



# Upper Arrow Lakes: Airport Slough Dike Initiation Phase Assessment – Final Report

Prepared For: Fish and Wildlife Compensation Program (FWCP) Columbia Region

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## Executive Summary

Airport Slough is a regionally and locally significant wetland complex located adjacent to the Revelstoke Airport and within the drawdown zone of Upper Arrow Lakes. The wetland supports a diversity of plant life, nesting, foraging and shelter habitat for birds, hibernaculum and overwintering habitat for turtles and aquatic habitat for fish. Airport Slough provides critical nesting habitat for numerous resident and migratory bird species (e.g. Blue Heron, Osprey, Bald Eagle, Yellow-headed Blackbird, Pied-billed Grebe, Virginia Rail, Sora, and Marsh Wren) and foraging and overwintering habitat for Western Painted Turtles.

Recent studies in Airport Slough have confirmed a link between fluctuating water levels related to hydroelectric reservoir operations and nest mortality of ground, wetland and shrub nesting bird species. Reservoir operations were identified as the main cause of nest failure resulting in nest flooding for some species that utilized Airport Slough. Stabilizing water levels in Airport Slough by means of constructing a dike has been discussed and proposed by local biologists as a viable option for mitigating adverse impacts of reservoir operations on wildlife, including nest mortality, and to enhance overall productivity and function of the drawdown zone.

This project supports two of FWCP Riparian and Wetlands Action Plan high priority actions: (1) identification of threats to habitat connectivity and support opportunities, including but not limited to land securement, in order to secure and steward lands with high conservation values for wetland and riparian areas; and (2) restore and create wetland and riparian area habitat in this focal area, where feasible to address impacted, degraded or lost habitat (FWCP 2014).

The feasibility of a dike around Airport Slough in order to protect wetland features and stabilize water levels was explored. Outcomes from discussions with stakeholders and a summary of existing scientific studies on Airport Slough are presented and include recommendations for next steps. Stakeholder survey feedback was mixed and identified a number of knowledge gaps that should be answered prior to moving forward on any further development of a dike in the Airport Slough area. Knowledge gaps were also revealed by the literature review. The following are key results and recommendations:

1. Literature review revealed information gaps on hydrology, specifically to do with holding capacity of the system. This needs to be addressed prior to deciding whether dike is a viable option. Specifically, further steps will need collaboration with CSRD on understanding the influence of existing airport runway and their expansion plans on hydrology of the system.
2. The influence of water level stabilization on water quality, fish, invertebrates (including mosquitos), vegetation, amphibians, mammals, invasive species needs to be better understood. The need to explore a wide range of ecological aspects to assess potential ecological costs was highlighted by the literature review as well as by stakeholder feedback.
3. The influence of diking on fish communities in Revelstoke Reach wetlands needs to be further investigated; dike must be designed to accommodate fish to avoid unnecessary impacts and/or mortality to fish caused by entrapment and/or enhancement of nuisance species.
4. Issues associated with airplane safety need to be addressed. Understanding this risk was considered of utmost importance by most survey correspondents.
5. Several survey correspondents expressed that clear and succinct management objectives need to be developed for the system and highlighted the need to ensure that these are not in conflict with each other.



6. Carefully thought out and thorough engagement process to secure buy-in from community was also mentioned as requirement for success of any major project affecting the Airport Slough.
7. A committee should be established comprising of BC Hydro, the CSRD (airport owner/operator), landowners, First Nation representatives and other interested stakeholders to address next steps in the process. This project has highlighted the need for collaborative efforts.
8. A review of success and challenges of similar projects (e.g. Downie Marsh; Cartier Bay) in the Revelstoke Reach area should be conducted that needs to include engagement of experts that have worked on similar initiatives prior to developing a preliminary construction design and costs estimate. Further feasibility investigations should include input from engineer, hydrologist and/or reservoir specialist(s).
9. A scoping budget should be developed that could inform decision making whether to proceed towards construction or explore other projects that may provider greater benefit for the cost.



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## Acronyms and Abbreviations

ALR	Arrow Lakes Reservoir
ASL	Above Sea Level (elevation)
CSRD	Columbia Shuswap Regional District
DDZ	Draw Down Zone
FWCP	Fish & Wildlife Compensation Program
HKD	Hugh Keenleyside Dam
RR	Revelstoke Reach
WUP	Water Use Plan
WLR	Water License Requirements

## 1 Introduction

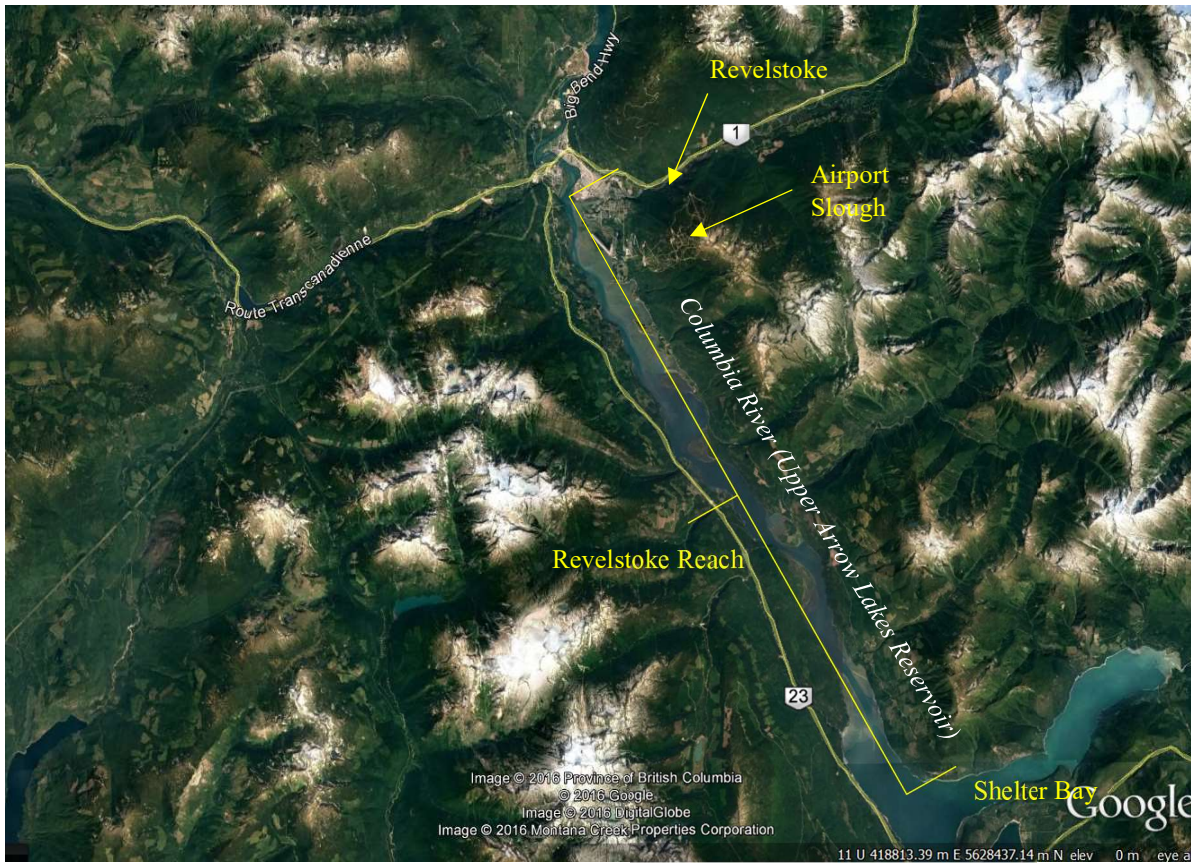
Yucwmenlúcwu (Caretakers of the Land) LLP, a SPlatsin owned environmental resource management company, and SEC Consultants (SEC) have partnered to undertake an initiation phase assessment to determine feasibility of stabilizing water levels in Airport Slough (also referred to as Airport Marsh) in Revelstoke, B.C. This project explores the feasibility of a dike around Airport Slough to protect wetland features and stabilize water levels in the Revelstoke Reach drawdown zone. Outcomes from discussions with stakeholders and a summary of existing scientific studies on Airport Slough are compiled, presented and include recommendations for going forward.

