have attempted to deal with terrestrial invasive plants along the river and wetlands, and have surveyed several areas for aquatic invasive plants and didimo, or "rock snot", an invasive diatom that is causing concerns in nearby watersheds. Two non-native fish species occur, small-mouthed bass and sunfish. Rainbow are a native species in this system and kokanee are generally seen as a major positive for the system. There are no known invasive mammals or invertebrates, though the information on the latter is close to non-existent.

Action: We should carry out a review of the potential for other invasive species to enter the wetlands system. Tamarisk, an invasive shrub that is used as an ornamental plant in gardens, a crayfish species, a water flea species and others have been identified as species of potential concern in nearby watersheds. This "threat analysis" could be carried out for the wetlands area, or for the East Kootenay region (Upper Columbia and Upper Kootenay drainages).

Action: We have budgeted in 2010/11 to continue to monitor and control invasive weeds in the system.
Issues related to non-native fish are addressed in the next section.

4. Identify habitat corridor issues.
Development in the Canal Flats to Edgewater area is limiting options for wildlife to move up and down the river and wetland system and, for terrestrial species, east to west across the valley from the mountain blocks on either side. There are major impediments to movement up and downstream for species such as otter and painted turtle. These occur at Athalmere, along the shoreline of Windermere Lake, in the narrow riparian corridor in the Riverside Golf Course at Fairmont; and between the Kootenay River and Columbia Lake near Canal Flats (Adams, 2010). The East Kootenay Integrated Lake Management Partnership has developed foreshore guidelines for the two major lakes that will provide some benefits to the movement of animals along the shores of the two lakes. The town of Canal Flats is moving to protect the area along the Baillie Grohman Canal as a National Historic Site. The Athalmere area faces intense development pressure and the riparian corridor is now restricted to a narrow band along the river.

Action: We will continue to work Parks Canada and others to identify issue areas and corridor options.

5. Potential climate change impacts on habitat.
Shifting climate conditions may alter river and wetland temperature and thus growing conditions in the system. There are indications that glaciers are in retreat in the watershed, which may have a significant impact on late season flows in the river and thus on levels in many of the wetlands that are connected to the river. The Wetland Partners have participated in a joint project looking at presently available climate, water flow and water quality data.

Action: The Columbia Wetland Stewardship Partners will continue to work with others groups and agencies on this issue since we do not have the resources alone to deal with this very large and complex problem.

6. Levee Process

A project to identify the human impacts on levees in the system is underway and should report next year. Based on this work, we will then need to craft decisions around how we may attempt to restore "perched" wetlands.

Action: The next step should be an inventory that identifies perched and annually drained wetlands throughout the wetland system (as part of action on item 1 above).

7. Changes in cottonwood stands on the levees and alluvial fans along the edge of the wetlands.

The loss of cottonwoods along levees in the Brisco and Spillimacheen areas is of concern to local people. Air photos are not available in sufficient resolution prior to 1948 to document changes over time, except perhaps to show gross changes on some of the larger alluvial fans such as occurs at Nicholson. Any review of the status of cottonwood stands would need to include private lands since the largest stands are on the alluvial fans, most of which are private.

Action: Develop an assessment using historic air photos (1948, 1975, 2004) of cottonwood stands and vegetation on alluvial fans and some reaches with well established levees.

8. Impact of fire

Action: In the long term, the Wetland Partners should consider doing a survey of fire records for the wetlands, as indicated in the previous section.

9. Impact of beaver on levee vegetation and on alluvial fans

There is evidence that beaver have had a major impact on levee vegetation, primarily cottonwood stands. They may contribute to breaks in the levees when they build lodges and feeding channels through the levees. In the first part of the 20th century beaver were trapped for a pelt that has significant value in that era. Their pelts are no longer worth enough to justify trapping except as a recreational pursuit for some trappers.

Action: A review of old trapping records and discussions with old timers may be of value to identify trends in beaver numbers in the wetlands.

10. Impact of muskrats in the wetlands

Several long time residents have identified the fact that muskrats go though population cycles, with huge numbers of muskrats in some decades in the past. They feed on emergent vegetation and use them to build their "pushups" and may have an impact on emergent stands in the wetlands, as has been documented elsewhere.

Action: A review of old trapping records and discussions with old timers may be of value to identify trends in muskrat numbers in the wetlands.

