Appendix 17-A

Brucejack Gold Mine Project: 2012 Wetland Baseline Report

ERM

Pretium Resources Inc.

BRUCEJACK GOLD MINE PROJECT
2012 Wetland Baseline Report

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Engineers & Scientists

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BRUCEJACK GOLD MINE PROJECT
2012 WETLAND BASELINE REPORT

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Prepared for:

Pretium Resources Inc.

Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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Executive Summary

Pretium Resources Inc. (Pretivm) has proposed the development of the Brucejack Gold Mine Project (the Project) which will be a reviewable project under the British Columbia Environmental Assessment Act and the Canadian Environmental Assessment Act.

This report presents the results of a wetland ecosystem baseline study in support of an Environmental Assessment (EA). Wetlands are a necessary study component because they represent special communities that a number of federal, provincial, and regional organizations and governments have recognized as integral to a properly functioning environment. Wetlands support processes specific only to wetlands and offer a diversity of habitat for a variety of wildlife species. The objectives of this baseline study were to:

1. survey, map and classify potentially affected wetland in the LSA;
2. describe wetland function; and
3. identify potentially rare or unique wetlands.

Wetland surveys were carried out in June and September 2012; 91 wetland surveys were conducted. Wetland mapping identified 517.7 ha of wetlands within the local study area (LSA). All five federal wetland classes were observed in the LSA with fens and swamps accounting for 58% (300 ha) of all mapped wetlands. The federal wetland classes were further divided into 18 wetland associations based on floristic characteristics of individual wetlands.

Ecosystem survey data were used to identify the primary wetland functions. Wetland functions are a series of processes specific to wetlands and are of a hydrological, biochemical, ecological, and habitat nature. These primary functions are valued because they contribute to:

1. adequate water supply and flood protection (hydrological function);
2. clean surface water resources as water is filtered and transferred to and from groundwater systems (biochemical function);
3. a diversity of ecosystems, including listed ecosystems, and wetland complexes (ecological function); and
4. wildlife habitat for a variety of species (habitat function).

Acknowledgements

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This report was prepared for Pretium Resources Inc. (Pretivm) by Rescan Environmental Services Ltd. (Rescan). Greg Norton (M.Sc.) was the Project Manager for the Environmental Baseline Studies. The wetland study was designed and coordinated by Wade Brunham (M.Sc., PWS, EP). The report was written by Wade Brunham and Reed Hentze (B.Sc. P.Biol., PWS, EP) and was reviewed by Dan McAllister (M.Sc. P.Ag.); Mike Stead (B.Sc.) completed the Wetland GIS. Field work was conducted by Wade Brunham and Ryan Durand (B.Sc) with assistance from Rolland Wright and Scott Muldoe.

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Glossary and Abbreviations

Engineers and Scientists

Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Avian	Of, or relating to birds.
Biochemical	Chemical substances and vital processes that occur in living organisms.
Box Plots	A graphic representation of a distribution by a rectangle, the ends of which mark the maximum and minimum values, and in which the median and first and third quartiles are marked by lines parallel to the ends.
Carex	A large genus of plants (Sedge) found in damp woodlands, bogs and ditches or at water margins.
Climax (Community)	A self-perpetuating community whose species composition is expected to be relatively stable and long lasting.
Conductivity	The degree to which a specified material conducts electricity.
Decile	A method of splitting ecological communities within a contiguous ecosystem polygon.
EA	Environmental assessment.
Ecosystem	A biological community of interacting organisms and their physical environment.
Ecosystem Polygon	A contiguous area representing similar vegetation structure and composition.
Edaphic Conditions	The factors related to the development of soil.
Fibric	Organic soil in the primary stage of decomposition where most plant material can be identified.
Floristic Composition	A group of plant species occurring in a particular region or time.
Genera	A grouping of organisms having common characteristics distinct from those of other such groupings.
GIS	Geographic information system.
HDI	Hydrodynamic index.
Hummocks (hummocky)	A mound composed of organic material, often composed of Sphagnum peat.
Hydrodynamic	The magnitude of lateral and vertical water movements in the soil on wet and very-wet sites.
Hydrogeomorphic Position	An ecosystem characterized by its landscape position and how water moves through it.
Hydrological	Properties, distribution, and effects of water on the earth’s surface.
Lacustrine	Describes something related to, or associated with lakes.
LSA	Local study area.

Mesic	Organic material in an intermediate stage of decomposition where some fibres can be identified as to botanical origin.
Minerotrophic	Refers to wetlands that receive nutrients from flowing or percolating mineral rich groundwater.
SOW	Shallow open water.
Peat	Unconsolidated material which is largely undecomposed organic matter that has accumulated under excess moisture.
pH	A measure of the acidity or alkalinity of a solution; ranges from 0 to 14.
Precipitation	Rain, snow, sleet, or hail that falls to the ground.
Predators	An animal that naturally preys on others organisms.
Pretivm	Pretium Resources Inc.
Primary Decile	The largest division of an ecosystem polygon.
Regime	The characteristic behaviour or orderly procedure of a natural phenomenon.
Rescan	Rescan Environmental Services Ltd.
Riparian	An area that is located along the bank of a river, lake or wetland.
Salinity	The amount of dissolved salt in the water.
Saturation	A soil condition in which all voids (pore spaces) between soil particles are filled with water.
Sedge	A grass-like plant (Carex and other genera, family Cyperaceae) with triangular stems and inconspicuous flowers.
Seepage	Groundwater discharge with less flow then from a spring.
Shrub	A perennial plant that usually has more than one low-branching woody stem and is generally less than 10 m tall.
SMR	Soil moisture regime.
SNR	Soil nutrient regime.
Sphagnum	A plant of the family Sphagnaceae belonging to the genus Sphagnum, which comprises the peat mosses.
Substrate	A substance or layer that underlies something, or on which some process occurs.
Synergistic	The effect of several variables whose combined effects are more than the sum of each individual effect.
TEM	Terrestrial ecosystem mapping.
Terrestrial	Of, on, or relating to the earth.
The Project	Brucejack Gold Mine Project.
tpd	Tonne per day.
TRIM	Terrain resource information management.

Ungulates	Any of a large group of mammals all of which have hooves.
UTM	Universal transverse Mercator.
Von Post	The scale of decomposition of organic matter (Fibric 1-3, Mesic 4-7, Humic 7-10).
Wetland	A site dominated by hydrophytic vegetation where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development.
WH	Wetland herb.
WHIF	Wetland Habitat Information Form.
WS	Wetland shrub.
WT	Wetland tree.

1. Introduction

1. Introduction

1.1 GENERAL INTRODUCTION

Resource projects proposed for development within British Columbia require an assessment of project related activities on the physical and biological environment. The level of assessment is related to the specific review process a project is subject to; this in turn is set by the scale of the project and the proposed activities. Pretium Resources Inc. (Pretivm) has proposed the development of the Brucejack Gold Mine Project (the Project) which will be a reviewable project under the *British Columbia Environmental Assessment Act* and the *Canadian Environmental Assessment Act*. Wetland ecosystems were identified as an important study component; as the Project has the potential to directly impact some wetland communities. Effects include changes to the surrounding landscape hydrology that could affect the permanence and floristic composition of wetlands. This report presents results of a baseline wetland study undertaken by Rescan Environmental Services Ltd. (Rescan) in 2012, on behalf of Pretivm for the Project.

Wetlands are dynamic, depressional or slightly sloping areas on the landscape that are saturated with water for a significant period of time during the growing season. The effects of this saturation are reflected in both soil development and vegetation community composition. Wetlands include both the wet basin and surrounding transitional areas between wetter zones and upland vegetation (Huel 2000). Wetlands are particularly important ecosystems as they fulfil a wide range of ecological, hydrological, biochemical and habitat functions (Milko 1998; Hansen et. al. 2008). They maintain water quality, regulate water flow, and provide erosion control. They also provide habitat for a wide variety of wildlife, including many economically important game species (Natural Resources Canada 2009). In British Columbia, wetlands comprise about 5.6% of the land base and provide habitat for most wildlife in the province including many red- and blue-listed wetland dependant species (MOE 2013).

Wetlands were surveyed and mapped using Geographic Information System (GIS) within the Local Study Area (LSA). The physical, chemical, and biological characteristics of selected wetlands, as well as wetland quantity, size, and distribution were assessed. Wetland ecosystem functions, at the Class level were identified using field data and information from scientific literature.

The objectives of the 2012 wetlands study were to:

1. survey, map, and classify wetlands in the local study area (LSA);
2. describe the functions of identified wetland classes; and
3. identify potentially rare or unique wetlands.

1.2 PROJECT DESCRIPTION

Pretium Resources Inc. (Pretivm) proposes to develop the Project as a 2,700 tonne per day (tpd) underground gold and silver mine. The Brucejack property is located at 56°28′20″ N latitude by 130°11′31″ W longitude, which is approximately 950 km northwest of Vancouver, 65 km north-northwest of Stewart, and 21 km south-southeast of the closed Eskay Creek Mine (Figure 1.2-1). The Project is located within the Kitimat-Stikine Regional District. Several First Nation and Treaty Nations have traditional territory within the general region of the Project including the Skii km Lax Ha, the Nisga'a Nation, the Tahltan Nation, the Gitxan First Nation, and the Gitanyow First Nation.

