Peace Project Water Use Plan

Reservoir Wetland Habitat Monitoring

Implementation Year 3

Reference: GMSMON-15

Study Period: April 2013 to February 2014

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GMSMON-15: Reservoir Wetland Habitat Monitoring
Year 3 - Final Report

Report submitted to:

BC Hydro

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Cover photo: Wilson's Snipe chicks, WDS 6-2 (Airport Lagoon), Williston Reservoir. Photo © H. van Oort, Cooper Beauchesne and Associates Ltd.

EXECUTIVE SUMMARY

Reservoir operations have created large unproductive areas within the drawdown zone of Williston Reservoir. This has resulted in limited aquatic and riparian habitats that reduce the area's capacity to support fish and wildlife and potentially increase the risk of predation for terrestrial wildlife using the drawdown zone. To address these impacts, the Riparian and Wetland Habitat Management Plan was developed under the Peace Water Use Plan to investigate the possibility of creating or enhancing perched wetland areas to increase riparian and wetland habitat. An inventory of potential enhancement sites was completed under GMSWORKS-16 *Williston Reservoir Wetlands Inventory* and detailed designs for two locations were completed under GMSWORKS-17 *Williston Reservoir Trial Wetlands*.

The GMSMON-15 project is a 10-year program to monitor the effectiveness of the two demonstration wetland enhancement projects at improving wildlife habitat and maintaining the habitat over the life of the projects. Waterfowl, songbirds, amphibians, and vegetation were identified as the indicator groups for determining the effectiveness of the wetland projects. Fish populations are also being monitored, although improving fish habitat is not one of the goals of the wetland projects. This report presents the results from the third year of monitoring under GMSMON-15. The results provide additional baseline information on the two selected wetland demonstration sites prior to the construction as well as initial post-construction results from one of the sites. The Airport Lagoon project was completed in late May 2013, mid way through the Year 3 monitoring.

In Year 3, habitat class descriptions and spatial distributions were reviewed. Two groups of habitat classes were merged, reducing the total number of classes from 17 to 15. A new habitat class was also identified and habitat mapping was refined based on more recent orthophotos. Similar to Year 2, fewer plant species and lower cover on the sampling transects was observed in Year 3 compared to Year 1. The change in vegetation was attributed to the different reservoir conditions for Years 2 and 3 than in Year 1. The species still present were considered to be those that were tolerant of extended periods of flooding. Plant species identified at lower elevations typically were adapted to wet soils and are considered to be more tolerant of periods of inundation. Plant species identified from higher elevations in the drawdown zone were considered to be less tolerant of inundation.

A total of 417 individuals representing 18 species of waterfowl and shorebirds were observed during the spring surveys. All observations during the waterfowl and shorebird surveys were at the Airport Lagoon. Green-winged Teal and Mallard were the most common species detected, followed by, American Wigeon, Canada Goose, and Ring-necked Duck. The majority of individuals and species were detected during the May 1 survey. Limited waterfowl and shorebird habitat is available at the Beaver Pond site although single individuals of Bufflehead, Surf Scoter, Blue-winged Teal, and Spotted Sandpiper were observed incidentally.

Songbird point counts detected a total of 61 species and 482 individuals. Species richness was higher at the Airport Lagoon site with 57 species compared to 23 species at the Beaver Pond site. An average of 12.1 (n=17) species were detected per point count station at the Airport Lagoon site compared to an average of 14.7 (n=3) species per station at the Beaver Pond site. The larger number of habitats in and adjacent to the Airport Lagoon site contributed to the higher diversity observed.

Western toad, wood frog, and long-toed salamander were observed during the amphibian surveys with western toad accounting for the majority of the observations. Western toad and long-toed salamander were observed at both sites and a single wood frog was observed at the Beaver Pond site. The numbers of amphibians observed may have been affected by dry conditions in May and the different reservoir conditions compared to Year 1.

Fish population sampling was completed by backpack electrofishing, minnow traps, and fyke nets at both sites. The number of fish collected at both sites was higher than in both previous years even with a reduced sampling effort. A total of 2,672 fish were captured representing 11 of the 22 species potentially present in Williston Reservoir. The fish collected were primarily non-sportfish including Lake Chub, Redside Shiner, Northern Pike Minnow, Brassy Minnow, and three species of sucker. The only sportfish collected in Year 3 were ten Burbot from the Airport Lagoon site.

The data collected in Years 1, 2, and 3 of the GMSMON-15 project appear to support the preliminary predictions for the wetland demonstration projects. Data collected in Year 1 was under different reservoir conditions than in Years 2 and 3. Reservoir conditions are considered to be the primary reason for the observed differences in results for vegetation, amphibians, and fish while the differences in results for waterfowl and songbirds were attributed primarily to natural variation. The stabilisation of water levels in the wetland enhancement projects is expected to improve wildlife habitat and increase wildlife use of these areas. Data collected in Year 3 was a combination of additional baseline data (both sites) and initial post-construction data at the Airport Lagoon site. The three years of baseline data (including two years under similar reservoir conditions) have described the existing conditions and wildlife use of both sites.

MANAGEMENT SUMMARY: STATUS OF GMSMON-15 MANAGEMENT QUESTIONS AND HYPOTHESES – YEAR 3

Management Question	Management Hypothesis (Null)	Year 3 (2013) Status
Is there a change in the abundance, diversity and extent of vegetation in the enhancement area?	H_{01}: The density, diversity and spatial extent of riparian and aquatic vegetation does not change following enhancement.	Testing of this hypothesis is not yet possible as no post-construction data has been collected. Baseline vegetation data collection at both sites is complete.
Are the enhanced (or newly created) wetlands used by waterfowl and other wildlife?		No post-construction data on wildlife habitat has been collected yet as the Airport Lagoon project was just completed in spring 2013 and the Beaver Pond project is scheduled for spring 2014. Baseline data collection on the existing use of the sites by waterfowl and other wildlife is complete.
	H_{02}: The species composition and density of waterfowl and songbirds does not change following enhancement.	Testing of this hypothesis is not yet possible as no post-construction data has been collected. Baseline data collection on waterfowl, shorebird, and songbird use of both sites is complete.
	H_{03}: Amphibian abundance and diversity in the wetland does not change following wetland enhancement.	Testing of this hypothesis is not yet possible as no post-construction data has been collected. Amphibian baseline data collection at both is complete.
Is the area and quality of wildlife habitat created by the wetland enhancement maintained over time?		No post-construction data on wildlife habitat has been collected yet as the Airport Lagoon project was just completed in spring 2013 and the Beaver Pond project is scheduled for spring 2014.

ACKNOWLEDGEMENTS

A number of people have contributed to completion of Year 3 of the GMSMON-15 project. BC Hydro WLR sponsored the project. Ongoing guidance and support was provided by Mike McArthur.

Field work was completed by CBA staff Andrew MacInnis, Allan Carson, Ryan Gill, and Harry van Oort with assistance from Emily Braam and Tim Schneider. Andrew MacInnis (CBA Senior Fisheries Biologist) was Project Manager with assistance from John Cooper the Project Advisor.

The report was written by Andrew MacInnis and Allan Carson. Ryan Gill conducted the GIS analyses and prepared maps for the report. John Cooper provided a review of the draft report.

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1 INTRODUCTION

1.1 Background

During consultations under the Peace Water Use Plan (WUP), the Consultative Committee recognized that reservoir operations created large unproductive areas within the drawdown zone of Williston Reservoir (Anon. 2003). The resulting limited aquatic and riparian habitats were hypothesized to have two primary impacts: they limit the area's capacity to support fish and wildlife and they potentially increase the risk of predation for terrestrial wildlife utilizing the drawdown zone. The large area (~450 km^2) of the drawdown zone between the low and high water levels, provides little wildlife habitat when exposed during low water levels and little habitat for fish when inundated (Anon. 2003). The fluctuating water levels were also identified as affecting riparian productivity around the reservoir.

It was noted that when water levels recede during drawdown, pools and isolated backwater areas formed in some locations around the reservoir. The contribution of these pools and backwaters to wildlife and fish productivity is variable, depending on the location. The Riparian and Wetland Habitat Management Plan was developed within the WUP to investigate the possibility of creating or enhancing additional perched wetland areas to increase riparian and wetland habitat (Anon. 2003). The components of the plan were an inventory of sites that were potentially suitable for enhancement, selection of sites for implementation of demonstration wetland enhancement projects, and a monitoring program to test their effectiveness in improving riparian and foreshore habitat for wetland species over the life of the project. If the projects were considered to be successful, then the potential for creating additional wetlands would be assessed (BC Hydro 2007).

The inventory of potential enhancement sites was completed under GMSWORKS-16 *Williston Reservoir Wetlands Inventory*. A total of 42 sites in the Parsnip Arm were reviewed as potential wetland enhancement sites by Golder (2010). Of the 42 sites reviewed, five candidate sites were identified for demonstration projects on the basis of a combination of factors including (but not limited to) cost, feasibility, and potential benefit to wildlife (Golder 2010). The second phase was completed under GMSWORKS-17 *Williston Reservoir Trial Wetland*. Two of the five candidate sites were selected as demonstration sites and detailed designs developed (Golder 2011). Monitoring of the effectiveness of the wetland demonstration projects in improving wildlife habitat on the reservoir will be completed under GMSMON-15 *Reservoir Wetland Habitat*.

1.2 Monitoring Plan Overview

The GMSMON-15 project is a 10-year monitoring program to assess the effectiveness of the demonstration wetland enhancement projects at improving wildlife habitat and maintaining the habitat over the life of the two projects (BC Hydro 2010). This effectiveness monitoring program is designed to determine the response of selected indicator groups to the wetland enhancements and to increase knowledge of wildlife use of the drawdown zone for the selected groups, particularly birds and amphibians. Monitoring the responses of all species is not feasible; therefore, BC Hydro (2010) identified waterfowl, songbirds, amphibians, and vegetation as the wildlife indicator groups to be used for monitoring in GMSMON-15. Fish populations were also identified for monitoring as fish were observed at both of the selected demonstration sites (Golder 2010, 2011). While improving fish habitat is not one of the goals of the wetland enhancement projects, little is known about the fish species composition and distribution at the selected locations (BC Hydro 2010).

This report presents the results from the third year of the GMSMON-15 monitoring program. The results provide a third year of baseline information for one of the two selected wetland demonstration sites (“Beaver Pond”) prior to the construction. Construction of one project (“Airport Lagoon”) was completed during the Year 3 (2013) monitoring period resulting in the collection of additional baseline data and some initial post-construction data on this project. Recommendations for post-construction monitoring are provided along with considerations for the final design and construction phases of the remaining demonstration project.

2 MANAGEMENT QUESTIONS AND HYPOTHESES

The monitoring objectives and hypotheses for GMSMON-15 were stated in the Terms of Reference for the project (BC Hydro 2010). These are restated below along with a brief summary of how the testing of each hypothesis is approached in the study design.

Three key management questions regarding the effectiveness of the wetland enhancements were identified for the Reservoir Wetland Habitat monitoring program:

1. Are the enhanced (or newly created) wetlands used by waterfowl and other wildlife?
2. Is there a change in the abundance, diversity and extent of vegetation in the enhancement area?
3. Is the area and quality of wildlife habitat created by the wetland enhancement maintained over time?

Based on these management questions, the study was designed to test the following hypotheses stated in the Terms of Reference:

H_{01}: The density, diversity and spatial extent of riparian and aquatic vegetation does not change following enhancement;
H_{02}: The species composition and density of waterfowl and songbirds does not change following enhancement;
H_{03}: Amphibian abundance and diversity in the wetland does not change following wetland enhancement.

The monitoring program will collect annual data on riparian and aquatic vegetation density, diversity, and spatial extent, waterfowl and songbird abundance and diversity, and amphibian abundance and diversity. Annual monitoring of fish diversity and abundance will also be completed. There are no specific management questions or hypotheses for fish to be tested as the focus of the projects is on enhancing wildlife habitat rather than fish habitat.

The general approach is to sample each of the indicator groups at locations within the core area of the enhancement treatments and in peripheral riparian areas at both sites. Riparian vegetation will be monitored using annual quadrat sampling and aerial photo analysis. Songbirds will be surveyed using breeding bird point counts and nest searches. Waterfowl and shorebirds will be surveyed by land-based observations. Amphibians will be inventoried using systematic surveys to determine relative abundance. Fish will be sampled with minnow traps, fyke nets and by electrofishing.

3 STUDY AREA

Williston Reservoir is located in northeastern British Columbia and was created by construction of the W.A.C. Bennett Dam at the head of the Peace River Canyon, about 20 km west of Hudson's Hope, B.C (BC Hydro 2007). The reservoir extends for about 260 km along the Rocky Mountain Trench from the Finlay River in the north to the Parsnip River in the south. The reservoir is generally divided into three geographic regions (from north to south): Finlay Reach, Peace Reach and Parsnip Reach (BC Hydro 2007).

The reservoir is located within the Sub-Boreal Spruce and Boreal White and Black Spruce biogeoclimatic zones (Meidinger and Pojar 1991). The Sub-Boreal Spruce zone is the dominant zone and occurs as two subzones and variants at lower elevations along most of the reservoir (Meidinger and Pojar 1991). The Boreal White and Black Spruce zone occurs only at the northern end of the reservoir in the Finlay Arm (Meidinger and Pojar 1991). The drawdown zone consists of large areas of mud, sand and gravel flats with stranded large woody debris. Limited amounts of vegetation occur even following extended periods of drawdown.

The water level in the reservoir varies annually with reservoir filling and drafting. The spring and summer reservoir levels (April – August, low to full pool) for the first three years of this study (Year 1: 2011, Year 2: 2012, and Year 3: 2013) are shown in Figure 1 along with the mean reservoir level. The reservoir levels from 2010 are also included as they were below average and influenced the results observed in 2011. In 2013, the reservoir reached its lowest level of 659.2 m on May 3 which is similar timing to 2011 and 2012. Water levels in 2013 increased relatively rapidly until early June when the rate of increase declined and the reservoir reached a maximum of 669.8 m on August 4 (BC Hydro CRO database). This is a lower maximum elevation than in 2011 and 2012 but is similar to long-term mean levels (Figure 1). Reservoir levels in all three years are higher than in 2010 when reservoir levels had only reached a level of 664.7 m in mid August and only reached a maximum of 665.54 m on November 8, 2010 (BC Hydro CRO database).

The two locations identified for the wetland demonstration projects are both located on the east side of the Parsnip Reach of the reservoir (Figure 2). The Airport Lagoon site (WDS 6-2) is located approximately six kilometres south of Mackenzie and is an approximately 75 ha site on the upstream side of a forest service road causeway. Except for two culverts at the base of the causeway the area is isolated from the main reservoir. Water supply to the lagoon is primarily from two unnamed streams located at the north end of the lagoon. At reservoir elevations >664.5 m, the reservoir becomes connected to the lagoon and water levels in the lagoon correspond to reservoir levels. The proposed treatment for this site was the installation of two new culverts at an elevation of 667.5 m to create a larger area of permanently flooded habitat and reduce water level changes (Golder 2011). The stable water level is anticipated to allow for colonization by submergent and emergent vegetation as well as enhance the riparian zone to benefit waterfowl, wading birds and amphibians (Golder 2011). Decommissioning of the old culverts and installation of the two new culverts was completed in late May 2013 (Golder 2013). The as-built culvert elevations were 666.99 m for the west culvert and 667.05 m for the east culvert (Golder 2013). A portion of the data collection in 2013 occurred after water levels in the lagoon were elevated as a result of the project. The approximate extent of flooding is included on the Airport Lagoon maps as the 667 m contour. This was generated from a digital elevation model (DEM) provided by BC Hydro. The resolution of this data may not accurately reflect true extent of flooding at this site due to complex micro-topography, particularly in the northeast quadrant.

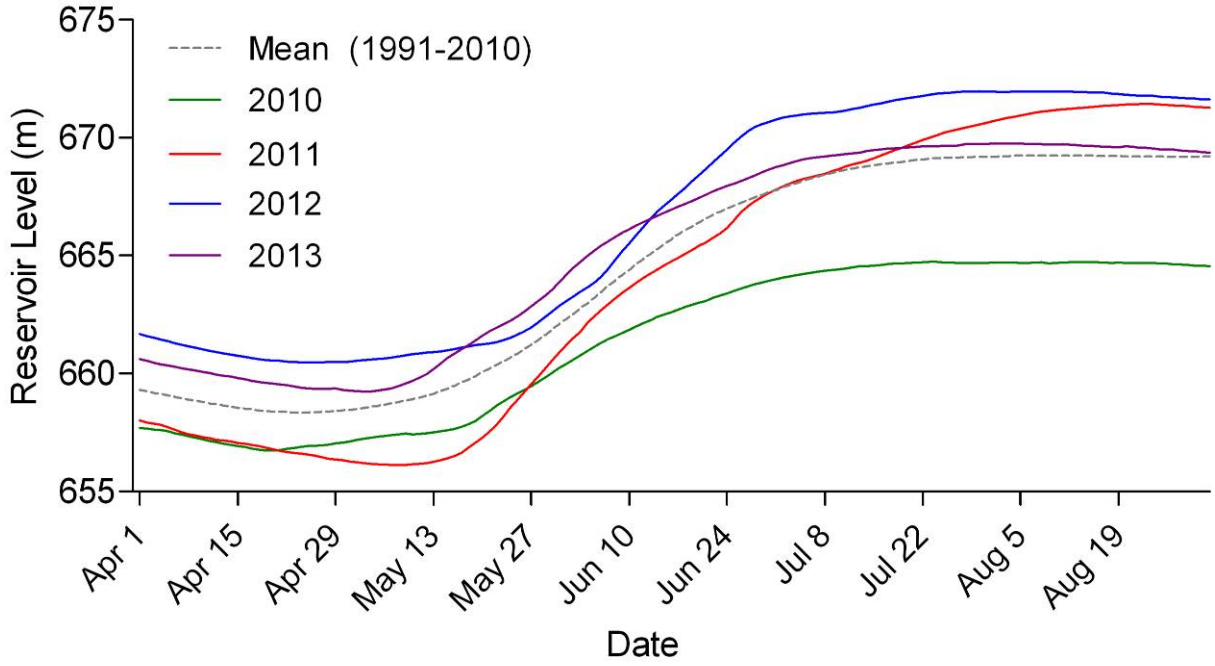

Figure 1. Spring and summer Williston Reservoir levels for 2010, 2011, 2012, and 2013.

The Beaver Pond site (WDS 34) is located approximately 22 km northwest of Mackenzie at the end of a narrow inlet on Heather Point. There are two beaver ponds located at the head of the inlet with a small stream draining the ponds. The stream also appears to be partially supplied by an area of ground water seepage. The proposed treatment for this site is the installation of a berm to create a wetland of approximately 2 ha in area (Golder 2011). The top of the berm will be at 669 m resulting in the wetland being directly connected to the reservoir during periods when it exceeds this elevation. With the exception of the stream and an adjacent area of groundwater seepage, this area is currently dry when water levels are below 666 m. The creation of an area with stable water levels is designed to allow for colonization by submergent and emergent vegetation, and enhance the riparian zone to benefit wading birds and amphibians (Golder 2011). Construction of this project is planned for spring 2014. The approximate extent of flooding is included on the Beaver Pond maps as the 669 m contour and the proposed berm. This was generated from a digital elevation model (DEM) provided by BC Hydro. The shapefile of the proposed berm was provided by Golder Associates Ltd. (Golder 2011).

The uniqueness of both sites, along with the specific physical works proposed for each, means there are no associated control sites in this project.

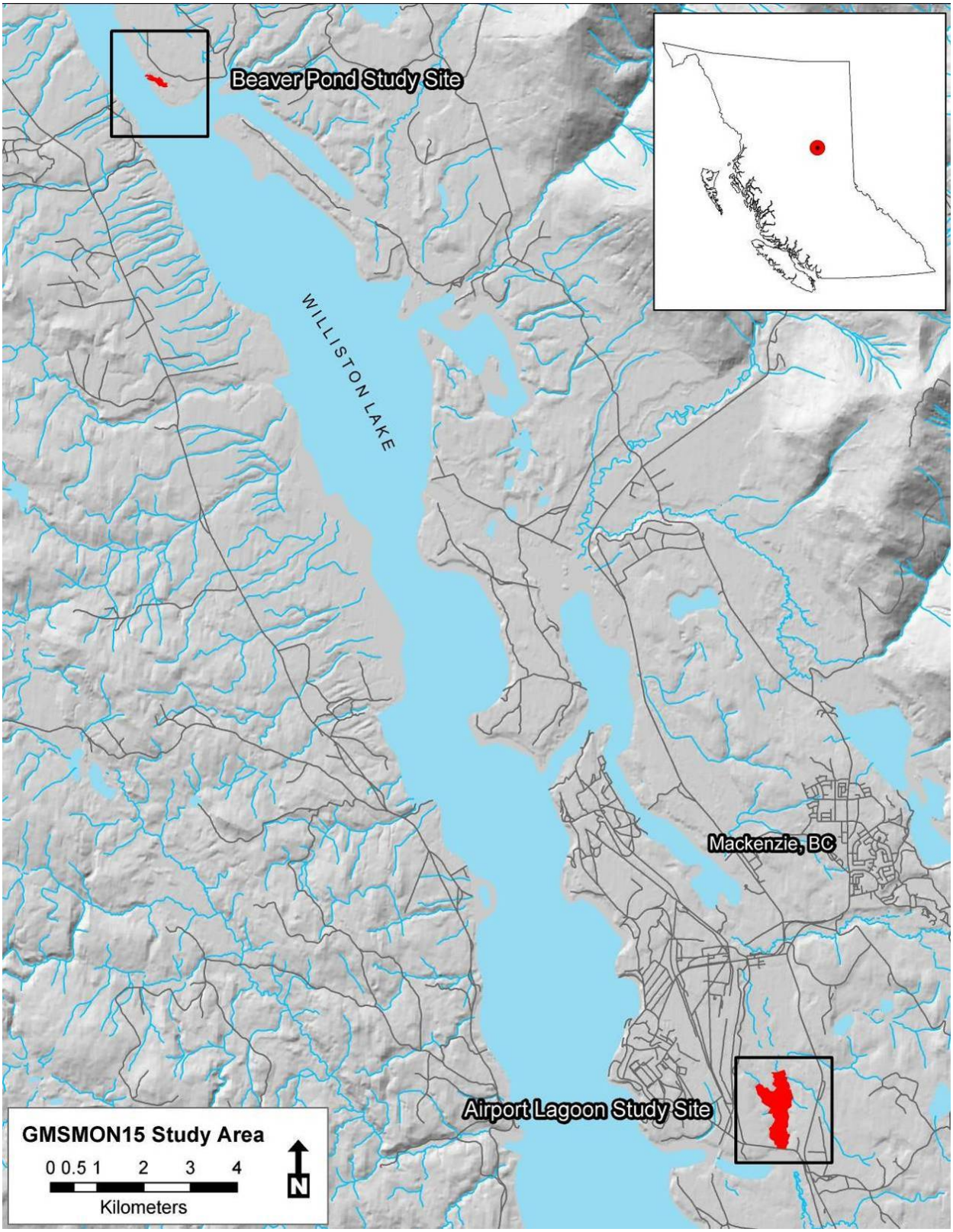

Figure 2. **Location of the two wetland demonstration sites on the Parsnip Reach of Williston Reservoir.**

4 METHODS

4.1 Environmental Conditions

Environmental conditions specific to each survey type were recorded at the start of each survey and periodically during the surveys. Daily mean air temperature and precipitation data prior to and during the survey period were obtained from Environment Canada and observed at the Mackenzie Airport weather station (Station names: Mackenzie A and Mackenzie Airport Auto).

Accumulated degree days were also calculated using a base temperature of 5°C as an additional method to compare environmental conditions between years. The base temperature of 5°C was selected as an indicator of activity for breeding amphibians. A minimum night–time temperature of 5°C is used as an indicator for the timing of early season call surveys (e.g., USGS North American Amphibian Monitoring Program, Bird Studies Canada Marsh Monitoring Program).

4.2 Vegetation Surveys

A combination of air photo interpretation and terrestrial ecosystem ground sampling was used to describe vegetation communities at both sites (Province of British Columbia 2010, RISC 2010). The TEM standards (Province of British Columbia 2010) were used as the plant species assemblages and soil profiles identified within the project sites were not consistent with the wetland classes described by Mackenzie and Moran (2004). Mackenzie and Moran (2004) describe naturally recurring wetlands within British Columbia that are relatively stable in terms of their hydrologic cycle and plant species composition and have established over long periods of time. Due to variability of flood events in the drawdown zone from dam operations, the plant species assemblages identified in this project are in constant transition to a stable state. Therefore, habitat classes were created based on information collected during initial site investigations and air photo interpretation instead of the Mackenzie and Moran (2004) wetland classes.

All photo interpretation was completed in 2-D softcopy using ArcGIS (version 9.3, ESRI 2008). Digital ortho-rectified 1:5000 air photos provided by BC Hydro were used as the background layer for delineating polygons. A habitat classification scheme based on RISC (2010) was developed to capture all the habitat classes in the study area visible at the resolution available. Habitat classes were first determined from an overview of the study area to identify the larger vegetation features. As the study area was viewed at finer scales during photo interpretation more vegetation features were identified. As new vegetation features were encountered, additional habitat classes were created to accommodate them.

Field notes on vegetation composition and structure from informal inspections of the study sites prior to the air photo interpretation assisted with establishing the initial habitat classes. Each habitat class was identified based on a common plant species assemblage and elevation position within the drawdown zone. The spatial arrangement of habitat classes often followed a similar pattern. For example, at the Airport Lagoon, a band of coarse woody debris parallel to the edge of the reservoir at full pool usually transitioned downslope into a band of sparsely vegetated sand followed by an area of sparsely vegetated mud adjacent to the water's edge.

Due to the relatively small area of both of the study sites, a map scale of 1:1000 was used as the initial resolution for polygon typing. Where required, a larger scale was used to differentiate

similar or small area polygons. Overall, the scale varied roughly between 1:2000 and 1:200 throughout the interpretation process depending on the size of the habitat polygon.

Following the air photo interpretation, Year 1 (2011) ground sampling was conducted to confirm habitat classes and to complete descriptions. Vegetation ground sampling was completed at both sites on June 17-23, 2011. The timing of the surveys in June was to assist in identification of plant species by observing species when they were fully flushed and flower inflorescences were present to assist in identification; and prior to the sites being flooded by rising reservoir levels. Prior to commencing sampling, lists of common plant species as well as red- and blue-listed species occurring in the area were reviewed. A total of ten transects were completed at the Airport Lagoon site and five transects at the Beaver Pond site. Coordinates for the transects are included in Appendix 1.

In Year 2 (2012), ground sampling at each of the vegetation transects established in 2011 (10 transects at the Airport Lagoon site and five transects at the Beaver Pond site) was completed between June 2-4, 2012. Sampling was completed earlier than in Year 1 due to higher forecasted reservoir levels in 2012 than in 2011. Based on forecasted reservoir levels the majority of sites would have been underwater if sampled at the same time as in 2011. Prior to sampling, the list of species detected at the two study sites in Year 1, along with an up-to-date list of red and blue-listed plant species from the Conservation Data Centre (CDC; May 2012) was reviewed.

In Year 3 (2013), ground sampling of the ten vegetation transects at the Airport Lagoon site and the five vegetation transects at the Beaver Pond site was completed between June 7-10, 2013. Sampling dates were selected to correspond with Year 2 sampling, expected reservoir levels, and coordinate with other planned sampling. Prior to sampling, the list of species detected at the two study sites in Year 1 and 2, along with an up-to-date list of red and blue-listed plant species from the Conservation Data Centre (CDC; May 2013) were reviewed.

As the habitats being surveyed were often linear in shape, a transect-based method for vegetation sampling was selected over a grid-based method (using design components from LGL (2007) and US EPA (2002a)). A 20 m long belt-line quadrat transect consisting of ten 2 m x 0.5 m rectangles was laid out (Figure 3) using a 30 m tape and 2 m measuring rod. UTM coordinates were recorded for the transect start and endpoints, and a spray-painted piece of re-bar was driven in the ground at both points. A photograph was taken at the start point and end point of the transect, each looking along the transect.

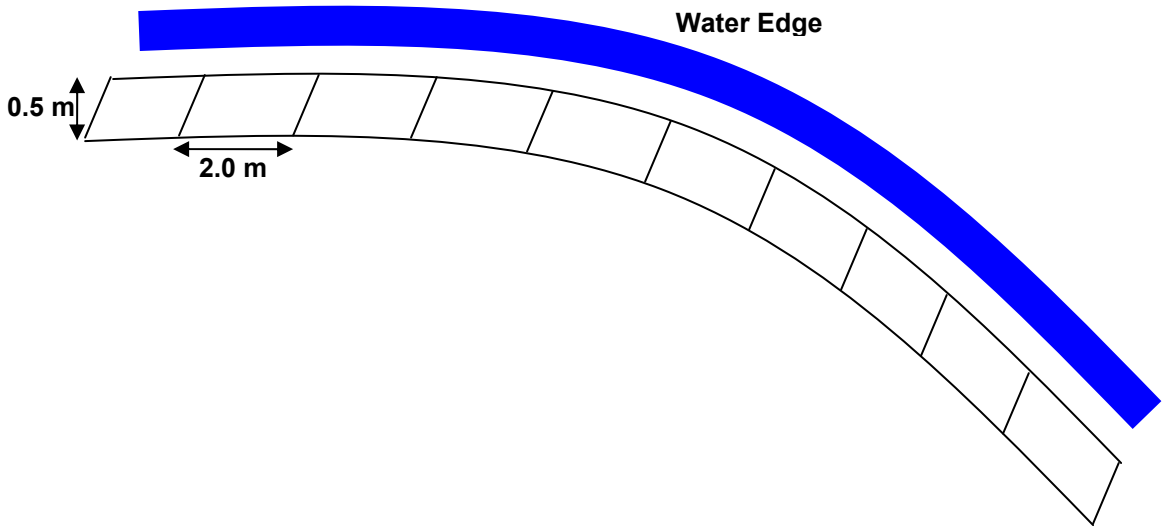

Figure 3. Belt-line quadrat transect for a sample site laid out adjacent to the riparian area.

Site and soil characteristics for the entire transect were recorded on provincial ecosystem field forms (Province of British Columbia 2010), including seral and structural stage characteristics (Appendix 2). Site characteristics representative of the whole site were recorded and a representative location was chosen for the soil pit. Within each quadrat, vegetation was identified to species and the percent cover of each species recorded. The terrestrial ecosystem keys (Province of British Columbia 2010) were used to describe soil characteristics and plant species were identified using MacKinnon et al. (1999). Where identification of species was not possible or uncertain, samples were taken and identified in the botany laboratory of the University of Northern British Columbia (UNBC) using Hitchcock and Cronquist (1973). Where species identification was still problematic or where correct identification was particularly important (i.e., with a potential red-listed species), a plant taxonomy expert from UNBC was asked to confirm the initial result. Plants listed as rare or endangered at the provincial or federal level were recorded on a Rare Plant Observation Form and submitted to the BC Conservation Data Centre.

Based on information collected during ground sampling in Years 2 and 3, a review of habitat classes identified in Year 1 of the study was completed to determine whether refinements to the description (i.e., vegetation and soil characteristics) of the existing habitat classes were required. Where two habitat classes were found to be very similar, they were merged into a single habitat class.