11. Listed plant communities
Several plant communities that occur in the wetlands are listed provincially (willow-sedge systems, low elevation western red cedar stands).

Action: The status of these communities should be reviewed in the future (as part of a project looking at listed plant species identified below).

OBJECTIVE 3. MAINTAIN BIODIVERSITY

The complexity of habitats found in the wetlands support a very wide range of species, from grizzly bears to dragonflies, all of which depend on the maintenance of system function and habitat quality, as described above.

Prior Work
Overviews of species at risk have been completed by Jamieson and Ohanjanian (1993) for the East Kootenay, by B. Ferguson (2004) for forest lands in the Upper Columbia Basin and by Jamieson et al. 2009, for the Shuswap Reserve lands adjacent to the wetlands. The Wetland Partners applied in 2009/10 for funding to do an overview of species at risk for the wetlands, through the SAR Habitat Fund, but the project was not funded. Species specific inventories have been completed for a large number of species (See Appendix III). A short review is provided below.

1. Mammals
There are no listed mammal species in the system that are wetland dependent. Otter comes to mind as being of concern, but the presence of several native fish and kokanee have made the system very attractive to this species and they are often seen up and down the system. Several large predators, some of which are listed, use the wetlands as part of their larger home ranges. We have little information on bat species or other small mammals but it would appear that the entire range of large mammals that occurred pre-settlement still occurs in the system. There are several hunted populations of ungulates and predators in the wetlands and associated areas.

2. Birds
There are several bird species that are listed, federally or provincially, that use the wetlands, either seasonally or for nesting. The system is in good condition and none of these species are of local concern. Bittern, Great Blue Heron, osprey and eagles have been the subject of ongoing inventory (Machmer 2008) One species, the Trumpeter Swan, nested in the wetlands until recent decades and is of some concern locally. White pelicans have been observed in the wetlands but do not appear to nest here. Canadian geese are a local problem in terms of grazing on hay fields. Geese and ducks are hunted in the wetlands.

3. Fish
Bull trout and West slope Cutthroat trout are presently listed fish species. Bull trout are doing well in the system due to the presence of the kokanee run and the downstream lake habitat provided by the Kinbasket reservoir. Cutthroat trout occur and there are some concerns about cross breeding between this species and rainbow trout. Sturgeon have been observed in the system in the past and are the subject of a survey by the Columbia Kootenay Intertribal Fisheries Commission in 2009. Burbot are also of concern in the system (Prince 2007). Columbia river Chinook salmon to 50 lbs. occurred in the river until 1937, along with Columbia River steelhead (Green 1995). Neither of these species is officially listed, which is a major oversight. They spawned in several places in the wetlands portion of the Upper Columbia. There is an active First Nations initiative to return salmon to the lower portion of the system (Wanneta to Keenleyside). Rainbow trout, bull trout, cuttrout trout and whitefish provide fishing opportunities in the wetlands. We have little information on the presence or abundance of non-game fish. Bass and pumpkin seed/sunfish now occur in the system, as a result of introductions.

4. Reptiles and amphibians
The Northern leopard frog is listed as an endangered species for this area. Recent surveys have not found any evidence of recent presence (P. Ohanjanian, pers. comm.). Work is underway to identify habitat that could support this species if it is re-introduced to the wetlands system. The western painted turtle is present in the wetlands are far north as Spillimacheen. The Western Toad is listed as of special concern. We have little information on other frogs, salamanders and snakes (see Jamieson 2009).

5. Freshwater Mussels
A short survey was carried out of these species in 2008 in the Upper Kootenay and Columbia watersheds by the Conservation Data Centre (Gelling et al. 2008). No listed species were found, but mussels do occur in Columbia and Windermere Lakes.

6. Insects
Very little is known about the insect fauna in this area, though the complex of habitats provided by the wetland system likely have very high insect diversity (See Jamieson et al. 2001). A survey of dragon flies was carried out by the Royal BC Museum in 2000 (Cannings et al. 2000). Several sites in the wetlands were sampled. Recently there has been interest in identifying the habitat requirements of fire flys; a survey is being carried out in 2010.

7. Plants
Surveys for listed species have been completed in the surrounding bench lands by the BC Forest Service, Range Division. However, there is very little data on the plant communities and plant species at risk in the wetlands. There are legal requirements for agencies to document and protect these species, so better information is required.