The SPlatsin are the most southern tribe of the Secwepemc Nation, the largest Interior Salish speaking First Nation in Canada whose aboriginal territory stretches from the BC/Alberta border near the Yellowhead Pass to the plateau west of the Fraser River, southeast to the Arrow Lakes and to the upper reaches of the Columbia River. Secwepemc peoples' history of use and knowledge of the Upper Columbia River valley is well documented (see Ignace and Ignace 2008; Kennedy and Bouchard 1998). The Upper Columbia River valley is an integral part of the Eastern Secwepemc seasonal round, a well-known travel corridor, and location of village sites. Within the Upper Columbia River valley, the Mica Creek, Revelstoke, and Arrow Lakes Areas, are especially significant. Culturally and traditionally, SPlatsin have great respect for their traditional territory and the ecosystems which support them and consider themselves to be caretakers of the plants, fish and animals that inhabit it. The caretaker responsibility is to act mindfully, learning from and caring for surrounding ecosystems on the land and water and how they interact with one another for the benefit of future generations.

The Airport Slough is a regionally and locally significant wetland complex located adjacent to the Revelstoke Airport and within the drawdown zone of Upper Arrow Lakes Reservoir (ALR) (Figure 1.1). The wetland supports a diversity of plant life, nesting, foraging and shelter habitat for birds, hibernaculum and overwintering habitat for turtles and aquatic habitat for fish. Airport Slough provides critical nesting habitat for numerous resident and migratory bird species, such as Blue Heron (*Ardea herodias*), Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus leucocephalus*), Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), Pied-billed Grebe (*Podilymbus podiceps*), Virginia Rail (*Rallus limicola*), Sora (*Porzana Carolina*), and Marsh Wren (*Cistothorus palustris*), and foraging and overwintering habitat for Western Painted Turtles [*Chrysemys picta*].

Recent studies in Airport Slough have confirmed a link between fluctuating water levels related to hydroelectric reservoir operations and nest mortality of ground, wetland and shrub nesting bird species (van Oort and Cooper 2015a and 2015b). Reservoir operations and the resulting nest flooding were identified as the main cause of nest failure. Stabilizing water levels in Airport Slough by means of constructing a dike has been proposed by local biologists Corey Bird and Harry van Oort as a viable option for mitigating adverse impacts of reservoir operations on wildlife, including nest mortality, and to enhance overall productivity and function of the drawdown zone.

This project supports two of FWCP Riparian and Wetlands Action Plan high priority actions: (1) identification of threats to habitat connectivity and support opportunities, including but not limited to land securement, in order to secure and steward lands with high conservation values for wetland and riparian areas; and (2) restore and create wetland and riparian area habitat in this focal area, where feasible to address impacted, degraded or lost habitat (FWCP 2014).



**Figure 1.1** Location of Airport Slough within the Revelstoke Reach Area

This screening level assessment consists of two components: (1) literature review and (2) summary of stakeholder survey results with the following objectives:

1. to compile and summarize studies, assessments, and physical works projects, conducted in Airport Slough;
2. to determine the feasibility of enhancing ecological values in Airport Slough through stabilizing water levels by soliciting input from key stakeholder to identify challenges and synergies from received feedback; and
3. to recommend to proceed, or not to proceed, with further studies and actions in support of stabilizing water levels in Airport Slough.

The ultimate project goal, should a way forward be identified, will be to ensure the long lasting ecological function and land preservation of Airport Slough. A management plan for Airport Slough (part of subsequent efforts) would be informed by the findings of this preliminary assessment, as would future development of the Revelstoke Airport.



## 2 Methods

### 2.1 Literature Review

The literature review involved a search of relevant reports of wetland research conducted in the Revelstoke Reach area, with specific focus on studies conducted in Airport Slough. Various websites and databases were used to search for literature, including BC government's Ecological Reports Catalogue (EcoCat) and Species Inventory Web Explorer, FWCP website, and BC Hydro Columbia River Water Use Plan (WUP) monitoring studies. In addition, discussions were conducted with local knowledge keepers and experts (e.g., Mandy Kellner, Harry van Oort) who pointed the authors in the direction of additional information and resources. Summary of reviewed literature is provided in Section 4.1.

### 2.2 Stakeholder Survey

The stakeholder survey involved the identification and selection of individuals, groups, and organizations with previously identified interest in the Airport Slough area. These included representatives from Columbia Shuswap Regional District, BC Hydro, local residents, City of Revelstoke, Revelstoke Airport, biology experts, First Nations, North Columbia Environment Society (NCES), and local clubs (i.e., ATV and flying clubs). After each stakeholder was identified, survey responses were solicited via email. The initial survey was sent on January 13, 2017. Upon feedback from first few correspondents a second survey was sent out on January 19<sup>th</sup>, 2017, with additional information including a map of the study location and conceptual footprint for the dike, and an option to submit the survey responses anonymously. The original intent was to have all survey responses identified so feedback from individuals and stakeholder groups could be best represented. Upon reflection and feedback, we didn't want to limit the survey responses based on concerns about anonymity. The second version of the survey is provided in Appendix A.

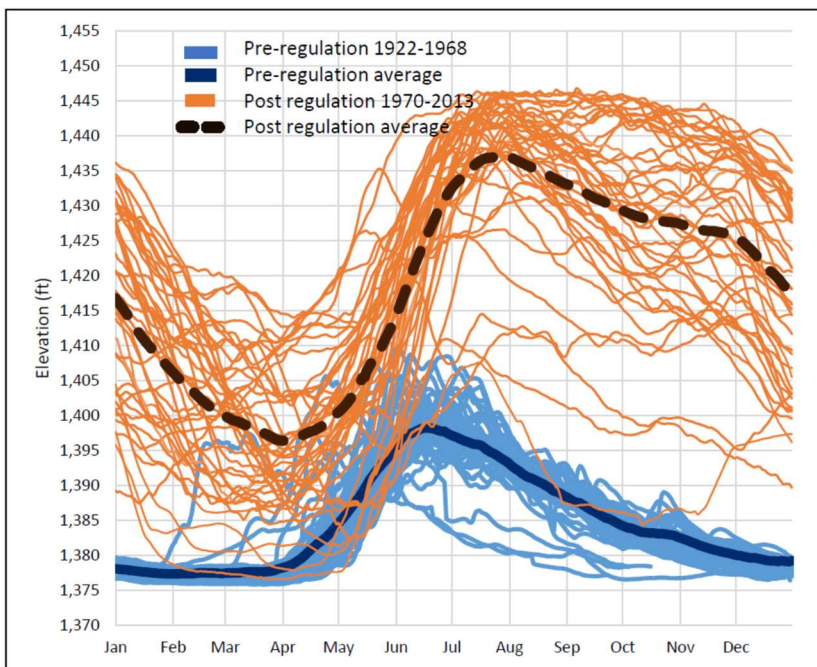
## 3 Results

### 3.1 Literature Review

#### 3.1.1 Background

The Arrow Lakes Reservoir (ALR) is a 230-km long section of the Columbia River drainage between Revelstoke and Castlegar, B.C. It has a north-south orientation and is set in the valley between the Monashee Mountains to the west and the Selkirk Range to the east. The Hugh Keenleyside Dam, located 8 km west of Castlegar, was built in 1968 under the Columbia River Treaty for flood control and power production, and created the Arrow Lakes Reservoir upstream of the dam. This raised the level of two natural Arrow Lakes upwards of 11.6 m, creating one water body that extends from the Hugh Keenleyside Dam to immediately north of Revelstoke (to Revelstoke Dam), and effectively eliminated about 80 km of riverine habitat. The ALR has a licensed storage volume of 7.1 million acre-feet, and the normal operating range of the reservoir is between 440.1 m and 418.6 m ASL (BC Hydro 2007). Revelstoke Dam, located upstream of the City of Revelstoke, was completed in 1984 as a 'peaking' dam to meet electricity demands during highest seasonal and daily peak periods. This causes water levels downstream of the dam to fluctuate by about 1.5 meters.

Prior to 1968, the Canadian section of the Columbia River was free flowing and unimpeded from the headwaters in the headwaters at Canal Flats to the U.S. just border south of the City of Trail. The Arrow Lakes hydrograph was snow and glacier-melt driven, with high freshet flows and water levels occurring in the spring with a rapid rise, typically May 1 – June 30, and a slow decline back to the low stable elevation by late fall or early winter (Figure 3.1).