4.3 Waterfowl and Shorebird Surveys

Land-based surveys, following the protocols for absolute abundance inventories of waterfowl species (Resources Inventory Committee 1999a), were used to record waterfowl and shorebird occurrence at the study sites. Shorebirds were not included in 2011 but were added in 2012 to provide additional detail on bird use of the sites. Surveys began in early spring to capture migrating waterfowl and continued through to late spring. Waterfowl surveys were completed on May 1, 12, and 25, and June 10 at the Airport Lagoon site and on May 13 and 26 at the Beaver Pond site. The surveys started later at the Beaver Pond site due to access issues (late spring ice

on Williston Reservoir). Surveys at both sites were completed at the previously established stations at each site, including the fourth station added at the Airport Lagoon in 2012 (Figure 4). Coordinates for the survey stations are provided in Appendix 3.

A combination of a modified RIC data form (1999a) and a map with an orthophoto background of each site was used to record waterfowl observations (Appendix 4). Survey conditions (temperature, wind direction, wind speed, precipitation, cloud cover, and ceiling height) were noted at the beginning and end of each survey, and any unusual events (if any) in the wetland area that may have affected survey results. Upon arrival at a station, the observer scanned the area with binoculars to obtain an overview of birds present and also note any bird or group of birds that may have taken flight upon arrival. Any birds that took flight on arrival at the station were recorded on the data form. Observers ensured that groups of birds were not double counted if they could be seen from more than one observation station. To avoid double counting birds, observers noted a suitable landmark to set the limit of the observations taken from that station. The location of such a boundary changed from survey to survey depending on water levels and the distribution of groups of waterfowl.

From a survey station the respective survey area was slowly and systematically scanned at low magnification with binoculars. A spotting scope was used to identify birds or groups of birds that could not be identified with binoculars due to small size or distance from the observer. Observers drew a polygon with a unique ID number for every group of birds on field data maps created for this purpose (Appendix 4). Care was taken to draw the polygon as accurately as possible by matching up landmarks with their corresponding location on the orthophoto background. On the observation form, a new data line was recorded for all groups that could be defined by species and number of individuals, with associated information such as number of broods present, sex, behavioural activity, and habitat within each polygon. Behaviour was recorded as one of several categories as were habitat descriptors for the polygon. Species codes followed RIC (2008).

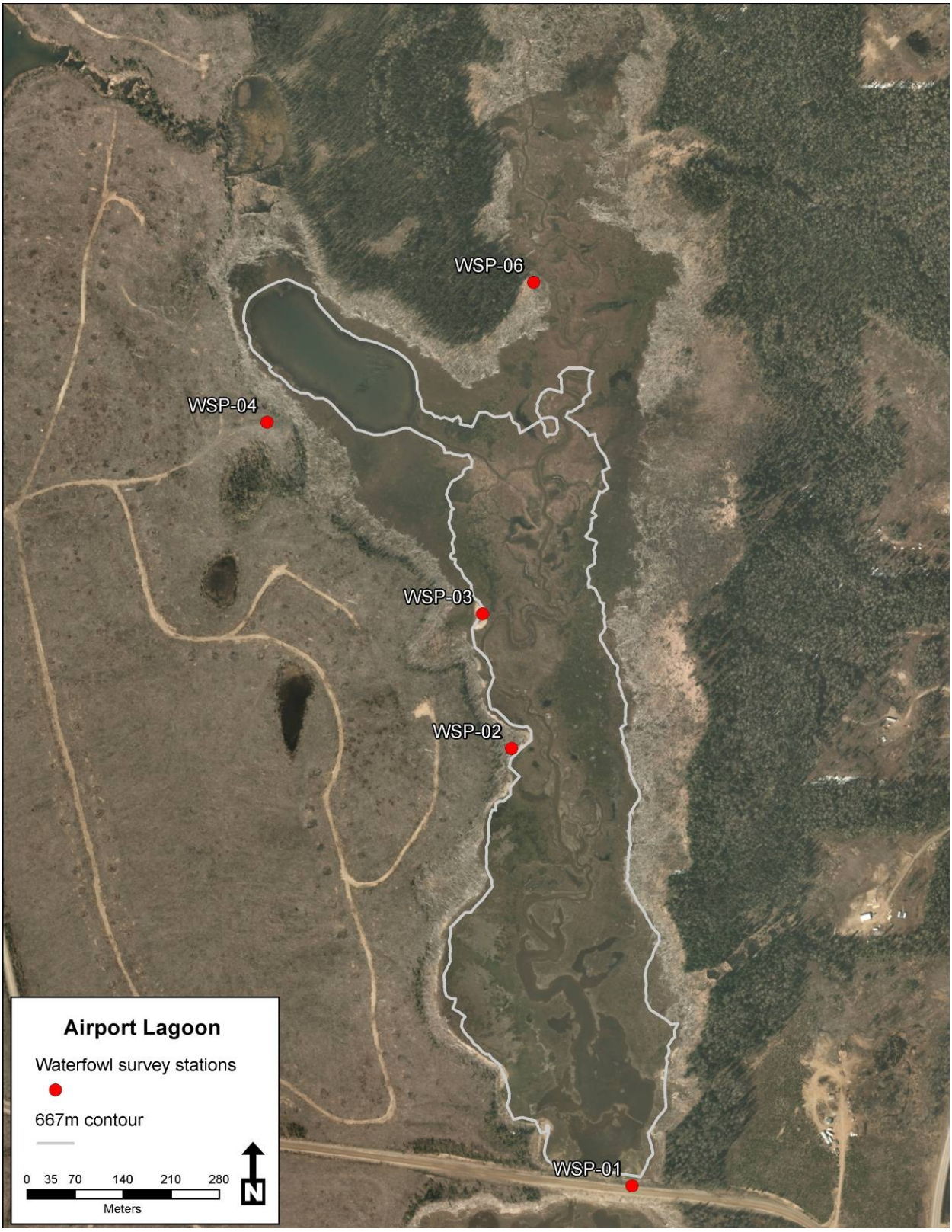

Figure 4. Waterfowl survey station locations at the Airport Lagoon site.

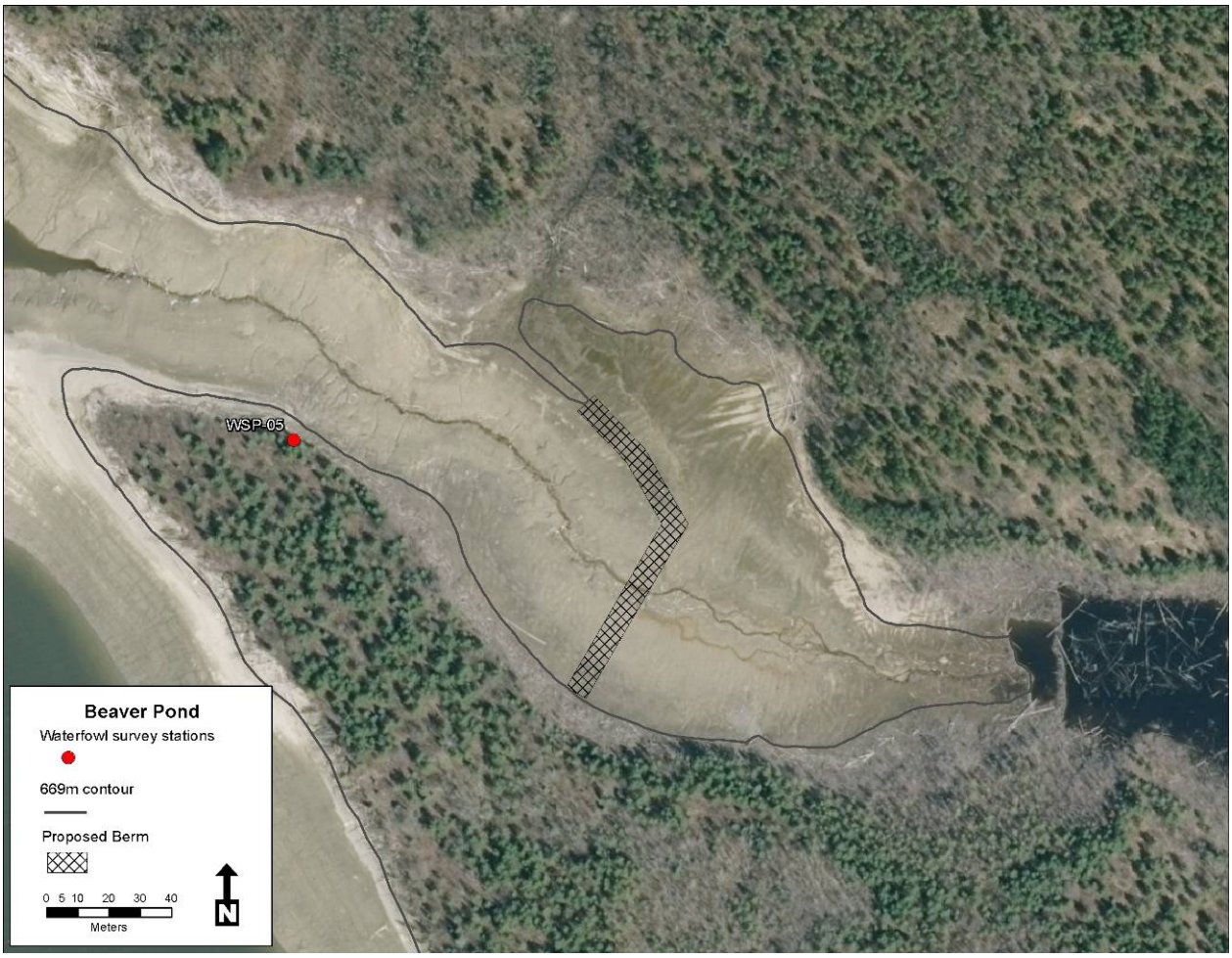

Figure 5. Waterfowl survey station locations at the Beaver Pond site.

4.4 Songbird Surveys

Variable radius point counts and nest searches following Bird Studies Canada and RIC methods (Resources Inventory Committee 1999b, Bird Studies Canada 2009) were used to record breeding bird communities in the study sites. Point count surveys were conducted from June 4-9, 2013 at the Airport Lagoon and Beaver Pond sites. All surveys were conducted during the breeding season (May 28 – July 10) (Bird Studies Canada 2009) within a four hour period commencing at sunrise. Previous work in the area (Hentz and Cooper 2006, CBA 2008) suggested that mid-June is the peak of the breeding season. Three replicates were completed at each site to give a 'snapshot' of the breeding bird community (Resources Inventory Committee 1999b).

Point counts were completed at the seventeen Airport Lagoon survey stations (Figure 6) and three Beaver Pond survey stations (Figure 7) established in Year 1. Point count stations were distributed throughout the study sites to ensure maximum coverage of the areas. The same locations were also surveyed in Year 2. Point count station centres were spaced a minimum of 200 m apart to prevent overlap of the 100 m radius survey areas. The UTM coordinates for the centre of each point count station were recorded to ensure subsequent survey replicates were

repeated in the same location. Coordinates for the point count stations are provided in Appendix 5.

Breeding bird surveys were conducted by performing five minute point count surveys and recording all species heard or seen. Upon arriving at a point count station, the observer waited one minute to allow any disturbance effects on resident birds to dissipate. The point count form was oriented north for each survey. During point counts, each bird detection (a detection can include more than one individual; e.g., one detection of a flock of ten Pine Siskins) within 100 m was spatially mapped on a data sheet with concentric radii of 25, 50, 75, and 100 m from the point count station (Appendix 6). Birds beyond 100 m were noted on the data sheets but not spatially located, as distance estimation at further distances is problematic (Alldredge et al. 2007). Time was broken down into intervals of 0-3 and 3-5 minutes and detections were assigned to the time interval they were initially detected in.

Bird detections were categorised as in the drawdown zone, in the shrub fringe at the upper edge of the drawdown zone, in forested habitat bordering the shrub fringe, as 'flying-over' and not associated with any vegetation type, or unknown. These data will allow separation of bird detections into those occurring within the drawdown zone and those occurring above the drawdown zone in terrestrial habitats. Species detected in the drawdown zone are considered more likely to have a response to the proposed wetland enhancements than those using terrestrial habitats above the drawdown zone.

Environmental variables (ceiling, cloud cover, wind, precipitation) (Appendix 7) and time of day were also recorded. Birds detected flying over the point count station were recorded but were noted as "fly-overs" rather than detections associated with habitat sampled by the point count survey. Based on previous experience conducting point count surveys in the cool, wet northern BC spring (Hentz and Cooper 2006, CBA 2008), surveys were conducted according to 'modified' RISC standards for environmental conditions (Resources Inventory Committee 1999b). These standards are as follows: wind speed ≤ Beaufort 3 (gentle breeze, leaves and twigs constantly move), precipitation = 'very' light rain, temperature > 3˚C. Species codes followed RIC (2008).

Nest searches were conducted opportunistically after morning point count surveys. Areas where breeding behaviour (e.g., carrying nest-building material) was observed during the point counts were the focal areas for conducting subsequent nest searches. Searches were focused on the drawdown zone and adjacent areas (within 50 m the drawdown zone). The UTM coordinates, type, height off the ground, and species using the nest were recorded for each nest. Coarse resolution vegetation composition data were also collected around nests to better describe nest sites.

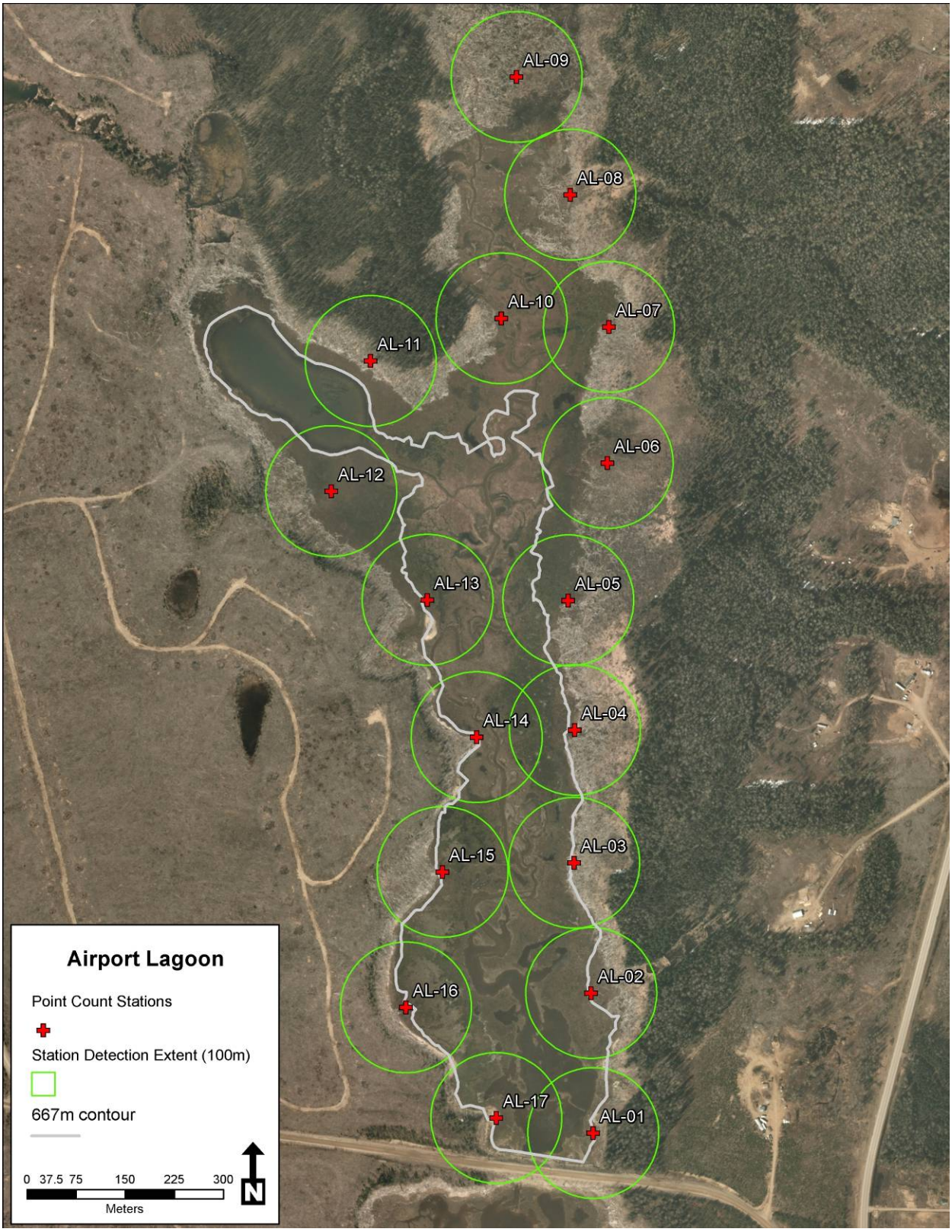

Figure 6. Point count station locations at the Airport Lagoon site.

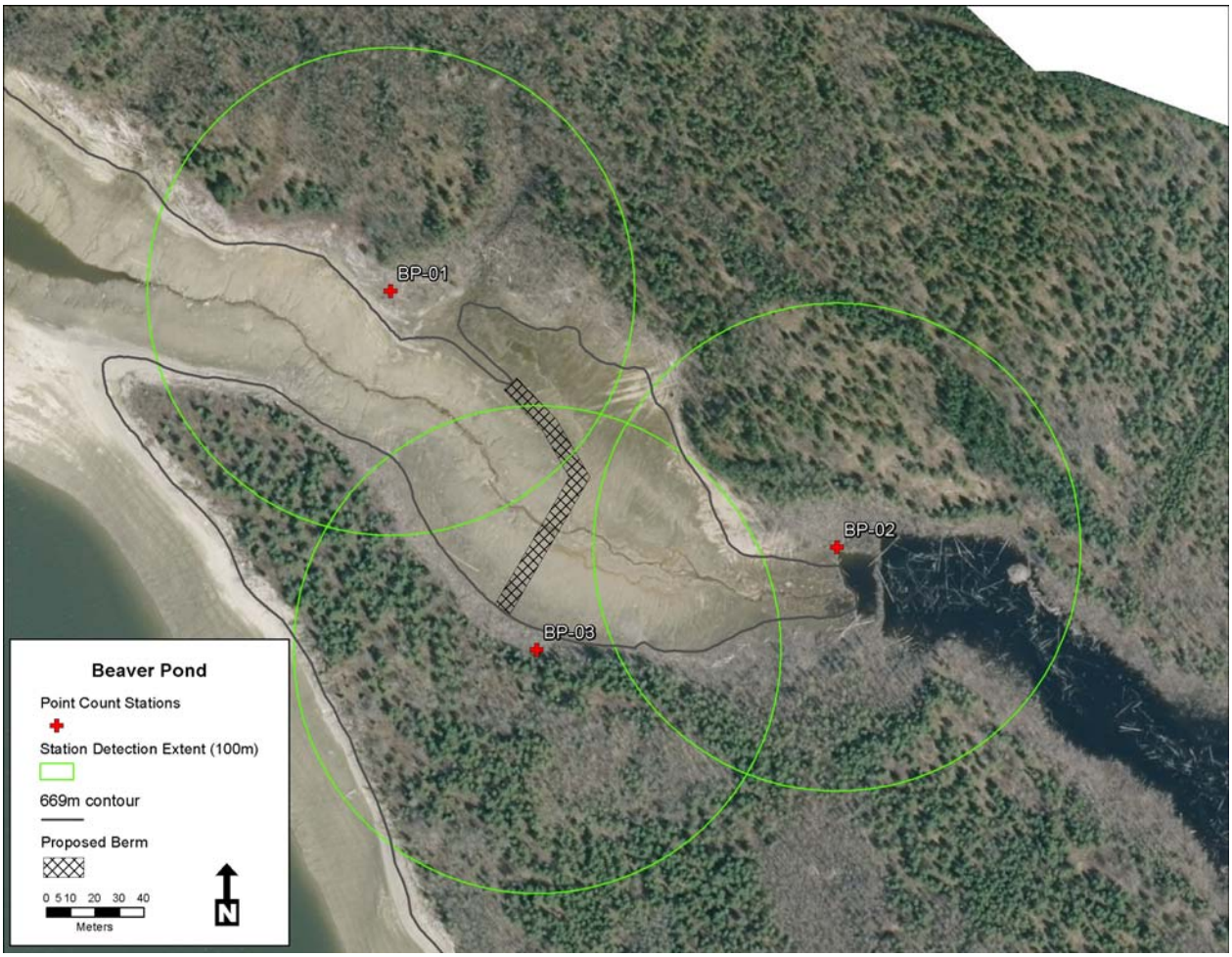

Figure 7. Point count station locations at the Beaver Pond site.

4.5 Amphibian Surveys

In 2013, systematic surveys following RIC (1998) were used to record amphibian species on four occasions at each study site. Consistent with the Years 1 and 2 efforts, surveys involved systematic searches of the same 11 randomly distributed transects on the peripheries of the inundated area of the Airport Lagoon site (Figure 8) and the entire Beaver Pond site (Figure 9). There were no obvious strata, so both sites were treated as a single stratum for sampling (Resources Inventory Committee 1998). Replicates were completed at the Airport Lagoon site on May 1, 12, 24, and 25, and June 6; and at the Beaver Pond site on May 13 and 26 and June 9.

The shallow water (<1m deep), shoreline, and shore (within 3 m of shoreline) zones of ponds, streams and riparian areas were searched in a zigzag pattern (except the shoreline which was followed in a linear pattern) to ensure complete coverage of the area. A dip-net sweep was used in the shallow water zone in a standardized fashion and at regular intervals. Smaller areas were completely surveyed using straight-line transects. Searchers on the shore and shoreline flipped

up pieces of woody debris and other potential cover objects to find amphibians sheltering underneath. All pieces of woody debris and cover were returned to their original position after determining if amphibians were present.

Prior to the field surveys, Hengeveld (2000) and the results for Years 1 and 2 (CBA 2012, 2013) were reviewed to compile a list of species likely to be encountered during surveys. Amphibians were only captured if identification was not possible during the initial sighting; all individuals were released immediately upon identification. Species, developmental stage, and approximate size were recorded for each observation. Transect start and end points along with survey tracks were recorded using hand-held Garmin 76CSx GPS units to allow for repeat surveys and for calculations of detections per unit distance. A photograph was taken at each transect start point, oriented towards the end point. All adults, larvae, and egg masses were recorded on RISC Animal Observation forms for amphibians (Appendix 8). At locations with large numbers of tadpoles (>100) the observation was recorded as ‘tadpoles’ if it was not possible to count an exact number. Species identifications were confirmed using Matsuda et al. (2006) for adults, and an unpublished tadpole key from the Ministry of Environment in Fort St. John, BC. Species codes followed RIC (2008).

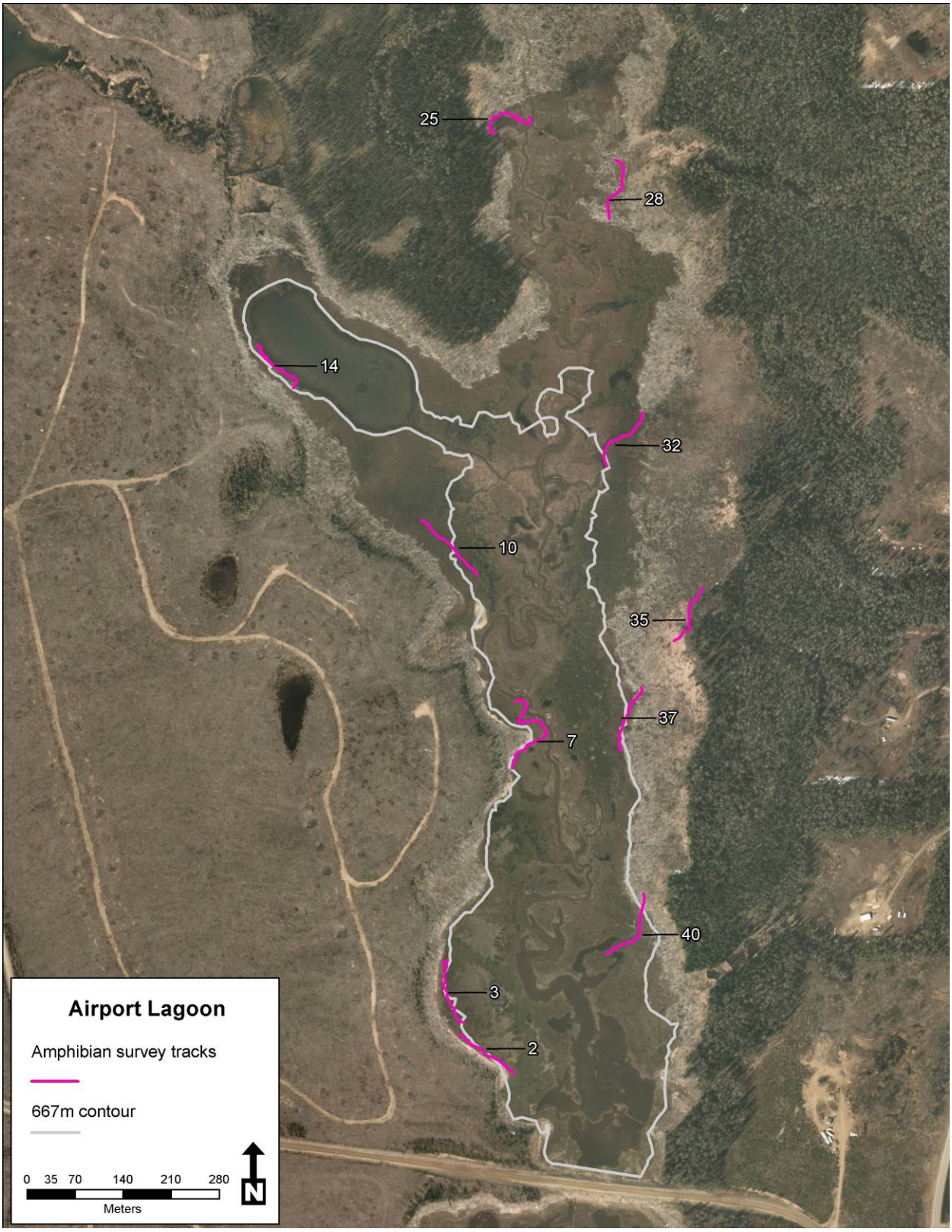

Figure 8. Amphibian survey transect locations at the Airport Lagoon site.

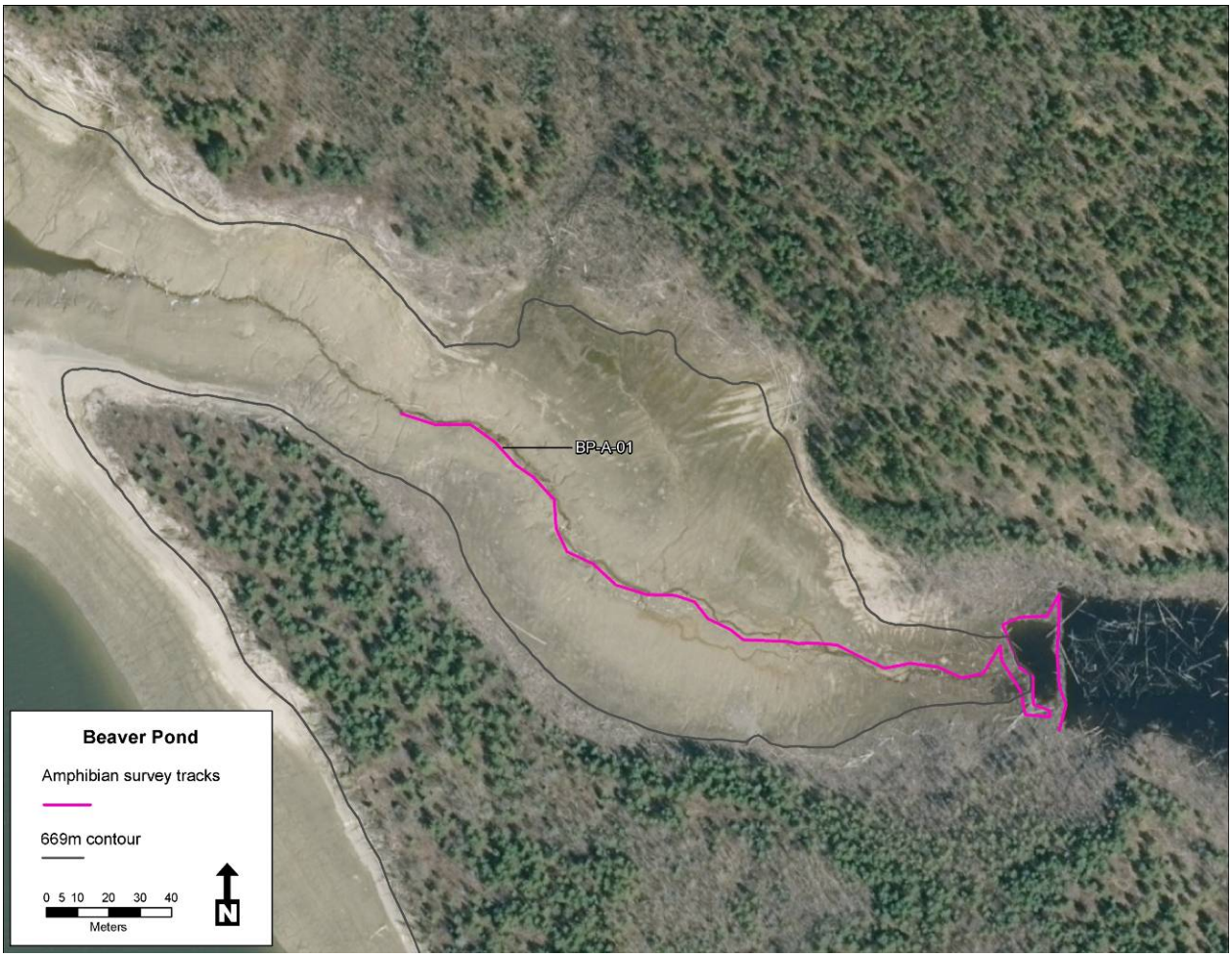

Figure 9. Amphibian survey tracks locations at the Beaver Pond site.

4.6 Fish Surveys

Fish populations were sampled at both sites using a combination of methods following RIC (2001) guidelines. Fish sampling was conducted under Fish Collection Permit PG13-87359 issued by the Ministry of Forests, Lands and Natural Resource Operations. A combination of methods was used to ensure sampling of both large and small fish at each site and the different habitats available at low and high reservoir levels. Fish sampling at the Beaver Pond and Airport Lagoon sites was completed using minnow traps, backpack electrofishing, and fyke nets.

Fish sampling was completed at the Airport Lagoon site on May 24-25 and July 15-16, 2013 and at the Beaver Pond site on May 26 and July 16-17, 2013. The sampling locations are shown in Figure 10 and Figure 11 for the Airport Lagoon and Beaver Pond sites, respectively. The methods used on each date are summarized in Table 1. It was not possible to deploy a fyke net during the May sampling (as recommended in Year 1 and completed in Year 2) (CBA 2012, 2013) as the causeway was inaccessible due to construction and water levels were at an intermediate level due to the presence of a coffer dam during construction. It was not possible to use a fyke net in the upper pond in the northwest arm of the lagoon due to lack of boat access for setting the net. The first fish sampling at the Beaver Pond site was completed prior to this area being inundated.

