Appendix 5.1.2.5A
Wetlands 2011 - 2013 Baseline Report

Blackwater Gold Project

Wetlands
2011-2013 Baseline Report

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ACRONYMS

Abbreviations and Units of Measure	Definition
AMEC	AMEC Environment & Infrastructure
BAFAun	Boreal Altai Fescue Alpine, Undifferentiated
BC	British Columbia
BC CDC	British Columbia Conservation Data Centre
BC *EAA*	British Columbia *Environmental Assessment Act*
BC MELP	British Columbia Ministry of Environment, Land and Parks
BC MFLNRO	British Columbia Ministry of Forests, Lands and Natural Resource Operations
BC MOE	British Columbia Ministry of Environment
BC MOF	British Columbia Ministry of Forests
BC MOFR	British Columbia Ministry of Forests and Range
BCSEE	British Columbia Species and Ecosystem Explorer
BEC	Biogeoclimatic Ecosystem Classification
BGC	biogeoclimatic
BWBS	Boreal White and Black Spruce
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWCD	Canadian Wetland Classification System
DO	dissolved oxygen
EC	Environment Canada
ESSF	Engelmann Spruce – Subalpine Fir
ESSFmc	Engelmann Spruce – Subalpine Fir moist cold
ESSFmv1	Engelmann Spruce – Subalpine Fir moist very cold Nechako
ESSFmvp	Engelmann Spruce – Subalpine Fir moist very cold Nechako parkland
ESSFxv1	Engelmann Spruce – Subalpine Fir west Chilcotin very dry very cold
ha	hectare
HGM	hydrogeomorphic
km	kilometre
LSA	Local Study Area
m	metre
m^2	square metres
µS/cm	microSiemens per centimetre
mg/L	milligrams per litre
MSxv	Montane Spruce very dry very cold
NWWG	National Wetlands Working Group
PEM	Predictive Ecosystem Mapping

Abbreviations and Units of Measure	Definition
proponent	New Gold Inc.
Project (the)	proposed Blackwater Gold Project
QA/QC	quality assurance and quality control
RIC	Resource Inventory Committee
RSA	Regional Study Area
SARA	*Species at Risk Act*
SPS	Sub-Boreal Pine Spruce
SBPSdc	Sub-Boreal Pine Spruce dry cold
SBPSmk	Sub-Boreal Pine Spruce moist cool
SBSdw2	Sub-Boreal Spruce dry warm Stuart
SBSdw3	Sub-Boreal Spruce dry warm Stuart
SBSmc2	Sub-Boreal Spruce moist cold Babine
SBSmc3	Sub-Boreal Spruce moist cold Kluskus
SBSmw	Sub-Boreal Spruce moist warm
SWB	Spruce Willow Birch
TDS	total dissolved solids
TEM	Terrestrial Ecosystem Mapping
TRIM	Terrain Resource Information Management Program
TSS	total suspended solids
UBC	University of British Columbia
VFD	Vanderhoof Forest District

GLOSSARY

Term	Definition
Blue-listed	Any plant taxa or ecological community considered to be of special concern (formerly vulnerable) in British Columbia.
Ecoregion	A lower level of classification within the Ecoregion Classification system. Ecoregion represents an area with major physiographic and minor macroclimatic or oceanographic variation, defined at the regional level
Ecosection	A lower level of classification within the Ecoregion Classification system. Ecosection represents an area with minor physiographic and macroclimatic or oceanographic variation, defined at the sub-regional level
Extinct	A species that no longer exists
Extirpated	A species that is facing imminent extirpation or extinction
Invasive Plant	Any non-native plant that cause economic or environmental harm and can spread quickly to new areas
Red-listed	Any plant taxa or ecological community that is extirpated, endangered, or threatened in British Columbia
Salmonid (fish)	The family salmonidae (i.e., salmonids) include trout, char, salmon, whitefish and graylings
SARA-listed	Schedule 1 species, *Species at Risk Act (SARA)* legal list
Schedule 1	The legal list of species that are extirpated, endangered, threatened, and of special concern
Site Association	Site associations represent sites capable of producing the same near-climax vegetation, regardless of biogeoclimatic unit
Site Series	Site series refers to sites capable of producing the same mature or climax plant communities within a biogeoclimatic subzone or variant
Special Concern	A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats
Species At Risk	An extirpated, endangered or threatened species or a species of special concern
Zone	Biogeoclimatic zones are generalized units representing extensive areas of broad homogeneous macroclimates
Subzone	Biogeoclimatic zones are subdivided into subzones. Subzones have characteristic plant communities occurring on zonal sites
Threatened	A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction
Variant	Biogeoclimatic subzones are subdivided into variants based on climatic variation such as slightly drier, wetter, snowier, and warmer than other areas within a subzone

EXECUTIVE SUMMARY

The wetlands baseline report presents the results of the wetlands baseline program conducted for the proposed Blackwater Gold Project (the Project) located south of Vanderhoof, British Columbia (BC). The wetlands baseline program was designed to document and describe the distribution, size, composition, and primary functions of wetland resources within and adjacent to the Project area. Description of wetland function incorporates hydrological, biochemical, and ecological/habitat data. This report updates previous versions with 2013 data. The wetland study area includes the mine site, as well as an associated mine site Local Study Area (LSA) and a mine site Regional Study Area (RSA), and four linear features: the water pipeline, mine access road, airstrip, and transmission line. The transmission line is the only linear feature that extends outside the mine site LSA.

Two-hundred and ten (210) wetland-related field surveys were completed between summer 2011 and summer 2013 in the wetland study areas. Within the proposed mine site, approximately 575 hectares (ha) (13% by area) were classified as wetlands. Swamp wetlands were the most common wetland class identified in the mine site (9.5%, 421 ha). Provincially Blue-listed wetland ecosystems were found to occupy approximately 39 ha (0.9%) of the mine site. One red-listed and several Blue-listed wetland ecosystems also occurred within the mine site LSA and RSA. Mapped wetland resources comprise approximately 3,122 ha (12%) of the mine site LSA and 5,846 ha (5%) of the mine site RSA.

Collected data on hydrological function of wetlands revealed that 50% of the wetlands classified by hydrogeomorphic (HGM) unit were linked basins or hollows. This indicates that wetlands may play an important role in surface water storage, flow moderation, and erosion protection in the Project area. Riparian swamps and linked marsh wetlands provided the highest hydrological functions of the wetlands surveyed.

Wetland biochemical function was described using water quality parameters related to nutrient, chemical, and metal concentrations found in the surface water of the sampled wetlands. Overall, baseline water quality results suggest normal conditions for sampled wetlands. Indicators such as low pH, high nutrients (nitrogen and phosphorus), and moderate levels of organic carbon at sampled wetlands were within the natural range of variation for wetland ecosystems in BC. Freshwater aquatic guideline exceedances were detected for total and dissolved metals in all years for some parameters tested, particularly total cadmium, total iron, total zinc, dissolved aluminum, and dissolved iron. These results indicate that naturally elevated metals occur in some sampled wetlands.

Wetland ecological function involves the role of wetlands in relation to their surroundings and their ability to support a variety of plant and animal species and communities. Twenty-one distinct wetland ecosystems were classified within the wetlands study area. Of the 16 wetland types encountered in the mine site, four are of special concern (Blue-listed) in BC. A total of 318 plant species were identified during the wetland field surveys, four of

which are Blue-listed in BC: swollen beaked sedge *(Carex rostrata*), small-flowered lousewort *(Pedicularis parviflora ssp. parviflora*), meesia moss *(Meesia longiseta*), and sickleleaf tomentypnum moss (*Tomentypnum falcifolium*). One population of *T. falcifolium* was observed within the mine site boundaries. The Red-listed Hudson Bay clubrush – red hook-moss wetland site association (Wf10) was observed in the mine site LSA and RSA but not inside the proposed mine site.

Wetland habitat function relates to the ability of a wetland ecosystem to support wildlife. The sampled wetlands have the potential to support at least 132 wildlife species including 4 amphibians, 64 birds, 10 mammals, 54 odontates, and 7 lepidopterans. Of the 132 wildlife species identified in the wetland study areas, 18 are provincial wildlife species at risk. Seven of these are *SARA*-listed species including the western toad (*Anaxyrus boreas*), Yellow rail (*Coturnicops noveboracensis*), long-billed curlew (*Numenius americanus*), short-eared owl (*Asio flammeus*), olive-sided flycatcher (*Contopus cooperi*), rusty blackbird (*Euphagus carolinus*), and caribou (*Rangifer tarandus).* Wildlife habitat functionality values and ranks were developed for a representative sample of wetlands. With the exception of seven wetlands that were ranked high and one ranked low, 48 wetlands were ranked as moderate for wetland habitat function. Wetlands that were ranked high generally had high habitat value for multiple wildlife species.

1.0 INTRODUCTION

Wetlands are defined as “land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment” (National Wetlands Working Group (NWWG), 1988). Characteristics of each wetland feature (e.g., hydrological and ecological) are used to describe, map, and classify wetland resources (**Table 1.1-1**).

Wetland features are interconnected. For example, changes in wetland hydrologic gradients (e.g., water source, flows, inundation, and ground water recharge) are directly linked to changes in chemistry, nutrient availability, structure, and community composition. Wetlands encompass a variety of ecosystems ranging from permanently flooded, isolated wetlands to seasonally wet, forested wetland complexes (**Table 1.1-2**). Wetland ecosystems include fens, bogs, swamps, marshes, and shallow-water site classes (MacKenzie and Moran, 2004). Wetlands are classified by realm, class and site association (MacKenzie and Moran, 2004), and further characterized by function. Wetland functions are defined as natural processes (e.g., chemical, physical, and biological) that occur in wetlands and render services that are of value to humans and society (British Columbia Ministry of Environment (BC MOE), 2009). The Canadian Wildlife Service further identifies wetland functions as having particular importance for species at risk, wildlife, maintenance of biological diversity, and ecosystem processes (Milko, 1998; Hanson et al., 2008). Physical and functional attributes of wetland resources also provide information on other ecological landscape components, including salmonid bearing waters, wildlife areas, and native and at-risk vegetation species and communities (Hanson et al., 2008). Furthermore, wetlands are ecotones between terrestrial and aquatic environments and are closely linked to upstream processes (Naiman and Decamps, 1990).

The main wetland functions described in this baseline report are hydrological, biochemical, and ecological/habitat (Hanson et al., 2008; Milko, 1998). Ecological and habitat functions are closely related and, thus, are addressed together in this report.

Wetland protection and conservation in British Columbia (BC) is guided by governmental input. Regulatory tools within federal and provincial legislation that support wetland protection in conjunction with other statutory objectives enforce such policies (Rubec and Lynch Stewart, 1998). **Table 1.1-3** identifies key policies related to wetland resources.

Table 1.1-1: Features (Hydrological and Ecological) Used to Describe, Map, and Classify Wetlands to the Site Association (plant community) Level

Hydrological Features	Ecological Features
HGM Unit	Soil characteristics
Period of inundation	Biogeoclimatic zone
pH	Terrain features
Electrical conductivity	Plant communities
Watershed position	Geology

Note: HGM = hydrogeomorphic

Source: Adapted from BC MOFR and BC MOE, 2010; MacKenzie and Moran, 2004

Table 1.1-2: Summary Characteristics of Wetland Classes in British Columbia

Site Class	Environmental Feature	Cover Type	Species Group
Bogs	+/- ombrotrophic; pH < 5.5; > 40 cm fibric/mesic peat	Conifer treed or low shrub	Sphagnum mosses, ericaceous shrubs, conifers
Fens	Groundwater-fed; pH > 5; > 40 cm fibric/mesic peat	Graminoid or low shrub	Deciduous shrubs, sedges, brown mosses
Marshes	Mineral soils or well-humified peat; protracted shallow flooding (0.5 m to 2.0 m)	Graminoid or forb	Large emergent sedge, grass, forb, horsetail species
Swamps	Mineral soils or well-humified peat; temporally shallow flooding (0.1 m to 1.0 m); significant water flow	Tall shrub or forested	Conifers, willows, alders, forbs, grasses, leafy mosses
Shallow waters	Permanent deep flooding (0.5 m to 2.0 m)	Aquatic	Aquatic species, emergent vegetation, < 10% cover

Source: Adapted from MacKenzie and Moran, 2004

Table 1.1-3: Federal and Provincial Regulations and Policies Related to Wetland Resources

Regulations and Policies	Purpose
Canadian Environmental Assessment Act (CEAA) (2012)	Responds to Canada's economic and environmental resources by implementing responsible and timely resource development for the benefit of all Canadians. The environmental assessment focuses on potential adverse environmental effects that are within federal jurisdiction. Cumulative effects, mitigation measures, and comments received from the public are factors considered during the assessment. Project development requiring a CEAA review may result in impacts to wetlands.
Species at Risk Act (SARA) (2002)	Developed with three main goals: 1. prevent endangered or threatened species from becoming extinct or extirpated; 2. help in the recovery of endangered, threatened, or extirpated species; 3. manage species of concern to help prevent them from

Regulations and Policies	Purpose
	becoming endangered or threatened; and 4. SARA plants and animals may occur in wetlands.
Migratory Birds Convention Act (1994)	Protects migratory birds and their nests. Migratory birds may forage, breed, and/or seek cover in wetlands.
Canada Wildlife Act (1985)	Protects wildlife and wildlife habitat for conservation, research, and interpretation. Wetlands may impact wildlife protected under the *Canada Wildlife Act*.
Fisheries Act – Policy for Management of Fish Habitat (DFO, 1986)	Protects habitats directly or indirectly supporting existing or potential fisheries. Wetlands may support fish that are protected under the *Fisheries Act*.
Federal Policy on Wetland Conservation (Government of Canada, 1991)	Approved by Cabinet in 1992, directs all departments to implement the seven strategies of the Policy. Two key commitments include no-net-loss of wetland functions on all federal lands and waters, and enhancement and rehabilitation of wetlands in areas where the continuing loss or degradation of wetlands or their functions have reached critical levels. Not only does the Policy apply to the management of federal lands but all federal programs, services, and expenditures.
Federal Policy on Wetland Conservation: Implementation Guide, for Federal Land Managers (Government of Canada: Lynch-Stewart et al., 1996)	Developed to ensure compliance with the Policy, the Implementation Guide outlines the sequence of mitigation alternatives, compensation, and monitoring to meet the policy goal of no-net-loss of wetland functions.
British Columbia *Water* Act (1996)	Wetland protection is applied when an application is made to withdraw water from a wetland, or carry on activities in and around streams that may be part of a wetland system.
Policy for Mitigating Impacts on Environmental Values: Final Working Draft (Environmental Mitigation Policy) (BC MOE, 2012)	Intended to provide a consistent approach and guidance for provincial staff, decision-makers, and proponents in the natural resource sector. The Policy and supporting procedures provide a basis for developing mitigation plans to address impacts of proposed activities on environmental values including wetlands.

1.1 Scope of Work

Baseline data were collected during summer months from 2011 to 2013, to identify and determine wetland resources. Data collection protocols were developed to determine hydrological, biochemical, and ecological/habitat functions for sampled wetlands. Data collected include:

- Hydrological data for the hydrogeomophological classification of wetlands;
- Surface water samples as part of the wetland baseline program used to describe biochemical function; and
- Ecological data as part of the wetland, vegetation, and wildlife baseline program used to describe wetland ecological functions including habitat use by wildlife.

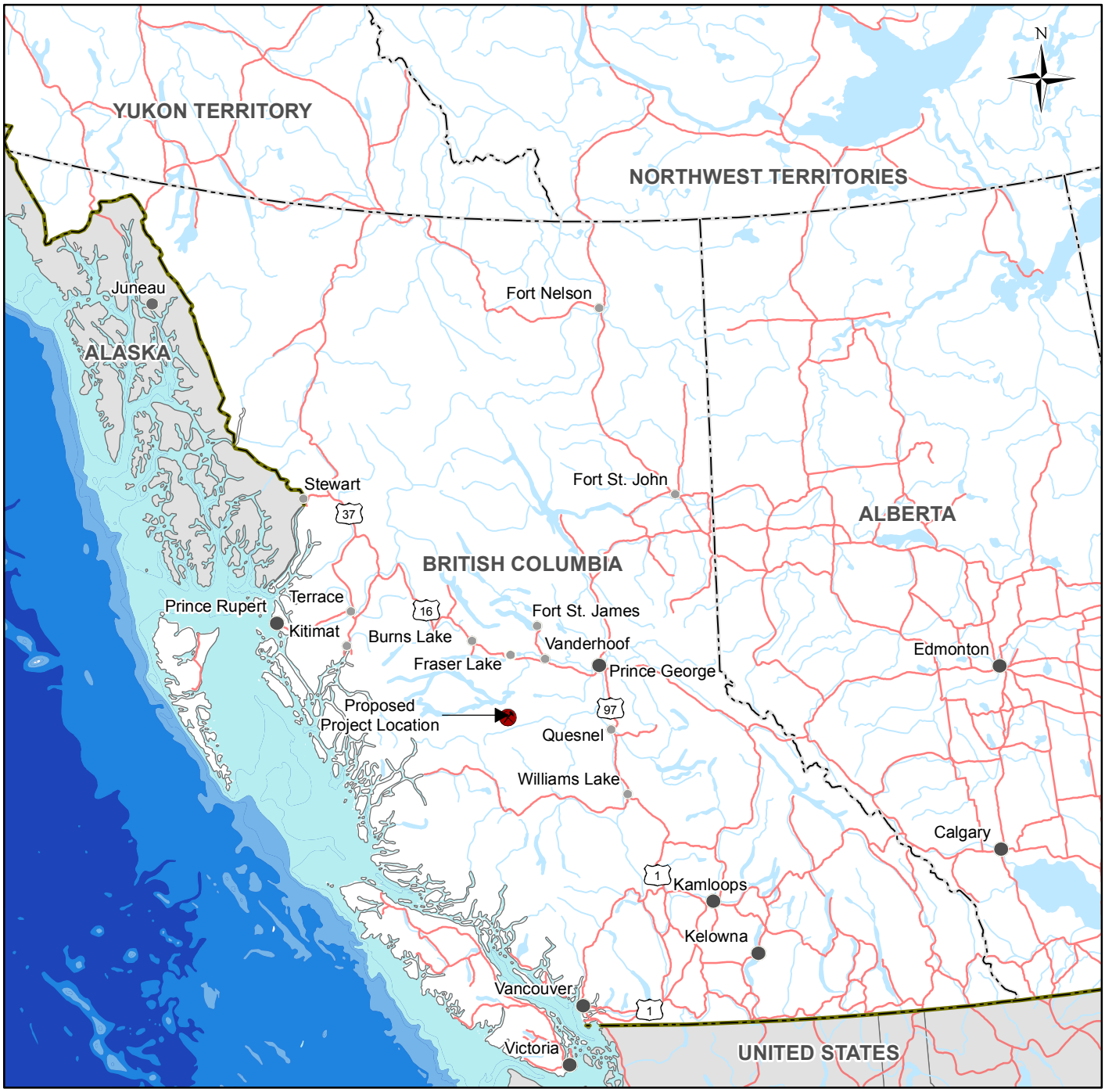
1.2 Objective

The wetlands baseline report was developed to describe, classify, and map the existing (i.e., baseline conditions) wetland resources. The report describes results from the 2011, 2012, and 2013 studies on wetland characteristics and primary functional attributes: hydrological, biochemical, and ecological/habitat.

1.3 Study Areas

The Project is located on the North Central Interior Plateau, approximately 110 kilometres (km) south of Vanderhoof, near the geographical center of BC (**Figure 1.3-1**). For wetland delineation, classification, and functional value assessments, wetlands were separated into two primary components: 1) the mine site and 2) the linear features. The mine site has a Local Study Area (LSA) and Regional Study Area (RSA) based on watershed drainage basins (**Table 1.3-1**). The water pipeline, mine access road, and airstrip are located within the mine site LSA. The transmission line extends north from the mine site and beyond the boundary of the mine site LSA. Each study area is mutually exclusive and further defined in **Table 1.3-1** and **Table 1.3-2**.

Wetlands are transitional ecosystems between aquatic and upland systems. Their description therefore requires a multidisciplinary approach for classification and delineation. For the mine site, wetlands share the same study area as the fish and aquatic resources disciplines due to similar hydrological influences. For the linear features, wetlands share the same study area as the terrestrial vegetation discipline due to similar ecosystem composition and habitat values. As such, the most inclusive and comprehensive study area for wetlands is used, which includes both aquatic and vegetation features.



Legend

- Blackwater Gold Project
- City
- Town
- Road
- Stream
- Waterbody
- Provincial Boundary
- International Boundary

Reference
Atlas of Canada scale 1:7,500,000

Scale: 1:9,000,000

0 50 100 200 300 400 500
Kilometres

CLIENT: newgold		
PROJECT: Blackwater Gold Project		
Proposed Project Location		
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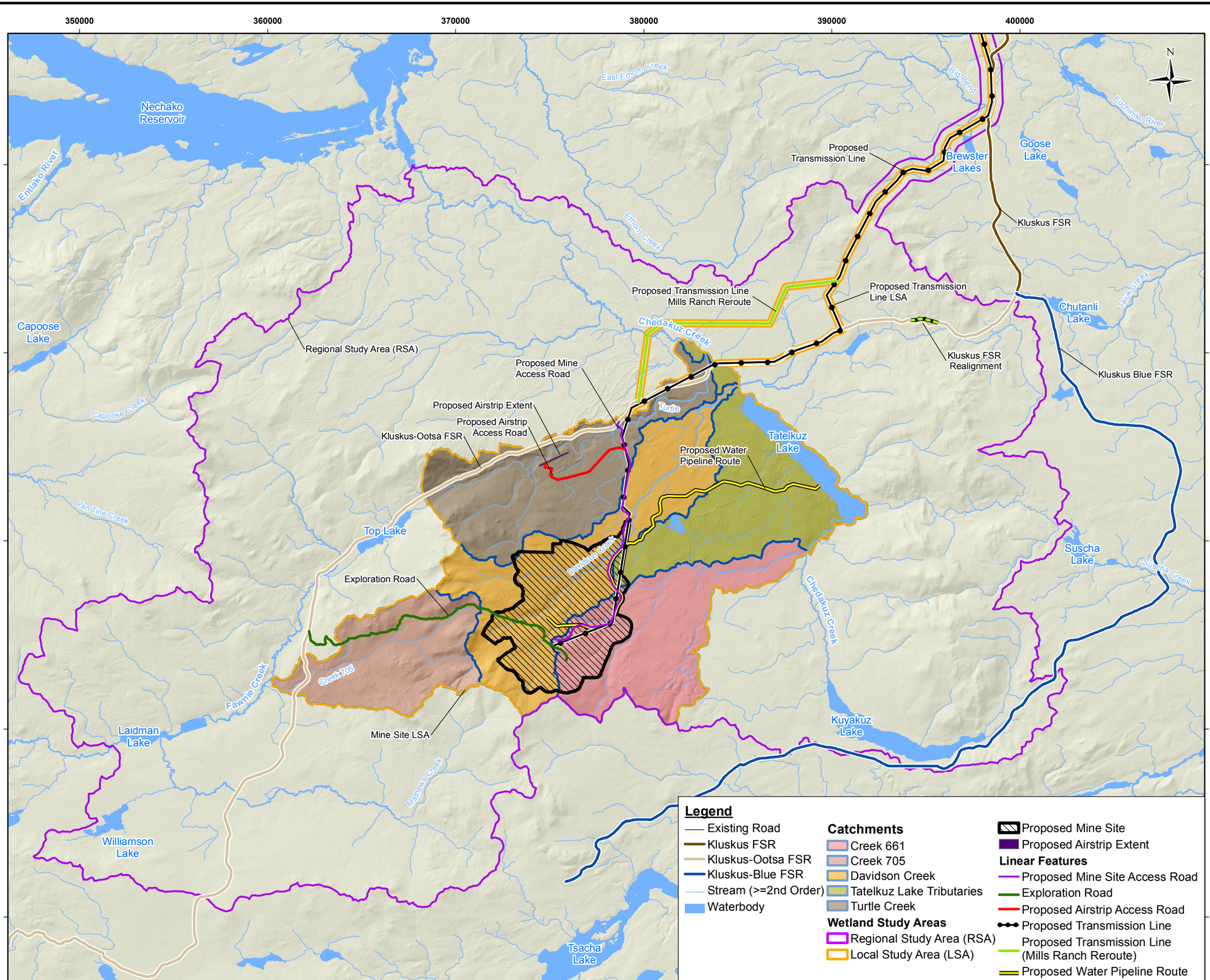

Legend

- Existing Road
- Kluskus FSR
- Kluskus-Ootsa FSR
- Kluskus-Blue FSR
- Stream (>=2nd Order)
- Waterbody

Catchments

- Creek 661
- Creek 705
- Davidson Creek
- Tatelkuz Lake Tributaries
- Turtle Creek

Wetland Study Areas

- Regional Study Area (RSA)
- Local Study Area (LSA)
- Proposed Mine Site
- Proposed Airstrip Extent

Linear Features

- Proposed Mine Site Access Road
- Exploration Road
- Proposed Airstrip Access Road
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Reroute)
- Proposed Water Pipeline Route

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Wetland Study Areas

DATE: September, 2014	ANALYST: KA	**Figure** 1.3-2
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Table 1.3-1: Description of Wetland Local and Regional Study Area Locations

Study Area	Description
LSA	**Mine Site:** Entire watersheds of Davidson Creek, Creek 661, Turtle Creek, and Creek 705. Tributaries flowing in to the south side of Tatelkuz Lake. Chedakuz Creek from confluence with Creek 661 to Tatelkuz Lake. Chedakuz Creek from Tatelkuz Lake to confluence with Turtle Creek. **Linear Features**: Mine access road, water pipeline route, and airstrip do not have an LSA as they are within the mine site LSA. The transmission line LSA coincides with the vegetation discipline (100 m beyond each side of the 140 m transmission line corridor) and applies outside the mine site LSA.
RSA	**Mine Site**: Entire watershed of Chedakuz Creek not included in the LSA. Entire watershed of Laidman Lake not included in the LSA. The mine site RSA also includes 500 m on either side of the 140 m wide transmission line corridor extending north of the LSA watershed boundaries. **Linear Features**: Mine access road, water pipeline route, airstrip, and transmission line are included in the mine site RSA.

Table 1.3-2: Study Area Boundaries

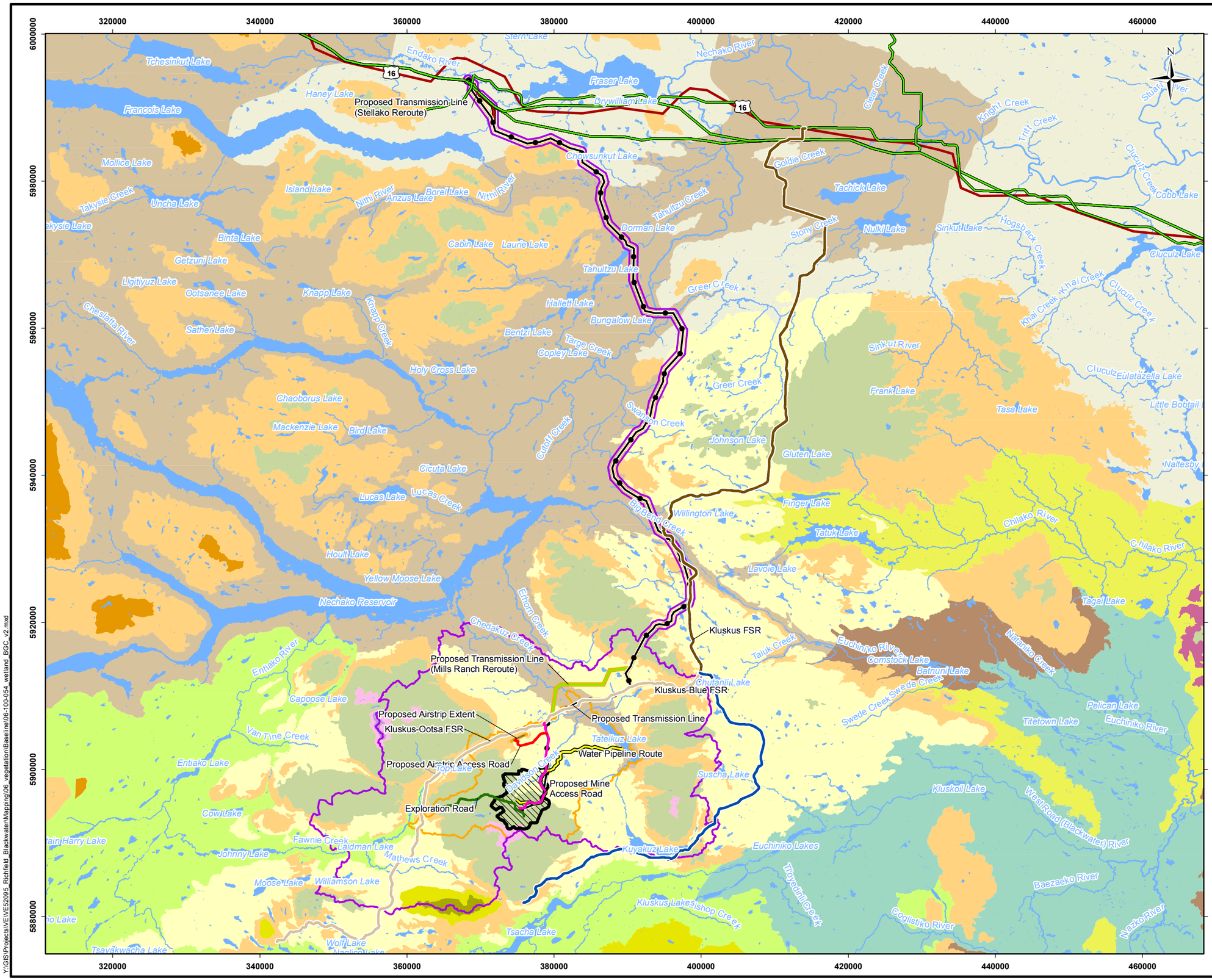
	Study Area Boundaries
Mine Site	LSA RSA (includes 500 m on either side of Transmission Line Corridor)
Linear Features	Transmission Line Corridor (140 m wide), including Mills Ranch and Stellako re-routes Transmission Line LSA (includes 100 m on either side of corridor and applies outside of mine site LSA), including Mills Ranch and Stellako re-routes Mine Access Road Corridor (120 m wide) Water Pipeline Corridor (110 m wide) Airstrip (2km long, 200 m wide) including associated access road (10 m wide)

Wetlands occur in all 14 biogeoclimatic (BGC) zones in BC. Although most BGC zones are geographically specific or elevation dependent, wetland classes are not necessarily specific to particular BGC zones or subzones.

The BGC zones, subzones, and variants (**Figure 1.3-3**) located within the wetland study areas include:

- Boreal Altai Fescue Alpine, Undifferentiated subzone (BAFAun);
- Engelmann Spruce-Subalpine Fir, moist cold subzone (ESSFmc);
- Engelmann Spruce-Subalpine Fir, moist very cold Nechako parkland subzone (ESSFmvp);
- Engelmann Spruce-Subalpine Fir, moist very cold Nechako variant (ESSFmv1);

- Engelmann Spruce-Subalpine Fir, West Chilcotin very dry very cold variant (ESSFxv1);
- Montane Spruce, very dry very cold subzone (MSxv);
- Sub-Boreal Pine Spruce, dry cold subzone (SBPSdc);
- Sub-Boreal Pine Spruce, moist cool subzone (SBPSmk);
- Sub-Boreal Spruce, dry cool subzone (SBSdk);
- Sub-Boreal Spruce, dry warm Blackwater variant (SBSdw2);
- Sub-Boreal Spruce, dry warm Stuart variant (SBSdw3);
- Sub-Boreal Spruce, moist cold Babine variant (SBSmc2);
- Sub-Boreal Spruce, moist cold Kluskus variant (SBSmc3); and
- Sub-Boreal Spruce, moist warm subzone (SBSmw).



Legend

- Existing Transmission Line
- Highway
- Kluskus FSR
- Kluskus-Ootsa FSR
- Kluskus-Blue FSR
- Stream (>= 4th Order)
- Waterbody
- Proposed Mine Site
- Airstrip Extent

Wetland Study Areas

- Regional Study Area (RSA)
- Local Study Area (LSA)

Biogeoclimatic Zones

- BAFAun • Boreal Altai Fescue Alpine Undifferentiated
- ESSFmc • Engelmann Spruce-Subalpine Fir Moist Cold
- ESSFmv 1 • Engelmann Spruce-Subalpine Fir Nechako Moist Very Cold
- ESSFmvp • Engelmann Spruce-Subalpine Fir Moist Very Cold Parkland
- ESSFxv 1 • Engelmann Spruce-Subalpine Fir West Chilcotin Very Dry Very Cold
- MS xv • Montane Spruce Very Dry Very Cold
- SBPSdc • Sub-Boreal Pine Spruce Dry Cold
- SBPSmc • Sub-Boreal Pine Spruce Moist Cold
- SBPSmk • Sub-Boreal Pine Spruce Moist Cool
- SBS dk • Sub-Boreal Spruce Dry Cool
- SBS dw 2 • Sub-Boreal Spruce Blackwater Dry Warm
- SBS dw 3 • Sub-Boreal Spruce Stuart Dry Warm
- SBS mc 2 • Sub-Boreal Spruce Babine Moist Cold
- SBS mc 3 • Sub-Boreal Spruce Kluskus Moist Cold
- SBS mw • Sub-Boreal Spruce Moist Warm

Linear Features

- Proposed Mine Site Access Road
- Proposed Transmission Line
- Proposed Transmission Line (Stellako Reroute)
- Proposed Transmission Line (Mills Ranch Reroute)
- Exploration Road
- Water Supply Pipeline

0 5 10 20
Kilometres

Scale:1:495,000

Note: Comprehensive wetland plots include ecological, biochemical, and habitat data.

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Wetland Study Areas and Associated Biogeoclimatic Zones

DATE:	ANALYST:	**Figure** 1.3-3
September, 2013	AA	
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2.0 METHODS

2.1 Information Sources

Data collection methods (desktop reviews and 2011 to 2013 field sampling) were conducted in accordance with accepted scientific practices and current information. The following information sources were reviewed and methods were adapted, where appropriate, to complete the baseline study:

- Federal Policy on Wetland Conservation (Government of Canada, 1991);
- Canadian Wetland Classification System (National Wetlands Working Group (NWWG), 1998);
- Illustrated Flora of British Columbia. Volumes 1 to 8 (Douglas et. al., 1998a, b; 1999a, b; 2000, 2001);
- Field Guide to the Sedges of the Pacific Northwest (Wilson et al., 2008);
- Ecology of Wetland Ecosystems (BC Ministry of Forests (BC MOF), 2000);
- Wetland Environmental Assessment Guideline (Milko, 1998);
- Wetlands of British Columbia: A Guide to Identification (MacKenzie and Moran, 2004);
- Wetland Ecological Functions Assessment: An Overview of Approaches (Hanson et al., 2008);
- Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in BC (Wetland Stewardship Partnership, 2009);
- Field Manual for Describing Terrestrial Ecosystems (BC MOFR and BC MOE, 2010);
- British Columbia Conservation Data Centre (BC CDC) – provincially listed species and wetland communities at risk (BC CDC, 2012); and
- Official Provincial Plant Species Codes Database: Version 7 (BC MFLNRO, 2012).

2.2 Methods for Wetlands Ecosystem Mapping

Wetland ecosystems were mapped in accordance with Terrestrial Ecosystem Mapping (TEM) protocols (Resource Inventory Committee (RIC), 1998). TEM is the stratification of a landscape into map units according to a combination of ecological features, primarily climate, physiography, surficial material, bedrock geology, soil, and vegetation. The hierarchical approach combines ecosections (Demarchi, 1996), BGC units (zones, subzones, and variants), and ecosystem units. An ecosystem unit combines site series or site associations, site modifiers (denotes site conditions), and structural stages. This is a multi-phase process and includes desktop pre-typing, field sampling, and final mapping, as described below.

- *Pre-typing.* Existing Predictive Ecosystem Mapping (PEM) for portions of the Vanderhoof Forest District (VFD) (Timberline, 2001a, b) was used to prepare the field sampling plan. Overview maps were examined to identify accessible areas for potential field sampling. The potential sampling sites were selected within anticipated BGC and ecosystem units to provide a cross-section of the BGC/ecosystem units, structural stages, and topographic relief present on the landscape within the wetland study areas.
- *Field Sampling.* Potential sampling areas were identified using aerial imagery and wetland data from the Terrain Resource Information Management Program (TRIM) (BC MELP, 1991). Field sampling was conducted to confirm ecosystem unit designations and to collect data for ecosystem descriptions in accordance with provincial standards (RIC, 1998).

  All data collections followed the Field Manual for Describing Terrestrial Ecosystems 2nd Edition (BC MOFR, 2010) by establishing 400 square metre (m^2) plots in areas of relatively uniform vegetation, topography, soils, and hydrology to evaluate the plant community structure, composition, and abundance. Detailed surveys (i.e., plot card FS882) were conducted in representative ecosystems throughout the wetland study areas (BC MOFR, 2010). Site visits (i.e., plot card FS1333 – BC MOFR, 2010) and visual checks (RIC, 1998) were also conducted to confirm the presence of wetland ecosystems. The structure of the plant community was described by estimating the percent cover of each species within various layers (e.g., moss/lichen/seedling, herb, low shrub, tall shrub, sub-canopy, and main canopy).

  Rare plant surveys were conducted in select wetlands throughout the study areas. Prior to the field surveys, a list of potential at-risk plants and ecosystems thought to occur in the study areas was used to guide survey site selections. Specimens were collected where population characteristics allowed and deposited in the University of British Columbia (UBC) herbarium (refer to the Vegetation Baseline Report, Section 2.2.6, (AMEC, 2013) for more information on rare plant survey protocols).
- *Final Mapping*. Finalized mapping varied among study areas based on data availability, field sampling confirmations, and mapping requirements (**Table 2.2-1**). Additional information on vegetation mapping methods is available in the Vegetation Baseline Report, Section 2.2.2 (AMEC, 2013).

Table 2.2-1: Wetland Ecosystem Mapping Methods and Techniques Used by Study Area

Study Area Boundaries	Mapping Methods and Technique
Mine Site	Provincial TEM standards using 3-D imagery. Mapped to the ecosystem site unit level (MacKenzie and Moran, 2004).
Mine Site LSA (includes mine access road, water pipeline, and airstrip with airstrip access road and part of the transmission line).	Provincial TEM standards using 3-D imagery; and available 2-D PEM imagery. Mapped to five wetland classes (Warner and Rubec, 1997).
Mine Site RSA	Terrain Resource Information Management (TRIM) (BC MELP, 1991) data. The RSA boundaries extend along the part of the transmission line for inclusion of Project effects.
Transmission Line LSA	Provincial TEM standards using 2-D imagery, aspect-slope models (Brewer and Marlow, 1993) and PEM/Vegetation Resource Inventory (VRI) data where available. Mapped to the ecosystem site unit level and the five federal wetland classes where practical.

2.3 Methods for Data Collections and Analyses

2.3.1 Wetland Classifications

Field studies were conducted between spring 2011 and fall 2013 in conjunction with TEM mapping efforts to classify wetland ecosystems. Visual checks, site visits, and full plot data were entered into the V-Pro07 software (MacKenzie and Klassen, 2009).

Wetlands were classified in accordance to the site unit classification model (MacKenzie and Moran, 2004) based on the Biogeoclimatic Ecosystem Classification (BEC) (Pojar et al., 1987) and Canadian Wetland Classification System (CWCS) (Warner and Rubec, 1997) systems. Wetland descriptions include floristics, site information (e.g., biotic and abiotic), soil characteristics, and HGM information were applicable.

2.3.2 Wetland Functional Assessments

Wetland functional assessments were conducted within the mine site LSA in conjunction with wetland classification field sampling. Baseline data were collected using both desktop review and field techniques for three primary wetland functions (hydrological, biochemical, and ecological/habitat functions) (**Table 2.3-1**). Although wetlands perform a multitude of functions (Barbier, 2011), the functional components selected and associated protocols for data collections were developed using two EC Wetland Assessment Documents: *Wetland Ecological Functions Assessment*: An Overview of Approaches *(*Hanson et al., 2008) and Wetland Environmental Assessment Guideline (Milko, 1998).

Table 2.3-1: Wetland Functional Assessments Conducted within the Mine Site Study Areas

Wetland Function	Assessment Component
Hydrological	• HGM classification
Biochemical	• Water quality • Nutrients • Organics
Ecological/Habitat	• Size • Shape • Distribution on the landscape • Species richness and diversity • Ecosystems and species at risk • Wildlife habitat potential

Reference wetlands were selected and sampled in an area approximately 13 km NNW of the mine site. This area was selected because it: 1) is located in a similar geomorphic setting as the mine site; 2) has a similar water source and hydrodynamics; 3) is located in a similar biogeoclimatic region and aspect as the mine site; and 4) covers common wetland site associations found in the mine site. These reference sites can be used in future monitoring programs to assess wetland function in the mine site relative to conditions in similar, fully functioning, self-sustaining ecosystems (Brinson and Rheinhardt, 1996, Rheinhardt et al., 1999). Reference sites included 3 bogs, 6 fens, 1 marsh, 1 swamp, and 1 shallow-water class for a total of 12 wetlands. **Annex 6** presents summary data for the reference sites.

2.3.2.1 Hydrological Functional Assessment

The hydrodynamics of wetlands are determined by the characteristics of the main water sources and sinks, and the interaction of these with site topography and wetland substrate (peat, mineral, and vegetation cover). Hydrological function relates to the contribution of the wetland to the flow of surface water and groundwater in the area of interest. The HGM classification system places the wetland in the context of the larger watershed system (Smith et al., 1995, Hanson et al., 2008). HGM also helps evaluate the basic hydrological wetland processes and conditions relative to other wetlands. These hydrological characteristics of wetlands exert a strong influence upon the ecological character, biota and functional performance of wetlands. Generalized information on the functional performance of wetland classes is shown in **Table 2.3-2**.

Table 2.3-2: Wetland Class Hydrological Function Performance Summary

Function	Wetland Class						
	Bog	Fen	Marsh	Discharge Swamp	Riparian Swamp	Shallow-Open Water Basin	Shallow-Open Water Riparian
Water Flow Control	Low	Moderate	Variable	Low	High	High	Low
Ground Water Recharge	Variable	Variable	Variable	Low	Low	Unknown	Unknown
Erosion Protection	Low	Variable	High	Unknown	High	Low	Moderate
	Performance						

Source: Table adapted from Hanson et al. (2008)

HGM is a hierarchical classification described by *systems* and *element groups*. There are six HGM *systems* recognized in regionally in BC (BC MOFR and BC MOE, 2010): upland, palustrine, lacustrine, fluvial, estuary, and marine. These systems describe the influence of major water source(s) and hydrological processes. The *element group* depicts the patterns of waterflow related to the general water sources, hydrodynamics, and connectivity in the landscape. Refer to Tables 2.11 and 2.12 in the Field Manual for Describing Terrestrial Ecosystems (BC MOFR and BC MOE, 2010) for more information on HGM units.

Wetland hydrology may be difficult to determine, as the contribution of seasonal water flows, precipitation and groundwater are not always readily apparent. However, the HGM classification can be used to guide understanding of hydrological mechanisms. Water balance information also adds to hydrological understanding, but only deals with bulk water volume transfers and not with wetland water levels, which may be important to wetland flora and fauna. Future wetland monitoring may involve quantification of water levels in long-term monitoring areas.

2.3.2.2 Biochemical Functional Assessment

The biochemical functional assessment quantifies the water quality status and elemental composition of surface water associated with wetland resources. Surface water samples were collected at selected wetlands following standard water collection guidelines and laboratory protocols as described in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE, 2012b). Surface water grab samples were collected and analyzed for routine physical parameters, major ions, nutrients, total and dissolved metals, and organic carbon (**Table 2.3-3**). During sampling, in-situ field measurements (i.e., pH, conductivity, dissolved oxygen (DO), and temperature) were also measured in different areas throughout the wetlands.

Table 2.3-3: Composite Surface Water Sample Assay Parameters

Physical Tests	Total and Dissolved Metals
pH @ 25°C	Aluminum
Conductivity @ 25°C	Antimony
Total dissolved solids 180°C	Arsenic
Total suspended solids @105°C	Barium
Turbidity	Beryllium
Total hardness as $CaCO_3$	Boron
	Cadmium
Dissolved Anions	Calcium
Total alkalinity as $CaCO_3$	Chromium
Fluoride – dissolved	Cobalt
Sulphate – dissolved	Copper
Chloride – dissolved	Iron
	Lithium
Nutrients	Magnesium
Ammonia – nitrogen	Manganese
Nitrate-nitrogen – dissolved	Mercury
Nitrite-nitrogen – dissolved	Molybdenum
Total Kjeldahl Nitrogen (TKN)	Nickel
Phosphorus-ortho – dissolved-LL	Phosphorus
Phosphorus – total dissolved-LL	Potassium
	Selenium
Organic Parameters	Silicon
Carbon (total organic)	Silver
Carbon (dissolved organic)	Sodium
	Strontium
Cyanide	Thallium
Cyanide, total	Tin
Cyanide, WAD	Titanium
Cyanate	Uranium
Thiocyanate	Vanadium
	Zinc

Note: $CaCO_3$ = calcium carbonate; D = dissolved; °C = degrees Celsius; LL = low level; TKN = Total Kjeldahl Nitrogen

At some sample locations, open water areas were not present. In these cases, a shallow groundwater well was dug by the initial field crew several days in advance of sampling, to allow for stabilization of the water column within the well. In locations where open water was present but not easily accessible, sample bottles were opened and an extension pole was used to collect the water samples. Sample bottles were laboratory sterilized and therefore did not require pre-rinsing. Samples were packed with ice and shipped via ground courier to the AMEC Edmonton assay lab within 24 hours of collection. **Annex 1-1** provides analytical methods and quality assurance and control (QA/QC) associated with the water sampling and analyses.

Potential loss of wetlands in the mine site due to development activities will prevent long-term monitoring of wetlands occurring within the mines site boundaries. As a result, the focus of sampling was to establish potential long term monitoring sites surrounding the final mine site footprint.

Water quality results were compared to the British Columbia Approved Water Quality Guidelines (BC MOE, 2006a, b). The ammonia (NH_3) guideline is based on biologically available un-ionized ammonia, whereas laboratory analysis is based on the ionized form. The proportion of un-ionized ammonia in water varies with pH and temperature; therefore, the BC MOE Water Quality Guidelines are a compendium of working water quality guidelines in BC. A summary of the guidelines is provided in **Annex 1-2A**.

2.3.2.3 Ecological Functional Assessment

The ecological functional assessment quantifies the extent, structure, and complexity of the sampled wetlands. Wetland ecosystems were identified and inventoried as per provincial TEM standards. Once mapped and classified, the area of wetland ecosystems was calculated using ArcMAP 10.0 (ESRI Redlands, CA). Wetland class, area, and distribution were then described and summarized.

The habitat assessments document wetland species and ecosystems at risk, and describe wetland habitat potential (vegetation and wildlife), biological diversity, and productivity. Habitat was described using the following techniques:

- Classified wetland ecosystems were compared against a database of Red- and Blue-listed ecological communities generated by the BC CDC (2012). Listed wetland communities were then revisited to confirm the classification;
- Rare plant surveys were conducted in select wetlands throughout the various study areas;
- Wildlife species potentially occurring in specific wetland habitats (i.e. amphibians, migrating birds, ungulates, etc.) were identified; and
- Biodiversity metrics, such as species richness and Shannon's Diversity Index were calculated using full floristic information for select wetland plots.

A list of potentially occurring wildlife species (e.g., amphibians, birds, mammals, and invertebrates (dragonflies, damselflies and lepidoptera) was developed for each wetland classification. Species selected for initial inclusion were identified as locally dependent on wetlands for a portion of their lifecycle (Stevens, 1995; Delesalle, 1998; and Klinkenberg, 2013). The species list was refined based on the life requisites for each species (BC CDC, 2012) and reviewed to determine the likelihood of wetland use as identified by BGC zone and wetland class (MacKenzie and Moran, 2004). Wildlife survey data (i.e., wildlife detections) and literature research associated with biological productivity and support of biodiversity were used to determine habitat function ratings (Hanson et al., 2008) for each wildlife data collection location.

Wildlife biodiversity attributes were determined by the presence of significant wildlife species, including species at risk, species related to recreation or subsistence, and commercially valued species (Hanson et al., 2008). Commercially valued species were derived from the BC Hunting and Trapping Regulations (BC MFLNRO, 2010). Wildlife analysis includes data from habitat ranking for all comprehensive plots but does not include detection data from 2013 as this data is currently being collected.

Habitat functionality values were developed for specific wildlife species that spend a critical portion of their lifecycle (e.g., breeding, nesting, or foraging) in wetlands (**Table 2.3-4**). Wildlife species ratings were determined by dividing the average number of annual usage events detected (e.g., moose were rated for both winter and fall use) by the number of wildlife species expected to use specific wetland habitat. Overall habitat functional values were ranked into high (1 to 2), moderate (2 to 3), and low (≥3) categories for each wetland.