**Figure 3.1 Pre and Post Regulation Water Levels of the Arrow Lakes Reservoir (from: Thomson et al. 2016)**

Although the maximum and minimum water levels changed from year to year as a result of variability in snow pack depth, spring melt timing and rainfall intensity, the seasonal pattern was consistent year over year (Thomson et al. 2016). The hydrograph changed significantly after 1968, with spring freshet captured behind the dam and slowly released over the fall and winter months to minimum elevation in the early spring. Overall, reservoir elevations are higher at all times of year and have a greater average range than that which occurred prior to impoundment: 1,377 ft. (420 m) to 1,401 ft. (427.0 m) pre-impoundment versus 1,396 ft. (425.5 m) to 1,440 ft. (438.9 m) post-impoundment (Thomson et al. 2016). Year over year this pattern is repeated, however with much more variation than the pre-dam water elevations (Figure 3.1).

Numerous studies describe the change in ecological, social and economic environments that resulted from the Arrow valley being flooded and subjected to annual fluctuations of the reservoir water levels (e.g. Wilson, 1973, Utzig and Schmidt 2011; Penfold 2012). These impacts were and remain significant and express themselves regionally and locally. As a result of the annual inundation of these reservoirs, habitat along the reservoir perimeters has been largely modified with little terrestrial habitat remaining (Utzig and Schmidt 2011). Valley bottom wetland ecosystems have experienced the largest impacts with 26% of their original area modified or lost completely (Utzig and Schmidt 2011). Few intact riparian ecosystems remain between Valemount and the Canada/US border at Trail, BC, with the most extensive wetland and riparian forests occurring in the

Revelstoke Reach of the Upper ALR (Boulanger 2005). This area contains several wetland complexes, including the Airport Slough, and is one of the six areas highlighted under the FWCP’s Columbia Basin Riparian and Wetland Action Plan (FWCP 2014).

### 3.1.2 Airport Slough Hydrology

Airport Slough, once farmland, was unintentionally created in depressions remaining from borrow pits when material was excavated to create a dike that forms the existing airport runway. Figure 3.2 shows the location of the wetland in relation to the airport, with blue outline representing broadly defined boundary at the highest reservoir water levels. Photograph of the wetland at high water levels is shown in Photo 3.1.



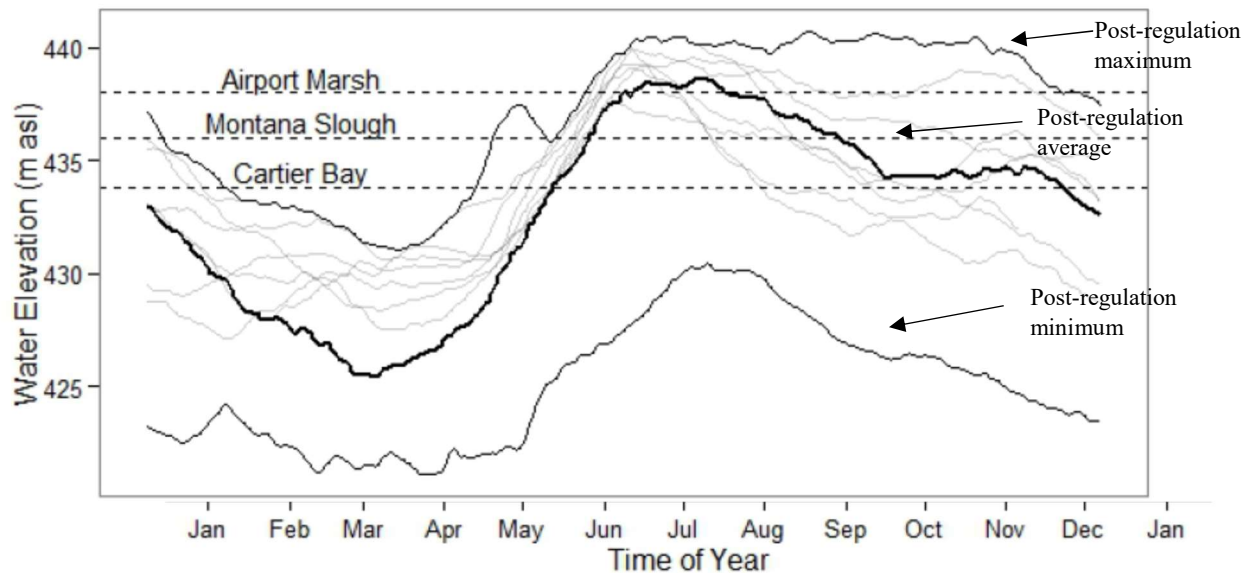
Figure 3.2 Airport Slough Extent at Highest Reservoir Water Levels (as indicated by blue line)





**Photo 3.1** View northeast towards Airport Slough at high reservoir water level. 2014. G. Shearing photo.

Wetlands in the Revelstoke Reach (e.g., Airport Slough, Montana Slough and Cartier Bay) are situated between 434 m and 438 m ASL and are differentially impacted by reservoir operations during different times of the year (Figure 3.3; Gill and van Oort 2015). Compared to the other riparian wetlands in the Revelstoke Reach, the functioning of Airport Slough is least impacted by reservoir water levels (Miller and Hawkes 2014; van Oort and Cooper 2015b). For example, Montana Slough and Downie Marsh become completely inundated by the reservoir at full pool whereas the Airport Slough is perched at a higher elevation and isolated from the reservoir proper by the airstrip which limits circulation of reservoir water in this wetland (Miller and Hawkes 2014) (Figure 3.3). Consequently, the Airport Slough continues to function, but in a diminished capacity, during high water periods (Golder 2009, van Oort and Cooper 2015b). Due to the high elevation of the wetland, greater water level stability and relatively infrequent and short-term inundation by the Arrow Lakes Reservoir, the ecological communities at Airport Slough are much more developed, complex and diverse than those in other wetlands located in the drawdown zone (e.g. Cartier Bay or Montana Slough; Miller and Hawkes 2014).



**Figure 3.3 Wetland elevations within the Revelstoke Reach (from Gill and van Oort 2015)**

Hydrology at the Airport Slough has not been extensively monitored and many uncertainties exist. Bird and van Oort (2015a) observed that the water levels in this marsh fluctuate among years for reasons unrelated to reservoir operations. In addition to flooding from Columbia River, the wetland also receives inputs from Locks Creek, which originates in Williamson Lake as well as a storm drain located in the northwest portion of the marsh, neither of which have been quantified to date. Bird and van Oort (2015a) hypothesize that several determining factors are responsible for this unstable hydrology, some of which are unpredictable and vary annually such as snowpack depth, timing of snowmelt and spring freshet, and the amount of spring and early summer precipitation. The understanding of the wetland’s holding capacity is limited and needs to be further investigated as there is indication that water escapes the wetland from more than one exit point (e.g., through the airstrip rip-rap, via a breach in a small dike at the north end of the marsh and, potentially, through collapsed culverts under the airport runway; Bird and van Oort 2015a).

### 3.1.3 Vegetation/Habitat

Habitats within the drawdown zone of the Revelstoke Reach vary with topographic elevation. Grasses (e.g., *Phalaris arundinacea*), sedges (*Carex* spp.) and horsetails (*Equisetum* spp.) become well-established at 434 m ASL; willow (*Salix* spp.) and black cottonwood (*Poplar balsamifera*) grow as low as 436 m ASL, but become well-established at 438 m within a matrix of dense graminoid cover. Above 439 m, multi-storied mature cottonwood riparian forests have become established in some areas (e.g., Machete Island) (van Oort and Cooper 2015b).