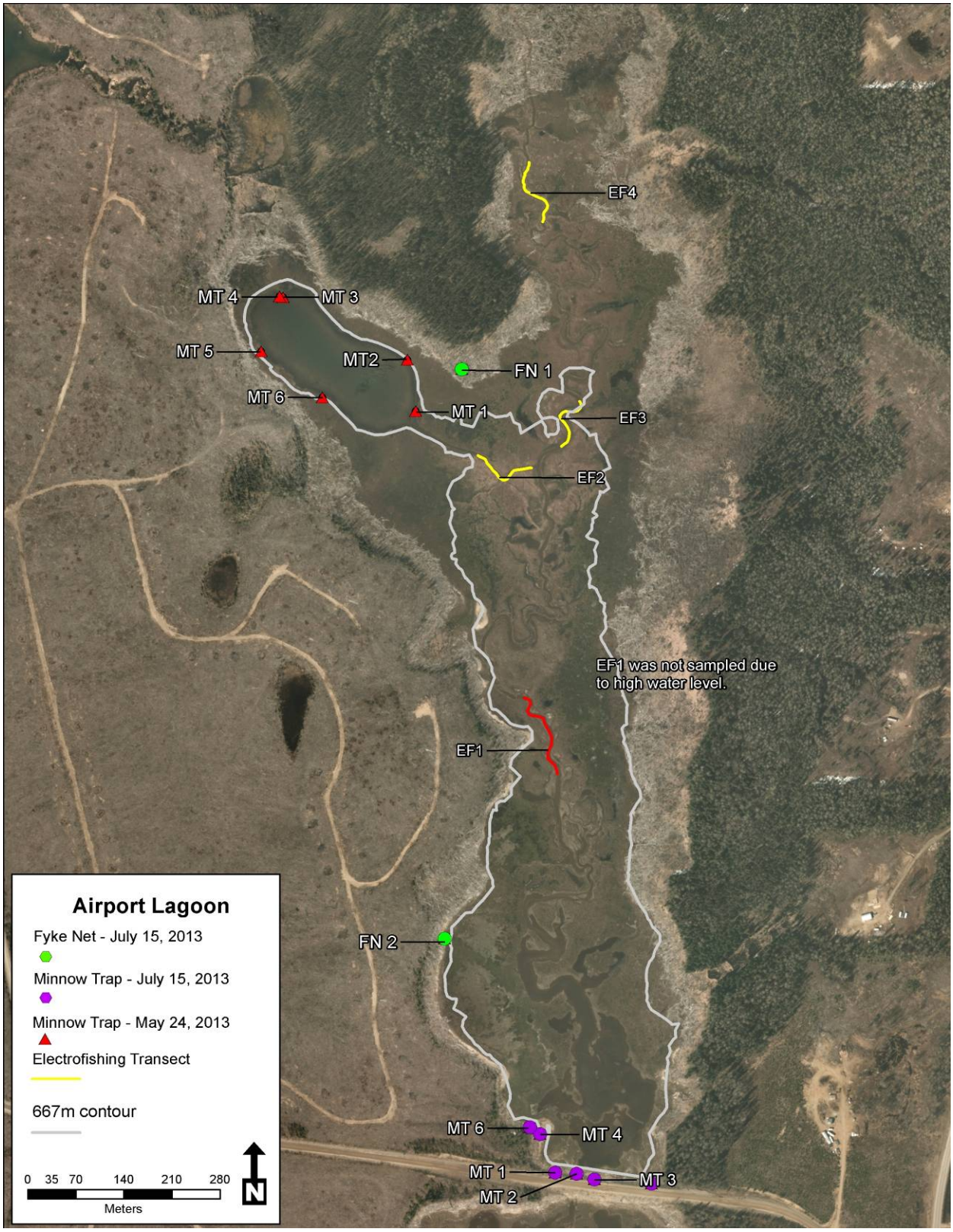

Figure 10. Fish sampling locations by date and method at the Airport Lagoon site.

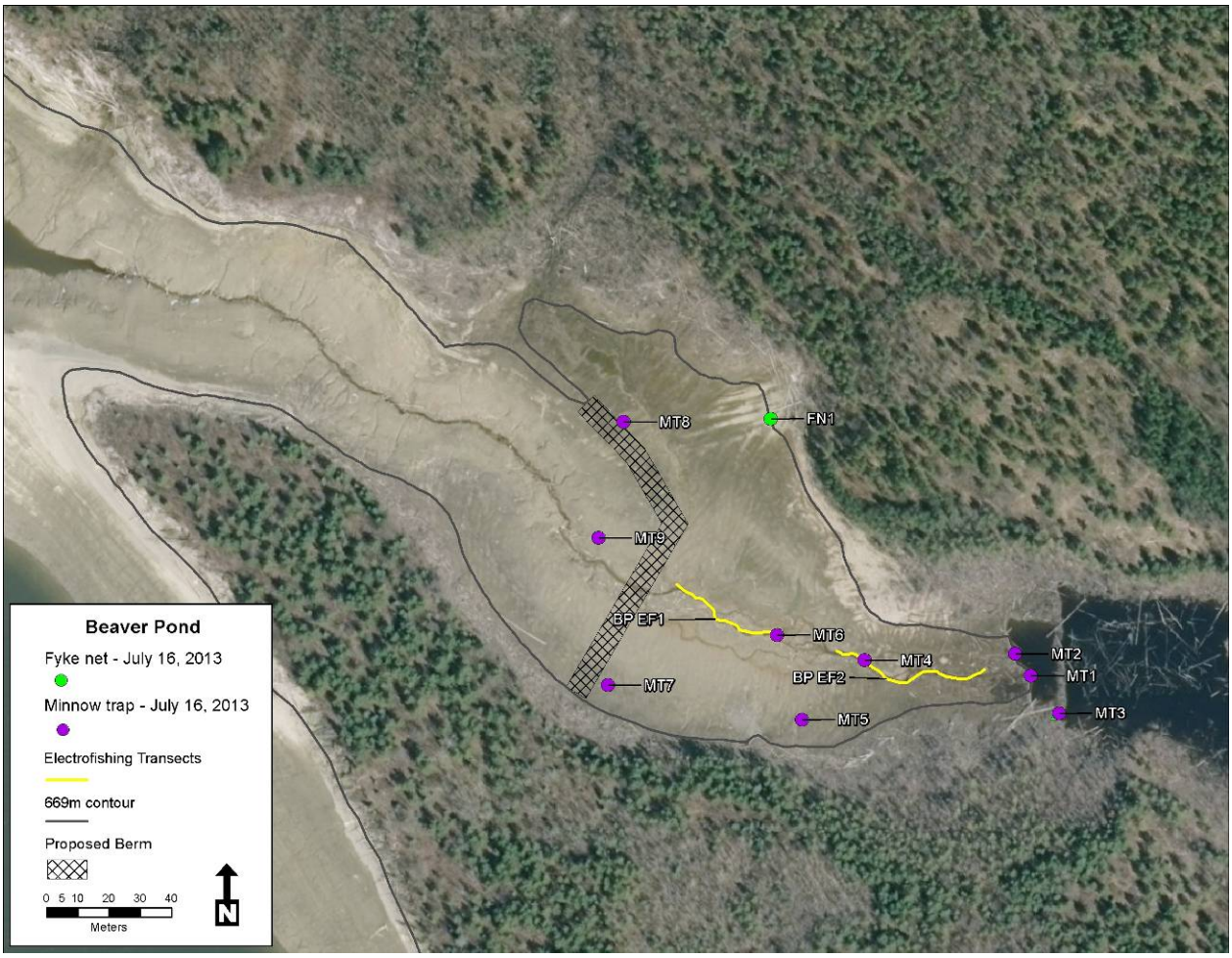

Figure 11. Fish sampling locations by date and method at the Beaver Pond site.

Table 1. Fish sampling methods in 2013 at the Airport Lagoon and Beaver Pond sites.

Site	Date	Method	Number of Samples
Airport Lagoon	May 24 -25	Minnow traps Electrofishing	6 traps 3 reaches
	July 15-16	Minnow traps Fyke nets	6 traps 2 nets
Beaver Pond	May 26	Electrofishing	2 reaches
	July 16-17	Minnow traps Fyke net	9 traps 1 net

Two minnow trap sampling sessions were completed at the Airport Lagoon and one was completed at the Beaver Pond. At the Airport Lagoon the first sampling session was completed during installation of the new culverts with partial inundation of the site and the second session was completed after inundation. Minnow trapping at the Beaver Pond site was completed after inundation. Minnow traps were baited with cat food and set for a minimum of 12 hours at random

locations at each site. At the Beaver Pond site, nine minnow traps were deployed at random locations during the single sampling session. Due to access issues, six minnow traps were used for each sampling session at the Airport Lagoon. During the first sampling session (during construction) the six minnow traps set in random locations around the pond in the northwest arm of the lagoon. No traps were set in the lower pond due to the installation of a coffer dam resulting in partial inundation of the site and restricted access to the causeway due to construction. During the second session (after inundation) the six minnow traps were deployed at random locations near the causeway due to an outboard motor malfunction. Minnow trap locations will be standardized following completion of the wetland enhancement projects.

Backpack electrofishing (Smith-Root LR-20B) was used to sample the stream habitat that is present at both sites prior to inundation. Three reaches were sampled at the Airport Lagoon site (Figure 10) and two stream reaches were sampled by electrofishing at the Beaver Pond site (Figure 11). A fourth reach was not sampled at the Airport Lagoon due to construction of the new culverts. Elevated water levels associated with the construction of project meant that it was not possible to sample this site by electrofishing. Except for the one inaccessible site at the Airport Lagoon, the reaches sampled at both sites in 2013 were the same reaches as sampled in previous years.

Fyke net construction was based on the design in Bonar et al. (2000). Two nets were used at the Airport Lagoon during the July sampling. No fyke net was used during the May sampling at the Airport Lagoon as the causeway was inaccessible due to construction. A single net used to sample the Beaver Pond site in July. Fyke nets were randomly deployed at each site with the lead anchored to the shore and the net set perpendicular to the shoreline. All sets were overnight for a minimum of 12 hours. Net locations will be standardized following completion of the wetland enhancements and stabilization of water levels.

All collected fish were held in live wells after capture and processed as soon as the electrofishing pass, or net/trap haul was complete. Captured fish were anaesthetized using CO_2 to ease handling and reduce the potential for handling injury. Captured fish were identified to species, enumerated, and the fork length recorded to the nearest millimetre. All anaesthetized fish were allowed to fully recover prior to release. All fish data were recorded on the RIC Fish Collection and Individual Fish Forms (Appendix 9).

Environmental data were also collected during field visits to record the sampling conditions during each site visit. Additional data included water temperature, water depth, water clarity (relative turbidity or Secchi depth), pH, dissolved oxygen (DO), and conductivity. Water temperature, pH, DO and conductivity were recorded at the surface using a calibrated YSI 556 multi-parameter meter (YSI Inc., Ohio). Relative turbidity was recorded for each electrofishing reach according to RIC (2001) standards. Secchi depth (20 cm diameter disk) was used as a measure of turbidity for the sampling completed after inundation. The fish data collected were standardized to catch-per-unit-effort (CPUE) for each gear type (electrofishing = fish/minute, minnow traps and fyke nets = fish/hour) to allow for future interannual comparison of fish diversity and abundance to identify changes related to the wetland treatments.

4.7 Data Entry and Analysis

Immediately after a field survey was completed, data sheets were scanned into .pdf documents and stored in a redundant file storage system. Similarly, photographs taken during field surveys were labelled and filed by survey type. All data were entered into a customized database

designed to minimize data entry errors by restricting the permissible range of values for a field or by using selections from drop-down lists.

Data were exported from the database to MS Excel to provide data summaries for each component of the monitoring project. Data from each vegetation transect were summarized to provide an overview of the vegetation community at each site. The vegetation % cover data from each of the ten quadrats in a belt-transect were pooled to provide an average % cover for each species. Waterfowl and amphibian survey results were summarized by survey date and site. As the intent of the breeding bird survey was to provide a snapshot of the breeding bird community at a site, data from all three replicates were pooled to provide summaries on species richness and relative abundance.

With the collection of three years of baseline data (including two years under similar reservoir conditions), sufficient information to describe the baseline conditions at the two sites is now available. Baseline conditions for each of the indicator groups are described and predictions are made of which indicators are expected to change following completion of the wetland enhancement projects. More detailed analyses are planned once additional years of post-construction data become available.

5 RESULTS

5.1 Environmental Conditions

In Year 3 (2013), temperatures in April were generally below average although both warmer and cooler than average temperatures occurred just prior to and at the start of the 2013 surveys (Figure 12). Temperatures in early to mid May were warmer than average and warmer than in Years 1 and 2 (2011 and 2012) (Figure 12). Cumulative precipitation in Year 3 was consistently below average for April, May, and June (Figure 13). In previous years, May 2012 (Year 2) was the only month with below average cumulative precipitation (Figure 13). Cumulative precipitation in May 2011 (Year 1) was well above average and higher than in either Years 2 or 3 (Figure 13).

Based on degree days, Year 3 was warmer than either Years 1 or 3 and was consistently higher than the long term mean during the survey period (Figure 14). Year 1 was colder than average until late May when it was warmer than average for the remainder of the sampling period. Year 2 was the coldest of the three years and was typically slightly below average. The date when mean daily temperatures were consistently above 5°C was similar for Years 2 and 3 (April 25 and April 23, respectively) and close to the long term average (April 25). In Year 1, temperatures were not consistently above 5°C until May 3.

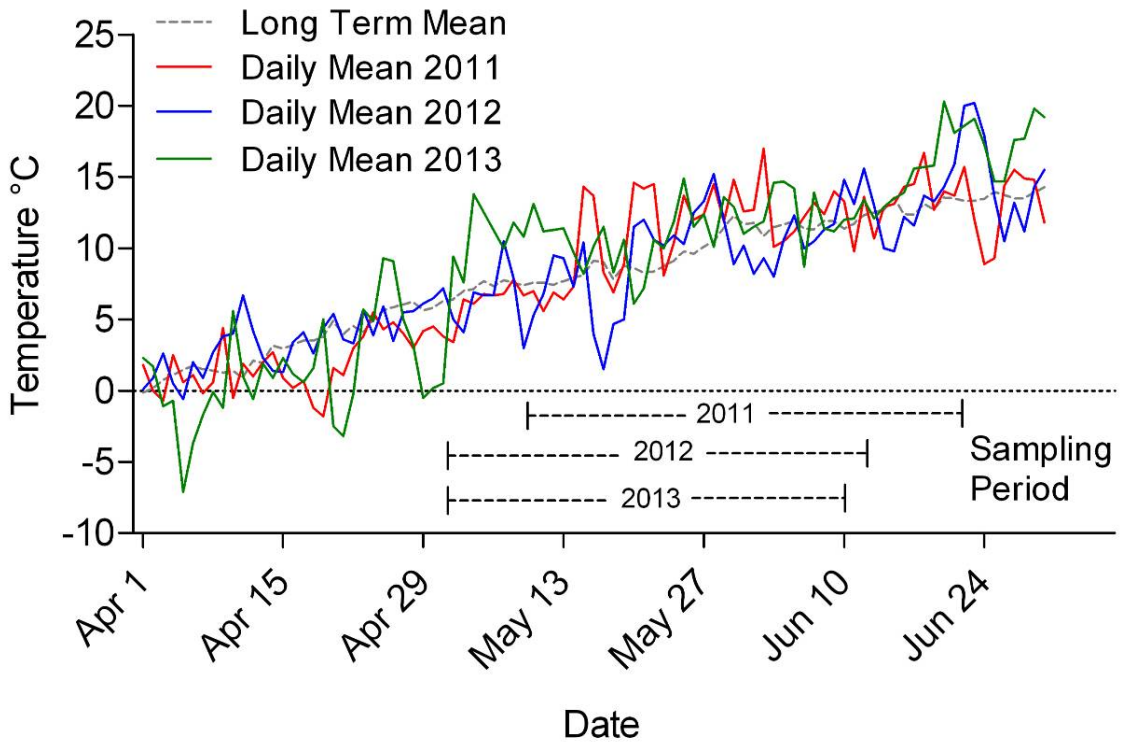

Figure 12. Daily mean air temperature and the long term mean in the study region. Data from Environment Canada and observed at the Mackenzie Airport weather station (Station name: Mackenzie A and Mackenzie Airport Auto).

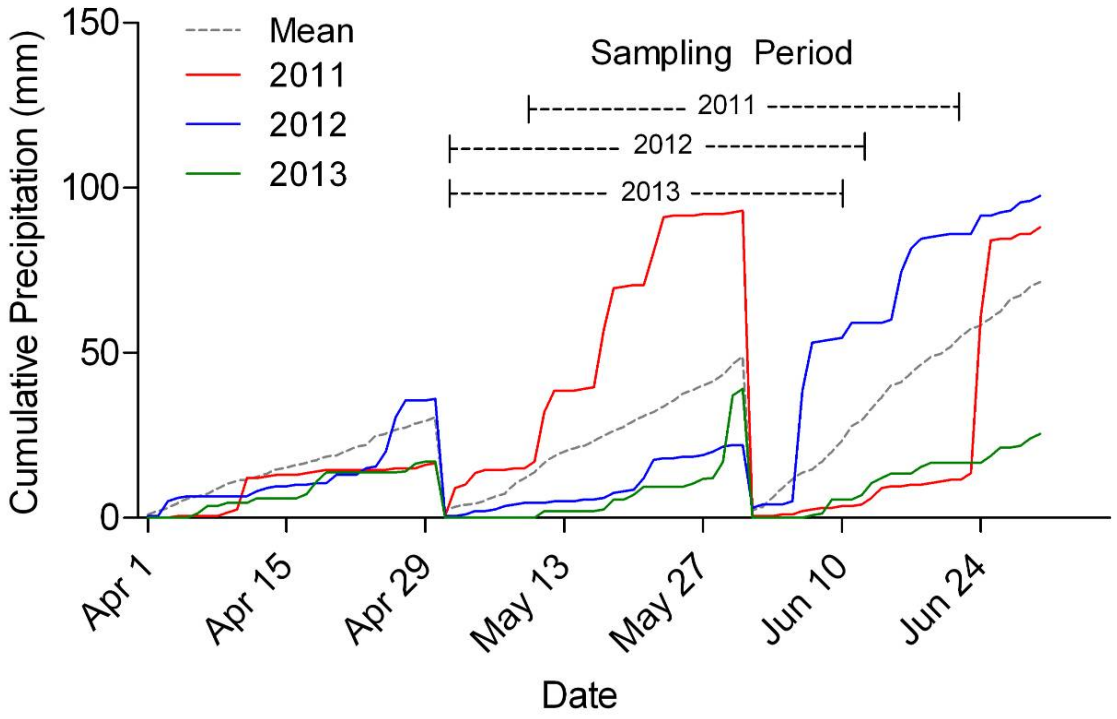

Figure 13. **Cumulative monthly total precipitation and the long term means in the study region. Data from Environment Canada and observed at the Mackenzie Airport weather station (Station name: Mackenzie A and Mackenzie Airport Auto).**

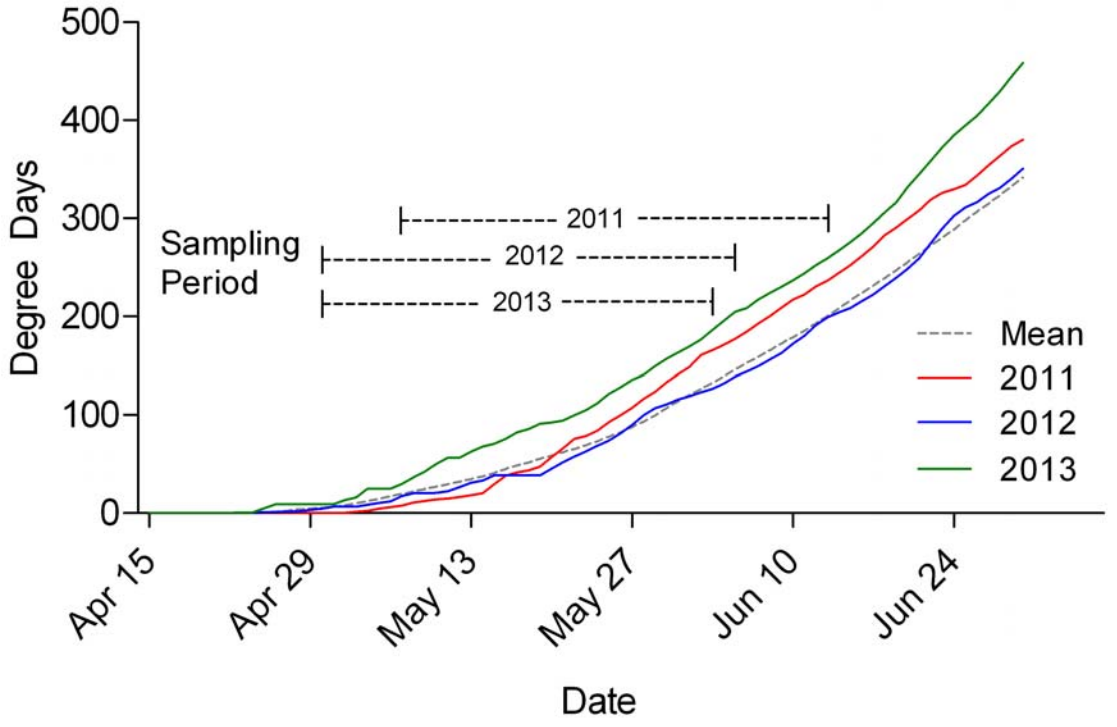

Figure 14. **Accumulated degree days (5°C base temperature) in the study region. Calculated from Environment Canada daily maximum and minimum temperatures observed at the Mackenzie Airport weather station (Station names: Mackenzie A and Mackenzie Airport Auto).**

5.2 Vegetation Surveys

In Year 1 of the study, a total of 19 habitat classes describing vegetation communities at the Airport Lagoon and Beaver Pond site were identified and mapped. A total of 13 habitat classes were identified at the Airport Lagoon site and eight habitat classes were identified at the Beaver Pond site. The plant species assemblages identified within habitat classes consisted mostly of herbaceous perennials (grasses and herbs) and bryophytes with minimal woody shrubs and no live tree cover (with the exception of occasional paper birch [*Betula papyrifera*] and trembling aspen [*Populus tremuloides*] seedling). A few classes had a high percentage (≥50%) of coarse woody debris from driftwood accumulation.

In Year 2, a re-assessment of habitat class descriptions and their spatial distribution was completed. As a result of the re-assessment, two groups of habitat classes were merged, reducing the total number of classes from 19 to 17. In addition, the boundary of a single habitat class polygon was revised. Changes to Year 1 habitat classifications were based on information collected during of Year 2 ground sampling and include:

- *Habitat classes 1 and 2 merged into class 1.*
    - The main water source (i.e., precipitation) and dominant vegetation cover (grasses; e.g., bluejoint [*Calamagrostis canadensis*]) for both habitat classes are equivalent. The main water source for habitat class 2 was revised in Year 2 from groundwater (surface and subsurface seepage) to precipitation. Based on these similarities, the two habitat classes were merged into a single class.

- *Habitat classes 15 and 16 merged into class 15.*
    - The amount of vegetation observed in polygons of these two classes (sparse to no vegetation cover) did not differ considerably in Year 2 and both experience annual to frequent flooding. Based on these similarities, the two habitat classes were merged into a single class.

- *Boundary of habitat class 12 was extended.*
    - During vegetation surveys during Year 2, it was determined that the vegetation cover for habitat class 12 extended further down the drawdown zone (West) and was therefore extended into habitat class 15 in order to reflect this observation.

In addition, the numeric values identifying habitat classes (i.e., 1-17) in Year 1 were replaced with a two letter code and descriptive title for Year 2.

In Year 3, further re-assessment of habitat class descriptions and their spatial distribution was completed. Resulting from the re-assessment, two groups of habitat classes were merged and one new habitat class was identified; the total number of classes was reduced from 17 to 15. In addition, further delineation of small streams entering the Airport Lagoon and Beaver Pond site was completed, as well as identification of a previously unobserved wetland habitat. Furthermore, some of the habitat class names were revised to more accurately reflect expected annual vegetation cover (e.g., common plant species) and location (e.g., shoreline). Changes to Year 2 habitat classifications were based on information collected during Year 3 ground sampling and include:

- *Habitat classes Cattail Thread Rush (CT), Cinquefoil Moss (CM) and Cinquefoil Fireweed (CF) were merged into a single class named Basin Moss (BM)*

  - These habitat classes were originally identified in Year 1 and reflect species that colonized the Airport Lagoon in 2010 when the site was not inundated (reservoir levels did not exceed 665 m during the growing season) and were present prior to inundation in 2011. In 2012 and 2013, vegetation cover within these habitat classes did not differ considerably (common cattail [*Typha latifolia*] and Norwegian cinquefoil [*Potentilla norvegica*] were not present) and thus the habitat classes were combined and the name of the habitat class was revised.

- *A portion of the Cattail Thread Rush (CT) habitat class was revised to Shoreline Clay (SC)*
  - This habitat class was originally identified in Year 1 as Shoreline Cinquefoil (SC) and reflected species that colonized the Airport Lagoon site in 2010 when the site was not inundated (reservoir levels did not exceed 665 m during the growing season) and were present prior to inundation in 2011. In 2012 and 2013, vegetation cover within this habitat class was generally absent and thus the name was revised to more accurately reflect the conditions.

- *Habitat classes Cryptantha Speedwell (CS) and Cinquefoil Bluegrass (CB) were merged into a single class named Basin Cryptantha (BC)*
  - These habitat classes were originally identified in Year 1 and reflect species that colonized the Airport Lagoon in 2010 when the site was not inundated (reservoir levels did not exceed 665 m during the growing season) and were present prior to inundation in 2011. In 2012 and 2013, vegetation cover within these habitat classes did not differ considerably (Norwegian cinquefoil was not present) and thus the habitat classes were combined and the name of the habitat class was revised.

- *A new habitat class Shoreline Grassland (SG) was identified.*
  - An area of very high grass cover and low coarse woody debris in the Airport Lagoon site was identified neighbouring the Shoreline Driftwood (SD) habitat class, which consists of a low to moderate cover of grasses and high coarse woody debris. Based on this distinction, a new habitat class was created.

- *Further delineation of streams entering Airport Lagoon and Beaver Pond site; habitat class Water Body (WB) was revised to Streams and Ponds (SP).*
  - Small streams located within the Airport Lagoon and Beaver Pond site provide habitat for fish and amphibians. Therefore, revisions to the spatial distribution of habitat classes for Year 3 included further delineation of small streams entering both sites. These delineations were added to the Waterbody (WB) habitat class; thus the name was revised to reflect both stream and waterbody habitat.

- *A previously unknown wetland area was identified.*
  - On west side of the Airport Lagoon site, a previously unknown wetland was identified. The wetland is located along the upper boundary of the drawdown zone and consists of vegetation cover and surface soil (i.e., organic) similar to the other wetlands identified at this site. This area has now been delineated and classed as Wetland Sedge (WS); the area was previously classed as Cattail Thread Rush (CT).

- *Habitat class Shoreline Cinquefoil (SC) was revised to Shoreline Clay (SC).*

  - This habitat class was originally identified Year 1 as Shoreline Cinquefoil (SC) and reflected species that colonized the Beaver Pond site in 2010 when the site was not inundated (reservoir levels did not exceed 665 m during the growing season) and were present prior to inundation in 2011. In 2012 and 2013, vegetation cover within this habitat class was generally absent and thus the name was revised to more accurately reflect the conditions.

- *Habitat Class Stream Bluejoint was revised to Stream Sedge (SE).*
  - To more accurately reflect this habitat class, the name was revised using the location (i.e., stream) and the most common vegetation (i.e., sedges).

A summary of the final habitat classification and changes from Years 1 and 2 is provided in Table 2 and detailed descriptions of each class are provided in Appendix 10.

At the Airport Lagoon site, a total of 12 habitat classes were identified and mapped (Figure 15), while at the Beaver Pond site six habitat classes were identified and mapped (Figure 16). Of the 17 habitat classes identified, only classes SW, SC and SP were common to both sites (Figure 15 and Figure 16, Table 3). The 15 habitat classes identified within the two study sites included a total of 75 polygons covering 68.80 ha at the Airport Lagoon site and 4.39 ha at the Beaver Pond site (Table 3). The number of polygons for each habitat class ranged from one (classes SG, WD, WH, WW, SP and SR) to 19 (class BM; Table 3). The percentage of total area covered by habitat classes ranged from 0.26 (class SC) to 39.94 (class SP) at the Airport Lagoon and 1.82 (class SP) to 36.45 (class SC) at the Beaver Pond site.

The most abundant habitat classes at the Airport Lagoon by number of polygons were BM (19 polygons), and SP (18 polygons). All other classes had five or fewer polygons. By area, habitat classes SP and SD accounted for the largest area, covering 62.41% of the total area at the Airport Lagoon site. The next largest habitat class by area was class BM, accounting for 15.10% of the total area at this site. All other classes at this site had a cover of ≤7%.

At the Beaver Pond site, the most abundant habitat class by number of polygons was SW (4 polygons); by area, habitat class SW accounted for 21.64% of the total area of the site. The largest habitat classes were SC and BC, which accounted for 36.45% and 33.03% of the total area respectively. The remaining three habitat classes each represented less than 4% of the total area (Table 3).

Vegetation transects at the Airport Lagoon site were generally located on moist, organic rich soils, with slight to gentle slopes and frequent to annual flooding (Table 4). All transects were in a graminoid-dominated structural stage (with the exception of habitat class SW); no mature tree cover was observed on any of the survey transects (dead standing trees were present within habitat class WD). The surface substrate at the site was dominated by organic matter or decayed wood, with a subset having a large percentage of exposed mineral soil (Table 4).

Vegetation transects at the Beaver Pond site were located on clay rich soils with gentle to moderate slopes and frequent to annual flooding (Table 4). All transects were in a graminoid-dominated structural stage (with the exception of habitat class SW); no mature tree cover was observed on any of the survey transects. The surface substrate at the site was dominated by exposed mineral soil with minimal woody debris and little to no organic matter (Table 4).

During Years 2 and 3, a total of 50 herb species were recorded across all 15 transects. Average percent herb cover by transect ranged from 0.35% to 32.01% (Table 5). Seven species of moss

were recorded during ground sampling on seven of the 15 transects. No moss species occurred on eight of the 15 transects. On transects where moss species did occur, the percent cover ranged from 0.88% to 99.99% (Table 5). Shrub species only occurred on four of the 15 transects, and only in the B2 (30-200 cm) layer. A total of two shrub species were identified; however, with the exception of Bebb's willow (*Salix bebbiana*), willow species were only identified to genus (i.e., *Salix* spp.). A summary of the plant species and percent cover for each transect is provided in Appendix 11.

Table 2. Final habitat classification summary for the Airport Lagoon and Beaver Pond sites including previous classes from Year 1 and 2.