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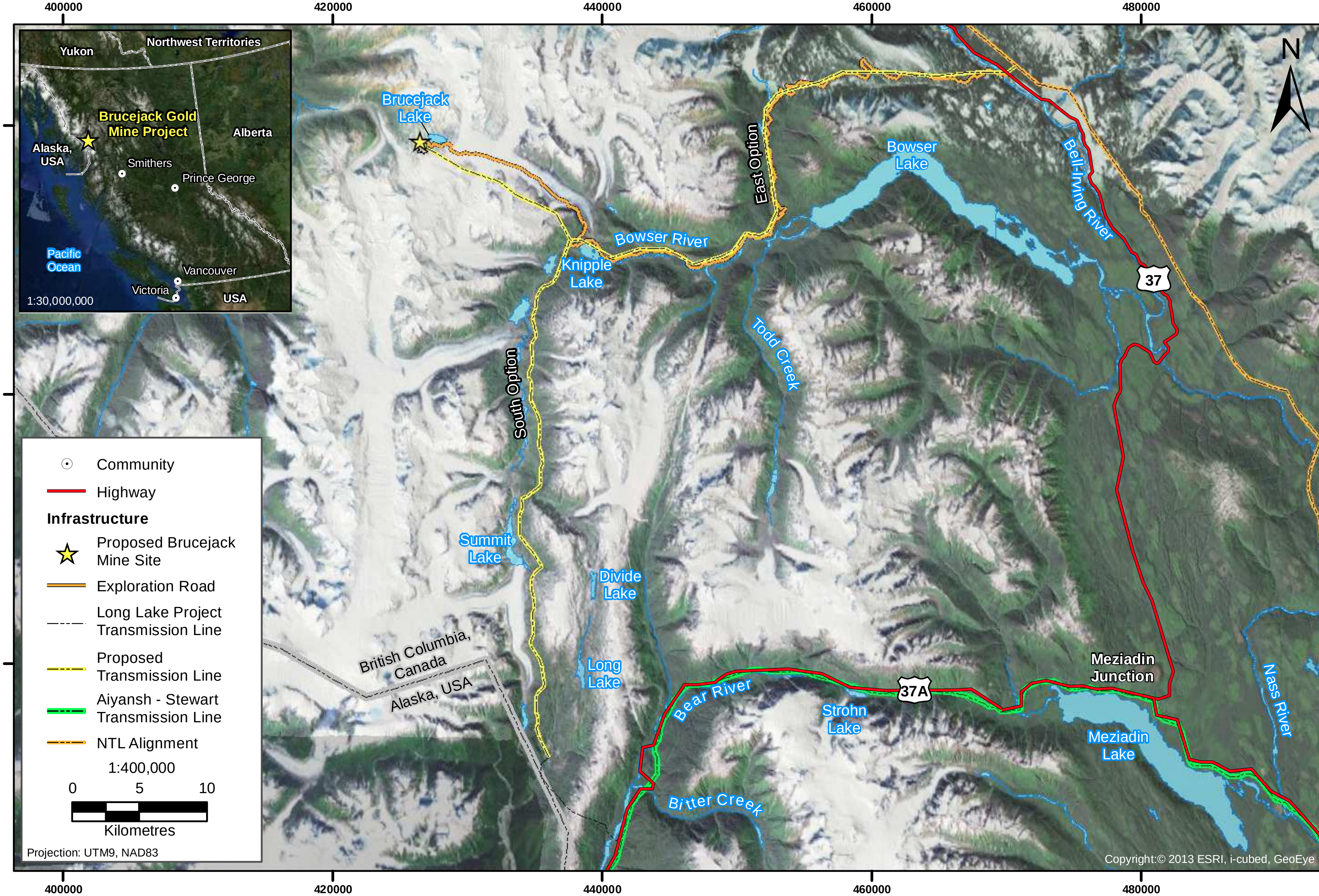

Figure 1.2-1

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Brucejack Gold Mine Project Overview

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The mine site area will be located near Brucejack Lake. Vehicle access to the mine site will be via an existing exploration access road from Highway 37 that may require upgrades to facilitate traffic during mine operations. A transmission line will connect the mine site to the provincial power grid near Stewart or along Highway 37; two options are currently under consideration.

The Project is located within the boundary range of the Coast Mountain Physiographic Belt, along the western margin of the Intermontane Tectonic Belt. The local terrain ranges from generally steep in the western portion of the Project area in the high alpine with substantial glacier cover to relatively subdued topography in the eastern portion of the Project area towards the Bell-Irving River. The Brucejack mine site will be located above the tree line in a mountainous area at an elevation of approximately 1,400 masl; surrounding peaks measure 2,200 m in elevation. The access and transmission corridors will span a range of elevations and ecosystems reaching a minimum elevation near the Bell Irving River of 500 masl. Sparse fir, spruce, and alder grow along the valley bottoms, with only scrub alpine spruce, juniper, alpine grass, moss, and heather covering the steep valley walls.

The general area of the Brucejack Property has been the target of mineral exploration since the 1960s. In the 1980s Newhawk Gold Mines Ltd. conducted advanced exploration activities at the current site of the proposed Brucejack mine site that included 5 km of underground development, construction of an access road along the Bowser River and Knipple Glacier, and resulted in the deposition of 60,000 m^3 of waste rock within Brucejack Lake.

Environmental baseline data was collected from Brucejack Lake and the surround vicinity in the 1980s to support a Stage I Impact Assessment for the Sulphurets Project proposed by Newhawk Gold Mines Ltd. Silver Standard Resources Inc. commenced recent environmental baseline studies specific to the currently proposed Project in 2009 which have been continued by Pretivm, following its acquisition of the Project in 2010. The scope and scale of the recent environmental baseline programs have varied over the period from 2009 to the present as the development plan for the Project has evolved.

2. Methods

2. Methods

2.1 STUDY AREA

Wetlands were characterized within the local study area (LSA) – defined for the terrestrial ecosystem baseline studies for the Project; (Figure 2.1-1). The LSA is 31,847 ha in size and is defined by a buffer extending at least to the height of land or 1.0 km buffer around the outer limits of the proposed infrastructure and linear developments. Watershed height-of-land borders were often used to define study areas, as they are physical barriers to transference of many project related effects. Buffers are used to account for the potential effects that could migrate beyond the project footprint, such as those related to hydrologic change and dust. In certain areas other physical features were also used to define the LSA, when they were considered likely to be the limit of the potential effects of the Project. For example, along the proposed Transmission Line – South Option, the western bank of the Salmon River forms much of the western LSA boundary, as downstream effects of upstream construction, such as erosion and sedimentation, are unlikely to impact beyond this physical barrier.

The LSA was divided into three separate sub-areas for the purposes of this report because of the variety of landforms and vegetation types present in the LSA, the different types of effects that may result from the various infrastructure components, and the relatively large geographical separation among some of the various infrastructure components. These three areas include the Access Road LSA, the Mine Site LSA, and the Transmission Line – South Option LSA. The Access Road LSA is 13,835 ha, and has a climate that transitions from coastal at the western edge to continental at the eastern edge. The Mine Site LSA is 5040 ha, and is situated above the tree line in alpine and parkland ecosystems. The Transmission Line – South Option LSA is 12,972 ha, and extends from around the Premier Mine Site to the Project Mine Site. Wetlands were not surveyed in the southern transmission line portion of the LSA.

The Access Road has a climate that transition from coastal at the western edge to continental at the eastern edge. The Minesite LSA is situated above the tree line in alpine and parkland ecosystems. The Transmission LSA was not specifically considered for wetlands due to its geographic location; however, ecosystems identified in the Terrestrial Ecosystem Mapping (TEM) study that may be wetlands are summarized in this report. For the purpose of this baseline report the LSA includes the mine site and access road portions only.

2.2 FIELD SURVEY

Wetlands were surveyed in July and September 2012; 91 wetland survey plots were established. Survey methods followed *Field Description of Wetland and Related Ecosystems in the Field*, (MacKenzie 1999) and *Wetlands of British Columbia: A Guide to Identification*, (MacKenzie and Moran 2004). Data collected during these field surveys were used to classify wetland ecosystems following the Canadian Wetland Classification System (class level; Warner and Rubec 1997) and the BC classification system (association level; MacKenzie and Moran 2004). Wetland survey locations are displayed in Figure 2.1-1; ecosystem data are available from each survey location in Appendix 1.

Prior to field surveys, equipment and field clothing were cleaned using a 1% Virkon solution, to prevent the spread of *Batrachochytrium dendrobatidis* between wetland sites which is a pathogen for amphibians.