Objectives for maintaining biodiversity
We need to:

- Identify species at risk and of concern.
- Identify species that are not listed but may become of concern in the future.

- Identify long term monitoring that is required for maintaining species.
- Maintain hunted species and species that play an important functional role in the system.

Action required

1. Maintain individual species by maintaining ecosystem processes and habitat.
The primary objective in the management of this system should be the maintenance of effective ecosystem process such that habitat quality is maintained. A focus on this element of management is likely the best tool for retaining listed species and keeping other species from being listed and/or becoming a concern in this system.

Action: Focus on understanding and maintaining critical ecosystem function in the wetlands.

2. Support the re-introduction of Northern Leopard frog.
The Columbia wetlands are the single largest wetland complex in the Kootenays and in southern B.C. Re-establishing leopard frog in this system would substantially increase the health and viability of leopard frog populations in the province. A project is in underway (2010) to identify the best potential habitat for re-introductions when they become feasible. There are major concerns around the viability of the present populations at Creston and the small introduced population at Bummer's Flats.

Action: The decision to attempt further re-introductions will be made by the Recovery Team. The Columbia Wetland Stewardship Partners will assist with any proposed re-introductions.

3. Support salmon recovery.
The major objective should be to maintain habitat quality in the major historic salmon spawning areas. It would appear that the major spawning areas for kokanee are the same sites used historically by salmon.

Action: The Partners and other players need to identify realistic options for recovery, likely on a 50-100 year time frame.

6. Support ongoing monitoring of Great Blue heron, Canada goose, bald eagle and osprey.
The Compensation Program has had an ongoing program monitoring these species and issues around nesting site competition and predation (M. Machmer, 2008).

Action: The Partners should support the continuation of these projects.

7. Monitor Swans and bittern, and pelicans.
The Compensation Program has monitored Bittern populations in the past. Locals have identified a concern with Trumpeter Swan, which nested in the wetlands until about 20 years ago. Pelicans

use the wetlands during migration and may at some point begin to nest here. The primary objective should be to maintain quality habitat for these species.

Action: Monitoring should also be considered for these species.

8. Monitor waterfowl.
Monitoring of waterfowl is the responsibility of the Canadian Wildlife Service. They have done annual surveys for many years in the wetlands.

Action: The Partners should encourage the Canadian Wildlife Service to continue this monitoring in this area and should encourage the release of the data to the public.

9. Monitor Hunted species.
Monitoring of large ungulates and predators is the responsibility of Wildlife Branch.

Action: The Partners should encourage the Wildlife Branch to establish better monitoring in this area.

10. Non-game fish survey.
Nongame fish provide a food source for osprey, eagles, and otter. Their status in the wetlands and their use of seasonal wetlands connected to the river is very poorly known. Some knowledge of the status of these species is needed if we are to understand how they will react to temperature and hydrograph changes that may occur as a result of climate change.

Action: An inventory of these species should be carried out in the next five year period.

11. Survey of introduced warm water species.

Action: At some point in the next decade a survey of bass and sunfish should be carried out, as a follow-up to work completed in 1994 (Griffith 1994, 1994a).

12. Amphibians and reptiles.

Action: The Partners should support the proposed Compensation Program survey for these species proposed for the next fiscal year.

13. Freshwater Mussels.
Surveys completed two years ago indicated that there are significant freshwater mussel beds in Columbia and Invermere Lakes. These species are sensitive to water quality issues.

Action: Consideration should be given to mapping the present extent of the mussel beds and maintaining a watching brief on the status of these beds. This may best be accomplished as part of the ongoing water quality monitoring program of the Lake Windermere Project.

14. Fire fly project
Several sites that support fire flys were surveyed in 2010.

Action: A more detailed inventory of these species should be carried out in the next five year period.

15. Invertebrate Survey.
We know very little about insect populations in the wetlands, as described above.

Action: A survey of insects present in the wetlands system is required at some point in the future.

16. Listed Plants and Plant Communities

Action: A survey of listed plants and plant communities is required in the future, if and when funded.

5.0 WORK PLAN AND PRIORITIES

These action items have been identified in a five year work plan, as indicated below in Tables 1 to 3.