Site	Habitat Class		Previous Habitat Class		Comment
	Year 3 Habitat Class	Habitat Class Description	Year 1 Habitat Class	Year 2 Habitat Class	
Airport Lagoon	BM	Basin Moss	4, 5, 7	Cattail Thread Rush Cinquefoil Moss Cinquefoil Fireweed	Combines Year 2 habitat classes to reflect vegetation observed in 2012 and 2013.
	BS	Basin Smartweed	6	Smartweed Moss	Name revised to reflect vegetation and location.
	SC	Shoreline Clay	4	Cattail Thread Rush	Revised to reflect the lack of vegetation observed in 2012 and 2013.
	SD	Shoreline Driftwood	1, 2	Shoreline Driftwood	
	SG	Shoreline Grassland	12	Shoreline Willow	New habitat class identified in a previously mapped area.
	SP	Streams and Ponds	19	Water Body	Includes all surface water bodies.
	SS	Shoreline Sand	3	Shoreline Sand	
	SW	Shoreline Willow	12	Shoreline Willow	
	WD	Wetland Dead Trees	10	Wetland Dead Trees	
	WH	Wetland Horsetail	11	Wetland Horsetail	
	WS	Wetland Sedge	8	Wetland Sedge	
	WW	Wetland Willow	9	Wetland Willow	
Beaver Pond	BC	Basin Cryptantha	13, 14	Cryptantha Speedwell Cinquefoil Bluegrass	Combines Year 2 habitat classes to reflect vegetation observed in 2012 and 2013.
	SC	Shoreline Clay	15, 16	Shoreline Cinquefoil	Name revised to reflect the lack of vegetation observed in 2012 and 2013.
	SE	Stream Sedge	17	Stream Bluejoint	Name revised to more accurately reflect the vegetation observed at this site.
	SR	Shoreline Gravel	18	Shoreline Gravel	
	SP	Streams and Ponds	19	Water Body	Includes all surface water bodies.
	SW	Shoreline Willow	12	Shoreline Willow	

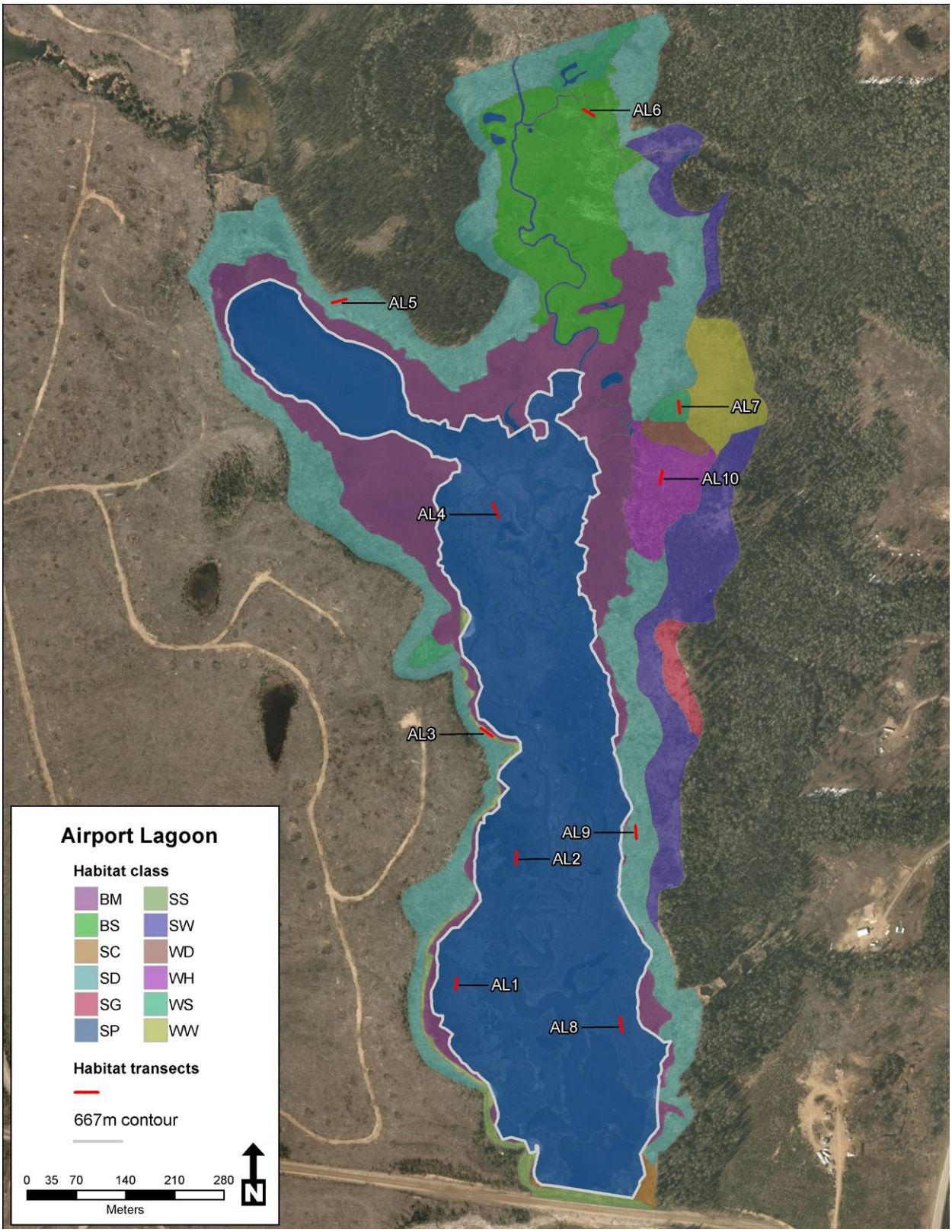

Figure 15. Habitat classes and transect locations in the Airport Lagoon site.

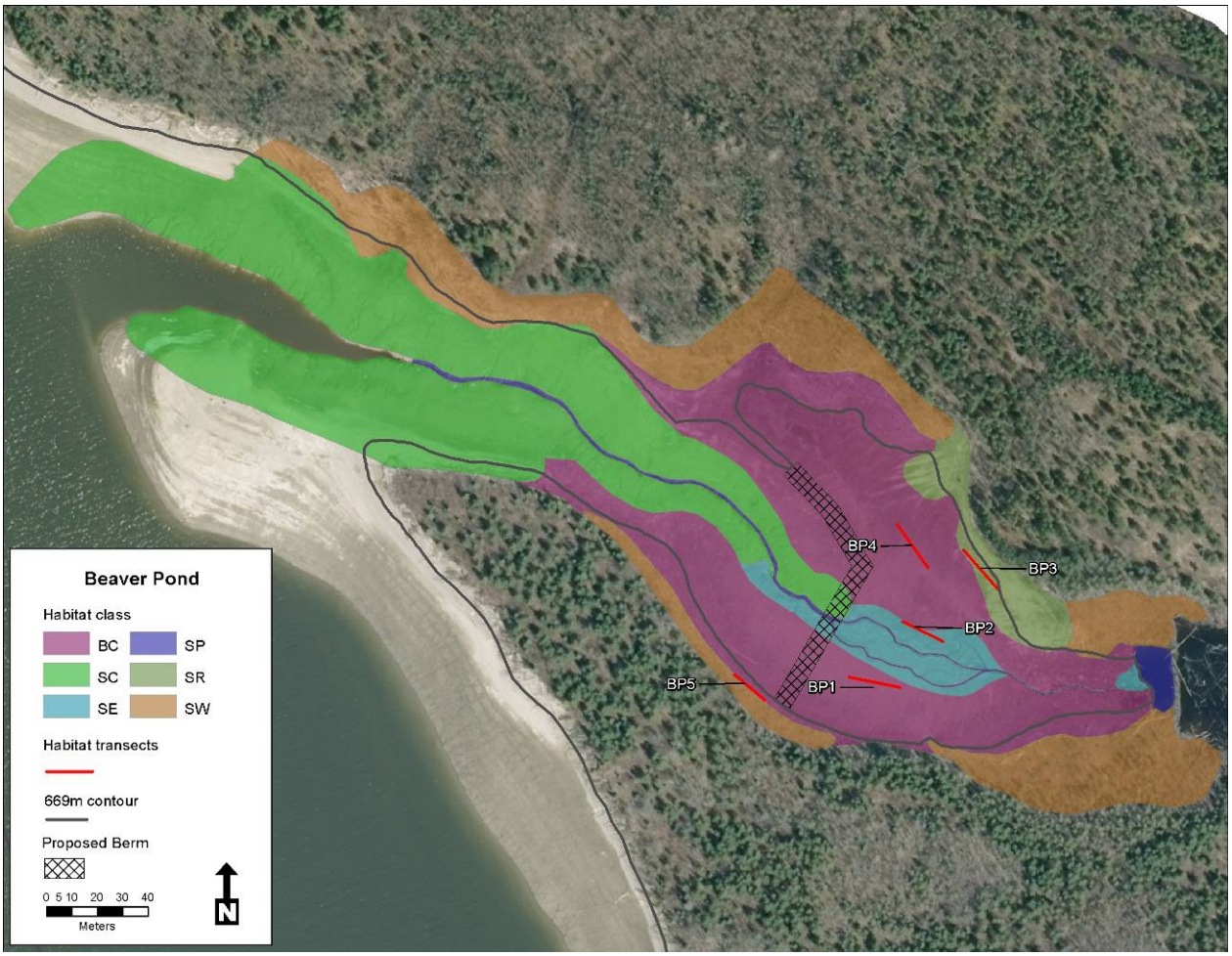

Figure 16. Habitat classes and transect locations in the Beaver Pond site.

Table 3. Number of polygons and areas of final riparian habitat classes identified during photo interpretation for the Airport Lagoon and Beaver Pond sites. Refer to Appendix 10 for detailed descriptions of the habitat classes.

Site	Habitat Class	Number of Polygons	Area (ha)				Percent of Total Area
			Minimum	Maximum	Mean	Total	
Airport Lagoon	BM	19	<0.01	5.96	0.55	10.39	15.10
	BS	3	0.47	3.58	1.78	5.34	7.76
	SC	2	0.03	0.15	0.09	0.18	0.26
	SD	5	0.42	8.25	3.09	15.46	22.47
	SG	1	0.46	0.46	0.46	0.46	0.67
	SP	18	<0.01	26.89	1.53	27.48	39.94
	SS	5	0.03	0.67	0.17	0.85	1.24
	SW	3	0.30	3.60	1.52	4.55	6.61
	WD	1	0.29	0.29	0.29	0.29	0.42
	WH	1	1.41	1.41	1.41	1.41	2.05
	WS	3	0.18	0.47	0.28	0.85	1.24
	WW	1	1.54	1.54	1.54	1.54	2.24
	Totals	**62**				**68.80**	**100**
Beaver Pond	BC	2	0.64	0.81	0.73	1.45	33.03
	SC	2	0.55	1.05	0.80	1.60	36.45
	SE	3	0.01	0.11	0.05	0.16	3.64
	SP	1	0.08	0.08	0.08	0.08	1.82
	SR	1	0.15	0.15	0.15	0.15	3.42
	SW	4	0.08	0.51	0.24	0.95	21.64
	Totals	**13**				**4.39**	**100**

Table 4. Site characteristics for each transect at the Airport Lagoon and Beaver Pond study sites, Williston Reservoir, BC

Site	Transect	BGC Unit	Water Source[1]	Soil Moisture Regime[2]	Soil Nutrient Regime[3]	Successional Status[4]	Structural Stage[5]	Elevation (m)	Slope (%)	Aspect (°)	% Organic Matter[6]	% Rocks[6]	% Decayed Wood[6]	% Mineral Soil[6]	% Bedrock[6]	% Water[6]	Drainage[7]	Flood Regime[8]
Airport Lagoon	AL1	SBSmk1	F	7	E	DC	2b	671	1	140	93	0	2	0	0	5	v	A
	AL2	SBSmk1	F	7	E	DC	2a	668	0	999	97	0	3	0	0	0	v	A
	AL3	SBSmk1	P	2	A	DC	2b	677	15	30	5	0	9	85	0	0	r	A
	AL4	SBSmk1	F	6	E	DC	2b	672	1	170	98	0	2	0	0	1	i	A
	AL5	SBSmk1	P	3	B	DC	2b	679	15	169	64	0	33	4	0	0	r	A-F
	AL6	SBSmk1	F	7	E	DC	2b	673	1	999	98	0	2	0	0	1	p	F
	AL7	SBSmk1	F	7	E	DC	2b	676	3	260	95	0	6	0	0	0	v	F
	AL8	SBSmk1	F	7	C	DC	2a	674	3	260	96	0	3	0	0	1	i	A
	AL9	SBSmk1	P	6	E	DC	2b	675	6	272	66	0	34	0	0	0	i	A
	AL10	SBSmk1	F	7	E	DC	2b	675	2	284	70	0	29	0	0	3	v	A-F
Beaver Pond	BP1	SBSmk2	G	5	C	DC	2a	670	6	4	0	1	1	99	0	0	v	A
	BP2	SBSmk2	F	7	C	DC	2b	679	1	220	0	0	11	40	0	50	v	A
	BP3	SBSmk2	P	3	B	DC	2b	675	25	230	2	13	1	80	0	0	r	A-F
	BP4	SBSmk2	G	7	D	DC	2a	673	5	227	0	2	1	98	0	0	m	A
	BP5	SBSmk2	P	4	D	DC	2b	685	20	44	37	2	40	23	0	0	m	A-F

[1] P=Precipitation, G=Groundwater, S=Snowmelt, F=Stream sub-irrigation and flooding, M=Mineral spring, T=Tidal, freshwater, E=Tidal, saltwater, Z=Permafrost
[2] 0=Very Xeric, 1 = Xeric, 2 = Subxeric, 3= Submesic, 4= Mesic, 5= Subhygric, 6=Hygric, 7=Subhygric, 8=Hydric
[3] A=Very poor, B=Poor, C=Medium, D=Rich E=Very rich, F=Saline
[4] DC = Disclimax
[5] 2a= Forb dominated – includes non-graminoid herbs and ferns; 2b= Graminoid dominated – includes grasses, sedges, reeds, and rushes
[6] Values represent an average of observations in 2012 and 2013.
[7] v=very poorly drained, p=poorly drained =imperfectly drained, m=moderately well drained, w=well drained, r=rapidly drained, x = very rapidly drained
[8] A=annual flood, O=occasional flooding, F=frequent flooding

Table 5. Vegetation cover summary for transects sampled in Year 2 and Year 3 at the Airport Lagoon and Beaver Pond sites.

Site	Transect	No. herb species	Average % Herb cover	No. moss/ lichen species	Average % Moss/Lichen Cover	No. shrub species	Average % shrub cover
Airport Lagoon	AL1[a]	2	0.35	1	9.7	0	0
	AL2[a]	1	0.61	1	13.1	0	0
	AL3[b]	5	2.04	0	0	0	0
	AL4[b]	3	20.97	0	0	0	0
	AL5[b]	9	7.62	0	0	0	0
	AL6[b]	9	22.59	1	29.95	0	0
	AL7[b]	7	32.01	2	99.99	1	0.06
	AL8[a]	2	2.84	1	9.2	0	0
	AL9[b]	7	7.31	5	0.88	0	0
	AL10[b]	8	12.63	5	17.50	1	0.23
			10.9		**18.03**		**0.03**
Beaver Pond	BP1[b]	5	13.54	0	0	0	0
	BP2[b]	6	7.44	0	0	1	0.05
	BP3[b]	8	3.00	0	0	0	0
	BP4[b]	5	17.24	0	0	0	0
	BP5[b]	8	4.58	0	0	0	0
			9.16		**0**		**0.01**

[a] - Values represent average number of species and % cover based on plot surveys in 2012. Surveys of these plots were not completed in 2013 as plots were located in areas recently flooded due to physical works;
[b] - Values represent an average number of species and % cover based on plot surveys completed in 2012 and 2013; the average for number of species are rounded up to whole numbers where necessary.

A variety of plant species were identified at the two study sites during Year 1, 2 and 3 ground surveys. A majority of these species were observed within habitat classes located in the lower elevations of the drawdown zone. Many of these species were observed during Year 1 and reflect species that colonized the sites in 2010 when reservoir levels did not exceed 665 m during the growing season. The Year 1 surveys were completed prior to inundation of the sites in 2011. In Years 2 and 3, many of the species observed during ground surveys in Year 1 were not present, likely due to intolerance to flooding as a result of high reservoir levels in late summer 2011 and 2012. However, some species observed in Year 1 were also observed in Years 2 and 3 and this may suggest some tolerance to flooding from reservoir operations.

Examples of the most common of these species (observed at 3 or more survey transects) include bluejoint, swamp horsetail (*Equisetum fluviatile*), Lady's Thumb (*Persicaria maculosa*), Torreys Cryptantha (*Cryptantha torreyana*), water smartweed (*Persicaria amphibian*), sedges (*Carex* spp.), common mare's-tail (*Hippuris vulgaris*) and creeping feathermoss (*Amblystegium serpens*). In an experiment testing the tolerance of a few species of herbaceous perennials to a variety of flooding regimes, bluejoint was identified as a species with a relatively high tolerance to flooding (Kercher and Zedler 2004). Other species identified as having a high tolerance were sedges, reed canarygrass (*Phalaris arundinacea*) and common cattail (Kercher and Zedler 2004), species that were also observed at the Airport Lagoon and Beaver Pond site.

Plant species identified at the study sites during Year 1 ground surveys that were not detected (either absent or only dead remains were observed) during Years 2 or 3 are suspected to have a low tolerance or intolerance to flooding; these include Norwegian cinquefoil, fireweed (*Epilobium angustifolium*), red raspberry (*Rubus idaeus*), tree seedlings (e.g., trembling aspen), willows (*Salix spp*.), members of Brassicaceae (e.g., spreading-pod rockcress [*Arabis divaricarpa*]) and Asteraceae (e.g., Smooth Hawksbeard [*Crepis capillaris*]), little meadow foxtail (*Alopecurus aequalis*) and small bedstraw (*Galium trifidum*). While common cattail is considered to have a relatively high tolerance to flooding (Kercher and Zedler 2004), it appears to be intolerant of the depth (>4 m) and duration of flooding at the Airport Lagoon.

In Year 1, a candidate red-listed species was identified during ground surveys (green-sheathed sedge [*Carex feta*]). As there are 197 species (including subspecies) of *Carex* in BC (Meidinger et al. 2009), an independent confirmation of the species identification was requested. The original identification of green-sheathed sedge was confirmed by D. Coxson (Professor, UNBC). Following discussion with the BC Conservation Data Centre (J. Penny, Program Botanist), a sample was sent to the UBC Herbarium for further confirmation as there are no previous records of the species from northern BC. Upon receipt, the specimen was identified by a UBC Botanist (Frank Lomer) as bronze sedge (*Carex aenea*), a yellow-listed species.

5.3 Waterfowl and Shorebird Surveys

A total of 417 individuals distributed among 18 species of waterfowl and shorebirds were detected at the Airport Lagoon in Year 3 (Table 6). No detections were made at the Beaver Pond site during the waterfowl surveys in Year 3. The two most commonly observed species in Year 3 were Green-winged Teal and Mallard. Other common species were American Wigeon, Canada Goose and Ring-necked Duck (Table 6). Canada Goose, Mallard, Northern Shoveler, and Killdeer were the only species detected in all four surveys (Table 6). As in previous years, the majority of individuals (289) and species (12) were detected during the first survey on May 1 at the Airport Lagoon site. Incidental observations during other surveys at the Airport Lagoon included a flock of 30 Long-billed Dowitcher and a pair of Common Loon. Incidental observations of waterfowl and shorebirds at the Beaver Pond site included single observations of Bufflehead, Surf Scoter, Blue-winged Teal, and Spotted Sandpiper.

Table 6. Summary of waterfowl and shorebird observations in 2011, 2012, and 2013 at the Airport Lagoon and Beaver Pond sites, Williston Reservoir, BC. No waterfowl or shorebirds were observed in 2013 during targeted surveys at the Beaver Pond site.

	Airport Lagoon														Beaver Pond						
	2011[a]				2012					2013					2011[a]			2012			
	May 9	May 22	June 7	Total	May 1	May 9	May 16	May 31	Total	May 1	May 12	May 25	June 10	Total	June 8	June 21	Total	May 18	June 1	June 8	Total
Greater White-fronted Goose	1			1																	
Canada Goose	35	8	27	70	19	5	7	18	49	12	2	10	10	34	4		4				
American Wigeon	37			37	34		4		38	44			2	46							
Mallard	6	4	4	14	9		3		12	49	3	7	30	89	2		2				
Blue-winged Teal		3		3				1	1		14	2	3	19							
Cinnamon Teal		1		1							1			1							
Northern Shoveler	4	2	3	9	12		4		16	3	1	2	2	8							
Northern Pintail			1	1	9	6			15	5		2	5	12							
Green-winged Teal	4	2		6	18	5	4		27	85	2		5	92							
Canvasback						2			2												
Ring-necked Duck	35	4	2	41	49				49	33				33							
Lesser Scaup	15	3		18	6				6									2			2
Bufflehead	5	4		9	7				7	22	1			23							
Barrow's Goldeneye	4			4	1				1	17				17							
Hooded Merganser					2				2												
Common Merganser					10				10	13				13							
Common Loon						1	1		2												
Red-necked Grebe	5	2		7	1				1												
Semipalmated Plover						4	3		7		1			1				1			1
Killdeer						4	1	2	7	3	1	1	3	8					1		1
Spotted Sandpiper							3	1	4		1	1	3	5							
Greater Yellowlegs							6	4	12	3				3							
Lesser Yellowlegs					7		13		20		5	3		8							
Semipalmated Sandpiper						6	1		7		5			5							
Long-billed Dowitcher							68		68												
Totals	**151**	**33**	**37**	**221**	**184**	**35**	**118**	**26**	**363**	**289**	**37**	**28**	**63**	**417**	**6**		**6**	**3**	**1**		**4**

[a] – Shorebirds were not a component of the 2011 surveys.

5.4 Songbird Surveys

A total of 61 species were detected encompassing 401 detections and 482 individuals. The Airport Lagoon site had higher species richness, with 57 of the 61 total species being detected versus 23 of 61 total species at the Beaver Pond site (Table 7). All species detected at the Beaver Pond site were detected at the Airport Lagoon, except for four species (Bufflehead, Common Raven, Dusky Flycatcher, and Red-eyed Vireo). The number of species detected at each site in 2013 was similar to previous years (Table 7). An average of 12.1 (n=17) species were detected per point count station at the Airport Lagoon site compared to an average of 14.7 (n=3) per station at the Beaver Pond site (Table 8). This is a slight decrease in detections per station at the Airport Lagoon and a slight increase at the Beaver Pond site. A summary of the species detected at each station in 2013 is included in Appendix 12.

At the Airport Lagoon site, the majority of detections (37.5%, n=120) were made in forested habitat above the drawdown zone, with slightly fewer birds detected in the shrub band adjacent to the drawdown zone (30.3.0%, n=97) (Table 8). The remaining detections were either in the drawdown zone (19.1%, n=61) or fly-overs (13.1%, n=42) (Table 8). This is a similar pattern to 2012 except for the change between forest and shrub detections. In contrast, the majority of detections at the Beaver Pond site were in the forest area (81.5%, n=66) surrounding the drawdown zone (8.6% of detections, n=7). The remaining detections were in shrubs (6.2%, n=5) or were fly-overs (3.7%, n=3) (Table 8). This is similar to the pattern observed in 2012.

Nest searching surveys found a total of eight nests of seven different species, with seven nests at the Airport Lagoon site and one nest at the Beaver Pond site. Nests were found both within the drawdown zone and in adjacent shrub and forest areas (up to ~50 m from edge of drawdown zone). At the Airport Lagoon, nests located in the drawdown zone during the point count surveys included Osprey, Spotted Sandpiper, Mountain Bluebird, Lincoln's Sparrow, and American Robin. A Canada Goose nest was incidentally encountered in the drawdown zone on the east side of the lagoon during amphibian surveys on May 12. A brood of Wilson's Snipe were encountered in the drawdown zone during the songbird surveys. A Mallard nest was located in a small wetland in the cutblock on the west of the site. Greater and Lesser Yellowlegs may have also been nesting near this wetland. A Red-tailed Hawk nest was the only nest located above the drawdown zone. At the Beaver Pond site, a single American Redstart nest was located in the forest on the edge of the drawdown zone on the southwest side of the site.

Table 7. Summary of the number of species detected and mean species per station for point count surveys in 2011, 2012, and 2013 at the Airport Lagoon and Beaver Pond sites.

	Year	Airport Lagoon	Beaver Pond	Combined Total
Number of Species	2011	57	21	59
	2012	56	24	59
	2013	57	23	61
Species per Station	2011	13.8	11.3	13.4
	2012	14.5	12	14.2
	2013	12.1	14.7	12.5
Number of Stations		17	3	20

Table 8. Summary of the detection locations for point count surveys in 2012 and 2013 at the Airport Lagoon and Beaver Pond sites. Detection location was not recorded in 2011.

Year	Detection Location	Airport Lagoon		Beaver Pond	
		Number of Detections	%	Number of Detections	%
2012	Drawdown Zone	82	22.3	5	6.8
	Shrubs	112	30.5	9	12.3
	Forest	99	27	58	79.5
	Flyover	69	18.8	1	1.4
	Unknown	5	1.4		
	Total Detections	367		73	
2013	Drawdown Zone	61	19.1	7	8.6
	Shrubs	97	30.3	5	6.2
	Forest	120	37.5	66	81.5
	Flyover	42	13.1	3	3.7
	Total Detections	320		81	

5.5 Amphibian Surveys

In 2013, three amphibian species were detected during the systematic surveys: western toad, long-toed salamander, and wood frog (Table 9). The western toad (*Anaxyrus boreas*), a blue-listed species in BC and a federal Special Concern species, again represented the majority of amphibian detections (Table 9). There was only a single detection of a wood frog (*Lithobates sylvatica*) at the Beaver Pond site in 2013. Long-toed salamanders (*Ambystoma macrodactylum*) were detected at both sites with three individuals observed at the Airport Lagoon on two separate occasions (May 1 and 12) and a single individual at the Beaver Pond site on May 26 (Table 9). In addition to adult and juvenile frogs, egg masses and strands and tadpoles were also observed during the surveys. Four frog egg masses were observed on May 12 at the Airport Lagoon site (1 on transect 32 and 3 on transect 40). Western toad egg strands were observed on May 26 at the Beaver Pond site. Recently hatched tadpoles were observed at both the Airport Lagoon (transects 25 and 32) and Beaver Pond sites on the May 24 and 26 surveys, respectively. Western toad tadpoles were also observed on transect 25 at the Airport Lagoon during the June 6 survey. Numerous toadlets were observed at the Beaver Pond site adjacent to the beaver ponds on July 16. The UTM coordinates for all amphibian detections are provided in Appendix 13.

Table 9. Adult and juvenile amphibian detections in 2011, 2012, and 2013 at the Airport Lagoon and Beaver Pond sites.

		Species									Survey Effort		
		Western Toad			Wood Frog			Long-toed Salamander					
Site	Transect	2011	2012	2013	2011	2012	2013	2011	2012	2013	2011	2012	2013
Airport Lagoon	2										0:17	0:55	0:31
	3	1									0:21	0:33	0:58
	7		1		1					1	0:29	0:56	0:33
	10	2		3							0:22	0:55	0:79
	14	2									0:27	1:04	0:50
	25	7	4	6					2		0:51	1:33	1:31
	28										0:29	0:43	1:02
	32	1	1	1							0:24	0:52	0:40
	35		1								0:29	0:43	0:42
	37	3								1	0:22	0:27	0:42
	40									1	0:29	0:46	0:31
Total		**16**	**7**	**10**	**1**				**2**	**3**	**5:00**	**9:27**	**9:19**
Beaver Pond	BP-A-01	3	1	2	10		1			1	1:13	3:02	2:59
Grand Total		**19**	**8**	**12**	**11**		**1**		**2**	**4**	**6:13**	**12:29**	**12:18**

5.6 Fish Surveys

A total of 2,672 fish representing 11 species were collected over the duration of the sampling program in Year 3. As in previous years, more fish and species were collected at the Airport Lagoon site (2,484 fish, 9 species) than at the Beaver Pond site (188 fish, 8 species) (Table 10). At the Airport Lagoon site the majority of fish were collected by minnow trap (1,476 fish), followed by fyke net (702 fish), and electrofishing (306 fish) (Table 10). At the Beaver Pond site, the majority of fish were collected by fyke net (119 fish), followed by electrofishing (64 fish), and minnow traps (5 fish) (Table 10). The number fish captured in Year 3 was higher than in the previous two years of the project at both sites and for all methods. With the exception of electrofishing at the Beaver Pond site, the CPUE was also higher in Year 3 than in previous years at all sites and for all methods. The Year 3 CPUE for all methods at the Airport Lagoon was also higher despite a lower sampling effort than in previous years. Fish capture data from Year 3 are included in Appendix 14.

The high numbers of fish captured at the Airport Lagoon in 2013 are primarily the result of large numbers of Brassy Minnow (*Hybognathus hankinsoni*) captured during the first minnow trapping session in May. No Brassy Minnows were captured during the second minnow trapping session at this site but they were the second most abundant species captured by fyke net in 2013. The numbers of Lake Chub (*Couesius plumbeus*), and Redside Shiner (*Richardsonius balteatus)* captured in Year 3 were also notably higher than in previous years, with the exception of Redside Shiner by minnow trap. During the May sampling session at the Airport Lagoon, large schools of small fish were commonly observed both while electrofishing and when setting the minnow traps. While some small fish were observed in Years 1 and 2, the number and size of the schools was much higher in Year 3.

At the Beaver Pond site, all three sampling methods captured higher numbers of fish in Year 3 than in previous years (Table 10). While more fish were captured by electrofishing than in previous years, the CPUE was not the highest due to higher sampling effort. The higher effort is the result of fish being captured in the upper reach at this site for the first time, increasing the amount of effort required to complete sampling of this reach. Fish captures by fyke net at this site were also much higher in 2013 than in previous years. Also, the July minnow trapping resulted in the first collection of a fish from one of the beaver ponds. A single Longnose Sucker (*Catostomus catostomus*) (117 mm fork length) was captured from the lower beaver pond.

At both sites, all three sampling methods had overlap in the size of fish they captured with the smallest fish captured by electrofishing and the largest by fyke net (Table 10). Electrofishing also captured the highest diversity of fish, followed by fyke net and minnow traps although this was variable depending on the sampling year.

As in previous years, the majority of fish species captured were non-sportfish. At the Airport Lagoon site, Brassy Minnow were the most commonly captured species, followed by Lake Chub and Redside Shiner. Other common species at the Airport Lagoon site included Northern Pikeminnow (*Ptychocheilus oregonensis*), Longnose Sucker, and Prickly Sculpin (*Cottus asper*). The only sportfish species captured were juvenile Burbot (*Lota lota*) at the Airport Lagoon. At the Beaver Pond site, juvenile suckers (*Catostomus* spp.) and Peamouth (*Mylocheilus caurinus*) were the most commonly captured species followed by Northern Pikeminnow and Redside Shiner. Other species collected at this site included three species of sucker (Longnose Sucker, White Sucker [*C. commersonii*], Largescale Sucker [*C. macrocheilus*]).

Water quality data collected on each sampling date are included in Appendix 15.