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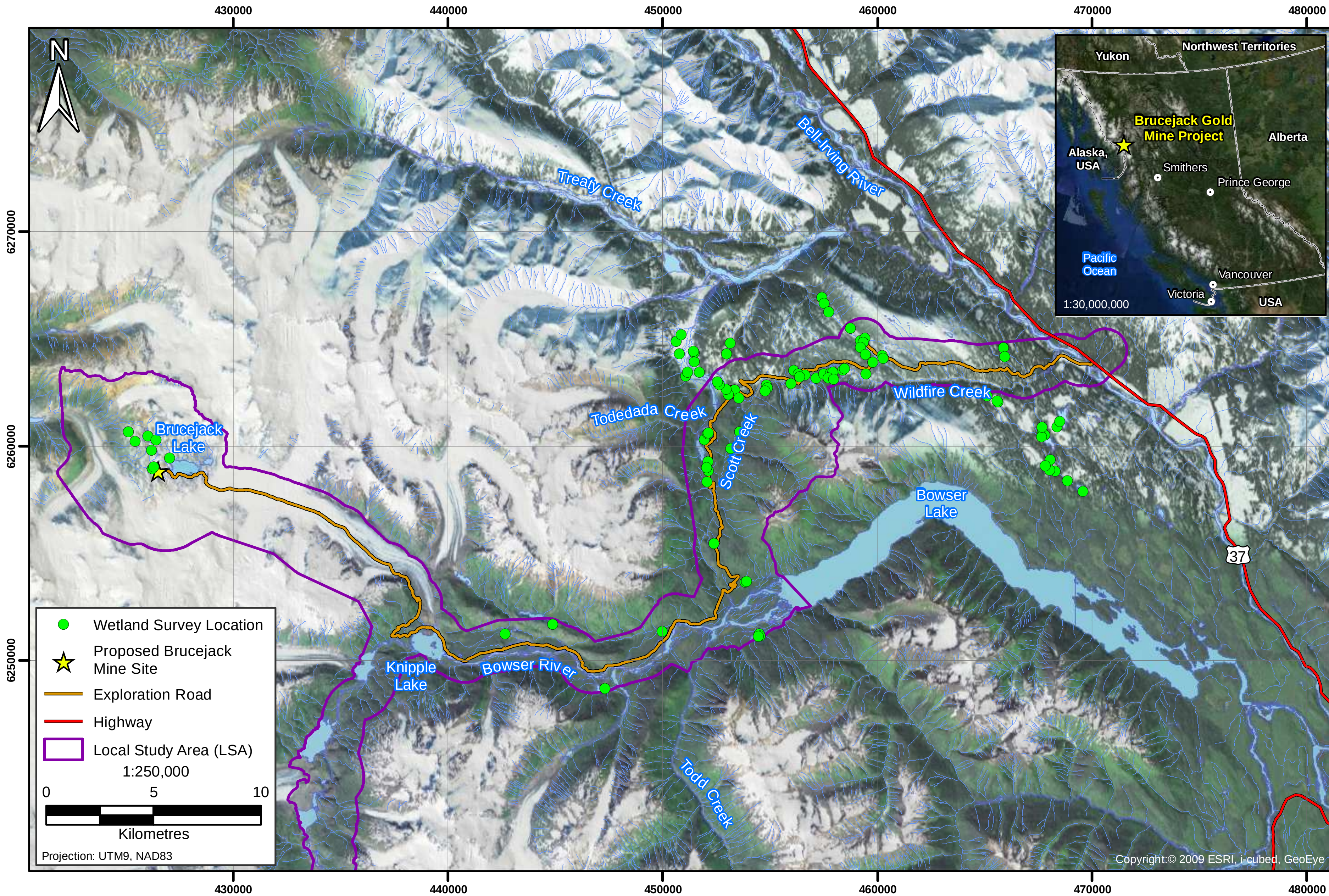

Figure 2.1-1

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Wetland LSA and 2012 Survey Locations

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Wetland surveys were planned at all TRIM identified wetlands and at areas of interest identified through aerial photograph interpretation. Areas of interest included level or slightly sloping areas near mapped surface water features such as streams, rivers, and lakes. A plot was established at each survey site. Plots were 20 by 20 m and were established in large uniform wetlands or at the centre of wetlands smaller than 400 m^2. The edges of wetlands smaller than 400 m^2 were used as the survey plot boundary. A series of soil cores were established throughout each plot. At the centre of the plot, a GPS coordinate was recorded and photographs of the soil surface and of other significant features such as landforms, unique vegetation, and wildlife were taken in each cardinal direction.

Wetland Habitat Information Forms (WHIF; Appendix 2) were completed at each sample site. These forms, developed by Rescan, are based on the provincial Ground Inspection Forms but were adapted for use in wetland studies. Information recorded on the field forms includes:

- Plot number;
- Project ID;
- Surveyor;
- Date;
- Photograph numbers;
- GPS coordinates in Universal Transverse Mercator (UTM);
- Aspect (slope direction);
- Slope;
- Meso slope position (site position in the overall landscape);
- Soil Moisture Regime (SMR; Table 2.2-1);
- Hydrodynamic index (HDI; Table 2.2-1);
- Soil Nutrient Regime (SNR; Table 2.2-1);
- Hydrogeomorphic position;
- Drainage mineral soils;
- Moisture subclasses – organic soils;
- Mineral soil texture;
- Organic soil texture and von Post scale of decomposition;
- Surface organic horizon thickness;
- Humus form (decomposition of surface layer);
- Root restricting layer;
- Coarse fragment content;
- List of vegetation (dominant or indicator plant species and percent cover);
- Water colour and basic water chemistry (pH and conductivity);
- Soil profile diagram;
- Wildlife observations; and
- Site diagram.

Table 2.2-1. Wetland HDI, SMR, and SNR Field Codes

HDI Code	Soil Moisture Code	Soil Nutrient Code
St - Stagnant	VM - Very Moist	A - Very Poor
Sl - Sluggish	W – Wet	B - Poor
Mo - Mobile	VW - Very Wet	C - Medium
Dy - Dynamic		D - Rich
VD - Very Dynamic		E - Very Rich
		F - Hyper

The soil survey methodologies for wetland ecosystem classification incorporated aspects from *The Canadian System of Soil Classification* (Canada Soil Survey Committee 1987), *Towards a Taxonomic Classification of Humus Forms* (Green, Trowbridge, and Klinka. 1993), *Describing Ecosystems in the Field* (Luttmerding et al. 1990), and *Field Description of Wetland and Related Ecosystems in the Field* (MacKenzie 1999). These methods require soil identification to a depth of 160 cm or lithic contact. Super-saturated soils prohibited deep sampling at numerous sites. Soil pits were dug to a minimum depth of 40 cm, or when significant contact with the water table or lithic/parent material was made. Plate 2.2-1 shows a typical soil core.

Plate 2.2-1. Soil core from wetland site W004.

A list of vegetation species and the relative percent cover of plant classes (forbs, shrubs) was recorded at each plot. Special focus was placed on the identification of wetland association indicator species such as *Carex spp.* (sedge) and *Salix spp.* (willow). Vegetation identification references included: *Plants of Coastal British Columbia* (Pojar and MacKinnon 1994), *Plants of Northern British Columbia* (MacKinnon, Coupe, and Pojar 1999), and *Plants of the Western Boreal Forest and Aspen Parkland* (Johnson et al. 1995). Species not identified in the field were collected and identified using *The Illustrated Flora of British Columbia* (Douglas, Meidinger, and Pojar 2001). Vegetation data are available in Appendix 3.

2.3 CLASSIFICATION

Wetland classification is the process by which ecologically important factors are interpreted so that commonalities among sites are identified. The classification process in BC integrates several classification models into a single hierarchical framework (MacKenzie and Moran 2004). The "Class" concept, as described in the Canadian Wetland Classification System, is used as the broad description of a site. The "Site Association" concept is used as a more precise description of individual sites. Each wetland class (bog, fen, marsh, swamp, shallow open water) is composed of a number of site associations, which are defined as sites capable of supporting a similar community at climax (MacKenzie and Moran 2004).

Currently, limited information is available detailing wetland classification at the site level. The principal data source describing wetlands in BC is the Terrain Resource Information Management (TRIM) database. TRIM data are useful for identifying the locations of wetlands larger than 2 hectares. However, it does not provide detailed ecosystem information and often wetland areas are inaccurately mapped or classified. Wetlands in TRIM are classified as 1) marsh and 2) swamp. These two wetland classes are recognized as two of the five federal wetland classes (Warner and Rubec 1997). Bogs, fens, and shallow open water wetlands (the remaining three federal wetland classes) are not differentiated by TRIM and are either included in the two TRIM classes or not mapped as wetlands at all. The definitions for marsh and swamp supplied by TRIM (MOELP 1991) are:

1. **Marsh** - A water-saturated, poorly drained, treeless area intermittently or permanently water covered, having cattail, rushes or grass-like vegetation.
2. **Swamp** - A water-saturated area, intermittently or permanently covered with water, having shrubs.

It is likely that some shallow open water, fens and tree-less bogs are included in the TRIM marsh class. The TRIM swamp class does not include treed swamps; treed swamp associations can represent a major percentage of wetlands in northwest British Columbia and high elevation biogeoclimatic zones (MacKenzie and Moran, 2004). Bogs and shallow open water are not included in either TRIM class; however, shallow open water wetlands may appear as small "indefinite" and/or "intermittent" lakes in the TRIM data set. Although there are some problems associated with the classification of TRIM wetlands the data set provides a provincially-consistent form of wetland mapping. For this study TRIM wetlands were incorporated into the wetland GIS and used to generate wetland areas where as field study data were used to classify wetlands.

Wetlands were assigned a given wetland class (bog, fen, marsh, swamp, and shallow open water) (Warner and Rubec 1997) using soil matrix, soil nutrient, and vegetation indicators. Wetland ecosystems were then assigned to a site association following the wetland edatopic grids for wetland class and corroborating dominant vegetation, and landscape position. Wetland classification was typically done in the field at the time of the wetland survey; however, wetland classification was checked for accuracy against standard literature once field studies were complete. Wetland classification data were recorded in the wetland database (Appendix 1).

Wetlands occurring in complexes (a number of wetland classes and/or site associations within a wetland ecosystem) were described in terms of the dominant community with a maximum of two subdominant communities. The percentage of each of the communities observed in the wetland complex was estimated and recorded as a decile. Up to three deciles were recorded and described at each site. Wetland area was calculated for each wetland class and association in each decile. This methodology is consistent with Terrestrial Ecosystem Mapping (TEM) methodologies (RISC 1998) and was used to estimate the area of each community type once mapping was complete.

2.4 MAPPING

Wetland ecosystems were mapped using ArcView GIS 10.0. Prior to mapping a number of data sources were identified and queried. These data sources included:

- Wetland field plot survey locations and classification information;
- TEM ecosystem polygons containing at least one wetland field survey plot;
- TEM polygons with their dominant decile containing more than 50% Wetland Herb (WH), Wetland Shrub (WS), or Wetland Tree (WT) ecological classifications; and
- TRIM wetlands.