Table 2.3-4: Selected Wildlife Species and Temporal Wetland Ecosystem Use

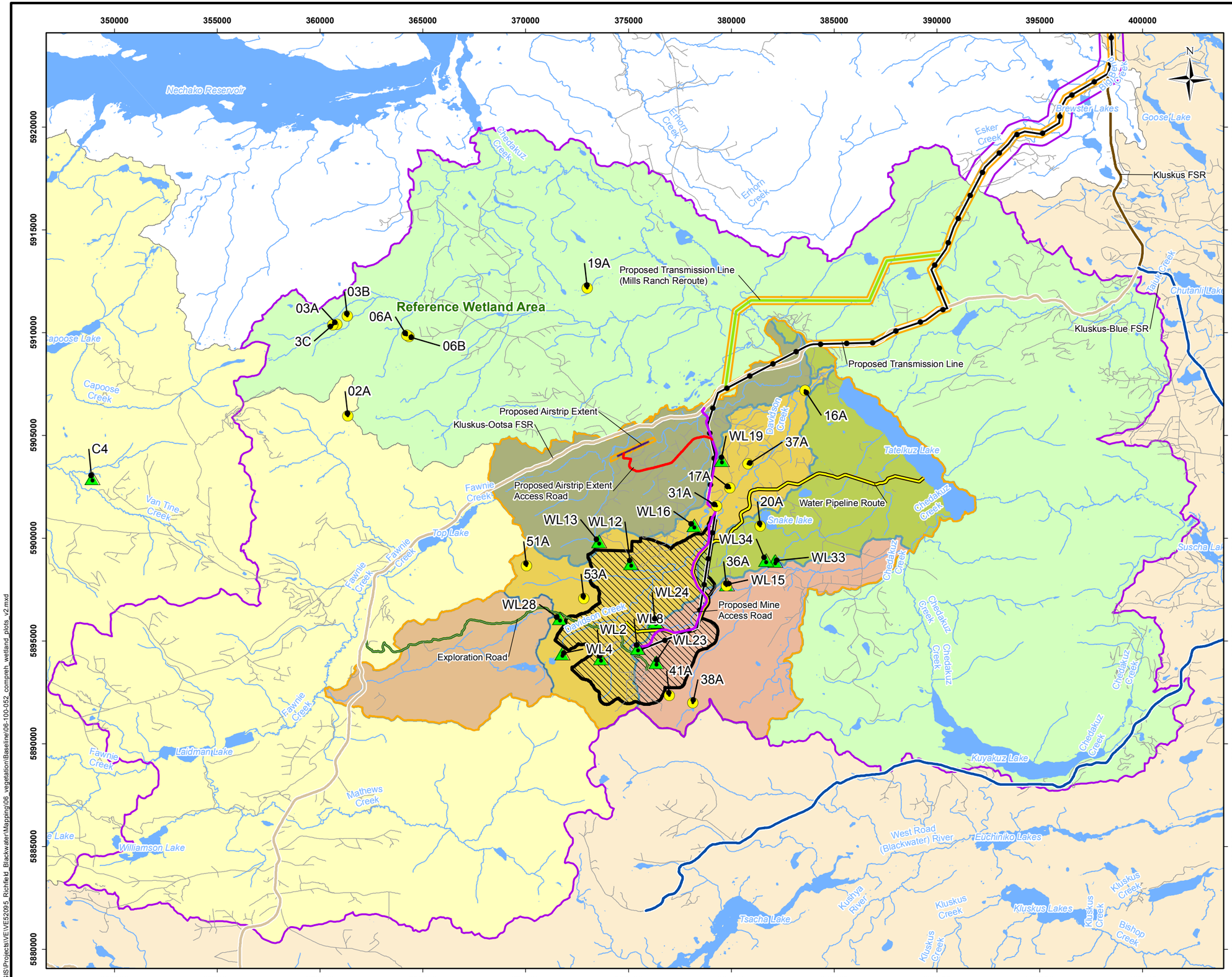
Wildlife Species	Temporal Wetland Ecosystem Use
Grizzly bear	Spring and Summer
Fisher	Winter
Caribou	Summer and Winter
Olive-sided flycatcher	Summer
Common nighthawk	Summer
Western toad	Summer
Bat*	Summer
Moose	Winter and Fall

Note: *Bats ranked for reproduction and denning.

Vegetation biodiversity analyses focused on data collections associated with rare plant surveys and comprehensive wetland data (i.e., with full vegetation, water quality, and wildlife data). Summary statistics including plant species richness and Shannon's Diversity Indices were calculated using PC-ORD v6 (McCune and Mefford, 2011).

2.3.3 Sampling Effort

Field surveys to classify and assess wetland resources were completed July to August 2011, July to September 2012, and July to August 2013. Survey intensity varied based on wetland study area so that biochemical and water quality data was largely collected in and around, as well as upstream and downstream, of the mine site (**Figure 2.3-1**). Other data collection surveys (e.g. TEM, hydrological and ecological/habitat) were completed throughout the wetland study area to meet functional assessment needs (**Figure 2.3-2**). A breakdown of survey plot type is provided in **Table 2.3-5** and **Table 2.3-6**. **Annex 5** provides a summary of wetland plot environmental data.



Note: Comprehensive wetland plots include ecological, biochemical, and habitat data.

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Comprehensive Wetland Plot Locations

DATE: September, 2013	ANALYST: AA	**Figure** 2.3-1
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-100-052_compreh_wetland_plots_v2.pdf
GIS FILE: 06-100-052_compreh_wetland_plots_v2.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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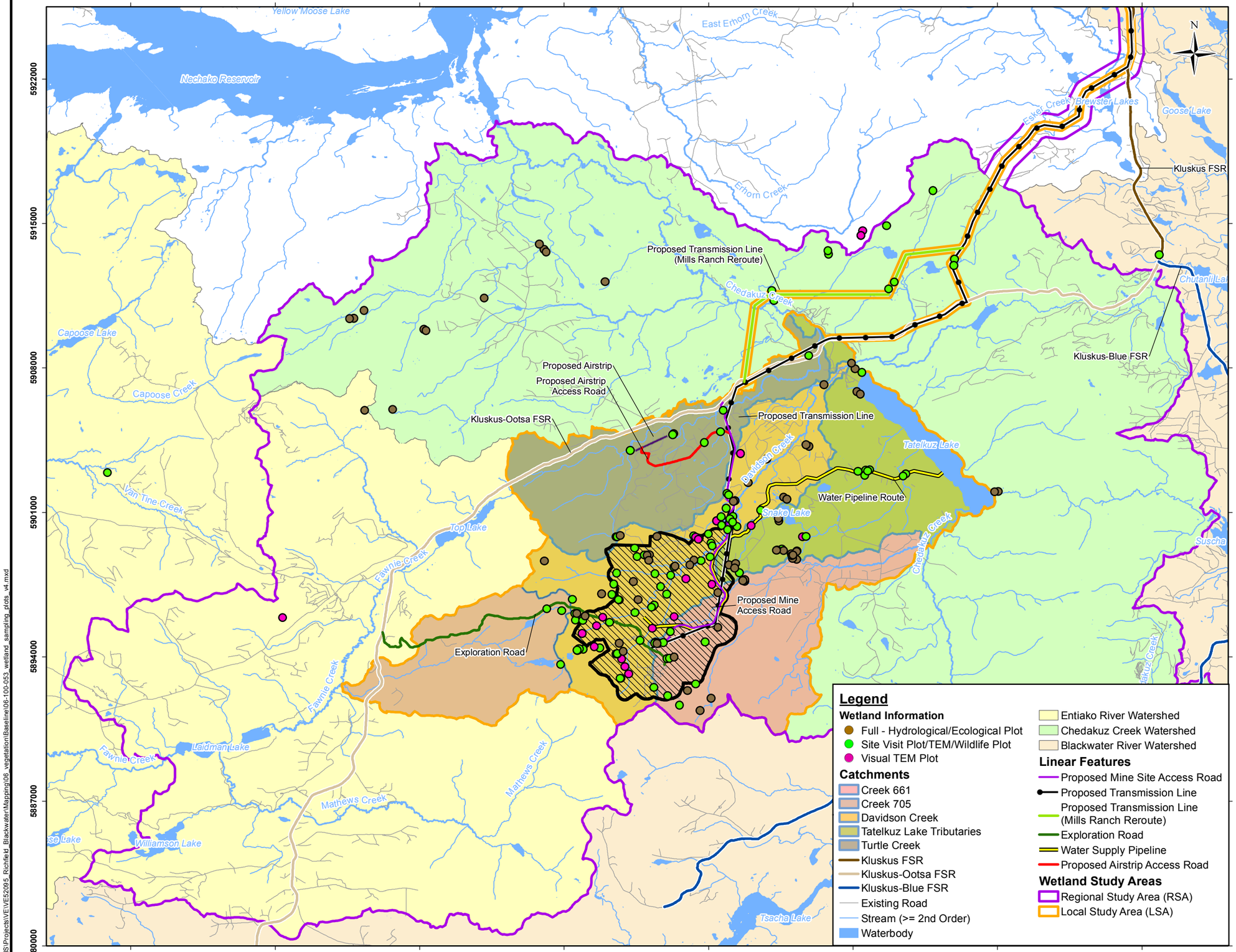


Note: Wetland plots identified are used for ecological and vegetation assessment purposes.

Reference

BC Government GeoBC Data Distribution

Legend

Wetland Information
- Full - Hydrological/Ecological Plot
- Site Visit Plot/TEM/Wildlife Plot
- Visual TEM Plot

Catchments
- Creek 661
- Creek 705
- Davidson Creek
- Tatelkuz Lake Tributaries
- Turtle Creek
- Kluskus FSR
- Kluskus-Ootsa FSR
- Kluskus-Blue FSR
- Existing Road
- Stream (>= 2nd Order)
- Waterbody
- Entiako River Watershed
- Chedakuz Creek Watershed
- Blackwater River Watershed

Linear Features
- Proposed Mine Site Access Road
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Reroute)
- Exploration Road
- Water Supply Pipeline
- Proposed Airstrip Access Road

Wetland Study Areas
- Regional Study Area (RSA)
- Local Study Area (LSA)

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Sampling Plots for Classification and Ecological Assessments

DATE: September, 2014	ANALYST: KA	**Figure 2.3-2**
JOB No: VE52095	QA/QC: MY	PDF FILE: 06-100-053_wetland_sampling_plots_v4.pdf
GIS FILE: 06-100-053_wetland_sampling_plots_v4.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

Y:\GIS\Projects\VE52095_Richfield_BlackwaterMapping\06_vegetationBaseline\06-100-053_wetland_sampling_plots_v4.mxd

Table 2.3-5: Wetland Functional Assessments Field Survey Information

Associated Wetland Function	Data Collections	Associated Baseline Programs	Survey Timeframes	No. of Plots Surveyed			
				2011	2012	2013	Total
Hydrological	HGM classes	Wetlands	Summer	47	83	42	172
Biochemical	Water quality sampling	Wetlands	September	9	4	17	30**
Ecological	Ecosystem (TEM) plots	Vegetation	August	50	76	41	167*
	Wildlife habitat assessment plots and wildlife surveys***	Wildlife	March to August	50	76	42	168
	Rare plant surveys	Vegetation Wetlands	July	14	31	56	101
	Biodiversity surveys	Vegetation Wetlands	July	1	31	73	105

Notes: Ecological assessment surveys were conducted for classification purposes to include 73 full plots (i.e., detailed vegetation plots), 113 site visit plots, and 24 visual inspections for a total of 210 wetland information plots.
**Some water quality locations were revisited over multiple years.
***Wildlife habitat assessments were conducted during the TEM plot data collections.

Table 2.3-6: Wetland Data Collection Locations

Study Area Boundaries	No. of Plots
Mine Site	73
Mine Site LSA	83
Mine Site RSA	23
Transmission Line corridor	6
Transmission Line LSA	4
Mine Access Road	2
Water Pipeline	7
Airstrip	1
Location Breakdown	**No. of Plots**
Mine Site	73
Inside Mine Site RSA	200
Outside Mine Site RSA	10
Linear Features	32

3.0 RESULTS/DISCUSSION

3.1 Mine Site and Associated LSA and RSA

3.2 Study Areas and BEC Unit Coverage

3.2.1 Mine Site and Associated LSA and RSA

The mine site comprises approximately 4,413 hectares (ha). An additional 26,048 ha is associated with the mine site LSA and 117,350 ha are associated with the mine site RSA. Each study area is mutually exclusive (**Table 3.2-1**). The mine site spans three BGC units. Most of the higher elevations are in the ESSFmv1 BGC zone variant (3,113 ha) and lower elevation areas are in the SBSmc3 varient (1,234 ha). The ESSFmvp varient (66 ha) lies above the ESSFmv1 variant (**Figure 1.3-3**).

In the LSA, the tree line and above was represented by a 6 ha area of the BAFAun. The dominant BGC zone variant in the LSA was the SBSmc3 (12,226 ha). Other low elevation units nearby include the SBSmc2, SBSdk, and SBPSmc variants (**Table 3.2-1**).

Table 3.2-1: Approximate Areas of Biogeoclimatic Units in the Mine Site, LSA, and RSA

	Mine Site		LSA		RSA	
BGC Label	**Area (ha)**	**(%)**	**Area (ha)**	**(%)**	**Area (ha)**	**(%)**
BAFAun	-	-	6	<1	194	<1
ESSFmv1	3,113	71	8,937	34	35,324	30
ESSFmvp	66	1	385	1	1,485	1
ESSFxv1	-	-	-	-	909	1
MSxv	-	-	-	-	1,941	2
SBPSmc	-	-	79	<1	3199	3
SBSdk	-	-	2,825	11	12,798	11
SBSdw3	-	-	-	-	2,306	2
SBSmc2	-	-	1,589	6	16,579	14
SBSmc3	1,234	28	12,226	47	42,614	36
Total	**4,413**	**100**	**26,048**	**100**	**117,350**	**100**

NOTE: Areas are determined within a 1% margin of error.

3.2.2 Linear Features

The transmission line corridor comprises approximately 2,074 ha, and the transmission LSA comprises approximately 2,829 ha. The mine access road corridor, water pipeline corridor,

and the airstrip and airstrip access road corridor comprise much smaller areas, and do not have LSAs associated with them because they are situated within the mine site LSA. The BEC units and zone variants for these linear corridors are shown in **Table 3.2-2**. The corridors for the linear features have been subtracted from the mine site LSA and RSA.

Table 3.2-2: Approximate Areas of Biogeoclimatic Units in the Linear Project Components

	Transmission Line				Mine Access Road Corridor		Water Pipeline Corridor		Airstrip and Airstrip Access Road Corridor	
	Corridor		LSA							
BGC Label	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
BAFAun	-	-	-	-	-	-	-	-	-	-
ESSFmv1	65	3	92	3	-	-	-	-	-	-
ESSFmvp	-	-	-	-	-	-	-	-	-	-
ESSFxv1	-	-	-	-	-	-	-	-	-	-
MSxv	-	-	-	-	-	-	-	-	-	-
SBPSmc	-	-	-	-	-	-	-	-	-	-
SBSdk	757	37	1,023	36	-	-	13	9	-	-
SBSdw3	426	21	593	21	-	-	-	-	-	-
SBSmc2	143	7	197	7	-	-	-	-	23	45
SBSmc3	684	33	924	33	103	100	126	91	28	55
Total	**2,074**	**100**	**2,829**	**100**	**103**	**100**	**139**	**100**	**51**	**100**

Note: Areas are determined within a 1% margin of error. The transmission line corridor and LSA includes the re-routes.

3.3 Wetland Functional Assessments

3.3.1 Hydrological Function

HGM classes (**Figure 3.3-1**) were assigned to each site based on a combination of analysis of digital elevation models (distribution of contour lines, depressions and presence of natural stream channels in or adjacent to the site, size of the stream relative to the size of the wetland), and in-situ inspections.

Hydrologic analysis was focused on 157 wetlands in and around the mine site, as well as upslope and downslope of the mine site. A wetland may have had more than one and up to three wetland site associations or vegetation types. Seventy-eight (78) wetland types occur in palustrine, linked basins (63) or linked hollows (15). These wetlands include the largest sites; they often occupied flat areas that were part of historical, small lake or flood plain bottoms, and likely have little ground-water input. In total, 50% of the wetlands classified by HGM unit

were linked basins or hollows. This indicates that wetlands may play an important role in surface water storage, flow moderation, and erosion control in the wetland study area.

A group of 34 wetlands, all with organic soils in most or the entire site, are within palustrine overflow basins. These wetlands rely on groundwater and precipitation (snowmelt) as sources of water. Overflow usually occurs in winter and spring after snowmelt or heavy rains.

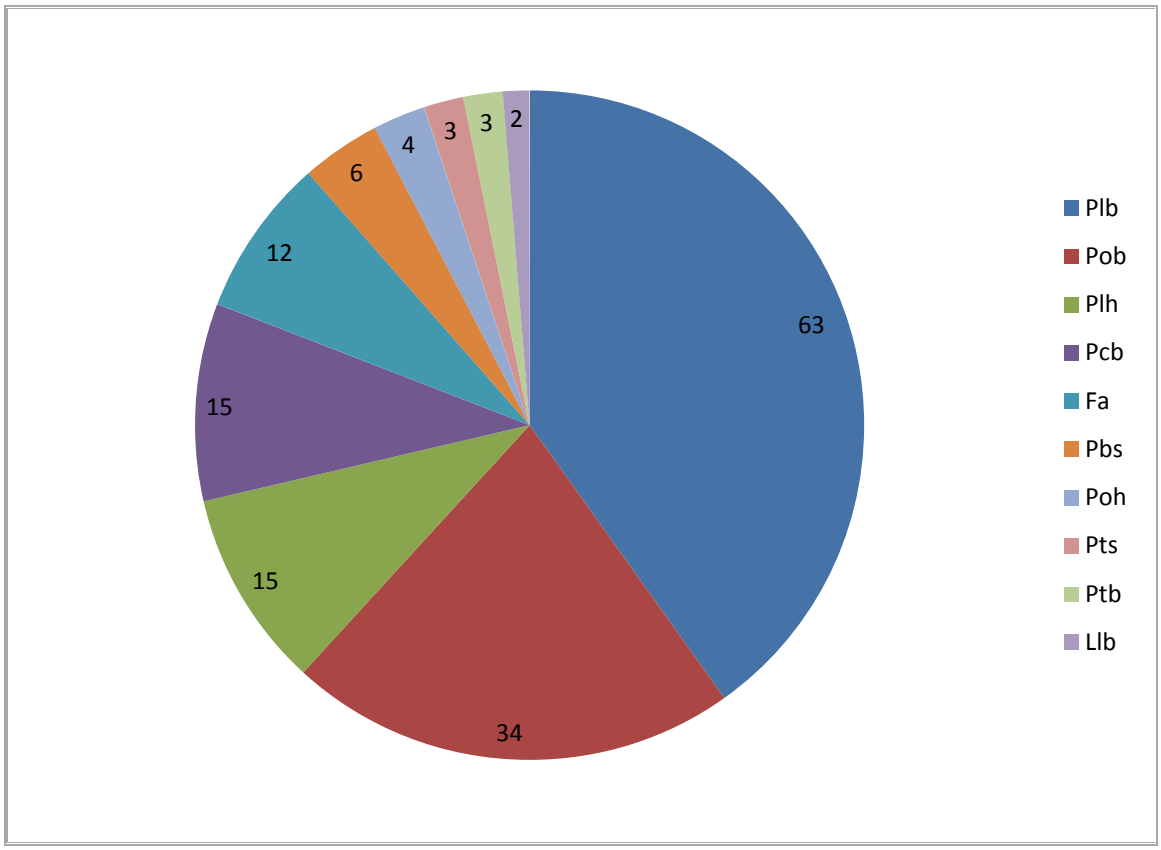
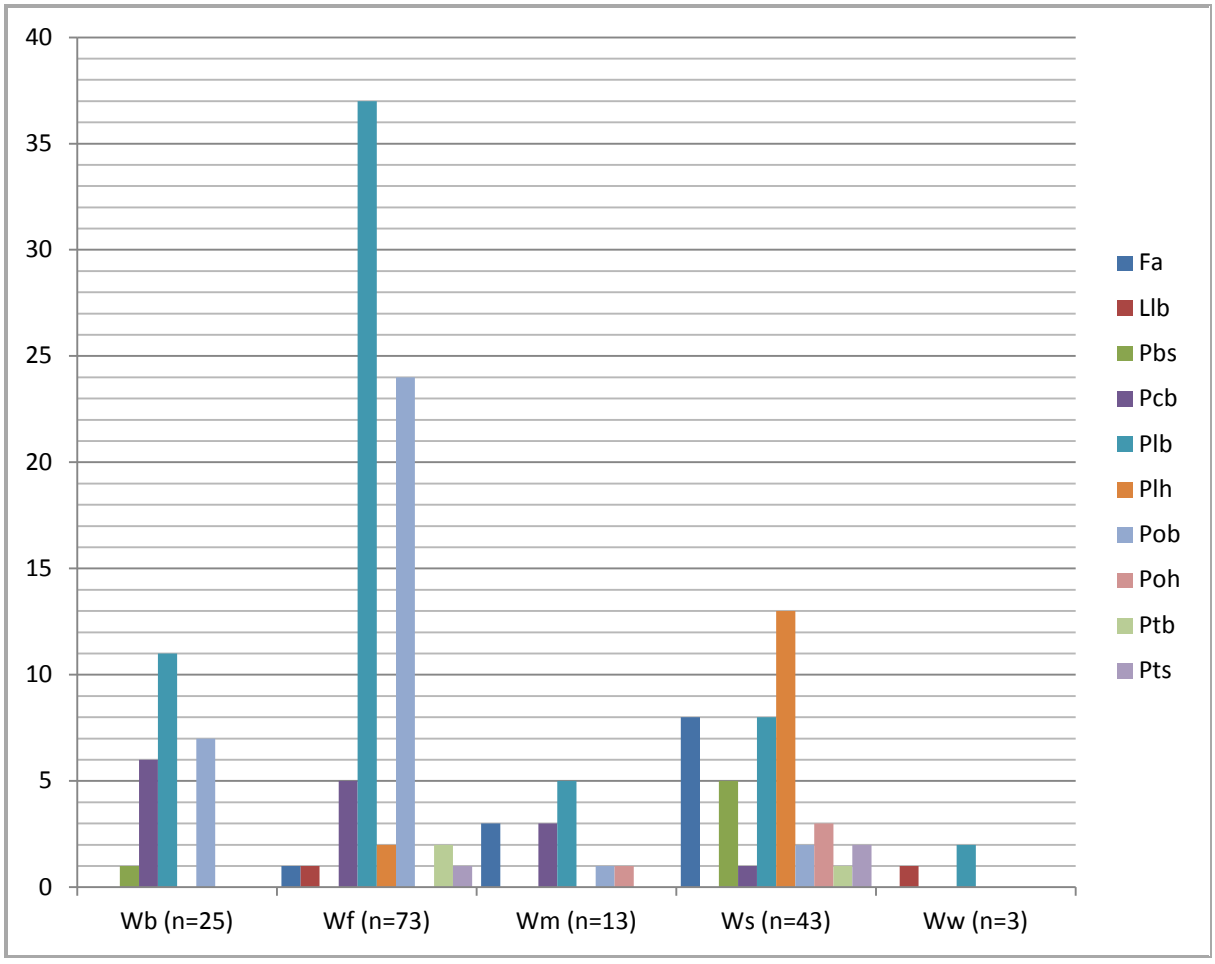


Figure 3.3-1: Distribution of Hydrogeomorphic Classes for 157 Select Wetlands

Note: P = Palustrine, F = Fluvial, lb = linked basin, ob = overflow basin, cb = closed basin, lh = linked hollow, a = alluvial, bs = blanket slope, oh = overflow hollow, tb = terminal basin, ts = toe slope

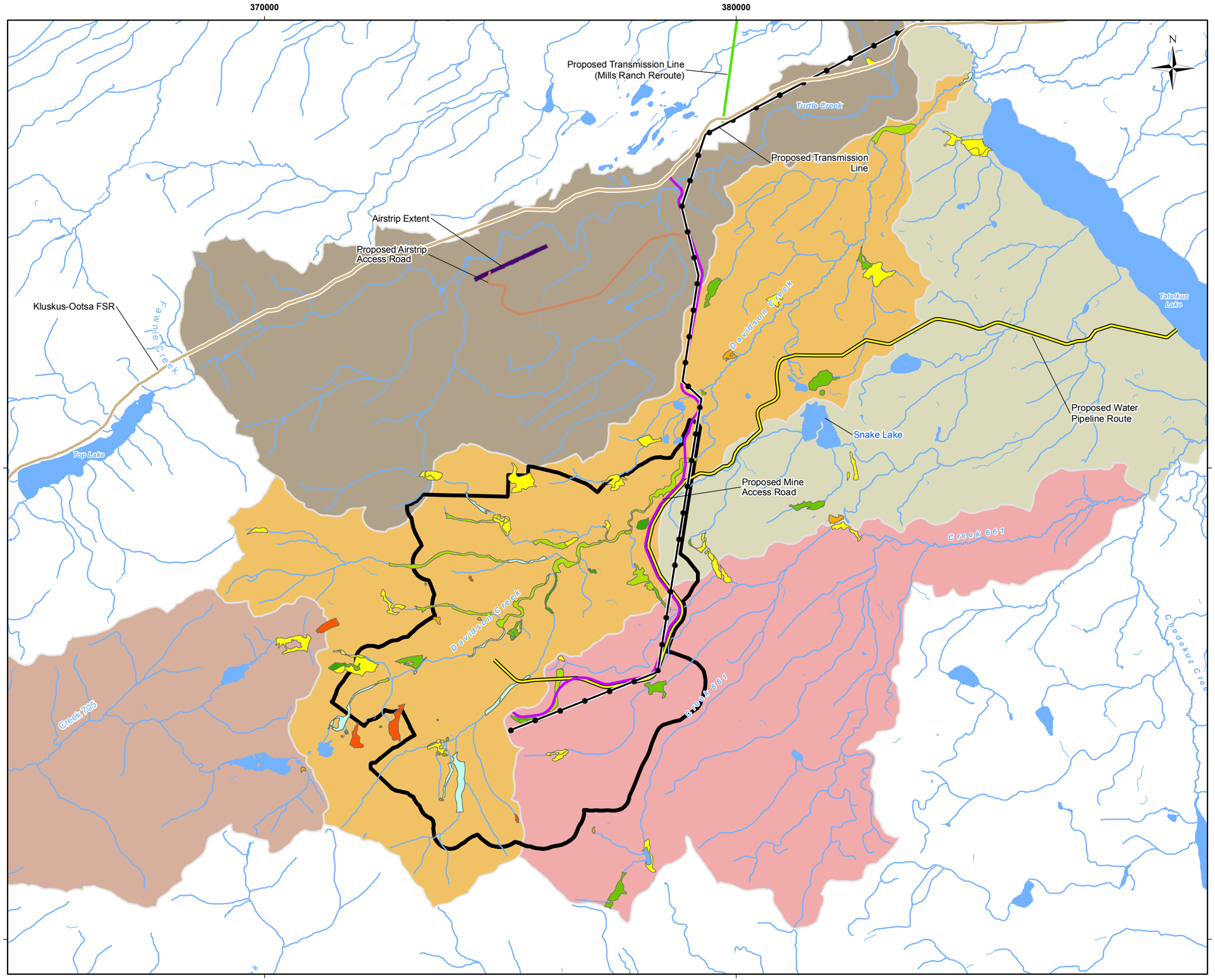
In addition, there were 15 palustrine, closed basin wetlands documented. Closed basin wetlands have no surface water flow (in or out) and depended on inputs such as snowmelt and precipitation to maintain water balance. **Figure 3.3-3** shows the HGM classification of wetlands near the mine site.

The general hydrological functional performance for each wetland class was identified following Hanson et al. (2008) and referenced therein (**Table 2.3-2**). These generalizations were compared to HGM classification data, and used to describe wetland function. **Figure 3.3-2** illustrates the distribution of HGM classes in each wetland class.



Note: P = Palustrine, F = Fluvial, U = Upland, lb = linked basin, ob = overflow basin, cb = closed basin, lh = linked hollow, a = alluvial, bs = blanket slope, oh = overflow hollow, tb = terminal basin, ts = toe slope, Wb = Bog Wetland, Wf = Fen Wetland, Wm = Marsh Wetland, Ws = Swamp Wetland, Ww = Shallow-water.

Figure 3.3-2: Hydrogeomorphic Class Types for Each Wetland Class Sampled



Legend

- Reach Break
- Proposed Mine Access Road
- Kluskus-Ootsa FSR
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch Reroute)
- Proposed Water Pipeline Route
- Proposed Airstrip Access Road
- Stream
- Waterbody
- Proposed Airstrip Extent
- Proposed Mine Site

Catchments

- Creek 661
- Creek 705
- Davidson Creek
- Tatelkuz Lake Tributaries
- Turtle Creek

Wetland Information

Hydrogeomorphic Unit

- Poh
- Pob
- Plh
- Plb
- Pcb
- Pbs
- Fa

Hydrogeomorphic Unit Key

P = Palustrine, F = Fluvial, U = Upland,
lb = linked basin, ob = overflow basin,
cb = closed basin, lh = linked hollow,
a = alluvial, bs = blanket slope,
oh = overflow hollow, tb = terminal basin,
ts = toe slope

Scale:1:80,000

0 1 2 4

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Hydrogeomorphic Classification of Wetlands near the Mine Site

DATE: September, 2013	ANALYST: AA	**Figure** 3.3-3
JOB No: VE52277	QA/QC: BM	PDF FILE: 06-100-079_HGM.pdf
GIS FILE: 06-100-079_HGM.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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Bog hydrological function is typically low to variable because bogs are isolated from surface water inputs as indicated by the high proportion of closed basin bogs in the study area (**Figure 3.3-3**). However, bogs were often in wetland complexes with fens and therefore may contribute to the control of flow during extreme flooding events.

The hydrological functions of fens are moderate to low; however, many of the fens sampled were linked or overflow basins and may provide some mitigation to local flooding as water is intercepted and passes through.

Riparian swamps generally function well for water flow control and erosion protection. Linked hollow and fluvial HGM class swamps (both riparian associated) are common in the mine site area (**Figure 3.3-4**) and may function to slow runoff and store water for extended periods.

Marsh wetlands have a high potential for erosion protection. The hydrological function of marshes is variable for water flow control and groundwater recharge depending greatly on the terrain and vegetation community present. Marshes are often adjacent to shallow-water wetlands, and can be effective for stormwater retention when part of a linked system.

Shallow-water wetlands function well for water storage (Hanson et al., 2008) but have a low to moderate function for water flow control and erosion protection. These wetlands were found as part of linked basins and are important sources of water, especially in the drier summer months.

The sampled wetlands represent a diverse and complex array of hydrological characteristics. Half of the sampled wetlands associated with the mine site study area are overflow or linked headwater wetlands (**Figure 3.3-2**). Headwater wetlands are associated with intermittent and perennial streams at the higher reaches of the watershed and act to intercept and modify runoff and shallow groundwater entering streams and rivers. Headwater wetlands are important for water flow supply to lower reaches of the watershed.

3.3.2 Biochemical Function

3.3.2.1 Water Quality Sample Sites

Water quality samples were collected from 9 wetlands in September 2011 and 14 wetlands in July and September 2012. With the exception of the reference site (wetland C4), wetlands targeted for water quality sampling and analyses were selected based on accessibility and location in the mine site study areas. As a result, data collection in 2011 and 2012 focused on fen wetlands but also captured three bogs, one marsh, and one swamp. Water samples were collected in association with other data collections so that sites could be identified as comprehensive wetland plots. A list of wetland sites sampled for water quality is included in **Annex 5**.

In 2013, a total of 21 wetlands were sampled for analysis of water quality parameters. Four of these sites (WL13, WL16, WL19, and WL28) were sampled in previous years. Seven wetlands, located in a separate watershed from the mine site, were added as reference sites and an additional 10 wetlands were included in the data set based on their proximity to the mine site footprint.

Water quality results were summarized by wetland class, as well as by sample event for purposes of comparison and, in some cases, by individual plots where results are outside of the natural range of variation. In some cases mentioned below anomalous data points were removed from analysis in order to represent average conditions.

3.3.2.2 In-Situ Field Measurements

Field measurements (temperature, pH, percent DO, DO concentration, and conductivity) were collected from all comprehensive plots sampled during the 2011 and September 2012 survey periods. Temperature, percent DO, and DO concentration were not collected at nine of the wetlands sampled during the July 2012 sampling period. In 2013, field parameters were collected from four plots sampled in previous years. Additional in-situ analysis was conducted at 38 other locations. All field data collected are averaged over all sample periods by wetland type and summarized in **Table 3.3-1**.

Table 3.3-1: Summary Statistics for In-Situ Field Measurements by Wetland Type

Sample Period	Wetland		Temperature (°C)	Conductivity (µS/cm)	DO (%)	DO (mg/L)	pH
All Years	Fen	max	22.40	274.75	97.70	11.55	10.49
		mean	10.42	63.33	52.50	5.73	6.73
		min	2.30	10.40	14.20	1.48	5.26
		count	48.00	55.00	39.00	39.00	56.00
	Bog	max	18.97	191.00	110.00	9.33	7.15
		mean	10.68	67.90	57.88	5.84	6.30
		min	3.16	14.00	6.10	0.69	5.50
		count	15.00	17.00	9.00	9.00	17.00
	Swamp	max	14.94	166.00	51.50	6.41	8.65
		mean	9.36	82.69	37.60	3.61	6.67
		min	3.83	44.55	19.60	1.48	5.36
		count	8.00	8.00	5.00	5.00	7.00
	Marsh	max	15.40	169.00	92.10	9.97	7.61
		mean	11.90	102.04	56.30	6.13	6.84
		min	5.74	46.00	38.00	3.98	5.63
		count	8.00	9.00	3.00	3.00	9.00
	All Sites	max	22.40	274.75	110.00	11.55	10.49
		mean	10.69	68.94	52.58	5.66	6.71
		min	2.30	10.40	6.10	0.69	5.26
		count	68.00	76.00	48.00	48.00	76.00

The complete set of in-situ field measurements is provided in **Annex 3-1**. In addition, summary statistics for all in-situ data based on wetland type is included in **Annex 3-2.**

Temperature

Water temperatures for the sampled wetlands varied widely among locations over all sampling periods. In September 2011, the temperature range was 2.30°C to 6.51°C with an average of 3.80°C. In July 2012, the average temperature was 16.05°C with a range of 14.55°C to 18.97°C, compared to September 2012 when the average temperature was 10.16°C and ranged from 5.74°C to 17.06°C. During the sampling event completed in July 2013, field temperature ranged from 5.20°C to 22.40°C and averaged 11.63°C.

Variations in temperature did not correlate to the types of wetlands sampled. Lower temperatures were found to occur when samples were collected from flowing water sources. When all four data sets are considered as a whole, fen wetlands account for the highest and lowest temperature readings, likely due to the larger number of samples collected from this wetland class. Overall, swamps had the lowest average temperature and marshes had the highest temperature.

pH

Over all sample periods, pH ranged widely. In 2011, field pH measurements indicated alkaline conditions in all but one wetland (W19 was slightly acidic at pH 6.11). In both sampling periods for 2012, acidic to neutral measurements were recorded (pH ranged from 5.50 to 7.15 in July and 5.26 to 7.03 in September). The marsh sampled in 2012 was found to be of neutral pH, while the bogs and swamp sampled trended towards being more acidic. The larger set of fens that were sampled ranged from neutral to acidic (5.26 to 7.03). In 2013, pH ranged from 5.39 to 7.61 in all wetlands sampled. Although a swamp wetlands accounted for the lowest pH overall in 2013 (5.39), bogs were the lowest pH on average, at 6.30. Marsh wetlands were the highest pH on average, at 6.78. When all years are considered as a complete dataset, fens account for the highest and lowest pH readings (10.5 and 5.3, respectively), while bogs are the lowest pH on average (6.3) and marshes are the highest (6.8).

Dissolved Oxygen

Although DO percent saturation was moderate to moderately high in 2011 and low to moderately high in 2012 and 2013, measurements reflected local conditions where the samples were taken. A link between depth of water and flowing versus stagnant water and DO was not observed. Percent saturation ranged from 6.1% to 110% over all sampling events and averaged 52.6%.

When all four data sets are combined, the highest and lowest DO percent saturation readings were collected from bog wetlands. Bogs also accounted for the highest percent saturation on average over all years. However, when DO is considered as a concentration

(mg/L) over all sample periods, fens account for the highest measurement (11.6 mg/L) and bogs for the lowest (0.7 mg/L). When the data are averaged, marsh wetlands have the highest DO concentrations overall (6.1 mg/L) and swamps have the lowest (3.6 mg/L).

Conductivity

Conductivity measurements were collected as an indirect measure of the major ion concentrations, although fine sediments being disturbed during sample collection can often affect field analysis of conductivity. The range of conductivities from all wetlands, measured in microSiemens per centimetre (µS/cm) are as follows:

- September 2011: 21 to 150 µS/cm;
- July 2012: 26 to 117 µS/cm;
- September 2012: 20 to 170 µS/cm; and
- July 2013: 10 to 275 µS/cm.

Moderate conductivity values are between 150 µS/cm and 170 µS/cm. Wetland type was not found to correlate to variations in conductivity. When the entire dataset is considered as a whole, fens account for the lowest and highest conductivity readings (10 µS/cm and 275 µS/cm, respectively) as well as the lowest on average at 63 µS/cm. Marsh wetlands were found to have the highest average conductivity over all years at 102 µS/cm.

3.3.2.3 Lab Analyses

Laboratory results of routine indicators (pH, hardness, total dissolved solids, etc), major ions, nutrients, total and dissolved metals, and all other analytical parameters are provided in **Annex 3-3**.

pH

As a primary indicator of water quality that directly effects the composition of biota in an ecosystem, analysis of pH was conducted through laboratory testing during all four sampling events. Values ranged from 4.29 to 7.92 over the course of the study. pH data were averaged for each wetland over all sampling periods and are presented in **Figure 3.3-4**.

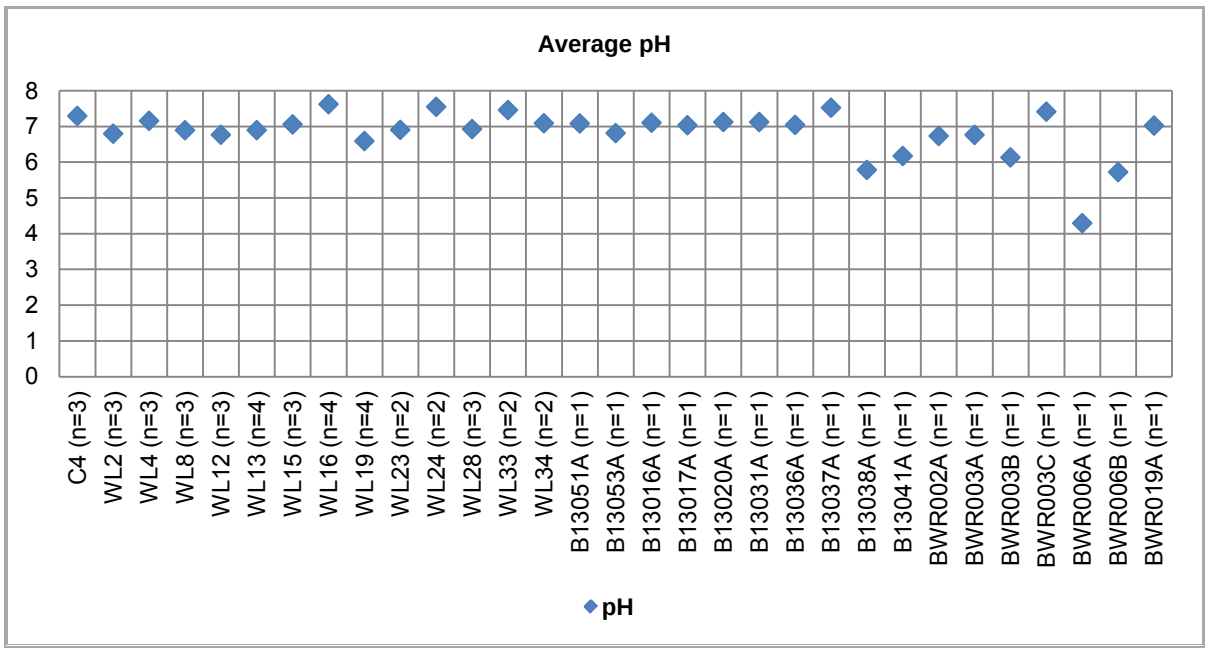


Figure 3.3-4: Average Wetland pH

In 2011, laboratory pH results ranged from 5.95 to 7.64. Wetlands WL2 (pH 5.95) and WL19 (pH 6.25) were below the 30-day minimum described in the BC protection of freshwater aquatic life guidelines (BC MOE 2006a, 2006b, 2008, 2009, and 2012), which specify an acceptable pH range of 6.5 to 9.0.

In 2012, laboratory analysis of pH ranged from 6.12 to 7.92. Although all wetland pH measurements collected in July 2012 fell within the acceptable range specified in the BC protection of freshwater aquatic life guidelines, the September monitoring event indicated two wetlands that failed to meet the guideline (WL15 at pH 6.12 and WL23 at pH 6.41).

The laboratory measured pH range for 2013 was 4.29 to 7.52, and several wetlands were above guidelines laid out in the BC protection of freshwater aquatic life document as follows:

- Wetland WL19, 6.46;
- Wetland B13038A, 5.78;
- Wetland B13041A, 6.17;
- Wetland BWR003B, 6.13;
- Wetland BWR006A, 4.29; and
- Wetland BWR006B, 5.72.

Note that five of these sites (all but WL19) were added to the study in 2013 and that three of them (the BWR sites) are included as reference wetlands.

The pH identified during in-situ sampling indicates a more alkaline environment with a range of 5.26 to 10.49, compared to the laboratory results with a range of 4.29 to 7.92. When pH data for all wetlands are averaged over all sample periods the results indicate a neutral to slightly acidic environment at 6.71 (field measurements) and 6.93 (lab results). **Table 3.3-2** compares laboratory pH results averaged by wetland types to corresponding reference sites for all sample periods.

Table 3.3-2: Average pH by Wetland Type

Wetland Type	Average pH	n
Fen	6.94	41
Fen - Reference	6.85	6
Bog	6.89	9
Bog - Reference	6.85	3
Swamp	6.98	3
Swamp - Reference	4.29	1
Marsh	7.29	4
Marsh - Reference	-	-
All Types	6.91	67

Conductivity

Conductivity is a measure of the ionic content of a sample and is an important indicator of aquatic contamination, although there is no conductivity limits specified in the BC protection of freshwater aquatic life guidelines (BC MOE 2006a, 2006b, 2008, 2009, and 2012). Laboratory conductivity results were generally similar to field measurements for all sampling periods with a range of 13 µS/cm to 252 µS/cm overall (compared to a range of 10 µS/cm to 275 µS/cm for in-situ measurements). Conductivity data for each wetland site have been averaged over all sampling periods and presented as **Figure 3.3-5**.

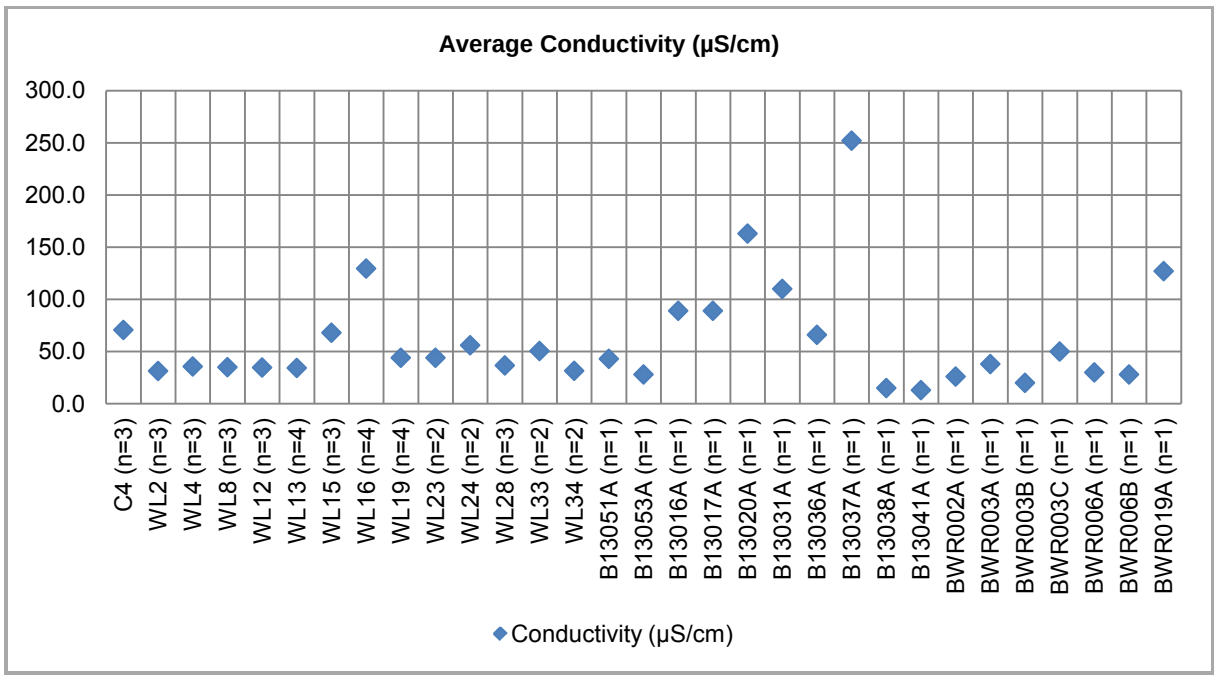


Figure 3.3-5: Average Conductivity

In 2011, laboratory conductivity values ranged from 19.0 µS/cm to 167 µS/cm, with the highest measurement coinciding with an elevated total dissolved solids (TDS) value of 144 mg/L at wetland WL16. Conductivity ranged from 28 µS/cm to 145 µS/cm in 2012. Wetland WL16 had the highest conductivity results in both July (112 µS/cm) and September (145 µS/cm), although these values did not correlate to elevated TSS and TDS measurements as was the case in 2011. Elevated conductivity readings were not recorded at other monitored wetlands in 2012.

A higher rate of variability was found for 2013, with a range of 13 µS/cm to 252 µS/cm. Wetland WL16 was found to have a conductivity of 94 µS/cm and, although higher than the 2013 average conductivity of 57.2 µS/cm, was not the highest. Wetland B103037A, one of the wetlands added to the program for 2013, was the highest at 252 µS/cm. Other wetlands with elevated conductivity were B13020A at 163 µS/cm and WR019A, a reference wetland, at 127 µS/cm.

Solids, Total Suspended, and Total Dissolved

Total suspended and total dissolved solids were sampled to establish baseline conditions in relation to nutrient and organic material transport in wetland ecosystems. Overall total suspended solids ranged from <2 to 626 mg/L in 2011, <2 to 84 mg/L in 2012 and <2 to 4010 mg/L in 2013. The high TSS values were recorded when water samples could not be collected without sediments being disturbing and becoming entrained in the sample. Turbidity values were consistent with TSS values. Total dissolved solids ranged from <2 to

192 mg/L over all years, with an average of 59.1 mg/L. **Figure 3.3-6** shows TDS values for each wetland averaged over all sample events.

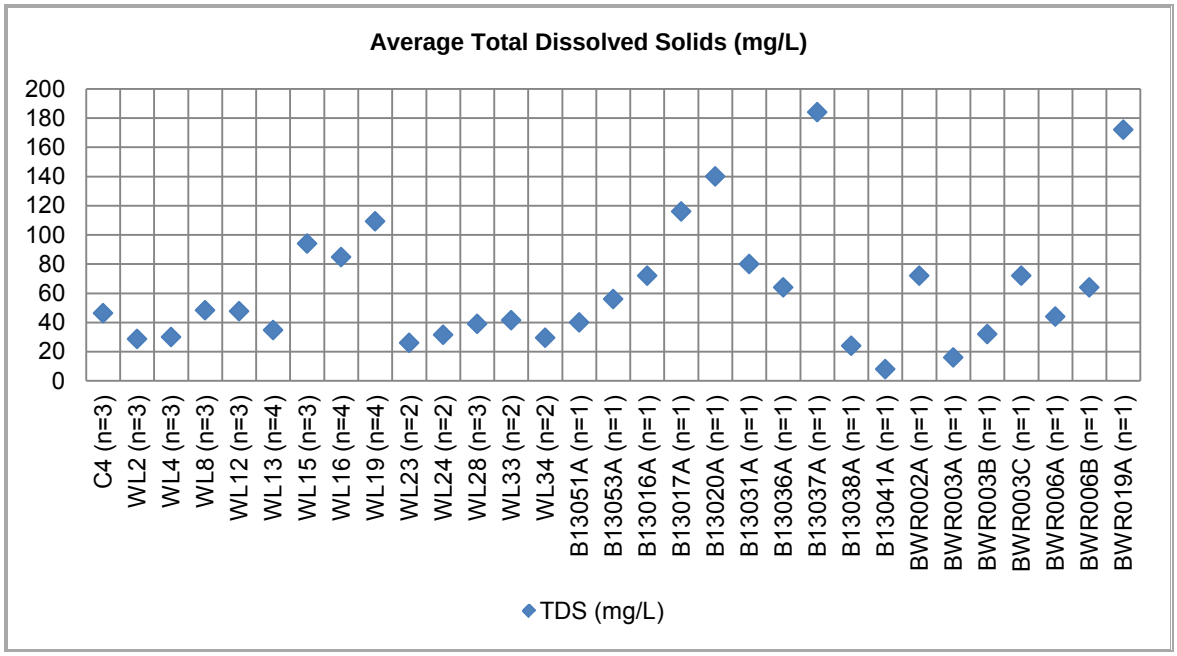


Figure 3.3-6: Average Total Dissolved Solids

Elevated TDS values were recorded at WL16 and WL19 in 2011 (144 and 148 mg/L respectively), WL15 in 2012 (192 mg/L) and B13020A, B13037A and WR019A in 2013 (140, 184 and 172 mg/L, respectively). With the exception of WL15 in 2012 these TDS values correspond to elevated TSS and turbidity measurements, indicating that the higher TDS results are due to dissolved major ions being introduced to the water column as a result of elevated TSS. **Table 3.3-3** compares TDS values by wetland type to corresponding reference wetlands. Data from all sampling periods was averaged by wetland type.