Table 10. Summary of fish species captured by date and method in 2011, 2012, and 2013 at the Airport Lagoon and Beaver Pond sites.

		Method											
		Electrofishing			Minnow Trap			Fyke Net			Totals		
Site	**Species**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
Airport Lagoon	Lake Chub	49	12	127	42	21	326		166	268	91	199	721
	Brassy Minnow	1	1	91	2	2	1123		53	213	3	56	1427
	Peamouth								1			1	
	Northern Pikeminnow	1	40	1		1	4	2	43	22	3	84	27
	Redside Shiner	7	3	45	4	10	8		113	192	11	126	245
	Longnose Sucker	4	1	3			9	1	48	5	5	49	17
	White Sucker								14			14	
	Largescale Sucker	2	5	1		2	3		9	2	2	16	6
	Sucker sp.	32	3	2			3				32	3	5
	Rainbow Trout	2									2		
	Burbot	1	35	10	1	5		1	7		3	47	10
	Prickly Sculpin	22	17	25	1	2					23	19	25
	Slimy Sculpin			1	1						1		1
	Totals	121	117	306	51	43	1476	4	454	702	176	614	2484
	Effort[1]	6500	9201	5715	379.58	536.62	240.27	39.64	65.417	30.47	-	-	-
	CPUE[2]	1.117	0.763	3.213	0.134	0.080	6.143	0.101	6.925	23.039	-	-	-
	No. of Species	9	8	9	6	7	6	3	9	6	10	10	9
	Size Range (mm)	42-145	25-182	22-290	48-98	50-143	41-97	69-359	27-380	29-420	42-359	25-380	22-420
Beaver Pond	Lake Chub	1		5							1		5
	Peamouth					1		10		54	10	1	54
	Northern Pikeminnow	1		1	1			4	1	38	6	1	39
	Redside Shiner	9	1	1						16	9	1	17
	Longnose Sucker	4		3			1		1	3	4	1	7
	White Sucker									2			2
	Largescale Sucker	1		1					1	6	1	1	7
	Sucker sp.	43		53			1				43		54
	Bull Trout								1			1	
	Prickly Sculpin	1					3				1		3
	Method Totals	60	1	64	1	1	5	14	4	119	75	6	188
	Effort[1]	1048	897	1580	129.72	133.50	150.42	21.75	22.75	17	-	-	-
	CPUE[2]	3.435	0.067	2.430	0.008	0.007	0.298	0.6437	0.1758	7	-	-	-
	No. of Species	6	1	5	1	1	2	2	4	6	7	6	8
	Size Range (mm)	29-59	27	33-71	119	127	51-117	165-338	210-352	38-369	29-338	27-352	33-369
Grand Totals	**Fish**	**181**	**118**	**370**	**52**	**44**	**1481**	**18**	**458**	**821**	**251**	**620**	**2672**
	Effort[1]	**7548**	**10098**	**7295**	**509.3**	**670.12**	**390.69**	**61.39**	**88.167**	**47.47**	**-**	**-**	**-**
	CPUE[2]	**1.439**	**0.701**	**3.043**	**0.102**	**0.066**	**3.791**	**0.293**	**5.195**	**17.295**	**-**	**-**	**-**
	No. of Species	**9**	**8**	**9**	**7**	**8**	**7**	**4**	**10**	**8**	**11**	**11**	**11**
	Size Range (mm)	**29-145**	**25-182**	**22-290**	**48-119**	**50-143**	**41-117**	**69-359**	**27-380**	**29-420**	**29-359**	**25-380**	**22-420**

[1] – Electrofishing effort expressed in seconds (active sampling), minnow traps and fyke nets in hours (passive sampling)
[2] – Electrofishing CPUE = fish/minute; minnow trap and fyke net CPUE = fish/hour

6 DISCUSSION

As this is the third year of a ten year monitoring program, the results presented provide a baseline of the wildlife habitats and indicator groups at the two project sites. The focus of field activities in Year 3 was to collect additional baseline data from established survey stations and transects prior to construction of the wetland enhancements. The Airport Lagoon project was constructed in late May 2013, so the data collected from this site is a combination of baseline and initial post-construction observations. A summary of the progress towards addressing the management questions and hypotheses is provided in Table 11.

Table 11. The status of the GMSMON-15 management questions and hypotheses following completion of Year 3 of the monitoring program.

Management Question	Management Hypothesis (Null)	Year 3 (2013) Status
Is there a change in the abundance, diversity and extent of vegetation in the enhancement area?	H_{01}: The density, diversity and spatial extent of riparian and aquatic vegetation does not change following enhancement.	Testing of this hypothesis is not yet possible as no post-construction data has been collected. Baseline vegetation data collection at both sites is complete.
Are the enhanced (or newly created) wetlands used by waterfowl and other wildlife?		No post-construction data on wildlife habitat has been collected yet as the Airport Lagoon project was just completed in spring 2013 and the Beaver Pond project is scheduled for spring 2014. Baseline data collection on the existing use of the sites by waterfowl and other wildlife is complete.
	H_{02}: The species composition and density of waterfowl and songbirds does not change following enhancement.	Testing of this hypothesis is not yet possible as no post-construction data has been collected. Baseline data collection on waterfowl, shorebird, and songbird use of both sites is complete.
	H_{03}: Amphibian abundance and diversity in the wetland does not change following wetland enhancement.	Testing of this hypothesis is not yet possible as no post-construction data has been collected. Amphibian baseline data collection at both is complete.
Is the area and quality of wildlife habitat created by the wetland enhancement maintained over time?		No post-construction data on wildlife habitat has been collected yet as the Airport Lagoon project was just completed in spring 2013 and the Beaver Pond project is scheduled for spring 2014.

The general conditions observed at both sites in Year 3 were similar to Year 2. As observed in Year 2, there was significantly less vegetation cover present in Year 3 compared to Year 1 (refer to Appendix 10 for examples of the differences in vegetation between years). The differences in vegetation cover are considered to be primarily a result of the different reservoir conditions prior to the surveys in each year. The Year 1 surveys occurred following a year of low reservoir levels that did not result in the inundation of either site during the growing season. The Years 2 and 3

surveys occurred following a years where the reservoir either was close to (2011) or at (2012) full pool and both sites were inundated for an extended period during the growing season.

As noted in previous years (CBA 2012, 2013), weather conditions during the sampling period may have influenced some of the survey results. In Year 3, temperatures were generally close to or above average. Unlike Years 1 and 2, temperatures during early to mid May were warmer than average. The warmer temperatures were also confirmed by degree day calculations (5°C base temperature) with more degree days accumulated on any given date in Year 3 than in either Years 1 or 2. Precipitation in Year 3 was consistently below average for April, May, and June. In previous years, cumulative precipitation was above average for most months in the sampling period.

The pre-construction vegetation mapping and ground-truthing identified 14 vegetated habitat classes and one non-vegetated (open water) habitat class at both sites. With the exception of one vegetated habitat class that was common to both sites (SW - Shoreline Willow), the vegetation communities documented at both sites were different. However, the distribution of the habitat classes followed a similar pattern at both the Airport Lagoon and Beaver Pond sites. The general pattern of habitats was a band of coarse woody debris parallel to the edge of the reservoir at full pool transitioning into a band of sparsely vegetated sand or clay to an area of sparsely vegetated mud adjacent to the water's edge.

The habitat classes observed have developed in response to the annual flooding regime from reservoir operations. As the timing of reservoir filling and the maximum elevation reached varies from year to year the species present in each of the habitat classes is expected to be variable, particularly in higher elevation habitat classes that may not be flooded every year. In 2010 reservoir levels did not exceed 665 m during the growing season resulting in most of the mapped area at both sites not being flooded. This allowed for colonization by species that are less tolerant of inundation. Reservoir levels in both Years 1 (2011) and 2 (2012) were much higher than in 2010 with the water level reaching 665 m in mid-June 2011 and early June 2012. The maximum water levels reached were 671.4 m in late August 2011 and 672 m at the end of July 2012. As a result, all transects and the majority of mapped habitat classes were inundated in both 2011 and 2012.

Plant species that were identified at the two study sites during the last three growing seasons (Years 1, 2, and 3 ground surveys) are likely to be tolerant to flooding events. A majority of these species are adapted to wet soils that are often saturated for most of or the entire growing season (e.g., swamp horsetail). Many of these species have also been observed as regularly occurring within the drawdown zone of other reservoirs located in B.C (e.g., bluejoint at Arrow Lakes).

Plant species identified at the study sites during Year 1 ground surveys that were not detected (either absent or only dead remains were observed) during the Year 2 or 3 ground surveys are likely to be intolerant to flooding events. Based on their life history, some of the species identified are adapted to dry to mesic soils (e.g., fireweed, red raspberry and trembling aspen) and therefore, their intolerance to flooding is expected. However, a few species identified are adapted to moist to wet soils and yet were still found to be intolerant to flooding (e.g., dead remains of Norwegian cinquefoil and common cattail were apparent across the Airport Lagoon site). Their intolerance is partly related to the timing (early to middle of the growing season) of flooding but is also a result of the depth (can be >4 m) and duration of flooding (the remainder of the growing season).

The lower number of species identified during the Year 2 and 3 ground surveys may have also been related survey timing. Surveys in Years 2 and 3 were conducted earlier in the growing season due to risk of early flooding of the sites (June 2–4, 2012 and June 6-10, 2013) compared to Year 1 (June 17-23, 2011). During this time some species may not have been identifiable due to a lack of distinguishing characteristics or not detected due to a lack of above-ground growth (i.e., many species germinate and emerge from the soil in the late spring to early summer).

The waterfowl survey results in Year 3 were similar to those in Years 1 and 2, although as noted in CBA (2013), the inclusion of shorebirds increased both species richness and overall numbers detected. Waterfowl surveys were started and completed in similar dates to Year 2 and are considered to have provided an accurate characterization of migrating waterfowl use of the sites. While the results of the Year 3 waterfowl surveys were similar to previous years, two of the surveys at the Airport Lagoon were completed either during or after installation of the new culverts. The May 25 surveys were completed during the installation of the new culverts at the causeway and water levels were elevated in the southern portion of the lagoon due to the installation of a coffer dam. The final surveys on June 10 were completed after construction had been completed and water levels were at or close the design elevation.

Data collected in Year 3 prior to construction (May 1 and 12) provide additional baseline data on the use of the site by migratory waterfowl and shorebirds. The data from May 25 was at least partially influenced by construction with no waterfowl observed adjacent to the causeway. However, no survey was completed from survey station WSP-01 due to construction. Water levels in the lower part of the lagoon on May 25 were elevated above those observed in previous years and may have influenced the survey results from survey station WSP-02. While the results from the June 10 survey were completed in the same season, the results from this date are considered to be initial post-construction data and not part of the baseline as water levels were at or close to the design levels. The June 10 survey data may be useful in interpreting post-construction changes in waterfowl abundance and diversity but should be used with caution for any before/after comparisons of the wetland enhancement.

Two of the species detected during the waterfowl and shorebird surveys were also confirmed as nesting on site. These include the incidental observation of nesting Canada Goose during amphibian surveys and the detection of a Spotted Sandpiper nest during the songbird surveys at the Airport Lagoon site in 2013. Greater and Lesser Yellowlegs are also suspected of breeding near the Airport Lagoon site, but this has not been confirmed. Killdeer may also nest at the site. Given that the sites were thoroughly nest-searched, the majority of waterfowl and shorebirds detected at the Airport Lagoon are likely migrants. Variability in species composition detected during the surveys probably reflects variability in timing and route of migration from year to year.

In the first three years of the monitoring program, the vast majority of waterfowl (e.g., American Wigeon) and shorebirds (e.g., Long-billed Dowitcher) using the Airport Lagoon site were migrants stopping over and then moving to other breeding areas. Based on breeding habitat requirements of several of the waterfowl species that were detected during out surveys, the lack of good nesting habitat (e.g., well developed areas of emergent vegetation for Ring-necked Ducks and well-vegetated grasslands/shrublands for American Wigeon, Green-wing Teal, and Mallards) is the main reason for the observed lack of breeding waterfowl. However, the increase in wetland area has increased the amount of habitat available for waterfowl and increased the proximity to potential nesting habitat. The first post-construction survey (June 10, 2013) did identify higher numbers and diversity of waterfowl than the late season surveys in Years 1 and 2 and may be an initial indicator that the project will result in increases in waterfowl abundance and diversity.

As in previous years, access to the Beaver Pond site was limited by early spring ice on Williston Reservoir. It is expected that fewer surveys will continue to be completed each year at the Beaver Pond than at the Airport Lagoon site. No waterfowl or shorebirds were detected at the Beaver Pond site during Year 3 and few were detected in Years 1 and 2 of the monitoring program. This is partly due to the much smaller size of the site compared to the Airport Lagoon and the limited amount of habitat available. As surveys of this site have not occurred until after Williston Reservoir is ice free, it is possible that there is some use of the site that has not been captured by these surveys if the beaver ponds are free of ice before the lake. Construction of the wetland will increase the amount and quality of waterfowl habitat available at this site and increases in waterfowl abundance and diversity are expected after construction.

Overall, songbird survey results from 2013 were similar to previous results from 2011 and 2012 at both the Airport Lagoon and Beaver Pond sites. The total species detected in 2013 was slightly higher than in previous years with two more species detected than in either 2011 or 2012. However, the overall number of detections and number of individuals was lower than the previous two years. As occurred in 2012 (CBA 2013), some differences in species composition were recorded in 2013. A total of ten species (16%) were unique to 2013. American Widgeon, Ring-neck Duck, Bufflehead, Red-tailed Hawk, Belted Kingfisher, Red-naped Sapsucker, Hairy Woodpecker, Bank Swallow, Blackpoll Warbler, and Purple Finch were detected in 2013 but not in 2011 or 2012. The majority of species detected in 2013 (61%, n=37) were also detected in both 2011 and 2012. The remaining 14 species (22%) detected in 2013 were also detected in either 2011 or 2012.

The difference in frequency of detections in the different areas (e.g., drawdown zone, forest) at the two sites is accounted for by the difference in area. The Beaver Pond has a small, featureless drawdown zone with low use by birds and lacks the well-developed shrub habitat that exists on the eastern side of the Airport Lagoon site. The small drawdown zone area relative to the surrounding forest habitat also explains why a high proportion of detections are in forest habitat at the Beaver Pond site.

Nest searching efforts in 2013 again included areas adjacent to the drawdown zone. However, few nests were found. This is likely a result of random variability in nest searching success. While few nests were located, observations indicated that a number of other species were likely nesting in the area, including some of the shorebird species noted above. Given the relatively small area of both sites and relatively large nesting territories of some species, small changes in nesting patterns by some species will result in variability in the number of nests found each year.

The amphibian surveys detected the same species as in 2012 and slightly higher numbers. Western toad, wood frog, and long-toed salamander were all observed again in 2013. As in 2011, this is consistent with other inventory work completed in the area. Hengeveld (2000) recorded long-toed salamander, western toad, wood frog, and Columbia spotted frog in wetlands in the Parsnip reach of the Williston Reservoir watershed. Western toad was the species most commonly observed (Hengeveld 2000). Columbia spotted frog has not been observed to date at either the Airport Lagoon or Beaver Pond sites. The frog egg masses observed at the Airport Lagoon are likely wood frog as this species has been observed on the site and in adjacent areas. Long-toed salamanders were again detected at the Airport Lagoon and on different transects than the observations in 2012. Adult long-toed salamanders were also observed on the survey transect at the Beaver Pond site. The earlier start of the surveys in 2012 and 2013 likely assisted in the detection of long-toed salamander, an early breeding species. Long-toed

salamanders and wood frog are known to start breeding before the snow and ice melts in northern British Columbia (Matsuda et al. 2006).

Weather conditions may have had some influence on the number of detections as amphibians are ectotherms and tend to be more active during warmer weather and after rainfall (RIC 1998). The low numbers of amphibians detected in Year 2 may be partly related to the cooler than average temperatures (Figure 12) during amphibian sampling (May 2012) and the below average precipitation (Figure 13) during the same period. In contrast, in Year 1 (when the highest number of amphibian detections was recorded), weather conditions during amphibian sampling (late May – early June) were warmer than average (Figure 12) and precipitation was well above average in May (Figure 13). Weather conditions in Year 3 were intermediate between the two years (warmer than average, below average precipitation) (Figure 12 and Figure 13) and the number of amphibian detections were intermediate as well.

Other factors may have also contributed to the variation in amphibian detections during the first three years of the project. The lack of vegetation observed at both sites in Year 2 was considered to have reduced the quality of amphibian habitat due to reduced cover (CBA 2013). The extent of vegetation was similar in Year 3 and considerably reduced when compared to Year 1. However, amphibian numbers are known to vary considerably from year to year (RIC 1998, US EPA 2002). Consistency in the timing and number of surveys and conducting surveys under appropriate environmental conditions will assist in controlling variability related to annual differences in the timing of peak breeding activity as a result of weather conditions.

Fish sampling by electrofishing, minnow trapping, and fyke nets was effective and provided additional information on fish populations at both proposed wetland enhancement sites. The three methods of sampling resulted in the collection of 11 of 22 species known to occur in the reservoir in 2013. All species collected in 2013 had been observed in previous years. Between the two sites a total of 13 fish species have been observed over the first three years of the project.

The fish sampling results for 2011, 2012, and 2013 from the Airport Lagoon confirms that this site has a resident fish population of cyprinids, suckers, and sculpins. In 2013, Brassy Minnow was the most abundant species while Lake Chub was the most abundant species in 2011 and 2012. The relative abundance of most species was similar to previous years. However, the relative abundances of Brassy Minnow, Lake Chub, and Redside Shiner were much higher than in previous years, especially Brassy Minnow. These three species are considered to be resident in the Airport Lagoon.

The high numbers of Brassy Minnow, Lake Chub, and Redside Shiner observed in 2013 are assumed to be the result of two years of high reservoir levels increasing the amount of suitable habitat available for these species. The low reservoir levels in 2010 restricted the area of available habitat to the stream flowing through this site and the two ponds (adjacent to the causeway and in the northwest arm). The high reservoir levels in 2011 and 2012 resulted in the inundation of the site and increased the amount of habitat available. This is particularly true in 2012 when reservoir levels increased earlier and more rapidly than in 2011. Installation of the new culverts in 2013 increased water levels in the lagoon beginning on May 23 and water levels were approaching the design elevation by June 6. Reservoir levels did not reach this elevation until June 16.

Fish sampling at the Airport Lagoon produced results more similar to 2012 than 2011. Sampling in both 2012 and 2013 was completed following a season where the reservoir was close to or at

full pool for an extended period of time. The reservoir level preceding the 2011 sampling was completed occurred following a year when the maximum reservoir level was just above the level of the outlet culverts at the Airport Lagoon. The culvert blockage observed during sampling in July 2012 did not appear to affect the sampling results for 2013. Completion of the July 2013 sampling after construction of the new culverts also did not appear to have any impact on the data.

Based on the description of the Beaver Pond site (Golder Associates Ltd 2010, 2011), it was originally expected that low numbers of fish would be encountered at this location. In 2011, electrofishing in one of the two reaches resulted in the capture of the highest number of fish and highest electrofishing CPUE of all sites sampled while only a single fish was captured in 2012 (CBA 2012, 2013). However, in 2013 more fish were captured by electrofishing than in 2011and fish were also collected from the upper transect for the first time. Reservoir conditions and sampling date were considered to be the likely reasons for the difference between 2011 and 2012. Sampling in 2013 was completed at an intermediate date compared to the previous two years. The reservoir level was approximately 1.5 m higher during sampling in 2013 compared to 2012 but the lower part of the stream that was identified as likely being impassable to small fish was still exposed. A mixed school of small fish was also observed at the stream mouth during sampling in 2013.

It was suggested in Year 1 that the sheltered nature of this inlet may provide preferred habitat for juvenile fish in comparison to adjacent, exposed areas of the reservoir shoreline (CBA 2012). Observations and water quality data collected in 2012 provided some support to this hypothesis (CBA 2013). With the completion of three years of fish sampling at this site it appears that the Beaver Pond site does provide rearing habitat for juvenile fish prior to inundation and some seasonal habitat for other fish following inundation. After inundation, the inlet has a large area of shallow water and stable shorelines that may result in higher productivity than in adjacent areas of the reservoir with steeply sloping and less stable, exposed shorelines.

7 CONCLUSIONS

The baseline data collected in Years 1 to 3 of the GMSMON-15 project appear to support the preliminary impact and benefit predictions for the proposed wetland enhancements (Golder Associates Ltd 2011). The additional baseline data from Year 3 was collected under similar reservoir conditions to Year 2. The data collected in Year 1 was following a year (2010) when reservoir elevations did not reach a high enough level to inundate either the Airport Lagoon or the Beaver Pond sites. Data collected in Years 2 and 3 were collected following years when reservoir levels were close to or at full pool for an extended period. Differences in the data collected for vegetation and fish are considered to be primarily associated with the different reservoir conditions in Year 1 compared to Years 2 and 3. The differences in amphibian detections may have been influenced by environmental conditions with the lowest detections in Year 2 when both temperature and precipitation was lower than in either Years 1 or 3. Differences in waterfowl and songbird observations over the first three years of the project are attributed primarily to natural variability and not to differences in reservoir conditions.

The construction of the Airport Lagoon in late May 2013 allowed for collection of additional baseline data for amphibians and waterfowl and shorebirds at this site. The Year 3 songbird point counts were completed in early June just after completion of construction and when water levels were close to or at the design elevation. The Year 3 fish data from the Airport Lagoon was collected both during and after construction. While some modifications to the fish sampling were required, the data collected during construction is considered to be additional baseline data. As noted in the Year 2 report (CBA 2013), the additional baseline data collected in Year 3 will assist in making comparisons of pre- and post-enhancement abundance of these indicator groups. The data collected in spring 2013 was collected under similar reservoir conditions to 2012 (i.e., following a year when the reservoir level was close to full pool for an extended period).

Depending on the timing of construction of the Beaver Pond project in spring 2014, the collection of additional baseline data may be possible. The collection of two years of baseline data under similar reservoir conditions (i.e., following a year when the reservoir level was close to full pool for an extended period) the baseline conditions at this site have been described. However, the collection of additional baseline data will assist in the ability to make comparisons of pre- and post-enhancement abundance of the target species.

For vegetation, the additional baseline data collected in Year 3 provided a better characterization of the vegetation types that existed prior to completion of the wetland enhancement projects. The completion of the enhancement projects is expected to allow the development of aquatic vegetation that is currently non-existent (Beaver Pond) or limited in extent (Airport Lagoon). More detail on the current status of these vegetation types will assist in separating changes associated with the wetland enhancement projects from those associated with reservoir levels. The proposed wetland designs reduce the influence of reservoir conditions on these sites but do not entirely isolate them. Vegetation communities above the wetland enhancement design elevations are expected to be primarily influenced by annual reservoir elevations. Changes in vegetation communities as a result of the wetland enhancements are most likely to be observed in areas that are permanently flooded (change from drawdown zone to aquatic habitat) and in areas adjacent to the new wetlands as a result of the increased and stabilized water levels.

The differences in the waterfowl and songbird results were observed in the first three years of the monitoring program are considered to be a result of natural variability. For both waterfowl

and songbirds, stabilization of the water regime may allow for development of wetland and riparian vegetation at both sites and therefore increase habitat availability. Depending on the time of ice off at the Airport Lagoon in relation to the reservoir following completion of the wetland enhancement, there may also be an increase in the numbers of spring migrants due to increased habitat area. The change in habitat area at the Airport Lagoon is also expected to result in some changes to the patterns of waterfowl use at the site. The waterfowl observations from the first post-construction survey in June 2013 may indicate that this is already occurring. Spatial analysis of waterfowl locations recorded during the surveys will assist in identifying changes once additional post-construction monitoring is completed. As there was little to no use of the Beaver Pond site by waterfowl or shorebirds the increase in habitat as a result of the wetland enhancement should result in an increase in use by both groups.

Review of the pre-enhancement waterfowl data for both sites detected little annual or seasonal variation (Appendix 16). Data for the Airport Lagoon site included only waterfowl stations 1, 2, and 3 as these stations have had the greatest change in habitat as a result of the wetland enhancement. However, close examination of the data shows that when both seasonal and annual effects are considered, there were consistently more waterfowl observed in 2011, and there was a better defined seasonal decline within the other years. Modelling of the mean (negative binomial distribution) number of waterfowl estimated a mean of 34 waterfowl at the Airport Lagoon site but with wide variation. The addition of seven more years of data may allow the models to become considerably more complex, which will greatly reduce the error, and enhance the ability of the study to detect changes associated with the Airport Lagoon impoundment project. At Beaver Pond, modelling estimated there to be one waterfowl. The error around this estimation was larger than standard Poisson variation, but was still relatively small, indicating considerable potential to detect relatively small effect sizes of the Beaver Pond impoundment project. The existing monitoring programs at both sites are expected to detect changes in waterfowl abundance associated with the wetland enhancement projects.

For songbirds, the reduced vegetation cover observed in Year 2 (CBA 2013) and Year 3 compared to Year 1 also resulted in some changes in use of the site by some species with reduced use by some species (e.g., Savannah Sparrow) or a shift in use to the periphery of the site. Point count data collected in 2012 and 2013 included additional information on the detection location to separate detections based on the habitat they were located in – forest (above the drawdown zone), shrubs (on the edge of the drawdown zone), and drawdown zone. There was little annual variation in the number of species detected in habitats affected or potentially affected by the wetland enhancements (drawdown zone and shrubs) at both sites (Appendix 17). With the low annual variation, detection of even small changes associated with completion of the wetland enhancements is expected. Evaluation of changes in the species detected will also assist in determining the effectiveness of the wetland enhancements. The species detected in the drawdown zone habitat are expected to show the greatest degree of change post-enhancement with the change from a seasonally flooded to a permanently flooded habitat.

Similar to Year 2, the lack of vegetation observed at both sites in Year 3, may have contributed to the lower number of amphibians observed due to poorer quality habitat (less cover). Below average precipitation in both May 2012 and 2013 may have also reduced the numbers of amphibians observed compared to Year 1 when May precipitation was well above average. At both sites, the wetland enhancements should increase the amount of amphibian breeding habitat available, particularly at the Beaver Pond site. Additionally, at the Airport Lagoon, the changes may increase the accessibility of breeding habitat by reducing the distance to be traversed between upland areas and breeding habitat. However, the higher water levels at this

site will likely eliminate some of the small pools currently used for breeding and potentially increase the risk of predation by fish at this site.

While low numbers of amphibians were detected at both sites during the pre-enhancement phase of the monitoring program the use of both sites by three species of breeding amphibians was confirmed. However, the low numbers of amphibians detected in during baseline monitoring at both the Beaver Pond (mean = 2.44) and Airport Lagoon (mean = 3.83) (Appendix 18) sites will assist in determining if the wetland enhancement projects result in an increase in amphibian abundance at both sites. Based on the mean annual abundance during the pre-enhancement phase, a minimum increase in mean abundance of four to five individuals at each site after construction of the wetlands is expected to be detectable. While there are some confounding factors that contribute to annual variability in amphibian populations, if the projects are effective at increasing amphibian populations, it is expected that larger increases will be observed. This is particularly true at the Beaver Pond site where the wetland enhancement will result in a large increase in the amount of amphibian breeding habitat available. At the Airport Lagoon, additional comparisons among transects and within transects will also be possible.

While there were differences observed in the fish results between the three years of pre-enhancement sampling at the Beaver Pond site, the results do confirm the use of the site by fish with seasonal differences that are associated with reservoir level. At low reservoir levels, the stream at the site appears to provide rearing habitat for juvenile fish, particularly suckers (*Catostomus* sp.). At high reservoir levels that inundate the site, use of the site appears to switch to primarily larger fish (juveniles and adults). The numbers of small fish may also be under-represented in the July sampling due to the use of different sampling methods. However, there is no habitat available for larger fish in the small stream at low reservoir levels. Completion of this project is expected to have minimal effects on fish use of this area. There is the potential for fish to become trapped in the wetland during years when reservoir levels exceed the height of the proposed berm but this will not be different from the existing situation with the beaver dams at this site. It is unknown if conditions in the wetland will provide suitable conditions for fish to overwinter (e.g., potential oxygen depletion under the ice). A single Longnose Sucker was captured in the lower pond in July 2013 suggests that suitable overwintering conditions may occur. The existing sampling methods will be suitable for determining the extent of fish use of the constructed wetland.

At the Airport Lagoon, the fish sampling results from 2013 are similar to what was observed in 2012 and confirm that the differences observed between 2011 and 2012 are likely related to the differences in reservoir levels. Reservoir levels in 2010 were at or near the level of the outlet culverts for an extended period which likely increased the potential for young-of-the-year fish to move into the lagoon. Lower rates of movement are assumed to be associated with the higher water levels that occurred in 2011 and 2012 when the reservoir level is at the culvert elevation for a reduced period. The blocked culvert observed in July 2012 did not appear to result in detectable differences in the fish community in 2013. It is not known when the blockage occurred or how long it persisted. Water levels at the site were normal at the time of the first field survey in May 2013. In 2013, following installation of the new culverts, the reservoir and lagoon water level reached a maximum of approximately 1.5 m above the top of the new outlet culverts and remained at an elevation close to the top of the culverts for an extended period. This has likely provided a better opportunity for fish to move into the lagoon than in 2010 through the old culverts. If the new culverts have increased movement of fish into the lagoon this would be confirmed through the collection of new species or increases in the numbers of uncommon species in 2014.

While large increases in the populations of Lake Chub, Brassy Minnow, and Redside Shiner were observed during the pre-enhancement phase of the project, there was little interannual variability in the relative abundance (CPUE) of the other species collected by minnow traps (Appendix 19) or fyke net (Appendix 20). As there was little variability in most species, it is expected that it will be possible to detect small increases in relative abundance for most species with the existing sampling methods. Although the interannual variability was much higher for the three most abundant species (Lake Chub, Brassy Minnow, and Redside Shiner), the effectiveness of the methods in sampling these species will allow for continued population monitoring to determine if the populations of these species are subject to large annual fluctuations or if their abundance remains relatively stable at a higher abundance than observed during the first two years of the program.

8 LITERATURE CITED

Alldredge, M. W., T. R. Simons, and K. H. Pollock. 2007. A field evaluation of distance measurement error in auditory avian point count surveys. The Journal of Wildlife Management 71:2759–66.

Anon. 2003. Committee report: Peace River water use plan. Peace River Water Use Plan Consultative Committee.

BC Hydro. 2007. Peace project water use plan. Revised for acceptance for the comptroller of water rights. BC Hydro.

BC Hydro. 2010. Peace Project Water Use Plan, Monitoring Program Terms of Reference, GMSMON-15 Reservoir Wetland Habitat.

Bird Studies Canada. 2009. British Columbia breeding bird atlas. Guide for atlassers. British Columbia Breeding Bird Atlas, Delta.

Bonar, S. A., B. D. Bolding, and M. Divens. 2000. Standard fish sampling guidelines for Washington state ponds and lakes. Washington Department of Fish and Wildlife.

Cooper Beauchesne and Associates Ltd (CBA). 2008. Forest songbird and woodpecker monitoring in the Mackenzie defined forest area, 2007. Canadian Forest Products Ltd., Prince George, B.C.

Cooper Beauchesne and Associates Ltd (CBA). 2012. GMSMON-15: Reservoir Wetland Habitat Monitoring, Year 1 – Final Report. BC Hydro Generation, Water Licence Requirements, Burnaby, BC.