Mapping was then conducted systematically moving from the east portion of the LSA along the exploration road to the mine area on the western edge of the LSA. Wetlands were mapped by comparing polygonal information from the data sources against field observations and satellite imagery. Wetland boundaries were established by taking all TEM polygons where the primary decile was greater than 50% of WH, WS, and/or WT where no survey data had been gathered. At TRIM wetlands, where no surveyed data had been gathered, the polygon was selected but then was redrawn to match adjacent TEM boundaries. Wetland areas within TEM and TRIM polygons where wetland field survey data had been collected were mapped by digitizing areas off the satellite imagery, using TEM/TRIM polygons, and/or using TEM/TRIM polygons and modifying one or more edge to reflect individual wetland ecosystems. These data sources were recorded in the wetland mapping file as:

- TEM (where an un-modified TEM polygon was used);
- TRIM (where an un-modified TRIM polygon was used);
- Modified TEM (where one or more boundary of a TEM polygon was modified);
- Modified TRIM (where one or more boundary of a TRIM polygon was modified); and
- Digitized (where the wetland was drawn on the satellite imagery using field sketches as a guide).

The final data set was saved as a geo-database and contains only ecological units considered to be 100% wetland. Although the individual polygons may contain wetland complex information only wetland units are captured in the mapping.

2.5 FUNCTION

Wetland function is defined as a process or series of processes that wetlands carry out, such as storage and filtration of water. Four primary functions (hydrological, biochemical, ecological, and habitat) are considered during an environmental assessment (Milko 1998). Wetland functions include a series of complex interactions between various wetland components such as water, soil, and vegetation. Table 2.5-1 shows which field work components provide field data to describe aspects of the wetland functions of interest.

The principle wetland functions for each wetland class were determined by integrating data collected in support of the functional component of the baseline study. This included individual wetland class and landscape position, and scientific literature, principally Hanson et al. (2008).

Table 2.5-1. Wetland Function and Associated Fieldwork Component

Wetland Function	Fieldwork Component
Hydrological Function	• Wetland classification (wetland class) • Ecosystem survey (hydrodynamics) • Ecosystem survey (hydrogeomorphic position)
Biochemical Function	• Wetland Classification (wetland class) • Vegetation tissue samples
Ecological Function	• Ecosystem survey (wetland size and distribution) • Wetland classification (wetland complexes, rare or unique wetlands)
Habitat Function	• Ecosystem survey (wildlife observations) • Wetland classification (wetland class)

2.5.1 Hydrologic Function

Wetland hydrologic function is defined as a wetland's contribution to ground and surface water resources. Physical features of wetlands and geographical properties such as wetland class, landscape position, and hydrodynamic index both influence and are influenced by wetland hydrologic function (Table 2.5-2).

Table 2.5-2. Primary Hydrological Functions

Wetland Class	Hydrological Function[1]	Hydrogeomorphic Position[2]	Level of Function and Description[3]
Fen	Water Flow Moderation	All	Low – Performance is seasonal and is higher with wetlands in the fluvial HGP[4]. Most fen wetlands were in the basins and hollows and seepage slopes HGPs.
Fen	Groundwater Recharge	All	Low – Well decomposed peat is an impermeable layer to vertical flow and 50% of fens had a von post of 4 or greater, meaning decomposition was moderate to high.
Fen	Erosion Protection	All	Low – Function is highest in high energy environments and fens are general found in low energy environments. Most fen wetlands were in the basins and hollows and seepage slopes HGPs.
Fen	Climate Regulation	All	Moderate – Performance is related to evapotranspiration and wetland size. Important in very large wetlands and there are a number of fen wetlands greater than 20 ha.
Marsh	Water Flow Moderation	Fluvial and Lacustrine	High - Marshes in the fluvial and lacustrine HGPs provide storm water retention. Most marshes were observed in the fluvial HGP.
Marsh	Groundwater Recharge	Basins and Hollows	Low – Performance is related to marsh wetlands in the basins and hollows HGP. No marsh wetlands were identified in this HGP.
Marsh	Erosion Protection	Fluvial and Lacustrine	High - Marshes in the fluvial and lacustrine HGPs dissipate high energy flows and waves and maintain shoreline integrity. Most marshes were observed in the fluvial HGP.
Marsh	Climate Regulation	All	Moderate – Performance is related to evapotranspiration and wetland size. Important in very large wetlands and there are a number of marsh wetlands greater than 20 ha.
Marsh	Water Quality Treatment	All	High – Marsh wetland improve water quality because water and root bacterial assemblages interact. This function is dependent on loading rates and input water quality but is generally considered high.
Swamp	Groundwater Recharge	Fluvial and Lacustrine	Low – Swamps are generally associated with surface water and do not typically have groundwater recharge functions.

(continued)

Table 2.5-2. Primary Hydrological Functions (completed)

Wetland Class	Hydrological Function[1]	Hydrogeomorphic Position[2]	Level of Function and Description[3]
Swamp	Erosion Protection	Fluvial and Lacustrine	Moderate - Swamps in the fluvial and lacustrine HGPs dissipate high energy flows and waves and maintain shoreline integrity. Approximately 50% of the swamps surveyed were observed in the fluvial HGP.
Swamp	Climate Regulation	All	Moderate – Performance is related to evapotranspiration and wetland size. Important in very large wetlands and there are a number of swamp wetlands greater than 20 ha.

[1]As identified in Hanson et. al. 2008.
[2] Described as Wetland sub-form in Hanson et. al. 2008.
[3] Adapted from Hanson et. al. 2008 but includes site specific parameters
[4] HGP – Hydrogeomorphic Position

Wetland hydrodynamics (Table 2.2-1) were recorded at each site. Hydrodynamics are the vertical and lateral water flow in a given wetland and relate to the speed and frequency of water flow. For example, an isolated bog wetland, receiving the majority of its water from precipitation, may be described as stagnate to sluggish; whereas a riparian swamp, receiving seasonal water fluctuations associated with the surface water network, may be described as mobile or dynamic. The hydrogeomorphic position (Table 2.5-3) was recorded at each site. The hydrogeomorphic position describes the topographic position and hydrology of a wetland (W. H. MacKenzie and J. R. Moran 2004).

Table 2.5-3. Wetland Hydrogeomorphic Position

Hydrogeomorphic Position	Definition
Fluvial System	Site associated with flowing water and subject to flooding, erosion, and sedimentation.
Lacustrine System	Sites at lakesides, directly affected by lake hydrological processes
Palustrine Basins and Hollows System	Sites in depressions and other topographic low points with the watertable near or at the surface; receive water mainly from groundwater and precipitation
Palustrine Ponds and Potholes System	Sites associated with small waterbodies
Palustrine Seepage Slope System	Sloping sites with near-surface ground-water seepage

Note: adapted from MacKenzie and Moran (2004).

2.5.2 Biochemical Function

Wetland biochemical function is defined as a wetland's contribution to the quality of surface and groundwater. Water, sediment, and vegetation components of a wetland influence its biochemical function. Detailed and accurate descriptions of biochemical function at the site level are not possible given site specific interactions between wetland components (water, soil, and vegetation), landscape position, and environmental factors such as salinity, precipitation, and climate (Almas and Singh 2001; Brunham and Bendell 2010). However, aspects of biochemical function can be measured during baseline studies to establish baseline condition so that environmental monitoring during pre-construction, operations, and post-closure will have a point of reference.

Vegetation tissue samples were collected to establish the baseline metals concentration in plant tissue (Appendix 4). Triplicate samples were collected of the dominant emergent sedge (*Carex aquatilis*), at ten sites in 2012 (Table 2.5-4; Figure 2.5-1). The analytical parameters and their detection limits are presented in Table 2.5-5.