Table 3.3-3: Average Total Dissolved Solids Concentrations by Wetland Type

Wetland Type	Average TDS	n
Fen	60.48	40
Fen - Reference	48.50	6
Bog	70.78	9
Bog - Reference	92.00	3
Swamp	90.00	3
Swamp - Reference	44.00	1
Marsh	60.75	4
Marsh - Reference	-	-
All Types	62.42	67

Dissolved Anions and Organic Carbon

Dissolved anion analysis was conducted for total alkalinity as well as fluoride, sulphate and chloride. The BC guidelines for the protection of aquatic life define maximum acceptable concentrations for dissolved fluoride (0.4 to 1.33 mg/L, hardness dependent), sulphate (115 to 270 mg/L, hardness dependent) and chloride (150 mg/L). None of these guidelines were exceeded in the results obtained during any sampling event.

Organic carbon, both dissolved and total, were measured and found to be moderately elevated when compared to stream samples, which are often <2 mg/L. This is expected, however, since the samples were from wetlands. For all sample events, the data ranged from 3.5 to 88.7 mg/L for total organic carbon (TOC) and 3.5 to 76.3 mg/L for dissolved organic carbon (DOC). Although the highest TOC reading (88.7 mg/L) was recorded in a fen, the highest DOC measurement (76.3 mg/L) occurred in a swamp/fen complex. The lowest readings (3.5 mg/L for both TOC and DOC) were collected in a bog. When the data were average by ecosystem type, the average TOC and DOC values were found at their highest levels in swamp ecosystems (34.2 and 32.1 mg/L, respectively). Interestingly, bog ecosystems had the second highest TOC and DOC readings when all data were average by ecosystem type at 23.7 mg/L TOC and 22.0 mg/L DOC. The overall average values for fen ecosystems were 19.2 mg/L TOC and 16.8 mg/L DOC. Marsh ecosystems accounted for the lowest average values at 9.1 mg/L TOC and 8.8 mg/L DOC.

Nutrients

Nutrients are an indicator of wetland productivity and, as such, have been identified as an important indicator of valued ecosystem components for long term monitoring. Laboratory analysis was conducted for total phosphorous and ortho phosphorous, as well as for nitrogen species (ammonia, nitrate, nitrite, and total Kjeldahl nitrogen). Analytical results averaged by wetland site over all sample periods can be found in **Figure 3.3-7** for phosphorous parameters and **Figure 3.3-8** for nitrogen species.

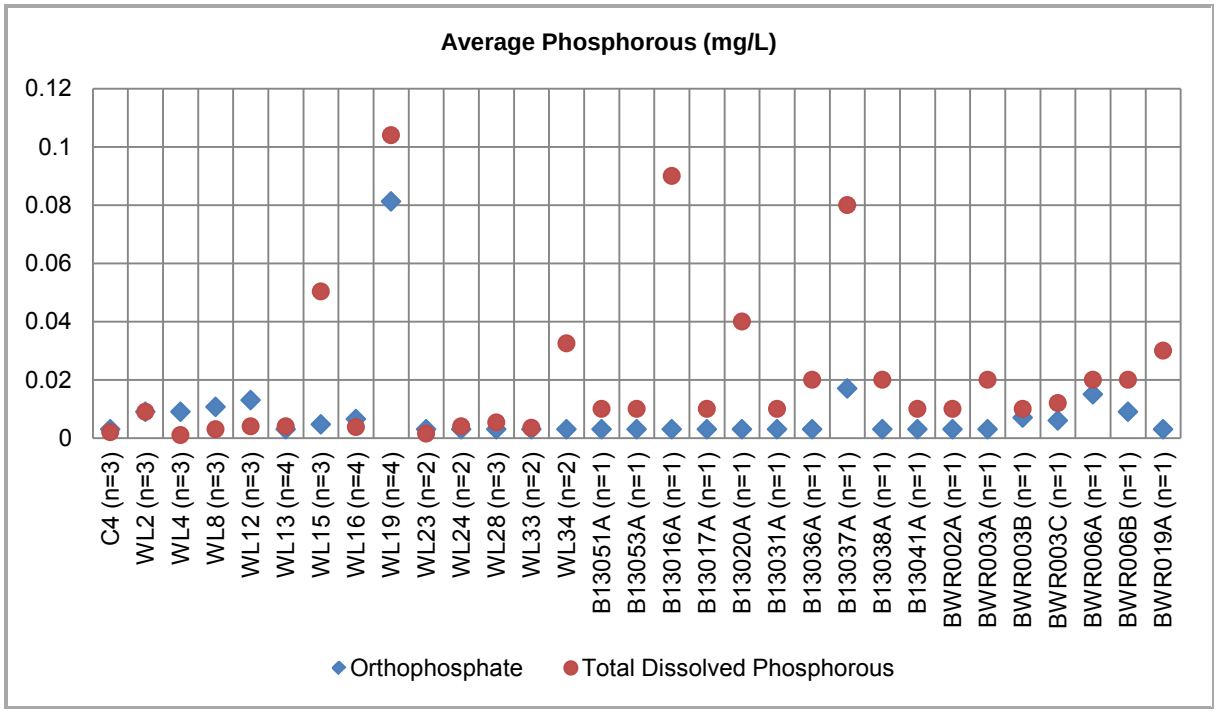


Figure 3.3-7: Average Phosphorous

Phosphorus was found at generally low concentrations through all monitoring events, with the exception of the fen wetland WL19. Total dissolved phosphorous ranged from 0.001 to 0.032 mg/L and averaged 0.007 mg/L in 2011 when fen WL19 is removed due to its exceptionally high result of 0.221 mg/L. This elevated phosphorous concentration was likely the result of sediment entrained within the sample, as it corresponded to elevated results for TSS, TDS and turbidity which were not seen in other samples.

This was the case for July 2012 as well, when WL19 again accounted for the highest total phosphorous reading at 0.159 mg/L. When this anomalous reading is removed from the dataset the range of total phosphorous in 2012 is from <0.001 mg/L (below detection) to 0.065 mg/L and the average is 0.015 mg/L. WL19 did not have elevated phosphorous results in both later sample events. For 2013, the range for total phosphorous was from below detection (<0.01 mg/L), to 0.09 mg/L and had an average of 0.022 mg/L. Elevated results for WL19 have been kept in the averages used in **Figure 3.3-7** for descriptive purposes, but were removed from the data used in **Table 3.3-4**, which compares total phosphorous values averaged by wetland type over all sampling events to corresponding reference wetlands.

Table 3.3-4: Average Total Dissolved Phosphorous and Orthophosphate Concentrations by Wetland Type

Wetland Type	Average Total Phosphorous	Average Orthophosphate	n
Fen	0.014	0.006	39
Fen - Reference	0.009	0.004	6
Bog	0.049	0.038	9
Bog - Reference	0.017	0.005	3
Swamp	0.070	0.003	3
Swamp - Reference	0.020	0.015	1
Marsh	0.010	0.003	4
Marsh - Reference	-	-	-
All Types	0.021	0.010	65

Ortho phosphorous, or orthophosphate, is the biologically available component of total phosphorous and can often be the limiting nutrient for plant growth in aquatic ecosystems. WL19 had abnormally high results in 2011 and July 2012, which corresponds with elevated results for TSS, TDS, and turbidity. These anomalous data points were removed for statistical analysis.

Average orthophosphate in 2011 was 0.0165 mg/L and ranged from below detection (<0.003 mg/L) to 0.033 mg/L. In 2012, orthophosphate results were below detection for all but wetland W19, which had a concentration of 0.159 mg/L during the July sampling event. Orthophosphate had an average concentration of 0.005 mg/L in 2013, and was below detection limits for all but five sites. One of these locations was wetland B13037A, at 0.017 mg/L. All of the other sites that had results for orthophosphate were reference wetlands: BWR003B, BWR003C, BWR006A, and BWR006B (at 0.007, 0.006, 0.015, and 0.009 mg/L, respectively).

With the exception of total Kjeldahl nitrogen (TKN), all nitrogen parameters were regularly below laboratory detection limits. None of the BC protection of aquatic life guidelines for nitrogen species were exceeded at any time. **Figure 3.3-8** describes all nitrogen species averaged by wetland site over all sample periods. **Table 3.3-5** compares values averaged by wetland type over all sampling events to reference wetlands for ammonia, nitrate, nitrite, and TKN.

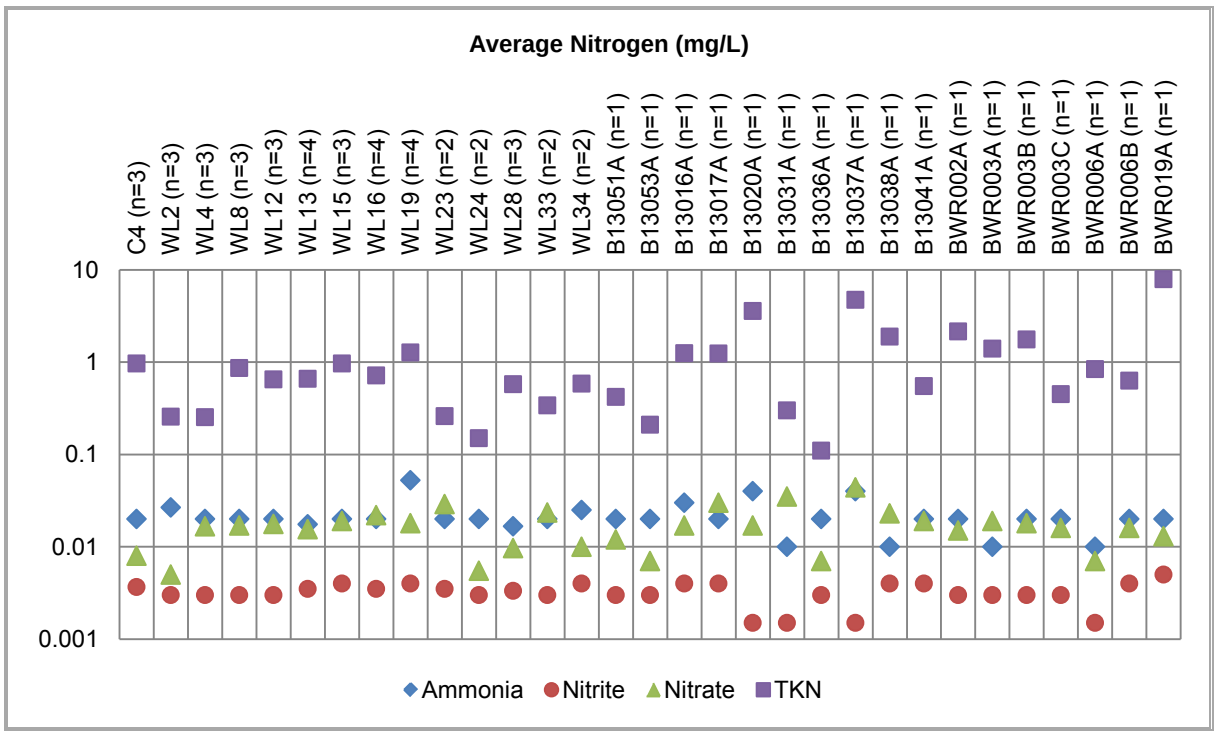


Figure 3.3-8: Average Nitrogen

Table 3.3-5: Average Ammonia, Nitrate, Nitrite, and TKN Concentrations by Wetland Type

Wetland Type	Average Ammonia	Average Nitrate	Average Nitrite	Average TKN	n
Fen	0.024	0.017	0.003	0.850	41
Fen - Reference	0.018	0.012	0.004	1.180	6
Bog	0.033	0.016	0.004	0.830	9
Bog - Reference	0.020	0.016	0.004	3.370	3
Swamp	0.023	0.023	0.004	0.880	3
Swamp - Reference	0.010	0.007	0.002	0.840	1
Marsh	0.020	0.012	0.003	0.410	4
Marsh - Reference	-	-	-	-	-
All Types	0.024	0.016	0.003	0.963	67

Metals

The extent of metal concentrations in wetlands can be used as an indicator of both contamination from anthropogenic activities and of a wetland's ability to remove and store elemental compounds. Thus, extensive analysis was conducted for total and dissolved metals during all sample periods. Results indicated that the BC protection of freshwater aquatic life guidelines were exceeded for certain species of both total and dissolved metals in all four sample events. A full list elemental analytes, along with specific guideline

exceedances, is included in **Appendix B-2**. **Table 3.3-6** summarizes the number of sites that exceeded the BC protection of freshwater aquatic life guidelines for each sample event.

Table 3.3-6: Number of BC Protection of Freshwater Aquatic Life Guidelines Exceeded for Total and Dissolved Metals

Element		Number of Exceedances			
		September 2011 N = 9	**July 2012 N = 14**	**September 2012 N = 14**	**July 2013 N = 21**
Total Metals	Arsenic	-	-	-	2
	Barium	-	-	-	1
	Cadmium	7	-	-	13
	Chromium	-	-	1	1
	Cobalt	-	-	-	2
	Copper	-	-	-	5
	Iron	1	-	2	6
	Manganese	-	-	-	4
	Mercury	-	-	-	2
	silver	-	-	-	1
	zinc	-	1	1	4
Dissolved Metals	Aluminum	6	9	8	10
	iron	-	1	3	4

The number of total metals that were exceeded according to the BC FWG increased in the 2013 sample event compared to previous years. The increase in the number of exceedances is likely due to the larger number of wetlands that were sampled in 2013. For instance, total cadmium exceeded guidelines in 6 of the 9 samples collected in 2011. In 2013, the guideline for total cadmium was exceeded in 13 of 21 samples. Although there were more actual exceedances for total cadmium reported for 2013, it is a similar percentage overall when compared to 2011.

The wider range of exceedances may also be due in part to the increase in exploration in the area since the September 2012 sample event. Disturbance due to drilling, land clearing and road activity has the potential to introduce dust and soils containing the elements in question to surface water. It is also worth noting that older metal concentration data is not available for many of the wetlands included in the 2013 study as only 4 of the 21 wetlands sampled had been included in previous water quality assessments.

The metal species that consistently exceeded guidelines were total cadmium, iron (both total and dissolved), total zinc, and dissolved aluminum. Zinc and aluminum (and to a lesser extent, cadmium) are typically found in surface waters as a result of weathering processes on local rocks and soils. Iron concentrations in surface waters are often related to

contributions from groundwater sources. These elements were also found in surface waters included in the baseline water quality study, particularly dissolved aluminum, which was found to exceed the BC FWG in several of the samples collected.

There was no notable difference in BC FWG metal exceedances between comprehensive plots and reference wetlands. For total iron, reference wetland C4 was the one site that produced a BC FWG exceedance in 2011, and one of two wetlands that exceeded in September 2012 (the other was WL15, which also accounted for the exceedance of total chromium). C4 was the only exceedance of dissolved iron in July 2012 and was one of three wetlands that exceeded for dissolved iron in September 2012 (the others were WL15 and WL23). Both total zinc exceedances in 2012 were associated with wetland WL23. In 2013, reference wetlands accounted for three of the six total iron exceedances and three of the four exceedances for dissolved iron (reference wetlands BWR003B and BWR006B exceeded in both cases). Reference wetlands accounted for four of the ten exceedances for dissolved aluminum in 2013, which was the one element that consistently exceeded BC FWG over all sampling events.

3.3.3 Ecological/Habitat Functions

3.3.3.1 Size and Distribution of Wetlands

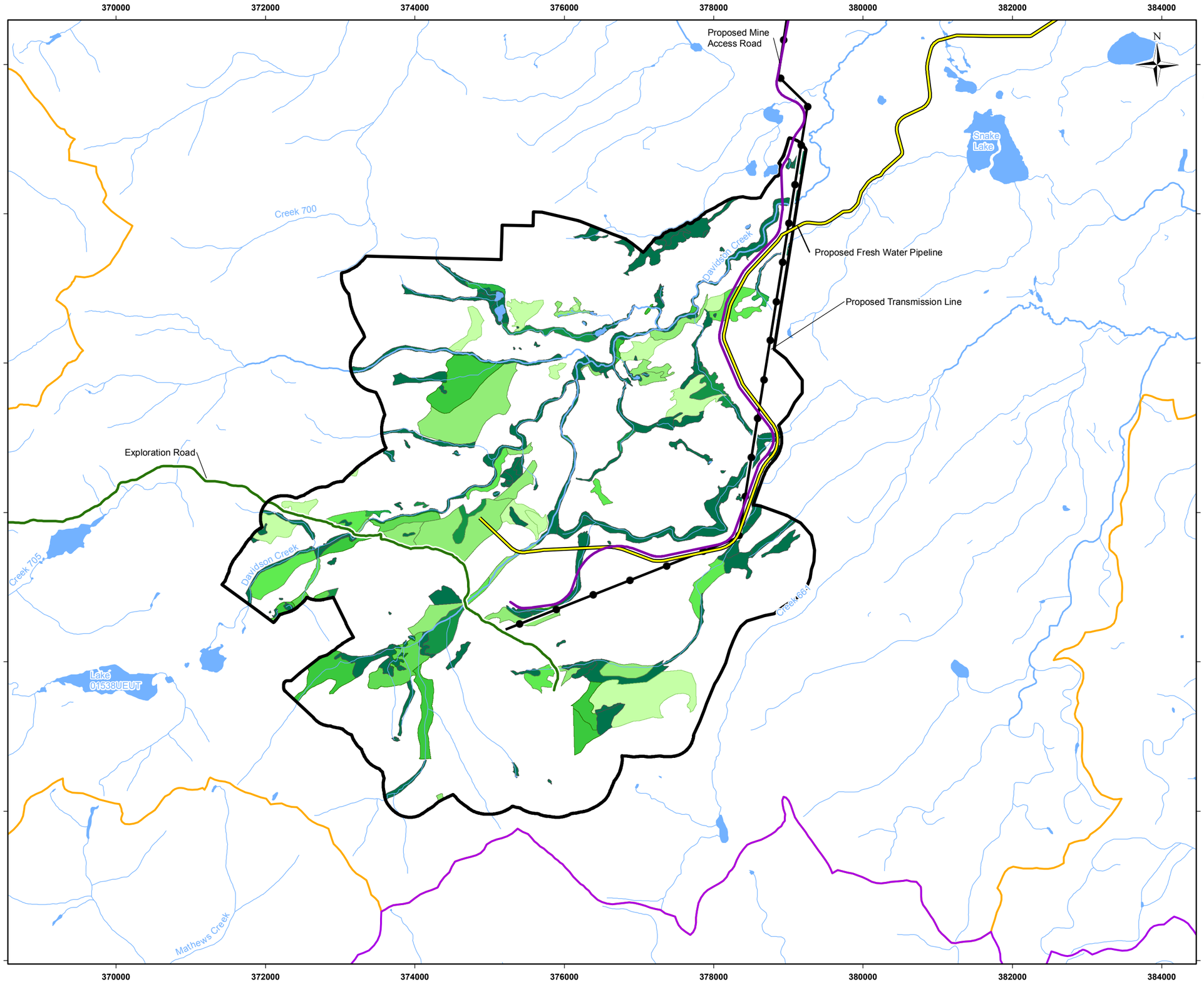
Wetlands occur in all BGC zone varients identified in the study area with the exception of the BAFAun and ESSFmvp (**Figure 1.3-3**). Wetland resources are found throughout the mine site (**Figure 3.3-11**), LSA (**Figure 3.3-10**), and RSA (**Figure 3.3-9**). The mine site LSA is composed of five drainage catchments and covers the main outflow from the mine site; mainly the Davidson Creek catchment (**Figure 1.3-2**). The mine site LSA occupies approximately 26,048 ha exclusive of the mine site, which covers 4,413 ha. The mine site RSA covers an expansive area (117,350 ha) and encompasses much of the Entiako River and Chedakuz Creek watersheds (**Figure 3.3-9**; **Figure 3.3-12**).

Wetlands in the mine site LSA and RSA are diverse and strongly connected with the upland environment as complexes of wetland plant associations transition into upland vegetation. Wetlands occurring in the ESSF zone are primarily headwater wetlands. Headwater wetlands are associated with intermittent and perennial streams at the higher reaches of the watershed and act to intercept and modify runoff and shallow groundwater entering streams and rivers. Headwater wetlands are usually small and bowl shaped. In the SBS zone, the terrain is more rolling and wetlands tend to occur in lower basin areas. Lower basin wetlands can occupy larger flood prone valley bottoms and often have more open water areas.

The most common wetlands in the mine site are swamps (Ws, 9.5%) and bogs (Wb, 2.3%). Marshes (Wm) and shallow-water (Ww) communities are the least common wetland type in the mine site (0.1% and 0.3% respectively); while fens cover 0.9% of the mine site (**Table 3.3-7**, **Figure 3.3-12**). TEM mapping indicates approximately 575 ha (13% by area) of the mine site is covered by wetland ecosystems.

The area covered by each wetland site association in the mine site varied greatly with Ws08 (Swamp Wetland – Bl – Horsetail – Glow moss) and Ws07 (Swamp Wetland – Spruce – Horsetail) covering the greatest area (274 ha and 122 ha respectively). The next most common wetlands in the mine site are Wb08 (Blackspruce – Soft-leaved sedge – Peat-moss bogs, 47 ha), Wb05 (Blackspruce – Water sedge – Peat-moss bogs, 37 ha), and Ws04 (Drummond's willow – Beaked sedge) communities covering a combined area of 109 ha. **Table 3.3-8** presents the areas of wetland site associations in the mine site. **Figure 3.3-13** depicts the TEM mapped wetland site associations in the mine site and in the mine site LSA in poster format. For descriptions of the wetland site associations encountered refer to **Annex 2**.

Approximately 3,122 ha of wetland ecosystems were mapped within the LSA and 5,846 ha have been identified within the RSA. The area and percent of the wetland classes found in the mine site, LSA, and RSA are summarized in **Table 3.3-7**.



Legend

- Stream
- Waterbody

Project Components

- Exploration Road
- Proposed Transmission Line
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Mine Site

Wetland Study Areas

- Regional Study Area
- Local Study Area

Percent Wetland in TEM Mapped Polygon

- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

0 0.5 1 2

Kilometres

Scale:1:50,000

Note

Wetlands shown may contain multipl ecosystems.
Wetland areas were determined using Terrain Resource Information Management Program (TRIM) data for the RSA and Terrestrial Ecosystem Mapping (TEM) for the LSA / Proposed Mine Site.

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Wetlands within Mine Site

DATE:	ANALYST:	**Figure** 3.3-9
May, 2014	AA	
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-016_wetland_ecosystem_footprint_v4.pdf
GIS FILE: 06-200-016_wetland_ecosystem_footprint_v4.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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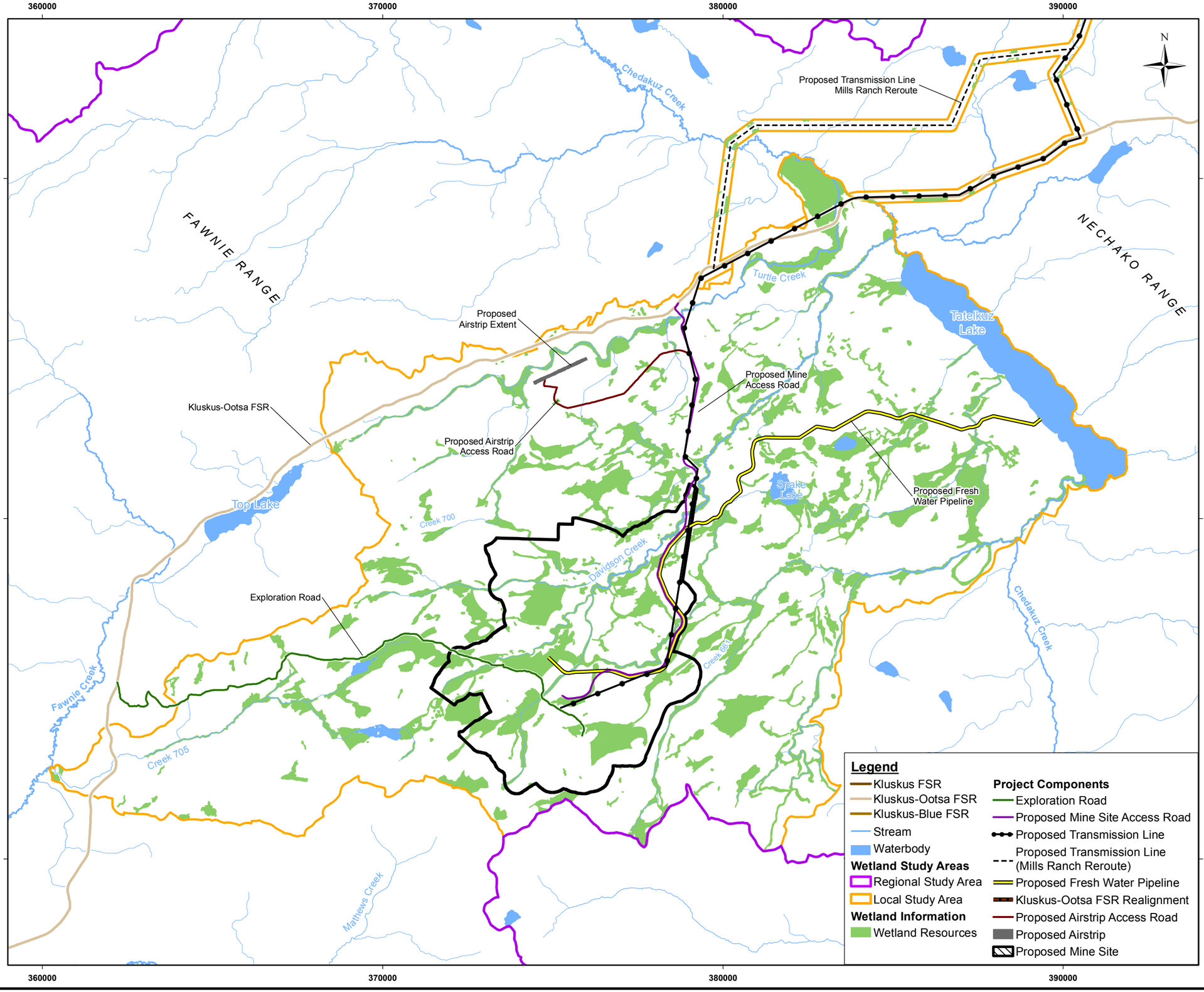

Note
Wetland areas were determined using Terrain Resource Information Management Program (TRIM) data for the RSA and Terrestrial Ecosystem Mapping (TEM) for the LSA / Proposed Mine Site.

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Wetlands within Mine Site Local Study Area

DATE: September, 2014	ANALYST: KA	**Figure** 3.3-10
JOB No: VE52420	QA/QC: JG	PDF FILE: 06-200-038_wetland_ecosystem_LSA.pdf
GIS FILE: 06-200-038_wetland_ecosystem_LSA.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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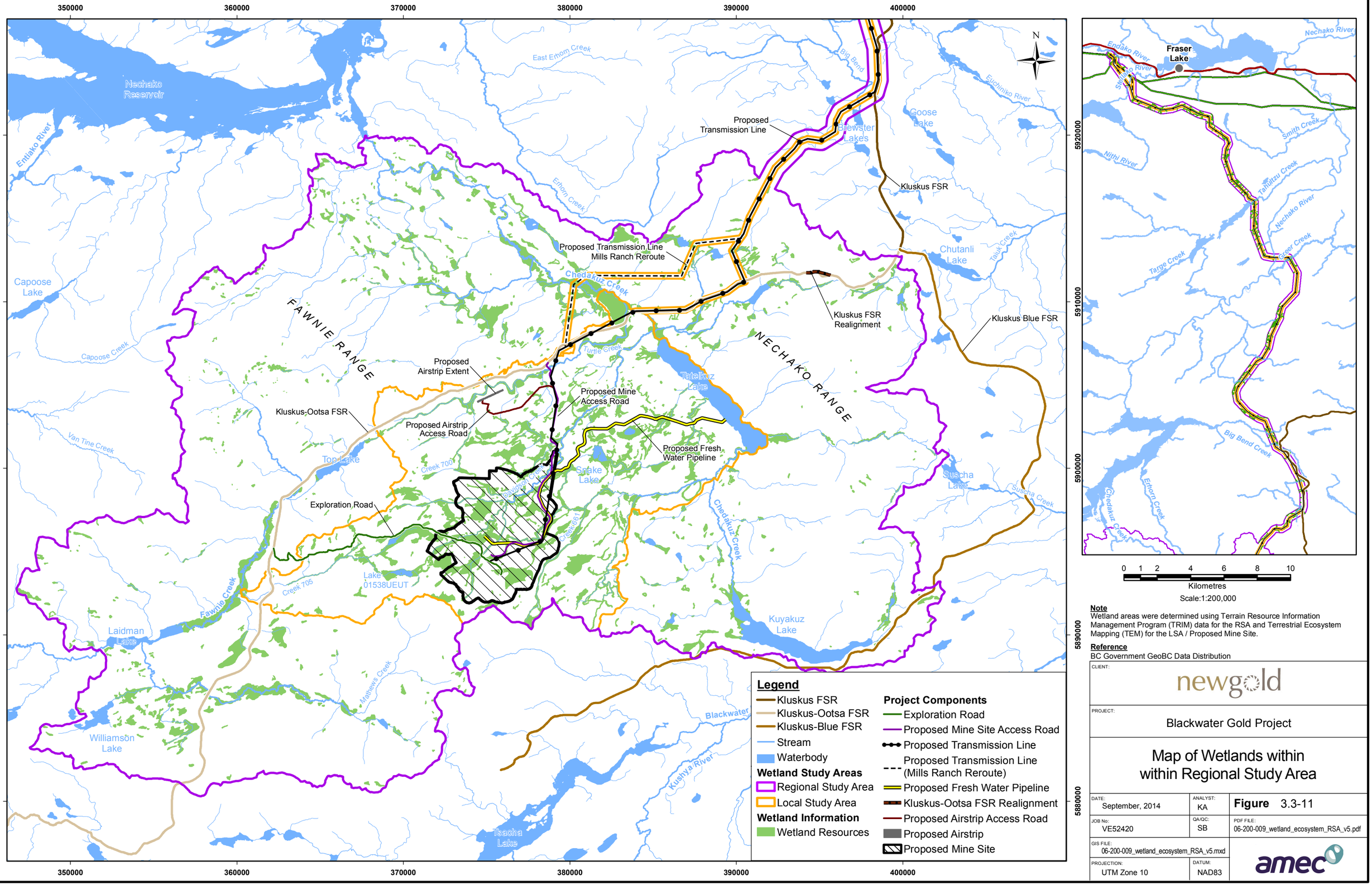

Note
Wetland areas were determined using Terrain Resource Information Management Program (TRIM) data for the RSA and Terrestrial Ecosystem Mapping (TEM) for the LSA / Proposed Mine Site.

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Wetlands within within Regional Study Area

DATE: September, 2014	ANALYST: KA	**Figure** 3.3-11
JOB No: VE52420	QA/QC: SB	PDF FILE: 06-200-009_wetland_ecosystem_RSA_v5.pdf
GIS FILE: 06-200-009_wetland_ecosystem_RSA_v5.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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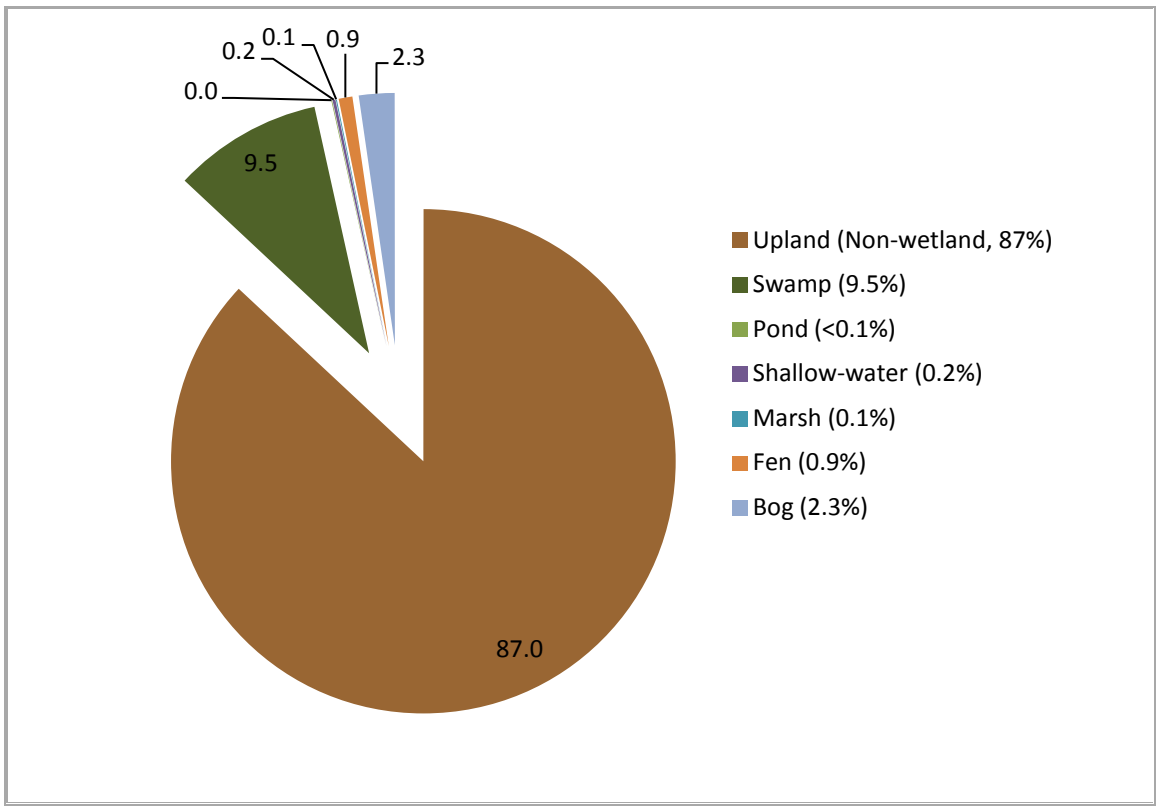
Table 3.3-7: Area of Wetland Classes

BGC Zone Variant	Wetland Class	Code	Mine Site		LSA		RSA***	
			(ha)*	(%)**	(ha)*	(%)**	(ha)*	(%)**
SBSdk	Bog	Wb	-	-	165.83	*0.63*	-	
	Fen	Wf	-	-	130.85	*0.50*	-	
	Marsh	Wm	-	-	0.81	*<0.01*	-	
	Swamp	Ws	-	-	168.93	*0.65*	-	
	Shallow-water	Ww	-	-	-	-	-	
	TRIM/TEM Wetland	WL	-	-	-	-	1,545.44	*1.32*
	Total Wetland		**-**	**-**	**466.43**	***1.79***	**1,545.44**	***1.32***
SBSmc2	Bog	Wb	-	-	16.10	*0.06*	-	-
	Fen	Wf	-	-	9.61	*0.04*	-	-
	Marsh	Wm	-	-	10.31	*0.04*	-	-
	Swamp	Ws	-	-	69.90	*0.27*	-	-
	Shallow-water	Ww	-	-	8.22	*0.03*	-	-
	TRIM/TEM Wetland	WL	-	-	-	-	137.43	*0.12*
	Total Wetland		**-**	**-**	**114.13**	***0.44***	**137.43**	***0.12***
SBSmc3	Bog	Wb	44.21	*1.00*	658.40	*2.53*	-	-
	Fen	Wf	11.74	*0.27*	348.29	*1.034*	-	-
	Marsh	Wm	0.97	*0.02*	37.20	*0.14*	-	-
	Swamp	Ws	135.13	*3.06*	757.47	*2.91*	-	-
	Shallow-water	Ww	6.24	*0.14*	43.74	*0.17*	-	-
	Pond	PD	2.16	*0.05*	-	-	-	-
	TRIM/TEM Wetland	WL	-	-	-	-	3,051.33	*2.60*
	Total Wetland		**200.44**	***4.54***	**1,845.10**	***7.08***	**3,051.33**	***2.60***
ESSFmv1	Bog	Wb	57.22	*1.30*	100.70	*0.39*	-	-
	Fen	Wf	27.60	*0.63*	123.44	*0.47*	-	-
	Marsh	Wm	1.81	*0.04*	2.20	*<0.01*	-	-
	Swamp	Ws	286.12	*6.48*	456.24	*1.75*	-	-
	Shallow-water	Ww	1.72	*0.04*	5.64	*0.02*	-	-
	TRIM/TEM Wetland	WL	-	-	-	-	316.43	*0.27*
	Total Wetland		**374.47**	***8.49***	**688.22**	***2.64***	**316.43**	***0.27***
ESSFmvp	Bog	Wb	-	-	-	-	-	-
	Fen	Wf	-	-	-	-	-	-
	Marsh	Wm	-	-	-	-	-	-
	Swamp	Ws	-	-	-	-	-	-
	Shallow-water	Ww	0.23	*0.01*	0.57	*<0.01*	-	-
	TRIM/TEM	WL	-	-	-	-	1.37	*<0.01*

BGC Zone Variant	Wetland Class	Code	Mine Site		LSA		RSA***	
			(ha)*	(%)**	(ha)*	(%)**	(ha)*	(%)**
	Wetland							
	Total Wetland		**0.23**	***0.01***	**0.57**	***<0.01***	**1.37**	***<0.01***
ESSFxv1	TRIM/TEM Wetland		-	-	-	-	10.00	*0.01*
	Total Wetland		**-**	-	**-**	-	**10.00**	***0.01***
BAFAun	Bog	Wb	-	-	-	-	-	-
	Fen	Wf	-	-	-	-	-	-
	Marsh	Wm	-	-	-	-	-	-
	Swamp	Ws	-	-	-	-	-	-
	Shallow-water	Ww	-	-	-	-	-	-
	TRIM/TEM Wetland	WL	-	-	-	-	-	-
	Total Wetland		**-**	-	**-**	-	-	-
SBPSmc	Bog	Wb	-	-	6.75	*0.03*	-	-
	Fen	Wf	-	-	0.47	*<0.01*	-	-
	Marsh	Wm	-	-	-	-	-	-
	Swamp	Ws	-	-	-	-	-	-
	Shallow-water	Ww	-	-	-	-	-	-
	TRIM/TEM Wetland	WL	-	-	-	-	593.23	***0.51***
	Total Wetland		**-**	-	**7.22**	***0.03***	**593.23**	***0.51***
MSxv	TRIM/TEM Wetland	WL	-	-	-	-	4.09	*<0.01*
	Total Wetland		**-**	-	**-**	-	**4.09**	***<0.01***
All BGC Zones	Bog	Wb	101.40	*2.29*	947.79	*3.64*	-	-
	Fen	Wf	39.34	*0.89*	612.66	*2.35*	-	-
	Marsh	Wm	2.77	*0.06*	50.52	*0.19*	-	-
	Swamp	Ws	421.25	*9.54*	1,452.54	*5.58*	-	-
	Shallow-water	Ww	8.19	*0.18*	58.17	*0.22*	-	-
	Pond	PD	2.16	*0.05*	-	-	-	-
	TRIM/TEM Wetland	WL	-	-	-	-	5,846.42	*4.98*
Total Wetland Area			**575.15**	***13.03***	**3,121.68**	***11.98***	**5,846.42**	***4.98***
Total Area of Study Area			**4,412.66**		**26,047.57**		**117,349.82**	

Note: *Areas Calculated in UTM projection, Zone 10, NAD 83.
**Percents are % of total area.
*** RSA wetlands were mapped using TRIM data and TEM data where available.



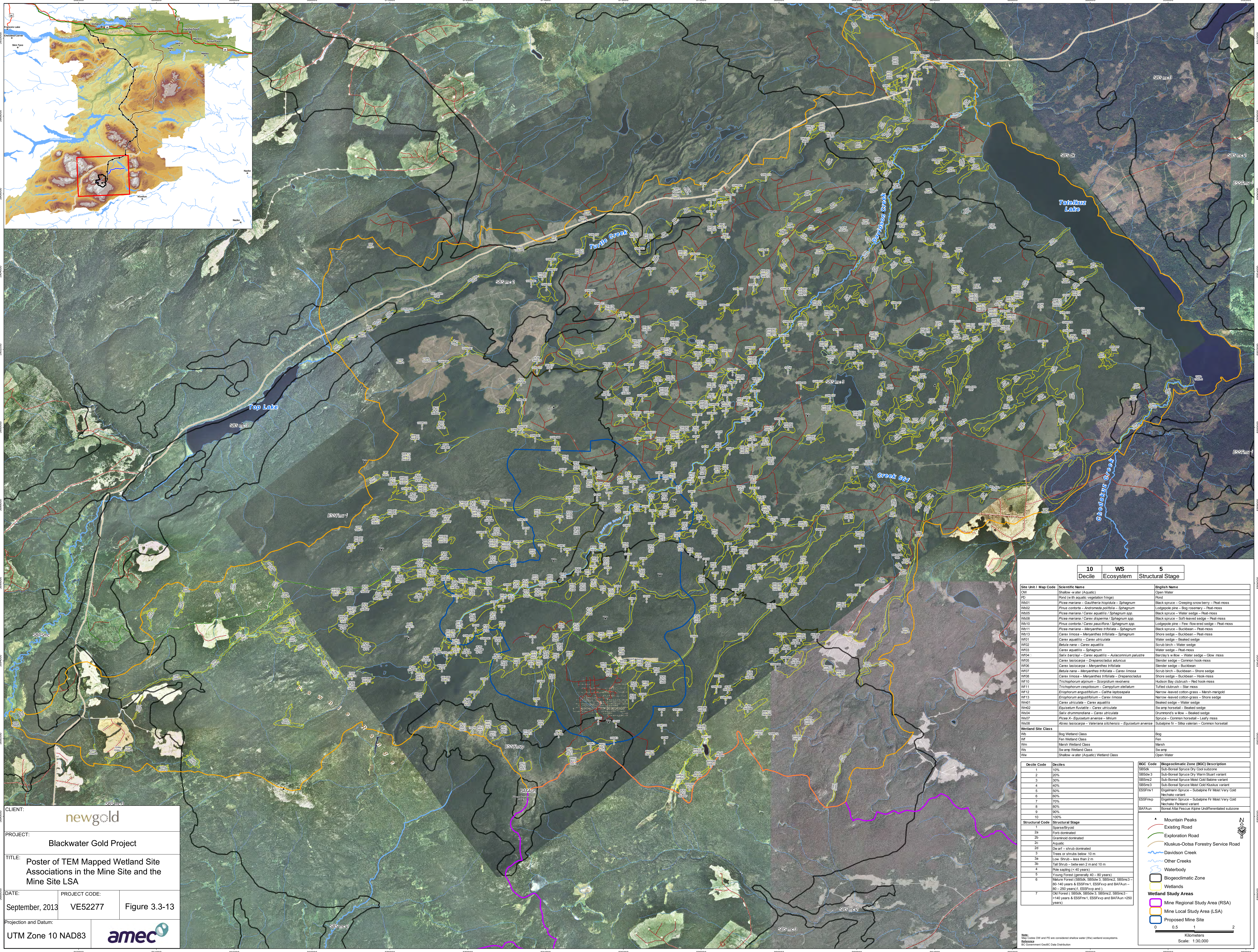
Note: Swamp includes forested swamps.

Figure 3.3-12: Percent Cover of TEM Mapped Wetland Classes and Upland Ecosystems in the Mine Site Study Area

Table 3.3-8: Wetland Site Associations by Area within the Mine Site

BGC Zone Variant	Wetland Type	Site Association	CDC List	Area (ha)	Percent of Mine Site
ESSFmv1	Shallow-water	Ww	NL	1.721	0.04
	Bog	Wb05	Yellow	15.372	0.35
	Bog	Wb08	Yellow	27.907	0.63
	Bog	Wb10	Blue	13.943	0.32
	Fen	Wf01	NL	2.116	0.05
	Fen	Wf02	Blue	11.085	0.25
	Fen	Wf03	Yellow	6.386	0.14
	Fen	Wf04	Yellow	1.657	0.04
	Fen	Wf07	Yellow	2.171	0.05
	Fen	Wf11	Blue	4.187	0.09
	Marsh	Wm01	Yellow	1.805	0.04
	Swamp	Ws04	NL	12.21	0.28
	Swamp	Ws08	NL	273.914	6.21
ESSFmv1 Wetland Total				**374.474**	**8.49**
ESSFxvp1	Shallow-water	Ww	NL	0.233	0.01
ESSFxvp1 Wetland Total				**0.233**	**0.01**
SBSmc3	Shallow-water	Ww	NL	6.236	0.14
	Bog	Wb05	Yellow	22.39	0.51
	Bog	Wb08	Yellow	18.793	0.43
	Bog	Wb10	Blue	3.028	0.07
	Fen	Wf01	Yellow	2.757	0.06
	Fen	Wf02	Blue	3.491	0.08
	Fen	Wf03	Yellow	2.827	0.06
	Fen	Wf08	Blue	2.232	0.05
	Fen	Wf11	Blue	0.436	0.01
	Marsh	Wm01	Yellow	0.965	0.02
	Swamp	Ws04	NL	13.302	0.30
	Swamp	Ws07	NL	121.826	2.76
SBSmc3 Total				**200.44**	**4.54**
Blue-Listed Total				**39.131**	**0.89**
Wetland Grand Total				**575.147**	**13.03**
Total				**4,412.656**	**100.00**

Note: BGC = Biogeoclimatic, CDC = Conservation Data Centre, ha = hectares, NL = Not Listed, Ww = Shallow-water, Wb05 - Sb = Water sedge - Peat-moss, Wb08 = Sb - Soft-leaved sedge - Peat-moss, Wb09 = Black spruce - Common horsetail - Peat-moss, Wb10 = Pl - Few-flowered sedge = Peat-moss, Wf01 - Water sedge = Beaked Sedge, Wf02 = Scrub birch - Water sedge, Wf03 = Water sedge - Peat-moss, Wf04 = Barclay's willow - Water sedge - Glow moss, Wf07 = Scrub birch - Buckbean - Shore sedge, Wf08 = Shore sedge - Buckbean = Hook-moss, Wf11 = Tufted clubrush - Star-moss, Wm01 = Beaked Sedge - Water Sedge, Ws04 = Drummond's willow - Beaked sedge, Ws07 = Spruce - Horsetail, Ws08 = Bl - Horsetail - Glow moss, Wb = Bog Wetland, Wf = Fen Wetland, Wm = Marsh Wetland, Ws = Swamp Wetland.



CLIENT: newgold

PROJECT: Blackwater Gold Project

TITLE: Poster of TEM Mapped Wetland Site Associations in the Mine Site and the Mine Site LSA

DATE: September, 2013 | PROJECT CODE: VE52277 | Figure 3.3-13

Projection and Datum: UTM Zone 10 NAD83

amec

10	WS	5
Decile	Ecosystem	Structural Stage

Site Unit / Map Code	Scientific Name	English Name
OW	Shallow-water (Aquatic)	Open Water
PD	Pond (with aquatic vegetation fringe)	Pond
Wb01	*Picea mariana – Gaultheria hispidula – Sphagnum*	Black spruce – Creeping-snowberry – Peat-moss
Wb02	*Pinus contorta – Andromeda polifolia – Sphagnum*	Lodgepole pine – Bog rosemary – Peat-moss
Wb05	*Picea mariana / Carex aquatilis / Sphagnum spp.*	Black spruce – Water sedge – Peat-moss
Wb08	*Picea mariana / Carex disperma / Sphagnum spp.*	Black spruce – Soft-leaved sedge – Peat-moss
Wb10	*Pinus contorta / Carex pauciflora / Sphagnum spp.*	Lodgepole pine – Few-flowered sedge – Peat-moss
Wb11	*Picea mariana – Menyanthes trifoliata – Sphagnum*	Black spruce – Buckbean – Peat-moss
Wb13	*Carex limosa – Menyanthes trifoliata – Sphagnum*	Shore sedge – Buckbean – Peat-moss
Wf01	*Carex aquatilis – Carex utriculata*	Water sedge – Beaked sedge
Wf02	*Betula nana – Carex aquatilis*	Scrub birch – Water sedge
Wf03	*Carex aquatilis – Sphagnum*	Water sedge – Peat-moss
Wf04	*Salix barclayi – Carex aquatilis – Aulacomnium palustre*	Barclay's willow – Water sedge – Glow moss
Wf05	*Carex lasiocarpa – Drepanocladus aduncus*	Slender sedge – Common hook-moss
Wf06	*Carex lasiocarpa – Menyanthes trifoliata*	Slender sedge – Buckbean
Wf07	*Betula nana – Menyanthes trifoliata – Carex limosa*	Scrub birch – Buckbean – Shore sedge
Wf08	*Carex limosa – Menyanthes trifoliata – Drepanocladus*	Shore sedge – Buckbean – Hook-moss
Wf10	*Trichophorum alpinum – Scorpidium revolvens*	Hudson Bay clubrush – Red hook-moss
Wf11	*Trichophorum cespitosum – Campylium stellatum*	Tufted clubrush – Star moss
Wf12	*Eriophorum angustifolium – Caltha leptosepala*	Narrow-leaved cotton-grass – Marsh-marigold
Wf13	*Eriophorum angustifolium – Carex limosa*	Narrow-leaved cotton-grass – Shore sedge
Wm01	*Carex utriculata – Carex aquatilis*	Beaked sedge – Water sedge
Wm02	*Equisetum fluviatile – Carex utriculata*	Swamp horsetail – Beaked sedge
Ws04	*Salix drummondiana – Carex utriculata*	Drummond's willow – Beaked sedge
Ws07	*Picea X– Equisetum arvense – Mnium*	Spruce – Common horsetail – Leafy moss
Ws08	*Abies lasiocarpa – Valeriana sitchensis – Equisetum arvense*	Subalpine fir – Sitka valerian – Common horsetail
Wetland Site Class		
Wb	Bog Wetland Class	Bog
Wf	Fen Wetland Class	Fen
Wm	Marsh Wetland Class	Marsh
Ws	Swamp Wetland Class	Swamp
Ww	Shallow-water (Aquatic) Wetland Class	Open Water

Decile Code	Deciles
1	10%
2	20%
3	30%
4	40%
5	50%
6	60%
7	70%
8	80%
9	90%
10	100%
Structural Code	**Structural Stage**
1	Sparse/Bryoid
2a	Forb dominated
2b	Graminoid dominated
2c	Aquatic
2d	Dwarf – shrub dominated
3	Trees or shrubs below 10 m
3a	Low Shrub – less than 2 m
3b	Tall Shrub – between 2 m and 10 m
4	Pole sapling (< 40 years)
5	Young Forest (generally 40 – 80 years)
6	Mature Forest (SBSdk, SBSdw3, SBSmc2, SBSmc3 – 80-140 years & ESSFmv1, ESSFxvp and BAFAun – 80 – 250 years)1, ESSFxvp and).
7	Old Forest (SBSdk, SBSdw3, SBSmc2, SBSmc3 - >140 years & ESSFmv1, ESSFxvp and BAFAun >250 years)

BGC Code	Biogeoclimatic Zone (BGC) Description
SBSdk	Sub-Boreal Spruce Dry Cool subzone
SBSdw3	Sub-Boreal Spruce Dry Warm Stuart variant
SBSmc2	Sub-Boreal Spruce Moist Cold Babine variant
SBSmc3	Sub-Boreal Spruce Moist Cold Kluskus variant
ESSFmv1	Engelmann Spruce – Subalpine Fir Moist Very Cold Nechako variant
ESSFmvp	Engelmann Spruce – Subalpine Fir Moist Very Cold Nechako Parkland variant
BAFAun	Boreal Altai Fescue Alpine Undifferentiated subzone

Mountain Peaks
Existing Road
Exploration Road
Kluskus-Ootsa Forestry Service Road
Davidson Creek
Other Creeks
Waterbody
Biogeoclimatic Zone
Wetlands

Wetland Study Areas

Mine Regional Study Area (RSA)
Mine Local Study Area (LSA)
Proposed Mine Site

0 0.5 1 2
Kilometers
Scale: 1:30,000

Note:
Map Codes OW and PD are considered shallow water (Ww) wetland ecosystems.