Table 1. Process and Function

black font- Previous work
green font - Ongoing projects in fiscal 2010/11l.
red font -Proposed for future years.

Project	1970-2008	2009/10	2010/11	2011/12 to 2014/15
PROCESS				
Studies of Geomorphological processes	Several U of C. students 1980-2000	Makaske students		Encourage future students
Climate, flow and water quality Monitoring		MacDonald Review 2009		Maintain watching brief, work with Wildsight water monitoring project
Lake Water quality monitoring	Lake Windermere Project	Lake Windermere Project (ongoing)	Lake Windermere Project (ongoing, separate funding)	Continue to support
Nutrient Cycling in the river and wetlands				Encourage future work in this area
Carbon and methane processes				Encourage future work in this area

Table 2. Habitat Issues

Project	1970-2008	2009/10	2010/11	2011/12 to 2014/15
HABITAT				
Habitat Overview	Pedology Consultants 1978			Habitat Mapping and status overview
Ongoing Monitoring		Comparison of habitat change over time as part of levee project	Photoplot Survey - Stage 1.	Photoplot Survey -Stage 2.
Invasive Species Inventory and Management	Wildsight Golden Project	Wildsight Golden Project (ongoing)	Wildsight Golden Project	Continue to support Wildsight project Find funding for an overview of all invasive species issues
Corridor Assessment		Adams 2010 overview	Corridor options in the Fairmont to Edgewater area	Action in issue areas
Climate change impacts on habitat	Regional assessments of impacts			Work with others on this issue
Levee Process			C. Carli thesis on levee process	Find funding to identify vegetation communities in the marshes along the hydrologic gradient
Cottonwood presence in the wetlands	Regional Cottonwood surveys, Ohanjanian and Teske report			Do comparison over time of forest stand change on the levees and alluvial fans
Fire process in the				Review of fire

wetlands				history records and mapping based on local knowledge
Impacts of beaver and muskrat on levee and wetland vegetation				Review of muskrat and beaver trapping records
Listed plant communities				Review as part of survey for listed plants

Table 3. Biodiversity Issues (Specific species)

Project	1970-2008	2009/10	2010/11	2011/12 to 2014/15
BIODIVERSITY				
Maintain species by maintaining functional processes and habitat				Reapply for funding for SARA species review
Leopard frog habitat inventory	Regional surveys		Leopard frog habitat inventory project	Re-introduction subject to priorities of the recovery team
Salmon Recovery				Work with Intertribal Fisheries Commission
Great Blue heron, Canada Goose, Bald Eagle and osprey issues	Machmer 2008			Continue to monitor these species.
Swans, bittern and pelicans	Cooper and Beauchesne 2003			Initiate monitoring for these species
Waterfowl Surveys	CWS annual waterfowl surveys			Continue to monitor on a annual basis
Ungulate Surveys	Once a decade			Continue to monitor
Non-game Fish				Initiate inventory
Introduced warm water species	Prince 2007			Initiate inventory
Amphibians/Reptiles			Survey by Compensation Program	Continue to monitor
Freshwater Mussels		CDC survey 2008		Map Mussel Beds in large lakes

Fire Flies		Cannings paper on provincial status	Survey of sites in the East Kootenay	Consider detailed assessment of habitat requirements
Invertebrates	Cannings 2000			Inventory for the wetlands
Listed Plant Species	G. Berg surveys in adjacent areas			Inventory for the wetlands, including listed plant communities

In addition, the science committee and others have completed work around management planning, as indicated in Table 4.

Table 4. Management Planning

Project	**1970-2008**	**2009/10**	**2010/11**	**2011/12 to 2014/15**
Management Planning	Jamieson and Hennan 1998 WMA Mgnt Plan, Mgnt Plan for the National Wildlife Area			Review and update all management plans
Boating impact on levees	Bayley and Galbraith, 2008			
Parsons Bridge assessment		Bayley and Carli air photo comparisons of river channel &vegetation change	Bayley and Carli air photo comparisons of river channel &vegetation change	

6.0 CONCLUSIONS

This plan will assist in guiding decisions on funding for science and monitoring for the wetlands system for the next five years and will assist in making decisions on how best to allocate available resources. In addition the Science Committee will provide information to the Partners on issues as they arise, to inform any decisions or recommendations made, based on good science and an understanding of how the entire system works. The Committee will also work with local people and members of the Partners to bring to bear the knowledge of local people around the various management problems we face in the wetlands.