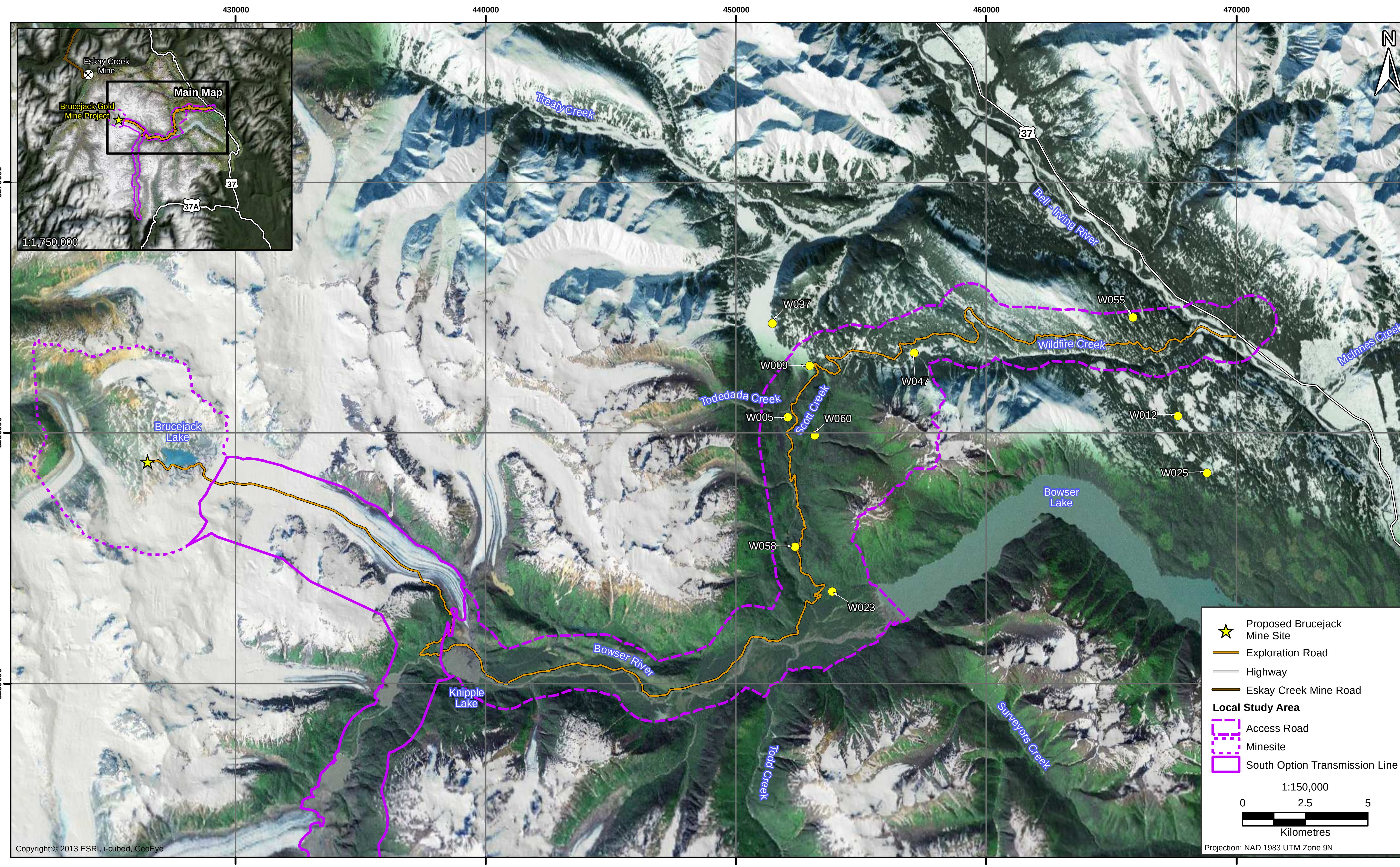

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Figure 2.5-1

Vegetation Tissue Metal Sample Sites

Table 2.5-4. Vegetation Tissue Metal Sample Sites and Coordinates

Sample Site	Northing	Easting
W005	6260624	452059
W009	6262682	452931
W012	6260673	467665
W023	6253678	453833
W025	6258420	468828
W037	6264375	451453
W047	6263193	457119
W055	6264618	465858
W058	6255470	452356
W060	6259907	453137

Table 2.5-5. Metal Analysis and Associated Detection Limits for Plant Tissue Samples

Metal	Abbreviation	Dry Weight Detection Limit (mg/kg)	Average Wet Weight Detection Limit (mg/kg)
Aluminum	Al	10	2.7
Antimony	Sb	0.05	0.0135
Arsenic	As	0.05	0.0135
Barium	Ba	0.05	0.0135
Beryllium	Be	0.3	0.135
Bismuth	Bi	0.3	0.0405
Cadmium	Cd	0.03	0.00675
Calcium	Ca	10	2.7
Chromium	Cr	0.5	0.135
Cobalt	Co	0.1	0.027
Copper	Cu	0.05	0.0135
Lead	Pb	0.1	0.027
Lithium	Li	0.5	0.135
Magnesium	Mg	3	1.35
Manganese	Mn	0.05	0.0135
Mercury	Hg	0.005	0.001
Molybdenum	Mo	0.05	0.0135
Nickel	Ni	0.5	0.135
Selenium	Se	1	0.27
Strontium	St	0.05	0.0135
Thallium	Tl	0.03	0.0135
Tin	Sn	0.2	0.0675
Uranium	U	0.01	0.0027
Vanadium	V	0.5	0.135
Zinc	Zn	0.5	0.135

2.5.3 Ecological Function

Wetland ecological function is defined as the relationship between a wetland and its surrounding ecosystem. For this study, the aspects of ecological function that were recorded include sensitive wetlands and wetland complexes. These aspects of ecological function are easily observable in the field or through classification and represent some of the most important ways wetlands are related to adjacent ecosystems.

2.5.3.1 Sensitive Wetland Ecosystems

Sensitive wetlands are those that are rare or fragile. Rare ecosystems are those whose formation and maintenance is dependent on factors that are uncommon or threatened. They can be dependent on specialized habitats and/or complex ecological processes (Farmer 1993; McPhee et al. 2000).

For rare ecosystems, the following must be known in order to determine the level of risk, or rarity, associated with it (McPhee, et al. 2000):

- the ecosystem must be definable by an accepted and tested method of classification; and
- there must be knowledge of the number of occurrences of the particular ecosystem, and the distribution thereof.

Rare wetlands are catalogued in BC through the BC Ecosystems Explorer. To identify potential presence of rare wetlands in the LSA a search was conducted for rare wetlands in BEC zones and the forest district (Skeena Stikine Forest District) where the Project is located. Five BEC zones occur within the LSA (Table 2.5-6). The search of rare wetlands identified 13 listed wetlands as potentially occurring in the LSA (Table 2.5-6).

Table 2.5-6. Potentially Occurring Red- and Blue-listed Ecosystems

BEC Zones in the LSA	ICH	ESSF	MH	BAFA	CMA
Red and Blue Listed Wetland Associations	Wb04	Wb07	Wf51	None	None
	Wb07	Wb10			
	Wb10	Wf02			
	Wb11	Wf08			
	Wb12	Wf09			
	Wb13	Wf11			
	Wf02	Wf13			
	Wf05	Wm02			
	Wf06	Wm04			
	Wf11	Ws05			
	Wf51				
	Wm02				
	Ws09				

2.5.3.2 Wetland Complexes

Wetland complexes are a combination of multiple wetland classes and associations. They are often transitional to each other, such as a bog and fen complex, where portions of the fen are developing ecologically towards a more bog-like ecology. Complexes often form synergistic ecological units providing multiple ecological values within localized areas. Wetland complexes were documented when encountered within the LSA.

2.5.4 Habitat Function

Wetlands provide key habitat for terrestrial wildlife (Milko 1998). Functional wetland habitats host a high diversity of avian and small mammal species which in turn provide prey for raptors, wolves, foxes, and other predators. Wetland habitat function includes both terrestrial and aquatic habitat components and is defined as a wetland's contribution to the wildlife habitat within a given region. For example wetlands provide important staging habitat for migratory birds because of the open water and emergent communities they contain when wetland marsh and shallow open waters exist in complex. This habitat type is specific to wetlands and supports not only the migratory bird populations that rely on both ecosystem components but also aquatic and upland species that rely on the individual components. Habitat function was identified by carrying out an inventory of dominant and sub-dominant plant species, classification of vegetation associations and wetland ecosystems, and wildlife observations. In addition, wetlands provide foraging habitat for ungulates and waterfowl (Natural Resources Canada 2009).

3. Results

3. Results

3.1 WETLAND TYPE

3.1.1 Bog Class Wetlands

A bog is a nutrient poor wetland generally dominated by Sphagnum moss species and woody vegetation. Bogs are common throughout British Columbia where cool climate limits evapotranspiration and slows decomposition, allowing for the accumulation of peat. Bogs generally occur in closed basins, at the fringes of other wetland ecosystems or as raised bogs in the centre of fen ecosystems (MacKenzie and Moran 2004).

Since mineral bearing groundwater is located below the rooting zone, nutrient status is low, soils are acidic, and minerotrophic vegetation is rare (Warner and Rube 1997; MacKenzie and Moran 2004).

Although bog ecosystems tend to be low is vegetation diversity, the edaphic and microclimate conditions provide unique habitats for plant species such as the carnivorous sundew (*Drosera* species) and the pitcher plant (*Sarracenia purpurea*). Willow and birch species, common in fens and swamps provide forages opportunities for species such as moose (*Alces alces*). Open water areas within bog ecosystems can provide habitat for a wide variety of amphibian species dependent on the species range and the location of the bog. These open water areas also can provide waterfowl opportunities for staging, feeding and breeding depending on the species.

Two bog associations were observed in the LSA (Wb05, Wb13) as primary deciles of wetland ecosystems. A description of these associations based on data observed at field plots can be found in the following section.

Site Association Code:	**Site Name:**
Wb05	Black spruce - Water sedge – Peat moss
Wetland Class:	**Total Wetland Area Observed:**
Bog	1.3 ha

Site Description:

The Wb05 bog site association is common throughout the sub-boreal and central interior of British Columbia at elevations below 1300m. Generally it is located in small basin and hollows hydrogeomorphic positions and adjacent to larger peatland systems (MacKenzie and Moran 2004). This association was observed at two locations in the LSA as the primary wetland component (W026, W044), in the seepage slope and basins and hollows hydrogeomorphic position. The two Wb05 associations were observed in isolation from other wetland associations, i.e., a monotypical wetland ecosystem. Site W026 is pictured in Plate 3.1-1.

Vegetation assemblages observed within these bog ecosystems was dominated by *Sphagnum capillaceum*, *S. angustifolium*, and *S. girgensohnii*. Other species included *Carex aquatilis*, *Salix barclayi*, and *Equisetum arvense* with *Abies lasiocarpa* being present as the only tall tree species.

The soils from both sample sites were classified as mesic. The SMR was classified as W for both sites. SNR was classified as C for both sites. The von Post level of decomposition was recorded as 5 for both sites. Soil water at W044 had a pH of 5.6, and a conductivity of 10 µs/cm. Soil water was not assessed at site W026.

Plate 3.1-1. Wb05 Bog at Site W044.