Cooper Beauchesne and Associates Ltd (CBA). 2013. GMSMON-15: Reservoir Wetland Habitat Monitoring, Year 2 – Final Report. BC Hydro Generation, Water Licence Requirements, Burnaby, BC.

Golder Associates Ltd. 2010. GMSWORKS 16. Williston Reservoir wetlands inventory. BC Hydro, Burnaby, BC.

Golder Associates Ltd. 2011. GMSWORKS 17. Williston Reservoir wetlands demonstration sites. BC Hydro, Burnaby, BC.

Golder Associates Ltd. 2013. BC Hydro -Williston Reservoir Wetland Demonstration Site 6-2 - Airport Lagoon, Completion Report. Unpublished Report, BC Hydro, Burnaby, BC.

Hengeveld, P. E. 2000. Presence and distribution of amphibians in the Williston and Dinosaur Reservoir watersheds. Peace/Williston Fish and Wildlife Compensation Program, Prince George, B.C.

Hentz, N. T., and J. M. Cooper. 2006. Donna Creek Forestry/Biodiversity project (Phase III): Breeding-bird and cavity-nest monitoring 2006. Manning, Cooper and Associates Ltd., Prince George, BC.

Hitchcock, C. L., and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA.

Kercher, S., and J. Zedler. 2004. Flood tolerance in wetland angiosperms: a comparison of invasive and non-invasive species. Aquatic Botany 80: 89-102. Aquatic Botany 80:89–102.

LGL Limited. 2007. Columbia River project water use plan. Kinbasket and Arrow Lake revegetation management plan. BC Hydro Generation, Burnaby, B.C.

MacKenzie, W. H., and J. R. Moran. 2004. Wetlands of British Columbia: a guide to identification. B.C. Ministry of Forests, Victoria, B.C.

MacKinnon, A., J. Pojar, and R. Coupe. 1999. Plants of northern British Columbia. Second edition. Lone Pine Publishing, Vancouver BC, Edmonton AB, Auburn Washington.

Matsuda, B. M., D. M. Green, and P. T. Gregory. 2006. Amphibians and reptiles of British Columbia. Royal British Columbia Museum, Victoria, BC.

Meidinger, D., and J. Pojar. 1991. Ecosystems of British Columbia. BC Ministry of Forests, Victoria, B.C.

Province of British Columbia. 2010. Field manual for describing terrestrial ecosystems. 2nd ed. Ministry of Forests and Range and Ministry of Environment, Forest Science Program, Victoria, BC.

Resources Information Standards Committee. 2010. Vegetation resources inventory. Photo interpretation procedures. Ministry of Forests and Range, Victoria, B.C.

Resources Inventory Committee. 1998. Inventory methods for pond-breeding amphibians and painted turtle. Ministry of Environment, Lands and Parks, Victoria, B.C.

Resources Inventory Committee. 1999a. Inventory methods for waterfowl and allied species: loons, grebes, swans, geese, ducks, American Coot, and Sandhill Crane. Page 90. Ministry of Environment, Lands and Parks, Victoria, B.C.

Resources Inventory Committee. 1999b. Inventory methods for forest and grassland songbirds. Ministry of Environment, Lands and Parks, Victoria, BC.

Resources Inventory Committee. 2001. Reconnaissance (1:20 000) fish and fish habitat inventory: standards and procedures. BC Fisheries Information Services Branch, Victoria, BC.

Resources Inventory Committee (RIC). 1998. Inventory methods for pond-breeding amphibians and painted Turtle. Standards for components of British Columbia's biodiversity No. 37, ver. 2.0, Mar1998. Ministry of Environment, Lands and Parks, Victoria, BC.

Resources Inventory Standards Committee. 2008. The vertebrates and invertebrates of British Columbia: Scientific and English names. Ministry of Environment, Victoria, BC.

US Environmental Protection Agency. 2002a. Methods for evaluating wetland condition: using vegetation to assess environmental condition in wetlands. Office of Water, US Environmental Protection Agency, Washington, DC.

US Environmental Protection Agency. 2002b. Methods for evaluating wetland condition: using amphibians in bioassessments of wetlands. Office of Water, US Environmental Protection Agency, Washington, DC.

Appendix 1. Locations of vegetation belt-transects.

Site	Transect[1]	UTM Zone	Easting	Northing
Airport Lagoon	AL1-1	10U	492406	6125720
	AL1-2	10U	492404	6125703
	AL2-1	10U	492491	6125900
	AL2-2	10U	492490	6125882
	AL3-1	10U	492440	6126076
	AL3-2	10U	492456	6126064
	AL4-1	10U	492457	6126395
	AL4-2	10U	492465	6126375
	AL5-1	10U	492229	6126681
	AL5-2	10U	492249	6126686
	AL6-1	10U	492586	6126956
	AL6-2	10U	492601	6126947
	AL7-1	10U	492721	6126541
	AL7-2	10U	492723	6126524
	AL8-1	10U	492641	6125643
	AL8-2	10U	492638	6125664
	AL9-1	10U	492660	6125937
	AL9-2	10U	492661	6125918
	AL10-1	10U	492695	6126423
	AL10-2	10U	492698	6126442
Beaver Pond	BP1-1	10U	479296	6148230
	BP1-2	10U	479276	6148234
	BP2-1	10U	479313	6148248
	BP2-2	10U	479297	6148256
	BP3-1	10U	479335	6148268
	BP3-2	10U	479321	6148284
	BP4-1	10U	479307	6148277
	BP4-2	10U	479295	6148294
	BP5-1	10U	479243	6148225
	BP5-2	10U	479231	6148235

[1] -The ‘1’ suffix denoted the beginning of a transect and the ‘2’ suffix the end

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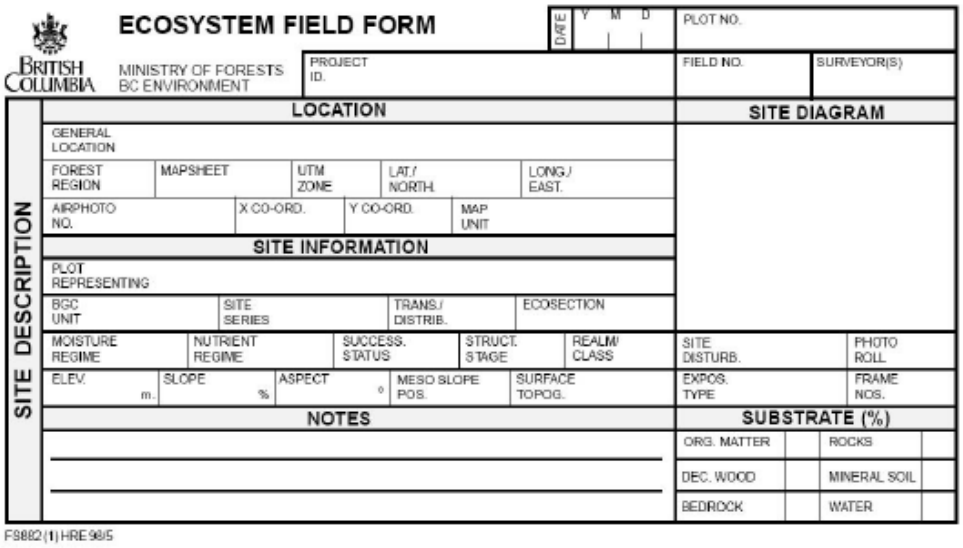
Appendix 2. Ecosystem field forms used for ground sampling of vegetation polygons.



ECOSYSTEM FIELD FORM

BRITISH COLUMBIA — MINISTRY OF FORESTS, BC ENVIRONMENT

DATE (Y M D) | PLOT NO.

PROJECT ID. | FIELD NO. | SURVEYOR(S)

SITE DESCRIPTION

LOCATION

GENERAL LOCATION

FOREST REGION | MAPSHEET | UTM ZONE | LAT./ NORTH. | LONG./ EAST.

AIRPHOTO NO. | X CO-ORD. | Y CO-ORD. | MAP UNIT

SITE INFORMATION

PLOT REPRESENTING

BGC UNIT | SITE SERIES | TRANS./ DISTRIB. | ECOSECTION

MOISTURE REGIME | NUTRIENT REGIME | SUCCESS. STATUS | STRUCT. STAGE | REALM/ CLASS | SITE DISTURB. | PHOTO ROLL

ELEV. m. | SLOPE % | ASPECT ° | MESO SLOPE POS. | SURFACE TOPOG. | EXPOS. TYPE | FRAME NOS.

NOTES

SITE DIAGRAM

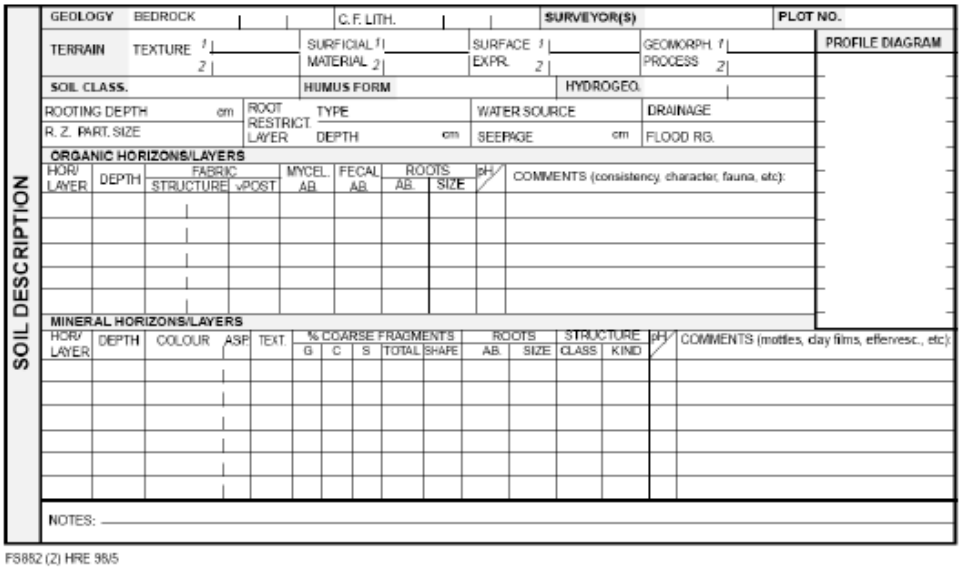
SUBSTRATE (%)

ORG. MATTER | ROCKS

DEC. WOOD | MINERAL SOIL

BEDROCK | WATER

FS882 (1) HRE 98/5



SOIL DESCRIPTION

GEOLOGY: BEDROCK | C.F. LITH. | SURVEYOR(S) | PLOT NO.

TERRAIN: TEXTURE 1 / 2 | SURFICIAL MATERIAL 1 / 2 | SURFACE EXPR. 1 / 2 | GEOMORPH. PROCESS 1 / 2 | PROFILE DIAGRAM

SOIL CLASS. | HUMUS FORM | HYDROGEO.

ROOTING DEPTH cm | ROOT RESTRICT. LAYER TYPE / DEPTH cm | WATER SOURCE | DRAINAGE

R. Z. PART. SIZE | SEEPAGE cm | FLOOD RG.

ORGANIC HORIZONS/LAYERS

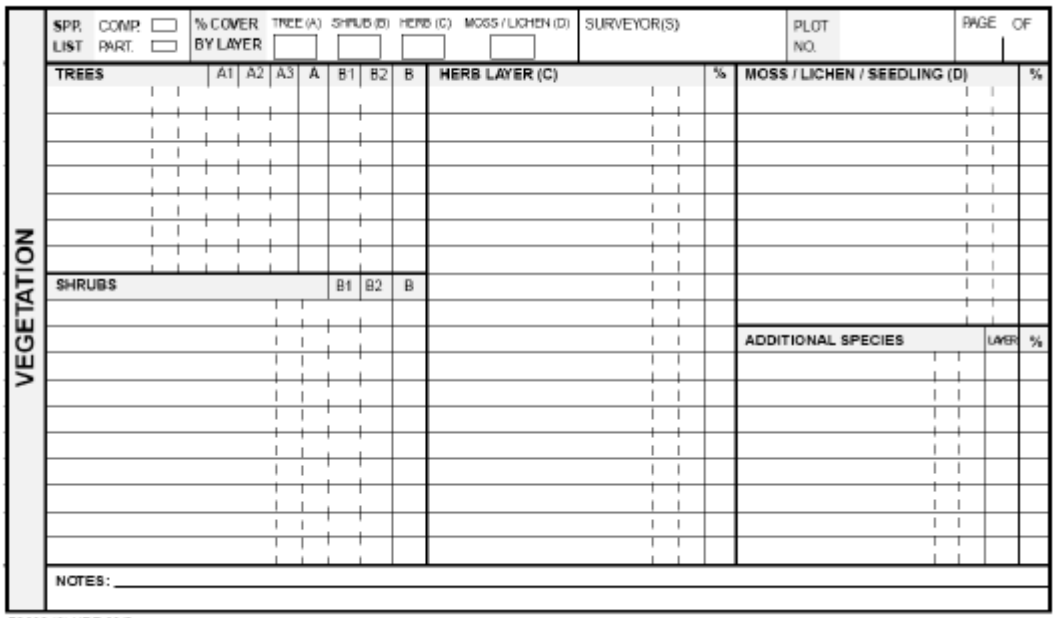
HOR/ LAYER	DEPTH	FABRIC STRUCTURE	FABRIC vPOST	MYCEL. AB.	FECAL AB.	ROOTS AB.	ROOTS SIZE	pH	COMMENTS (consistency, character, fauna, etc):

MINERAL HORIZONS/LAYERS

HOR/ LAYER	DEPTH	COLOUR	ASP	TEXT.	% COARSE FRAGMENTS G	C	S	TOTAL	SHAPE	ROOTS AB.	ROOTS SIZE	STRUCTURE CLASS	STRUCTURE KIND	pH	COMMENTS (mottles, clay films, effervesc., etc):

NOTES:

FS882 (2) HRE 95/5



VEGETATION

SPP. LIST COMP. ☐ PART. ☐ | % COVER BY LAYER | TREE (A) | SHRUB (B) | HERB (C) | MOSS / LICHEN (D) | SURVEYOR(S) | PLOT NO. | PAGE OF

TREES	A1	A2	A3	A	B1	B2	B

SHRUBS	B1	B2	B

HERB LAYER (C)	%

MOSS / LICHEN / SEEDLING (D)	%

ADDITIONAL SPECIES	LAYER	%

NOTES: _____

FS882 (3) HRE 96/5

Appendix 3. Waterfowl survey station UTM coordinates on Williston Reservoir, BC.

Site	Station	UTM Zone	Easting	Northing
Airport Lagoon	WSP-01	10U	492643	6125394
	WSP-02	10U	492468	6126031
	WSP-04	10U	492112	6126506
	WSP-03	10U	492426	6126227
	WSP-06	10U	492500	6126710
Beaver Pond	WSP-05	10U	479160	6148304

Appendix 4. Field form and site maps for waterfowl surveys.

Land-based Waterfowl Survey

Project:		Survey:	
Study Area:		Date (dd/mm/yyyy):	
Station:		Station UTM Zone and Coordinates:	
Surveyors:			

	Time	CC	Ceiling	Wind	Wind Direc.	Temperature	Reservoir	Snow Depth (cm)	Precipitation
Start									
End									

% snow	% ice	% sand	% gravel	% cobble	% flooded veg.	% other

Polygon ID	Species	#	Sex	# of broods	Age	Moving	Foraging	Other activity	Water	Land	Shallow	Deep	Mud	Shore	Emerg. veg.	Submer. Veg.	Flooded veg.	Grass	Shrub	Tree	Channel	Log stump	Ice	Snow

Comments:	

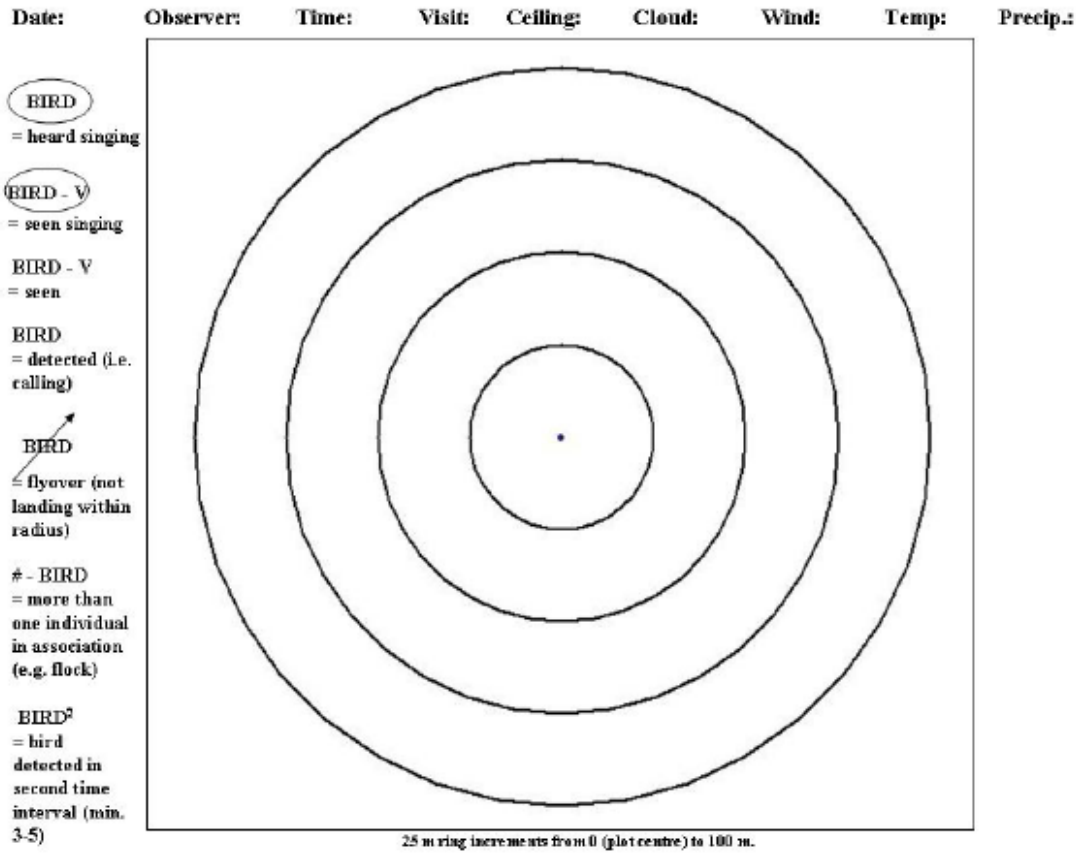

0 0.125 0.25 Kilometers


Beaver Pond
0 0.05 0.1 Kilometers
N

Appendix 5. UTM coordinates of point count stations at the Airport Lagoon and Beaver Pond sites on Williston Reservoir, BC.

Site	Point Count Station	UTM Zone	Easting	Northing
Airport Lagoon	AL-01	10U	492671	6125451
	AL-02	10U	492668	6125665
	AL-03	10U	492642	6125864
	AL-04	10U	492643	6126067
	AL-05	10U	492633	6126265
	AL-06	10U	492693	6126475
	AL-07	10U	492695	6126683
	AL-08	10U	492636	6126885
	AL-09	10U	492554	6127065
	AL-10	10U	492531	6126696
	AL-11	10U	492331	6126631
	AL-12	10U	492271	6126432
	AL-13	10U	492418	6126266
	AL-14	10U	492493	6126056
	AL-15	10U	492441	6125850
	AL-16	10U	492385	6125643
	AL-17	10U	492523	6125474
Beaver Pond	BP-01	10U	479204	6148354
	BP-02	10U	479387	6148249
	BP-03	10U	479264	6148207

Appendix 6. Field form for breeding bird surveys.



Appendix 7. Environmental variable codes and definitions for breeding bird surveys.

Ceiling:
The height of cloud cover. Record the average height of clouds during the survey.

ATT = Above Tree-tops
BTT = Below Tree-tops
AR = Above Ridge
BR = Below Ridge
H = High
VH = Very High

Cloud Cover (CC):
The extent of cloud cover during the survey period.

1 = clear, 0% cloud cover
2 = scattered clouds, <50% cloud cover
3 = scattered clouds, >50% cloud cover
4 = unbroken clouds, 100% cloud cover

Wind:
The strength of the dominant wind over the survey period using the Beaufort Scale. If wind strength split evenly between 1 or more classes, choose that which best characterized the conditions and detectability of birds. Acceptable conditions are Winds 0-3. >3 is considered unacceptable for conducting point counts.

0 = calm (<2 km/h)
1 = light air (2-5 km/h)
2 = light breeze, leaves rustle (6-12 km/h)
3 = gentle breeze, leaves and twigs constantly move (13-19 km/h)
4 = moderate breeze, small branches move, dust rises (20-29 km/h)
5 = fresh breeze, small trees sway (30-39 km/h)
6 = strong breeze, large branches moving, wind whistling (40-49 km/h)
7 = moderate gale+, whole trees in motion (≥50 km/h)

Precipitation:
The type of precipitation (if any) during the survey period. Acceptable conditions are no rain through very light drizzle.

N = None
F = Fog
M = Misty Drizzle
D = Drizzle
LR = Light Rain
HR = Hard Rain
LS = Light Snow/Flurries
HS = Heavy Snow

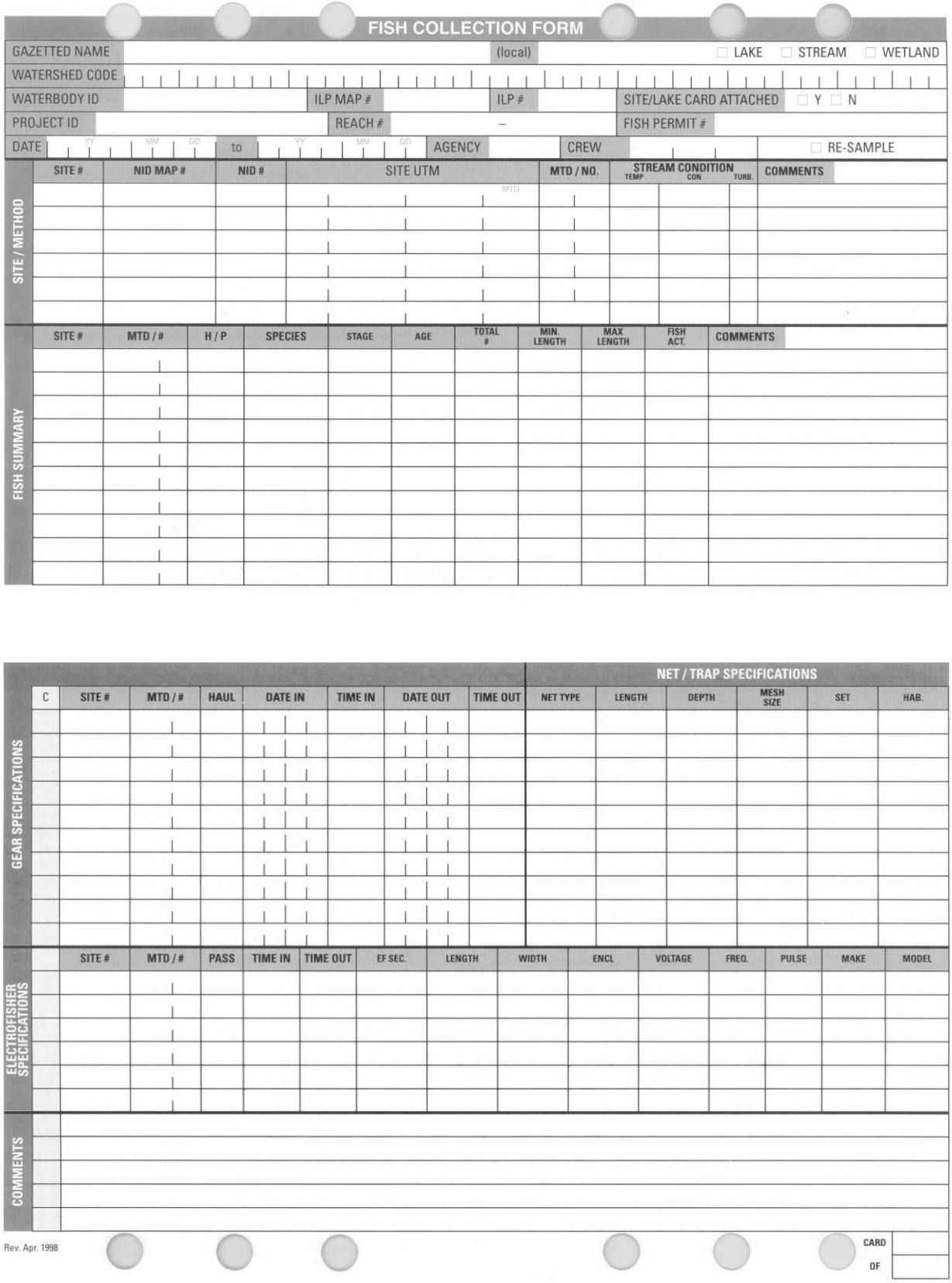
Appendix 8. Field form for systematic amphibian surveys.

ANIMAL OBS. FORM – Pond Breeding Amphibians - *Adult*							
Project:							
Survey:							
Study Area:							
Trans. Label:				Stratum:			
Trans. Length (m):				Trans. Bearing (°):			
Date (dd/mm/yyyy):							
UTM Zone and Coordinates:	POC - _____						
	POT - _____						
Surveyors:							

Obs. Day	Time	Ceiling	CC	Wind	Precip.	Temp. (ambi./ water)	Water Cond.
Start							
End							

Wpt. #	Time	Species	Sex	Age Class	Activity	Loc.	Cov. Obj.	Bot. Sub.

Appendix 9. Field form for fish sampling.



FISH COLLECTION FORM

GAZETTED NAME (local) ☐ LAKE ☐ STREAM ☐ WETLAND

WATERSHED CODE

WATERBODY ID ILP MAP # ILP # SITE/LAKE CARD ATTACHED ☐ Y ☐ N

PROJECT ID REACH # – FISH PERMIT #

DATE YY MM DD to YY MM DD AGENCY CREW ☐ RE-SAMPLE

SITE / METHOD

SITE #	NID MAP #	NID #	SITE UTM (MTD)	MTD / NO.	STREAM CONDITION TEMP	CON	TURB.	COMMENTS

FISH SUMMARY

SITE #	MTD / #	H / P	SPECIES	STAGE	AGE	TOTAL #	MIN. LENGTH	MAX LENGTH	FISH ACT.	COMMENTS

GEAR SPECIFICATIONS

C	SITE #	MTD / #	HAUL	DATE IN	TIME IN	DATE OUT	TIME OUT	NET / TRAP SPECIFICATIONS NET TYPE	LENGTH	DEPTH	MESH SIZE	SET	HAB.

ELECTROFISHER SPECIFICATIONS

SITE #	MTD / #	PASS	TIME IN	TIME OUT	EF SEC.	LENGTH	WIDTH	ENCL	VOLTAGE	FREQ.	PULSE	MAKE	MODEL

COMMENTS

Rev. Apr. 1998

CARD
OF

INDIVIDUAL FISH DATA

FISH COLLECTION FORM #

C	SITE #	MTD / #	H / P	SPEC.	LENGTH	WEIGHT	SEX	MATUR.	AGE STRUCTURE	AGE SAMPLE #	AGE AGE	VOUCHER #	GENETIC STRUCTURE	GENETIC SAMPLE #	COMMENTS	PHOTO
		|														R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
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		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__

INDIVIDUAL FISH DATA

C	SITE #	MTD / #	H / P	SPEC.	LENGTH	WEIGHT	SEX	MATUR.	AGE STRUCTURE	AGE SAMPLE #	AGE AGE	VOUCHER #	GENETIC STRUCTURE	GENETIC SAMPLE #	COMMENTS	PHOTO
		|														R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__
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		|													R__ F__
		|													R__ F__
		|													R__ F__
		|													R__ F__

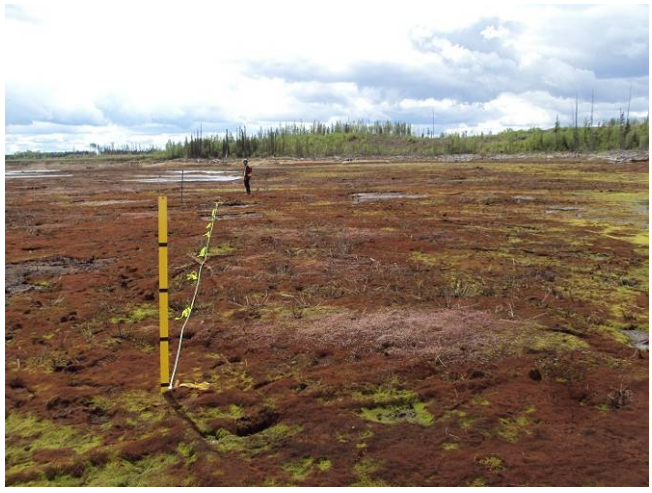
COMMENT

Rev. Apr. 1998

CARD
OF

Appendix 10. Habitat class descriptions in the draw-down zone at the Airport Lagoon and Beaver Pond sites.

Habitat Class	Description	Representative Photographs
BC	Basin Cryptantha (BC): Moderate herbaceous perennial cover with negligent coarse woody debris and low coarse rock cover (5%) on a plain to gentle sloping surface expression. Common species includes Torrey's cryptantha (*Cryptantha torreyana*), purslane speedwell (*Veronica peregrina* var. *xalapensis*), red sandy-spurry (*Spergularia rubra*) and Arctic pearlwort (*Sagina saginoides*). Soils are composed of a deep clay mineral layer; organic layer is absent. Groundwater is the main water source, soils are very poorly drained and flooding is expected to occur annually.	**2011**  **2012**  **2013** 

Habitat Class	Description	Representative Photographs
BM	Basin Moss (BM): High bryophyte and moderate herbaceous perennial cover with low coarse woody debris cover on a plain to hummock surface depression. Dominating species include creeping feathermoss, Norwegian cinquefoil, fireweed (*Epilobium angustifolium*), seedlings of willow (*Salix* spp.) and trembling aspen (*Populus tremuloides*) and a few other unidentified herbaceous perennials. Soils are composed of a shallow to moderate organic layer (at least 30 cm) overlying a clay mineral layer. Groundwater is the main water source, soils are very poorly drained and reservoir flooding is expected to occur annually.	**2011**  **2012**  **2013** Area Flooded

Habitat Class	Description	Representative Photographs
BS	Basin Smartweed (BS): High cover of water smartweed (*Persicaria* amphibia) and Lady's Thumb (*Persicaria maculosa*), including remnants from previous growing seasons, with negligible coarse wood debris cover (<3%) on a plain to hummock surface expression. Other species present may include Norwegian cinquefoil, hook moss and marsh thread moss. Soils are composed of shallow to moderate organic layer (20 cm depth) overlying a clay mineral layer. Groundwater is the main water source, soils are imperfectly drained and reservoir flooding is expected to occur annually.	  