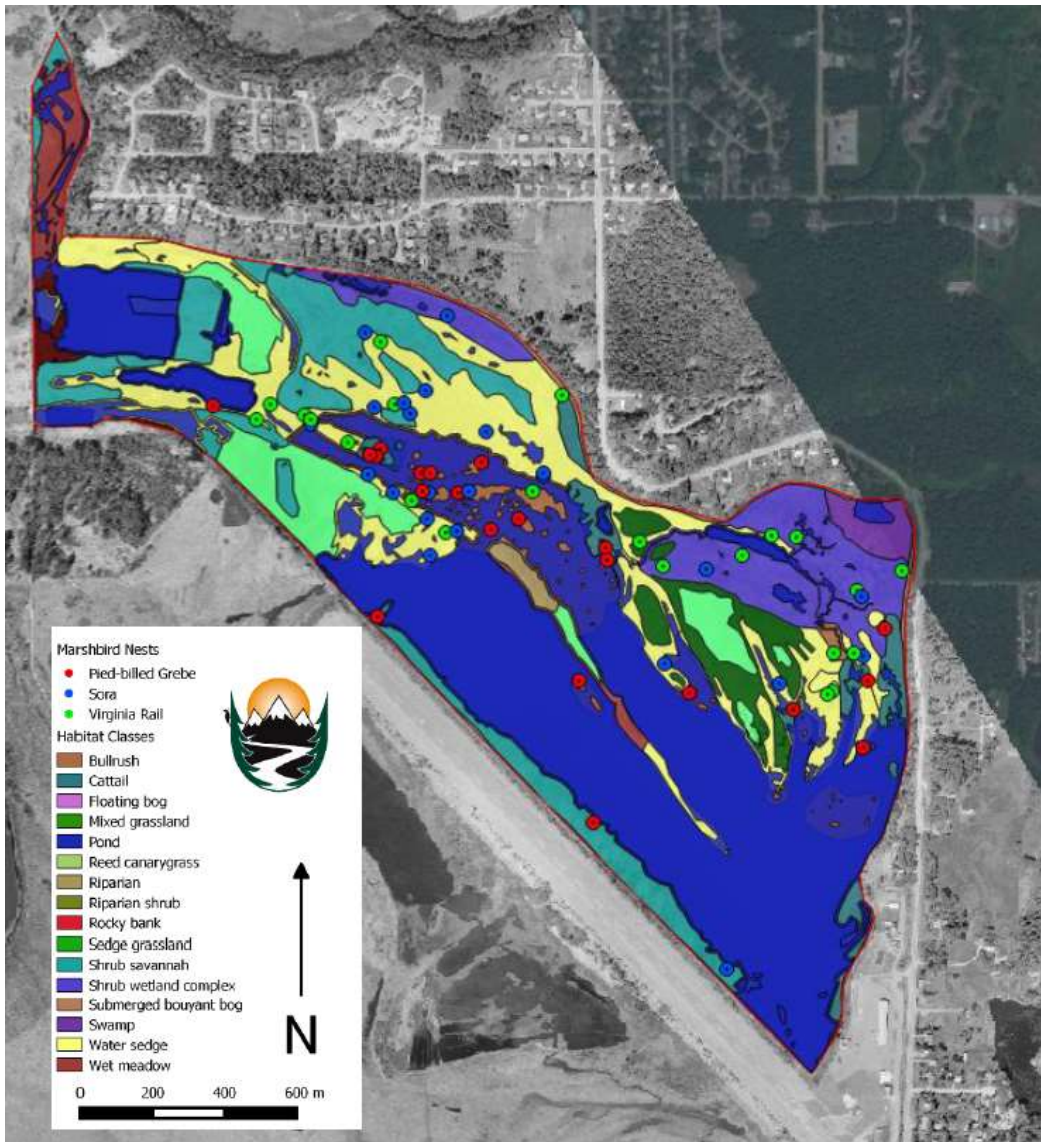
Comparison of Airport Slough to other similar wetlands in the Revelstoke Reach (i.e., Cartier Bay, Montana Slough) showed that this wetland was the most established wetland of the three sites assessed (Miller and Hawkes 2014). The heterogeneity of the substrate and water depth, in combination with the high elevation of the wetland in the drawdown zone (and thus minimal annual inundation by the reservoir), has allowed a relatively diverse community of aquatic and emergent macrophytes to become established. The vegetation at Airport Slough is characterized by

the presence of extensive communities of emergent vegetation around the perimeter of the wetland, and a diverse assemblage of submergent species in more open water areas as well as throughout the emergent communities. These communities support high diversity and density of aquatic invertebrates, important food sources for fish and wildlife (Miller and Hawkes 2014). The wetland is characterized by large diversity of emergent vegetation habitat classes and includes some of the best examples of water sedge, cattail (*Typha* spp.) and bullrush (*Blysmus* spp.) habitat in Revelstoke Reach; of key importance to the region's rare marsh-birds and songbirds (Photo 3.2, Figure 3.4; van Oort and Cooper 2015). It is unknown to what degree normal reservoir operations impede the growth of emergent vegetation, but it is likely that the up to 2 m fluctuation in water depth is not beneficial, and limits the ecological functioning of the Airport Slough. Overwatering by reservoir operations may change water temperatures and result in the influx or loss of various biota (e.g., fish), which likely disrupts the marsh ecology (Miller and Hawkes 2014).



**Photo 3.2** View east towards Airport Slough. H. van Oort photo.





**Figure 3.4** Airport Slough Study Area with Habitat Classes and Pied-billed Grebe, Virginia Rail and Sora nest Locations found between 2008 and 2014 (from Gill and van Oort 2015)

Invasive plant species occur in this system and include Eurasian water milfoil (*Myriophyllum spicatum*) and knotweed (*Fallopia sp.*) (Hooper et al. 2016). Eurasian milfoil is found throughout Airport Slough and dominates macrophyte communities in open water (Miller and Hawkes 2014). This common aquatic invasive has the ability to outcompete and replace native plant communities, reducing overall biological diversity and water quality (ISC BC 2016). Knotweed, one of the top-ten invasive species for eradication in BC, has been detected on the edge of the wetland adjacent to the roadway (Locks Creek inflow) and poses a risk to biodiversity and ecosystem function of the Airport Slough (H. van Oort, personal communication). This invasive is often found in riparian areas and grows rapidly, forming monocultures that limit resources for native plants. Knotweed roots lack the true root hairs necessary to bind to the soil, and cause erosion and stream sedimentation along banks of creeks and rivers after establishing, impacting fish and fish habitat and other aquatic organisms (ISC BC 2016).

### 3.1.4 Wildlife

Bird communities have been studied extensively in the wetlands of the Revelstoke Reach, with common theme being the importance this area to migratory birds (e.g., AXYS 2002, Boulanger 2002, Boulanger et al. 2005, Tremblay 1993, van Oort and Cooper 2015a and 2015b, Bird and van Oort 2016a and 2016b). Jarvis and Woods (2001) documented 65 bird species utilizing seven zones, including Montana Slough, Cartier Bay and the Airport Slough, within the Revelstoke Reach with species diversity being greater in the spring than fall. The Airport Slough, specifically, has been identified as locally and regionally important breeding and nesting habitat for a number of bird species that are rarely found elsewhere in the Upper Columbia Basin in the province. These regionally uncommon species include Pied-billed Grebe, Virginia Rail, Marsh Wren, Sora and Yellow-headed Blackbird, two of which (Marsh Wren and Yellow-headed Blackbird) are known to nest regionally only in this wetland (Bird and van Oort 2015a; van Oort and Cooper 2015a). The Airport Slough also holds some of the highest diversity and density of nests. A total of 25 species have been recorded breeding in this wetland, 17 of which have received high or very high species impact ratings in the Dam Footprint Impacts Summary for the Columbia Basin (Utzig and Schmidt 2011). The high density in nests in Airport Slough unfortunately results in a high rate of nest submersion, as the nesting period (mid May to beginning of August) coincides with most rapidly increasing reservoir water levels (van Oort and Cooper 2015a).

The availability of habitat in the Revelstoke Reach wetlands is dependent on water control regimes, as water levels rise, habitat accessible to a waterfowl is compromised. Specific to the Airport Slough, waterfowl use was observed to be highest when wetlands were not affected by reservoir operations (Gill and van Oort 2015). A number of other factors have also been identified as affecting the number and diversity of waterbirds in Revelstoke Reach and their use of available habitat. These factors include the success of BC Hydro's revegetation program, weather conditions and human activity (i.e., recreational activities using motorized equipment; Jarvis and Woods (2001). Bird and van Oort (2015b) present a compelling argument on how regulating water levels of the Airport Slough would mitigate adverse impacts of reservoir operations on wildlife, including bird nest submersions, and enhance waterfowl productivity of the drawdown zone. A model was used to estimate that as much as 25% of the nest submersions in Revelstoke Reach may be avoided by regulating water levels in the Airport Slough, representing <3% of the Revelstoke Reach drawdown zone area.

Several studies within the Revelstoke Reach, including in and adjacent to the Airport Slough, have also been conducted on the Western Painted Turtle, with specific focus on nesting success and overwintering behaviour (Maltby 2000, Wood and Hawkes 2015, Duncan 2016). Airport Slough was identified as a key Western Painted Turtle overwintering area (Wood and Hawkes 2015, Duncan 2016). The populations studied showed behavioral plasticity in overwintering tactics and did not appear to be impacted by water level fluctuations in winter (Duncan 2016). Painted Turtles are known to make very large movements in times of reservoir inundation, potentially indicating a negative impact to this species, however, reservoir operations do not appear to influence nesting success (Wood and Hawkes 2015). Factors reported to influence Painted Turtle nesting success include the selection of nesting sites by female turtles, presence of disturbance and predation. Most observed impacts to nests were related to destruction by human activities as a result of compaction (e.g., road maintenance, horse riding, bicycles, pedestrian and vehicles). Mortality of eggs and hatchlings resulted from predation by dogs, cats, snakes and birds (e.g. Blue Heron). Suggested mitigation strategies include identification of the nesting grounds as an "environmentally sensitive site", elimination or moving of an existing pathway adjacent to the nesting grounds, and care in how road maintenance is completed in the area (Maltby 2000).