Site Association Code:

Wb13

Site Name:

Shore sedge – Buckbean – Peat moss

Wetland Class:

Bog

Total Wetland Area Observed:

0.5 ha

Site Description:

The Wb13 bog site association is an uncommon bog association generally found in interior rainforests and coastal transition regions of British Columbia below 1600 m. These associations occur in the wettest areas of larger peatlands in basin and hollows hydrogeomorphic positions (MacKenzie and Moran 2004). This association was observed at two locations in the LSA as the primary wetland component (W027, W056), in the basins and hollows hydrogeomorphic position. The two Wb13 associations were observed in complex with shallow open water wetland systems, with W028 also in complex with a tertiary Wb05 association. Site W027 is pictured in Plate 3.1-2.

Vegetation assemblages observed within these bog ecosystems was dominated by *Sphagnum angustifolium*, *S. capillaceum*, *S. fuscum, and S. squarrosum*. Other observed species included *Carex aquatilis*, *Eriophorum angustifolium*, and *Kalmia microphylla occidentailis*.

The soils from both sample sites were classified as fibric. The classified SMR ranged from W to VW. SNR was classified from B to C. The von Post level of decomposition ranged from 2 to 3. Soil water ranged in pH from 3.2 to 6.1. Soil water conductivity ranged from 10 to 12 µs/cm.

Plate 3.1-2. Wb13 Bog at Site W027.

3.1.2 Fen Class Wetlands

A fen is a peatland ecosystem generally dominated by sedges and brown mosses. Fens are the most common wetland class in British Columbia, occurring in all but the driest and warmest climates. Unlike bogs which tend to be nutrient poor, fens tend to be more nutrient-medium with mineral-bearing groundwater within the rooting zone. It is the presence of this groundwater source that permits the presence of minerotrophic plant species (MacKenzie and Moran 2004).

Fen ecosystems generally have permanently high water table and saturated soils throughout the year (Warner and Rubec 1997; MacKenzie and Moran 2004).

Fens may provide critical habitat for species such as moose (*Alces alces*), grizzly bear (*Ursus arctos horribilis*), and the black bear (*Ursus americanus*). They provide browse and forage such as willow, sedge and aquatic vegetation at different times of the year. They provide habitat for a multitude of amphibian species which may use the ecosystem for all, or a portion, of their life cycles. Open water within fen complexes provide opportunities for waterfowl staging, feeding and breeding.

Six fen associations were observed in the LSA (Wf01, Wf03, Wf04, Wf08, Wf12, Wf50) as primary components of wetland ecosystems. A Wf06 fen site association was also observed as secondary and tertiary components of wetland complexes. A description of these associations based on data observed at field plots is found in the following section.

Site Association Code:	**Site Name:**
Wf01	Water sedge – Beaked sedge
Wetland Class:	**Total Wetland Area Observed:**
Fen	12.3 ha

Site Description:

The Wf01 fen site association is the most common fen in British Columbia. It can occupy all but the warmest and driest subzones from low to subalpine elevations, and can be found in basins and hollows, seepage slopes, potholes, fluvial and lacustrine systems (MacKenzie and Moran 2004). This is most commonly found in palustrine basins, occupying the wetter zones in large peat complexes, and sometimes forming extensive meadows. This association was observed seven times in the LSA as the primary wetland component (W013, W019, W029, W030, W032, BJ15, BJ16), and was the second most common association observed. Most often this association was observed in the seepage slope hydrogeomorphic position although it was also observed in all other categories. A typical Wf01 site in the LSA is represented by W030, Plate 3.1-3.

Observed vegetation assemblages within the central area of these wetlands included species such as Carex aquatilis, C. sitchensis, Sphagnum species, *Eriophorum angustifolium*, *Menyanthes trifoliatea*, and *Rubus chamaemorus*. Woody shrub species such as *S. sitchensis*, S. *barclayi*, and *Picea* species were present along the periphery.

The soils ranged from humic to mesic organic soils with mesic soils dominating most sites. The SMR ranged from VM to VW, with the majority of sites being W. SNR ranged from B to D, with most sites as C. The von Post level of decomposition ranged from 3 to 6, most sites with a von Post of 4. Soil water had a pH ranging from 5.2 to 7.5, and a conductivity range of 10 to 150 µs/cm.

Plate 3.1-3. Wf01 Fen at Site W030.

Site Association Code:	**Site Name:**
Wf03	Water sedge – Peat-moss
Wetland Class:	**Total Wetland Area Observed:**
Fen	18.0 ha

Site Description:

These fens occur mainly above 1100 m and are similar in structure to the Wf12 fens, but generally have less surface water flow (Mackenzie and Moran 2004). The Wf03 association is most often found in basins and hollows and seepage slopes. Eight Wf03 fen communities were observed as the primary wetland complex component within the LSA (W003, W004, W068, W069, W070, W071, BJ8, BJ12, BJ13), making this the second most observed association. Most often this association was observed in the seepage slope hydrogeomorphic position. A typical Wf03 site in the LSA is represented by W070, Plate 3.1-4. Though often the dominant association at many sites, when in complex, the Wf03 associations most often was observed with Wf04 associations.

Observed vegetation assemblages within Wf03 fens were dominated by species such as *Carex aquatilis*, *Aulacommium palustre, Eriophorum angustifolium and Sphagnum* species. Some sites also supported a variety of shrubby species, including *Salix barclayi* and *S. glauca*.

Soils varied between sites, and were characterized as fibric or mesic with mesic soils being observed at the majority of sites. The SMR ranged from W to VW, the majority of sites being VW. SNRs ranged from B to D, with most sites having a C nutrient regime. The von Post level of decomposition ranged from 2 to 6, most sites with a von Post of 5. Soil water had a pH ranging from 5.2 to 7.4, and a conductivity range of 10 to 22 μs /cm.

Plate 3.1-4. Wf03 Fen at Site W070.

Site Association Code:	**Site Name:**
Wf04	Barclay's willow – Water sedge – Glow moss
Wetland Class:	**Total Wetland Area Observed:**
Fen	72.2 ha

Site Description:

These fens are common in the subalpine elevations, and often occur on seepage slopes, glacier-fed creeks, and in frost-prone basins (Mackenzie and Moran 2004). Fifteen Wf04 fen associations were observed as the primary wetland complex component within the LSA (W002, W007, W008, W009, W015, W028, W033, W037, W039, W040, W046, W049, W067, W074, BJ11), making this the most observed association. This association was observed predominantly in the basins and hollows, and fluvial hydrogeomorphic positions. A typical Wf04 site in the LSA is represented by W046, Plate 3.1-5. Wf04 associations were often observed as a monotypic wetland community or in complex with Wf01 and Wf03 associations.

Observed vegetation assemblages within Wf04 fens were dominated by shrub species such as *Salix barclayi*, *S. bebbiana*, *S. commutate*, and *S. glauca*, with an understory dominated by *Carex aquatilis*, *Aulacommium palustre*, *Sphagnum* species, *and Equisetum arvense*.

Observed soils in these associations were predominantly mesic in texture. The SMR ranged from VM to VW, with the majority of sites being W. SNRs ranged from B to D, with most sites having a D nutrient regime. The von Post level of decomposition ranged from 2 to 5, most sites had a von Post of 5. Soil water had a pH ranging from 5.0 to 8.7, and a conductivity range of 10 to 421 µs/cm.

Plate 3.1-5. Wf04 Fen at Site W046.

Site Association Code:	**Site Name:**
Wf06	Slender Sedge - Buckbean
Wetland Class:	**Total Wetland Area Observed:**
Fen	n/a – tertiary wetland component; area included with primary component polygon

Site Description:

This association was observed as a secondary and tertiary component of a wetland complex and was one of two secondary or tertiary component that was not recorded as a dominant association in a complex. The other being the Ws01 swamp association. It is included here for information purposes.

Wf06 Fens are uncommon at altitudes less than 1300 m in the Central and Sub-boreal Interior regions of British Columbia; usually located in ponds and potholes, basins and hollows, or lacustrine hydrogeomorphic positions in the landscape. These wetlands can occur as floating mats next to larger water bodies associated with peatlands or within patterned fens with permanent surface water or soil saturation (Will H. MacKenzie and J.R. Moran 2004).

This association was observed twice in the LSA. One time as a secondary component of a Wf04 dominated fen association within the LSA (W039) in a fluvial hydrogeomorphic position. A second time as a tertiary component (W040; Plate 3.1-6) in complex with a Wf04 (dominant) and a Wf01 (secondary component) associations, also in a fluvial hydrogeomorphic position.

No plots were conducted within this specific wetland association, however, they are characterized slightly by hummocky terrain, a vegetation herb layer dominated by *Carex lasiocarpa* and *Menyanthes trifoliate*, and a well-developed moss layer (Will H. MacKenzie and J.R. Moran 2004).

Plate 3.1-6. Wf06 Fen association adjacent to open water in complex with Wf04 and Wf01 associations (W040).

Site Association Code:	**Site Name:**
Wf08	Shore sedge – Buckbean – Hook-moss
Wetland Class:	**Total Wetland Area Observed:**
Fen	11.7 ha

Site Description:

Wf08 fens are uncommon rich fen site associations occurring at higher elevations within the interior of BC (Mackenzie and Moran 2004). The Wf08 association is most commonly found in basins and hollows, seepage slopes, and ponds and potholes. A single Wf08 fen association was observed as the primary wetland complex component within the LSA (site W018), making this the least observed association along with the Willow/Horsetail, Wm04, Ws02, and yellow pond lily associations. This association was observed in a basins and hollows hydrogeomorphic position, and is represented by Plate 3.1-7. The single Wf05 association was observed in complex with a Wf04 association.