Reference
BC Government GeoBC Data Distribution

3.3.3.2 Ecosystems At-Risk

The BC CDC identifies 20 wetland communities at risk that potentially occur in the mine site RSA (**Annex 4**). A total of 21 distinct wetland ecosystems were encountered and classified during the 2011 to 2013 baseline studies. Ten of these wetland ecosystems are listed as threatened (Red-listed) or of special concern (Blue-listed) in BC and are confirmed in the wetland study area (**Table 3.3-9**). Four Blue-listed wetland ecosystem types occupy 39 ha (0.9%) of the mine site and are mapped in **Figure 3.3-12**. No Red-listed ecosystems were indentified in the mine site; however, the Red-listed Hudson Bay clubrush–red hook-moss wetland site association (Wf10) was observed in the LSA. Red-listed wetlands cover approximately 6.19 ha at three separate sites east of the mine site. Areas of at-risk ecosystems found within the mine site are shown in **Table 3.3-8**. A full list of wetland ecosystems with descriptions and sampling effort is included in **Annex 2**.

Table 3.3-9: Confirmed At-Risk Wetland Ecosystems in the Wetland Study Area

Site Association Label	Scientific Name	Common Name	No. of Plots	BC CDC List
Wb01	*Picea mariana – Gaultheria hispidula – Sphagnum*	Black spruce – Creeping-snowberry – Peat-moss	1	Blue
Wb10	*Pinus contorta/Carex pauciflora/Sphagnum* spp.	Lodgepole pine – Few-flowered sedge – Peat-moss	2	Blue
Wb11	*Picea mariana – Menyanthes trifoliata – Sphagnum*	Black spruce – Buckbean – Peat-moss	1	Blue
Wb13	*Carex limosa – Menyanthes trifoliata – Sphagnum* spp.	Shore sedge – Buckbean – Peat-moss	3	Blue
Wf02	*Betula nana – Carex aquatilis*	Scrub birch – Water sedge	31	Blue
Wf05	*Carex lasiocarpa – Drepanocladus aduncus*	Slender sedge – Common hook-moss	2	Blue
Wf08	*Carex limosa – Menyanthes trifoliata – Drepanocladus*	Shore sedge – Buckbean – Hook-moss	9	Blue
Wf10	*Trichophorum alpinum – Scorpidium revolvens*	Hudson Bay clubrush – Red hook-moss	5	Red
Wf11	*Trichophorum cespitosum – Campylium stellatum*	Tufted clubrush – Star moss	10	Blue
Wf13	*Eriophorum angustifolium – Carex limosa*	Narrow-leaved cotton-grass – Shore sedge	2	Blue

Note: Site Association Label: Bog Wetland Class (Wb), Fen Wetland Class (Wf)

3.3.3.3 Plant Species at Risk

The BC CDC identifies 69 plant species at risk that potentially occur in wetlands found in the region (**Annex 4**). The species at-risk surveys confirmed the presence of four wetland Blue-listed plant species. No Red-listed plant species were encountered. All of the at-risk

herbaceous plants were found in wetlands, and their proximity to the mine site is shown in **Figure 3.3-14**.

Swollen beaked sedge *(Carex rostrata*), a Blue-listed graminoid, was found at four locations in the wetlands study area. *C. rostrata* usually occupied the center of the fen ecosystems but was also found in a marsh wetland (**Figure 3.3-11**). All populations seemed stable and numbered at least several hundred individuals.

Small-flowered lousewort *(Pedicularis parviflora ssp. parviflora*), a Blue-listed herb, was found in three wetland types (**Table 3.3-10**). All populations consisted of approximately 40 to 50 sporadically occurring individuals. **Figure 3.3-15** depicts the habitat of the small-flowered lousewort and **Figure 3.3-16** shows the plant.

Meesia moss (*Meesia longiseta*), a Blue-listed bryophyte, was found in three wetlands and only occurred in a few very sporadic clumps. The Blue-listed sickleleaf tomentypnum moss (*Tomentypnum falcifolium*) was found in two locations, one population about 450 m west of the mine site and another population inside the eastern portion of the mine site, near the transmission line (**Figure 3.3-14**).

One population of blue listed sickleleaf tomentypnum moss (*Tomentypnum falcifolium*) was observed within the mine site boundaries, and a second population was observed approximately 450 m west of the mine site in the headwaters of Davidson Creek.

Refer to the Plant Species at Risk sections in the Vegetation Baseline Report for more information on at-risk plants.

Table 3.3-10: Confirmed At-Risk (Blue Listed) Wetland Plants with Locations

ScientificName	EnglishName	PlotNumber	UTMEasting	UTMNorthing	Wetland Type	Elevation
Carex rostrata	swollen beaked sedge	B13017A	379921	5902439	Wm01	1,085
Carex rostrata	swollen beaked sedge	B13031A	379291	5901569	Wf08	1,108
Carex rostrata	swollen beaked sedge	RPW007	382275	5899095	Wf01	1,121
Carex rostrata	swollen beaked sedge	T13-042	389888	5912964	Wf01	1,080
Meesia longiseta	Meesia moss	T13-G080	377015	5892321	Wf13	1538
Meesia longiseta	Meesia moss	B13031A	379291	5901569	Wf08	1,108
Meesia longiseta	Meesia moss	RPW033	382044	5898898	Wb13	1,142
Meesia longiseta	Meesia moss	RPW103	373726	5899875	Wf10	1,289
Pedicularis parviflora ssp. parviflora	small-flowered lousewort	B13043B	381797	5901633	Wf08	1,088
Pedicularis parviflora ssp. parviflora	small-flowered lousewort	RPW033	382044	5898898	Wb13	1,142
Pedicularis parviflora ssp. parviflora	small-flowered lousewort	RPW103	373726	5899875	Wf10	1,289
Tomentypnum falcifolium	sickleleaf tomentypnum moss	B13027A	378454	5897119	Wf02	1234
Tomentypnum falcifolium	sickleleaf tomentypnum moss	T13148G	371637	5894328	Wb13	1349

370000 372000 374000 376000 378000 380000 382000 384000

5902000 5900000 5898000 5896000 5894000 5892000 5890000

SBSmc2
SBSmc2
ESSFmv1
SBSmc3
ESSFmvp
BAFAun

Proposed Mine Access Road
Carex rostrata
Carex rostrata
Meesia longiseta
Pedicularis parviflora ssp. parviflora
Snake Lake
Proposed Fresh Water Pipeline
Meesia longiseta
Pedicularis parviflora ssp. parviflora
Creek 700
Davidson Creek
Carex rostrata
Meesia longiseta
Pedicularis parviflora ssp. parviflora
Proposed Transmission Line
Tomentypnum falcifolium
Exploration Road
Creek 705
Davidson Creek
Creek 656
Tomentypnum falcifolium
Lake 01538UEUT
Meesia longiseta
Mathews Creek
Carex rostrata

N

Legend

- Blue Listed Plant Population
- Stream
- Waterbody

Project Components

- Exploration Road
- Proposed Transmission Line
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Mine Site

Biogeoclimatic Zone

- BAFAun
- ESSFmv1
- ESSFmvp
- SBSmc2
- SBSmc3

Wetland Information

- Listed Wetlands < 20%

Red Listed Wetlands

- Wf10 - Hudson Bay clubrush - Red hook-moss

Blue Listed Wetlands

- Wb09 - Black spruce – Common horsetail – Peat-moss
- Wb11 - Black spruce – Buckbean – Peat-moss
- Wf13 - Narrow-leaved cotton-grass – Shore sedge
- Wb10 - Pine – Few-flowered sedge - Peat-moss Bog
- Wf02 - Scrub birch - Water sedge Fen
- Wf08 - Shore sedge - Buckbean - Hook-moss Fen
- Wf11 - Tufted clubrush - Star-moss Fen
- Wb13 - Shore sedge - Buckbean - Peatmoss

Wetland Study Areas

- Regional Study Area
- Local Study Area

0 0.5 1 2
Kilometres
Scale:1:50,000

Note
Blue and Red listed wetlands are only displayed where they occupy 20% or more of the TEM Mapped polygon.

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Map of Verified At-Risk Species and Wetland Ecosystems

DATE:	ANALYST:	**Figure** 3.3-14
May, 2014	KA	
JOB No: VE52277	QA/QC: SB	PDF FILE: 06-200-010_wetland_at_risk_species_v5.pdf
GIS FILE: 06-200-010_wetland_at_risk_species_v5.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

\\bby-fs2\bby-ee-gis\GIS\Projects\VE\VE52095_Richfield_BlackwaterMapping\06_vegetation\EIA\06-200-010_wetland_at_risk_species_v5.mxd

Note: Two provincially Blue-listed plants (*Meesia longiseta* and *Pedicularis parviflora*) were documented (Rare Plant Location RPW-033 Easting 382044/Northing 5898898).

Figure 3.3-15: Photo of Red-Listed Wf10 – Hudson Bay clubrush – Red hook-moss site association approximately 0.5 km north of the Mine Site

Figure 3.3-16: Pedicularis parviflora documented at Rare Plant Wetland Location (RPW 033)

3.3.3.4 Wetland Biodiversity

Based on plot data collected during 2011 to 2013, a total of 318 native wetland plant species were documented within the mine site RSA. Three invasive plants were encountered in wetlands: small-flowered buttercup (*Ranunculus parviflorus*), green sorrel (*Rumex acetosa*), and common dandelion (*Taraxacum officinale*). A complete list of plant species is provided in **Annex 4-3**. **Table 3.3-11** provides a list of wetland ecosystems covered in the biodiversity analysis. One species of fresh water pea clam (yellow listed, *Pisidium casertanum*) was found approximately 1.5 km west of the mine site in a Blue- listed fen (plot B13051A, Wf11).

Table 3.3-11: Wetland Ecosystems Covered in the Biodiversity Analysis

Site Unit/Map Code	Scientific Name	English Name
OW	Shallow-water (Aquatic)	Open Water
PD	Pond (with aquatic vegetation fringe)	Pond
Wb01	*Picea mariana – Gaultheria hispidula – Sphagnum*	Black spruce – Creeping-snowberry – Peat-moss
Wb02	*Pinus contorta – Andromeda polifolia – Sphagnum*	Lodgepole pine – Bog rosemary – Peat-moss
Wb05	*Picea mariana/Carex aquatilis/Sphagnum spp.*	Black spruce – Water sedge – Peat-moss
Wb08	*Picea mariana/Carex disperma/Sphagnum spp.*	Black spruce – Soft-leaved sedge – Peat-moss
Wb09	*Picea mariana – Equisetum arvense – Sphagnum*	Black spruce – Common horsetail – Peat-moss
Wb10	*Pinus contorta/Carex pauciflora/Sphagnum spp.*	Lodgepole pine – Few-flowered sedge – Peat-moss
Wb11	*Picea mariana – Menyanthes trifoliata – Sphagnum*	Black spruce – Buckbean – Peat-moss
Wb13	*Carex limosa – Menyanthes trifoliata – Sphagnum*	Shore sedge – Buckbean – Peat-moss
Wf01	*Carex aquatilis – Carex utriculata*	Water sedge – Beaked sedge
Wf02	*Betula nana – Carex aquatilis*	Scrub birch – Water sedge
Wf03	*Carex aquatilis – Sphagnum*	Water sedge – Peat-moss
Wf04	*Salix barclayi – Carex aquatilis – Aulacomnium palustre*	Barclay's willow – Water sedge – Glow moss
Wf05	*Carex lasiocarpa – Drepanocladus aduncus*	Slender sedge – Common hook-moss
Wf06	*Carex lasiocarpa – Menyanthes trifoliata*	Slender sedge – Buckbean
Wf07	*Betula nana – Menyanthes trifoliata – Carex limosa*	Scrub birch – Buckbean – Shore sedge
Wf08	*Carex limosa – Menyanthes trifoliata – Drepanocladus*	Shore sedge – Buckbean – Hook-moss
Wf10	*Trichophorum alpinum – Scorpidium revolvens*	Hudson Bay clubrush – Red hook-moss
Wf11	*Trichophorum cespitosum – Campylium stellatum*	Tufted clubrush – Star moss

Site Unit/Map Code	Scientific Name	English Name
Wf12	*Eriophorum angustifolium – Caltha leptosepala*	Narrow-leaved cotton-grass – Marsh-marigold
Wf13	*Eriophorum angustifolium – Carex limosa*	Narrow-leaved cotton-grass – Shore sedge
Wm01	*Carex utriculata – Carex aquatilis*	Beaked sedge – Water sedge
Wm02	*Equisetum fluviatile – Carex utriculata*	Swamp horsetail – Beaked sedge
Ws04	*Salix drummondiana – Carex utriculata*	Drummond's willow – Beaked sedge
Ws07	*Picea X– Equisetum arvense – Mnium*	Spruce – Common horsetail – Leafy moss
Ws08	*Abies lasiocarpa – Valeriana sitchensis – Equisetum arvense*	Subalpine fir – Sitka valerian – Common horsetail

Biodiversity indices (e.g., species richness and Shannon's Diversity Index) were calculated using 61 wetland biodiversity plots. These plots contained the highest quality full floristic surveys. Species richness (i.e., number of plant species recorded per plot) was determined for the biodiversity wetland plots (**Figure 3.3-17**) excluding the reference wetland plots that will be used for the monitoring program. The site associations encountered harboured an average of 41.5 species with the number of plots per wetland type ranging from 1 to 18 plots (**Figure 3.3-17**). Ninety-nine (99) species were identified in the "richest" wetland site association. Spruce – Common horsetail – Leafy moss (Ws07, n=6) and the Shallow-water wetlands (Ww, n=3) had the lowest species richness (12).

Mean Shannon's Diversity Indices were determined to identify the abundance and evenness of species for the comprehensive wetland plots. Diversity is determined within a range; higher indices indicate communities that are more diverse. The mean Shannon's Diversity Indices for the 61 biodiversity plots ranged from 1.7 to 3.8 with a mean diversity of 2.75 (**Figure 3.3-18**). The mean diversity value compares to a mean value of 1.50 for upland plots (refer to the Vegetation Baseline Report for additional information).

Wetlands with higher species richness values have also been shown to have higher aboveground biomass and productivity levels (Engelhardt and Kadlec, 2001). By comparison, upland ecosystems found in the wetlands study area generally have poor productivity and low forage and timber values, while non-forested wetlands provide some of the highest productivity levels in the area (Roberts, 1984). The native sedge fens, in particular, are used extensively for forage and hay production in the surrounding regions (Roberts, 1984).

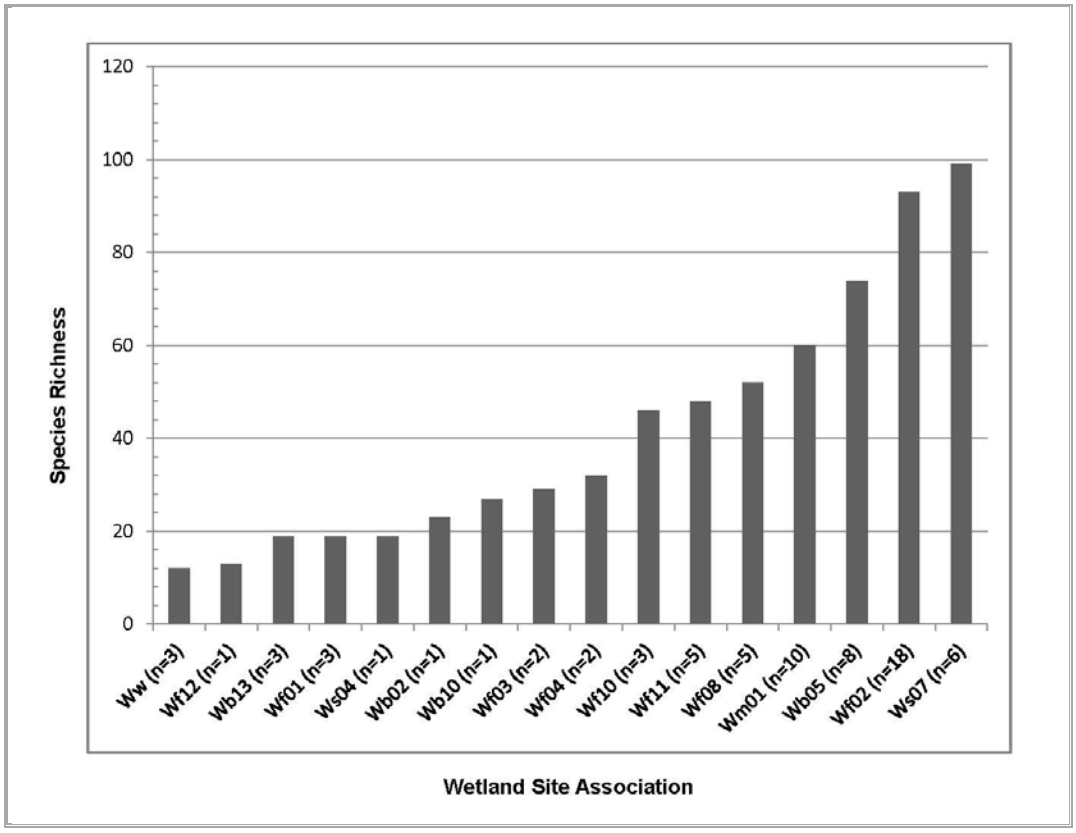


Figure 3.3-17: Species Richness for Wetland Site Associations with Biodiversity Plots

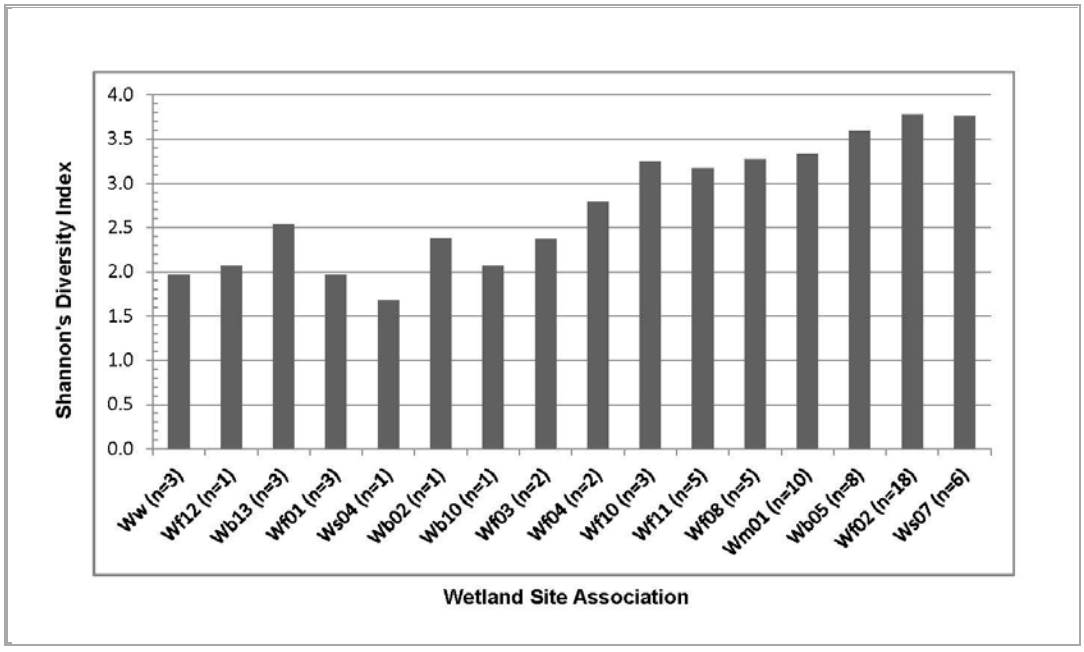


Figure 3.3-18: Mean Shannon's Diversity Index for Wetland Site Associations with Biodiversity Plots

3.3.3.5 Wildlife Species Dependent on Wetlands

A minimum of 132 wildlife species potentially occurring in northern BC depend on wetlands for a portion of their lifecycle including, 4 amphibians, 64 birds, 10 mammals, and 54 invertebrates. Of the 132 wildlife species indentified, 69 were detected during field surveys in the wetland study area. A comprehensive list of wildlife species potentially occurring versus detected in the wetland study area is provided in **Annex 4**. In general, fewer wildlife species are likely to occur at higher elevation (ESSF and BAFA) wetlands than lower elevation (SBS and SBPS) wetlands (**Figure 1.3-3**; **Figure 3.3-19**). A table showing animal groups by wetland class and BGC zone is provided in **Annex 4**. Marshes were represented by the highest number of potentially occurring wildlife species followed by open shallow-water, bogs, swamps, and fens in decreasing order (**Figure 3.3-20**). The higher potential of wildlife species in marshes is linked to the increased number of waterfowl, grebes, and loons that use standing water, which is often associated with marsh wetlands. Although few marshes were observed, they potentially occur within the BGC units identified within the wetland study areas.

Wildlife habitat functionality values and ranks were developed for each comprehensive wetland plot (**Table 3.3-12**). Selected wetlands were evaluated for their suitability for up to 12 species and/or life stages of wildlife. These values were then summed and divided by the number of wildlife species that wetland was rated for to determine the wildlife functional value for each wetland. With the exception of seven wetlands that were ranked high and one ranked low, 48 wetland plots were ranked as moderate for wildlife habitat function. Wildlife species specifically used to determine habitat functional values included amphibians, birds, and mammals (**Table 2.3-4**).

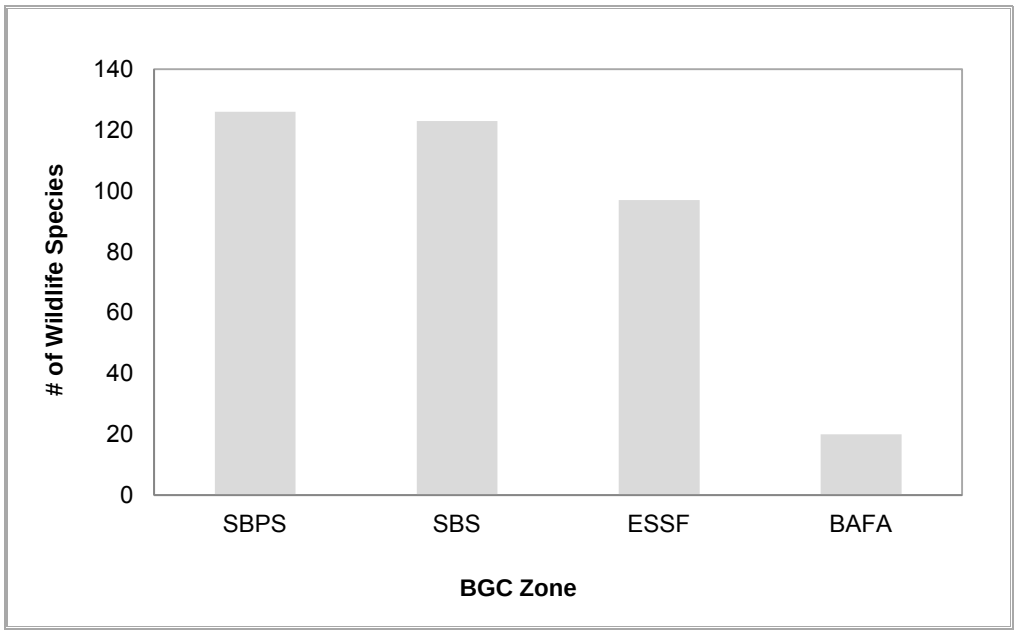


Figure 3.3-19: Number of Wildlife Species by BGC Zone

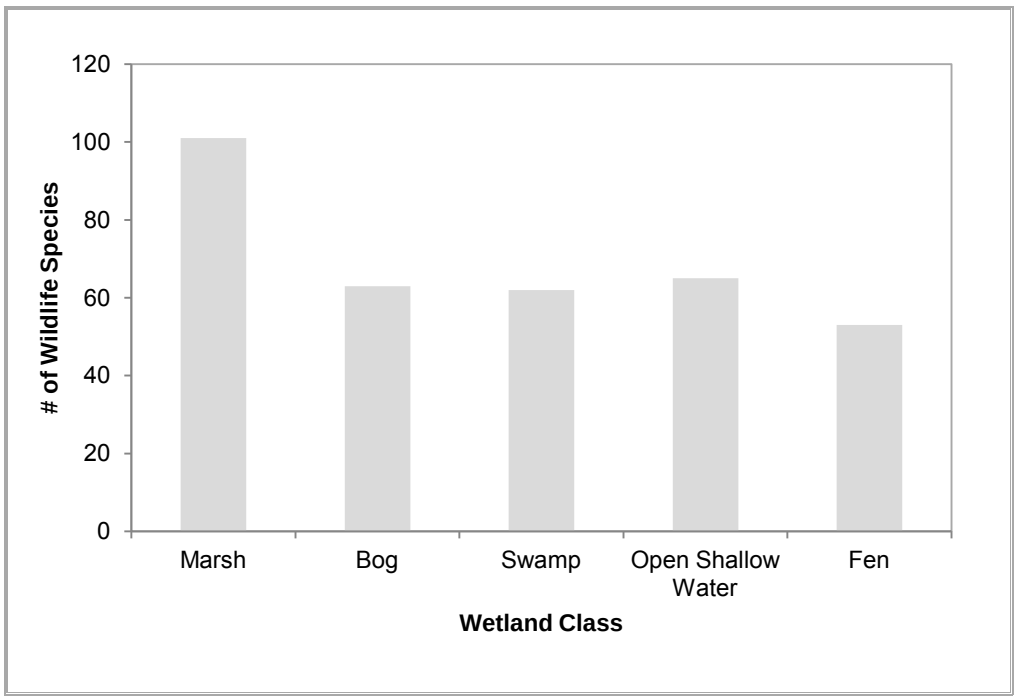


Figure 3.3-20: Number of Wildlife Species by Wetland Class

Table 3.3-12: Wildlife Habitat Functional Values and Rankings for the Comprehensive Wetland Plots

Comprehensive Wetland Plot	Wetland Type	Wetland Site Association	Summed Wildlife Species Habitat Ratings	Total Wildlife Species Rated	Functional Value	Functional Rank*
C4	Fen	Wf02	31	12	2.58	Moderate
WL2	Fen	Wf02, Wf07	24	10	2.40	Moderate
WL4	Fen	Wf03	29	12	2.42	Moderate
WL8	Fen	Wf11	28	12	2.33	Moderate
WL12	Bog, Fen	Wb13, Wf02, Wf11	29	12	2.42	Moderate
WL13	Fen	Wf02, Wf10	28	12	2.33	Moderate
WL15	Fen, Swamp	Wf01, Ws04	28	12	2.33	Moderate
WL16	Fen	Wf01, Wf02	26	12	2.17	Moderate
WL19	Fen, Bog	Wf08, Wb11	28	12	2.33	Moderate
WL23	Fen	Wf02	28	10	2.80	Moderate
WL24	Marsh	Wm01	28	12	2.33	Moderate
WL28	Bog, Fen	Wb05, Wf02	18	12	1.50	High
WL33	Bog	Wb13	31	12	2.58	Moderate
WL34	Fen	Wf02	28	12	2.33	Moderate
B13012A	Bog	Wb05	27	10	2.70	Moderate

Comprehensive Wetland Plot	Wetland Type	Wetland Site Association	Summed Wildlife Species Habitat Ratings	Total Wildlife Species Rated	Functional Value	Functional Rank*
B13012B	Swamp	Ws07	18	9	2.00	High
B13013A	Fen	Wf02	25	10	2.50	Moderate
B13013B	Swamp	Ws07	18	9	2.00	High
B13014A	Marsh	Wm01	23	9	2.56	Moderate
B13015A	Marsh	Wm01	21	9	2.33	Moderate
B13016A	Swamp/fen	Ws04	20	10	2.00	High
B13017A	Sedge Marsh	Wm01	25	9	2.78	Moderate
B13018A	Fen	Wf02	28	10	2.80	Moderate
B13018B	Bog	Wb05	28	10	2.80	Moderate
B13020A	Fen	Wf02	28	10	2.80	Moderate
B13020B	Shallow Water	Ww	28	9	3.11	Low
B13023A	Fen/Swamp	Wf04	31	12	2.58	Moderate
B13027A	Fen	Wf02	34	12	2.83	Moderate
B13031A	Fen	Wf08	23	10	2.30	Moderate
B13031B	Swamp	Ws07	21	10	2.10	Moderate
B13036A	Marsh	Wm01	27	12	2.25	Moderate
B13036C	Shallow Water	Ww	31	12	2.58	Moderate
B13036D	Swamp	Ws07	27	12	2.25	Moderate
B13037A	Fen	Wf02	27	10	2.70	Moderate
B13038A	Fen	Wf11	28	12	2.33	Moderate
B13038B	Fen/Swamp	Wf04	31	12	2.58	Moderate
B13041A	Fen	Wf12	31	12	2.58	Moderate
B13043A	Fen	Wf08	18	9	2.00	High
B13043B	Fen	Wf08	20	9	2.22	Moderate
B13050A	Fen	Wf02	25	10	2.50	Moderate
B13050B	Bog	Wb02	25	10	2.50	Moderate
B13051A	Fen	Wf11	28	12	2.33	Moderate
B13053A	Fen	Wf10	28	12	2.33	Moderate
B13060A	Fen	Wf10	29	12	2.42	Moderate
BWR001A	Fen	Wf02	31	12	2.58	Moderate
BWR002A	Fen	Wf11	29	12	2.42	Moderate
BWR003A	Fen	Wf02	32	12	2.67	Moderate
BWR003B	Bog	Wb05	35	12	2.92	Moderate

Comprehensive Wetland Plot	Wetland Type	Wetland Site Association	Summed Wildlife Species Habitat Ratings	Total Wildlife Species Rated	Functional Value	Functional Rank*
BWR003C	Bog	Wb05	36	12	3.00	Moderate
BWR005A	Marsh	Wm01	18	9	2.00	High
BWR005B	Fen	Wf02	31	12	2.58	Moderate
BWR005C	Shallow Water	Ww	14	7	2.00	High
BWR006A	Swamp	Ws08	28	12	2.33	Moderate
BWR006B	Fen	Wf02	32	12	2.67	Moderate
BWR008A	Fen	Wf02	31	12	2.58	Moderate
BWR019A	Bog	Wb05	27	10	2.70	Moderate

Note: *Ranking categories include high (1 to 2), moderate (2 to 3), and low (≥ 3).

3.3.3.6 Wildlife Species of Conservation Concern

Sixteen of the 132 wildlife species identified within the wetland study areas are provincial species at risk, including one amphibian, nine birds, three mammals, and three invertebrates. Additionally, of the 16 wildlife species identified within the wetland study areas, one is Red-Listed (Yellow rail (*Coturnicops noveboracensis*)), 13 are Blue-Listed, and seven are listed in the *Species at Risk Act (SARA*) (Government of Canada, 2002). The SARA-listed species in the wetland study areas include the western toad (*Anaxyrus boreas*), Yellow rail (*Coturnicops noveboracensis*), long-billed curlew (*Numenius americanus*), Short-eared owl (*Asio flammeus*), olive-sided flycatcher (*Contopus cooperi*), rusty blackbird (*Euphagus carolinus*), and caribou (*Rangifer tarandus)*. Detection information for each of the species of concern is provided in **Annex 4**. Three additional COSEWIC-listed species were identified as potentially occurring in the wetland study areas (**Table 3.3-13**). For additional information, refer to Section 3.2 of the Wildlife Baseline Report, Section 3.2.

Table 3.3-13: Wildlife Species At-Risk that Depend on Wetlands Located with the Potential to Occur within Mine Site and Linear Features Study Areas

Species Group	Common Name	Scientific Name	COSEWIC	SARA	BC List
Amphibian	Western toad	*Anaxyrus boreas*	SC (2002)	1-SC (2005)	Blue
Bird	Horned grebe	*Podiceps auritus*	SC (2009)	-	
Bird	American bittern	*Botaurus lentiginosus*	-	-	Blue
Bird	Yellow rail	*Coturnicops noveboracensis*	SC (2002)	1-SC (2003)	Red
Bird	American golden-plover	*Pluvialis dominica*	-	-	Blue
Bird	Long-billed curlew	*Numenius americanus*	SC (1992)	SC (2005)	Blue
Bird	Short-eared owl	*Asio flammeus*	SC (2008)	3 (2005)	Blue
Bird	Olive-sided flycatcher	*Contopus cooperi*	T (2007)	1-T (2010)	Blue
Bird	Rusty blackbird	*Euphagus carolinus*	SC (2006)	1-SC (2009)	Blue

Species Group	Common Name	Scientific Name	COSEWIC	SARA	BC List
Mammal	Caribou (northern populations)	*Rangifer tarandus*	T/SC (2002)	1-SC (2005)	Blue
Mammal	Grizzly bear	*Ursus arctos*	SC (2002)		Blue
Mammal	Little brown myotis	*Myotis lucifugus*	E (2012)	-	
Mammal	Northern myotis	*Myotis septentrionalis*	E (2012)	-	Blue
Mammal	Eastern red bat	*Lasiurus borealis*	-	-	Red
Odonate	Hagen's Bluet	*Enallagma hageni*	-	-	Blue
Odonate	Beaverpond baskettail	*Epitheca canis*	-	-	Blue
Odonate	Kennedy's emerald	*Somatochlora kennedyi*	-	-	Blue
Odonate	Forcipate emerald	*Somatochlora forcipata*	-	-	Blue

Notes: SC = special concern; T = threatened; 1 = Schedule 1; 3 = Schedule 3.

3.4 Linear Features Study Area – Mapping and Distribution

The four linear features associated with the wetland baseline include the mine access road, water pipeline, airstrip, and transmission line. The access road, water pipeline, and airstrip are located completely within the mine site LSA (**Figure 1.3-2** and **Figure 1.3-3**). The area and percent of the wetland classes found in each linear feature are summarized in **Table 3.4-1**.

Wetlands found within the linear features are identified throughout the wetlands study area (**Figure 3.3-10**). The wetlands found near the linear features inside the mine site LSA are accounted for in the mine site LSA calculations. The total length of the portion of the mine access road within the mine site LSA is approximately 15 km, and the total length of the water pipeline is approximately 20 km. The airstrip includes a 5.5 km access road.

Wetlands comprise approximately 6 ha (6%) of the access road corridor. The water pipeline corridor contains approximately 11 ha (8% by area) of wetlands. The airstrip linear feature includes 2 ha (4% by area) of wetlands. Bogs and swamps are the most prevalent wetland class identified within these linear features.

The proposed transmission line has multiple reroute options and wetland areas provided in **Table 3.4-1** include these anticipated route modifications. Wetlands found within the transmission line corridor (**Figure 3.3-10** and **Figure 3.3-11**) include cover approximately 144 ha or 7% of the total area. Bogs and swamps are the most prevalent wetland class identified along the transmission line.

Table 3.4-1: Area of Wetland Classes in the Linear Features Study Area

BGC* Zone	Wetland Class	Code	Transmission Line				Mine Access Road		Water Pipeline Route		Airstrip and Airstrip Rd	
			Corridor		LSA		Corridor		Corridor		Corridor	
			(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
SBSdk	Bog	Wb	18.91	0.90	21.78	0.77	-	-	-	-	-	-
	Fen	Wf	12.41	0.60	12.18	0.43	-	-	-	-	-	-
	Marsh	Wm	1.00	<0.01	3.35	0.12	-	-	-	-	-	-
	Swamp	Ws	48.32	2.30	73.70	2.61	-	-	0.05	0.04	-	-
	Shallow-water	Ww	0.17	<0.01	1.78	0.06	-	-	-	-	-	-
	Total SBSdk Wetland		80.82	3.90	112.78	3.99	-	-	0.05	0.04	-	-
SBSdw3	Bog	Wb	-	-	-	-	-	-	-	-	-	-
	Fen	Wf	-	-	0.51	0.02	-	-	-	-	-	-
	Marsh	Wm	1.57	0.10	2.42	0.09	-	-	-	-	-	-
	Swamp	Ws	21.25	1.00	41.62	1.47	-	-	-	-	-	-
	Shallow-water	Ww	0.12	<0.01	0.10	<0.01	-	-	-	-	-	-
	Total SBSdw3 Wetland		22.93	1.10	44.65	1.58	-	-	-	-	-	-

BGC* Zone	Wetland Class	Code	Transmission Line				Mine Access Road		Water Pipeline Route		Airstrip and Airstrip Rd	
			Corridor		LSA		Corridor		Corridor		Corridor	
			(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
SBSmc2	Bog	Wb	-	-	-	-	-	-	-	-	1.07	2.10
	Fen	Wf	-	-	-	-	-	-	-	-	-	-
	Marsh	Wm	-	-	-	-	-	-	-	-	-	-
	Swamp	Ws	5.85	0.30	7.97	0.28	-	-	-	-	0.77	1.50
	Shallow-water	Ww	-	-	0.05	<0.01	-	-	-	-	-	-
	Total SBSmc2 Wetland		**5.85**	**0.30**	**8.02**	**0.28**	**-**	**-**	**-**	**-**	**0.77**	**1.50**
SBSmc3	Bog	Wb	8.17	0.40	10.14	0.36	1.66	1.60	1.60	1.19	-	-
	Fen	Wf	3.50	0.20	4.99	0.18	0.51	0.50	1.09	0.78	-	-
	Marsh	Wm	0.40	<0.01	0.92	0.03	0.11	0.10	0.05	0.04	-	-
	Swamp	Ws	21.73	1.00	27.37	0.97	4.00	3.90	8.09	5.84	0.11	0.20
	Shallow-water	Ww	0.31	<0.01	1.30	0.05	-	-	0.01	0.07	-	-
	Total SBSmc3 Wetland		**34.10**	**1.60**	**44.71**	**1.58**	**6.28**	**6.10**	**10.98**	**7.90**	**0.11**	**0.20**
ESSFmv1	Bog	Wb	-	-	-	-	-	-	-	-	-	-
	Fen	Wf	-	-	-	-	-	-	-	-	-	-
	Marsh	Wm	-	-	-	-	-	-	-	-	-	-
	Swamp	Ws	-	-	0.33	0.01	-	-	-	-	-	-
	Shallow-water	Ww	-	-	-	-	-	-	-	-	-	-
	Total ESSFmv1 Wetland		**-**	**-**	**0.33**	**0.37**	**-**	**-**	**-**	**-**	**-**	**-**

BGC* Zone	Wetland Class	Code	Transmission Line				Mine Access Road		Water Pipeline Route		Airstrip and Airstrip Rd	
			Corridor		LSA		Corridor		Corridor		Corridor	
			(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
All BGC Zones	Bog	Wb	27.08	1.30	31.92	1.13	1.66	1.60	1.64	1.20	1.07	2.10
	Fen	Wf	15.91	0.80	17.68	0.62	0.51	0.50	1.08	0.80	-	-
	Marsh	Wm	2.97	0.10	6.68	0.24	0.11	0.10	0.05	<0.01	-	-
	Swamp	Ws	97.15	4.70	151.00	5.34	4.00	3.90	8.14	5.90	0.88	1.70
	Shallow-water	Ww	0.60	<0.01	3.21	0.11	-	-	-		-	-
	Total Wetland Area		**143.70**	**6.90**	**210.49**	**7.44**	**6.28**	**6.10**	**11.03**	**8.00**	**1.95**	**3.86**
Total Area of Linear Component			**2074.41**	**-**	**2828.76**	**-**	**103.15**	**-**	**138.59**	**-**	**50.51**	**-**

Note: *BGC = Biogeocliamtic. Areas Calculated in UTM projection, Zone 10, NAD 83. Percents are % of total area for that linear feature.

4.0 CONCLUSIONS

Approximately 3,122 ha of wetland ecosystems were mapped within the LSA and 5,846 ha have been identified within the RSA. Hydrological classification indicates that sampled wetlands are linked to the flow of water upstream and downstream of the mine site. Of the 21 wetland ecosystems classified, 11 wetland ecosystems are listed in BC as threatened or of special concern. Six Blue-listed wetland ecosystems at risk, covering 39 ha, are found within the mine site. A total of 318 wetland plant species were documented within the wetland ecosystems. Four Blue-listed plant taxa were documented and no Red-listed taxa were encountered.

Overall, the baseline levels of the water quality results within wetlands suggest normal conditions for wetlands. Results such as low pH, high nutrients (nitrogen and phosphorus), and moderate levels of organic carbon for some sampled wetlands were expected and considered usual for wetlands in this region. Freshwater aquatic guideline exceedances were detected for total metals and dissolved metals in 2012 and 2013 for some parameters tested, which indicates some naturally elevated metals in the region.

An assessment of the ability of wetlands to support wildlife included 132 species dependent on wetlands for part of their lifecycle. As expected, fewer wildlife species are likely to occur at higher elevation (ESSF and BAFA) wetlands than lower elevation (SBS and SBPS) wetlands. In total, there are 16 wildlife species at risk potentially occurring in wetlands, of which six species were detected in the mine site RSA.

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ANNEXES

Appendix 1
Biochemical Function Methods and Guidelines

Appendix 1-1
AMEC Laboratory QA/QC

AMEC Environment & Infrastructure

Statement of Qualifications

Edmonton, Alberta

Laboratory

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1.0 AMEC ENVIRONMENT & INFRASTRUCTURE OVERVIEW

1.1 AMEC Environment & Infrastructure

AMEC Environment & Infrastructure is an environmental sciences, geotechnical and material services company offering professional engineering, scientific and contracting services to industry, investors, financial institutions and governments in all national and international markets. The company is a division of AMEC Americas and is diversified into engineering, construction, environmental services, and waste management.

The AMEC Group provides a wide range of integrated engineering and professional management services in the environment; geological, geotechnical, materials and earthquake engineering; applied chemistry and biology; and air, water and earth resource management for industry and government. These services have been successfully used in the energy, mining, transportation, construction, environment, water and sanitation, forestry, agriculture, food, tourism and recreation industry sectors.

The Group is dedicated to providing quality services to clients, integrating technology and innovation with recommendations aimed at practical and sustainable solutions that maintain an appropriate balance between socio- economic development, the environment, and the rational exploitation of the earth's limited natural resources. Clients include industry, investors, International Financial Institutions, and government related to the sustainable development, industry and human settlements.

1.2 Laboratory Services

AMEC Environment & Infrastructure has one environmental laboratory, located in Edmonton, Alberta. The lab is housed in a modern facility equipped with the latest analytical instrumentation to analyze numerous matrices for a large number of physical and chemical parameters. The laboratory takes great pride in providing exceptional service to all clients.

The Edmonton lab analyzes air, asbestos, cement, metals, and soil, sludge, and water samples for a large number of parameters. These parameters include BTEX, petroleum hydrocarbons (gasoline, diesel, heavy oil), glycols, PCBs, trace organics (GC/MS) (including PAH's, Chlorinated Phenols, and Organo-chlorines), metals (by cold vapour, ICP-AES and ICP-MS), water potability parameters, soil salinity and leachability, metal weld composition, chloride in cement, alkalies in flyash, and more.

The lab also provides quick turn-around, quantitative screening tests for hydrocarbons in soil and water samples based on either volatile or semi-volatile components in soil. The volatile components (carbon range C6-C10) are determined by Purge & Trap or Headspace, and gas chromatography which may be related to BTEX concentration. Semi-volatile components (C10-C50) are determined by gas chromatography (GC/FID) or an

infrared instrument. Procedures are based on U.S. EPA, CCME (Canadian Council of the Ministers of the Environment) or British Columbia Environment ministry protocols.

To assure precise and accurate data, the lab is certified, and accredited for ISO 17025 Standard and has an extensive Quality Assurance and Quality Control (QA/QC) program. Steps within this QA/QC program include:

1. appropriate containers and preservatives for field sampling protocol;
2. trip and field blanks;
3. chain of custody forms;
4. sample temperature control;
5. use of references, standards and duplicates with each batch of samples analyzed;
6. control charts to record progress;
7. review of reports by Quality Assurance Compliance officer and Lab Manager; and
8. client liaison officer.

All data generated by the lab is the sole property of the client and strict confidentiality is maintained.

2.0 EXPERIENCE

AMEC Edmonton Chemistry analyzes thousands of water and soil samples yearly. Parameters range from pH, ICP metals to GC/MS for trace organics. Other matrices analyzed by the laboratory include air for industrial hygiene and source emission surveys, ground and surface waters, effluents, cements, concrete, metals, etc. Samples have been received from within the Prairie Provinces, BC, Ontario, North West Territories, and internationally from Russia, Ecuador, Libya, Japan, Panama and Peru.

The Edmonton Chemistry Lab provided analytical services for the Komi Arctic oil spill containment in Northern Russia, and AMEC Environment & Infrastructure was awarded the 1996 Emerald Award for their efforts in this project. Edmonton Chemistry was classified as a preferred laboratory in the Exxon Mobil system in 2011. In addition to providing services to the private sector, the laboratory performs analyses for local and provincial governments.

Our laboratory staff has extensive experience in environmental analysis. Professional experience ranges from 5 to 20 years combined with academic backgrounds ranging from Chemical Technology Diplomas to Bachelor of Science Degrees in Chemistry. Several staff members have provided seminars on environmental chemistry issues on a national and international basis in Canada and Pakistan regarding gas chromatography techniques, and Laboratory Quality Assurance programs.

3.0 GENERAL ANALYTICAL METHODOLOGY

AMEC Environment & Infrastructure follows accepted methodologies from various sources. These sources include United States Environmental Protection agency, American Public Health Association (APHA), American Society for Testing and Materials (ASTM); National Institute for Occupational Safety and Health (NIOSH), Alberta Environment, British Columbia Environment, Canadian Council of Ministers of the Environment (CCME) and Canadian Society of Soil Sciences (CSSS).

Analytical Methods are written in standard form as part of a set of Standard Operating Procedures (SOP). These procedures include, in part, a discussion of potential interferences, calibration methodology, calculations, acceptable ranges of check standards, and a detailed description of the methods.

4.0 QA/QC OVERVIEW

4.1 Quality Assurance Management

Laboratory analytical reports contain pertinent information regarding the sample(s) submitted for analyses. This information includes the date the sample was collected and received by the lab, date of analysis, technician's initials, parameters, methodology, method reference, method detection limit and results. The report is reviewed by the lab Quality Assurance / Quality Control Manager and Laboratory Manager for completeness and accuracy. All documentation associated with the analysis including raw data, chromatograms, calibration curves, calculations, etc. are stored on site in a numerical file for a period of 7years.

4.2 Elements of QA/QC

4.2.1 Quality Policy (or Mission)

AMEC Environment & Infrastructure is an international professional services company dedicated to the consistent achievement of industry-leading standards of excellence in engineering, construction, environment and technology. We are committed to innovation and the highest standards of business practice in all our endeavours for our customers, employees, shareholders, society and environment.

4.2.2 Quality Objectives

- To ensure a quality system that is documented, communicated, understood, implemented and incorporates adequate review, audit and internal quality control.
- To ensure personnel are adequately supervised and are proficient to carry out assigned activities.

- To ensure test methods and operating procedures are validated and incorporate adequate quality control.
- To ensure all equipment, supplies and services are functioning properly and/or meet required specifications.
- To ensure facilities are adequate to carry out the testing activity.
- To ensure that test results are supported by a traceable system of measurement and accorded uncertainties appropriate to requirements.
- To ensure sample management that incorporates adequate procedures for the security, receipt, identification, checking, routing, storage and disposal of all samples.
- To ensure data management that incorporates adequate procedures for the security, recording, calculation, validation, authorization, transmittal, storage and disposal of all test data and related records.
- To ensure workload management that incorporates acceptable turnaround time and verification of resource availability prior to the receipt of additional testing.
- To ensure that all planned changes to the quality system are adequately communicated to personnel to maintain quality management system integrity.
- To continuously improve the effectiveness of the management system, the quality management system and the overall productivity of the Laboratory.
- To maintain a high level of client satisfaction.