### 3.1.5 Fisheries and Aquatic Resources

Similar to macrophytes, the aquatic invertebrate communities in Airport Slough are also well developed. Although invertebrate abundance is lower than at Cartier Bay, the diversity of organisms was much greater. As with Cartier Bay, cladocerans and chironomids dominate the invertebrate communities (Miller and Hawkes 2014).

Limited information exists on fish usage of Airport Slough and similar sites. Assessments of other similar wildlife physical works requiring water control have noted that they must be designed to accommodate fish to avoid unnecessary impacts and/or mortality to fish caused by entrapment and/or enhancement of nuisance species (Golder 2009). It is quite likely that entrapment of sport fish species such as Rainbow Trout (*Oncorhynchus mykiss*) likely already occurs in Airport Slough as water levels recede. Winter kill of Yellow Perch (*Perca flavescens*) has already been observed in similar water bodies thus any sport fish species such as rainbow trout which requires relatively higher oxygen concentrations and cooler water than yellow perch, may suffer a similar fate (Golder 2009). The proposed dike at Airport Slough will likely not change the potential for such entrapment, although depending on how water levels are managed, it may physically reduce the number of sports fish entering the wetland thus reducing entrapment.

Yellow perch is a nuisance species that inhabits warmer more productive aquatic and wetland habitats and have been observed in many of the existing waterbodies along the margins of the drawdown zone, including in the Airport Slough (Golder 2009). Diking of the wetland may increase the abundance of yellow perch creating competitive interactions with resident species, although winter die-offs may continue to control these populations (Golder 2009). The dike, however, may also entrap these fish making extermination efforts easier and an increased focus of wetland management. Another invasive fish species observed in Revelstoke Reach wetlands (e.g. Montana Slough and Cartier Bay) is the common carp (*Cyprinus carpio*) which feeds exclusively on aquatic vegetation. Studies have shown that the common carp may be severely affecting the distribution and abundance of aquatic macrophytes (and, presumably, their vertebrate and invertebrate communities) following inundation by the reservoir (Miller and Hawkes 2014). An unintended consequence of diking the Airport Slough may be provision of yellow perch and common carp, as an important food source for herons, osprey, piscivorous water fowl (e.g., grebes, mergansers, loons), otters and other predators. On the other hand, the presence of a dike may reduce the likelihood of this species entering the wetland from the mainstem. The influence of diking on fish communities in Revelstoke Reach wetlands needs to be investigated further.

### 3.1.6 Wildlife Physical Works Conducted in Airport Slough To Date

In lieu of changes to the operating regime of the reservoir, the feasibility of wildlife physical works identified in the WUP (2005) to help mitigate the impacts from the Arrow Lakes Reservoir operations on wildlife habitat were reviewed (Golder 2009). One site selected for construction was the Airport Slough outflow (Figure 3.2). In the fall of 2013, BC Hydro conducted the work to stabilize banks of Columbia River adjacent to the Airport Slough to prevent the channel from continuing to erode river banks potentially resulting in the drainage of the wetland. Artificial nesting islands were also constructed to provide nesting sites for local painted turtles (BC Hydro 2013). In an effort to halt erosion and incision into the existing dike around Airport Slough, BC Hydro placed large rip-rap on the eroding channel bank adjacent to the old Arrowhead highway, just downstream of the mouth of the Illecillewaet River.

### 3.1.7 Recreational

### Considerations

After installation of the Mark Kingsbury pedestrian bridge over the Illecillewaet River, the City of Revelstoke has been actively looking at ways to increase usage and connect trail networks south of the River. There appears significant interest within the city for improved trails and protection and preservation of Airport Slough.

Conflict between the preservation of habitat and wildlife and that of maintaining recreational opportunities in Revelstoke Reach represents a larger problem throughout the province. A primary concern during planning processes of similar projects in the area (e.g., Golder 2009) was disturbance to wildlife by ATVs or other motorized vehicles. Damage to nests and habitat, either inadvertently or wilfully, by motorized vehicles accessing the drawdown zone has been well documented (e.g., Jarvis and Woods 2001) and continues to be a topic of discussion within the BC Hydro Drawdown Zone Committee. In contrast, there are members and groups within the community looking to maintain and even enhance motorized vehicle access in the reservoir for recreational purposes (personal communication with anonymous resident, Golder 2009). One of the obvious challenges will be how to address these issues in subsequent phases of the project. Although recreational access may result in disturbance to wildlife during certain times of the year, habitat enhancement projects such as this one may serve to reduce damage to habitat and disturbance to wildlife by keeping recreational users along an identified corridor via appropriate specifications and trail design (e.g., width).

### 3.1.8 Concept of Water Level Stabilization

The concept of stabilization of water levels in Airport Slough was formally proposed by Bird and van Oort (2015a and 2015b). They state that the regulation of water levels in the Airport Marsh would likely require building new dikes and fortifying other retaining structures to diminish permeability, as well as adding some pump stations. Such habitat enhancements would be relevant to the FWCP and would meet the criteria for Water License Requirements (WLR) physical works projects. It would also be possible to have trail networks integrated, creating social benefits for the City of Revelstoke and CSRD. Bird and van Oort (2015a) suggest that funding to explore the idea could be available from many sources including the FWCP, WLR, Columbia Basin Trust, and Revelstoke's Tourism Infrastructure funds.

## 3.2 Stakeholder Survey

A total of 26 surveys were sent out to identified stakeholders and 8 responses were returned. Responses were provided by three local organizations (ATV club, Revelstoke Flying Club, and North Columbia Environmental Society), four local residents, and one First Nations company (Estsek' Environmental Services LLP of the Simpcw First Nation). For the purposes of maintaining the respondent's anonymity, detailed responses are not provided in this report. In general, one respondent expressed a positive support for stabilization of water levels in the Airport Slough, three were against it, and four respondents expressed that they would potentially support the project if particular issues they were concerned about would be addressed.

CSRD, the owner and operator of Revelstoke Airport did not complete a survey form; however, they provided by email information on their expansion plans based on their 2008 document entitled: Land Use Plan Brief and Potential Canada Border Services Agency (CBSA) Service for the Revelstoke Airport which shows plans for runway widening and extension of existing runway onto the existing wetlands.



Hydro representatives declined to respond at this point due to the preliminary nature of the project, however they expressed they may provide information from their experience of delivering similar types of projects (i.e., Cartier Bay). A review of similar type projects fell outside of the scope of the current project; however, this should be conducted during the next phase.

Bellow is summary of comments and concerns expressed by survey respondents organized by general topic (e.g. ecosystem function, costs, airport operations, recreation, construction considerations and other):

#### Ecosystem Function:

- Concerns were expressed about unknown impacts of stabilizing water levels on wetland ecology.
- Most information provided is about how water level stabilization will benefit birds (e.g., reduce bird nest flooding and improve waterfowl habitat quality) however not much is known about how it will influence other ecosystem components (e.g. water quality, fish, amphibians, vegetation, mammals, turtles, invertebrates etc.). This is an information gap that needs to be addressed.
- Potential benefits of reduced water fluctuation are reduction of fish entrainment and increase in fish habitat (e.g., increase in food, off-channel habitat for juveniles and forage fish)
- Uncertainty was expressed by couple of respondents as to what natural water level fluctuations should look like for the system.
- Few respondents had issues with potential impact on wetland function as a result of stagnating water levels. Some respondents were under the impression that water level fluctuation was a requirement for healthy wetland function and that stable levels will not benefit the wetlands.
- Importance of connectivity to the mainstem needs to be understood – e.g., how will this project restrict fish movement and impact life cycles, how will productivity be effected etc.
- Several respondents expressed concerns with increased population of mosquitos if water levels stabilized.
- Invasive species exist in the system – how will water stabilization influence their occurrence.

#### Costs/Funding:

- There was a general understanding that will be a very costly project and uncertainty was expressed about funding sources.
- Most expressed that construction and maintenance costs/funding, and long term legal responsibility need to be clarified.
- Recommended funding sources included Columbia Basin Trust, BC Hydro, Municipal Government, Ducks Unlimited or other wetland-enhancement partners, grants only, not direct tax financial support.