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3.0 APPENDICIES

APPENDIX I. A REVIEW OF PROJECTS TO DATE IN THE COLUMBIA WETLANDS

APPENDIX III. BIBLIOGRAPHY ON BIODIVERSITY AND PROCESS IN THE COLUMBIA WETLANDS

APPENDIX I. A REVIEW OF PROJECTS TO DATE IN THE COLUMBIA WETLANDS

ACTIONS TO DATE, JUNE 2010.

The group and its partner groups and agencies has taken on a wide range of projects to further the management and protection of the wetland system. These include:

1. Dutch Creek stream restoration proposal. This has been a long standing concern. The Wetland Partners, working with the Columere Park Community Association and the Canadian Columbia Intertribal Fisheries Commission, are having professionals look at this issue so that a information based decision can be made on if and how to proceed on this project.

2. Fairmont Resort riparian habitat enhancement. The Partners are close to completing a project to restore cottonwood and other hardwoods along the river reach that goes through the Riverside Golf Course, working with the staff at the golf course and the Fairmont Hot Springs Resort. Support has been received from the Upper Columbia Conservation Fund and the Royal Bank Blue Water Fund.

3. Wilmer Slough cleanup. The federal government has initiated a cleanup on this site, which is a National Wildlife Area. Two local photographers and film makers, Pat and Biaba Morrow, have taken the lead in planning a public cleanup day on the site to assist in this project, working with the Partners, the local chapter of Wildsight, the Windermere Rod and Gun Club and the District of Invermere. The major cleanup event occurred on April 24, with 25 community members removing 175 tires and other junk from the wetlands and the slopes above. This work was supported financially by Wildsight, Friends of the Columbia Wetlands, the Windermere Rod and Gun Club, the District of Invermere and the Wetland Partners. The group will continue to work with the federal ministries responsible for final cleanup of the site.

4. Removal of old vehicles from along the river. The Min. of Environment Parks and Protected Areas staff removed a large number of old vehicles and other junk from along the river in the Athalmere to Edgewater reach in 2008 and 2009, with the assistance of the Wetland Partners.

5. Radium overlook site cleanup and kiosk. The Min. of Environment Parks and Protected Areas staff and members of the Wetland Partners cleaned up this site last year, removing several tons of junk from the site. The Partners are part of a group looking at improving this site and putting in a kiosk explaining local recreational opportunities and the importance of the wetlands.

6. Goose Nesting Platforms in the wetlands
The Rod and Gun Clubs established nesting platforms for geese many years ago, working with Tom Sterling and Ducks Unlimited. Many of the platforms are falling down and could be removed or replaced. The Wetland Partners have been discussing how best to manage this issue.

7. Parsons Bridge replacement and River access. The series of bridges and roadway across the river and wetlands at Parsons is being replaced. We have been working with the BC Forest Service Engineering staff to ensure that the bridge design will accommodate major flood events

and maintain natural river flows. We are also working with the Forest Service and the Columbia Shuswap Regional District to develop a proper boat launch site at the bridge after the new bridge is completed.

8. Horse Creek Restoration and Access. This site has been a source of controversy for some time, around access to the river and the state of the lower portion of Horse Creek.
A meeting was held with the local land owner and we have come up with a joint plan to provide access and restore riparian vegetation at the site.

9. Nicholsen Bridge Access. the Wetland Partners are working with the Columbia Shuswap Regional District to provide river access options on this site, working with a local land owner.

10. Invermere to Golden Power Line Alignment Project. The Wetland Partners participated in the review of this project to ensure that there would be minimal impact on the wetlands. Agreement has been reached on a route for the power line will stay entirely away from the wetlands proper and cross the river at one place at Golden.

11. Old Golden Log Mill Site Cleanup. The old mill site beside the river at Golden has historic value, the area around it needs a major cleanup. Irv Graham and the Wetland Partners have been working with the town of Golden to sort out a strategy for the site.

12. Confluence Park. There are ongoing concerns at this site (the Kicking Horse confluence with the Columbia River, the bridge to the ski resort and motorized use at the site). We are working with others on a strategy for this site.