4.3 Sample Containers and Preservatives

The lab utilizes the list of recommended containers, preservation techniques and holding times published by USEPA, CCME, BCME, and APHA to guide project managers and clients in making the correct choices for particular samples. All sample containers used by the chemistry laboratory are purchased as pre- cleaned according to EPA protocol. The laboratory provides support to field sampling crews by recommending and supplying the necessary Class 1 US EPA pre cleaned sampling containers with the required preservatives and sampling instructions, and transportation coolers including refrigerants. All samples submitted to the lab are kept at 4°C until the time of analysis and they are analyzed within the maximum holding time.

4.4 Chain of Custody

It is necessary for each sample or group of samples to be accompanied by a chain-of-custody record from the time of sampling in order to trace possession. The record should contain the following information:

- Name of client;

- Project name or sampling address;
- Sample ID;
- Date and time of collection;
- Size of sample containers;
- Analysis required;
- Signature of all individuals involved in the chain of possession; and
- Inclusive dates of possession.

4.5 Sample Hold Time

United States Environmental Protection Agency and many other regulatory agencies have established holding times for most analytical parameters. Quality data requires that analyses be performed within the specified holding times. AMEC will notify the project manager of any expired holding times prior to proceeding with the analysis.

4.6 Trip Blanks

Trip blanks are a required quality control element for sampling and analysis, and provided to the client with bottle orders for specific analyses. Trip blanks should be regarded as one of the most critical aspects of the sampling regime. Processed accurately, a trip blank becomes a guarantee that primary samples were not contaminated during transportation.

A trip blank is a sample of analyte free media collected in the same type of container that is required for the analytical test, taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures.

Blank correction are not performed rather the Trip blank values above method detection limit are noted and reported in the report.

4.7 Field Blanks

A field blank is similar to a trip blank; collected in the same type of container that is required for the analytical test. Capped and clean containers are taken from the laboratory to the sampling site and processed along with site samples. A field blank is used to identify errors or contamination in sample collection and analysis. Consultants are reminded to supply the lab with appropriate field blanks so any contamination from the air can be measured and accounted for. Distilled and de-ionized water for field blanks are provided upon request.

Blank corrections are not performed, but the blank values above the detection limit are noted and reported in the report.

4.8 Surrogate Standards and Internal Standards

Surrogates are compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which is not normally found in environmental samples. Surrogate spike recoveries are used to determine the accuracy of the method recovery, and monitor analysis for unusual matrix effects. The surrogate recovery results are used in a manner similar to check samples including control charts of expected recoveries. Any analyses with values outside the action limits are re-analyzed and checks are made for calculation and preparation errors.

4.9 Instrument Calibrations

Instruments are calibrated prior to analyses using a series of high-purity standards that cover the working range of the instrument. Instrument responses are collated in an appropriate quality control sheet and this data is plotted regularly to monitor for inappropriate changes.

4.10 Calibration Check Standards & Drift Control Standards

When the instrument is not running continuously, a check calibration standard is analyzed at the end of an analytical run. A check calibration standard is a mid- range standard that is analyzed as an unknown. The calibration check standard is reviewed and its response is compared with the response for the beginning standards. If the response for the check calibration standard differs from the response for the beginning standards by more than 15 % corrective action will be taken.

4.11 Field Duplicates

Field Duplicates are independent samples collected as close as possible to the same point in space and time; taken from the same source, stored in separate containers, and analyzed independently. The purpose of field duplicate sampling is to monitor the precision of the sampling process. Field duplicates should be included by the field samplers at a rate of 10% of the number of samples.

4.12 Laboratory Duplicate

Duplicate analysis is performed on every 15-20 samples submitted to the lab. Projects, with a large number of samples submitted as one lot, are automatically assigned laboratory duplicates at a rate of 1 in 20 samples (5%). The results from lab duplicate analyses are reported along with sample results.

4.13 Standard Reference Material (SRM) and Matrix Spikes

Standard reference materials (SRM's), if available, are analyzed concurrently with sample analyses. The laboratory purchases SRM's from Environmental Resources Associates,

USA, for water and soil matrices. An in-house soil standard evaluated internally and externally, is used for salinity analysis. A QC report accompanies the reports providing details of lab results versus the SRM certified value and advisory ranges.

Matrix spikes are analyzed to determine the effect of the sample matrix on the analyte of interest. Spikes are usually performed on the same sample analyzed in duplicate when required. They are performed when the analyst suspects potential matrix interference or when specifically requested by the client.

4.14 Method Blanks

With every batch of samples, a method blank is prepared with deionized water and/or extraction solvent and is analyzed to verify the absence of interferences or contaminants associated with storage, preparation and instrumental analyses.

4.15 Control Charts

Analysts report the results from the SRM's onto control charts. The control charts are used to document the statistical control of the measurement process and to determine the limits of acceptable data. Control charts are prepared from surrogate standard values and spike values on an ongoing basis but entered daily. A minimum of 20 points are used in preparing each control chart. It is the responsibility of the analyst to prepare the control charts pertaining to his/her analyses and to refer to those charts regularly. Warning limits are set at +2 and -2 standard deviations from the mean and action limits are set at +3 and -3 deviations from the mean. The charts are reviewed regularly by the Director of QA/QC.

4.16 Inter-laboratory Comparisons

The laboratory is in good standing with the following groups: Canadian Association for Laboratory Accreditation (CALA) Inc., Western Enviro-Agricultural Laboratory Association (WEALA), and the Cement and Concrete Reference Laboratory (CCRL).

4.17 Certifications

The laboratory is a recognized participant in the Proficiency Testing program operated by the Canadian Association for Laboratory Accreditation (CALA) Inc. for a number of trace organic and inorganic parameters. CALA's Proficiency Testing Program is accredited to ILAC:G13 International Laboratory Accreditation Cooperative), and ISO Guide 43. A list of Proficiency Testing parameters for the Edmonton lab can be found in the directory of labs at http://www.CALA.ca lab membership # 2349.

4.18 Accreditations

The Edmonton Chemistry Laboratory is accredited by the Canadian Association for Laboratory Accreditation (CALA) Inc. to ISO/IEC 17025 for specific environmental tests listed in the scope of accreditation by CALA. A list of the Edmonton Lab accredited tests can be found at http://www.CALA.ca lab membership # 2349.

Appendix 1-2A
BC MOE Water Quality Guidelines

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Units	Wildlife	Units
pH	6.5 - 8.5		6.5 - 9.0				
Conductivity	700	µS/cm					
Hardness (as mg $CaCO_3$)	80 - 100	mg/L					
Colour	15	TCU					
Dissolved oxygen			8		mg/L		
Total dissolved solids	500	mg/L					
Total suspended solids			25 in 24 hour (bg ≤25)		mg/L	20 (bg ≤100)	mg/L
			mean of 5 in 30 day (bg ≤25)		mg/L	20% (bg >100)	mg/L
			25 (bg 25 - 250)		mg/L		
			10% (bg >250)		mg/L		
Turbidity	0.1	NTU	8 in 24 hour (bg ≤8)		NTU	10 (bg ≤50)	NTU
			8 (bg 8 - 80)		NTU	20% (bg >50)	NTU
			10% (bg >80)		NTU		
Chlorine (as TRC or ClO)			2	100	µg/L		
Chloride (d)	250	mg/L	150		mg/L	600	mg/L
Fluoride	1	mg/L		0.4 (hardness ≤50 mg/L $CaCO_3$)	mg/L	1	mg/L
				0.3 (hardness >10 mg/L $CaCO_3$)	mg/L		
Sulphate	500	mg/L	65	250	mg/L*		
Sulphide (as H_2S)	50	µg/L					
Nitrate-nitrogen	10	mg/L	3	31.3	mg/L		
Nitrite-nitrogen	1	mg/L	0.02	0.06	mg/L		
Ammonia-nitrogen			1.95 - 1.94 (T=5ºC at pH 6.5 - 7.5)	26.8 - 13.4 (T=5ºC at pH 6.5 - 7.5)	mg/L		
Phosphorus (lakes)	10	µg/L	5 - 15		µg/L		
Total organic carbon	4	mg/L	±20% 30 day median background		mg/L	±20% 30 day median background	mg/L
Dissolved organic carbon			±20% 30 day median background		mg/L	±20% 30 day median background	mg/L
Cyanide							
Cyanide (t)	200	µg/L					
Cyanide (WAD)			5	10	µg/L		
Total Coliforms							
Fecal Coliforms	0	/100 mL		Shellfish harvesting ≤43, 90th percentile†††	/100 mL		

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Units	Wildlife	Units
				≤14, median[†††]			
Aluminum (d)	0.2	mg/L	0.05 (pH ≥6.5)	0.1 (pH ≥6.5)	mg/L[**]		
			e(1.6-3.327 [median pH] + 0.402pH^2) (pH <6.5)	e(1.209 - 2.426pH + 0.286pH^2) (pH <6.5)	mg/L[†]		
Aluminum (t)						5	mg/L
Antimony (t)	6	µg/L		20[w]	µg/L		
Arsenic (t)	5	µg/L	5		µg/L	25	µg/L
Barium (t)[††]	1	mg/L	1	5	mg/L		
Beryllium (t)				5.3[w]	µg/L		
Boron (t)	5	mg/L	1.2		mg/L	5	mg/L
Cadmium (t)	5	µg/L		10e(0.86[log{hardness}] - 3.2)[w]	µg/L		
Calcium(d)				Up to 4, highly sensitive to acid inputs[w]	mg/L		
				4 to 8, moderately sensitive[w]	mg/L		
				Over 8, low sensitivity[w]	mg/L		
Chromium (t)[††]	50	µg/L		1, maximum, Cr(VI)[w]	µg/L		
				8.9, interim max, Cr(III)[w]	µg/L		
Cobalt (t)			4	110	µg/L		
Copper (t)	1	mg/L	2 (hardness ≤50 mg/L)	(0.094[hardness]) + 2 (hardness ≤50 mg/L)	µg/L	300 (max)	µg/L
			0.04 x [mean hardness] (hardness >50 mg/L)	(0.094[hardness]) + 2 (hardness >50 mg/L)	µg/L		
Iron (t)	0.3	mg/L		1	mg/L		
Iron (d)				0.35	mg/L		
Lead (t)	10	µg/L	none proposed (hardness <8 mg/L $CaCO_3$);	3 (hardness <8 mg/L $CaCO_3$)	µg/L	100	µg/L
			3.31 + e(1.273 ln [mean hardness] - 4.704) (hardness ≥8 mg/L $CaCO_3$)	e(1.273 ln [hardness] - 1.460) (hardness ≥ 8 mg/L $CaCO_3$)	µg/L		
Lithium(t)				0.014, secondary chronic	mg/L		
				0.096, final chronic	mg/L		
				0.870, aquatic maximum	mg/L		
Magnesium (d)	100	mg/L					

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Units	Wildlife	Units
Manganese (t)	50	µg/L	(0.0044 * hardness) + 0.605	(0.01102 * hardness) + 0.54	mg/L		
Mercury (t)	1	µg/L	0.02	0.1	µg/L	0.02 (<0.5% MeHg:Hg (t))	µg/L
Molybdenum (t)	0.25	mg/L max	1	2	mg/L	0.05	mg/L max
Nickel (t)				25 (hardness 0 to 60 mg/L as $CaCO_3$)	µg/L		
				65 (hardness 60 to 120 mg/L as $CaCO_3$)	µg/L		
				110 (hardness 120 to 180 mg/L as $CaCO_3$)	µg/L		
				150 (hardness >180 mg/L as $CaCO_3$)	µg/L		
Selenium (t)	10	µg/L	2		µg/L	4	µg/L
Silver (t)			0.05 (hardness $\leq$100 mg/L $CaCO_3$)	0.1 (hardness $\leq$100 mg/L $CaCO_3$)	µg/L		
			1.5 (hardness >100 mg/L $CaCO_3$)	3 (hardness >100 mg/L $CaCO_3$)	µg/L		
Sodium (t)	200	mg/L					
Thallium(t)				0.3	µg/L		
Titanium(t)				2000, median threshold level: *Scenedesmus*	µg/L		
				4600, median threshold level: *Daphnia*	µg/L		
Uranium (t)	20	µg/L		300	µg/L		
Vanadium(t)				6, Ontario WQO	µg/L		
				10, secondary chronic value	µg/L		
Zinc	5	mg/L	7.5 + 0.75 (hardness - 90)	33 + 0.75 (hardness - 90)	µg/L		
Naphthalene			1		µg/L		
Acenaphthene			6		µg/L		
Fluorene			12		µg/L		
Anthracene			4		µg/L		
Phenanthrene			0.3		µg/L		
Acridene			3		µg/L		
Fluoranthene			4		µg/L		
Benz[a]anthracene	0.01	µg/L	0.1		µg/L		

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Units	Wildlife	Units
Benzo[a]pyrene			0.01		µg/L		

Appendix 1-2B
BC MOE Water Quality Guidelines

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Unit	Wildlife	Unit
pH	6.5 - 8.5		6.5 - 9.0				
Conductivity	700	µS/cm					
Hardness (as mg $CaCO_3$)	80 - 100	mg/L					
Colour	15	TCU					
Dissolved oxygen			8		mg/L		
Total dissolved solids	500	mg/L					
Total suspended solids			25 in 24 hour (bg ≤25)		mg/L	20 (bg ≤100)	mg/L
			mean of 5 in 30 day (bg ≤25)		mg/L	20% (bg >100)	mg/L
			25 (bg 25 - 250)		mg/L		
			10% (bg >250)		mg/L		
Turbidity	0.1	NTU	8 in 24 hour (bg ≤8)		NTU	10 (bg ≤50)	NTU
			8 (bg 8 - 80)		NTU	20% (bg >50)	NTU
			10% (bg >80)		NTU		
Chlorine (as TRC or ClO)			2	100	µg/L		
Chloride (d)	250	mg/L	150		mg/L	600	mg/L
Fluoride	1	mg/L		0.4 (hardness ≤50 mg/L $CaCO_3$)	mg/L	1	mg/L
				0.3 (hardness >10 mg/L $CaCO_3$)	mg/L		
Sulphate	500	mg/L	65	250	mg/L*		
Sulphide (as H_2S)	50	µg/L					
Nitrate-nitrogen	10	mg/L	3	31.3	mg/L		
Nitrite-nitrogen	1	mg/L	0.02	0.06	mg/L		
Ammonia-nitrogen			1.95 - 1.94 (T=5ºC at pH 6.5 - 7.5)	26.8 - 13.4 (T=5ºC at pH 6.5 - 7.5)	mg/L		
Phosphorus (lakes)	10	µg/L	5 - 15		µg/L		
Total organic carbon	4	mg/L	±20% 30 day median background		mg/L	±20% 30 day median background	mg/L
Dissolved organic carbon			±20% 30 day median background		mg/L	±20% 30 day median background	mg/L

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Unit	Wildlife	Unit
Cyanide							
Cyanide (t)	200	µg/L					
Cyanide (WAD)			5	10	µg/L		
Total Coliforms							
Fecal Coliforms	0	/100 mL		Shellfish harvesting ≤43, 90th percentile††† ≤14, median†††	/100 mL		
Aluminum (d)	0.2	mg/L	0.05 (pH ≥6.5)	0.1 (pH ≥6.5)	mg/L**		
			e(1.6-3.327 [median pH] + 0.402pH^2) (pH <6.5)	e(1.209 - 2.426pH + 0.286pH^2) (pH <6.5)	mg/L†		
Aluminum (t)						5	mg/L
Antimony (t)	6	µg/L		20 w	µg/L		
Arsenic (t)	5	µg/L	5		µg/L	25	µg/L
Barium (t) ††	1	mg/L	1	5	mg/L		
Beryllium (t)				5.3 w	µg/L		
Boron (t)	5	mg/L	1.2		mg/L	5	mg/L
Cadmium (t)	5	µg/L		10e(0.86[log{hardness}] - 3.2)w	µg/L		
Calcium(d)				Up to 4, highly sensitive to acid inputs w	mg/L		
				4 to 8, moderately sensitive w	mg/L		
				Over 8, low sensitivity w	mg/L		
Chromium (t) ††	50	µg/L		1, maximum, Cr(VI) w	µg/L		
				8.9, interim max, Cr(III) w	µg/L		
Cobalt (t)			4	110	µg/L		
Copper (t)	1	mg/L	2 (hardness ≤50 mg/L)	(0.094[hardness]) + 2 (hardness ≤50 mg/L)	µg/L	300 (max)	µg/L

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Unit	Wildlife	Unit
			0.04 x [mean hardness] (hardness >50 mg/L)	(0.094[hardness]) + 2 (hardness >50 mg/L)	µg/L		
Iron (t)	0.3	mg/L		1	mg/L		
Iron (d)				0.35	mg/L		
Lead (t)	10	µg/L	none proposed (hardness <8 mg/L $CaCO_3$);	3 (hardness <8 mg/L $CaCO_3$)	µg/L	100	µg/L
			3.31 + e(1.273 ln [mean hardness] - 4.704) (hardness ≥8 mg/L $CaCO_3$)	e(1.273 ln [hardness] - 1.460) (hardness ≥ 8 mg/L $CaCO_3$)	µg/L		
Lithium(t)				0.014, secondary chronic	mg/L		
				0.096, final chronic	mg/L		
				0.870, aquatic maximum	mg/L		
Magnesium (d)	100	mg/L					
Manganese (t)	50	µg/L	(0.0044 * hardness) + 0.605	(0.01102 * hardness) + 0.54	mg/L		
Mercury (t)	1	µg/L	0.02	0.1	µg/L	0.02 (<0.5% MeHg:Hg (t))	µg/L
Molybdenum (t)	0.25	mg/L max	1	2	mg/L	0.05	mg/L max
Nickel (t)				25 (hardness 0 to 60 mg/L as $CaCO_3$)	µg/L		
				65 (hardness 60 to 120 mg/L as $CaCO_3$)	µg/L		
				110 (hardness 120 to 180 mg/L as $CaCO_3$)	µg/L		
				150 (hardness >180 mg/L as $CaCO_3$)	µg/L		
Selenium (t)	10	µg/L	2		µg/L	4	µg/L
Silver (t)			0.05 (hardness ≤100 mg/L $CaCO_3$)	0.1 (hardness ≤100 mg/L $CaCO_3$)	µg/L		
			1.5 (hardness >100 mg/L $CaCO_3$)	3 (hardness >100 mg/L $CaCO_3$)	µg/L		

Parameter	Drinking Water	Unit	Freshwater Aquatic (30 day Avg.)	Freshwater Aquatic (Max. grab)	Unit	Wildlife	Unit
Sodium (t)	200	mg/L					
Thallium(t)				0.3	µg/L		
Titanium(t)				2000, median threshold level: *Scenedesmus*	µg/L		
				4600, median threshold level: *Daphnia*	µg/L		
Uranium (t)	20	µg/L		300	µg/L		
Vanadium(t)				6, Ontario WQO	µg/L		
				10, secondary chronic value	µg/L		
Zinc	5	mg/L	7.5 + 0.75 (hardness - 90)	33 + 0.75 (hardness - 90)	µg/L		
Naphthalene			1		µg/L		
Acenaphthene			6		µg/L		
Fluorene			12		µg/L		
Anthracene			4		µg/L		
Phenanthrene			0.3		µg/L		
Acridene			3		µg/L		
Fluoranthene			4		µg/L		
Benz[a]anthracene	0.01	µg/L	0.1		µg/L		
Benzo[a]pyrene			0.01		µg/L		

Appendix 2
Ecological Function

Appendix 2-1
Field Verified Wetland Site Association Descriptions Found within the Mine Site Footprint

Realm/Class	Site Unit/ Map Code	Scientific Name	Common Name	BGC Subzone (No. of Plots)	Total No. of Plots	BC CDC List	Description (Adapted from MacKenzie and Moran 2004)
Shallow -water (Aquatic) Wetland Class (Wa)	OW		Shallow-water (Aquatic)	SBSmc3 (2)	2	NL	Shallow open waters are defined as having up to 2 meters of water at midsummer levels (BC MOF 1991). This wetland class is often associated with marshes (Wm) and provides important habitat for wildlife. Vegetation cover is usually less than 10% and, in the Blackwater area, largely consisted of *Utriculatia* sp., *Potamogeton* sp. and *Nuphar* species.
Bog Wetland Class (Wb)	Wb01	*Picea mariana – Gaultheria hispidula – Sphagnum*	Black spruce – Creeping-snowberry – Peat-moss	SBSdk (1)	1	Blue	The Wb01 is typically in closed basins with little groundwater influence. *Picea mariana* and *Ledum groenlandicum* are always present and generally occupy raised microsites. *Gaultheria hispidula* is characteristic and is often prominent. The hummock-forming peat-mosses are the dominant component of the moss layer.
Bog Wetland Class (Wb)	Wb02	*Pinus contorta – Andromeda polifolia – Sphagnum*	Lodgepole pine – Bog rosemary – Peat-moss	ESSFmv1(1)	1	Yellow	Lodgepole pine – Bog rosemary – Peat-moss bogs are scattered throughout the wet regions of the Central and Sub-Boreal Interior at elevations below 1,100 m. They occur in closed basins, isolated zones in larger peatlands, and occasionally around acidic peatland lakes. *Pinus contorta* usually dominates in the sparse and stunted canopy but *Picea mariana* can also form a significant component. *Betula nana, Eriophorum chamissonis* and *Sphagnum* sp. were dominant in the Blackwater area along with lesser coverage of Dwarf woody plants such as *Kalmia microphylla* and *Andromeda polifolia*. Soils are Fibrisols and Mesisols typically composed of deep Sphagnum peat but sometimes they occur on peat veneers over dense, fine-textured glaciolacustrine deposits.
Bog Wetland Class (Wb)	Wb05	*Picea mariana/Carex aquatilis/Sphagnum spp.*	Black spruce – Water sedge – Peat-moss	SBSdw3(1), SBSmc2(1), SBSmc3(12), SBSdk(1), ESSFmv1(9)	24	Yellow	The Wb05 Bog/Poor Fen Site Association is common throughout the Sub-Boreal and Central Interior. It is found in small closed basins and peripheral areas of larger peatlands with minimal groundwater movement and watertable depression. Sites in the study area were hummocky with trees and other common bog species rooting on elevated *Sphagnum* and *Tomentypnum nitens* mounds, and minerotrophic indicators such as *Carex aquatilis*, *Equisetum* spp., and *Comarum palustre* rooting in the wetter swales. *Betula nana* and *Rhododendron groenlandicum* were common low shrubs. Stunted *Picea mariana* was the predominant tree species with a lesser cover of *Pinus contorta* on some sites. Soils are typically Mesisols of deep (to 4 m) sedge and wood peat. A surface tier of poorly decomposed *Sphagnum* moss occurs discontinuously, mainly under the raised hummocks.

Realm/Class	Site Unit/ Map Code	Scientific Name	Common Name	BGC Subzone (No. of Plots)	Total No. of Plots	BC CDC List	Description (Adapted from MacKenzie and Moran 2004)
Bog Wetland Class (Wb)	Wb08	*Picea mariana/Carex disperma/Sphagnum spp.*	Black spruce – Soft-leaved sedge – Peat-moss	ESSFmv1(1), SBSmc3(3), SBSdk(1)	5	Yellow	Spruce – Soft-leaved sedge – Peat-moss bogs/poor swamps are uncommon throughout Interior BC below 1,700 m in palustrine depressions fed by slow-moving groundwater. Wb08 sites were hummocky; with trees and upland species occurring on raised mounds. Standingwater was present in patches between hummocks, but sites were not fullyflooded.The coniferous canopy of hybrid spruce and black spruce is open. *Equisetum arvense* dominated the herb layer while Sphagnum sp. was common in the diverse moss layer.
Bog Wetland Class (Wb)	Wb10	*Pinus contorta/Carex pauciflora/Sphagnum spp.*	Lodgepole pine – Few-flowered sedge – Peat-moss	ESSFmv1(2)	2	Blue	Lodgepole pine – Few-flowered sedge – Peat-moss bogs/poor fens are uncommon at montane elevations in the Sub-Boreal Interior. These ecosystems occur as small stands in frost-prone basins or on gradual slopes. *Pinus contorta* was present with *Picea mariana* dominating some areas of the generally sparce canopy. The shrub layer consisted almost entirely of stunted conifers, giving these sites an open, park-like character. *Carex pauciflora* usually dominates the herb layer but there is a diversity of other graminoids and typical bog dwarf shrubs. The moss layer is most often a continuous lawn of *Sphagnum angustifolium* with scattered *Tomentypnum nitens*. This Site Association usually has a smooth microtopography and is saturated at the surface from seepage. Soil water is moderately acid, suggesting that groundwater inputs are poor in minerals. Soils are Typic Humisols and Mesisols with a surface tier of poorly decomposed *Sphagnum* peat.
Bog Wetland Class (Wb)	Wb11	*Picea mariana – Menyanthes trifoliata – Sphagnum*	Black spruce – Buckbean – Peat-moss	SBSmc3(1)	1	Blue	The Black spruce – Buckbean – Peat-moss Bog Site Association is uncommon in the wet climates of the Sub-Boreal Interior at elevations below 1,200 m. These sites are found in small infilled basins or on edges of larger peatlands where the watertable is stagnant. *Picea mariana* was the dominant tree with *Betula nana* in the shrub layer. *Carex limosa* and *Oxycoccus oxycoccos* were common with *Menyanthes trifoliata* prominent in wetter areas. The moss layer consisted of a continuous *Sphagnum* lawn.
Bog Wetland Class (Wb)	Wb13	*Carex limosa – Menyanthes trifoliata – Sphagnum*	Shore sedge – Buckbean – Peat-moss	SBSmc3(3), ESSFmv1(1)	4	Blue	Shore sedge – Buckbean – Peat-moss bogs are uncommon elevationsbelow 1,600 m. In the Blackwater area, they occupy the wettest portions of a peatland complex on floating mats.Species tolerant of acidic, continually saturated conditionsand concurrent lack of oxygen were prominent. The most consistent of these is Carex limosa. Drosera anglica, Menyanthes trifoliata and *Oxycoccus oxycoccos* were common on Wb13 sites.*Sphagnum* species formed large patches with wetter hollows in betweenWb13 soils were deep (to >5 m) sedge-derived Mesisols with asurface tier

Realm/Class	Site Unit/ Map Code	Scientific Name	Common Name	BGC Subzone (No. of Plots)	Total No. of Plots	BC CDC List	Description (Adapted from MacKenzie and Moran 2004)
							of poorly decomposed Sphagnum peat. The watertable was typically at or near the surface withlittle standing water.
Fen Wetland Class (Wf)	Wf01	*Carex aquatilis – Carex utriculata*	Water sedge – Beaked sedge	SBSdk (1), SBSmc3(10), ESSFmv1(3)	14	NL	The Water sedge – Beaked sedge Fen Site Association is the most common and widespread Fen Site Association in the province. It occurs in all but the warmest and driest subzones from low to subalpine elevations on sites that are annually inundated by shallow, low-energy floodwaters and that experience some late-season drawdown. Wf01 fens occur in areas of seasonal standing water amongst other wetland types but were also found as extensive pure "meadows." *Carex aquatilis* and *Carex utriculata* dominated these palustrine basins, although one sample site had a high cover of *Carex exsiccata*. Only sparse covers of forbs, aquatics, and mosses were encountered. On sites that dried out at the surface in summer, *Calamagrostis canadensis* was prominent. Fibrisols and Mesisols with variable peat depths were common.
Fen Wetland Class (Wf)	Wf02	*Betula nana – Carex aquatilis*	Scrub birch – Water sedge	SBSdk(2), SBSmc3(18), ESSFmv1(11)	31	Blue	The Scrub birch – Water sedge Fen Site Association is common in Interior BC and is a major component of larger peatlands. Wf02 sites in the Blackwater area were somewhat hummocked, with *Betula nana* and *Carex aquatilis* dominant and *Salix* spp. rooting on elevated microsites. *Carex utriculata* was common on wetter sites. The moss layer was variable but generally dominated by *Tomentypnum nitens*, *Aulacomnium palustre* and *Sphagnum*. Common soil types were Mesisols and Fibrisols with peat depths are between 1 and 2 m.
Fen Wetland Class (Wf)	Wf03	*Carex aquatilis – Sphagnum*	Water sedge – Peat-moss	ESSFmv1(8)	8	Yellow	Water sedge – Peat-moss fens occur mainly at elevations above 1,100 m in the Interior (ESSF zone), where they are the counterpart to the Wf02 of lower elevations. In the Blackwater area, the Wf03 occurs in small pocket depressions with little sign of flooding. Carex aquatilis was the dominant species, though ESSF herb species such as *Senecio triangularis* and *Valeriana sitchensis* were found on some sites. Peat-mosses dominate the Wf03. Mesisols derived from sedge peat were common at these sites.
Fen Wetland Class (Wf)	Wf04	*Salix barclayi – Carex aquatilis – Aulacomnium palustre*	Barclay's willow – Water sedge – Glow moss	SBSdk(1), ESSFmv1(2)	3	Yellow	Wf04 fen/swamps are common at subalpine elevations of the Sub-Boreal Interior. They occur on seepage slopes, along creeks, and in frost-prone basins. *Salix barclayi* usually dominates the shrub layer but in this cold air drainage *Salix maccalliana* was also common. *Carex aquatilis* dominated the herb layer a scattering of herb species. The moss layer consisting of *Aulacomnium palustre* and *Tomentypnum nitens* was well developed. Peat is often shallow at higher elevations but deeper mesisols and fibrisols can accumulate.

Realm/Class	Site Unit/ Map Code	Scientific Name	Common Name	BGC Subzone (No. of Plots)	Total No. of Plots	BC CDC List	Description (Adapted from MacKenzie and Moran 2004)
Fen Wetland Class (Wf)	Wf05	*Carex lasiocarpa* – *Drepanocladus aduncus*	Slender sedge – Common hook-moss	SBSmc3(1), ESSFmv1(1)	2	Blue	Slender sedge – Common hook-moss fens are common throughout the Interior at elevations below 1,400 m. These fens occur on peat flats surrounding small lakes and ponds or in infilled palustrine basins. Prolonged shallow surface flooding and continual surface peat saturation are typical. *Carex lasiocarpa* and *Drepanocladus aduncus* are dominants. Other hydrophiles such as C. *aquatilis* and C. *utriculata* and *Eriophorum chamissonis* were also common. The shrub layer was poorly developed but the moss layer had a high cover of *Drepanocladus* sp. and *Tomentypnum nitens*. Mesisols were the common soil type.
Fen Wetland Class (Wf)	Wf07	*Betula nana* – *Menyanthes trifoliata* – *Carex limosa*	Scrub birch – Buckbean – Shore sedge	SBSmc3(1), ESSFmv1(1)	2	Yellow	Scrub birch – Buckbean – Shore sedge fens occur throughout the Central and Sub-Boreal Interior at middle elevations below 1,400 m, in palustrine basins or patterned fens with permanently high water tables. Most sites are prominently hummocked or ribbed with elevated sites and permanent shallow-water hollows. In the Blackwater area, the Wf07 had an open cover of *Betula nana* and *Salix pedicellaris* rooted on elevated microsites. *Carex utriculata* and *Carex* limosa was prominent, while *Equisetum fluviatile*, *Comarum palustre* and *Menyanthes trifoliata* were found in wet depressions. The well-developed bryophyte layer was dominated be *Sphagnum* species. Wf07 soils were Mesisolic with sedge/moss derived peat.

Realm/Class	Site Unit/ Map Code	Scientific Name	Common Name	BGC Subzone (No. of Plots)	Total No. of Plots	BC CDC List	Description (Adapted from MacKenzie and Moran 2004)
Fen Wetland Class (Wf)	Wf08	Carex limosa – Menyanthes trifoliata – Drepanocladus	Shore sedge – Buckbean – Hook-moss	SBSmc3(7), ESSFmv1(2)	9	Blue	The Shore sedge – Buckbean – Hook-moss is an uncommon, rich Fen Site Association that occurs mainly at higher elevations throughout the Interior (700 m to 1,800 m). These fens occur on pond-side floating mats or in flarks of patterned fens where there is prolonged shallow flooding to no more than several centimetres. At Blackwater, *Carex limosa* and *Carex aquatilis* were constant dominants. *Menyanthes trifoliata* occurred throughout as well as *Eriophorum* species. *Drepanocladus* sp. were the most common bryophytes. Peat deposits were derived from fine sedges and brown mosses and were largely Fibrisolic.
Fen Wetland Class (Wf)	Wf10	Trichophorum alpinum – Scorpidium revolvens	Hudson Bay clubrush – Red hook-moss	SBSmc3(1), ESSFmv1(4)	5	Red	The Hudson Bay clubrush – Red hook-moss Site Associationis rare and seems to occur only in the moist subzones of theSBS or lower ESSF. It is floristically related to the Wf11, but occurs where thewater table is more stagnant and at or slightly above the peat surface formuch of the growing season. Common locations are around small peatland lakes and ponds, and in flarks. At Blackwater, *Trichophorum alpinum* dominated, but there was a diverse array of other species typical of saturated peatland habitats such as *Carex limosa*, *Drosera angelica*, *Menyanthes trifoliata*, and *Equisetum fluviatile*. The moss flora was dominated *Scorpidium revolvens* with lesser amounts of *Calliergon stramineum*. Organic peat layers often show little sign of decomposition. Typic Fibrisols were common in the Wf10 and organics layers were deep (>3 m).
Fen Wetland Class (Wf)	Wf11	Trichophorum cespitosum – Campylium stellatum	Tufted clubrush – Star moss	SBSmc3(1), ESSFmv1(9)	10	Blue	The Tufted clubrush – Star moss Fen Site Association is scattered throughout the Interior at middle to subalpine elevations, most commonly in regions underlain with base-rich parent materials. These fens occur on level and gently sloping, groundwater-fed peatlands that are permanently saturated but rarely inundated. Sites have smooth, ribbed, or slightly hummocked topography and any depressions are water-filled. *Trichophorum cespitosum*, *Sphagnum* and *Campylium stellatum* and were conspicuous and occured mainly on elevated microsites. *Menyanthes trifoliata* and *Scorpidium scorpioides* were found in very shallow pools. Deep peat was typical for these Mesisol soil types.

Realm/Class	Site Unit/ Map Code	Scientific Name	Common Name	BGC Subzone (No. of Plots)	Total No. of Plots	BC CDC List	Description (Adapted from MacKenzie and Moran 2004)
Fen Wetland Class (Wf)	Wf12	*Eriophorum angustifolium – Caltha leptosepala*	Narrow-leaved cotton-grass – Marsh-marigold	ESSFmv1(1)	1	Yellow	The Wf12 occurs on gently sloping peatlands where there is continual seepage from snowmelt and groundwater. *Carex magellanica* and *Eriophorum angustifolium* are common graminoids. The moss layer was well developed with *Sphagnum* sp. and *Aulacomnium palustre* dominating. Soils were deep, mushy sedge peat.
Fen Wetland Class (Wf)	Wf13	*Eriophorum angustifolium – Carex limosa*	Narrow-leaved cotton-grass – Shore sedge	ESSFmv1 (2)	2	Blue	The Wf13 is dominated by *Eriophorum angustifolium* with *Carex limosa* and/or *Carex* magellanica. Grasses such as *Calamagrostis canadensis* and *Vahlodea atropurpurea* and the herb *Comarum palustre* being abundant. The moss layer is well developed and is often diverse, with *Sphagnum* sp common.
Marsh Wetland Class (Wm)	Wm01	*Carex utriculata – Carex aquatilis*	Beaked sedge – Water sedge	SBSmc3(14), SBSdk(3), ESSFmv1(2)	19	Yellow	Beaked sedge – Water sedge marshes constitute the most common and widespread Marsh Site Association in the BC. The Wm01 occurs on sites that are inundated by shallow, low-energy floodwaters and that experience some late-season drawdown. These marshes are found in a wide variety of landscape positions including flooded beaver ponds, lake margins, floodplains, and palustrine basins. Species diversity is low and plant cover is strongly dominated by *Carex utriculata* and C. *aquatilis* with scattered forbs, aquatics, and mosses. At Blackwater some Wm01 sites were dominated by *Carex exsiccata*. On sites experiencing significant surface drying, species diversity increases and sites become more meadow-like. Species such as Calamagrostis canadensis, Geum macrophyllum, or *Deschampsia cespitosa* can become prominent. The Wm01 occurs over a wide range of site conditions on mineral substrates with thin peat veneers. Common soil types include Gleysols and Terric Humisols.
Swamp Wetland Class (Ws)	Ws04	*Salix drummondiana – Carex utriculata*	Drummond's willow – Beaked sedge	SBSdk(2), SBSmc3(3), SBSmc2(1)	3	NL	Drummond's willow – Beaked sedge swamps/fens are commonin the Central and Sub-Boreal Interior in back-levee depressions of low-gradient creeks or channel margins in peatland streams. Ws04 sites can be deeply flooded during the spring freshet and after drawdown maintain a high watertable due to fine-textured soils or low-lying position relative to the watertable.In the Blackwater area, *Salix drummondiana* dominated along with other *Salix species*. The herb layer was moderately well developed and predominantly *Carex aquatilis* and C. *utriculata* with *Calamagrostis canadensis* and C. *canescens* having a moderate cover. *Mnium* species were common in the moss layer.Sedge peat veneers and blankets over fine- to medium-textured fluvialor lacustrine materials were typical.

Realm/Class	Site Unit/ Map Code	Scientific Name	Common Name	BGC Subzone (No. of Plots)	Total No. of Plots	BC CDC List	Description (Adapted from MacKenzie and Moran 2004)
Swamp Wetland Class (Ws)	Ws07	*Picea X– Equisetum arvense – Mnium*	Spruce – Common horsetail – Leafy moss	SBSdk(2), SBSmc3(14)	16	NL	The Spruce – Common horsetail – Leafy moss Swamp Site Association is common in the Sub-Boreal Interior from low to subalpine elevations. It occurs on lower and toe slopes and margins of wetlands, where there is significant flow of mineral-rich groundwater. These can be moderately productive sites with spruce to 25 m tall rooting on elevated mounds. At Blackwater, the shrub layer was well developed with *Lonicera involucrata*, *Salix* and *Ribes* species prominent. *Equisetum arvense* was well represented along with many of other upland and wetland species in this structurally diverse ecosystem. The moss layer can be well developed with leafy mosses (*Mnium* spp.) and *Aulacomnium palustre* prominent in depressions and *Pleurozium schreberi* and other feathermosses on raised mounds. Soils most often have a thin, dark, well-humified, woody peat veneer over fine-textured mineral soils but occasionally deeper peat deposits are encountered.
Swamp Wetland Class (Ws)	Ws08	*Abies lasiocarpa – Valeriana sitchensis – Equisetum arvense*	Subalpine fir – Sitka valerian – Common horsetail	ESSFmv1(19)	19	NL	Subalpine fir – Sitka valerian – Common horsetail swamps are common at elevations above 1,100 m throughout the Interior. The Ws08 occurs on lower and toe slopes and margins of wetlands, where there is significant flow of mineral-rich groundwater. The canopy is open and patchy with groups of interior spruce and subalpine fir separated by forb-rich openings. The shrub layer may be well developed or sparse. The herb layer is generally well developed; an abundance of *Equisetum* arvense and subalpine forbs is typical. Leafy mosses (*Mnium* spp.) and *Aulacomnium palustre* are usually prominent in depressions and *Barbilophozia* and *Hylocomium splendens* prominent on raised mounds. The Gleysolic soils of the Ws08 have a thin, dark, well-humified, woody peat veneer over fine-textured mineral soil, but occasionally deeper organic deposits are encountered where Sphagnum builds up.

Appendix 3
Biochemical Function

Appendix 3-1
Water Quality - In Situ Field Measurements

Table 3.1-1: In Situ Field Measurements - 2011/2012

Wetland	Water Temp (C°)			Water Depth (cm)			Cond. (µS/cm)			% DO			DO mg/L			pH		
	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12
C1	2.14	15.5	6.60	35	15	10	31	26	48	83.2	70.7	86.5	11.11	7.05	8.83	9.87	6.63	7.32
2011 Comments	Ice and snow present. Sample taken from small oxbow of stream flowing through the wetland. Woody shrubs dominate.																	
2012 Comments	July - Sample taken from pool in a channel. Channel has no visible flow but shows evidence of alluvial substrate. Dwarf birch is dominant species with occasional spruce and sedge. September - Sample taken from pool in drainage, water flowing through, conifers throughout as well as willow and birch. Moderate wind present.																	
C4	6.51	14.72	9.23	10-15	15	12	118	45	85	74.5	34.7	23.7	9.14	3.54	2.38	8.86	6.37	6.06
2011 Comments	Sample taken from small, shallow open water (i.e., puddle). Vegetation is almost all sedges with some drawf birch.																	
2012 Comments	July - Main area in wetland is dry. Sample taken from a hummocky area surrounding the wetland. The sample located is dominated by black spruce, and a small amount of water is present. September - Very little water present. Available pools are located along edge of spruce vegetation.																	
W2	2.3	N/A	10.59	10-15	25	12	21	29	3	43.3	N/A	96.2	5.92	N/A	9.10	9.66	6.70	6.40
2011 Comments	Snow present. Sample taken from hummocky wetland area dominated by sedge, dwarf birch, and some *Sphagnum* moss. A stream is present within the wetland.																	
2012 Comments	July - Sample taken from a slow flow channel within the wetland. The channel contained emergent vegetation and algae. Sedges, dwarf birch, and a limited number of pine were present. September - Sample taken from a pool with limited flow.																	
W4	5.26	N/A	11.79	50	0 (i.e., Surface)	15	44	30	34	86.7	N/A	75.0	11.55	N/A	6.95	10.49	6.70	7.03
2011 Comments	Sample taken from an open water pond. Surrounding vegetation included, sedges and *Sphagnum* moss hummocks.																	
2012 Comments	July - Sample taken from pond. Surrounding vegetation is mostly emergent vegetation (e.g., reeds and sedges). No trees or shrubs present within the wetland area. September - Samples from an open pond.																	
W8	2.69	N/A	16.77	45	10	6	40	33	35	60	N/A	42.6	8.15	N/A	3.52	7.15	6.40	5.65
2011 Comments	Snow present. Sample taken near open water pond (some ice). Dominant vegetation is sedges, with some dwarf birch, *Sphagnum* moss, and buckbean.																	
2012 Comments	July – Sampled form small pools where 10cm of water on top of thick brown algae and moss growth is present. Small standing pools/puddles and wet seams present. Emergent vegetation dominates (reed grass, horsetail, and buckbean. September – Little water present – nearly dry conditions.																	
W12	2.44	N/A	8.58	5-35	13	10	36	27	20	70.1	N/A	55.4	9.57	N/A	5.60	8.40	5.80	5.35

Wetland	Water Temp (C°)			Water Depth (cm)			Cond. (µS/cm)			% DO			DO mg/L			pH		
	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12
2011 Comments	Sample taken in a shallow layer of water over a floating vegetation mat. Emergent vegetation dominates (e.g., buckbeen, horsetail, sedges, and dwarf birch).																	
2012 Comments	July - Mostly floating vegetative mats with few small pools. Emergent vegetation. Sporadic black spruce present. Sedges and reeds with occasional hummocks. September – Sample taken along the water column within shallow water areas of the wetland.																	
W13	2.66	14.55	8.84	8-35	20	15	40	29	30	78.8	24.2	21.4	10.68	2.36	2.04	9.87	6.05	5.26
2011 Comments	Sample taken in a shallow layer of water over a floating vegetation mat. Emergent vegetation dominates (e.g., buckbeen, horsetail, sedges, and dwarf birch).																	
2012 Comments	July – Sample taken from scattered patches of open water with brown algae and emergent sedges. Stunted lodgepole pine scattered throughout. September – Sample taken along the water column within shallow water areas (10-30 cm deep) of the wetland.																	
W15	3.83	14.94	9.27	45	15	15	90	63	53	49	19.6	44.6	6.41	1.98	1.48	8.65	6.34	5.36
2011 Comments	Sample taken from open water area; willows and sedges dominate.																	
2012 Comments	July – Sample taken from drainage outflow. Dominant vegetation includes sedges and black spruce along the edge of the open water. September –Moss dominates the wetland with an open pond present at one end.																	
W16	5.34	N/A	7.27	5-10	20	12	150	117	170	68	N/A	35.8	8.65	N/A	3.79	8.34	6.60	6.33
2011 Comments	Sample taken from isolated shallow pools. Dominant vegetation includes *Sphagnum* moss, dwarf birch. Some willows and black spruce present.																	
2012 Comments	July - Sample taken from mouth of channel which discharges from an adjacent wetland into a pond with emergent and submergent vegetation. However, there wasn't enough water to sample so the sample was taken approximately 100 m from the UTM location. September - Sample taken from a drainage area into the wetland. The wetland is large with open water; however standing water was limited (e.g., a few cm sitting on top of mud).																	
W19	3.16	N/A	8.51	10-15	15	8	48	37	61	35.8	N/A	24.3	4.74	N/A	2.51	6.11	5.50	5.60
2011 Comments	Sample taken from a shallow open water pond. Dominant vegetation includes *Sphagnum* moss and sedges with some dwarf birch and black spruce.																	
2012 Comments	July – Sample taken in shallow open water area. Emergent vegetation present. September – Sample taken in shallow open water; however the wetland was primarily dry.																	
W23	N/A	N/A	8.83	N/A	0 (i.e., surface)	10	N/A	49	38	N/A	N/A	44.0	N/A	N/A	4.38	N/A	7.00	5.72

Wetland	Water Temp (C°)			Water Depth (cm)			Cond. (µS/cm)			% DO			DO mg/L			pH		
	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12	25/9/11	9-10/7/12	4/9/12
2012 Comments	July - Duplicate completed here. Sample taken from medium sized channel with minimal flow and no vegetation. Sedges are the dominant vegetation outside of the channel. Shrubs and black spruce are present in limited numbers. September – Sample taken from a drainage areas within the wetland.																	
W24	N/A	N/A	5.74	N/A	20	12	N/A	46	63	N/A	N/A	92.1	N/A	N/A	9.97	N/A	7.10	7.01
2012 Comments	July - Sample taken from small flowing channel (approx. 1ft wide). Water was absent outside of the channel and sedges were the dominant vegetation. September – Sample taken from small pools along the edge of the wetland adjacent to conifers.																	
W28	N/A	N/A	8.12	N/A	10	8	N/A	35	40	N/A	N/A	66.9	N/A	N/A	6.81	N/A	6.50	6.56
2012 Comments	July – Sample taken from small drainage through center of wetland. Emergent vegetation present; however shrubs (dwarf birch and willow) dominant the sample site location. September – Larges pools of water were absent.																	
W33	N/A	18.97	17.06	N/A	0 (i.e., surface)	10	N/A	58	45	N/A	78.6	110.0	N/A	7.24	9.33	N/A	7.15	6.71
2012 Comments	July - Sample taken from open water area within the wetland. The open water area had algae growth around edges and sedges were the dominant vegetation present. September – Deep open water pools were present; however sampling was difficult. Sample taken from a shallow pool area that was on top of moss.																	
W34	N/A	17.09	11.65	N/A	0 (i.e., surface)	18	N/A	26	25	N/A	48.3	25.9	N/A	4.65	2.48	N/A	6.46	6.13
2012 Comments	July – Sample taken in 100% open water pond (within the bottom of a bowl/gully) with no vegetation. Standing dead (i.e., aspen) were present. September - Sample taken off the road in 100% open water pond (within the bottom of a bowl/gully) with no vegetation.																	

Notes: Water quality field measurements were taken with a YSI 556 (calibrated September 16, 2011) on September 25, 2011 for the wetlands sampled. The field duplicate was taken in Wetland W2.
In 2012, five additional wetlands were assessed and water quality measurements were taken (W23, W24, W28, W33, & W34). The field duplicate was taken in Wetland W23.
July 2012 water quality measurements were taken with the Oakton handheld multi-meter 24 hours following sample collections for W2, W4, W8, W12, W16, W19, W23, W24, and W28. Therefore water temperature and oxygen levels were not recorded.
September 2012 water quality measurements were taken with the Hanna Probe HI9829. The field duplicate was taken in Wetland C4
.