#### Airport Operations and Safety:

- Airport safety with enhanced waterfowl use needs to be considered and better understood; this was a significant concern for all respondents.



- Plans are underway for extension of runway as funding becomes available which may result in runway dike extension to Machete Island (Figure 3.2). Recommendation was provided to work with CSRD on extension of existing runway which will contribute partly to the diking of Airport Slough and potential for increased stability in water levels.
- Transport Canada Regulations should be addressed regarding enhancing wildlife in the airport region as this is not allowed within 3.2 kilometers of the runway.

#### Recreation/Trails/Tourism:

- Two respondents expressed that the management of the area for tourism/recreation is in conflict with managing it for wildlife habitat and use, and that managing water levels and recreational/tourism opportunities should be treated as two different objectives. Project should focus on one objective with ancillary benefits managed to meet the main objective.
- Several respondents expressed that there is existing conflict between people and wildlife (i.e. motorized vehicles and dogs disturbing wildlife) in the drawdown zone and that any project in the area needs to take this into consideration.
- Concerns were expressed about trails in sensitive habitat areas (e.g. in vicinity of turtle nesting sites). Most respondents agreed that pathways should be located at the wetland fringes. Viewing blinds were generally considered as good idea.
- There was general support for improvement of trail networks and recreation access (low impact recreation), especially trails leading to south end of the airport as long as recreation access is regulated to reduce disturbance to wildlife.
- Project was observed as an opportunity to expand Revelstoke Greenbelt trail network from Mark Kingsbury bridge across Illecillewaet River, through Airport Slough and possibly towards Williamson Lake.
- Recommendation was made to work with City's trail planning initiative currently under way.
- Most respondents agreed that the first management priority should be ecological with need to minimize human impact of use, however one respondent stated that, if designed appropriately, it is possible to have trails and low impact recreation opportunities in waterfowl habitat [e.g. Rifle Refuge and Burns Bog in lower mainland, Creston Valley Wildlife Management Area, Dessert Centre Osoyoos, Skunk Cabbage Wetland, Mount Revelstoke National Park, Columbia Wetland Adventures near Golden, B.C].
- Public access via trail network would potentially promote wildlife viewing.
- Most respondents were concerned with motorized recreation in the area and whether this project would increase access to motorized vehicles. Most expressed that enforcement of motorized vehicle exclusion will be required.
- Few stated that motorized boating should be discouraged and equestrian use clarified.
- Recreation access will need to be planned to allow for safe and reasonable parking and public access while maintaining security requirements at the airport.

### Construction Considerations:

- It was recommended that proponents review other similar projects in the area and assess their management objectives and whether they were successfully met. This will help understand challenges such as unanticipated costs, highly permeable substrate, subsurface leakage, challenges with reservoir influences, erosion, water pressures, groundwater influence etc.
- Need to consider and mitigate for potential for introduction of invasive plants and noxious weeds in disturbed areas.
- Need to better understand stabilized water elevation targets in order to know the height of dike required and how water levels would be regulated.

### Other:

- Concerns were expressed regarding conflicts among jurisdictions (CSRD, airport, fisheries, property ownership, Fire Base, etc.).
- Respondents expressed lack of clarity and specifics of the project influenced their responses - that the current planning stage was too preliminary for them to respond properly (i.e., location and diking approach was not provided).
- It was recommended that other options for habitat enhancement should be investigated.
- Need for better understanding benefits and potential consequences of water level stabilization in this system is required.
- Need to consider climate change – i.e. impacts of more frequent high water years and more frequent and longer droughts.
- Need to secure broad community support, especially from adjacent landowners.
- Better communication with public is required on changes to public access to the area.

## 4 Recommendations and Conclusions

This project explores the feasibility of a dike around Airport Slough to protect and enhance wetland features through water regulation. Outcomes from discussions with stakeholders and a summary of existing studies on Airport Slough are presented, including the following recommendations for going forward. The following are key results and recommendations:

1. Literature review revealed information gaps on hydrology, specifically to do with holding capacity of the system. This needs to be addressed prior to deciding whether dike is a viable option. Specifically, further steps will need collaboration with CSRD on understanding the influence of existing airport runway and their expansion plans on hydrology of the system.
2. The influence of water level stabilization on water quality, fish, invertebrates (including mosquitos), vegetation, amphibians, mammals, invasive species needs to be better understood. The need to explore a

wide range of ecological aspects to assess potential ecological costs was highlighted by the literature review as well as by stakeholder feedback.

3. The influence of diking on fish communities in Revelstoke Reach wetlands needs to be further investigated; dike must be designed to accommodate fish to avoid unnecessary impacts and/or mortality to fish caused by entrapment and/or enhancement of nuisance species.
4. Issues associated with airplane safety need to be addressed. Understanding this risk was considered of utmost importance by most survey correspondents.
5. Several survey correspondents expressed that clear and succinct management objectives need to be developed for the system and highlighted the need to ensure that these are not in conflict with each other.
6. Carefully thought out and thorough engagement process to secure buy-in from community was also mentioned as requirement for success of any major project affecting the Airport Slough.
7. A committee should be established comprising of BC Hydro, the CSRD (airport owner/operator), landowners, First Nation representatives and other interested stakeholders to address next steps in the process. This project has highlighted the need for collaborative efforts.
8. A review of success and challenges of similar projects (e.g. Downie Marsh; Cartier Bay) in the Revelstoke Reach area should be conducted that needs to include engagement of experts that have worked on similar initiatives prior to developing a preliminary construction design and costs estimate. Further feasibility investigations should include input from engineer, hydrologist and/or reservoir specialist(s).
9. A scoping budget should be developed that could inform decision making whether to proceed towards construction or explore other projects that may provide greater benefit for the cost (see Mid-Columbia Ecosystem Enhancement Project Catalogue: <http://cmiae.org/resources/mid-columbia-ecosystem-enhancement-project-catalogue/>).

In conclusion, we believe the project would provide good ecological value in terms of offsetting BC Hydro footprint and operational impacts on the Upper Columbia River Basin. That said, our initial approach to community engagement proved challenging and therefore requires further consideration. We will continue to engage stakeholders and BC Hydro on the viability and value of these works over the coming year. Decisions on whether to submit an application to FWCP for development of a detail (engineered) design and ultimately completion of physical works will be made once further engagement is completed and concerns better understood.

## 5 References

- AXYS 2002. Mica-Revelstoke-Keenleyside Water Use Plan: breeding bird and migratory shorebird use of the Revelstoke wetlands. AXYS Environmental Consulting Ltd. Report submitted to BC Hydro, Burnaby, British Columbia, Canada.
- BC Hydro. 2007. Columbia River Project Water Use Plan, BC Hydro, Burnaby, BC.
- BC Hydro. 2013. BC Hydro's Revelstoke Wildlife Enhancement Projects Factsheet – January 2013. <https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/environment-sustainability/water-use-planning/southern-interior/revelstoke-wildlife-enhancement-projects-factsheet.pdf>
- Bird, C. and H. van Oort. 2015a. Marsh bird productivity and conservation in Revelstoke Reach. Prepared for Fish and Wildlife Compensation Program. 38pp.
- Bird, C. and H. van Oort. 2015b. Airport Marsh and a case for habitat enhancement. 2015 Regulated Rivers Conference Summary. 148pp. <http://cmiae.org/wp-content/uploads/Regulated-Rivers-Conference-Summary-Final.pdf>
- Boulanger, J., J.G. Woods, and J. Jarvis. 2002. Songbird use of four floodplain vegetation types in the Revelstoke Reach, Upper Arrow Reservoir, British Columbia, Canada. Report submitted to BC Hydro, Revelstoke, British Columbia, Canada.
- Boulanger, J. 2005. Land birds in a high human use riparian zone: Revelstoke Reach wetlands, Columbia Basin Fish and Wildlife Compensation Program, Nelson, BC.
- Duncan, A. 2016. Overwinter Ecology of Western Painted Turtles (*Chrysemis picta bellii*) in a Canadian Reservoir. M.Sc. Dissertation Thesis. Thomson Rivers University.
- FWCP. 2014. Riparian and Wetlands Action Plan. 101 pp.
- Gill, R. and H. van Oort 2015. How do fluctuating reservoir levels influence waterfowl use of wetlands? 2015 Regulated Rivers Conference Summary. 141pp. <http://cmiae.org/wp-content/uploads/Regulated-Rivers-Conference-Summary-Final.pdf>
- Golder Associates (Golder) 2009. Arrow Lakes Reservoir Wildlife Physical Works Feasibility Study Phase II. CLBWORKS-29A Phase 2. Columbia River Project Water Use Plan. Arrow Lakes Reservoir. Volume 1. Pg. 198.
- Hooper, R., L. Gaster and A. Barre. 2016. Year End Report 2016. Columbia Shuswap Invasive Species Society, Revelstoke, B.C. [http://columbiashuswapinvasives.org/wp-content/uploads/2015/12/CSISS\\_Year-End-Report-20161.pdf](http://columbiashuswapinvasives.org/wp-content/uploads/2015/12/CSISS_Year-End-Report-20161.pdf)
- Ignace, Ronald Eric (Stsmél'ecqen). 2008. "Our Oral Histories Are Our Iron Posts: Secwepemc Stories and Historical Consciousness." Vancouver, BC: Simon Fraser University.
- ISC BC (Invasive Species Council of British Columbia). 2015. Eurasian Watermilfoil. [http://bcinvasives.ca/documents/Eurasian\\_Watermilfoil\\_TIPS\\_Final\\_02\\_18\\_2015.pdf](http://bcinvasives.ca/documents/Eurasian_Watermilfoil_TIPS_Final_02_18_2015.pdf)