Habitat Class	Description	Representative Photographs
SC	Shoreline Clay (SC): Sparse herbaceous vegetation cover with low coarse woody debris and coarse rock cover on gentle to moderate sloping surface expression. The most common species present is Norwegian cinquefoil and common horsetail. Water source is precipitation and flooding is expected to be annual to frequent.	**2011**  **2012**  **2013** No picture available

Habitat Class	Description	Representative Photographs
SD	Shoreline Driftwood (SD): Low to Moderate, grass dominated vegetation cover with high coarse woody debris cover (ranging from 20-40%) on a gently sloping (3 to 15°) surface expression. Common species include bluejoint (*Calamagrostis canadensis*), common horsetail (*Equisetum arvense*), water smartweed (*Persicaria amphibian*) and reed canarygrass (*Phalaris arundinacea*). A diversity of bryophytes such as marsh thread moss (*Bryum pseudotriquetum*), tree moss (*Climancium dendroides*) and purple horn-toothed moss (*Ceratodon purpureus*) may be present. Soils consist of a shallow (1-10 cm depth) organic layer overlying a moderate (11-30 cm) sandy mineral layer. Precipitation is the main water source, soils are rapidly drained and reservoir flooding expected to be annual to frequent (every 2 to 5 years).	**2011**  **2012**  **2013** 

Habitat Class	Description	Representative Photographs
SG	Shoreline Grassland (SG): Very high grass dominated vegetation cover with low coarse woody debris cover on a gently sloping surface expression. Common species may include bluejoint, common horsetail, reed canarygrass, large-leaved avens (*Geum macrophyllum* ssp. *perincisum*) and a few unidentified grasses.	**2011**  **2012** No picture available **2013** No picture available

Habitat Class	Description	Representative Photographs
SR	Shoreline Gravel (SR): Low to moderate grass dominated vegetation cover with negligent coarse woody debris and moderate coarse rock cover on a gently to moderate sloping surface expression. Dominant species include bluejoint, Norwegian cinquefoil, bronze sedge, fireweed, common horsetail and purslane speedwell. Soils are composed of a deep sand and gravel mineral layer; organic layer is absent. Precipitation is the main water source, soils are rapidly drained and reservoir flooding is expected to be rare.	**2011**  **2012**  **2013** 

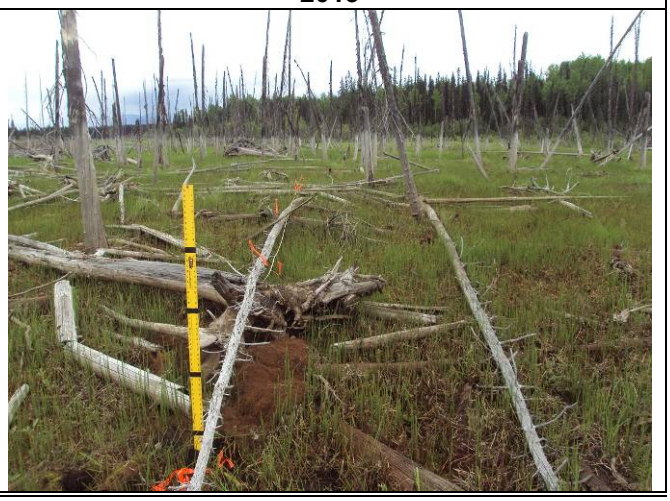
Habitat Class	Description	Representative Photographs
SS	Shoreline Sand (SS): Sparse herbaceous vegetation cover with low (5 to 15%) coarse woody debris cover on a gentle to moderate (15 to 26°) sloping surface expression. Common species include bluejoint, Norwegian cinquefoil, bronze sedge (*Carex aenea*), marsh yellow cress *(Rorippa palustris*) and pink corydalyis (*Corydalis sempervirens*). Soils are composed of a deep (30-50 cm) sandy mineral layer; organic layer is absent. Precipitation is the main water source, soils are rapidly drained and reservoir flooding is expected to be annual to frequent (every 2 to 5 years).	**2011**  **2012**  **2013** 

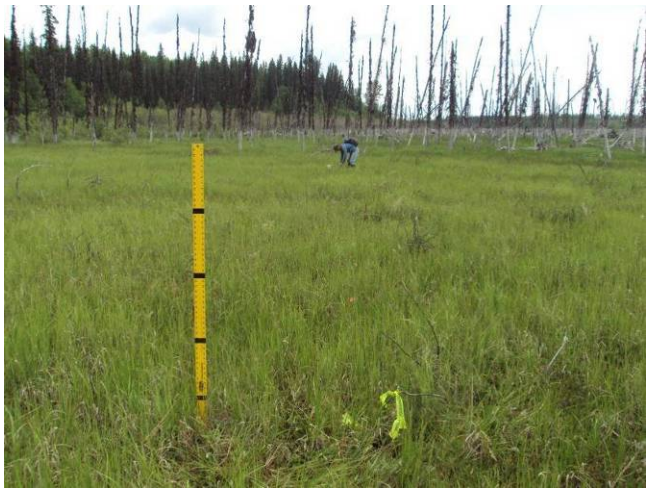
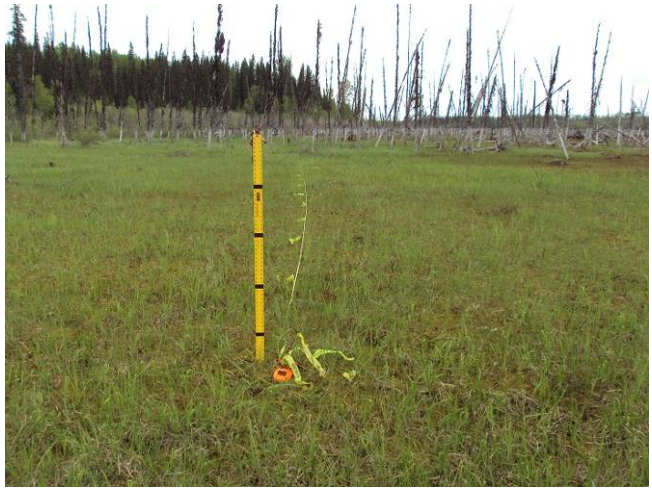
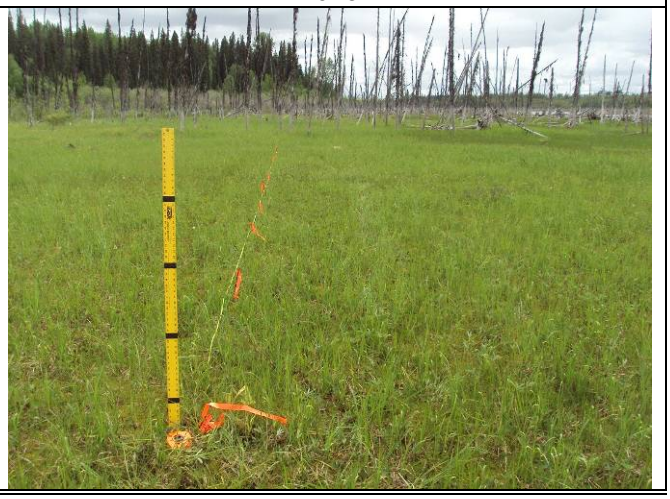
Habitat Class	Description	Representative Photographs
SW	Shoreline Willow (SW): High grass and shrub dominated vegetation cover with high coarse woody debris cover on a gently to moderate sloping surface expression. Common species include common horsetail, fireweed, bluejoint and Norwegian cinquefoil with patches of willow (e.g., Alaska willow [*Salix alaxensis*], Barclay's willow [*Salix barclayi*]. Soils are composed of a shallow organic layer overlying a clay mineral layer. Precipitation is the main water source, soils are moderately well drained and flooding is expected to be frequent (every 2 to 5 years) to rare (only during extreme events).	**2011**  **2012**  **2013** 

Habitat Class	Description	Representative Photographs
SP	Streams and Ponds (SP): Areas of open water and perennial water flow. Emergent or submergent vegetation identified include white water-buttercup (*Ranunculus aquatilis*), small yellow water-buttercup (*Ranunculus gmelinii*), buckbean, common cattail, common mare's-tail, water smartweed, common duckweed (*Lemna* spp.), variegated yellow pond-lily (*Nuphar variegata*), and hornwort (*Ceratophyllum* sp.).	
		
		

Habitat Class	Description	Representative Photographs
SE	Stream Sedge (SE): Moderate to high sedge and bryophyte cover with negligible coarse woody and low water cover on a plain to gently sloping surface expression. Common species include marsh thread moss and aquatic apple moss (*Philonotis fotana*), marsh yellow cress, bronze sedge, lakeshore sedge (*Carex lenticularis*), purslane speedwell, willow, American speedwell (*Veronica americana*) and bluejoint. Soil are composed of a moderate organic layer (10 cm depth) overlying a clay and sand mineral layer. Surface and groundwater are the main water sources, soils are very poorly drained and annual flooding is expected to occur.	**2011**  **2012**  **2013** 

Habitat Class	Description	Representative Photographs
WD	Wetland Dead Trees (WD): High herbaceous perennial and low dead standing tree (snag) cover with low to moderate coarse woody debris cover on a gently sloping surface expression. Common species include swamp horsetail, water smartweed, buckbean, sedges and slender cottongrass (*Eriophorum gracile*). A low cover (approximately 15%) of standing dead black spruce (*Picea mariana*) trees is present. Groundwater is the main water source (surface and subsurface seepage), soils are very poorly drained and flooding is expected to be annual to frequent (every 2 to 5 years).	  No picture available

Habitat Class	Description	Representative Photographs
WH	Wetland Horsetail (WH): High horsetail and bryophyte dominated vegetation cover with low to moderate coarse woody debris cover on a plain to gently sloping surface expression. Common species include swamp horsetail, Norwegian cinquefoil, buckbean, small bedstraw, willows, and a diversity of bryophytes (marsh thread moss, giant calliergon moss, glow moss and purple horn-toothed moss). Soils are composed of a moderate organic layer; mineral layer is absent. Groundwater is the main water source surface and subsurface seepage), soils are very poorly drained and flooding is expected to be annual to frequent (every 2 to 5 years).	**2011**  **2012**  **2013** 

Habitat Class	Description	Representative Photographs
WS	Wetland Sedge (WS): High sedge and bryophyte dominated vegetation cover with negligible coarse woody debris cover on a plain to depressed surface expression. Common species include hook moss, marsh thread moss, giant calliergon moss, common cattail, bronze sedge (along with 2 to 3 other species of sedges [*Carex* spp.]), swamp horsetail (*Equisetum fluviatile*), small bedstraw (*Galium trifidum*), water smartweed (*Persicaria amphibian*), common mare's-tail (*Hippuris vulgaris*) and buckbean (*Menyanthes trifoliata*). Soils are composed of a deep organic layer either overlying a clay mineral layer or mineral layer absent. Groundwater is the main water source (surface and subsurface seepage), soils are very poorly drained and reservoir flooding is expected to be annual to frequent (every 2 to 5 years).	**2011**  **2012**  **2013** 

Habitat Class	Description	Representative Photographs
WW	Wetland Willow (WW): Moderate shrub and high grass/sedge dominated vegetation cover with negligible coarse woody debris cover and a gentle sloping surface expression. Species present consist of a variety of willows, sedges, grasses and bryophytes. Flooding is expected to be frequent (every 2 to 5 years) to rare (only during extreme events).	**2011**  **2012** No picture available **2013** No picture available

Appendix 11. Summary of percent cover by plant species averaged across 10 quadrats in a 20 m belt-transect for 15 transects.

Group	Species	Transect															Total
		AL1[a]	AL2[a]	AL3[b]	AL4[b]	AL5[b]	AL6[b]	AL7[b]	AL8[a]	AL9[a]	AL10[a]	BP1[a]	BP2[a]	BP3[a]	BP4[a]	BP5[a]	
Herbs/Forbs/ Graminoids	Bluejoint					4.36	0.05	3.93		2.50	0.38					0.33	**11.55**
	Buckbean							12.03									**12.03**
	Bronze Sedge													0.08			**0.08**
	Common horsetail					1.37				2.45	1.10			1.18		2.88	**8.98**
	Common mare's-tail						0.47										**0.47**
	Common spike-rush							1.71									**1.71**
	Green sedge						0.33										**0.33**
	Lady's thumb	0.10	0.41	1.65	20.30	0.01			1.07		0.10	1.84	2.64	0.03	0.13		**28.28**
	Marsh cinquefoil							5.28		0.05	0.39						**5.72**
	Reed canarygrass					0.32				0.05							**0.37**
	Sedge sp.					0.50	0.10	6.13			0.03		1.60	0.17		0.48	**9.01**
	Small yellow water-buttercup						0.05										**0.05**
	Swamp horsetail						8.53	0.63			8.58						**17.74**
	Thread rush	0.25															**0.25**
	Torrey's cryptantha									1.90	0.00	9.94	0.59	0.41	15.62	0.46	**28.92**
	Gramineae 4			0.07													**0.07**
	Unknown 15								1.77	0.18							**1.95**
	Unknown 18			0.03								0.05			0.08		**0.16**
	Unknown 19			0.02													**0.02**
	Unknown 20			0.03		0.28				0.10							**0.41**
	Unknown 21			0.09	0.01	0.52	0.02			0.39	0.01			0.26		0.01	**1.31**
	Unknown 23			0.02													**0.02**
	Unknown 24			0.04	0.14		0.06			0.06	0.01						**0.31**
	Unknown 25			0.02			0.01										**0.03**
	Unknown 26						0.38										**0.38**

Group	Species	Transect														Total
		AL1[a]	AL2[a]	AL3[b]	AL4[b]	AL5[b]	AL6[b]	AL7[b]	AL8[a]	AL9[a]	AL10[a]	BP1[a]	BP2[a]	BP3[a]	BP4[a]	BP5[a]	
	Unknown 27						0.88			0.03							**0.91**
	Unknown 28						0.50			0.68							**1.18**
	Unknown 30									0.32							**0.32**
	Unknown 31									0.21	1.00						**1.21**
	Unknown 35										0.01						**0.01**
	Unknown 36										0.33						**0.33**
	Unknown 37										0.03						**0.03**
	Unknown 40											1.04	0.06	0.18	0.17		**1.45**
	Unknown 41														0.06	0.13	**0.19**
	Unknown 42											0.10			0.07		**0.17**
	Unknown 43			0.09	0.52						0.03	0.64		0.03	0.03	0.09	**1.43**
	Unknown 45													0.02			**0.02**
	Unknown 46					0.01								0.04			**0.05**
	Unknown 47					0.15							1.58	0.17		0.11	**2.01**
	Unknown 48												0.00	0.01			**0.01**
	Unknown 49					0.01							0.07				**0.08**
	Unknown 50												0.06				**0.06**
	Unknown 51												2.55			0.10	**2.65**
	Unknown 52															0.21	**0.21**
	Unknown 53															0.03	**0.03**
	Unknown 54															0.01	**0.01**
	Unknown 55					0.01											**0.01**
	Water sedge													0.15			**0.15**
	Water smartweed					0.25	10.78	2.38		0.38	0.63						**14.42**
	Whitewater buttercup										0.04						**0.04**
	Herb/Forb/Graminoid Total	**0.35**	**0.41**	**2.06**	**20.97**	**7.79**	**22.16**	**32.09**	**2.84**	**9.3**	**12.67**	**13.61**	**9.15**	**2.73**	**16.16**	**4.84**	

Group	Species	Transect														Total
		AL1[a]	AL2[a]	AL3[b]	AL4[b]	AL5[b]	AL6[b]	AL7[b]	AL8[a]	AL9[a]	AL10[a]	BP1[a]	BP2[a]	BP3[a]	BP4[a]	BP5[a]	
Mosses	Creeping Feathermoss	9.70	13.10				29.95	6.05	9.20	0.25	0.15						**68.4**
	Giant Calliergon Moss							93.85			0.13						**93.98**
	Tree Moss									0.35							**0.35**
	Hook Moss										11.28						**11.28**
	Unknown 32									0.10	4.80						**4.9**
	Unknown 33									0.08	1.05						**1.13**
	Unknown 34									0.10	0.10						**0.2**
	Moss Total	**9.7**	**13.1**	**0**	**0**	**0**	**29.95**	**99.9**	**9.2**	**0.88**	**17.51**	**0**	**0**	**0**	**0**	**0**	
Shrubs	Bebb's willow							0.10			0.56		0.03				**0.69**
	Willow															0.15	**0.15**
	Shrub Total							**0.10**			**0.56**		**0.03**			**0.15**	

[a] - Values represent average number of species and % cover based on plot surveys in 2012. Surveys of these plots were not completed in 2013 as plots were located in areas recently flooded due to physical works;
[b] - Values represent an average number of species and % cover based on plot surveys completed in 2012 and 2013; the average for number of species are rounded up to whole numbers where necessary.

Appendix 12. Summary of bird detections by point count station in 2013 across three replicates at the Airport Lagoon and Beaver Pond sites, Williston Reservoir, BC.

Species	Point Count Station																			Species Totals
	AL-01	AL-02	AL-03	AL-04	AL-05	AL-06	AL-07	AL-08	AL-09	AL-10	AL-11	AL-12	AL-13	AL-14	AL-15	AL-16	AL-17	BP-01	BP-02	BP-03	
Canada Goose									1	1		1				1					4
American Wigeon								1													1
Mallard								1	1								1				3
Green-winged Teal														1							1
Ring-necked Duck											1										1
Bufflehead																			1		1
Red-breasted Merganser		1																			1
Common Loon													1		1						2
Osprey			1		4	1															6
Red-tailed Hawk								1			1										2
Merlin																1					1
Killdeer					1							3	3		1	2					10
Spotted Sandpiper		1	2		2					1		3	1	1	1	1	1	1	2	2	19
Solitary Sandpiper									1					1							2
Greater Yellowlegs					2	1			1			1									5
Lesser Yellowlegs												1									1
Wilson's Snipe									2			1						2			5
Calliope Hummingbird					1																1
Belted Kingfisher		1																			1
Red-naped Sapsucker					1																1
Red-breasted Sapsucker							1														1
Unidentified Sapsucker							1														1
Hairy Woodpecker								1													1
Northern Flicker					1													1			2
Western Wood-Pewee		1					1	1			1									2	6

Species	Point Count Station																			Species Totals
	AL-01	AL-02	AL-03	AL-04	AL-05	AL-06	AL-07	AL-08	AL-09	AL-10	AL-11	AL-12	AL-13	AL-14	AL-15	AL-16	AL-17	BP-01	BP-02	BP-03	
Alder Flycatcher								1	1												2
Least Flycatcher				1	1	1	3	3	3		1										13
Hammond's Flycatcher	1	3	1	1						2	1							2		1	12
Dusky Flycatcher																		1	1	1	3
Warbling Vireo		1		1		1	3	3					3					3	3	2	20
Red-eyed Vireo																			1	1	2
American Crow		2	1																		3
Common Raven																				1	1
Tree Swallow			1				1				2	1	5			3	2				15
Northern Rough-winged Swallow													1								1
Bank Swallow				1								1	2	2	1		1				8
Golden-crowned Kinglet	4	1									1									1	7
Ruby-crowned Kinglet					1	2	2	3													8
Mountain Bluebird															2						2
Swainson's Thrush			1			2	4	3			1	1						1	1		14
American Robin		1	1	1	1	2	2	1	2	2	2	1	1	4	1		1		1	1	25
Cedar Waxwing	1	1																			2
Tennessee Warbler			1	3	3														2	1	10
Orange-crowned Warbler					1		1						1	1		1		3	3	3	14
Yellow Warbler	1				1	2	2	2				1									9
Magnolia Warbler	2	1	3																		6
Yellow-rumped Warbler	2	1			2		2	2		1	2	2	1	2			1	2	3	3	26
Blackpoll Warbler						1															1
American Redstart	1					1		2										5	1	1	11
Northern Waterthrush	2	4			1	2		3	1									3	2		18
Common Yellowthroat						2															2

Species	Point Count Station																			Species Totals
	AL-01	AL-02	AL-03	AL-04	AL-05	AL-06	AL-07	AL-08	AL-09	AL-10	AL-11	AL-12	AL-13	AL-14	AL-15	AL-16	AL-17	BP-01	BP-02	BP-03	
Wilson's Warbler						1														2	3
Chipping Sparrow						1	5	2			1						1	2	1		13
Song Sparrow				3		2		2	2												9
Lincoln's Sparrow	1			2		1	2	2	1			1		1							11
White-throated Sparrow	2	2		1	1			2				2	2		2	1	2	1		1	19
Dark-eyed Junco			1							1	1	1			2	2		3	5		16
Western Tanager		1		2	1																4
Brown-headed Cowbird					1																1
Purple Finch											1							1			2
Pine Siskin			1	1	3	2				1		1									9
Station Totals	**17**	**22**	**14**	**17**	**29**	**25**	**30**	**36**	**16**	**9**	**16**	**22**	**21**	**13**	**11**	**12**	**10**	**31**	**27**	**23**	**401**

Appendix 13. UTM coordinates of amphibian detections at the Airport Lagoon and Beaver Pond sites on Williston Reservoir, BC.

Site	Date	Transect	Start Time	End Time	Species	Time	Age Class	UTM Zone	Easting	Northing
Airport Lagoon	1-May-13	37	12:09	12.25	Long-toed Salamander	12:12	Adult	10U	492657	6126120
	1-May-13	40	12:31	12:44	Long-toed Salamander	12:38	Adult	10U	492669	6125786
	12-May-13	7	9:27	9:24	Long-toed Salamander	9:40	Adult	10U	492645	6126015
	24-May-13	10	12:50	13:21	Western Toad	12:55	Adult	10U	492348	6126351
	24-May-13	10	12:50	13:21	Western Toad	13:03	Juvenile	10U	492352	6126356
	24-May-13	10	12:50	13:21	Western Toad	13:10	Juvenile	10U	492310	6126396
	24-May-13	25			Western Toad	12:06	Juvenile	10U	492438	6126946
	24-May-13	25			unknown	12:51	Tadpoles	10U	492475	6126946
	24-May-13	32			Western Toad	10:35	Adult	10U	492620	6126488
	6-Jun-13	25			Western Toad	10:20	Juvenile	10U	492444	6126933
	6	25			Western Toad	10:35	Juvenile	10U	492450	6126944
	6	25			Western Toad	10:40	Juvenile	10U	492460	6126949
	6	25			Western Toad	10:50	Juvenile	10U	492477	6126941
	6	25			Western Toad	10:52	Juvenile	10U	492463	6126940
Beaver Pond	26-May-13	BP-A-01			Western Toad	11:15	Tadpoles	10U	479404	6148258
	26-May-13	BP-A-01			Wood Frog	11:36	Juvenile	10U	479280	6148256
	26-May-13	BP-A-01			Western Toad	12:06	Adult	10U	479244	6148270
	26-May-13	BP-A-01			Long-toed Salamander	12:11	Adult	10U	479288	6148272
	9-Jun-13	BP-A-01			Western Toad	10:00	Juvenile	10U	479389	6148241

Appendix 14. Fish capture data for 2013 (Year 3).