Table 3.1-2: In Situ Measurements - 2013

2013	Date	Temp (Co)	Cond (µS/cm)	DO (%)	DO (mg/L)	pH
B13012A	11-Jul	-	-	-	-	-
		No surface water present for sampling.				
B13012B	11-Jul	-	-	-	-	-
		No surface water present for sampling.				
B13013A	11-Jul	12.7	163	-	-	6.62
		-				
B13013B	11-Jul	10.1	166	-	-	7.05
		-				
B13014A	11-Jul	12.3	169	-	-	6.91
		Water quality collected from side channel connecting to river, near plot centre.				
B13015A	11-Jul	11.8	123	-	-	7.58
		Water quality collected from stagnant side channel.				
B13016A	15-Jul	9.67	69	51.5	5.84	-
		Temperature ~20°C, <10% cloud cover. Sample taken from small stagnant pond of surface water ~20 m from creek. Tadpoles observed in pool.				
B13017A	15-Jul	15.4	113.4	38.8	3.98	6.69
		Sunny, Temperature ~18° C. Lots of water. Sample taken at flagging.				
B13018A	12-Jul	7.5	86	-	-	6.86
		Water quality collected from shallow water between hummocks.				
B13020A	15-Jul	12.15	167.7	20.7	2.13	6.73
		Sample taken 30 m away from flagging.				
B13020B	12-Jul	14.7	74	-	-	7.61
		Water quality collected from snake lake (lakeside veg. community).				
B13023A	12-Jul	9.4	82	-	-	6.75
		Water quality collected approximately 50 m north of tagged plot.				
B13027A	9-Jul	15	191	-	-	6
		-				
B13031A	15-Jul	10.66	115	49.2	5.35	6.545
		Sample taken from surface pool within sedge. Sunny, Temperature ~20° C.				
B13031B	10-Jul	6.6	81	-	-	7.11
		-				
B13036A	9-Jul	10.35	81	38	4.45	5.63
		High water level. Sample taken in mostly open water with tall sedges.				
B13036C	16-Jul	11	66	-	-	7.23
		-				
B13036D	9-Jul	8.7	95	-	-	6.77
		Water quality collected from shallow pool beneath overturned stump.				
B13037A	15-Jul	9.35	274.75	16.6	1.89	7.09

2013	Date	Temp (Co)	Cond (µS/cm)	DO (%)	DO (mg/L)	pH
		Very little water, sunny, Temperature ~20° C.				
B13038A	12-Jul	15.4	14.25	70	7.58	5.82
		Sample taken from stagnant water within peat and sedges.				
B13038B	16-Jul	11.3	11	-	-	6.4
		-				
B13041A	16-Jul	15.85	10.4	53.3	5.67	6.035
		Sample taken from clear water at edge of sedge. Very soft/muddy bottom. Sunny, clear skies. Temperature ~20° C.				
B13043A	12-Jul	14.7	120	-	-	6.85
		-				
B13043B	12-Jul	15.9	102	-	-	7.05
		Water quality collected from open water pond.				
B13050A	11-Jul	11.4	178	-	-	7.21
		-				
B13050B	11-Jul	11	149	-	-	6.9
		-				
B13051A	15-Jul	12.685	32	97.7	10.17	6.715
		Samples taken in small, slow moving, stream. Sunny, clear, Temperature ~22° C.				
B13053A	15-Jul	12.8	29.45	68.7	7.17	6.61
		Sunny with clouds. Temperature ~20° C. Sample taken at UTM 10U 0380836 5903598.				
B13060A	15-Jul	15.1	20	-	-	7.14
		Samples taken from standing open water in sedge meadow.				
BWR001A	13-Jul	6.2	53	-	-	7.15
		Water quality collected from nearby creek.				
BWR002A	16-Jul	8.35	57.55	58.5	6.69	6.79
		Wetland mostly composed of mosses and grasses. Sample taken from small, shallow patch of stagnant water. Duplicate taken here.				
BWR003A	16-Jul	5.2	34.95	57	7.33	6.645
		Difficult to find surface water. Sample taken from small mossy water hole at wetland edge (in shade). Sunny, clear skies, Temperature ~23° C.				
BWR003B	16-Jul	10.45	21.6	37.7	4.17	5.885
		Sample taken from pool in sedges. Wetland mostly composed of grasses.				
BWR003C	14-Jul	9.2	14	-	-	5.62
		Water quality collected from standing water approximately 20 m north of plot centre.				
BWR005A	13-Jul	12.2	86	-	-	6.39
		Water quality collected from standing pools.				
BWR005B	13-Jul	10.4	113	-	-	6.13
		Water quality collected from small pockets of standing water.				
BWR006A	16-Jul	11.8	44.55	23.3	2.32	5.395

2013	Date	Temp (Co)	Cond (µS/cm)	DO (%)	DO (mg/L)	pH
		Small pool in mosses and grasses.				
BWR006B	16-Jul	11.9	30.25	14.2	1.57	5.9
		Small pool in shrubs and mosses at wetland edge.				
BWR008A	13-Jul	11.5	-	-	-	6.77
		No surface water - water quality collected from hole made in moss. No EC or TDS due to turbidity resulting from making hole.				
BWR019A	16-Jul	8.25	95.95	6.1	0.69	5.73
		Sample taken from area of small shrubs and sedges. Sunny, clear, Temperature ~25° C.				
WL13	15-Jul	22.4	43	86.2	7.49	6.67
		Sample taken at UTM 10 U 0373465 5899837. Sunny, light winds, Temperature ~20° C.				
WL16	15-Jul	11.09	74	45.2	4.97	6.67
		Pocket of water in vegetation. Field Blank done here.				
WL19	15-Jul	15.42	37	82.8	8.31	5.89
		Sample taken from edge of open water on surface of vegetation.				
WL28	15-Jul	10.5	41.7	78.7	8.8	6.89
		Sunny with clouds. Temperature ~20° C.				

Notes: 2013 field water quality measurements were collected partly by AMEC staff (for samples collected between July 9 to 14) using a Hanna Instruments handheld probe HI98129 and by Avison Management Services (for July 15 and 16) using a YSI 556 handheld multimeter.

Appendix 3.2
Field Data Summary Statistics by Wetlands Type

Sample Period	Ecosite		Temp (℃)	Cond (µS/cm)	DO (%)	DO (mg/L)	pH
Sep-11	Fen	max	6.51	150	86.7	11.55	10.49
		mean	3.80	65.22	62.91	8.31	8.61
		min	2.3	21	35.8	4.74	6.11
	Bog	n=1	3.16	48	35.8	4.74	6.11
	Swamp	n=1	3.83	90	49	6.41	8.65
	All Sites	max	6.51	150	86.7	11.55	10.49
		mean	3.80	65.22	62.91	8.31	8.61
		min	2.3	21	35.8	4.74	6.11
Jul-12	Fen	max	17.09	117	48.3	4.65	7
		mean	15.33	43.33	31.70	3.13	6.37
		min	14.55	26	19.6	1.98	5.5
	Bog	max	18.97	58	78.6	7.24	7.15
		mean	18.97	43.33	78.60	7.24	6.38
		min	18.97	35	78.6	7.24	5.5
	Swamp	n=1	14.94	63	19.6	1.98	6.34
	Marsh	n=1	-	46	-	-	7.1
	All Sites	max	18.97	117	78.6	7.24	7.15
		min	14.55	26	19.6	1.98	5.5
		mean	16.05	44.57	41.08	3.95	6.48
Sep-12	Fen	max	16.77	170	96.2	9.1	7.03
		mean	9.95	52.17	46.32	4.25	5.95
		min	7.27	20	21.4	1.48	5.26
	Bog	max	17.06	61	110	9.33	6.71
		mean	9.95	48.67	67.07	6.22	6.29
		min	8.12	40	24.3	2.51	5.6
	Swamp	n=1	9.27	53	44.6	1.48	5.36
	Marsh	n=1	5.74	63	92.1	9.97	7.01
	All Sites	max	17.06	170	110	9.97	7.03
		mean	10.16	52.43	54.14	5.02	6.08
		min	5.74	20	21.4	1.48	5.26
Jul-13	Fen	max	22.4	274.75	97.7	10.17	7.21
		mean	12.40	79.55	57.06	6.08	6.60
		min	5.2	10.4	14.2	1.57	5.82
	Bog	max	15.42	191	82.8	8.8	7.11
		mean	10.43	83.03	51.33	5.49	6.30
		min	6.6	14	6.1	0.69	5.62
	Swamp	max	11.8	166	51.5	5.84	7.11
		mean	9.37	91.11	37.40	4.08	6.58
		min	6.6	44.55	23.3	2.32	5.395

Sample Period	Ecosite		Temp (℃)	Cond (µS/cm)	DO (%)	DO (mg/L)	pH
	Marsh	max	15.4	169	38.8	4.45	7.61
		mean	12.78	115.63	38.40	4.22	6.78
		min	10.35	74	38	3.98	5.63
	All Sites	max	22.4	274.75	97.7	10.17	7.61
		mean	11.63	86.09	49.71	5.33	6.60
		min	5.2	10.4	6.1	0.69	5.395
All Years	Fen	max	22.4	274.75	97.7	11.55	10.49
		mean	10.42	63.33	52.50	5.73	6.73
		min	2.3	10.4	14.2	1.48	5.26
		count	48	55	39	39	56
	Bog	max	18.97	191	110	9.33	7.15
		mean	10.68	67.90	57.88	5.84	6.30
		min	3.16	14	6.1	0.69	5.5
		count	15	17	9	9	17
	Swamp	max	14.94	166	51.5	6.41	8.65
		mean	9.36	82.69	37.60	3.61	6.67
		min	3.83	44.55	19.6	1.48	5.36
		count	8	8	5	5	7
	Marsh	max	15.4	169	92.1	9.97	7.61
		mean	11.90	102.04	56.30	6.13	6.84
		min	5.74	46	38	3.98	5.63
		count	8	9	3	3	9
	All Sites	max	22.4	274.75	110	11.55	10.49
		mean	10.69	68.94	52.58	5.66	6.71
		min	2.3	10.4	6.1	0.69	5.26
		count	68	76	48	48	76

Appendix 3-3
Water Quality - Lab Results

Appendix 3.3 Table 1: September 2011 Wetland Surface Water Quality Results

		W2	W4	W8	W12	W13	W15	W16	W19	C4	BC MOE guideline FWA	
Parameter	**Units**										30-day	maximum
Physical Tests												
pH @ 25°C BC-T	pH units	5.95	6.98	6.78	6.65	6.89	7.32	7.64	6.25	7.26	6.5-9.0	
Conductivity @ 25°C	mS/cm	19.0	35.0	28.0	41.0	39.0	73.0	167.0	49.0	82.0		
T-Dissolved Solids180°C	mg/L (ppm)	40.0	48.0	52.0	68.0	76.0	84.0	144.0	148.0	56.0		
Total Suspended Solids @105°C	mg/L (ppm)	16.0	3.0	79.0	35.0	22.0	< 2	626.0	304.0	187.0		
Turbidity	NTU	4.4	1.1	28	11	31	0.50	200.00	110.00	89		
T-Hardness as CaCO3	mg/L (ppm)	< 6.0	13.10	10.60	15.00	17.10	31.50	84.20	19.60	34.60		
Dissolved Anions												
Total Alkalinity as CaCO3	mg/L (ppm)	4	13	10	13	14	33.0	81.0	10.0	40.0		
Fluoride-D	mg/L (ppm)	0.04	0.05	0.05	0.06	0.05	0.080	0.120	0.100	0.060		0.2-0.3 [a]
Sulphate-D	mg/L (ppm)	0.6	1	1	1.2	0.9	2	1.900	< 0.5	< 0.5	65	250
Chloride-D	mg/L (ppm)	0.5	0.5	0.4	0.9	0.6	0.60	1.50	2.50	0.70	150	
Nutrients												
Ammonia - Nitrogen	mg/L (ppm)	0.04	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	0.15	< 0.02		
Nitrate-N-D	mg/L (ppm)	< 0.005	0.006	0.02	0.012	0.006	0.006	< 0.005	0.012	< 0.005	3	31.3
Nitrite-N-D	mg/L (ppm)	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.02	0.06
Total Kjeldahl Nitrogen (TKN)	mg/L (ppm)	0.31	0.43	0.37	0.75	0.23	1.50	1.41	2.00	1.24	1.94-1.95 [b]	26.8-13.4
Phosphorus-Ortho-Dissolved-LL	mg/L (ppm)	0.021	0.021	0.026	0.033	< 0.003	0.008	0.017	0.16	0.003		
Phosphorus-Total Dissolved-LL	mg/L (ppm)	0.003	0.001	0.003	0.007	0.004	0.032	0.003	0.221	0.003		
Organic Parameters												
Carbon (Total Organic)	mg/L (ppm)	11.3	8.1	8.6	16.3	16.1	10.90	15.20	41.00	11.70		
Carbon (Dissolved Organic)	mg/L (ppm)	11.2	8.1	8.1	15.8	15.7	10.90	13.10	40.60	10.70		
Total Metals												
Aluminum	mg/L (ppm)	0.183	0.046	0.212	0.273	0.211	0.0930	0.0280	0.0670	0.0510		
Antimony	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00006	< 0.00005	< 0.00005	< 0.00005		0.02
Arsenic	mg/L (ppm)	0.0005	0.0002	0.0002	0.0002	0.0001	0.00070	< 0.0001	0.00020	0.00020	0.005	
Barium	mg/L (ppm)	0.0057	0.0028	0.0254	0.0109	0.0178	0.0055	0.0280	0.0237	0.0098	0.001	0.005
Beryllium	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		0.0053
Boron	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.0010	< 0.001	< 0.001	1.2	
Cadmium	mg/L (ppm)	0.000034	< 0.000015	0.000088	0.000024	0.000017	< 0.000015	0.000019	0.000354	0.000062		0.000003-0.000031
Calcium	mg/L (ppm)	1.5	4.2	3.2	4.4	5.1	9.100	24.300	4.400	7.200		
Chromium	mg/L (ppm)	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.001	< 0.0003	< 0.0003	< 0.0003		0.0089
Cobalt	mg/L (ppm)	0.00013	< 0.00002	0.00015	0.00007	0.00003	0.000150	0.000190	0.000160	0.000090	0.004	0.11
Copper	mg/L (ppm)	0.0003	0.0001	0.0005	0.0009	0.0004	0.0006	0.0003	0.0014	0.0001	0.002-0.0038	0.0026-0.0108
Iron	mg/L (ppm)	0.166	0.0325	0.422	0.386	0.148	0.263	0.357	0.325	4.630		1
Lead-T	mg/L (ppm)	< 0.00005	< 0.00005	0.00011	< 0.00005	< 0.00005	< 0.00005	0.000	0.000	< 0.00005	0.003438-0.0062	0.0033-3
Lithium	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.014	0.87
Magnesium	mg/L (ppm)	< 0.50	0.63	0.66	0.97	1.07	2.12	5.71	2.1	4.06		
Manganese	mg/L (ppm)	0.021	0.00251	0.0306	0.00946	0.00267	0.07310	0.45200	0.05330	0.0527	0.634-1.018	
Mercury	mg/L (ppm)	< 0.000008	< 0.000008	0.000012	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000013	0.00002	0.00002	0.0001
Molybdenum	mg/L (ppm)	0.0001	0.0001	0.0002	< 0.00005	< 0.00005	0.0003	0.0002	0.0001	0.0004	1	2
Nickel	mg/L (ppm)	0.00029	< 0.00005	0.00021	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.000620	< 0.00005		0.025-0.15
Phosphorus	mg/L (ppm)	< 0.02	< 0.02	0.1200	< 0.02	< 0.02	0.0500	0.1200	0.6700	0.0800		
Potassium	mg/L (ppm)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.90	0.9	< 0.5		
Selenium	mg/L (ppm)	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	2	
Silicon	mg/L (ppm)	2.33	3.16	5.10	3.69	4.05	7.07	5.75	7.86	5.54		
Silver	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00005-0.0015	0.0001-0.003
Sodium	mg/L (ppm)	1.20	1.80	1.60	1.80	1.70	2.80	4.40	3.40	2.60		
Strontium	mg/L (ppm)	0.0127	0.0397	0.0389	0.0352	0.0460	0.0623	0.1740	0.0318	0.0785		

Appendix 3.3 Table 1: September 2011 Wetland Surface Water Quality Results

		W2	W4	W8	W12	W13	W15	W16	W19	C4	BC MOE guideline FWA	
Parameter	**Units**										30-day	maximum
Thallium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		0.0003
Tin	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Titanium	mg/L (ppm)	0.000600	0.000200	0.002500	0.004000	0.001600	0.002500	0.000900	0.001800	0.001300		
Uranium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.0001300	< 0.00005	< 0.00005	< 0.00005		0.3
Vanadium	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	0.0004	< 0.0001	0.0010	< 0.0001	< 0.0001	< 0.0001		
Zinc	mg/L (ppm)	0.0010	0.0010	0.0049	0.0030	0.0011	0.0025	0.0010	0.0071	0.0016	0.0075-0.0104	0.033-0.0359
T-Hardness as CaCO3	mg/L (ppm)	< 6.0	13.10	10.60	15.00	17.10	31.50	84.20	19.60	34.60		
Dissolved Metals												
Aluminum	mg/L (ppm)	0.160	0.046	0.059	0.222	0.188	0.067	0.013	0.033	0.006	0.05	0.1
Antimony	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00006	< 0.00005	< 0.00005	< 0.00005		
Arsenic	mg/L (ppm)	0.0005	0.0002	0.0001	0.0002	0.0001	0.0006	< 0.0001	0.0002	0.0002		
Barium	mg/L (ppm)	0.0042	0.0027	0.0040	0.0065	0.0106	0.0047	0.0107	0.0015	0.0067		
Beryllium	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Boron	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Cadmium	mg/L (ppm)	0.000023	< 0.000015	0.000088	0.000024	0.000017	< 0.000015	0.000019	0.000354	0.000049		
Calcium	mg/L (ppm)	1.500	4.200	2.600	4.400	5.100	9.100	23.600	4.100	6.600		
Chromium	mg/L (ppm)	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.00060	< 0.0003	< 0.0003	< 0.0003		
Cobalt	mg/L (ppm)	0.00012	< 0.00002	0.00003	0.00006	0.00003	0.00006	0.00002	0.00010	0.00003		
Copper	mg/L (ppm)	0.00030	0.00010	0.00020	0.00090	0.00040	0.00060	0.00030	0.00130	< 0.0001		
Iron	mg/L (ppm)	0.1140	0.0243	0.0612	0.2490	0.0870	0.1600	0.0066	0.1540	0.2550		0.35
Lead-D	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		
Lithium	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Magnesium	mg/L (ppm)	< 0.50	0.600	0.520	0.920	1.010	2.020	5.200	1.850	3.680		
Manganese	mg/L (ppm)	0.0195	0.0021	0.0058	0.0066	0.0019	0.0113	0.0030	0.0382	0.0168		
Mercury	mg/L (ppm)	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008		
Molybdenum	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.0003000	< 0.00005	< 0.00005	0.00013		
Nickel	mg/L (ppm)	0.000260	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00039	< 0.00005		
Phosphorus-D	mg/L (ppm)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.0300	< 0.01	0.2400	< 0.01		
Potassium	mg/L (ppm)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.8000	0.6000	< 0.5		
Selenium	mg/L (ppm)	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006		
Silicon	mg/L (ppm)	2.33	3.16	4.21	3.69	4.05	7.07	5.75	7.86	5.46		
Silver	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		
Sodium	mg/L (ppm)	1.10	1.70	1.40	1.70	1.60	2.70	4.10	3.20	2.40		
Strontium	mg/L (ppm)	0.012	0.039	0.023	0.033	0.044	0.061	0.148	0.019	0.064		
Thallium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		
Tin	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Titanium	mg/L (ppm)	0.00050	0.00020	0.00040	0.00300	0.00120	0.00150	< 0.0002	0.00050	< 0.0002		
Uranium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.0001200	< 0.00005	< 0.00005	< 0.00005		
Vanadium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	0.0003800	< 0.00005	0.0009400	< 0.00005	< 0.00005	< 0.00005		
Zinc	mg/L (ppm)	0.0010	0.0010	0.0022	0.0030	0.0011	0.0025	0.0010	0.0065	0.0006		
D-Hardness as CaCO3	mg/L (ppm)	< 6.0	13.00	8.60	14.70	16.80	31.20	80.40	17.70	31.60		
Cyanide												
Cyanide, total	mg/L (ppm)	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005		
Cyanide, WAD	mg/L (ppm)	<0.005	<0.005	<0.005		0.0057		0.0058	0.0134	0.0052		
cyanate	mg/L (ppm)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
thiocyanate	mg/L (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		

Appendix 3.3 Table 2: July & September 2012 Wetland Surface Water Quality Results

		C4	C4	WL2	WL2	WL4	WL4	WL8	WL8	WL12	WL12	WL13	WL13	WL15	WL15	WL16	WL16	WL19	WL19	WL23	WL23	WL24	WL24	WL28	WL28	WL33	WL33	WL34	WL34	BC MOE guideline FWA	
Parameter	**Units**																													30-day	maximum
Physical Tests																															
pH @ 25°C BC-T	pH units	7.47	7.14	7.19	7.24	7.25	7.23	7.32	6.57	6.96	6.68	7.18	6.91	7.72	6.12	7.92	7.72	6.89	6.75	7.39	6.41	7.54	7.55	7.29	6.69	7.61	7.3	7.26	6.91	6.5-9.0	
Conductivity @ 25°C	mS/cm	45	85	37	38	33	39	34	43	28	35	32	42	76	55	112	145	37	49	49	39	47	65	35	41	54	47	33	30		
T-Dissolved Solids180°C	mg/L (ppm)	3	80	< 2	44	2	40	45	48	3	72	3	36	6	192	7	100	69	104	4	48	3	60	9	40	3	80	7	52		
Total Suspended Solids @105°C	mg/L (ppm)	32	57	48	< 2	40	< 2	8	48	64	5	56	< 2	40	33	60	6	84	14	36	< 2	36	5	52	< 2	60	< 2	60	3		
Turbidity	NTU	1.3	21	1.4	0.9	0.6	0.5	22	9.9	0.5	1.7	0.6	0.8	0.8	14	1.5	1.3	16	5.8	5.3	1.4	0.7	2.9	1.7	1.2	0.6	0.6	1.8	4		
T-Hardness as CaCO3	mg/L (ppm)	26	41.1	11.9	14.9	11.4	14.5	14.2	20	10.5	12.9	12.8	18.1	33.3	41.4	56.1	74.5	19	24.9	19	15.6	18.7	27	15.1	17.6	22	19.2	10.2	8.5		
Dissolved Anions																															
Total Alkalinity as CaCO3	mg/L (ppm)	26	43	13	16	15	16	17	16	10	10	13	17	45	14	66	75	14	14	21	13	27	33	17	17	33	23	16	10		
Fluoride-D	mg/L (ppm)	0.06	0.06	0.05	0.05	0.06	0.05	0.06	0.05	0.06	0.06	0.07	0.05	0.08	0.08	0.09	0.09	0.09	0.09	0.07	0.05	0.06	0.06	0.06	0.05	0.08	0.09	0.06	0.06		0.4-1.215755
Sulphate-D	mg/L (ppm)	< 0.5	< 0.5	2.6	< 0.5	1	< 0.5	1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.8	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	3.3	< 0.5	0.7	< 0.5	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	65	250
Chloride-D	mg/L (ppm)	0.8	< 0.1	0.6	< 0.1	0.8	0.2	0.8	< 0.1	0.9	0.3	0.9	0.1	0.6	< 0.1	0.9	0.2	1.1	1.2	1.9	0.7	1	0.1	0.9	< 0.1	0.9	< 0.1	1.1	0.2	150	
Nutrients																															
Ammonia - Nitrogen	mg/L (ppm)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	1.02-1.64 [b]	5.66-24.3 [b]
Nitrate-N-D	mg/L (ppm)	0.006	0.013	< 0.005	< 0.005	0.018	0.026	0.019	0.012	< 0.005	0.036	0.026	0.023	0.012	0.039	0.005	0.067	< 0.005	0.042	0.012	0.046	0.006	< 0.005	< 0.005	0.011	0.009	0.038	< 0.005	0.015	3	31.3
Nitrite-N-D	mg/L (ppm)	< 0.003	0.005	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.003	< 0.003	0.003	< 0.003	< 0.003	< 0.003	0.006	< 0.003	< 0.003	< 0.003	0.004	< 0.003	0.004	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.005	0.02	0.06
Total Kjeldahl Nitrogen (TKN)	mg/L (ppm)	0.96	0.7	0.38	0.08	0.25	0.08	0.61	1.61	0.53	0.67	0.26	0.11	0.47	0.93	0.73	0.34	1.13	0.9	0.17	0.35	0.2	0.1	0.33	< 0.08	0.53	0.15	0.74	0.43		
Phosphorus-Ortho-Dissolved-LL	mg/L (ppm)	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.159	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003		
Phosphorus-Total Dissolved-LL	mg/L (ppm)	0.002	< 0.001	0.004	0.02	0.001	< 0.001	< 0.001	0.005	0.002	0.003	< 0.001	< 0.001	0.054	0.065	< 0.001	< 0.001	0.159	0.016	0.002	< 0.001	0.007	< 0.001	0.005	< 0.001	0.006	< 0.001	0.031	0.034		
Organic Parameters																															
Carbon (Total Organic)	mg/L (ppm)	14.6	16	9.9	9.8	9.6	8.8	10.6	22.8	20.5	21.6	14.3	13.6	8.6	83.5	14.6	16.1	34.8	40.5	9.2	17.9	6.4	4.6	12.9	12.5	7.9	9.6	10	13.1		
Carbon (Dissolved Organic)	mg/L (ppm)	13.7	16	9.5	9.8	9	8.8	9.9	20.9	20.3	20.1	13.9	13	8.3	76.3	14.1	14.2	31.7	37.2	8.8	17.8	6.2	4.6	12.1	11.4	7.9	9.6	9.8	12.2		
Total Metals																															
Aluminum	mg/L (ppm)	0.076	0.042	0.175	0.185	0.077	0.036	0.074	0.17	0.417	0.285	0.194	0.171	0.034	0.307	0.028	0.004	0.037	0.077	0.27	0.253	0.062	0.071	0.247	0.182	0.013	< 0.002	0.065	0.101		
Antimony	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.0001	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00006	0.00012	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00013	< 0.00005	0.00008	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		0.02
Arsenic	mg/L (ppm)	0.0001	< 0.0001	0.0007	0.001	0.0003	0.0003	0.0002	0.0001	0.0002	0.0001	0.0002	< 0.0001	0.0012	0.0029	0.0001	0.0001	0.0001	0.0002	0.0014	0.0018	0.0005	0.0005	0.0009	0.001	0.0001	< 0.0001	0.0002	0.0002	0.005	
Barium	mg/L (ppm)	0.00718	0.0117	0.00476	0.0043	0.00265	0.00262	0.0161	0.0225	0.0143	0.0196	0.00749	0.00989	0.00853	0.0132	0.0119	0.0113	0.00094	0.0175	0.0045	0.00364	0.00374	0.00543	0.0111	0.0109	0.00169	0.00389	0.00512	0.0049	1	5
Beryllium	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		0.0053
Boron	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	1.2	
Cadmium	mg/L (ppm)	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	0.000033	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	0.000028	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015		0.00000397-0.00002571
Calcium	mg/L (ppm)	5.8	8.7	3.7	4.6	3.7	4.6	4.6	6.8	3	3.7	3.9	5.4	9.7	13	16.8	22.8	4.2	6.5	6	5.1	5.6	7.8	4.7	5.4	5.8	4.8	2.6	2		
Chromium	mg/L (ppm)	< 0.0003	0.0003	< 0.0003	0.0005	< 0.0003	0.0004	< 0.0003	0.0006	0.0004	0.0007	< 0.0003	0.0006	0.0005	0.004	< 0.0003	0.0003	< 0.0003	0.0006	< 0.0003	0.0005	< 0.0003	0.0006	< 0.0003	0.0005	0.0005	0.0003	0.0009	0.0006		0.001-0.0089
Cobalt	mg/L (ppm)	0.00008	0.0002	0.00004	0.00007	< 0.00002	< 0.00002	0.00002	0.00011	0.00009	0.00007	0.00002	0.00003	0.00006	0.00114	< 0.00002	0.00005	0.00015	0.00045	0.00009	0.00023	0.00002	0.00007	0.00004	0.00007	0.00004	< 0.00002	0.00011	0.00011	0.004	0.11
Copper	mg/L (ppm)	< 0.0001	0.0002	0.0005	0.0004	< 0.0001	0.0008	< 0.0001	0.0001	0.0001	0.0002	0.0003	0.0002	0.0005	0.001	< 0.0001	0.0001	< 0.0001	< 0.0001	0.0004	0.0002	0.0001	0.0002	0.0004	0.0004	< 0.0001	< 0.0001	0.0002	0.0005	0.002-0.00298	0.002799-0.009003
Iron	mg/L (ppm)	1	1.63	0.244	0.327	0.0419	0.0254	0.0936	0.252	0.215	0.144	0.0622	0.0859	0.165	3.19	0.25	0.126	0.15	0.515	0.251	0.416	0.12	0.231	0.396	0.717	0.0726	0.0104	0.123	0.157		1
Lead-T	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00011	0.00008	< 0.00005	0.00048	< 0.00005	< 0.00005	0.00013	< 0.00005	< 0.00005	0.00019	0.00014	< 0.00005	0.00008	< 0.00005	< 0.00005	< 0.00005	0.00009	< 0.00005	< 0.00005	0.00007	0.00007	0.003448-0.005499	0.00354-0.05613
Lithium	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.014	0.87
Magnesium	mg/L (ppm)	2.78	4.72	0.65	0.83	0.55	0.72	0.64	0.74	0.75	0.92	0.77	1.13	2.22	2.13	3.42	4.26	2.11	2.1	0.99	0.72	1.15	1.81	0.85	0.99	1.83	1.77	0.92	0.84		
Manganese	mg/L (ppm)	0.067	0.164	0.0126	0.0232	0.00303	0.00163	0.00486	0.0279	0.0197	0.0167	0.00037	0.00975	0.0259	0.126	0.258	0.0678	0.0905	0.237	0.0619	0.0786	0.00934	0.0262	0.0601	0.0272	0.00462	0.00098	0.0483	0.0355	0.6424-0.9328	0.63367-1.36099
Mercury	mg/L (ppm)	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.000011	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.000017	< 0.000005	< 0.000005	< 0.000005	0.000012	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.00001	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.00002	0.0001
Molybdenum	mg/L (ppm)	0.00025	0.00056	0.00008	0.00012	0.00008	0.00007	< 0.00005	0.00018	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00126	0.0002	0.00006	0.00006	< 0.00005	0.00011	0.00019	< 0.00005	0.00026	0.00037	0.00011	0.00012	0.00017	0.00005	0.00047	0.00037	1	2
Nickel	mg/L (ppm)	0.00013	0.00009	0.00077	0.00079	0.00006	0.00011	0.00006	0.00027	0.00036	0.00035	0.00016	0.0002	0.00022	0.00175	0.00013	0.00017	0.0004	0.001	0.00038	0.00042	0.00013	0.00015	0.00034	0.00042	< 0.00005	< 0.00005	0.00034	0.00039		0.025-0.065
Phosphorus	mg/L (ppm)	0.04	0.14	< 0.02	0.02	< 0.02	< 0.02	< 0.02	0.09	< 0.02	< 0.02	< 0.02	< 0.02	0.08	0.17	0.03	< 0.02	0.19	0.43	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	0.03	0.05	0.09		

Appendix 3.3 Table 2: July & September 2012 Wetland Surface Water Quality Results

		C4	C4	WL2	WL2	WL4	WL4	WL8	WL8	WL12	WL12	WL13	WL13	WL15	WL15	WL16	WL16	WL19	WL19	WL23	WL23	WL24	WL24	WL28	WL28	WL33	WL33	WL34	WL34	BC MOE guideline FWA	
Parameter	**Units**																													30-day	maximum
Potassium	mg/L (ppm)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	< 0.5	1.3	1.4		
Selenium	mg/L (ppm)	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	2	
Silicon	mg/L (ppm)	6.99	6.77	4.41	5.14	3.45	3.16	4.3	3.39	2.56	1.72	4.47	4.61	7.83	8.28	5.73	5.94	6.13	6.8	5.45	5.2	6.3	7.15	4.45	4.48	1.11	2.95	0.36	1.47		
Silver	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00005	0.0001
Sodium	mg/L (ppm)	2.3	3.4	1.6	2	1.9	2	1.3	1.8	1.8	2	1.5	1.8	3.1	2.8	3.2	3.9	2.8	3.4	2.3	1.8	2.2	2.8	1.5	1.7	2.3	2.2	1.9	1.9		
Strontium	mg/L (ppm)	0.0575	0.0894	0.0251	0.0297	0.0355	0.041	0.0478	0.0626	0.0397	0.0462	0.0297	0.0449	0.0732	0.0795	0.0918	0.118	0.0167	0.041	0.0406	0.0386	0.0434	0.0588	0.0443	0.0502	0.0397	0.0343	0.0164	0.0135		
Thallium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		0.0003
Tin	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Titanium	mg/L (ppm)	0.0013	0.0009	0.0017	0.002	0.0005	< 0.0002	0.0007	0.0019	0.0012	0.0007	0.0012	0.0009	0.0009	0.004	0.0004	< 0.0002	0.0006	0.0016	0.0052	0.0015	0.0011	0.0016	0.0026	0.0018	< 0.0002	< 0.0002	0.0042	0.0025		
Uranium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00007	0.00026	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00005	0.00006	0.00011	0.00007	< 0.00005	< 0.00005	< 0.00005	< 0.00005		0.3
Vanadium	mg/L (ppm)	0.0001	< 0.0001	0.0002	0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0002	< 0.0001	0.0003	< 0.0001	0.0013	0.0039	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0003	0.0002	0.0003	0.0003	0.0003	0.0001	< 0.0001	< 0.0001	0.0002	0.0001		
Zinc	mg/L (ppm)	0.0058	0.0033	0.0015	0.0023	0.001	0.0024	0.002	0.0088	0.0173	0.0052	0.0009	0.0023	0.0031	0.007	0.0013	0.0023	0.0035	0.0048	0.0392	0.0548	0.0011	0.0025	0.0028	0.0038	0.0034	0.0028	0.0038	0.0061	0.0075	0.033
T-Hardness as CaCO3	mg/L (ppm)	26	41.1	11.9	14.9	11.4	14.5	14.2	20	10.5	12.9	12.8	18.1	33.3	41.4	56.1	74.5	19	24.9	19	15.6	18.7	27	15.1	17.6	22	19.2	10.2	8.5		
Dissolved Metals																															
Aluminum	mg/L (ppm)	0.043	0.009	0.118	0.163	0.068	0.036	0.058	0.079	0.408	0.285	0.188	0.171	0.031	0.307	0.004	0.004	0.027	0.041	0.137	0.253	0.047	0.029	0.197	0.166	0.006	< 0.002	0.086	0.101	0.02-0.05	0.05-0.1
Antimony	mg/L (ppm)	< 0.00005	< 0.00005	0.00006	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.0001	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00006	0.00012	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00013	< 0.00005	0.00008	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		
Arsenic	mg/L (ppm)	< 0.0001	< 0.0001	0.0006	0.001	0.0002	0.0003	0.0001	0.0001	0.0001	0.0001	< 0.0001	< 0.0001	0.0011	0.0028	< 0.0001	0.0001	< 0.0001	0.0002	0.0012	0.0018	0.0004	0.0005	0.0005	0.0008	< 0.0001	< 0.0001	0.0002	0.0002		
Barium	mg/L (ppm)	0.00318	0.00547	0.00296	0.0043	0.00206	0.00253	0.00357	0.00724	0.0138	0.0196	0.0066	0.00989	0.00828	0.0133	0.00751	0.0113	0.00055	0.00042	0.00371	0.00364	0.00374	0.00474	0.00835	0.0101	0.00128	0.00373	0.00512	0.0049		
Beryllium	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Boron	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Cadmium	mg/L (ppm)	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	0.000033	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	0.000028	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015	< 0.000015		
Calcium	mg/L (ppm)	5.5	8.2	3.7	4.6	3.6	4.6	4.6	6.4	3	3.7	3.8	5.4	9.7	12.9	16.2	22.8	4.1	5.8	5.9	5.1	5.6	7.8	4.7	5.4	5.8	4.8	2.5	2		
Chromium	mg/L (ppm)	< 0.0003	0.0003	< 0.0003	0.0005	< 0.0003	0.0004	< 0.0003	0.0006	0.0004	0.0007	< 0.0003	0.0006	0.0005	0.004	< 0.0003	0.0003	< 0.0003	0.0006	< 0.0003	0.0005	< 0.0003	0.0006	< 0.0003	0.0005	0.0005	0.0003	0.0009	0.0006		
Cobalt	mg/L (ppm)	0.00008	0.00011	0.00004	0.00007	< 0.00002	< 0.00002	0.00002	0.00007	0.00009	0.00007	0.00002	0.00003	0.00006	0.00108	< 0.00002	0.00005	0.00015	0.00011	0.00009	0.00023	0.00002	0.00004	0.00003	0.00005	0.00004	< 0.00002	0.00011	0.00011		
Copper	mg/L (ppm)	< 0.0001	< 0.0001	0.0002	0.0004	< 0.0001	< 0.0001	< 0.0001	0.0001	< 0.0001	0.0002	< 0.0001	0.0002	0.0003	0.001	< 0.0001	0.0001	< 0.0001	< 0.0001	< 0.0001	0.0002	< 0.0001	0.0002	< 0.0001	0.0004	< 0.0001	< 0.0001	< 0.0001	0.0005		
Iron	mg/L (ppm)	0.382	0.548	0.153	0.287	0.0297	0.0248	0.0439	0.079	0.192	0.135	0.0525	0.0792	0.12	3.03	0.0336	0.109	0.128	0.123	0.148	0.416	0.0772	0.106	0.12	0.208	0.0555	0.0104	0.123	0.157		0.35
Lead-D	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00013	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00008	< 0.00005	< 0.00005	< 0.00005	0.00006	< 0.00005	< 0.00005	< 0.00005	0.00007		
Lithium	mg/L (ppm)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		
Magnesium	mg/L (ppm)	2.66	4.72	0.62	0.83	0.53	0.72	0.62	0.74	0.74	0.92	0.74	1.13	2.17	2.13	3.29	4.26	2.05	2.1	0.99	0.72	1.15	1.81	0.85	0.99	1.83	1.77	0.97	0.84		
Manganese	mg/L (ppm)	0.0396	0.0954	0.0113	0.0232	0.00198	0.00163	0.00301	0.0159	0.0197	0.0138	0.00037	0.00207	0.0179	0.119	0.0183	0.0678	0.0905	0.021	0.0565	0.0786	0.00548	0.0151	0.00993	0.0199	0.00456	0.00068	0.0463	0.0329		
Mercury	mg/L (ppm)	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.000014	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.00001	< 0.000005	< 0.000005	< 0.000005	< 0.000005		
Molybdenum	mg/L (ppm)	0.00005	0.00009	0.00008	0.00012	0.00008	0.00006	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00112	0.00017	0.00006	0.00006	< 0.00005	0.00006	0.00019	< 0.00005	0.00026	0.00037	0.00011	0.00012	0.00017	< 0.00005	0.00041	0.00036		
Nickel	mg/L (ppm)	0.00013	0.00007	0.00077	0.00079	0.00006	0.00007	0.00006	0.00019	0.00036	0.00035	0.00016	0.0002	0.00022	0.00175	0.00013	0.00017	0.0004	0.00043	0.00038	0.00054	0.00013	0.00016	0.00034	0.00053	< 0.00005	< 0.00005	0.00034	0.00039		
Phosphorus-D	mg/L (ppm)	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	0.09	< 0.01	< 0.01	0.15	0.03	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.03	0.06		
Potassium	mg/L (ppm)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	< 0.5	1.3	1.4		
Selenium	mg/L (ppm)	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006		
Silicon	mg/L (ppm)	6.82	6.77	4.29	5.14	3.26	3.16	4.19	3.39	2.48	1.7	4.47	4.61	7.83	8.28	5.73	5.94	6.13	6.8	5.26	5.2	6.03	7.15	4.24	4.48	1.13	2.95	0.36	1.47		
Silver	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		
Sodium	mg/L (ppm)	2.2	3.4	1.5	2	1.7	2	1.3	1.8	1.8	2	1.5	1.8	3.1	2.8	3.2	3.9	2.8	3.4	2.3	1.8	2.2	2.8	1.5	1.7	2.3	2.2	1.9	1.9		
Strontium	mg/L (ppm)	0.0491	0.0865	0.0239	0.0327	0.0342	0.0455	0.0395	0.0548	0.0385	0.0489	0.0284	0.0449	0.071	0.0795	0.0852	0.118	0.0136	0.025	0.0385	0.0386	0.0417	0.0588	0.0426	0.0502	0.038	0.0343	0.0158	0.0135		
Thallium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005		
Tin	mg/L (ppm)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
Titanium	mg/L (ppm)	0.0003	< 0.0002	0.0009	0.0016	0.0003	< 0.0002	0.0004	0.0002	0.001	0.0007	0.0011	0.0008	0.0009	0.0039	< 0.0002	< 0.0002	0.0005	0.0004	0.0022	0.0014	0.0007	0.0005	0.0015	0.0017	< 0.0002	< 0.0002	0.0042	0.0025		
Uranium	mg/L (ppm)	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00007	0.00026	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00005	< 0.00005	0.00011	0.00007	< 0.00005	< 0.00005	< 0.00005	< 0.00005		

Appendix 3.3 Table 2: July & September 2012 Wetland Surface Water Quality Results

		C4	C4	WL2	WL2	WL4	WL4	WL8	WL8	WL12	WL12	WL13	WL13	WL15	WL15	WL16	WL16	WL19	WL19	WL23	WL23	WL24	WL24	WL28	WL28	WL33	WL33	WL34	WL34	BC MOE guideline FWA	
Parameter	**Units**																													30-day	maximum
Vanadium	mg/L (ppm)	0.00005	< 0.00005	0.00012	0.0002	0.00007	< 0.00005	< 0.00005	< 0.00005	0.00019	< 0.00005	0.00027	0.00007	0.00125	0.00391	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00021	0.00017	0.00025	0.00025	0.00016	0.00013	< 0.00005	< 0.00005	0.00017	0.00014		
Zinc	mg/L (ppm)	0.0018	0.0033	0.0015	0.0023	0.001	0.0024	0.002	0.0088	0.0021	0.0052	0.0009	0.0023	0.0031	0.007	0.0013	0.0023	0.0035	0.004	0.0392	0.0548	0.0011	0.0025	0.0028	0.0038	0.0034	0.0028	0.0038	0.0061		
D-Hardness as CaCO3	mg/L (ppm)	24.8	40	11.7	14.9	11.2	14.5	14	19	10.5	12.9	12.6	18.1	33.2	41.1	53.9	74.5	18.7	23.1	18.8	15.6	18.8	27	15.1	17.6	21.9	19.2	10.3	8.5		
Cyanide																															
Cyanide, total	mg/L (ppm)																														
Cyanide, WAD	mg/L (ppm)																														
cyanate	mg/L (ppm)																														
thiocyanate	mg/L (ppm)																														

Notes:
(a) Based on miscalculation of safety factor. A factor of 10 yields 4 mg/L - 6 mg/L 30-day average.
(b) pH and temperature dependent. Assume pH ranges from 6.5 to 8.0, and temperature = 16ºC

Appendix 3.3 Table 3: July 2013 Wetland Surface Water Quality Results

Parameters	Units	B13051A 15/07/2013	B13053A 15/07/2013	B13016A 15/07/2013	B13017A 15/07/2013	B13020A 15/07/2013	B13031A 15/07/2013	B13036A 16/07/2013	B13037A 15/07/2013	B13038A 16/07/2013	B13041A 16/07/2013	BWR002A 16/07/2013	BWR003A 16/07/2013	BWR003B 16/07/2013	BWR003C 12/08/2013	BWR006A 16/07/2013	BWR006B 16/07/2013	BWR019A 16/07/2013	WL13 15/07/2013	WL16 15/07/2013	WL19 15/07/2013	WL28 15/07/2013	BC MoE Guideline 30-day	BC MoE Guideline Maximum
Physical Tests																								
pH @ 25°C BC-D	pH	7.08	6.81	7.1	7.03	7.12	7.12	7.04	7.52	**5.78**	**6.17**	6.73	6.76	**6.13**	7.41	**4.29**	**5.72**	7.02	6.59	7.19	**6.46**	6.79	6.5-9.0	
Conductivity @ 25°C	uS/cm	43	28	89	89	163	110	66	252	15	13	26	38	20	50	30	28	127	24	94	41	34		
T-Dissolved Solids180°C	mg/L	40	56	72	116	140	80	64	184	24	8	72	16	32	72	44	64	172	24	88	116	68		
Total Suspended Solids @105°C	mg/L	<2	3	20	45	672	9	4	4010	221	4	55	175	2500	< 2	5	15	95	101	373	22	66		
Turbidity	NTU	0.8	1	**10**	**13**	**93**	4	1	6.8	**25**	2.1	6.2	1.9	**330**	1	2.2	3.3	**18**	**14**	**18**	**9.2**	**22**	8	
T-Hardness as $CaCO_3$	mg/L	22.6	15.7	37.6	43.1	82	53.8	27.4	121	6	6	12.4	14.5	8.8	20.6	6	15.6	83.7	11	53.2	24.7	18.2		
Dissolved Anions																								
Total Alkalinity as $CaCO_3$	mg/L	20	9	42	43	80	53	30	128	2	3	10	11	5	18	<1	4	57	6	44	13	11		
Fluoride-D	mg/L	0.02	0.03	0.07	0.06	0.07	0.07	0.05	0.09	0.02	0.03	0.02	0.03	0.03	0.04	0.03	0.03	0.09	0.03	0.07	0.05	0.03		0.4-1.33[3]
Sulphate-D	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	3.1	<0.5	3.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	115-270[4]	
Chloride-D	mg/L	0.2	0.2	0.3	0.3	0.4	0.4	0.3	0.6	0.5	0.3	0.3	0.4	0.4	0.2	0.3	0.4	0.3	0.3	0.4	0.4	0.7	150	
Nutrients																								
Ammonia - Nitrogen	mg/L	<0.02	<0.02	0.03	<0.02	0.04	0.01	<0.02	0.04	0.01	<0.02	<0.02	0.01	<0.02	<0.02	0.01	<0.02	<0.02	0.01	<0.02	<0.02	0.01	0.424-2.08[a]	2.91-28.7[a]
Nitrate-N-D	mg/L	0.012	0.007	0.017	0.03	0.017	0.035	0.007	0.044	0.023	0.019	0.015	0.019	0.018	0.016	0.007	0.016	0.013	0.007	0.011	0.013	0.013	3	31.3
Nitrite-N-D	mg/L	0.003	0.003	0.004	0.004	0.0015	0.0015	<0.003	0.0015	0.004	0.004	0.003	0.003	0.003	< 0.003	0.0015	0.004	0.005	0.005	0.005	0.006	0.004	0.02	0.06
Total Kjeldahl Nitrogen (TKN)	mg/L	0.42	0.21	1.25	1.24	3.58	0.3	0.11	4.73	1.89	0.55	2.15	1.4	1.76	0.45	0.84	0.63	7.91	2.04	0.39	1.06	1.32		
Phosphorous-Ortho-DLL	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.017	< 0.003	< 0.003	< 0.003	< 0.003	0.007	0.006	0.015	0.009	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003		
Phosphorous (Total-Dissolved) LL	mg/L	0.01	<0.01	0.09	<0.01	0.04	<0.01	0.02	0.08	0.02	0.01	<0.01	0.02	0.01	0.012	0.02	0.02	0.03	0.01	0.01	0.02	0.01		
Organic Parameters																								
Carbon (Total Organic)	mg/L	10.9	15.6	13	17.5	36.7	14.1	8.1	88.7	16.6	11.6	6.2	6.1	18.9	3.5	31.6	30.8	56.4	19.1	16.4	29.9	16.3		
Carbon (Dissolved Organic)	mg/L	10.9	15.6	12.1	16.7	28.9	14.3	7.8	18.5	16.1	11.5	5.7	4	14.4	3.5	31.6	30	50.6	18.3	16.1	29	16		
Total Metals																								
Aluminum-T	mg/L	0.059	0.181	0.056	0.024	0.094	0.004	0.071	0.606	0.818	0.271	0.018	0.276	0.838	0.04	0.307	0.709	0.047	0.335	<0.002	0.023	0.646		
Antimony-T	mg/L	<0.00005	<0.00005	0.00006	0.00012	0.00008	<0.00005	0.00007	0.00016	0.00008	<0.00005	<0.00005	0.00009	<0.00005	< 0.00005	<0.00005	0.00007	0.00005	<0.00005	<0.00005	<0.00005	0.00005		0.02
Arsenic-T	mg/L	0.0001	0.0003	**0.0086**	0.0001	0.0013	0.0001	0.0006	**0.0072**	0.0003	<0.0001	0.0004	0.0002	0.0008	< 0.0001	0.0001	0.0004	0.0004	0.0002	0.0001	0.0001	0.0008	0.005	
Barium-T	mg/L	0.00523	0.0126	0.016	0.0365	0.145	0.00673	0.00521	**2.16**	0.0542	0.00206	0.00252	0.0129	0.0414	0.00325	0.00518	0.0137	0.0592	0.0335	0.00552	0.00339	0.0274	1	5
Beryllium-T	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001		0.0053
Boron-T	mg/L	<0.001	<0.001	0.001	0.002	0.004	<0.001	<0.001	0.08	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001	<0.001	<0.001	0.003	0.001	<0.001	<0.001	0.001	1.2	
Cadmium-T	mg/L	<0.000015	**0.000028**	**0.000034**	**0.000024**	**0.000096**	**0.000022**	<0.000015	**0.000384**	**0.000033**	<0.000015	<0.000015	**0.000085**	**0.000021**	< 0.000015	**0.00002**	**0.000042**	**0.000038**	<0.000015	<0.000015	<0.000015	**0.000047**	0.00000345-0.00003317	
Calcium-T	mg/L	7.4	4.8	11.4	13.5	32	15.7	8.5	191	1.9	0.9	4.1	4.8	5.4	5.8	1	4.4	24.6	3.7	15.9	6	5.9		
Chromium-T	mg/L	<0.0003	<0.0003	0.0014	0.0006	<0.0003	0.0008	0.0003	0.0006	0.0008	0.0007	<0.0003	<0.0003	<0.0003	< 0.0003	<0.0003	0.0005	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003		0.001-0.0089
Cobalt-T	mg/L	0.00004	0.00004	**0.00445**	0.00008	0.00246	0.00003	0.00005	**0.00552**	0.00112	0.00006	0.00013	0.00055	0.00227	< 0.00002	0.00035	0.00088	0.00164	0.00142	0.00002	0.0001	0.00015	0.004	0.11
Copper-T	mg/L	<0.0001	<0.0001	0.0003	<0.0001	**0.0081**	<0.0001	0.0001	**0.0254**	**0.0077**	<0.0001	<0.0001	0.0013	0.0011	**0.0086**	<0.0001	0.0005	0.0002	**0.009**	<0.0001	<0.0001	0.0007	0.002-0.004[4]	0.00267-0.0114[4]
Iron-T	mg/L	0.149	0.124	6.49	0.0503	1.06	0.0988	0.128	6.03	0.361	0.0478	0.796	1.94	50.5	0.0582	0.85	1.71	0.0559	0.171	0.0146	0.124	0.626		1
Lead-T	mg/L	<0.00005	<0.00005	0.0001	0.00009	0.00038	<0.00005	<0.00005	0.00317	0.0001	<0.00005	<0.00005	0.00022	0.00063	< 0.00005	0.00006	0.00012	0.00048	0.00007	<0.00005	<0.00005	0.00036	0.0036-0.0065[5]	0.003-0.081[1]
Lithium-T	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.014	0.87
Magnesium-T	mg/L	0.97	0.93	2.7	3.79	6.48	4.14	1.96	19.2	<0.50	<0.50	0.5	1	1.21	1.49	0.51	1.14	6.19	0.77	3.3	2.36	0.87		
Manganese-T	mg/L	0.00754	0.00964	**2.06**	0.0772	**8.8**	0.0319	0.0171	**92.5**	0.00658	0.00571	0.0334	0.117	0.481	0.00258	0.0264	0.0814	**6.01**	0.0102	0.015	0.0318	0.0483	0.64-1.05[5]	0.62-1.64[4]
Mercury-T	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	**0.000027**	<0.000005	<0.000005	0.000157	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	< 0.000005	<0.000005	<0.000005	0.000006	<0.000005	<0.000005	<0.000005	<0.000005	0.00002	0.0001
Molybdenum-T	mg/L	0.00005	0.0001	0.00103	0.00027	0.00121	0.00019	0.00035	0.00766	0.0002	0.00008	<0.00005	0.00023	0.00011	0.00058	<0.00005	<0.00005	0.00023	<0.00005	<0.00005	<0.00005	0.00024	1	2
Nickel-T	mg/L	<0.00005	<0.00005	0.00414	0.00208	0.00068	0.00327	<0.00005	0.00236	0.00217	0.00184	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		0.025-0.065[5]
Phosphorous-T	mg/L	0.01	0.02	0.17	0.16	0.91	0.02	0.05	3.13	0.16	0.02	0.03	0.14	0.31	< 0.01	0.08	0.04	0.4	0.1	0.01	0.09	0.04		
Potassium-T	mg/L	<0.5	<0.5	0.7	<0.5	0.8	<0.5	<0.5	3.6	<0.5	<0.5	<0.5	0.5	0.9	< 0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		