- ISC BC. 2016. Knotweeds. Japanese knotweed (*Fallopia japonica*) Bohemian knotweed (*Fallopia x bohemica*) Giant knotweed (*Fallopia sachalinensis*) Himalayan knotweed (*Polygonum polystachyum*) TIPS. [http://bcinvasives.ca/documents/Knotweeds\\_TIPS\\_Final\\_07\\_22\\_2016.pdf](http://bcinvasives.ca/documents/Knotweeds_TIPS_Final_07_22_2016.pdf)
- Jarvis, J., and J.G. Woods. 2001. Water birds of the Revelstoke Reach wetlands. Report submitted to BC Hydro, Revelstoke, British Columbia, Canada.
- Kennedy, Dorothy I. D. and Randall T. Bouchard. 1998. Northern Okanagan, Lakes, and Colville. In *Handbook of North American Indians, Vol. 12: Plateau*. Deward E. Walker, ed. Washington DC: Smithsonian Institution Press. Pp. 238-252.
- Maltby, F.L. 2000. Painted Turtle Nest Site Enhancement and Monitoring, Red Devil Hill Nest Site at Revelstoke, BC. Columbia Basin Fish and Wildlife Compensation Program, BC Hydro, B.C. Minist. Environ, Lands and Parks, B.C. Fish. in partnership with Arrow Heights Elementary School, City of Revelstoke. 18pp.
- Miller, M.T. and V.C. Hawkes. Okanagan Nation Alliance and LGL Limited. 2014. Monitoring Wetland and Riparian Habitat in Revelstoke Reach in Response to Wildlife Physical Works. CLBMON-11B Year 4.
- Pearce, C. 2016. Mid-Columbia Ecosystem Enhancement Project Catalogue. <http://cmiae.org/resources/mid-columbia-ecosystem-enhancement-project-catalogue/>
- Penfold, G.E. 2012. A Review of the Range of Impacts and Benefits of the Columbia River Treaty on Basin Communities, the Region and the Province. Unpubl. Rpt. for B.C. Ministry of Energy, Mines and Natural Gas – Columbia River Treaty Review. Victoria, B.C. 87pp. Available at: <http://blog.gov.bc.ca/columbiarivertreaty/files/2012/07/A-Review-of-the-Range-of-Impacts-and-Benefits-of-the-Columbia-River-Treaty6.pdf>
- Utzig, G. and D. Schmidt. 2011. Dam footprint impact summary – BC Hydro dams in the Columbia Basin. Prepared for Fish and Wildlife Compensation Program – Columbia. 49pp.
- Thomson, A., G. Utzig, B. Green, and N. Kapell. 2016. Arrow Lakes Reservoir Mid-Elevation Scenarios: Scoping Evaluation. Prepared for Ministry of Energy and Mines, Province of British Columbia and BC Hydro and Power Authority. Draft.Revision 2.0.
- Tremblay, E.M. 1993. Use of the Upper Arrow Reservoir at Revelstoke B.B. by waterfowl (Anatidae) and other water birds – 1991/92. Prep. by Friends of the Mt. Revelstoke and Glacier Field Naturalists. Revelstoke BC.
- van Oort, H. and J. Cooper. 2015a. CLBMON-36: Kinbasket and Arrow Lakes Reservoirs: nest mortality of migratory birds due to reservoir operations - Year 7, 2014. Prepared for BC Hydro Ware Licence Requirements. 55pp.
- van Oort, H. and J. Cooper. 2015b. CLBMON-40: Arrow Lakes Reservoir shorebird and waterbird monitoring program. Annual report – Year 7, 2014. Prepared for BC Hydro Generation, Water Licence Requirements. 48 pp.
- van Oort, H., D.J. Green, M. Hepp and J.M. Cooper. 2015. Do rising water levels alter nest survivorship in reservoir drawdown zone shrubs? 2015 Regulated Rivers Conference Summary. 148pp. <http://cmiae.org/wp-content/uploads/Regulated-Rivers-Conference-Summary-Final.pdf>



- 
- Wood, C.M. and V. C. Hawkes. Okanagan Nation Alliance and LGL Limited. 2015. Revelstoke Reach painted turtle monitoring program. Wildlife effectiveness monitoring of revegetation and wildlife physical works in the Arrow Lakes Reservoir. CLBMON-11B3 Year 5.
- Wilson, J. W. 1973. People in the Way: The Human Aspects of the Columbia River Project. Toronto: University of Toronto Press.
- WUP (Columbia River Water Use Plan Consultative Committee). 2005. Columbia River project water use plan, Arrow Lakes Reservoir wildlife management plan, Physical works terms of reference. BC Hydro, Revelstoke, British Columbia, Canada.



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# Appendix A

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## Stakeholder Survey



# **Airport Marsh Water Stabilization Project**

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## **Initiation Phase Assessment: Stakeholder Survey 2.0**

**PLEASE RESPOND BY FEBRUARY 10, 2017**



**View north towards Airport Marsh, Revelstoke, B.C. October 2015. G. Shearing photo.**

### **Prepared by:**

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## Introduction

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Yucwmenlucwu (Caretakers of the Land) LLP, SEC Consultants (SEC) have partnered to undertake an initiation phase assessment to determine feasibility of stabilizing water levels in Airport Marsh in Revelstoke, B.C. The initiation phase is the first step in determining feasibility and may be followed by the project definition and planning stage. This survey aims to understand from stakeholders the opportunities and challenges in stabilizing water levels in Airport Marsh and to determine very preliminary costs for implementation of a conceptual plan.

Airport Marsh is a regionally and locally significant wetland complex located in the drawdown zone of Upper Arrow Lakes, adjacent to the Revelstoke Airport. The wetland supports a diversity of plant life, nesting, foraging and shelter habitat for birds, hibernaculum and overwintering habitat for turtles and aquatic habitat for fish. Airport Marsh provides critical nesting habitat for numerous resident and migratory bird species (e.g. Blue Heron, Osprey, Bald Eagle, Yellow-headed Blackbird, Pied-billed Grebe, Virginia Rail, Sora, and Marsh Wren) and foraging and overwintering habitat for Western Painted Turtles. Within the Columbia River basin, no wetlands rival Airport Marsh for regional wildlife productivity.

Recent studies in Airport Marsh have confirmed a link between fluctuating water levels related to hydroelectric reservoir operations and nest mortality of ground, wetland and shrub nesting bird species. Reservoir operations and the resulting nest flooding were identified as the main cause of nest failure in Airport Marsh (Bird and van Oort 2015; van Oort 2015). Stabilizing water levels in Airport Marsh by means of constructing a dike is a possible option for mitigating adverse impacts of reservoir operations on wildlife, including nest mortality, and to enhance overall productivity of the drawdown zone and the Columbia Basin (Bird and van Oort 2015). If a dike system (see photos below) is determined to be feasible, then this project has great potential of restoring and creating a net increase in functioning wetland and riparian habitat.

Previous public events regarding wetlands, such as the one held on May 2<sup>nd</sup>, 2014 by the North Columbia Environmental Society (<http://www.revelstokecurrent.com/2014/04/25/revelstoke-wetlands-past-present-and-future/>), have generated significant community interest in protection and enhancement of Airport Marsh. In addition to valuable ecological function, Airport Marsh provides year-round opportunities to residents and visitors in Revelstoke including walking trails, mountain biking, bird watching, cross-country skiing and more. Additional benefits of protecting this area include the expansion of the existing trail network south of the Mark Kingsbury Bridge over the Illecillewaet River.