The observed Wf08 fen was dominated by *Menyanthes trifoliate*, *Carex sitchensis*, and *Tomenthypnum nitens*.

Observed soils in this association were fibric in texture. The SMR was VW, and SNR was B. The von Post level of decomposition was 5. Soil water pH was 7.2 with a conductivity of 200 µs/cm.

Plate 3.1-7. Wf08 Fen at Site W018.

Site Association Code:	**Site Name:**
Wf12	Narrow-leaved cotton-grass – Marsh-marigold
Wetland Class:	**Total Wetland Area Observed:**
Fen	34.7 ha

Site Description:

These fens are common at subalpine elevations throughout the sub-boreal and central interior of BC. They occur on gently sloping peatlands where there is continual seepage from snowmelt and groundwater (MacKenzie and Moran 2004). Seven Wf12 fen associations were observed as the primary wetland complex component within the LSA (W043, W045, W052, W053, W062, BJ2, BJ14). This association was observed predominantly in the seepage slopes hydrogeomorphic position although this association was also recorded in the basin and hollows position (W045), and in a fluvial position (BJ2). A typical Wf12 site in the LSA is represented by W052, Plate 3.1-8. Wf12 associations were most often observed in complex, almost exclusively with Wf04 associations.

Observed vegetation assemblages within Wf12 fens were dominated by species such as *Eriophorum angustifolium*, *Carex aquatilis*, and *Sphagnum* species. Fringe woody vegetation was limited to *Salix barclayi*.

Observed soils in these associations were predominantly mesic in texture. The SMR ranged from W to VW, the majority of sites being VW. SNRs ranged from C to D, with most sites having a C nutrient regime. The von Post level of decomposition ranged from 3 to 6, with most sites having a von Post of 5. Soil water had a pH ranging from 4.9 to 8.8, and a conductivity range of 10 to 11 µs/cm.

Plate 3.1-8. Wf12 Fen at Site W052.

3.1.3 Marsh Class Wetlands

A marsh is a relatively nutrient-rich, permanently to seasonally flooded non-tidal mineral wetland dominated by emergent grass-like vegetation (MacKenzie and Moran 2004). Soils are typically mineral but can also have a well-decomposed organic surface tier (Warner and Rube 1997; MacKenzie and Moran 2004). They tend to have highly dynamic hydrological regimes and have highly variable hydroperiods depending on location, ground water influence, and seasonal and local precipitation patterns. Many marsh ecosystems experience inundation that lasts throughout the year while some may have pronounced draw down with exposed substrates later in the year (MacKenzie and Moran 2004).

Marshes are the most heavily used wetland type for wildlife. They are typically eutrophic and support large standing crops of palatable vegetation, plankton, and aquatic invertebrates. They are the favoured wetland class for most waterfowl, amphibians, and semi-aquatic mammals because they provide variable cover, open water, and food.

Two marsh associations were observed in the LSA (Wm01, Wm04) as primary components of wetland ecosystems. A description of these associations based on data observed at field plots can be found in the following section.

Site Association Code:	**Site Name:**
Wm01	Beaked sedge – Water sedge
Wetland Class:	**Total Wetland Area Observed:**
Marsh	8.0 ha

Site Description:

This association is the most widespread marsh association in the province. These marshes are found on sites that are inundated by shallow low energy flood waters, on the margins of beaver ponds, lakes, and palustrine basins (Will H. MacKenzie and J.R. Moran 2004). This association was observed two times within the LSA as the primary wetland ecosystem component (W020 and W023); both were in fluvial hydrogeomorphic positions. Site W020 is represented in Plate 3.1-9 as a typical Wm01 marsh in the LSA. This association was found as a monotypic wetland ecosystem and also in complex with Ws06 and Ws swamps.

Observed vegetation assemblages in this association were dominated by the sedge species; *Carex aquatilis*, *C. rostrata*, and *C. sitchensis*. Vegetation in the fringe areas and drier microsites included *Salix sitchensis* and *Salix glauca*.

Observed soils in these associations were exclusively fibric in texture. The SMR was VW for both sites. SNRs ranged from C to D, with most sites having a D nutrient regime. The von Post level of decomposition was 3 at both sites. Soil water had a pH ranging from 6.9 to 7.9, and a conductivity range of 49 to 313 µs/cm.

Plate 3.1-9. Wm01 Marsh at Site W020.

Site Association Code:	**Site Name:**
Wm04	Common spike-rush
Wetland Class:	**Total Wetland Area Observed:**
Marsh	29.3 ha

Site Description:

The Wm04 marsh association is commonly found throughout the interior of British Columbia at elevations below 1300 m. These wetland ecosystems are found in fluvial, estuarine, lacustrine, and ponds and potholes hydrogeomorphic positions (Mackenzie and Moran, 2004). This association was observed at a single site (W021), in a fluvial hydrogeomorphic position. Site W021 is represented in Plate 3.1-10. This association was only observed as a monotypic wetland ecosystem within the LSA.

The vegetation assemblage observed at W021 was dominated by *Trichophorum caespitosum*, with a smaller component of *Equisetum variegatum*.

Soils in this association were mineral in nature having a clayey soil texture. The SMR was VW, with a SNR of D. The von Post level of decomposition of a thin Moder layer was three. Soil water had a pH of 9.0, and a conductivity of 274 μs/cm.

Plate 3.1-10. Wm04 Marsh at Site W021.

3.1.4 Swamp Class Wetlands

A swamp is a nutrient-rich wetland ecosystem dominated by tall trees or shrubs. There are two distinct types of swamps that may occur depending on a suite of site specific variables; the tall shrub and forested swamp (coniferous and deciduous; Warner and Rubec 1997). Swamp ecosystems are found throughout British Columbia, usually as components of larger wetland complexes. Wetland hydrology in these classes is linked to high semi-permanent water tables and microtopographic relief which enables woody shrub and tree species to persist with rooting zones just above the water table (MacKenzie and Moran 2004).

Vegetative cover in these ecosystems consists of more than 30% tree or tall shrub cover with a poor bryophyte layer due to shading from the over-story vegetation and frequent inundation. Soils are often gleyed mineral soils with a surface layer of anaerobically decomposed woody peat.

Swamps have a more vertical structure than other wetland classes and support more diverse avifaunal assemblages (MacKenzie and Moran 2004). Further, forested swamps typically have an open canopy that appears to be favoured by many bird and bat species (MacKenzie and Moran 2004; Lausen 2006). Two swamp associations (Ws02, Ws06) were observed in the LSA as the primary components of wetland ecosystems.

Two swamp associations were observed in the LSA (Ws06 and Willow - Horsetail). A Ws01 swamp site association was also observed as a secondary and tertiary component of wetland complexes. A description of these associations based on plot data can be found in the following section.

Site Association Code:	**Site Name:**
Ws01	Mountain alder – Skunk cabbage – Lady fern
Wetland Class:	**Total Wetland Area Observed:**
Swamp	n/a – tertiary wetland component; area included with primary component polygon

Site Description:

This association was observed as a secondary component of a wetland complex and was one of two secondary or tertiary components (the other being the Ws06). The Ws01 swamp association is commonly found in the wet regions of the Sub-boreal Interior and Southern Interior Mountains of British Columbia. These wetland ecosystems are generally found in fluvial and basins and hollows hydrogeomorphic positions (Mackenzie and Moran, 2004). This association was observed at a single site as a secondary component in complex with the YPL association (W058), in the basins and hollows hydrogeomorphic position. The Ws01 swamp association is represented in Plate 3.1-11 of this complex.

No plots were conducted within this specific wetland association, however, they are generally characterized by a lush understory, an overstory dominated by *Alnus incana*, and poorly drained fine textured soils (Will H. MacKenzie and J.R. Moran 2004).

Plate 3.1-11. Ws01 Swamp as a secondary component at Site W058.

Site Association Code:	**Site Name:**
Ws06	Sitka willow – Sitka sedge
Wetland Class:	**Total Wetland Area Observed:**
Swamp	90.9 ha

Site Description:

Sitka willow – Sitka sedge swamps are relatively uncommon at low elevations, and are usually associated with fluvial systems or in linked basin and hollows hydrogeomorphic positions. Ws06 swamps experience prolonged saturation and early season flooding (Mackenzie and Moran 2004). This association was observed five times as the primary wetland ecosystem component within the LSA (W014, W024, W038, W060, W061), predominantly in the fluvial hydrogeomorphic position, although also observed in the lacustrine, and basins and hollows, hydrogeomorphic positions. Site W014 is represented in Plate 3.1-12 as a typical Ws06 swamp in the LSA. This association was most often found in complex with shallow open water and Wm01 marsh associations.

Observed vegetation assemblages in this association were dominated by the *Carex sitchensis, C. aquatilis*, *Equisetum arvense* in the understory with *Salix sitchensis*, dominating the overstory in most locations. Other *Salix* species such as *S. Barclayi*, *S. lasiocarpa*, and *S. glauca* were also present.

Observed soils in these associations ranged from mesic to humic with most sites being classified as mesic soil texture. The SMR was VW for all three sites observed. SNRs ranged from C to D, with most sites having a D nutrient regime. The von Post level of decomposition ranged from 3 to 8 with half the sites (3) recorded as 5. Soil water had a pH ranging from 6.2 to 7.9, and a conductivity range of 25 to 90 µs/cm.

Plate 3.1-12. Ws06 Swamp at Site W014.