Appendix 3.3 Table 3: July 2013 Wetland Surface Water Quality Results

Parameters	Units	B13051A 15/07/2013	B13053A 15/07/2013	B13016A 15/07/2013	B13017A 15/07/2013	B13020A 15/07/2013	B13031A 15/07/2013	B13036A 16/07/2013	B13037A 15/07/2013	B13038A 16/07/2013	B13041A 16/07/2013	BWR002A 16/07/2013	BWR003A 16/07/2013	BWR003B 16/07/2013	BWR003C 12/08/2013	BWR006A 16/07/2013	BWR006B 16/07/2013	BWR019A 16/07/2013	WL13 15/07/2013	WL16 15/07/2013	WL19 15/07/2013	WL28 15/07/2013	BC MoE Guideline 30-day	BC MoE Guideline Maximum
Selenium-T	mg/L	<0.0001	<0.0001	0.0002	0.0001	0.0001	<0.0001	0.0001	0.0002	0.0001	<0.0001	<0.0001	0.0003	0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.002	
Silicon-T	mg/L	3.65	4.23	3.99	4.94	6.98	6.59	6.93	8.12	6.17	1.72	4.38	5.21	3.81	6.24	4.66	4.01	5.72	3	5.9	6.32	5		
Silver-T	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	0.00014	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005-0.0015[a]	0.0001-0.003[a]
Sodium-T	mg/L	1.4	1.5	3	3	3.4	3.5	2.7	5.4	1.7	1.3	1.2	1.8	1.3	2.4	1.1	1.4	4.9	1.5	3.3	2.2	1.7		
Strontium-T	mg/L	0.0723	0.0359	0.0955	0.0726	0.282	0.0923	0.0561	1.19	0.038	0.00614	0.026	0.0262	0.0365	0.026	0.00749	0.0273	0.114	0.0502	0.08	0.0273	0.0445		
Thallium-T	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		0.0003
Tin-T	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Titanium-T	mg/L	0.0006	0.0009	0.0031	0.0008	0.0034	0.0003	0.0014	0.0092	0.0066	0.0021	0.0004	0.0032	0.0088	0.0003	0.0022	0.0062	0.0014	0.0024	0.0002	0.0005	0.0112		
Uranium-T	mg/L	0.00014	<0.00005	0.0002	<0.00005	<0.00005	<0.00005	0.00011	<0.00005	0.00022	0.00005	<0.00005	0.00009	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00012		0.3
Vanadium-T	mg/L	<0.00005	<0.00005	0.00177	<0.00005	<0.00005	<0.00005	0.0009	0.0007	0.00048	<0.00005	<0.00005	0.00119	0.00428	< 0.00005	0.00009	0.00147	<0.00005	<0.00005	<0.00005	<0.00005	0.00055		0.006-0.01
Zinc-T	mg/L	0.0075	<0.0005	0.0036	0.0029	0.0267	0.0059	0.0026	0.138	0.0102	0.0061	0.0026	0.0036	0.0057	0.0036	0.007	0.0058	0.0079	0.0056	0.0059	0.0012	0.0055	0.0075-0.015[a]	0.033-0.0407[a]
																							BC MoE Guideline	
Parameters	**Units**																						**30-day**	Maximum
Dissolved Metals																								
Aluminum-D	mg/L	0.059	0.167	0.034	0.007	0.005	0.004	0.037	0.014	0.448	0.243	0.012	0.026	0.103	0.034	0.287	0.659	0.002	0.21	<0.002	0.022	0.392	0.05[b]	0.1[b]
Antimony-D	mg/L	<0.00005	<0.00005	0.00005	<0.00005	<0.00005	<0.00005	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		
Arsenic-D	mg/L	0.0001	0.0003	0.0064	0.0001	0.0004	0.0001	0.0006	0.0003	0.0001	<0.0001	0.0001	<0.0001	0.0001	< 0.0001	0.0001	0.0003	0.0003	0.0001	0.0001	0.0001	0.0005		
Barium-D	mg/L	0.00514	0.0126	0.0122	0.00939	0.0156	0.00456	0.00372	0.0196	0.00725	0.0004	0.00131	0.00371	0.00431	0.00324	0.00328	0.0118	0.00573	0.00408	0.0055	0.00185	0.0112		
Beryllium-D	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Boron-D	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Cadmium-D	mg/L	<0.000015	0.000023	0.000026	<0.000015	<0.000015	0.000022	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015	< 0.000015	<0.000015	0.000017	<0.000015	<0.000015	<0.000015	<0.000015	0.000044		
Calcium-D	mg/L	7.4	4.8	10.8	11.6	23.7	14.9	7.9	36.7	1.3	0.9	4.1	4.3	2.5	5.3	0.9	4.4	23.5	3.3	15.9	6	5.9		
Chromium-D	mg/L	<0.0003	<0.0003	0.0014	0.0006	0.0003	0.0008	<0.0003	0.0006	0.0008	0.0007	<0.0003	<0.0003	<0.0003	< 0.0003	<0.0003	0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003		
Cobalt-D	mg/L	0.00004	0.00003	0.00388	0.00003	0.00008	0.00003	0.00003	0.00004	0.00007	0.00005	0.00005	0.00003	0.00023	< 0.00002	0.00032	0.00076	0.00007	0.00003	0.00002	0.00007	0.00005		
Copper-D	mg/L	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Iron-D	mg/L	0.145	0.115	4.86	0.0093	0.078	0.0719	0.0811	0.0082	0.0749	0.0465	0.107	0.0565	1.57	0.0402	0.833	1.07	0.0089	0.0575	0.0146	0.108	0.214		0.35
Lead-D	mg/L	<0.00005	<0.00005	0.00007	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	0.00005	0.00008	<0.00005	<0.00005	<0.00005	<0.00005	0.0001		
Lithium-D	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Magnesium-D	mg/L	0.97	0.93	2.56	3.44	5.56	3.99	1.88	7.21	<0.50	<0.50	0.5	0.91	0.66	1.46	0.5	1.1	6.07	0.66	3.3	2.36	0.84		
Manganese-D	mg/L	0.00663	0.00816	1.8	0.00488	0.31	0.00543	0.00374	0.0533	0.00185	0.00429	0.012	0.0038	0.0437	0.00171	0.0257	0.0741	0.0134	0.00135	0.00996	0.0238	0.00534		
Mercury-D	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	< 0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005		
Molybdenum-D	mg/L	0.00005	<0.00005	0.00095	0.00014	0.00012	0.00019	0.00033	0.0005	0.00006	0.00008	<0.00005	0.00007	<0.00005	0.00058	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00021		
Nickel-D	mg/L	<0.00005	<0.00005	0.00414	0.00208	0.00068	0.00327	<0.00005	0.00132	0.00217	0.00184	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		
Phosphorous-D	mg/L	0.01	<0.01	0.09	<0.01	0.04	<0.01	0.02	0.08	0.02	0.01	<0.01	0.02	0.01	< 0.01	0.02	0.02	0.03	0.01	0.01	0.02	0.01		
Potassium-D	mg/L	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	< 0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		
Selenium-D	mg/L	<0.0001	<0.0001	0.0002	0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	< 0.0001	<0.0001	0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0001		
Silicon-D	mg/L	3.65	4.23	3.59	4.3	6.05	6.14	6.15	6.5	5.01	1.54	4.29	4.78	3.08	5.9	4.56	3.92	5.64	2.66	5.9	6.28	4.89		
Silver-D	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		
Sodium-D	mg/L	1.4	1.5	2.9	2.8	3.3	3.4	2.6	5.3	1.6	1.3	1.2	1.8	1.3	2.2	1.1	1.4	4.9	1.5	3.3	2.2	1.7		
Strontium-D	mg/L	0.0723	0.0359	0.0858	0.054	0.13	0.0849	0.051	0.182	0.0165	0.00533	0.025	0.0218	0.0132	0.0247	0.0064	0.0265	0.0851	0.0322	0.08	0.0248	0.0421		
Thallium-D	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		
Tin-D	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Titanium-D	mg/L	0.0005	0.0006	0.002	0.0003	0.0003	0.0002	0.0008	0.0008	0.0022	0.0016	0.0002	0.0003	0.0006	0.0003	0.0016	0.0045	0.0002	0.0007	0.0002	0.0003	0.007		
Uranium-D	mg/L	0.00014	<0.00005	0.00015	<0.00005	<0.00005	<0.00005	0.00008	<0.00005	0.00008	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0001		

Appendix 3.3 Table 3: July 2013 Wetland Surface Water Quality Results

Parameters	Units	B13051A 15/07/2013	B13053A 15/07/2013	B13016A 15/07/2013	B13017A 15/07/2013	B13020A 15/07/2013	B13031A 15/07/2013	B13036A 16/07/2013	B13037A 15/07/2013	B13038A 16/07/2013	B13041A 16/07/2013	BWR002A 16/07/2013	BWR003A 16/07/2013	BWR003B 16/07/2013	BWR003C 12/08/2013	BWR006A 16/07/2013	BWR006B 16/07/2013	BWR019A 16/07/2013	WL13 15/07/2013	WL16 15/07/2013	WL19 15/07/2013	WL28 15/07/2013	BC MoE Guideline 30-day	BC MoE Guideline Maximum
Vanadium-D	mg/L	<0.00005	<0.00005	0.0008	<0.00005	<0.00005	<0.00005	0.0004	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	< 0.00005	<0.00005	0.00057	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		
Zinc-D	mg/L	0.0075	<0.0005	0.0036	0.0029	0.004	0.0059	0.0026	0.0038	0.0036	0.0061	0.0026	0.0036	0.0036	0.0036	0.007	0.0058	0.0053	0.0033	0.0059	0.0012	0.0055		
D-Hardness as CaCO3	mg/L														19.2									
Cyanide																								
Cyanide (Total)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		
Cyanide (WAD)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005	0.01

Note: (a) pH and temperature dependent. Assume pH ranges from 6.7 to 8.25, and Temperature = 0 to 19^{o}C
(b) pH dependent
(c) Hardness dependent

Appendix 4
Habitat Function

Appendix 4-1
List of Potentially Occurring Wetland Communities at Risk in the Wetland Study Areas

Map Code	Scientific Name	English Name	BC List
Fl01	*Alnus incana/Equisetum arvense*	mountain alder/common horsetail	Blue
Fl02	*Alnus incana/Cornus stolonifera/Athyrium filix-femina*	mountain alder/red-osier dogwood/lady fern	Blue
Fl05	*Salix drummondiana/Calamagrostis canadensis*	Drummond's willow/bluejoint reedgrass	Blue
Fm02	*Populus spp. (balsamifera, trichocarpa) - Picea spp./Cornus stolonifera*	(balsam poplar, black cottonwood) - spruces/red-osier dogwood	Red
Fm03	*Populus trichocarpa - Abies lasiocarpa/Oplopanax horridus*	black cottonwood - subalpine fir/devil's club	Blue
Wb01	*Picea mariana/Gaultheria hispidula/Sphagnum spp.*	black spruce/creeping-snowberry/peat-mosses	Blue
Wb06	*Larix laricina/Carex aquatilis/Tomentypnum nitens*	tamarack/water sedge/golden fuzzy fen moss	Blue
Wb09	*Picea mariana/Equisetum arvense/Sphagnum spp.*	black spruce/common horsetail/peat-mosses	Blue
Wb10	*Pinus contorta/Carex pauciflora/Sphagnum spp.*	lodgepole pine/few-flowered sedge/peat-mosses	Blue
Wb11	*Picea mariana/Menyanthes trifoliata/Sphagnum spp.*	black spruce/buckbean/peat-mosses	Blue
Wb12	*Scheuchzeria palustris/Sphagnum spp.*	scheuchzeria/peat-mosses	Blue
Wb13	*Carex limosa - Menyanthes trifoliata/Sphagnum spp.*	shore sedge - buckbean/peat-mosses	Blue
Wf02	*Betula nana/Carex aquatilis*	scrub birch/water sedge	Blue
Wf05	*Carex lasiocarpa/Drepanocladus aduncus*	slender sedge/common hook-moss	Blue
Wf06	*Menyanthes trifoliata - Carex lasiocarpa*	buckbean - slender sedge	Blue
Wf08	*Carex limosa - Menyanthes trifoliata/Drepanocladus spp.*	shore sedge - buckbean/hook-mosses	Blue
Wf09	*Eleocharis quinqueflora/Drepanocladus spp.*	few-flowered spike-rush/hook-mosses	Red
Wf10	*Trichophorum alpinum/Scorpidium revolvens*	Hudson Bay clubrush/rusty hook-moss	Red
Wf11	*Trichophorum cespitosum/Campylium stellatum*	tufted clubrush/golden star-moss	Blue
Wf13	*Eriophorum angustifolium - Carex limosa*	narrow-leaved cotton-grass - shore sedge	Blue
Wm02	*Equisetum fluviatile - Carex utriculata*	swamp horsetail - beaked sedge	Blue
Wm03	*Carex atherodes Fen - Marsh*	awned sedge Fen - Marsh	Red
Wm04	*Eleocharis palustris Herbaceous Vegetation*	common spike-rush Herbaceous Vegetation	Blue
Wm06	*Schoenoplectus acutus Deep Marsh*	hard-stemmed bulrush Deep Marsh	Blue
Ws03	*Salix bebbiana/Calamagrostis canadensis*	Bebb's willow/bluejoint reedgrass	Blue
Ws05	*Salix maccalliana/Carex utriculata*	MacCalla's willow/beaked sedge	Blue
Ws06	*Salix sitchensis/Carex sitchensis*	Sitka willow/Sitka sedge	Blue
Ws09	*Picea mariana/Lysichiton americanus/Sphagnum spp.*	black spruce/skunk cabbage/peat-mosses	Blue
N/A	*Triglochin maritima Marsh*	seaside arrow-grass Marsh	Red
N/A	*Glyceria borealis Fen*	northern mannagrass Fen	Blue
N/A	*Larix laricina/Betula pumila/Calamagrostis canadensis - Carex spp./Sphagnum spp.*	tamarack/low birch/bluejoint reedgrass - sedges/peat-mosses	Red

Notes: CDC Search Criteria
Search Type: Ecological Communities; and BC Conservation Status: Red (Extirpated, Endangered, or Threatened) or Blue (Special Concern); and Ecosections: BUB, NAU, NEL

Appendix 4-2
List of Wetland Species at Risk Potentially Occurring in the Wetland Study Areas

Scientific Name	**BC List	BGC	Habitat Type
*Acorus americanus**	Blue	SBSdk	Lakes
Agoseris lackschewitzii	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Arctophila fulva	Blue	BAFA	Wetland; Stream/River
Arnica chamissonis subsp. *incana*	Blue	SBSmc	Forest; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Astragalus umbellatus	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Botrychium ascendens	Red	BAFA	Forest; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Callitriche heterophylla var. *heterophylla*	Blue	BAFA	Estuary; Lakes; Wetland
*Carex backii**	Blue	SBSdk	Forest; Grassland/Shrub Steppe; Lakes; Wetland; Rock/Sparsely Vegetated Rock
*Carex bicolor**	Blue	BAFA; ESSFmv	Alkali Pond/Salt flat; Alpine/Tundra; Grassland/Shrub Steppe; Lakes; Wetland; Rock/Sparsely Vegetated Rock; Shrubland
Carex enanderi	Blue	SBSmc	Alpine/Tundra; Grassland/Shrub Steppe; Lakes; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Carex membranacea	Blue	BAFA; SBSdw	Alpine/Tundra; Forest; Lakes; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Carex petricosa	Blue	BAFA	Alpine/Tundra; Wetland; Rock/Sparsely Vegetated Rock
*Carex rostrata**	Blue	SBSdw	Wetland
Carex sychnocephala	Blue	SBSdk	Grassland/Shrub Steppe; Lakes; Wetland; Rock/Sparsely Vegetated Rock
*Carex tenera**	Blue	ESSFmv	Alpine/Tundra; Forest; Lakes; Wetland; Rock/Sparsely Vegetated Rock
Cerastium fischerianum	Blue	BAFA	Alpine/Tundra; Lakes; Rock/Sparsely Vegetated Rock
Chrysosplenium wrightii	Red	BAFA	Alpine/Tundra; Stream/River; Rock/Sparsely Vegetated Rock
Claytonia tuberosa	Blue	BAFA	Alpine/Tundra; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Diapensia obovata	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Stream/River; Rock/Sparsely Vegetated Rock
*Draba corymbosa**	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Stream/River; Rock/Sparsely Vegetated Rock
Draba glabella var. *glabella*	Blue	BAFA	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock; Shrubland
*Draba lactea**	Blue	BAFA; ESSFmv	Alpine/Tundra; Forest; Stream/River; Rock/Sparsely Vegetated Rock
Eleocharis elliptica	Blue	BAFA	Lakes; Wetland
Epilobium davuricum	Red	BAFA	Alpine/Tundra; Lakes; Wetland; Rock/Sparsely Vegetated Rock

Scientific Name	**BC List	BGC	Habitat Type
Epilobium glaberrimum subsp. *fastigiatum*	Blue	BAFA	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Epilobium leptocarpum	Blue	BAFA	Forest; Grassland/Shrub Steppe; Wetland; Stream/River; Rock/Sparsely Vegetated Rock; Shrubland
Erigeron uniflorus var. *eriocephalus*	Blue	BAFA	Alpine/Tundra; Stream/River; Rock/Sparsely Vegetated Rock
Eutrema edwardsii	Blue	BAFA	Alpine/Tundra; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Glyceria pulchella	Blue	SBSdk	Lakes; Wetland
Hulteniella integrifolia	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Juncus albescens	Blue	BAFA	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Lakes; Wetland; Stream/River; Rock/Sparsely Vegetated Rock; Shrubland
*Juncus stygius**	Blue	SBSdw	Lakes; Wetland
Kobresia sibirica	Blue	BAFA	Alpine/Tundra; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Lewisia triphylla	Blue	BAFA	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Lomatogonium rotatum	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Lupinus kuschei	Blue	BAFA	Alpine/Tundra; Forest; Wetland; Rock/Sparsely Vegetated Rock; Sand/Dune; Shrubland
Luzula nivalis	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Malaxis paludosa	Blue	SBSdw	Wetland
Meesia longiseta	Blue	ESSF; SBS	
Melica spectabilis	Blue	SBSdk	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Wetland; Stream/River; Rock/Sparsely Vegetated Rock; Shrubland
Micranthes hieraciifolia	Red	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Stream/River; Rock/Sparsely Vegetated Rock
Micranthes nelsoniana var. *carlottae*	Blue	BAFA	Alpine/Tundra; Wetland; Rock/Sparsely Vegetated Rock
Micranthes razshivinii	Red	BAFA	Alpine/Tundra; Stream/River; Rock/Sparsely Vegetated Rock
Minuartia stricta	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Oxytropis campestris var. *davisii*	Blue	BAFA	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock; Shrubland
Oxytropis campestris var. *jordalii*	Blue	BAFA	Alpine/Tundra; Wetland; Rock/Sparsely Vegetated Rock; Shrubland
Oxytropis maydelliana	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Packera ogotorukensis	Red	BAFA	Alpine/Tundra; Wetland; Rock/Sparsely Vegetated Rock

Scientific Name	**BC List	BGC	Habitat Type
Pedicularis parviflora subsp. *parviflora**	Blue		Grassland/Shrub Steppe; Wetland; Stream/River; Rock/Sparsely Vegetated Rock; Shrubland
Pedicularis verticillata	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Lakes; Wetland; Rock/Sparsely Vegetated Rock; Shrubland
Phippsia algida	Blue	BAFA	Alpine/Tundra; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Physaria arctica	Blue	BAFA	Alpine/Tundra; Forest; Wetland; Rock/Sparsely Vegetated Rock
Pyrola elliptica	Blue	SBSdw	Forest; Wetland; Rock/Sparsely Vegetated Rock
Ranunculus pedatifidus subsp. *affinis*	Blue	BAFA	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Ranunculus sulphureus	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Stream/River; Rock/Sparsely Vegetated Rock
Ribes oxyacanthoides subsp. *cognatum*	Red	SBSdk	Forest; Wetland; Rock/Sparsely Vegetated Rock
Rumex arcticus	Blue	BAFA; ESSFmv	Alpine/Tundra; Forest; Grassland/Shrub Steppe; Lakes; Wetland; Rock/Sparsely Vegetated Rock
Rumex paucifolius	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Sagina nivalis	Blue	BAFA; SBSmc	Alpine/Tundra; Forest; Wetland; Rock/Sparsely Vegetated Rock
Salix boothii	Blue	SBSdw	Forest; Lakes; Wetland; Rock/Sparsely Vegetated Rock
Saxifraga serpyllifolia	Blue	BAFA	Alpine/Tundra; Stream/River; Rock/Sparsely Vegetated Rock
Senecio sheldonensis	Blue	BAFA	Alpine/Tundra; Forest; Wetland; Stream/River; Rock/Sparsely Vegetated Rock
Sparganium fluctuans	Blue	SBSdk; SBSdw	Lakes; Stream/River
*Stuckenia vaginata**	Blue	SBSdw	Lakes; Stream/River
Tephroseris frigida	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Rock/Sparsely Vegetated Rock
Tephroseris yukonensis	Blue	BAFA	Alpine/Tundra; Wetland; Rock/Sparsely Vegetated Rock
*Torreyochloa pallida**	Red	SBSdk	Lakes; Wetland
Utricularia ochroleuca	Blue	ESSFmv	Lakes
Viola biflora subsp. *carlottae*	Blue	BAFA	Alpine/Tundra; Grassland/Shrub Steppe; Wetland; Stream/River; Rock/Sparsely Vegetated Rock

Notes: *indicates a rare plant that meets one or both of the following criteria: is known to occur within 50 km of the study area; is known to occur in a BGC subzone that is contiguous with and intersects the study area.

**BC List = Provincial list of Species at Risk;

Appendix 4-3
Field Verified Wetland Species List

Scientific Name	Common Name	Life-Form
Abies lasiocarpa	subalpine fir	coniferous tree
Achillea millefolium	yarrow	forb
Aconitum delphiniifolium	mountain monkshood	forb
Actaea rubra	baneberry	forb
Agoseris aurantiaca	orange agoseris	forb
Agrostis aequivalvis	Alaska bentgrass	graminoid
Agrostis humilis	alpine bentgrass	graminoid
Agrostis scabra	hair bentgrass	graminoid
Agrostis sp.	bentgrass	graminoid
Alnus incana	mountain alder	broad-leaved tree
Amblystegium serpens	creeping feathermoss	moss
Amelanchier alnifolia	saskatoon	deciduous shrub
Andromeda polifolia	bog-rosemary	dwarf woody plant
Anemone richardsonii	yellow anemone	forb
Angelica genuflexa	kneeling angelica	forb
Antennaria lanata	woolly pussytoes	forb
Aquilegia formosa	Sitka columbine	forb
Arnica cordifolia	heart-leaved arnica	forb
Arnica mollis	hairy arnica	forb
Artemisia norvegica	mountain sagewort	forb
Athyrium filix-femina	lady fern	fern or fern-ally
Aulacomnium palustre	glow moss	moss
Barbilophozia lycopodioides	common leafy liverwort	hepatic
Barbarea orthoceras	American wintercress	forb
Betula nana	scrub birch	deciduous shrub
Betula pumila	low birch	deciduous shrub
Bistorta vivipara	alpine bistort	forb
Botrychium pinnatum	northwestern moonwort	fern or fern-ally
Brachythecium sp.	ragged-moss	moss
Bryoria fuscescens	pale-footed horsehair	lichen

Scientific Name	Common Name	Life-Form
Bryoria sp.	horsehair lichens	lichen
Calamagrostis canadensis	bluejoint reedgrass	graminoid
Calliergon cordifolium	heart-leaved water-moss	moss
Calliergon sp.	water-moss	moss
Calliergon stramineum	straw water-moss	moss
Caltha leptosepala	white mountain marsh-marigold	forb
Campylium stellatum	golden star-moss	moss
Campylium sp.	star-moss	moss
Cardamine pensylvanica	Pennsylvanian bittercress	forb
Carex aquatilis	water sedge	graminoid
Carex aquatilis var. aquatilis	water sedge	graminoid
Carex canescens		graminoid
Carex capillaris	hairlike sedge	graminoid
Carex chordorrhiza	cordroot sedge	graminoid
Carex diandra	lesser-panicled sedge	graminoid
Carex disperma	soft-leaved sedge	graminoid
Carex echinata ssp. echinata	star sedge	graminoid
Carex exsiccata	inflated sedge	graminoid
Carex gynocrates	yellow bog sedge	graminoid
Carex interior	inland sedge	graminoid
Carex lasiocarpa	slender sedge	graminoid
Carex leptalea	bristle-stalked sedge	graminoid
Carex limosa	shore sedge	graminoid
Carex livida	pale sedge	graminoid
Carex magellanica	poor sedge	graminoid
Carex magellanica ssp. irrigua	poor sedge	graminoid
Carex macloviana	Falkland Island sedge	graminoid
Carex media	Scandinavian sedge	graminoid
Carex pauciflora	few-flowered sedge	graminoid
Carex rostrata	swollen beaked sedge	graminoid

Scientific Name	Common Name	Life-Form
Carex stylosa	long-styled sedge	graminoid
Carex tenuiflora	sparse-flowered sedge	graminoid
Carex trisperma	three-seeded sedge	graminoid
Carex utriculata	beaked sedge	graminoid
Carex vesicaria	lesser blader sedge	graminoid
Castilleja miniata	scarlet paintbrush	forb
Cetraria pallidula	pallid ruffle	lichen
Chamaedaphne calyculata	leatherleaf	evergreen shrub
Chrysosplenium tetrandrum	northern golden-saxifrage	forb
Cinclidium stygium	lurid lantern-moss	moss
Cinna latifolia	nodding wood-reed	graminoid
Cladina sp.	reindeer lichens	lichen
Cladonia sp.	clad lichens	lichen
Climacium dendroides	tree-moss	moss
Coeloglossum viride	long-bracted frog orchid	forb
Comarum palustre	marsh cinquefoil	forb
Conocephalum conicum	snake liverwort	hepatic
Cornus canadensis	bunchberry	forb
Cornus stolonifera	red-osier dogwood	deciduous shrub
Deschampsia cespitosa	tufted hairgrass	graminoid
Dicranum sp.	heron's-bill moss	moss
Dicranum fuscescens	curly heron's-bill moss	moss
Drepanocladus sp.	hook-moss	moss
Drosera anglica	great sundew	forb
Dryopteris expansa	spiny wood fern	fern or fern-ally
Empetrum nigrum	crowberry	dwarf woody plant
Epilobium anagallidifolium	alpine willowherb	forb
Epilobium angustifolium	fireweed	forb
Epilobium ciliatum	purple-leaved willowherb	forb
Epilobium ciliatum ssp. ciliatum	purple-leaved willowherb	forb

Scientific Name	Common Name	Life-Form
Epilobium sp.	willowherb	forb
Epilobium palustre	swamp willowherb	forb
Equisetum arvense	common horsetail	fern or fern-ally
Equisetum fluviatile	swamp horsetail	fern or fern-ally
Equisetum palustre	marsh horsetail	fern or fern-ally
Equisetum pratense	meadow horsetail	fern or fern-ally
Equisetum scirpoides	dwarf scouring-rush	fern or fern-ally
Equisetum sylvaticum	wood horsetail	fern or fern-ally
Equisetum variegatum	northern scouring-rush	fern or fern-ally
Erigeron peregrinus	subalpine daisy	forb
Eriophorum angustifolium	narrow-leaved cotton-grass	graminoid
Eriophorum chamissonis	Chamisso's cotton-grass	graminoid
Eriophorum gracile	slender cotton-grass	graminoid
Eriophorum viridicarinatum	green-keeled cotton-grass	graminoid
Eurybia conspicua	showy aster	forb
Fontinalis neomexicana	New Mexican fontinalis moss	moss
Fragaria virginiana	wild strawberry	forb
Galium boreale	northern bedstraw	forb
Galium trifidum	small bedstraw	forb
Galium trifidum ssp. trifidum	small bedstraw	forb
Galium triflorum	sweet-scented bedstraw	forb
Gaultheria hispidula	creeping-snowberry	dwarf woody plant
Geocaulon lividum	false toad-flax	forb
Geum macrophyllum	large-leaved avens	forb
Geum rivale	water avens	forb
Gymnocarpium disjunctum	western oak fern	fern or fern-ally
Gymnocarpium dryopteris	oak fern	fern or fern-ally
Hamatocaulis lapponicus	Lapland hamatocaulis moss	moss
Hamatocaulis vernicosus	hamatocaulis moss	moss
Heracleum maximum	cow-parsnip	forb

Scientific Name	Common Name	Life-Form
Heuchera glabra	smooth alumroot	forb
Hylocomium splendens	step moss	moss
Juncus sp.	rush	graminoid
Kalmia microphylla	western bog-laurel	dwarf woody plant
Leptarrhena pyrolifolia	leatherleaf saxifrage	forb
Limprichtia sp.		moss
Linnaea borealis	twinflower	dwarf woody plant
Listera cordata	heart-leaved twayblade	forb
Lonicera involucrata	black twinberry	deciduous shrub
Lupinus arcticus	arctic lupine	forb
Luzula parviflora	small-flowered wood-rush	graminoid
Lycopodium annotinum	stiff club-moss	fern or fern-ally
Maianthemum stellatum	star-flowered false Solomon's-seal	forb
Marchantia polymorpha	green-tongue liverwort	hepatic
Meesia sp.	hump-moss	moss
Meesia longiseta	meesia moss	moss
Meesia triquetra	three-angled hump-moss	moss
Menyanthes trifoliata	buckbean	forb
Menziesia ferruginea	false azalea	deciduous shrub
Micranthes lyallii	red-stemmed saxifrage	forb
Mimulus guttatus	yellow monkey-flower	forb
Mitella nuda	common mitrewort	forb
Mnium sp.	leafy moss	moss
Moneses uniflora	single delight	forb
Muhlenbergia sp.		graminoid
Nephroma arcticum	green light	lichen
Oplopanax horridus	devil's club	deciduous shrub
Orthilia secunda	one-sided wintergreen	forb
Osmorhiza berteroi	mountain sweet-cicely	forb
Oxycoccus oxycoccos	bog cranberry	dwarf woody plant

Scientific Name	Common Name	Life-Form
Oxyria digyna	mountain sorrel	forb
Packera indecora	rayless mountain butterweed	forb
Packera pauciflora	rayless alpine butterweed	forb
Packera plattensis	plains butterweed	forb
Packera pseudaurea	streambank butterweed	forb
Paludella squarrosa	tufted fen-moss	moss
Parnassia fimbriata	fringed grass-of-Parnassus	forb
Pedicularis sp.	lousewort	forb
Pedicularis parviflora ssp. parviflora	small-flowered lousewort	forb
Pellia neesiana	shiny liverwort	hepatic
Peltigera aphthosa	freckle pelt	lichen
Peltigera sp.	pelt lichens	lichen
Peltigera leucophlebia	freckle plet	lichen
Persicaria amphibia	water smartweed	forb
Persicaria amphibia var. emersa	swamp smartweed	forb
Petasites frigidus	sweet coltsfoot	forb
Petasites frigidus var. frigidus	sweet coltsfoot	forb
Petasites frigidus var. palmatus	palmate coltsfoot	forb
Petasites frigidus var. sagittatus	arrow-leaved coltsfoot	forb
Petasites sp.		forb
Phleum alpinum	alpine timothy	graminoid
Picea sp. x Picea sp.	spruce hybrid	coniferous tree
Picea engelmannii x glauca	hybrid white spruce	coniferous tree
Picea engelmannii	Engelmann spruce	coniferous tree
Picea glauca	white spruce	coniferous tree
Picea mariana	black spruce	coniferous tree
Pinus contorta	lodgepole pine	coniferous tree
Plagiomnium cuspidatum	woods leafy moss	moss
Plagiomnium medium	common leafy moss	moss
Platanthera sp.	orchid	forb

Scientific Name	Common Name	Life-Form
Platanthera dilatata	fragrant white rein orchid	forb
Platanthera obtusata	one-leaved rein orchid	forb
Pleurozium schreberi	red-stemmed feathermoss	moss
Poa palustris	fowl bluegrass	graminoid
Poa pratensis	Kentucky bluegrass	graminoid
Pohlia nutans	nodding thread-moss	moss
Polytrichum commune	common haircap moss	moss
Polytrichum strictum	bog haircap moss	moss
Polytrichum sp.	haircap moss	moss
Populus balsamifera	balsam poplar	broad-leaved tree
Potamogeton alpinus	northern pondweed	forb
Potamogeton gramineus	grass-leaved pondweed	forb
Potamogeton sp.	pondweed	forb
Ptilium crista-castrensis	knight's plume	moss
Pyrola asarifolia	pink wintergreen	forb
Pyrola chlorantha	green wintergreen	forb
Pyrola minor	lesser wintergreen	forb
Ranunculus cymbalaria	shore buttercup	forb
Ranunculus lapponicus	Lapland buttercup	forb
Ranunculus repens	creeping buttercup	forb
Rhizomnium glabrescens	large leafy moss	moss
Rhizomnium sp.	leafy moss	moss
Rhododendron albiflorum	white-flowered rhododendron	deciduous shrub
Rhododendron groenlandicum	Labrador tea	evergreen shrub
Rhodobryum sp.		moss
Ribes hudsonianum	northern blackcurrant	deciduous shrub
Ribes lacustre	black gooseberry	deciduous shrub
Ribes oxyacanthoides	northern gooseberry	deciduous shrub
Ribes triste	red swamp currant	deciduous shrub
Rosa acicularis	prickly rose	deciduous shrub

Scientific Name	Common Name	Life-Form
Rubus arcticus	nagoonberry	forb
Rubus arcticus ssp. acaulis	nagoonberry	forb
Rubus chamaemorus	cloudberry	dwarf woody plant
Rubus idaeus	red raspberry	deciduous shrub
Rubus parviflorus	thimbleberry	deciduous shrub
Rubus pedatus	five-leaved bramble	forb
Rubus pubescens	dwarf red raspberry	forb
Rumex acetosa	green sorrel	forb
Salix barclayi	Barclay's willow	deciduous shrub
Salix bebbiana	Bebb's willow	broad-leaved tree
Salix brachycarpa	short-fruited willow	deciduous shrub
Salix candida	sage willow	deciduous shrub
Salix commutata	under-green willow	deciduous shrub
Salix discolor	pussy willow	broad-leaved tree
Salix drummondiana	Drummond's willow	deciduous shrub
Salix glauca	grey-leaved willow	deciduous shrub
Salix maccalliana	MacCalla's willow	deciduous shrub
Salix myrtillifolia	bilberry willow	deciduous shrub
Salix pedicellaris	bog willow	deciduous shrub
Salix planifolia	plane-leaved willow	deciduous shrub
Salix pseudomyrsinites	tall blueberry willow	deciduous shrub
Salix pseudomonticola	serviceberry willow	deciduous shrub
Salix richardsonii	Richardson's willow	deciduous shrub
Salix sitchensis	Sitka willow	broad-leaved tree
Sanguisorba stipulata	Sitka burnet	forb
Scapania irrigua		hepatic
Scapania paludicola		hepatic
Scorpidium revolvens	rusty hook-moss	moss
Scorpidium scorpioides	hooked scorpion-moss	moss
Senecio triangularis	arrow-leaved groundsel	forb

Scientific Name	Common Name	Life-Form
Shepherdia canadensis	soopolallie	deciduous shrub
Sibbaldia procumbens	sibbaldia	dwarf woody plant
Sorbus scopulina	western mountain-ash	deciduous shrub
Sparganium angustifolium	narrow-leaved bur-reed	forb
Sparganium emersum	emersed bur-reed	forb
Sphagnum fuscum	common brown peat-moss	moss
Sphagnum sp.	peat-moss	moss
Sphagnum pacificum	pacific peat-moss	moss
Sphagnum papillosum	fat peat-moss	moss
Sphagnum warnstorfii	Warnstorf's peat-moss	moss
Spiraea douglasii	hardhack	deciduous shrub
Spiranthes romanzoffiana	hooded ladies' tresses	forb
Stellaria borealis	boreal starwort	forb
Stellaria longipes	long-stalked starwort	forb
Stellaria longipes var. monantha	long-stalked starwort	forb
Stellaria longifolia	long-leaved starwort	forb
Streptopus amplexifolius	clasping twistedstalk	forb
Symphyotrichum ciliolatum	Lindley's aster	forb
Symphyotrichum ciliatum	rayless alkali aster	forb
Symphyotrichum foliaceum	leafy aster	forb
Tetraplodon mnioides	slender cruet-moss	moss
Thalictrum occidentale	western meadowrue	forb
Tiarella trifoliata	three-leaved foamflower	forb
Tiarella trifoliata var. trifoliata	three-leaved foamflower	forb
Timmia austriaca	false-polytrichum	moss
Tomentypnum nitens	golden fuzzy fen moss	moss
Trichophorum alpinum	Hudson Bay clubrush	graminoid
Trichophorum cespitosum	tufted clubrush	graminoid
Trientalis europaea ssp. arctica	northern starflower	forb
Triglochin maritima	seaside arrow-grass	forb

Scientific Name	Common Name	Life-Form
Trisetum spicatum	spike trisetum	graminoid
Trollius albiflorus	globeflower	forb
Urtica dioica	stinging nettle	forb
Utricularia minor	lesser bladderwort	forb
Vaccinium caespitosum	dwarf blueberry	dwarf woody plant
Vaccinium membranaceum	black huckleberry	deciduous shrub
Vaccinium scoparium	grouseberry	dwarf woody plant
Vaccinium vitis-idaea	lingonberry	dwarf woody plant
Vahlodea atropurpurea	mountain hairgrass	graminoid
Valeriana dioica	marsh valerian	forb
Valeriana sitchensis	Sitka valerian	forb
Veratrum viride	Indian hellebore	forb
Veronica beccabunga ssp. americana	American speedwell	forb
Veronica wormskjoldii	alpine speedwell	forb
Veronica wormskjoldii var. wormskjoldii	alpine speedwell	forb
Viburnum edule	highbush-cranberry	deciduous shrub
Vicia americana	American vetch	forb
Viola sp.	violet	forb
Viola macloskeyi	small white violet	forb
Viola palustris	marsh violet	forb
Warnstorfia exannulata	ringless hook-moss	moss
Warnstorfia sarmentosa	twiggy spear-moss	moss
Xanthoria sp.	orange lichens	lichen

Appendix 4-4
List of Wildlife Species Potentially Occurring versus Detected in the Mine Site Regional Study Area that Depend on Wetlands for any Part of Their Life Cycle

Species Group	Common Name	Scientific Name	Detected 2011	Detected 2012
Amphibians	western toad	*Anaxyrus boreas*	Y	Y
	Columbia spotted frog	*Rana luteiventris*	Y	Y
	wood frog	*Rana sylvatica*	Y	Y
	long-toed salamander	*Ambystoma macrodactylum*	N	Y
Birds	common loon	*Gavia immer*	Y	Y
	pied-billed grebe	*Podilymbus podiceps*	N	N
	horned grebe	*Podiceps auritus*	N	N
	red-necked grebe	*Podiceps grisegena*	N	N
	eared grebe	*Podiceps nigricollis*	N	N
	American bittern	*Botaurus lentiginosus*	N	N
	great blue heron	*Ardea herodias*	N	N
	Canada goose	*Branta canadensis*	Y	Y
	trumpeter swan	*Cygnus buccinator*	N	N
	gadwall	*Anas strepera*	N	N
	American wigeon	*Anas americana*	N	N
	mallard	*Anas platyrhynchos*	Y	Y
	blue-winged teal	*Anas discors*	N	N
	cinnamon teal	*Anas cyanoptera*	N	N
	northern shoveler	*Anas clypeata*	N	N
	northern pintail	*Anas acuta*	N	N
	green-winged teal	*Anas crecca*	Y	Y
	canvasback	*Aythya valisineria*	N	N
	redhead	*Aythya americana*	N	N
	ring-necked duck	*Aythya collaris*	Y	Y
	lesser scaup	*Aythya affinis*	N	N
	white-winged scoter	*Melanitta fusca*	N	N

Species Group	Common Name	Scientific Name	Detected 2011	Detected 2012
Birds (cont'd)	Bufflehead	*Bucephala albeola*	Y	Y
	common goldeneye	*Bucephala clangula*	N	N
	barrow's goldeneye	*Bucephala islandica*	Y	Y
	common merganser	*Mergus merganser*	N	Y
	red-breasted merganser	*Mergus serrator*	N	N
	hooded merganser	*Lophodytes cucullatus*	Y	Y
	ruddy duck	*Oxyura jamaicensis*	N	N
	Osprey	*Pandion haliaetus*	Y	Y
	bald eagle	Haliaeetus leucocephalus	Y	Y
	northern harrier	*Circus cyaneus*	Y	Y
	yellow rail	*Coturnicops noveboracensis*	N	N
	virginia rail	*Rallus limicola*	N	N
	Sora	*Porzana carolina*	N	N
	American coot	*Fulica americana*	N	N
	sandhill crane	*Grus canadensis*	N	Y
	American golden-plover	*Pluvialis dominica*	N	N
	Killdeer	*Charadrius vociferus*	N	N
	spotted sandpiper	*Actitis macularius*	Y	Y
	solitary sandpiper	*Tringa solitaria*	Y	N
	greater yellowlegs	*Tringa melanoleuca*	Y	N
	lesser yellowlegs	*Tringa flavipes*	N	Y
	least sandpiper	*Calidris minutilla*	N	N
	Wilson's snipe	*Gallinago delicata*	Y	Y
	Bonaparte's gull	*Chroicocephalus philadelphia*	Y	Y
	herring gull	*Larus argentatus*	Y	N
	black tern	*Chlidonias niger*	N	N

Species Group	Common Name	Scientific Name	Detected 2011	Detected 2012
Birds (cont'd)	great gray owl	*Strix nebulosa*	N	Y
	short-eared owl	*Asio flammeus*	N	N
	olive-sided flycatcher	*Contopus cooperi*	Y	Y
	alder flycatcher	*Empidonax alnorum*	N	Y
	eastern kingbird	*Tyrannus tyrannus*	Y	N
	barn swallow	*Hirundo rustica*	Y	Y
	tree swallow	*Tachycineta bicolor*	Y	Y
	marsh wren	*Cistothorus palustris*	N	N
	northern waterthrush	*Parkesia noveboracensis*	Y	Y
	Macgillivray's warbler	*Geothlypis tolmiei*	Y	Y
	common yellowthroat	*Geothlypis trichas*	N	Y
	yellow warbler	*Setophaga petechia*	N	Y
	Wilson's warbler	*Cardellina pusilla*	Y	Y
	red-winged blackbird	*Agelaius phoeniceus*	Y	N
	yellow-headed blackbird	*Xanthocephalus xanthocephalus*	N	N
	rusty blackbird	*Euphagus carolinus*	Y	Y
Mammals	river otter	*Lontra canadensis*	N	N
	mink	*Neovison vison*	N	N
	moose	*Alces alces*	Y	Y
	caribou (northern populations)	*Rangifer tarandus*	Y	Y
	muskrat	*Ondatra zibethicus*	N	N
	beaver	*Castor canadensis*	Y	N
	common shrew	*Sorex cinereus*	N	N
	pygmy shrew	*Sorex hoyi*	N	N
	common water shrew	*Sorex palustris*	N	N
	northern bog lemming	*Synaptomys borealis*	N	N

Species Group	Common Name	Scientific Name	Detected 2011	Detected 2012
	little brown myotis	*Myotis lucifugus*	Y	Y
	northern myotis	*Myotis septentrionalis*	N	N
Lepidopterans	Bog Fritillary	Boloria eunomia	Y	Y
	Silver-bordered Fritillary	Boloria selene	Y	Y
	Frigga Fritillary	Boloria frigga	Y	Y
	Freija Fritillary	Boloria freija	Y	Y
	Arctic Fritillary, grandis subspecies	Boloria chariclea grandis	Y	Y
	Jutta Arctic, chermocki subspecies	Oeneis jutta chermocki	Y	Y
	Dorcas Copper	Lycaena dorcas	Y	Y
Odontates	subarctic bluet	*Coenagrion interrogatum*	Y	N
	taiga bluet	*Coenagrion resolutum*	Y	Y
	northern bluet	*Enallagma annexum*	Y	N
	boreal bluet	*Enallagma boreale*	Y	Y
	tule bluet	*Enallagma carunculatum*	N	Y
	marsh bluet	*Enallagma ebrium*	Y	N
	Hagen's Bluet	*Enallagma hageni*	N	Y
	Pacific forktail	*Ischnura cervula*	N	N
	sedge sprite	*Nehalennia irene*	N	N
	spotted spreadwing	*Lestes congener*	N	N
	northern spreadwing	*Lestes disjunctus*	Y	Y
	emerald spreadwing	*Lestes dryas*	Y	Y
	sweetflag spreadwing	*Lestes forcipatus*	N	N
	Canada darner	*Aeshna canadensis*	N	N
	lake darner	*Aeshna eremita*	Y	Y
	variable darner	*Aeshna interrupta*	N	N
	sedge darner	*Aeshna juncea*	Y	Y

Species Group	Common Name	Scientific Name	Detected 2011	Detected 2012
Odontates (cont'd)	paddle-tailed darner	*Aeshna palmata*	Y	Y
	azure darner	*Aeshna septentrionalis*	N	N
	zigzag darner	*Aeshna sitchensis*	N	Y
	subarctic darner	*Aeshna subarctica*	N	N
	black-tipped darner	*Aeshna tuberculifera*	N	N
	shadow darner	*Aeshna umbrosa*	N	N
	California darner	*Rhionaeschna californica*	N	N
	beaverpond baskettail	*Epitheca canis*	N	N
	spiny baskettail	*Epitheca spinigera*	N	N
	chalk-fronted skimmer	*Ladona julia*	N	N
	four-spotted skimmer	*Libellula quadrimaculata*	Y	Y
	boreal snaketail	*Ophiogomphus colubrinus*	N	N
	pale snaketail	*Ophiogomphus severus*	N	N
	Whitehouse's emerald	*Somatochlora whitehousei*	N	Y
	brush-tipped emerald	*Somatochlora walshii*	N	Y
	muskeg emerald	*Somatochlora septentrionalis*	N	N
	mountain emerald	*Somatochlora semicircularis*	Y	Y
	ocellated emerald	*Somatochlora minor*	Y	N
	Kennedy's emerald	*Somatochlora kennedyi*	N	N
	Hudsonian emerald	*Somatochlora hudsonica*	Y	Y
	delicate emerald	*Somatochlora franklini*	Y	Y
	forcipate emerald	*Somatochlora forcipata*	N	N
	lake emerald	*Somatochlora cingulata*	N	N
	ringed emerald	*Somatochlora albicincta*	Y	N
	American emerald	*Cordulia shurtleffii*	Y	Y
	boreal whiteface	*Leucorrhinia borealis*	Y	Y

Species Group	Common Name	Scientific Name	Detected 2011	Detected 2012
Odontates (cont'd)	Canada whiteface	*Leucorrhinia patricia*	N	N
	crimson-ringed whiteface	*Leucorrhinia glacialis*	N	N
	Hudsonian whiteface	*Leucorrhinia hudsonica*	Y	Y
	belted whiteface	*Leucorrhinia proxima*	Y	Y
	saffron-bordered meadowhawk	*Sympetrum costiferum*	N	N
	black meadowhawk	*Sympetrum danae*	N	N
	variegated meadowhawk	*Sympetrum corruptum*	N	Y
	cherry-faced meadowhawk	*Sympetrum internum*	N	Y
	red-veined meadowhawk	*Sympetrum madidum*	N	N
	white-faced meadowhawk	*Sympetrum obtrusum*	Y	Y
	striped meadowhawk	*Sympetrum pallipes*	N	N

Notes: N = Not detected; Y = Detected

Appendix 4-5
Wildlife Species Groups by Wetland Group, Classification, and BGC Zone

Ecosystem Realm	Wetland Group	Wetland Class	BGC Zone	Species Dependant on Wetlands for any Part of their Life Cycle			
				Amphibians	Birds	Mammals	Invertebrates – Dragonflies/Damselflies
	Peatland	Bog	SBPS	3	21	7	36
			SBS	0	21	7	36
			ESSF	0	19	7	33
			BAFA	0	5	5	7
		Fen	SBPS	4	10	7	33
			SBS	4	9	7	32
			ESSF	4	6	7	32
			BAFA	0	5	5	8
	Mineral	Swamp	SBPS	4	24	6	30
			SBS	4	23	6	30
			ESSF	4	14	6	30
			BAFA	0	3	3	4
		Marsh	SBPS	4	52	5	44
			SBS	4	50	5	44
			ESSF	4	33	5	38
			BAFA	0	3	2	5
		Open Shallow Water	SBPS	4	36	3	25
			SBS	4	34	3	25
			ESSF	4	25	3	19
Wetland	Mineral		BAFA	0	1	0	3
Total No. of Species by Group				**4**	**62**	**10**	**51**

Notes: BAFA = Boreal Altai Fescue Alpine; BGC = biogeoclimatic unit; ESSF = Engelmann Spruce = Subalpine Fir; SBPS = Sub-Boreal Pine = Spruce; SBS = Sub-Boreal Spruce.