You have been selected as a stakeholder representative. We are very interested and grateful for your feedback. Your feedback is not anonymous and will be published in a report submitted to the Fish and Wildlife Compensation Program (<http://fwcp.ca>). FWCP reports are available to the general public through the provincial Ministry of Environment Ecocat database (<http://www.env.gov.bc.ca/ecocat/>).

### REFERENCES:

Bird, C. and H. van Oort. 2015. Marsh bird productivity and conservation in Revelstoke Reach. Prepared for Fish and Wildlife Compensation Program. 38pp.

van Oort, H. and J.M. Cooper. 2015. CLBMON 36: Kinbasket and Arrow Lakes Reservoirs: nest mortality of migratory birds due to reservoir operations— Year 7, 2014. Unpublished report by Cooper Beauchesne and Associates Ltd., Errington, BC, for BC Hydro Generation, Water License Requirements, Burnaby, BC. 31 pp. + Apps.

## Photographs of Airport Marsh



View northeast towards Airport Marsh at high reservoir level. 2014. G. Shearing photo.



View east towards Airport Marsh. H. Van Oort photo.



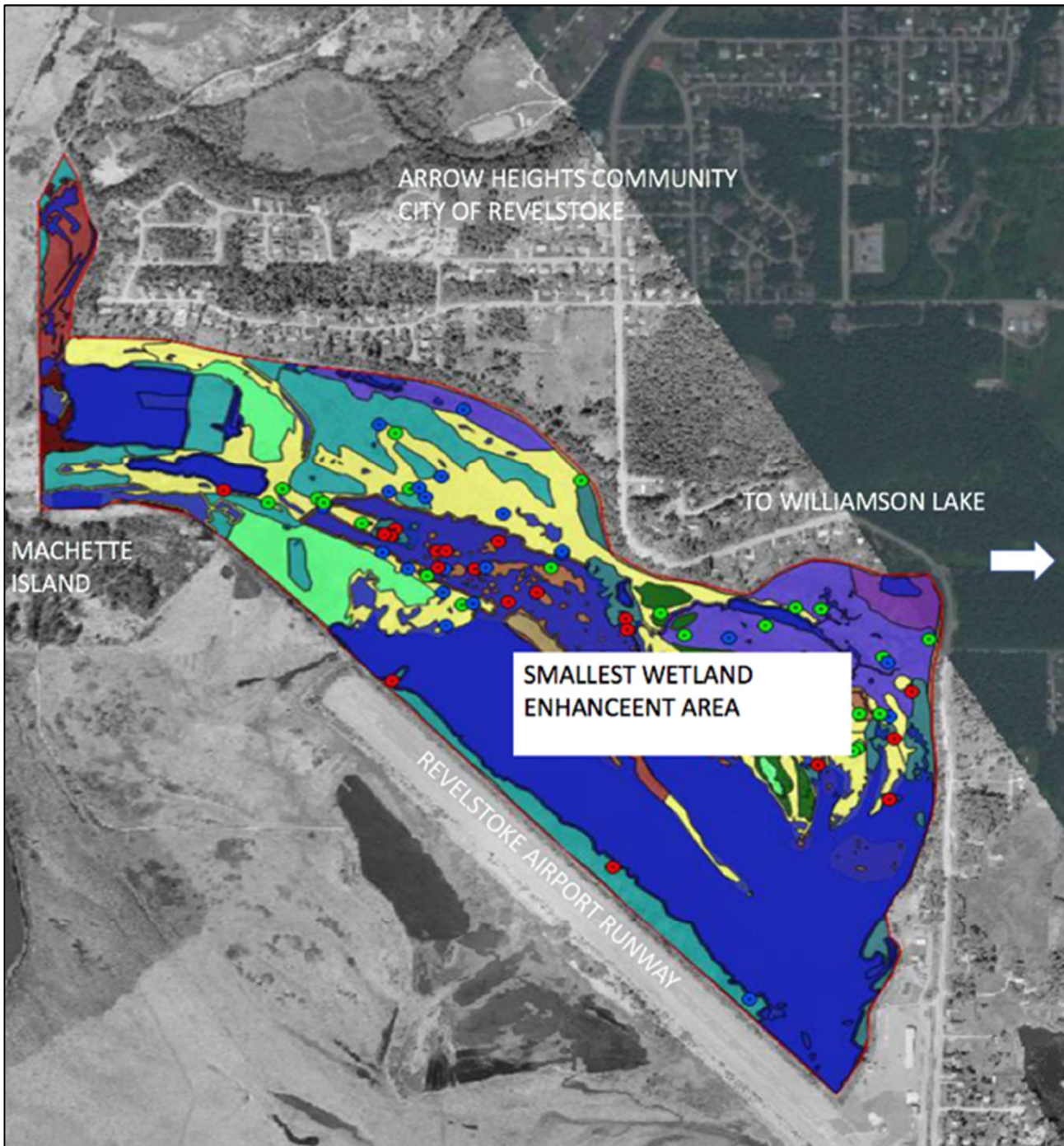


**Example dike around Downie Timber's lumber yard in Revelstoke, maintained by BC Hydro. Dike includes clay core, impermeable membrane, topsoil dressing for small shrubs and grass and paved walkway.**



**Example dike around Downie Timber's lumber yard in Revelstoke, maintained by BC Hydro. Dike includes clay core, impermeable membrane, topsoil dressing for small shrubs and grass and paved walkway.**





Conceptual Airport Marsh Wetland Enhancement and Protection Area (Figure from Bird and van Oort. 2015).



## Stakeholder Survey

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This survey is expected to take approximately 30 minutes to 1 hour to complete, depending on how detailed each participant's answer is to each question. Participants are encouraged to answer each question and to spend the most time writing responses to the questions according to their interest and/or area of expertise. You do not need to answer each question. Thank you very much for participating.

**This survey can be submitted identified OR anonymous. The objective is to understand how stakeholders feel about stabilizing water levels in Airport Marsh. Participant feedback will be compiled into a report, including a synthesis of opportunities and challenges identified from the results, and presented to the Fish and Wildlife Compensation Program, the funding agency for this assessment.**

**When saving your document, please titled the document "Airport Marsh Stakeholder Survey" with your last name or organization name in brackets (e.g., "Airport Marsh Stakeholder Survey (SEC)"). Thank you.**

### Stabilizing Water Levels

1. **Would you support stabilizing water levels in Airport Marsh? (click on check box to select option)**

YES

NO

Maybe  if the following issues were addressed:

- 1)
- 2)
- 3)

2. **Please describe your concerns with stabilizing water levels in Airport Marsh?**

### Wildlife

3. **What opportunities for and/or issues to wildlife/wildlife habitat do you see by stabilizing water levels in Airport Marsh?**



## **Fish**

- 4. What opportunities for and/or issues to fish/fish habitat, if any, do you see by stabilizing water levels in Airport Marsh?**

## **Public Access and Recreation**

The proposed dike project could provide opportunities to expand the Revelstoke 'Greenbelt' trail network south from the Mark Kingsbury bridge across the Illecillewaet River, through the Airport Marsh, possibly all the way towards Williamson Lake and south of the Airport. Such a trail network would enhance public access to the Marsh, and would promote wildlife viewing opportunities for Revelstoke residents and visitors/tourists.

- 5. What opportunities for and/or issues to public access do you see by stabilizing water levels in Airport Marsh?**
- 6. Are there any public use activities that should be encouraged or discouraged?**
- 7. Would you support additional trails and boardwalks through the marsh provided disturbance impacts to wildlife were minimized?**





### **Tourism**

- 8. What opportunities FOR TOURISM do you see by stabilizing water levels in Airport Marsh?**
  
  
  
  
  
  
  
  
  
  
- 9. Would a year-round trail around Airport Marsh increase ecotourism in Revelstoke?**

### **Dike Constructability**

- 10. What construction challenges do you see in stabilizing water levels in Airport Marsh?**
  
  
  
  
  
  
  
  
  
  
- 11. What funding sources should be pursued for this project?**

### **Other Comments**

- 12. Please write here any additional comments here:**



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**Permission to Publish Responses**

All survey results will be compiled into a report prepared for and submitted to the Fish and Wildlife Compensation Program, the funding agency for this assessment.

**13. Do we have permission to publish your name and/or organization along with your comments?**

YES  (Identified)

NO  (Anonymous)

**Respondent Name(s):**

**Response Date:**

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