13. River access at Donald Bridge. The Donald bridge will be replaced this summer. The Partners and Susan Abbott of the Columbia Shuswap Regional district have been working with the Min. of Highways to try to find a way to replace the unofficial river access point below the old bridge. An access point at this location is critical to allow larger boats to access the river and canyon below the bridge and as a pickup site for boaters floating down to the bridge from Golden.

14. Art in the Wetlands. The Wetland Partners supported and provided funding to a project called "Columbia Wetlands: Natural Inspiration", working with Kicking Horse Culture, an art studio in Golden and the Golden Chapter of Wildsight. The exhibition was a spectacular success with exhibits from 20 artists involved. You can see the art created for the exhibition at: http://www.kickinghorseculture.ca/agog/wetlands/index.html

15. A federal boating regulation for the river and wetlands. There has been a decade long debate over a boating regulation for the river system and wetlands. The group has come up with a compromise that lead to a three part regulation proposal. The first two elements are presently in place (a ban on water skiing and no motorized access to the wetlands portion of the system and we are assisting government in educating users concerning the new regulations. We are awaiting a decision from government on the final third piece of this legislation (a regulation for the main channel of the river).

SCIENCE PROJECTS

1. Linkage Project. The Partners, working with Parks Canada has completed a report that identifies and maps linkages for aquatic species along the Columbia River, and for terrestrial species along the east and west benches, to assist the Regional District of East Kootenay and others in their planning for the area.

2. Levee Process Project. Dr. Suzanne Bayley and her student, Chris Carli, are working on a project looking at the impact of breaks in the river levees on the health of the adjacent wetlands. Chris has collected old air photos that will allow us to look at changes in the river channel and wetlands over time (since 1947). We presently have comparisons of air photos from 1947, 1975 and 2004, for several sites in the wetlands.

3. Leopard Frog Habitat Assessment. Dr. Suzanne Bayley, Chris Carli and Penny Ohanjanian are identifying potential habitat for leopard frogs, the one species that occupied the wetlands in the past that no longer occurs in the system. The objective is to identify those wetlands that would be the best sites for a re-introduction of leopard frogs into the system.

4. Water Monitoring. Ryan MacDonald of the University of Lethbridge was contracted by the CBT, on behalf of the Partners and the Wildsight Lake Windermere Project, to provide an overview of climate, water flow, water quality and ground water monitoring for the Upper Columbia basin. The report provides an overview of the water supply issues faced by the wetlands and communities in the Upper Columbia Basin. We also worked with Crystal Slaught, A GIS student at Selkirk College, who developed a Power Point Presentatioin that described spatially our knowledge of water flows in the Upper Columbia.

5. Species at Risk Assessment. Funding for an overall assessment of species at risk in the wetlands was applied for through the Species at Risk Habitat Fund. The objective is to identify those species we need to be concerned about in the future. To date, the only species lost from this system are the Northern Leopard Frog, the Columbia River Chinook Salmon and Columbia River Steelhead, both of which spawned in this area prior to 1936 and the construction of the Grand Coulee dam. Groups in our area, with a lead by the Columbia Kootenay Intertribal Fisheries Commission are working with US interests to return salmon to the Canadian portion of the Upper Columbia River.

6. A Photo Plot survey for the wetlands. We do not have access to money to do a lot of higher level scientific monitoring in the wetlands. However, there is a valuable and cheap alternative called a photo plot survey that can be carried out by volunteers. Such photos become more and more valuable over time. As part of this project we are also collecting and scanning historic photos of the wetlands, to provide a record of habitat change over time in the wetlands.

7. Fire fly Project. Fire flies are a small beetle that live in wetlands, that glow in the dark during their mating ritual in June. They are a classic icon for wetland health and are part of many young people's first experiences with wetlands. There are international concerns with their fate in many

areas. They occur in a few areas in the wetlands and in the East Kootenays. We are working with the Royal BC Museum to identify their presence and habitat requirements.

8. Invasive Weeds in the wetlands. The Wetland Partners have provided funding for a Wildsight Golden project that has been working on invasive weeds for four years. We now have the cooperation of CP Rail on this issue and we are making headway on dealing with this issue in the wetlands. An assessment of several sites in the wetlands found no aquatic invasives in the system at this time.

APPENDIX II. BIBLIOGRAPHY-BIODIVERSITY AND PROCESS IN THE COLUMBIA WETLANDS

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