Appendix 4-6
Wildlife Species of Concern

Species Group	Common Name	Scientific Name	Significant Species*	Detected 2011	Detected 2012
Amphibians	western toad	*Anaxyrus boreas*	Y	Y	Y
Birds	American bittern	*Botaurus lentiginosus*	Y	N	N
	horned grebe	*Podiceps auritus*	Y	N	N
	yellow rail	*Coturnicops noveboracensis*	Y	N	N
	long-billed curlew	*Numenius americanus*	Y	N	Y
	American golden-plover	*Pluvialis dominica*	Y	N	N
	short-eared owl	*Asio flammeus*	Y	N	N
	barn swallow	*Hirundo rustica*	Y	Y	Y
	olive-sided flycatcher	*Contopus cooperi*	Y	Y	Y
Mammals	caribou (northern populations)	*Rangifer tarandus*	Y	Y	Y
	muskrat	*Ondatra zibethicus*	Y	N	N
	beaver	*Castor canadensis*	Y	Y	Y
	little brown myotis	*Myotis lucifugus*	Y	Y	Y
	northern myotis	*Myotis septentrionalis*	Y	N	N
Invertebrates	Hagen's Bluet	*Enallagma hageni*	Y	N	Y
	Kennedy's emerald	*Somatochlora kennedyi*	Y	N	N
	forcipate emerald	*Somatochlora forcipata*	Y	N	N

Note: * British Columbia Conservation Data Centre. 2012. Ecosystem Explorer. Available at: http://a100.gov.bc.ca/pub/eswp/. Accessed January 2013.

Appendix 5
2012 Wetlands Survey Environmental Data Summary

Plot Number	Site Association	Realm Class	Zone	Sub Zone	BEC Site Unit	Elevation (m)	Seepage Depth (cm)	Strata Cover Tree (%)	Strata Cover Shrub (%)	Strata Cover Herb (%)	Strata Cover Moss (%)	Moisture Regime	Nutrient Regime	Structural Stage	Flooding Regime Freq	Rooting Depth cm)	HydroGeo System	HydroGeo Sub System	Date	UTM Zone	UTM Easting	UTM Northing
T13086G	OW	Ww	SBS	mc3	SBSmc3	1,186			1	10		8	D	2c					16/07/2013	10	378123	5899507
T13116G	OW	Ww	SBS	mc3	SBSmc3	1,147				10									19/07/2013	10	378643	5900377
T13031G	Wb01	Wb	SBS	dk	SBSdk	978	16	20	70	30	90	7	B	3b					12/07/2013	10	394715	5952932
RPW043	Wb02	Wb	ESSF	mv1	ESSFmv1	1,303	0	0	25	45	35	7	B				P	bs	13/07/2012	10	374366	5897653
b12-002	Wb05	Wb	SBS	mc3	SBSmc3	1,134		0	55	50	70	7	B				P	ob	24/07/2012	10	381556	5899223
b12-054	Wb05	Wb	ESSF	mv1	ESSFmv1	1,362			50	47	55	8	C	2b			P	lb	28/07/2012	10	371611	5896084
b12-086	Wb05	Wb	SBS	mc2	SBSmc2	1,109		20	50	65	70	7	B	6			P	lb	31/07/2012	10	399853	5913478
B13012A	Wb05	Wb			SBSdk	936		5	45	25	45	7	B	7			P	lb	11/07/2013		392035	5902013
B13018B	Wb05	Wb			SBSmc3	1,168	20	5	30	25	75	8	D	7	A	25	P	lb	12/07/2013		377554	5899728
B13050B	Wb05	Wb			SBSmc3	1,017	0	5	50	45	45	8	D	7	A	35	P	ob	11/07/2013		382729	5904283
BWG-009	Wb05	Wb	ESSF	mv1	ESSFmv1	1,377		35	60	26	95	7	B	3b			P	ob	10/08/2011	10	371908	5895761
BWG-031	Wb05	Wb	ESSF	mv1	ESSFmv1	1,285		6	55	21	87	7	B	7			P	ob	13/08/2011	10	375368	5896505
BWG-042	Wb05	Wb	ESSF	mv1	ESSFmv1	1,383			50	37	90	7	A	2b			P	cb	14/08/2011	10	373681	5896748
BWG-078	Wb05	Wb	ESSF	mv1	ESSFmv1	1,263			20	45	80	7	A	2b			P	lb	18/08/2011	10	374896	5898928
BWR003B	Wb05	Wb			ESSFmv1	1,355	0		3	45	70	8	C		A	55	P	lb	13/07/2013		361316	5910791
BWR003C	Wb05	Wb			ESSFmv1	1,376	10	2	20	45	75	8	A	3b		35	P	lb	14/07/2013		360612	5910385
BWR019A	Wb05	Wb			SBSmc3	1,024	10					8	B	7a	A	30	P	cb	14/07/2013		372988	5912173
bwt-217	Wb05	Wb	SBS	dw3	SBSdw3	947		55	60	16	40	6	B	7			P	ob	27/09/2012	10	396423	5965852
BWVIS28	Wb05	Wb	ESSF	mv1	ESSFmv1	1,355		2	15	35	25	7	D	2b			P	lb	15/08/2011	10	371648.2	5894304
GIFTT23	Wb05	Wb	ESSF	mv1	ESSFmv1	1,375		3	5	45	18	7	C	3			P	cb	10/08/2011	10	373651	5896762
PL-237	Wb05	Wb	SBS	mc3	SBSmc3	1,005		20	70	25	90	6	D	5		32	P	lb	03/10/2012	10	387563	5902867
PL-239	Wb05	Wb	SBS	mc3	SBSmc3	1,035		20	55	80	10	7	C	4			P	lb	03/10/2012	10	385249	5902980
RPW013	Wb05	Wb	SBS	mc3	SBSmc3	1,188			30	39	80	6	B	2b			P	lb	12/07/2012	10	377296	5898688
RPW101	Wb05	Wb	SBS	mc3	SBSmc3	1,031		7	30	40	50	6	B				P	lb	12/07/2012	10	401896	5933697
T13069F	Wb05	Wb	SBS	mc3	SBSmc3	1,046	34	5	60	30	95	7	B	3b	R	42	P	bs	15/07/2013	10	376267	5904762
T13092V	Wb05	Wb	SBS	mc3	SBSmc3	1,173			50	20	95	7	B	3a					17/07/2013	10	377513	5899688
T13135G	Wb05	Wb	SBS	mc3	SBSmc3	1,131	2	30	30	40	80	7	D	5		23			20/07/2013	10	379173	5900531
T13140G	Wb05	Wb	SBS	mc3	SBSmc3	1,117	3	15	55	40	60	7	D	6		27			21/07/2013	10	378978	5901833
b12-007	Wb08	Wb	SBS	mc3	SBSmc3	1,108						7	A	3b			P	lb	24/07/2012	10	382559	5899812
BWVIS21	Wb08	Wb	ESSF	mv1	ESSFmv1	1,414			18	80	65	7	D	2b/3			P	ob	13/08/2011	10	372463.6	5894499
T13037G	Wb08	Wb	SBS	dk	SBSdk	972	45	60	30	20	90	6	C	5		35			12/07/2013	10	394433	5951931
T13060G	Wb08	Wb	SBS	mc3	SBSmc3	1,119	6	5	10	20	90	7	C	6					14/07/2013	10	380537	5901105
T13090G	Wb08	Wb	SBS	mc3	SBSmc3	1,174	35	30	45	40	95	6	C	6		24			17/07/2013	10	377281	5899856
b12-018	Wb10	Wb	ESSF	mv1	ESSFmv1	1,389	2		52	60	90	8	D	2b			P	cb	25/07/2012	10	373418	5897520

Plot Number	Site Association	Realm Class	Zone	Sub Zone	BEC Site Unit	Elevation (m)	Seepage Depth (cm)	Strata Cover Tree (%)	Strata Cover Shrub (%)	Strata Cover Herb (%)	Strata Cover Moss (%)	Moisture Regime	Nutrient Regime	Structural Stage	Flooding Regime Freq	Rooting Depth cm)	HydroGeo System	HydroGeo Sub System	Date	UTM Zone	UTM Easting	UTM Northing
RPW021	Wb10	Wb	ESSF	mv1	ESSFmv1	1,313			15	32	70	8	B				P	cb	10/07/2012	10	374582	5896768
b12-038	Wb11	Wb	SBS	mc3	SBSmc3	1,084	5		55	40	75	8	B	3a			P	ob	27/07/2012	10	379555	5903851
RPW017C	Wb13	Wf	SBS	mc3	SBSmc3	1,246			1	35	7	7	D				P	lb	10/07/2012	10	375100	5898671
RPW033	Wb13	Wb	SBS	mc3	SBSmc3	1,142		0	1	25	55	7	B				P	cb	12/07/2012	10	382044	5898898
RPW033B	Wb13	Wb	SBS	mc3	SBSmc3	1,142				38	4	7	B				P	cb	12/07/2012	10	382109	5898923
T13148G	Wb13	Wb	ESSF	mv1	ESSFmv1	1,349	2					8	C	2b					21/07/2013	10	371637	5894328
b12-037	Wf01	Wf	SBS	mc3	SBSmc3	1,144				55	10	7	D				P	lb	27/07/2012	10	378399	5900592
b12-084	Wf01	Wf	SBS	mc3	SBSmc3	1,133	2		10	90	25	8	B	2b			P	ob	30/07/2012	10	381324	5899166
b12-090	Wf01	Wf	SBS	mc3	SBSmc3	1,045			35	85	5	8	B	2b			P	lb	31/07/2012	10	401262	5937307
bwt-225	Wf01	Wf	SBS	dk	SBSdk	930	85			90	1	8	D	2b		21	P	lb	28/09/2012	10	385446	5907788
BWVIS38	Wf01	Wf	ESSF	mv1	ESSFmv1	1,433		4	41	75	80	8	D				P	ob	17/08/2011	10	373797.7	5893891
GIFTT07	Wf01	Wf	ESSF	mv1	ESSFmv1	1,370		3	5	60	20	7	C	2			P	lb	12/07/2011	10	370887	5896231
GIFTT17	Wf01	Wf	ESSF	mv1	ESSFmv1	1,352		4	1	90	2	7	E	2			P	cb	14/07/2011	10	370833	5893621
RPW007	Wf01	Wf	SBS	mc3	SBSmc3	1,121			1	40	10	7	C	2b			P	ob	11/07/2012	10	382275	5899095
RPW061	Wf01	Wf	SBS	mc3	SBSmc3	1,125			9	75	2	7	C	2b			P	ob	11/07/2012	10	381292	5899154
RPW071	Wf01	Wf	SBS	mc3	SBSmc3	1,184			10	65		7	C	2b			P	lb	11/07/2012	10	379267	5898307
T13040	Wf01	Wf			SBSmc3														13/07/2013		389916	5913273
T13042	Wf01	Wf			SBSmc3														13/07/2013		389888	5912964
T13053G	Wf01	Wf	SBS	mc3	SBSmc3	1,026	2		10	60	70		D	2b					14/07/2013	10	385816	5903060
T13139G	Wf01	Wf	SBS	mc3	SBSmc3	1,118		30	25	55	95	3	C	6		32			21/07/2013	10	378909	5901919
b117110	Wf02	Wf	ESSF	mv1	ESSFmv1	1,277		0	35	22	70	7	D	2b			P	ob	12/08/2011	10	375299	5896432
b12-011	Wf02	Wf	SBS	mc3	SBSmc3	1,129	2	0	35	65	0	7	D				P	ob	24/07/2012	10	382281	5899129
b12-034	Wf02	Wf	SBS	mc3	SBSmc3	1,056			10	80	55	8	E				P	lb	14/07/2012	10	383790	5913681
b12-036	Wf02	Wf	SBS	mc3	SBSmc3	1,145	25		60	33	62	7	B	3a			P	lb	27/07/2012	10	378399	5900592
b12-051	Wf02	Wf	SBS	mc3	SBSmc3	1,062			55	55	75	7	C				P	tb	27/07/2012	10	385390	5914412
b12-057	Wf02	Wf	SBS	mc3	SBSmc3	1,160	20		36	55	55	7	B	2b		30	P	lb	28/07/2012	10	348880	5902925
b12-058	Wf02	Wf	SBS	mc3	SBSmc3	1,266			55	45	75	8	B	2b			P	lb	28/07/2012	10	375025	5898926
b12-060	Wf02	Wf	SBS	mc3	SBSmc3	1,300	2		35	50	70	7	B	2b			P	lb	28/07/2012	10	373522	5899817
B13013A	Wf02	Wf			SBSdk	930			25	30	20	8	D	2b		30	P	lb	11/07/2013		385199	5906847
B13018A	Wf02	Wf			SBSmc3	1,165	3	0	35	35	55	8	D	2b	A	50	P	lb	12/07/2013		377515	5899755
B13020A	Wf02	Wf			SBSmc3	1,100	5	0	20	40	43	8	D	2b	A	55	L	lb	12/07/2013		381412	5900584
B13027A	Wf02	Wf			SBSmc3	1,234	3	0	51	47	40	8	C		R	45	P	ob	09/07/2013		378454	5897119
B13037A	Wf02	Wf			SBSmc3	1,056			50	20	65	6	D		A		P	lb	10/07/2013		380816	5903596
B13050A	Wf02	Wf			SBSmc3	1,017	2					8	D	2d	A	55	P	lb	11/07/2013		382877	5904200

Plot Number	Site Association	Realm Class	Zone	Sub Zone	BEC Site Unit	Elevation (m)	Seepage Depth (cm)	Strata Cover Tree (%)	Strata Cover Shrub (%)	Strata Cover Herb (%)	Strata Cover Moss (%)	Moisture Regime	Nutrient Regime	Structural Stage	Flooding Regime Freq	Rooting Depth cm)	HydroGeo System	HydroGeo Sub System	Date	UTM Zone	UTM Easting	UTM Northing
BWG-010	Wf02	Wf	ESSF	mv1	ESSFmv1	1,463		20	40	30	65	6	D	3a			P	lb	10/08/2011	10	375995	5893917
BWG-064	Wf02	Wf	ESSF	mv1	ESSFmv1	1,364		5	50	70	90	7	D	2b			P	ts	16/08/2011	10	370173	5896315
BWR001A	Wf02	Wf			ESSFmv1	1,532	4		22	60	75	8	D	2b	A	25	P	lb	13/07/2013		362703	5905982
BWR003A	Wf02	Wf			ESSFmv1	1,382	2		47	45	65	8	D	2b	A	50	P	lb	13/07/2013		360816	5910403
BWR005B	Wf02	Wf			SBSmc3	1,013	5					8	C		A	25	P	lb	13/07/2013		370142	5913615
BWR006B	Wf02	Wf			ESSFmv1	1,364	0		35	45	50	8	D	2b/3a	A	35	P	lb	13/07/2013		364315	5909803
BWR008A	Wf02	Wf			SBSmc3	1,122	9		60	45	65	8	D	2b	A	35	P	lb	13/07/2013		367141	5911387
GIFTT11	Wf02	Wf	ESSF	mv1	ESSFmv1	1,453		5	65	20	7	7	C	2b/3a			P	lb	12/07/2011	10	376111	5893930
GIFTT15	Wf02	Wf	ESSF	mv1	ESSFmv1	1,450		3	30	30	18	7	C	2			P	lb	14/07/2011	10	373597	5894140
RPW017B	Wf02	Wf	SBS	mc3	SBSmc3	1,249			30	25	30	8	C	3a			P	lb	10/07/2012	10	375037	5898916
RPW023	Wf02	Wf	ESSF	mv1	ESSFmv1	1,454			22	70	30	7	C				P	lb	14/07/2012	10	376346	5893991
RPW028	Wf02	Wf	ESSF	mv1	ESSFmv1	1,357			40	40	15	7	C				P	lb	12/07/2012	10	371612	5896090
RPW049	Wf02	Wf	SBS	mc3	SBSmc3	1,138			3	63	25	8	C	2b			P	ob	11/07/2012	10	381640	5899144
RPW100	Wf02	Wf	SBS	dk	SBSdk	966			3	55	6	7	C				P	lh	12/07/2012	10	399178	5928383
RPW105	Wf02	Wf	ESSF	mv1	ESSFmv1	1,426			12	40	43	7	C				P	ob	13/07/2012	10	373870	5894268
T13091V	Wf02	Wf	SBS	mc3	SBSmc3	1,175			25	80	15	8	D	2b					17/07/2013	10	377372	5899795
T13146G	Wf02	Wf	SBS	mc3	SBSmc3		1					8	C						21/07/2013		385575	5902784
BWG-004	Wf03	Wf	ESSF	mv1	ESSFmv1	1,368			19	70	90	7	D	2b			P	lb	10/08/2011	10	371526	5896099
BWG-037	Wf03	Wf	ESSF	mv1	ESSFmv1	1,443			15	60	90	7	D	2b			P	lb	13/08/2011	10	373529	5894134
BWG-053	Wf03	Wf	ESSF	mv1	ESSFmv1	1,347			10	78	45	7	D	2b			P	ob	15/08/2011	10	371764	5894371
BWVIS40	Wf03	Wf	ESSF	mv1	ESSFmv1	1,314			12	55	25	7	D	2b			P	lh	17/08/2011	10	372577.9	5895502
GIFTT16	Wf03	Wf	ESSF	mv1	ESSFmv1	1,348		1	1	40	5	7	E	2			P	ob	14/07/2011	10	371748	5894388
GIFTT18	Wf03	Wf	ESSF	mv1	ESSFmv1	1,275		0	2	40	50	7	B	2			P	ob	14/07/2011	10	375243	5896398
RPW028B	Wf03	Wf	ESSF	mv1	ESSFmv1	1,348			15	37	52	7	C				P	lb	12/07/2012	10	372022	5895970
RPW068	Wf03	Wf	ESSF	mv1	ESSFmv1	1,438			3	18	76	7	B		F		P	cb	13/07/2012	10	373668	5894655
b12-023	Wf04	Wf	SBS	dk	SBSdk	924	30	0	85	25	80	7	C	3a			P	lb	26/07/2012	10	381167	5911261
B13023A	Wf04	Wf			ESSFmv1	1,272	1		37	43	45	8	D	2b	F	50	P	ob	12/07/2013		378468	5895420
B13038B	Wf04	Wf			ESSFmv1	1,465	0		20	25	50	8	C	2b	F	25	P	ob	12/07/2013		377594	5891405
b12-052	Wf05	Wf	SBS	mc3	SBSmc3	1,063			10	75	80	8	D				P	tb	27/07/2012	10	385390	5914412
BWG-073	Wf05	Wf	ESSF	mv1	ESSFmv1	1,288			1	65	85	8	A	2b			P	lb	18/08/2011	10	373583	5899804
T13099G	Wf06	Wf	SBS	mc3	SBSmc3	1,052			15	50	10	8	D	2b					18/07/2013	10	386731	5911830
RPW001	Wf07	Wf	ESSF	mv1	ESSFmv1	1,439			10	75	53	6	C				P	lb	13/07/2012	10	373580	5894149
T13147G	Wf07	Wf	SBS	mc3	SBSmc3		3		30	60	80	8	D	3a		15			21/07/2013	10	385721	5902990
b12-039	Wf08	Wf	SBS	mc3	SBSmc3	1,077				45	40	8	B	2a			P	ob	27/07/2012	10	379555	5903851

Plot Number	Site Association	Realm Class	Zone	Sub Zone	BEC Site Unit	Elevation (m)	Seepage Depth (cm)	Strata Cover Tree (%)	Strata Cover Shrub (%)	Strata Cover Herb (%)	Strata Cover Moss (%)	Moisture Regime	Nutrient Regime	Structural Stage	Flooding Regime Freq	Rooting Depth cm)	HydroGeo System	HydroGeo Sub System	Date	UTM Zone	UTM Easting	UTM Northing
b12-053	Wf08	Wf	ESSF	mv1	ESSFmv1	1,346	2		10	80	22	8	C	2b			P	ob	28/07/2012	10	371740	5894362
b12-059	Wf08	Wf	SBS	mc3	SBSmc3	1,256			3	50	15	8	B				P	lb	28/07/2012	10	375093	5898906
B13031A	Wf08	Wf			SBSmc3	1,108	0		5	60	25	8	D		R		P	ob	10/07/2013		379291	5901569
B13043A	Wf08	Wf			SBSmc3	1,084	0		7	60	45	8	D	2b	A	50	P	ob	12/07/2013		381647	5901732
B13043B	Wf08	Wf			SBSmc3	1,088		0	0	15	15	8	D				P	ob	12/07/2013		381797	5901633
RPW102	Wf08	Wf	SBS	mc3	SBSmc3	1,034		0	2	23	33	8	C				P	lb	12/07/2012	10	401522	5933531
RPW104	Wf08	Wf	ESSF	mv1	ESSFmv1	1,294			6	46	38	7	C				P	lb	13/07/2012	10	375500	5899831
b12-061	Wf10	Wf	SBS	mc3	SBSmc3	1,293				60	40	7	D	2b			P	lb	28/07/2012	10	373575	5899813
B13053A	Wf10	Wf			ESSFmv1	1,403	0		1	60	65	8	D	2b		35	P	lb	14/07/2013	10	372827	5897060
B13060A	Wf10	Wf			ESSFmv1	1,341	4		2	45	60	8	D	2b	F	40	P	ob	15/07/2013	10	371714	5894391
BWVIS12	Wf10	Wf	ESSF	mv1	ESSFmv1	1,402				45	10	7	D	2b			P	ob	12/08/2011	10	375435	5894699
RPW103	Wf10	Wf	ESSF	mv1	ESSFmv1	1,289			1	65	20	8	C				P	lb	13/07/2012	10	373726	5899875
b12-068	Wf11	Wf	ESSF	mv1	ESSFmv1	1,416	4	0	14	70	85	8	B	2b			P	ob	29/07/2012	10	375547	5894675
B13038A	Wf11	Wf			ESSFmv1	1,454	0		4	42	65	8	C	2b	A	40	P	lb	12/07/2013		378131	5891994
B13051A	Wf11	Wf			ESSFmv1	1,479	0		2	60	43	8	D	2b	F	40	P	lb	14/07/2013		370042	5898645
BWG-026	Wf11	Wf	ESSF	mv1	ESSFmv1	1,538			2	53	35	7	D	2b			P	cb	12/08/2011	10	373756	5892958
BWR002A	Wf11	Wf			ESSFmv1	1,529	1	0	15	50	60	8	D	2b	A	20	P	lb	13/07/2013		361349	5905943
BWVIS15	Wf11	Wf	ESSF	mv1	ESSFmv1	1,343		2	5	30	60	8	d	2b			P	lb	12/08/2011	10	357362	5895897
GIFTT08	Wf11	Wf	ESSF	mv1	ESSFmv1	1,406		0	3	55	15	7	D	2			P	ob	12/07/2011	10	375392	5894658
GIFTT24	Wf11	Wf	ESSF	mv1	ESSFmv1	1,536		1	3	35	25	7	D	2			P	cb	10/08/2011	10	373725	5892954
RPW017	Wf11	Wf	SBS	mc3	SBSmc3	1,247			0.5	55	13	8	D	2b			P	lb	12/07/2012	10	375138	5898949
RPW106	Wf11	Wf	ESSF	mv1	ESSFmv1	1,406			9	75	30	7	B				P	ob	12/07/2012	10	375497	5894651
B13041A	Wf12	Wf			ESSFmv1	1,572		0	7	20	30	8	C	2b	A	35	P	cb	12/07/2013		376983	5892353
T13076	Wf13	Wf	ESSF	mv1	ESSFmv1	1,591	13		5	75	90	7	D	2b					16/07/2013		376607	5891655
T13080G	Wf13	Wf	ESSF	mv1	ESSFmv1	1,538	17		10	20	95	8	D	2b		31			16/07/2013	10	377378	5892676
b12067b	Wm01	Wm	ESSF	mv1	ESSFmv1	1,315			30	15	2	8	D				P	lb	21/07/2012	10	376344	5895935
b12-082	Wm01	Wm	SBS	mc3	SBSmc3	1,136			2	70	45	8	C	2a			P	cb	30/07/2012	10	382111	5898963
B13014A	Wm01	Wm			SBSdk	928	2	0	5	60	10	8	D	2b	A		F	a	11/07/2013		385114	5907958
B13015A	Wm01	Wm			SBSdk	932			11	90	5	7	E	Sb	A	30	F	a	11/07/2013		384937	5908223
B13017A	Wm01	Wm			SBSmc3	1,085	30	0	1	35	5	7	D		A		P	cb	10/07/2013		379921	5902439
B13036A	Wm01	Wm			SBSmc3	1,187		0	0	82	5	6	D				P	lb	09/07/2013		379761	5897668
BWR005A	Wm01	Wm			SBSmc3	1,014	0			90	1	8	D	2b	A	30	P	lb	13/07/2013		370039	5913750
BWVIS04	Wm01	Wf	ESSF	mv1	ESSFmv1	1,345			5	80		7	E	2b			F	a	10/08/2011	10	371872	5895138
BWVIS19	Wm01	Wm	SBS	mc3	SBSmc3	1,234				10		8	E	2b			P	oh	13/08/2011	10	376901.5	5897785

Plot Number	Site Association	Realm Class	Zone	Sub Zone	BEC Site Unit	Elevation (m)	Seepage Depth (cm)	Strata Cover Tree (%)	Strata Cover Shrub (%)	Strata Cover Herb (%)	Strata Cover Moss (%)	Moisture Regime	Nutrient Regime	Structural Stage	Flooding Regime Freq	Rooting Depth cm)	HydroGeo System	HydroGeo Sub System	Date	UTM Zone	UTM Easting	UTM Northing
GIFTT22	Wm01	Wm	SBS	mc3	SBSmc3	1,266			2	90	5	7	D	2			F	a	10/08/2011	10	374444	5896137
RPW002	Wm01	Wm	SBS	mc3	SBSmc3	1,134		0	0	40	5	7	D				P	lb	12/07/2012	10	382269	5898712
RPW003	Wm01	Wm	SBS	mc3	SBSmc3	1,127	2	0	9	37	3	6	D	2b	F		P	lb	11/07/2012	10	382079	5898753
RPW006	Wm01	Wm	SBS	mc3	SBSmc3	1,126		0	0	18	5	7	D	2b	A		P	cb	11/07/2012	10	382005	5898990
RPW011	Wm01	Wm	SBS	mc3	SBSmc3	1,214			2	65	3	8	C				P	lb	12/07/2012	10	376386	5898394
RPW059	Wm01	Wm	SBS	mc3	SBSmc3	1,184	0	0	2	62	1	7	D				P	ob	11/07/2012	10	379002	5898448
T13103G	Wm01	Wm	SBS	mc3	SBSmc3	1,059				10	20	8	C						18/07/2013	10	387007	5912163
T13121G	Wm01	Wm	SBS	mc3	SBSmc3	1,118	30		10	70		7	D	2b					19/07/2013	10	378859	5901193
T13126G	Wm01	Wm	SBS	mc3	SBSmc3	1,136				70		8	D	2b					19/07/2013	10	379037	5900683
T13005G	Wm02	Wm	SBS	dk	SBSdk	915	36		20	50	30	7	D	2b		25			09/07/2013	10	389050	5972523
b12-035	Ws04	Ws	SBS	mc3	SBSmc3	1,196			89	20	15	8	D	3a			P	lb	27/07/2012	10	379497	5898073
b12-085	Ws04	Ws	SBS	dk	SBSdk	926	36		80	55	55	6	D	3b		40	P	lb	31/07/2012	10	382867	5908593
B13016A	Ws04	Ws			SBSdk	949		0	35	60	1	6	D				P	lh	13/07/2013		383590	5907187
GIFTT21	Ws04	Ws	SBS	mc3	SBSmc3	1,223		4	30	47	5	7	D	3			P	lh	09/08/2011	10	375683	5897409
T13068G	Ws04	Ws	SBS	mc2	SBSmc2	1,039	47	2	65	50	30	6	D	3a		40			15/07/2013	10	376312	5904809
T13144G	Ws04	Ws	SBS	mc3	SBSmc3	1,023	25		75	60		6	D	3b		25			21/07/2013	10	378714	5905944
b12-008	Ws07	Ws	SBS	mc3	SBSmc3	1,107		50	6	60	80	7	C	5			P	lb	24/07/2012	10	382730	5899834
b12-025	Ws07	Ws	SBS	dk	SBSdk	944	20	60	5	55	70	6	D	5			P	ts	26/07/2012	10	381073	5911741
b12-033	Ws07	Ws	SBS	mc3	SBSmc3	1,054	3	26	14	65	50	7	D	5			P	ts	26/07/2012	10	383832	5913522
b12-048	Ws07	Ws	SBS	mc3	SBSmc3	1,117	25	30	50	50	25	6	D	5			P	lh	27/07/2012	10	386627	5914888
b12-050	Ws07	Ws	SBS	mc3	SBSmc3	1,065		45	5	35	10	7	C	5			P	tb	27/07/2012	10	385475	5914639
b12-063	Ws07	Ws	SBS	mc3	SBSmc3	1,192	25	7	60	40	20	7	D	3a		25	P	oh	28/07/2012	10	378080	5898834
b12-081	Ws07	Ws	SBS	mc3	SBSmc3	1,233		45	13	85	20	6	D	6			P	lh	29/07/2012	10	378176	5897508
B13012B	Ws07	Ws			SBSdk	930	7	10	25	55	20	6	D	7	A	30	P	lb	11/07/2013		391878	5901997
B13013B	Ws07	Ws			SBSdk	925		10	35	50	17	8	D	7			P	lb	11/07/2013		385361	5906733
B13031B	Ws07	Ws			SBSmc3	1,103	7	25	42	40	40	7	D		R	30	P	bs	10/07/2013		379212	5901533
B13036D	Ws07	Ws			SBSmc3	1,186	7	60	14	50	35	6	C		R		P	lb	09/07/2013		379664	5897699
BWG-033	Ws07	Ws	SBS	mc3	SBSmc3	1,263		34	20	45	40	5	D	5			P	oh	13/08/2011	10	375977	5897038
BWG-036	Ws07	Ws	SBS	mc3	SBSmc3	1,177		17	45	85	10	5	D	5			P	lh	13/08/2011	10	377641	5898646
BWG-050	Ws07	Ws	SBS	mc3	SBSmc3	1,213		35	25	70	60	7	D	6			P	lh	14/08/2011	10	376168	5897956
BWG-052	Ws07	Ws	SBS	mc3	SBSmc3	1,235		25	27	56	55	6	D	7			P	lh	14/08/2011	10	376321	5898355
bwt-210	Ws07	Ws	SBS	dk	SBSdk	797		55	30	25	60	5	C				P	cb	26/09/2012	10	380033	5979710
bwt-222	Ws07	Ws	SBS	mc3	SBSmc3	1,010	40	60	25	40	75	7	D	7			P	lh	27/09/2012	10	397489	5958015
PL-238	Ws07	Ws	SBS	mc3	SBSmc3	1,036				45	10	6	D	2			P	lb	03/10/2012	10	385631	5903050

Plot Number	Site Association	Realm Class	Zone	Sub Zone	BEC Site Unit	Elevation (m)	Seepage Depth (cm)	Strata Cover Tree (%)	Strata Cover Shrub (%)	Strata Cover Herb (%)	Strata Cover Moss (%)	Moisture Regime	Nutrient Regime	Structural Stage	Flooding Regime Freq	Rooting Depth cm)	HydroGeo System	HydroGeo Sub System	Date	UTM Zone	UTM Easting	UTM Northing
RPW014	Ws07	Ws	SBS	mc3	SBSmc3	1,184		5	10	90	39	6	C	2b			P	lh	10/07/2012	10	377106	5898451
RPW060	Ws07	Ws	SBS	mc3	SBSmc3	1,177		10	14	75	7	6	D	2b			P	lb	11/07/2012	10	379317	5898522
T13036G	Ws07	Ws	SBS	dk	SBSdk	967		50	35	25	60	5	C	7a		50			12/07/2013	10	394484	5952178
T13038G	Ws07	Ws	SBS	dk	SBSdk	960	12	30	50	50	90	7	D	7a					12/07/2013	10	394202	5951483
T13046G	Ws07	Ws	SBS	mc3	SBSmc3	1,085	28	25	35	40	80	6	D			28			13/07/2013	10	377804	5904391
T13048F	Ws07	Ws	SBS	mc3	SBSmc3	1,055	28	25	30	40	90	6	D	7a	X	28	U		13/07/2013	10	378578	5904901
T13049G	Ws07	Ws	SBS	mc3	SBSmc3	1,005	30	15	40	60	50	6	D	6		30			14/07/2013	10	387436	5902757
T13058V	Ws07	Ws	SBS	mc3	SBSmc3		25	45	25	60	70	6	D	7a					14/07/2013	10	380074	5900365
T13064G	Ws07	Ws	SBS	mc2	SBSmc2	1,060	56	35	45	60	45	6	D	7a		33			15/07/2013	10	374201	5904006
T13073G	Ws07	Ws	ESSF	xvp	ESSFxvp	1,667	20	10	30	40	60	6	C	7a		24			16/07/2013	10	376023	5892118
T13089G	Ws07	Ws	SBS	mc3	SBSmc3	1,159	10	35	20	50	80	6	D	7a		22			17/07/2013	10	378184	5899366
T13096G	Ws07	Ws	SBS	mc3	SBSmc3	1,165		30	50	45	80	6	D	7a		27			17/07/2013	10	377998	5899952
T13119G	Ws07	Ws	SBS	mc3	SBSmc3	1,134	37		45	50	15	6	D	2b		37			19/07/2013	10	378620	5900781
T13125G	Ws07	Ws	SBS	mc3	SBSmc3	1,132	31	40	30	70	90	6	D	7a		19			19/07/2013	10	379192	5900802
T13128G	Ws07	Ws	SBS	mc3	SBSmc3	1,134		5	10	80		5	C	7a		27			20/07/2013	10	378933	5900160
T13131F	Ws07	Ws	SBS	mc3	SBSmc3	1,131	6	35	30	50	80	7	D	7a		30	P		20/07/2013	10	379386	5900310
b12-012	Ws08	Ws	ESSF	mv1	ESSFmv1	1,259		25	65	55	15	6	D	4			F	a	25/07/2012	10	375414	5898022
b12-014	Ws08	Ws	ESSF	mv1	ESSFmv1	1,286		55	11	45	70	6	D				P	lh	25/07/2012	10	374541	5898845
b12-017	Ws08	Ws	ESSF	mv1	ESSFmv1	1,345		40	33	55	25	6	D	6			P	lh	25/07/2012	10	373557	5898055
b12-022	Ws08	Ws	ESSF	mv1	ESSFmv1	1,393	10	50	30	65	60	6	D	6			P	lh	25/07/2012	10	373324	5897015
b12-042	Ws08	Ws	ESSF	mv1	ESSFmv1	1,240		50	20	60	50	6	D	6			F	a	27/07/2012	10	388880	5916591
b12-069	Ws08	Ws	ESSF	mv1	ESSFmv1	1,405	30	22	40	88	55	7	B	6			P	ob	29/07/2012	10	375808	5894689
b12-073	Ws08	Ws	ESSF	mv1	ESSFmv1	1,368	40	50	14	85	70	5	D	6		30	P	lh	29/07/2012	10	376164	5895223
BWG-003	Ws08	Ws	ESSF	mv1	ESSFmv1	1,449		62	10	70	45	6	D	7			P	bs	10/08/2011	10	371401	5896771
BWG-006	Ws08	Ws	ESSF	mv1	ESSFmv1	1,337			9	45	65	7	D	7			P	oh	10/08/2011	10	371560	5895765
BWG-040	Ws08	Ws	ESSF	mv1	ESSFmv1	1,427		65	23	40	65	6	D	6			P	bs	13/08/2011	10	372730	5894430
BWG-060	Ws08	Ws	ESSF	mv1	ESSFmv1	1,378		45	9	40	75	6	D	7			P	bs	15/08/2011	10	371930	5894366
BWG-077	Ws08	Ws	ESSF	mv1	ESSFmv1	1,278		65	22	45	85	6	D	5			F	a	18/08/2011	10	374427	5899269
BWR006A	Ws08	Ws			ESSFmv1	1,362	15	30	25	45	30	8	C	6	A	10	P	lb	13/07/2013		364210	5909865
BWVIS14	Ws08	Ws	ESSF	mv1	ESSFmv1	1,360		20	45	35		6	D	3			F	a	12/08/2011	10	375282	5895380
BWVIS35	Ws08	Ws	ESSF	mv1	ESSFmv1	1,501		17	15	35	25	5	d	7			F	a	17/08/2011	10	374135.6	5893165
BWVIS36	Ws08	Ws	ESSF	mv1	ESSFmv1	1,474		35	15	35	10	6	D	6			F	a	17/08/2011	10	373944.2	5893519
BWVIS39	Ws08	Ws	ESSF	mv1	ESSFmv1	1,331		40	35	30	10	6	D	6			P	ob	17/08/2011	10	372882.3	5895915
GIFTT09	Ws08	Ws	ESSF	mv1	ESSFmv1	1,633		2	5	85	5	7	D	2			P	bs	12/07/2011	10	375354	5892508
GIFTT19	Ws08	Ws	ESSF	mv1	ESSFmv1	1,314			18	4		6	D	6			F	a	09/08/2011	10	373200	5895665

Plot Number	Site Association	Realm Class	Zone	Sub Zone	BEC Site Unit	Elevation (m)	Seepage Depth (cm)	Strata Cover Tree (%)	Strata Cover Shrub (%)	Strata Cover Herb (%)	Strata Cover Moss (%)	Moisture Regime	Nutrient Regime	Structural Stage	Flooding Regime Freq	Rooting Depth cm)	HydroGeo System	HydroGeo Sub System	Date	UTM Zone	UTM Easting	UTM Northing
GIFTT20	Ws08	Ws	ESSF	mv1	ESSFmv1	1,430		7	50	35	10	6	D	6			F	a	09/08/2011	10	374686	5894793
T13110G	Ws08	Ws	ESSF	mv1	ESSFmv1	1,333		10	40	65	90	5	C	6		30			18/07/2013	10	377834	5894720
B13020B	Ww	Ww			SBSmc3	1,099		0	0	20	0	8	D				L	lb	12/07/2013		381389	5900711
B13036C	Ww	Ww			SBSmc3	1,185		0	8	3	2	8	D				P	lb	09/07/2013		379749	5897741
BWR005C	Ww	Ww			SBSmc3	1,014				50		8	D				P	lb	13/07/2013		369809	5914007

Note: For information of the data summary fields and code see: BC MOFR and BC MOE (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment). 2010. Field Manual for Describing Terrestrial Ecosystems. 2nd Edition. Victoria, British Columbia. Land Manag. Handb. No. 25. Available at www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh25-2.htm (accessed 12 December 2012).

Appendix 6
Summary Data for Blackwater Reference Wetlands

Plot Number	BWR001A	BWR002A	BWR003A	BWR003B	BWR003C	BWR005A	BWR005B	BWR005C	BWR006A	BWR006B	BWR008A	BWR019A
Site Unit	Wf02	Wf11	Wf02	Wb05	Wb05	Wm01	Wf02	Ww	Ws08	Wf02	Wf02	Wb05
BEC Site Unit	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3	SBSmc3	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3
Elevation (m)	1,532	1,529	1,382	1,355	1,376	1,014	1,013	1,014	1,362	1,364	1,122	1,024
Seepage Depth (cm)	4	1	2	0	10	0	5		15	0	9	10
Strata Cover Tree (%)		0			2				30			
Strata Cover Shrub (%)	22	15	47	3	20				25	35	60	
Strata Cover Herb (%)	60	50	45	45	45	90		50	45	45	45	
Strata Cover Moss (%)	75	60	65	70	75	1			30	50	65	
Moisture Regime	8	8	8	8	8	8	8	8	8	8	8	8
Nutrient Regime	D	D	D	C	A	D	C	D	C	D	D	B
Structural Stage	2b	2b	2b		3b	2b			6	2b/3a	2b	7a
Substrate Decayed Wood (%(	0	0	0	2	2	0	2	0	10	1	0	1
Substrate Bedrock (%)	0	0	0	0	0	0	0	0	0	0	0	0
Substrate Rocks (%)	0	0	0	0	0	0	0	0	0	0	0	0
Substrate Mineral Soil (%)	0	0	0	0	0	0	0	0	0	0	0	0
Substrate Organic Matter (%)	95	98	99	73	97	60	97	0	65	89	99	99
Substrate Water (%)	5	2	1	25	1	40	1	100	25	10	1	0
Biochemical/Water Quality Site		Yes	Yes	Yes	Yes				Yes	Yes		Yes
Rooting Depth (cm)	25	20	50	55	35	30	25		10	35	35	30
HydroGeoSystem	P	P	P	P	P	P	P	P	P	P	P	P
HydroGeoSubSystem	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	cb
Date	13/07/2013	13/07/2013	13/07/2013	13/07/2013	14/07/2013	13/07/2013	13/07/2013	13/07/2013	13/07/2013	13/07/2013	13/07/2013	14/07/2013
UTMZone	10	10	10	10	10	10	10	10	10	10	10	10
UTMEasting	362703	361349	360816	361316	360612	370039	370142	369809	364210	364315	367141	372988
UTMNorthing	5905982	5905943	5910403	5910791	5910385	5913750	5913615	5914007	5909865	5909803	5911387	5912173
LocationAccuracy (m(	3	3	3	3	3	3	3	3	3	3	3	3
RealmClass	Wf	Wf	Wf	Wb	Wb	Wm	Wf	Ww	Ws	Wf	Wf	Wb

Plot Number	BWR001A	BWR002A	BWR003A	BWR003B	BWR003C	BWR005A	BWR005B	BWR005C	BWR006A	BWR006B	BWR008A	BWR019A
Site Unit	Wf02	Wf11	Wf02	Wb05	Wb05	Wm01	Wf02	Ww	Ws08	Wf02	Wf02	Wb05
BEC Site Unit	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3	SBSmc3	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3
Elevation (m)	1,532	1,529	1,382	1,355	1,376	1,014	1,013	1,014	1,362	1,364	1,122	1,024
Plant Species Cover (%)												
Abies lasiocarpa									15			
Picea engelmannii x glauca									15			
Picea mariana												3
Pinus contorta					2							
Abies lasiocarpa									10			
Alnus incana							15					
Betula nana	15	15	35	1	4		15			12	35	
Lonicera involucrata									5			
Picea engelmannii x glauca					5				2			
Picea mariana				1	2		12			2		15
Pinus contorta	1			1	10							
Rhododendron groenlandicum			2		3		15		2	12		45
Ribes hudsonianum									5			
Ribes lacustre									5			
Salix barclayi											3	
Salix candida											5	
Salix myrtillifolia		2	5				15			7	20	
Salix pedicellaris	7	4	5							5		
SALIXSP							3		5			
Achillea millefolium									0.5			
Anemone sp.		1										
Arnica cordifolia									0.5			
Calamagrostis canadensis							5		10			0.5
Caltha leptosepala	3	3										

Plot Number	BWR001A	BWR002A	BWR003A	BWR003B	BWR003C	BWR005A	BWR005B	BWR005C	BWR006A	BWR006B	BWR008A	BWR019A
Site Unit	Wf02	Wf11	Wf02	Wb05	Wb05	Wm01	Wf02	Ww	Ws08	Wf02	Wf02	Wb05
BEC Site Unit	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3	SBSmc3	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3
Elevation (m)	1,532	1,529	1,382	1,355	1,376	1,014	1,013	1,014	1,362	1,364	1,122	1,024
Cardamine oligosperma var. oligosperma						0.5						
Carex aquatilis	32	7	25	5		85	25				30	12
Carex canescens	1				2				1	5		
Carex disperma							2		7			
Carex garberi						0.5						
Carex gynocrates										5	12	
Carex leptalea										1	2	
Carex limosa		15										
Carex magellanica			10	12	5		5					
Carex tenera			1						0.5			
Carex tracyi		1										
Carex utriculata										20		
Carex vesicaria				12								
Castilleja miniata	3											
Comarum palustre			2			3	5					
Cornus canadensis									5			
Eleocharis palustris								20				
Elymus glaucus									1			
Empetrum nigrum			10		45				0.5			
Epilobium ciliatum	1											
Equisetum arvense	3						2			5		
Equisetum fluviatile							1					
Equisetum scirpoides									0.5			
Equisetum sylvaticum									12			
Erigeron peregrinus		1										

Plot Number	BWR001A	BWR002A	BWR003A	BWR003B	BWR003C	BWR005A	BWR005B	BWR005C	BWR006A	BWR006B	BWR008A	BWR019A
Site Unit	Wf02	Wf11	Wf02	Wb05	Wb05	Wm01	Wf02	Ww	Ws08	Wf02	Wf02	Wb05
BEC Site Unit	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3	SBSmc3	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3
Elevation (m)	1,532	1,529	1,382	1,355	1,376	1,014	1,013	1,014	1,362	1,364	1,122	1,024
Eriophorum chamissonis				12	3					5		
Festuca occidentalis									0.5			
Gaultheria hispidula					3							7
Hippuris vulgaris								3				
Kalmia microphylla				1	3					1		
Linnaea borealis									1			
Listera cordata									0.5			
Luzula parviflora	1											
Mitella nuda									1		1	
Orthilia secunda							0.5		1			
Oxycoccus oxycoccos			1	2	3		2					5
Petasites frigidus var. palmatus									1			
Platanthera aquilonis		1										
Platanthera dilatata	5	5							1	2	2	
Pyrola asarifolia									0.5		0.5	
Pyrola chlorantha			0.5									
Ranunculus gmelinii						0.5		3				
Ranunculus lapponicus									4			
Rubus arcticus		1	2			1						
Rubus arcticus ssp. acaulis	3									3		
Rubus pedatus									3			
Rubus pubescens									5			
Senecio triangularis	3	3							0.5			
Stellaria borealis			0.5									
Stellaria longifolia						0.5						

Plot Number	BWR001A	BWR002A	BWR003A	BWR003B	BWR003C	BWR005A	BWR005B	BWR005C	BWR006A	BWR006B	BWR008A	BWR019A
Site Unit	Wf02	Wf11	Wf02	Wb05	Wb05	Wm01	Wf02	Ww	Ws08	Wf02	Wf02	Wb05
BEC Site Unit	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3	SBSmc3	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3
Elevation (m)	1,532	1,529	1,382	1,355	1,376	1,014	1,013	1,014	1,362	1,364	1,122	1,024
Symphyotrichum foliaceum			1						1			
Tiarella trifoliata									1			
Trichophorum cespitosum		17										
Utricularia macrorhiza								5				
Veronica wormskjoldii	3	1										
Viola palustris	1								0.5			
Aulacomnium palustre	35	15	15	5	2		15		2	5	45	
Brachythecium sp.						1						
Calliergon stramineum				1								
Cephalozia bicuspidata				1	1							
Cephalozia lunulifolia					2							
Cetraria sp.					2							
Cladina rangiferina					1							
Cladina sp.												5
Cladonia chlorophaea					1							
Cladonia ecmocyna					2							
Cladonia pyxidata					2							
Cladonia sp.							1					5
Cladonia sulphurina					1							
Hylocomium splendens									5			
Icmadophila ericetorum					3							3
Mylia anomala					2							
Nephroma arcticum									1			
Paludella squarrosa	7			5								
Peltigera aphthosa									1			

Plot Number	BWR001A	BWR002A	BWR003A	BWR003B	BWR003C	BWR005A	BWR005B	BWR005C	BWR006A	BWR006B	BWR008A	BWR019A
Site Unit	Wf02	Wf11	Wf02	Wb05	Wb05	Wm01	Wf02	Ww	Ws08	Wf02	Wf02	Wb05
BEC Site Unit	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3	SBSmc3	ESSFmv1	ESSFmv1	SBSmc3	SBSmc3
Elevation (m)	1,532	1,529	1,382	1,355	1,376	1,014	1,013	1,014	1,362	1,364	1,122	1,024
Peltigera neopolydactyla									0.5			
Plagiomnium ellipticum									5			
Pleurozium schreberi									10			
Polytrichum strictum					2							
Ptilium crista-castrensis									2			
Sarmenthypnum sp.				15						10		
Scorpidium scorpioides		12										
Sphagnum angustifolium			50									
Sphagnum fuscum					10							
Sphagnum sp.	10	20	5	50	55		30		5	35		60
Timmia austriaca	1											
Tomentypnum nitens	35	15									20	