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	24/05/2013	electrofisher	2	Burbot	154	
Airport Lagoon	24/05/2013	electrofisher	2	Burbot	235	
Airport Lagoon	24/05/2013	electrofisher	2	Burbot	290	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	32	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	32	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	34	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	37	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	50	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	51	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	52	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	53	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	53	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	55	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	55	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	56	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	56	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	56	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	57	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	57	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	59	
Airport Lagoon	24/05/2013	electrofisher	2	Brassy Minnow	60	
Airport Lagoon	24/05/2013	electrofisher	2	Prickly Sculpin	38	
Airport Lagoon	24/05/2013	electrofisher	2	Prickly Sculpin	49	
Airport Lagoon	24/05/2013	electrofisher	2	Prickly Sculpin	76	
Airport Lagoon	24/05/2013	electrofisher	2	Largescale Sucker	82	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	38	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	40	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	41	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	41	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	42	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	42	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	43	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	43	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	44	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	44	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	45	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	45	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	46	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	46	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	46	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	46	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	47	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	47	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	47	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	48	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	50	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	51	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	52	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	52	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	53	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	54	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	54	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	54	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	55	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	56	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	58	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	63	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	68	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	69	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	70	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	71	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	73	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	73	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	74	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	77	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	77	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	78	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	79	
Airport Lagoon	24/05/2013	electrofisher	2	Lake Chub	79	
Airport Lagoon	24/05/2013	electrofisher	2	Northern Pikeminnow	46	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	42	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	43	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	47	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	48	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	48	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	49	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	62	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	67	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	69	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	70	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	75	
Airport Lagoon	24/05/2013	electrofisher	2	Redside Shiner	95	
Airport Lagoon	24/05/2013	electrofisher	3	Burbot	186	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	29	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	31	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	34	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	36	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	38	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	39	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	39	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	41	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	42	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	43	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	44	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	47	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	48	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	55	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	56	
Airport Lagoon	24/05/2013	electrofisher	3	Brassy Minnow	57	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	22	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	33	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	35	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	37	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	41	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	41	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	41	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	42	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	43	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	45	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	45	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	45	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	53	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	56	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	57	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	69	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	79	
Airport Lagoon	24/05/2013	electrofisher	3	Prickly Sculpin	86	
Airport Lagoon	24/05/2013	electrofisher	3	Slimy Sculpin	36	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	39	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	40	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	40	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	44	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	44	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	46	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	46	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	47	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	52	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	52	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	53	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	60	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	68	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	75	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	76	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	80	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	81	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	82	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	83	
Airport Lagoon	24/05/2013	electrofisher	3	Lake Chub	83	
Airport Lagoon	24/05/2013	electrofisher	3	Redside Shiner	38	
Airport Lagoon	24/05/2013	electrofisher	3	Redside Shiner	43	
Airport Lagoon	24/05/2013	electrofisher	3	sucker sp.	68	
Airport Lagoon	25/05/2013	electrofisher	4	Burbot	132	
Airport Lagoon	25/05/2013	electrofisher	4	Burbot	142	
Airport Lagoon	25/05/2013	electrofisher	4	Burbot	152	
Airport Lagoon	25/05/2013	electrofisher	4	Burbot	154	
Airport Lagoon	25/05/2013	electrofisher	4	Burbot	159	
Airport Lagoon	25/05/2013	electrofisher	4	Burbot	160	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	32	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	38	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	38	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	39	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	39	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	39	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	41	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	41	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	42	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	42	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	42	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	43	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	43	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	43	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	43	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	44	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	44	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	45	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	45	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	45	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	45	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	45	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	46	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	46	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	46	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	46	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	47	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	47	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	48	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	49	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	49	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	50	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	50	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	50	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	51	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	51	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	51	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	51	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	51	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	52	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	52	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	52	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	52	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	53	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	53	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	53	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	54	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	54	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	54	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	54	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	54	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	55	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	56	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	56	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	56	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	57	
Airport Lagoon	25/05/2013	electrofisher	4	Brassy Minnow	60	
Airport Lagoon	25/05/2013	electrofisher	4	Prickly Sculpin	46	
Airport Lagoon	25/05/2013	electrofisher	4	Prickly Sculpin	46	
Airport Lagoon	25/05/2013	electrofisher	4	Prickly Sculpin	58	
Airport Lagoon	25/05/2013	electrofisher	4	Prickly Sculpin	65	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	41	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	41	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	43	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	43	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	43	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	44	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	44	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	45	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	45	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	45	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	47	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	47	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	49	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	49	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	49	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	49	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	49	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	50	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	50	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	50	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	51	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	51	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	51	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	51	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	52	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	53	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	53	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	53	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	53	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	53	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	53	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	54	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	54	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	55	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	55	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	56	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	56	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	56	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	56	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	57	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	58	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	58	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	59	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	59	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	63	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	66	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	67	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	68	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	69	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	70	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	71	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	72	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	72	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	72	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	73	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	74	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	76	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	77	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	77	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	79	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	79	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	80	
Airport Lagoon	25/05/2013	electrofisher	4	Lake Chub	90	
Airport Lagoon	25/05/2013	electrofisher	4	Longnose Sucker	68	
Airport Lagoon	25/05/2013	electrofisher	4	Longnose Sucker	106	
Airport Lagoon	25/05/2013	electrofisher	4	Longnose Sucker	126	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	35	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	35	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	37	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	37	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	38	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	38	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	38	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	39	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	39	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	40	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	40	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	40	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	41	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	41	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	41	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	41	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	41	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	41	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	42	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	43	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	43	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	43	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	44	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	44	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	46	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	46	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	48	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	48	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	49	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	50	
Airport Lagoon	25/05/2013	electrofisher	4	Redside Shiner	57	
Airport Lagoon	25/05/2013	electrofisher	4	sucker sp.	57	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	41	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	41	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	42	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	43	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	44	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	45	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	46	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	47	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	47	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	47	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	47	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	48	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	48	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	50	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	50	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	51	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	51	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	51	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	52	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	52	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	52	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	52	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	53	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	53	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	53	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	53	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	53	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	53	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	53	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	54	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	54	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	54	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	54	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	54	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	55	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	55	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	55	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	55	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	55	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	56	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	57	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	57	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	57	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	57	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	57	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	58	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	58	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	59	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	60	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	70	
Airport Lagoon	25/05/2013	minnow trap	1	Brassy Minnow	76	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	44	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	45	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	46	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	47	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	47	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	48	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	49	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	49	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	49	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	50	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	51	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	51	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	52	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	52	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	54	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	56	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	56	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	57	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	59	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	59	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	61	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	62	
Airport Lagoon	25/05/2013	minnow trap	1	Lake Chub	84	
Airport Lagoon	25/05/2013	minnow trap	1	Longnose Sucker	57	
Airport Lagoon	25/05/2013	minnow trap	1	Redside Shiner	41	
Airport Lagoon	25/05/2013	minnow trap	1	Redside Shiner	43	
Airport Lagoon	25/05/2013	minnow trap	1	Redside Shiner	46	
Airport Lagoon	25/05/2013	minnow trap	2	Largescale Sucker	55	257 brassy minnow also captured
Airport Lagoon	25/05/2013	minnow trap	2	Largescale Sucker	75	
Airport Lagoon	25/05/2013	minnow trap	2	Largescale Sucker	81	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	43	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	46	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	46	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	47	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	47	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	48	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	49	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	49	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	50	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	50	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	50	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	51	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	51	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	52	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	52	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	52	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	52	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	53	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	53	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	54	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	54	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	54	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	55	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	55	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	56	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	56	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	57	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	57	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	58	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	59	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	59	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	60	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	61	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	61	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	65	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	71	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	72	
Airport Lagoon	25/05/2013	minnow trap	2	Lake Chub	73	
Airport Lagoon	25/05/2013	minnow trap	2	Longnose Sucker	63	
Airport Lagoon	25/05/2013	minnow trap	2	Northern Pikeminnow	55	
Airport Lagoon	25/05/2013	minnow trap	3	Longnose Sucker	85	303 brassy minnow and 119 lake chub also captured
Airport Lagoon	25/05/2013	minnow trap	3	Northern Pikeminnow	80	
Airport Lagoon	25/05/2013	minnow trap	4	Northern Pikeminnow	70	177 brassy minnow and 56 lake chub also captured
Airport Lagoon	25/05/2013	minnow trap	4	Northern Pikeminnow	71	
Airport Lagoon	25/05/2013	minnow trap	4	Redside Shiner	89	
Airport Lagoon	25/05/2013	minnow trap	5	Longnose Sucker	54	328 brass minnow and 44 lake chub also captured
Airport Lagoon	25/05/2013	minnow trap	5	Longnose Sucker	57	
Airport Lagoon	25/05/2013	minnow trap	5	Longnose Sucker	72	
Airport Lagoon	25/05/2013	minnow trap	5	Redside Shiner	47	
Airport Lagoon	25/05/2013	minnow trap	5	sucker sp.	53	
Airport Lagoon	25/05/2013	minnow trap	5	sucker sp.	57	
Airport Lagoon	25/05/2013	minnow trap	5	sucker sp.	58	
Airport Lagoon	25/05/2013	minnow trap	6	Lake Chub	50	
Airport Lagoon	25/05/2013	minnow trap	6	Lake Chub	51	
Airport Lagoon	25/05/2013	minnow trap	6	Lake Chub	53	
Airport Lagoon	25/05/2013	minnow trap	6	Lake Chub	55	
Airport Lagoon	25/05/2013	minnow trap	6	Redside Shiner	44	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	56	subsampled 47 of 213
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	57	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	58	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	59	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	59	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	59	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	59	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	59	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	61	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	62	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	63	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	63	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	64	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	64	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	64	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	65	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	66	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	67	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	67	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	71	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	73	
Airport Lagoon	15/07/2013	fyke net	1	Brassy Minnow	76	
Airport Lagoon	15/07/2013	fyke net	1	Largescale Sucker	96	
Airport Lagoon	15/07/2013	fyke net	1	Largescale Sucker	100	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	54	subsampled 49 of 261
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	56	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	56	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	57	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	58	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	58	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	61	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	61	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	62	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	63	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	63	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	63	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	63	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	63	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	64	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	65	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	66	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	66	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	67	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	67	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	67	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	67	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	67	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	67	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	67	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	68	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	68	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	68	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	68	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	69	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	70	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	70	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	70	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	70	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	71	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	71	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	71	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	72	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	72	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	72	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	72	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	73	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	75	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	75	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	76	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	76	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	76	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	80	
Airport Lagoon	15/07/2013	fyke net	1	Lake Chub	82	
Airport Lagoon	15/07/2013	fyke net	1	Longnose Sucker	78	
Airport Lagoon	15/07/2013	fyke net	1	Longnose Sucker	83	
Airport Lagoon	15/07/2013	fyke net	1	Longnose Sucker	83	
Airport Lagoon	15/07/2013	fyke net	1	Longnose Sucker	94	
Airport Lagoon	15/07/2013	fyke net	1	Longnose Sucker	94	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	194	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	256	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	258	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	272	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	284	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	285	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	287	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	290	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	303	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	305	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	313	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	334	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	341	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	346	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	349	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	354	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	355	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	363	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	367	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	374	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	412	
Airport Lagoon	15/07/2013	fyke net	1	Northern Pikeminnow	420	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	49	subsampled 80 of 173
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	50	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	54	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	54	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	54	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	54	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	55	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	55	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	55	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	56	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	56	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	57	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	57	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	57	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	58	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	58	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	58	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	58	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	58	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	59	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	59	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	59	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	59	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	60	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	60	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	61	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	62	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	62	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	63	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	63	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	64	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	64	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	65	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	66	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	66	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	67	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	67	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	68	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	69	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	72	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	73	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	73	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	73	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	74	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	74	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	74	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	75	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	75	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	76	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	76	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	77	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	77	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	80	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	80	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	84	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	84	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	85	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	86	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	86	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	86	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	86	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	87	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	89	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	89	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	89	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	91	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	91	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	91	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	93	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	100	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	101	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	103	
Airport Lagoon	15/07/2013	fyke net	1	Redside Shiner	111	
Airport Lagoon	15/07/2013	fyke net	2	Lake Chub	29	
Airport Lagoon	15/07/2013	fyke net	2	Lake Chub	53	
Airport Lagoon	15/07/2013	fyke net	2	Lake Chub	70	
Airport Lagoon	15/07/2013	fyke net	2	Lake Chub	71	
Airport Lagoon	15/07/2013	fyke net	2	Lake Chub	72	
Airport Lagoon	15/07/2013	fyke net	2	Lake Chub	76	
Airport Lagoon	15/07/2013	fyke net	2	Lake Chub	87	
Airport Lagoon	15/07/2013	fyke net	2	Redside Shiner	55	
Airport Lagoon	15/07/2013	fyke net	2	Redside Shiner	58	
Airport Lagoon	15/07/2013	fyke net	2	Redside Shiner	61	
Airport Lagoon	15/07/2013	fyke net	2	Redside Shiner	62	
Airport Lagoon	15/07/2013	fyke net	2	Redside Shiner	63	
Airport Lagoon	15/07/2013	fyke net	2	Redside Shiner	66	
Airport Lagoon	15/07/2013	fyke net	2	Redside Shiner	77	
Airport Lagoon	15/07/2013	minnow trap	4	Lake Chub	64	
Airport Lagoon	15/07/2013	minnow trap	4	Lake Chub	65	
Airport Lagoon	15/07/2013	minnow trap	4	Lake Chub	73	
Airport Lagoon	15/07/2013	minnow trap	4	Lake Chub	73	
Airport Lagoon	15/07/2013	minnow trap	4	Lake Chub	75	
Airport Lagoon	15/07/2013	minnow trap	4	Longnose Sucker	93	
Airport Lagoon	15/07/2013	minnow trap	4	Redside Shiner	65	
Airport Lagoon	15/07/2013	minnow trap	5	Longnose Sucker	85	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	55	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	62	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	64	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	64	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	64	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	65	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	65	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	65	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	66	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	66	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	67	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	67	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	67	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	67	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	68	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	68	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	68	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	69	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	69	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	70	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	70	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	70	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	71	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	71	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	71	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	72	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	73	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	73	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	74	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	74	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	74	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	76	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	77	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	78	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	86	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	87	
Airport Lagoon	15/07/2013	minnow trap	6	Lake Chub	91	
Airport Lagoon	15/07/2013	minnow trap	6	Longnose Sucker	97	
Airport Lagoon	15/07/2013	minnow trap	6	Redside Shiner	95	
Beaver Pond	26/05/2013	electrofisher	1	Lake Chub	33	
Beaver Pond	26/05/2013	electrofisher	1	Lake Chub	33	
Beaver Pond	26/05/2013	electrofisher	1	Lake Chub	44	
Beaver Pond	26/05/2013	electrofisher	1	Lake Chub	61	
Beaver Pond	26/05/2013	electrofisher	1	Longnose Sucker	66	
Beaver Pond	26/05/2013	electrofisher	1	Longnose Sucker	71	
Beaver Pond	26/05/2013	electrofisher	1	Northern Pikeminnow	34	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	40	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	42	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	44	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	46	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	46	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	47	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	48	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	48	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	49	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	49	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	50	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	54	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	55	
Beaver Pond	26/05/2013	electrofisher	1	sucker sp.	55	
Beaver Pond	26/05/2013	electrofisher	2	Largescale Sucker	65	
Beaver Pond	26/05/2013	electrofisher	2	Lake Chub	64	
Beaver Pond	26/05/2013	electrofisher	2	Longnose Sucker	63	
Beaver Pond	26/05/2013	electrofisher	2	Redside Shiner	35	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	39	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	42	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	42	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	43	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	43	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	45	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	45	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	45	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	46	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	47	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	48	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	48	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	48	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	49	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	49	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	49	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	49	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	49	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	50	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	50	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	51	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	51	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	52	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	52	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	52	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	53	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	53	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	53	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	53	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	54	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	55	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	55	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	56	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	56	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	56	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	56	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	57	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	58	
Beaver Pond	26/05/2013	electrofisher	2	sucker sp.	59	
Beaver Pond	16/07/2013	fyke net	1	Largescale Sucker	166	
Beaver Pond	16/07/2013	fyke net	1	Largescale Sucker	170	
Beaver Pond	16/07/2013	fyke net	1	Largescale Sucker	176	
Beaver Pond	16/07/2013	fyke net	1	Largescale Sucker	193	
Beaver Pond	16/07/2013	fyke net	1	Largescale Sucker	212	
Beaver Pond	16/07/2013	fyke net	1	Largescale Sucker	215	
Beaver Pond	16/07/2013	fyke net	1	Longnose Sucker	157	
Beaver Pond	16/07/2013	fyke net	1	Longnose Sucker	172	
Beaver Pond	16/07/2013	fyke net	1	Longnose Sucker	174	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	118	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	124	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	129	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	140	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	143	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	156	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	157	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	162	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	162	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	167	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	170	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	174	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	178	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	185	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	194	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	196	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	196	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	204	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	205	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	207	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	207	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	215	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	220	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	222	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	226	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	231	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	235	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	240	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	240	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	247	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	248	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	250	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	254	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	257	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	267	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	272	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	276	
Beaver Pond	16/07/2013	fyke net	1	Northern Pikeminnow	348	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	50	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	105	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	109	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	109	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	109	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	112	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	112	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	115	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	115	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	116	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	119	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	120	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	121	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Beaver Pond	16/07/2013	fyke net	1	Peamouth	121	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	126	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	130	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	131	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	132	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	134	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	136	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	137	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	138	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	139	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	139	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	139	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	140	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	140	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	141	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	141	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	141	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	143	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	144	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	144	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	145	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	148	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	149	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	149	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	153	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	153	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	157	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	158	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	158	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	159	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	159	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	165	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	165	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	169	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	170	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	173	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	179	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	181	

Site	Date (dd/mm/yyyy)	Capture Method	Sample Site	Species	Length (mm)	Comment
Beaver Pond	16/07/2013	fyke net	1	Peamouth	187	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	187	
Beaver Pond	16/07/2013	fyke net	1	Peamouth	218	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	38	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	39	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	39	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	39	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	39	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	41	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	41	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	41	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	44	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	48	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	52	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	53	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	94	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	97	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	104	
Beaver Pond	16/07/2013	fyke net	1	Redside Shiner	106	
Beaver Pond	16/07/2013	fyke net	1	White Sucker	346	
Beaver Pond	16/07/2013	fyke net	1	White Sucker	369	
Beaver Pond	16/07/2013	minnow trap	1	Longnose Sucker	117	
Beaver Pond	16/07/2013	minnow trap	2	Prickly Sculpin	64	
Beaver Pond	16/07/2013	minnow trap	6	Prickly Sculpin	51	
Beaver Pond	16/07/2013	minnow trap	6	Prickly Sculpin	57	
Beaver Pond	16/07/2013	minnow trap	8	sucker sp.	59	

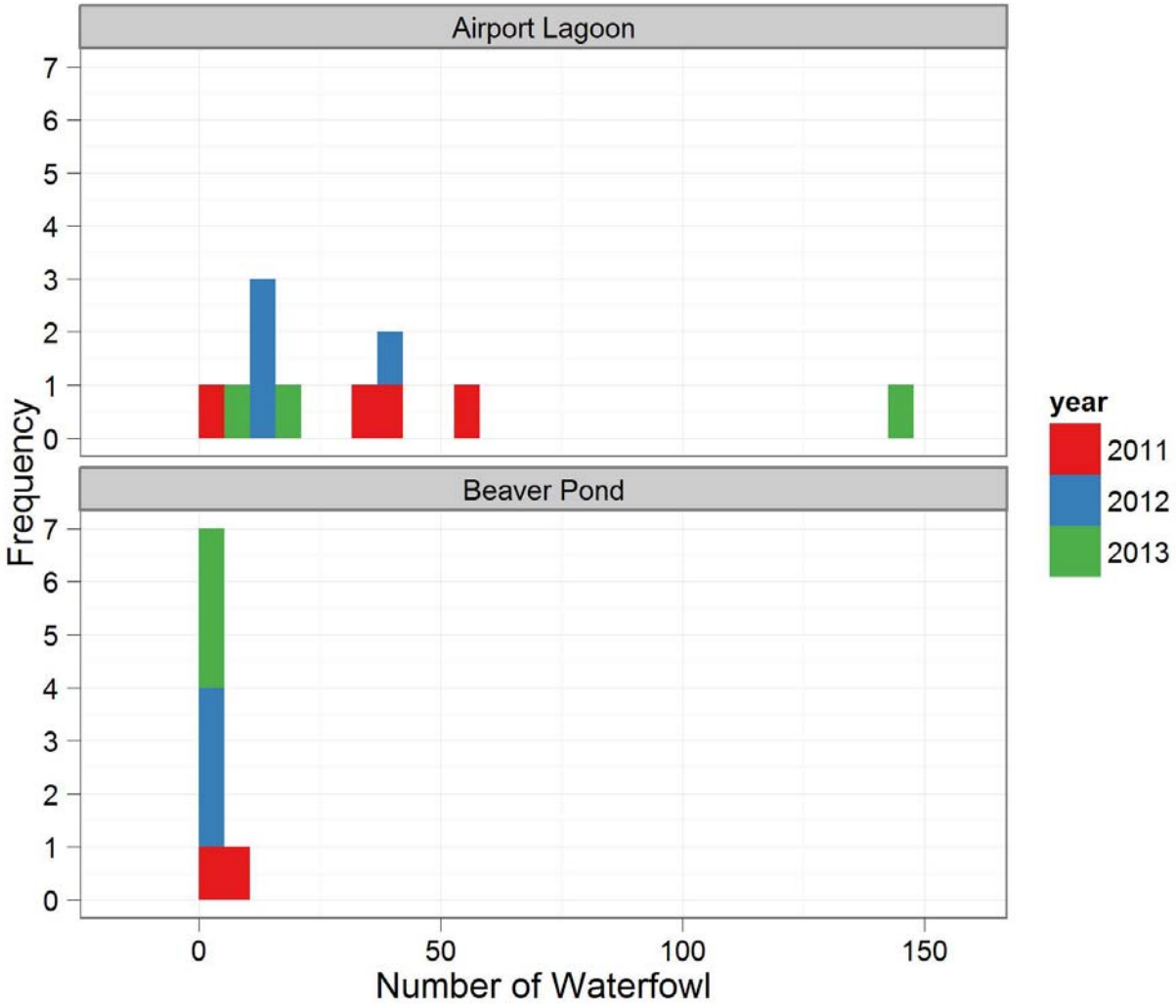
Appendix 15. Water quality data collected during fish sampling at the Airport Lagoon and Beaver Pond sites in 2013.

Site	Date	Location[1]	Temperature (°C)	Conductivity (µS/cm)	pH	Dissolved Oxygen (mg/L)	Turbidity[2]	Secchi Depth (m)
Airport Lagoon	May 24	EF2	14.1	248	7.75	-	C	n/a
		EF3	15.6	235	7.13	11.97	C	n/a
	May 25	EF4	15.3	242	-	9.95	C	n/a
	July 16	upper pond[3]	18.5	145	7.79	9.43	n/a	4.1
		near causeway[3]	18.1	126	7.95	9.49	n/a	4.0
Beaver Pond	May 26	EF1	12.4	138	-	-	C	n/a
	July 16	inlet[3]	18.8	96.5	7.55	9.45	n/a	1.7
		lake[3]	19.3	97	6.95	9.83	n/a	1.92

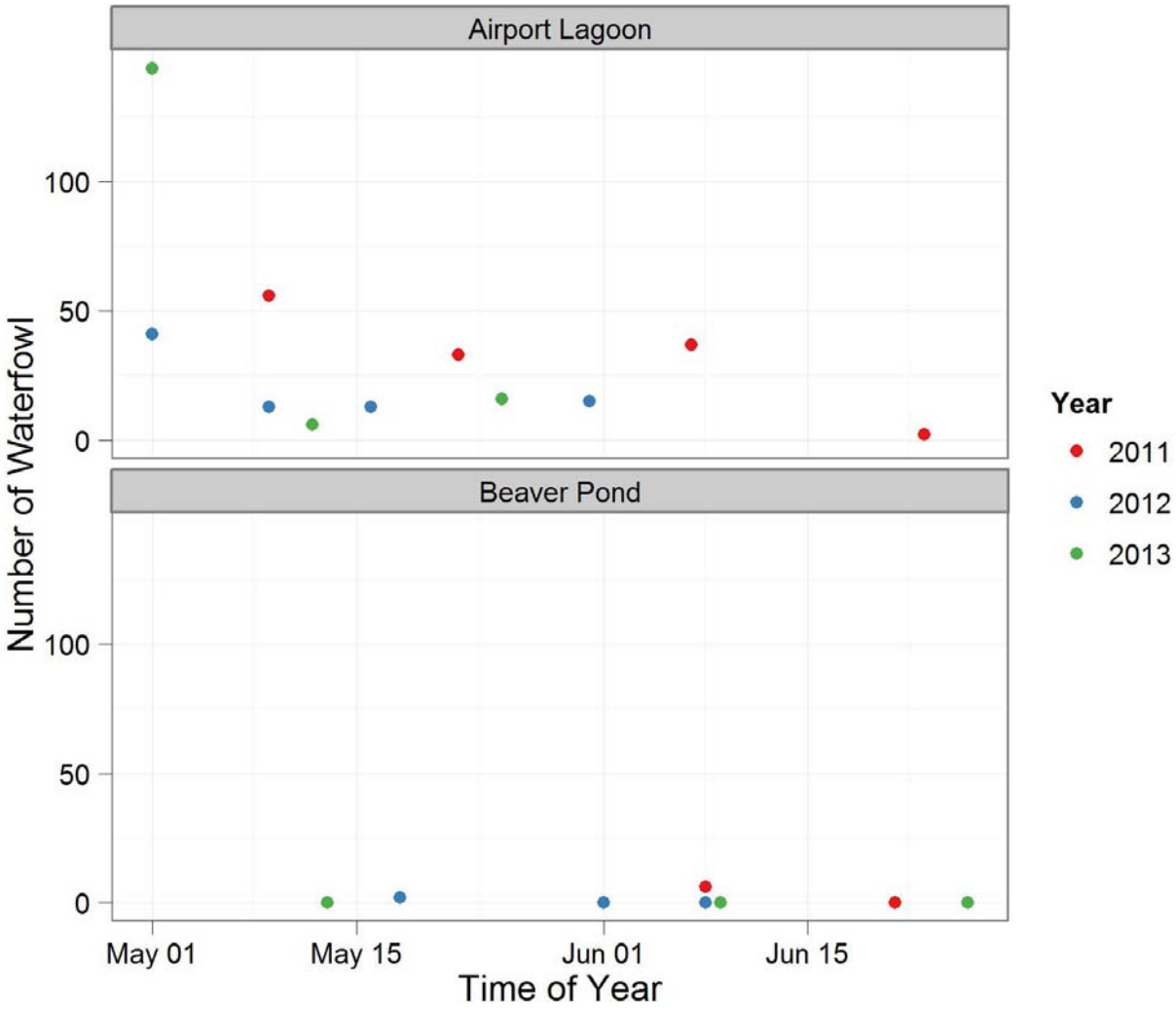
[1] – Refer to the fish sampling locations in Figures 9 and 10
[2] – Relative turbidity, see RIC (2001) for definitions.
[3] – Taken at surface.

Appendix 16. Distribution of waterfowl count data at Airport Lagoon and Beaver Pond annually and seasonally showing minimal variation.

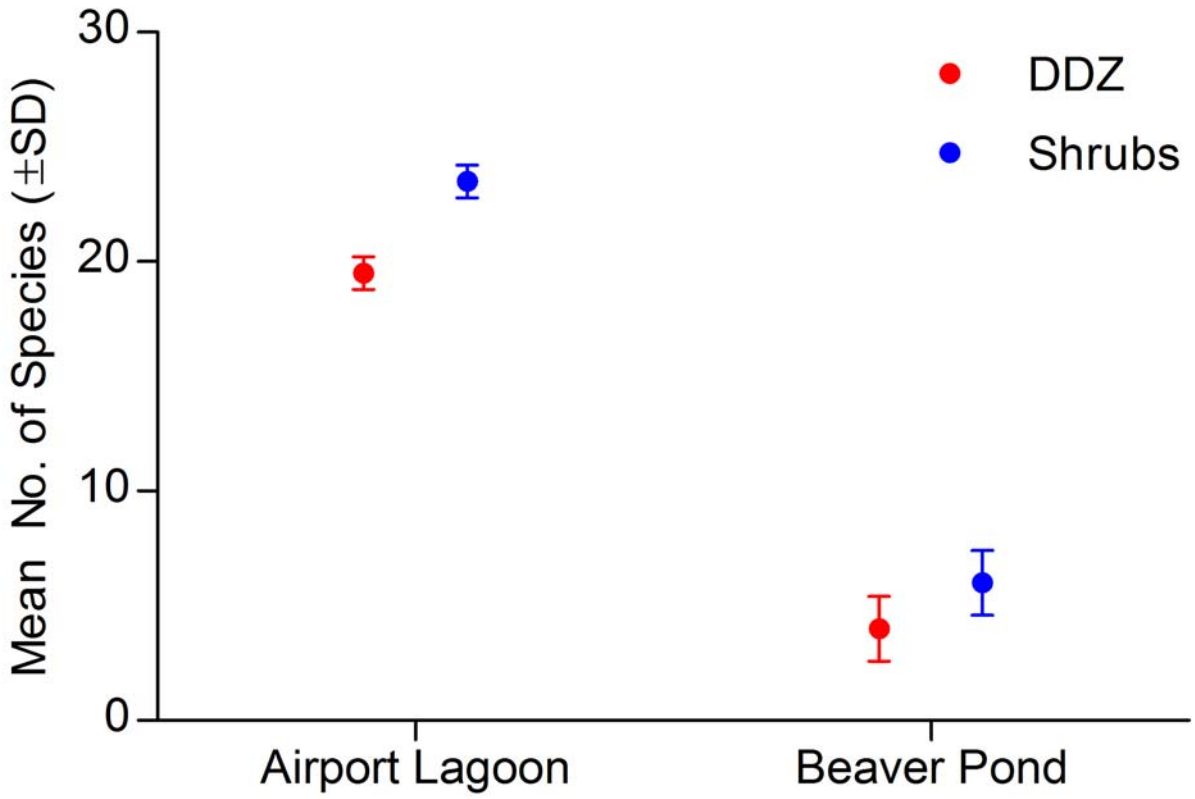
Annual variation



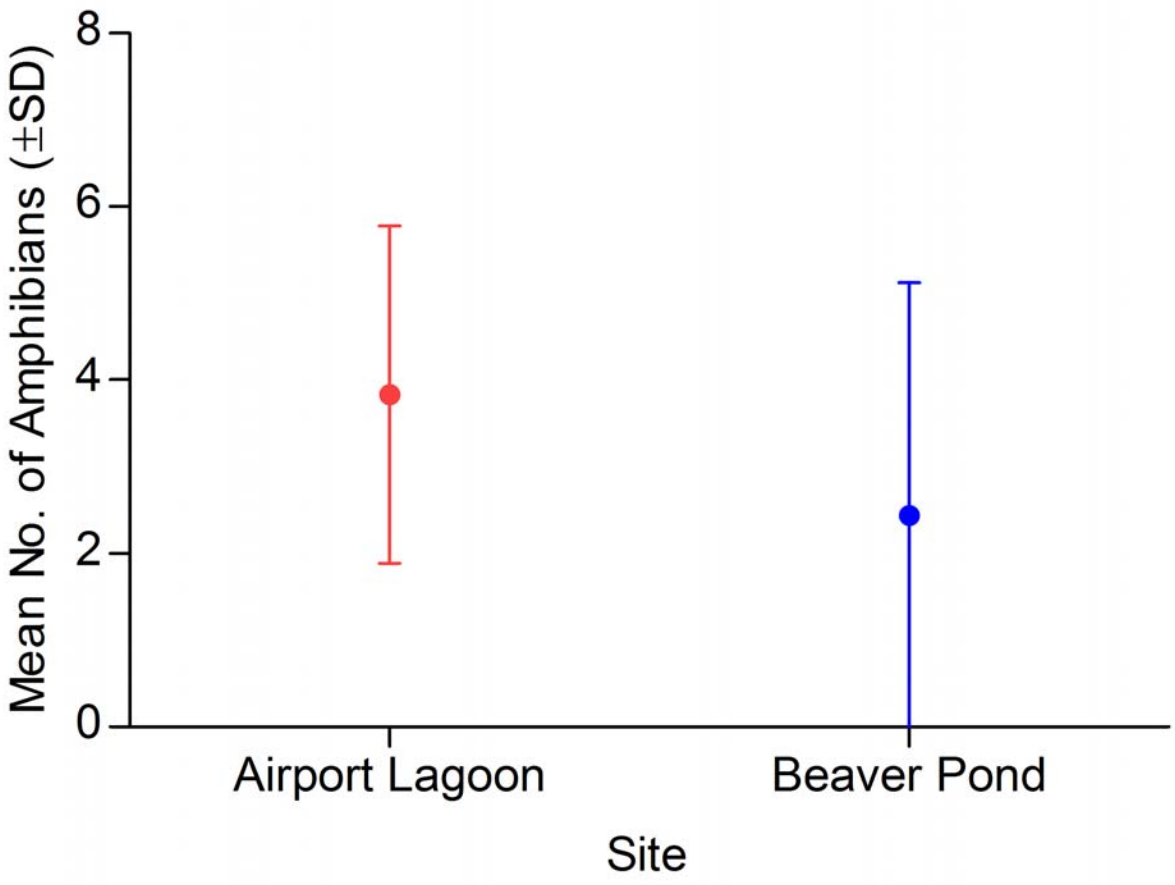
Seasonal variation



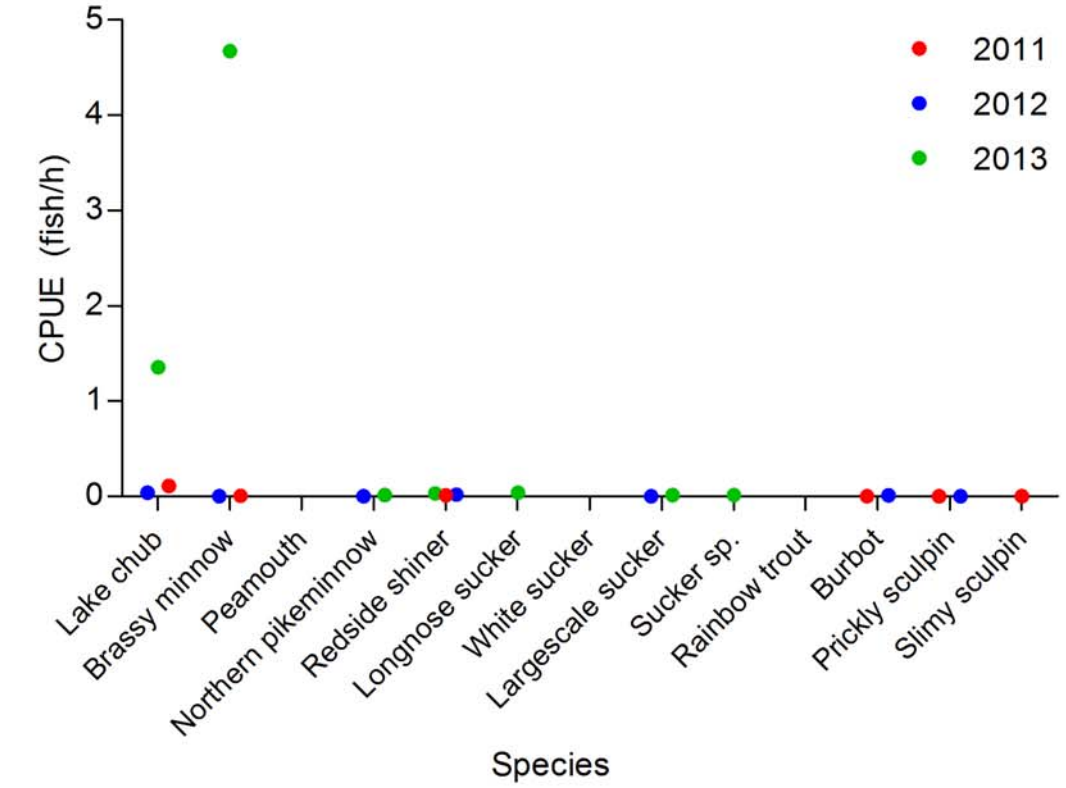
Appendix 17. Mean number of bird species detected in the drawdown zone and shrub habitats during point count surveys at the Airport Lagoon and Beaver Pond sites.

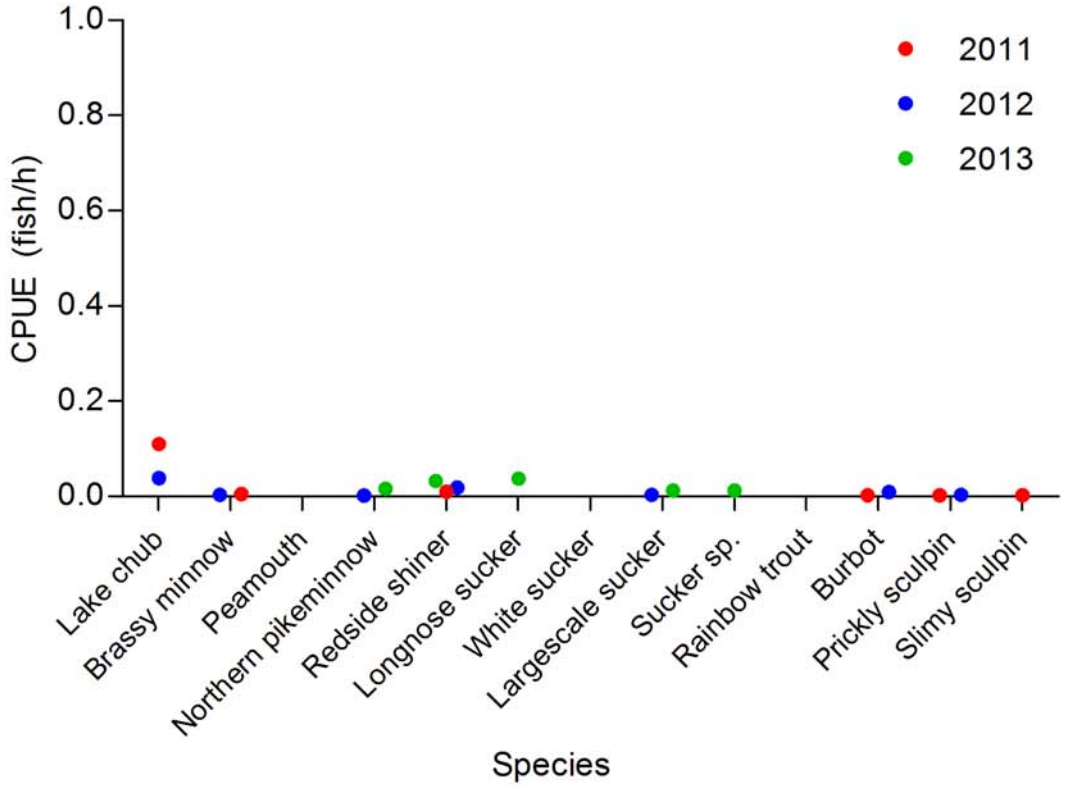


Appendix 18. Mean number of amphibians detected at the Airport Lagoon and Beaver Pond sites during the pre-enhancement phase.



Appendix 19. Annual catch-per-unit-effort by species for fish collected by minnow trap at the Airport Lagoon. The same data is shown on both figures except for different ranges on the y-axis.





Appendix 20. Annual catch-per-unit-effort by species for fish collected by fyke net at the Airport Lagoon. The same data is shown on both figures except for different ranges on the y-axis.