Site Association Code:

n/a

Site Name:

Willow - Horsetail

Wetland Class:

Swamp

Total Wetland Area Observed:

1.7 ha

Site Description:

The Willow – Horsetail Swamp association is not described by (MacKenzie and Moran 2004). One of these associations was observed at an elevation of 665 m in the basins and hollows hydrogeomorphic position. This site was shrub dominated with poorly drained organic soils. Site W059 is represented in Plate 3.1-13. This association was found as a monotypic wetland ecosystem.

Observed vegetation assemblages within the observed Willow - Horesetail swamp were dominated by *Salix sitchensis, S. barclayi*, *Dryopteris expansa*, *Auloacommium palustre*, and *Sphagnum squarrosum*.

Observed soils in this association was humic in texture. The SMR was observed to be W, the SNR was recorded at D, the von Post level of decomposition was 6. Soil water had a pH of 5.3 and a conductivity of 20 µs/cm.

Plate 3.1-13. Willow – Horsetail Swamp at Site W059.

3.1.5 Shallow Open Water Class Wetlands

Shallow open water wetlands are common and widespread throughout all of British Columbia in all climatic regimes. These wetlands are characterized as permanently flooded, slow or still water with submergent and floating aquatic vegetation (MacKenzie and Moran 2004). Substrates are typically not considered soils due to permanent flooding and the lack of soil profile development (MacKenzie and Moran 2004).

Shallow open water wetlands are permanently flooded and can be variable in depth depending on the photic depth of the water column. The photic depth is the depth in water that light can penetrate which allows photosynthesis and thus plant growth to occur. Water with little turbidity will permit for vegetation growth at deeper aquatic depths, while water with high turbidity will limit vegetative growth at depth.

Shallow open water wetlands provide habitat for both aquatic and terrestrial species and provide an often vital permanent source of fresh surface water within the upland landscape. Fish, waterfowl, shorebirds, amphibians, and mammals all use the open water associations.

Two shallow open water associations have been identified within the LSA (shallow open water and yellow pond lily) as primary components of wetland ecosystems. The shallow open water association was observed in complex with almost every observed association in the LSA. A description of these associations based on data observed at field plots can be found in the following section.

Site Association Code:	**Site Name:**
SOW	Shallow open water – no vegetation association
Wetland Class:	**Total Wetland Area Observed:**
Shallow open water	5.5 ha

Site Description:

Shallow open water wetlands are common and widespread throughout all of British Columbia in all climatic regimes. These wetlands are characterized permanently flooded, slow or still water with submergent and floating aquatic vegetation (MacKenzie and Moran 2004). This association was observed at three study plots as the primary component of a wetland ecosystem (W005, W031, W073), in the fluvial, lacustrine, and the ponds and potholes hydrogeomorphic positions. Site W031 is represented in Plate 3.1-14 as a lacustrine shallow open water wetland in the LSA. This association was most often found as the primary wetland ecosystem component in complex the Wf04 fen association. However, shallow open water was often in complex with other associations as a secondary or tertiary component of a wetland ecosystem. Observed fringe vegetation assemblages surrounding this association were dominated by the *Carex aquatilis*.

Observed soils in these associations ranged from mesic to humic soil texture with most sites being classified as mesic. The SMR was W for all three sites observed. SNRs ranged from C to D, with two of the three sites having a D nutrient regime. The von Post level of decomposition ranged from 3 to 4 for sites W031 and W073, with site W005 having a imperfectly drained sandy mineral soil. Soil water had a pH ranging from 5.2 to 6.4, and a conductivity range of 30 to 40 µs/cm.

Plate 3.1-14. Shallow open water wetland; Site W031.

Site Association Code:

YPL

Site Name:

Yellow Pond Lily

Wetland Class:

Shallow open water

Total Wetland Area Observed:

0.5 ha

Site Description:

The Yellow Pond Lily associations are widespread throughout British Columbia occurring in a wide variety of aquatic sites of varying depth and substrates (MacKenzie and Moran 2004). Like all shallow open water wetlands these associations are permanently flooded with submergent or floating vegetation. This association was observed at a single study plot as the primary component of a wetland ecosystem (W058, Plate 3.1-15), in the basins and hollows hydrogeomorphic position. This association was only identified in complex with a Ws01 swamp association.

Nuphar species were observed floating in the near shore areas of this association. Observed fringe vegetation assemblages surrounding this association were dominated by the Ws01 species assemblages of *Salix sitchensis*, *Carex aquatilis*, and *Dryopteris expansa*.

Observed soil in this association was humic in texture. The SMR was W, SNR was D. The von Post level of organic soil decomposition was recorded as 9. Soil water had a pH of 6.7, and a conductivity of 50 μs/cm.

Plate 3.1-15. YPL wetland; Site W058. Note Nuphar species floating in near shore area.

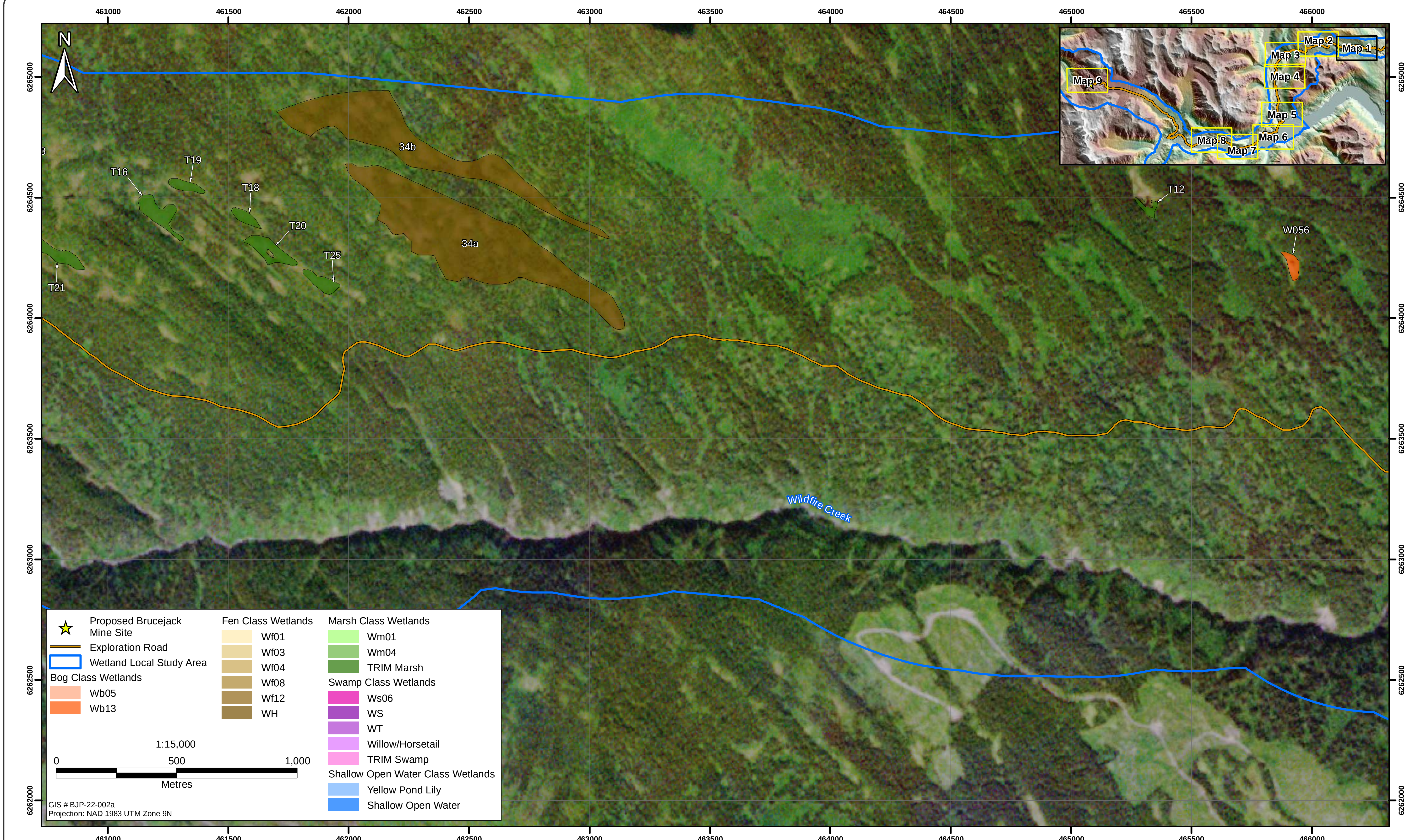
3.2 WETLAND EXTENT

A total of 517.8 ha of wetlands were mapped in the LSA. Fens and swamps accounted for the largest area of wetlands totalling 300 ha (58%) of all wetlands. The areas of each wetland class and association are presented in Table 3.2-1, while their size and distribution are presented in Figures 3.2-1 through 3.2-9.

Table 3.2-1. Area of Wetland Associations in the Brucejack LSA

Wetland Associations	Area (ha)	Wetland Associations	Area (ha)
Bog Class Wetlands		*Marsh Class Wetlands (cont'd)*	
Wb05	1.3	TRIM Marsh[2]	25.0
Wb13	0.5	*Swamp Class Wetlands*	
Fen Class Wetlands		Ws06	90.9
Wf01	12.3	WS[1]	29.4
Wf03	18.0	WT[1]	27.2
Wf04	72.2	Willow/Horsetail	1.7
Wf08	11.7	TRIM Swamp[2]	66.4
Wf12	34.7	*Shallow Open Water Class Wetlands*	
WH[1]	83.0	yellow pond lily	0.5
Marsh Class Wetlands		shallow open water	5.5
Wm01	8.0	**Total**	**517.7**
Wm04	29.3		

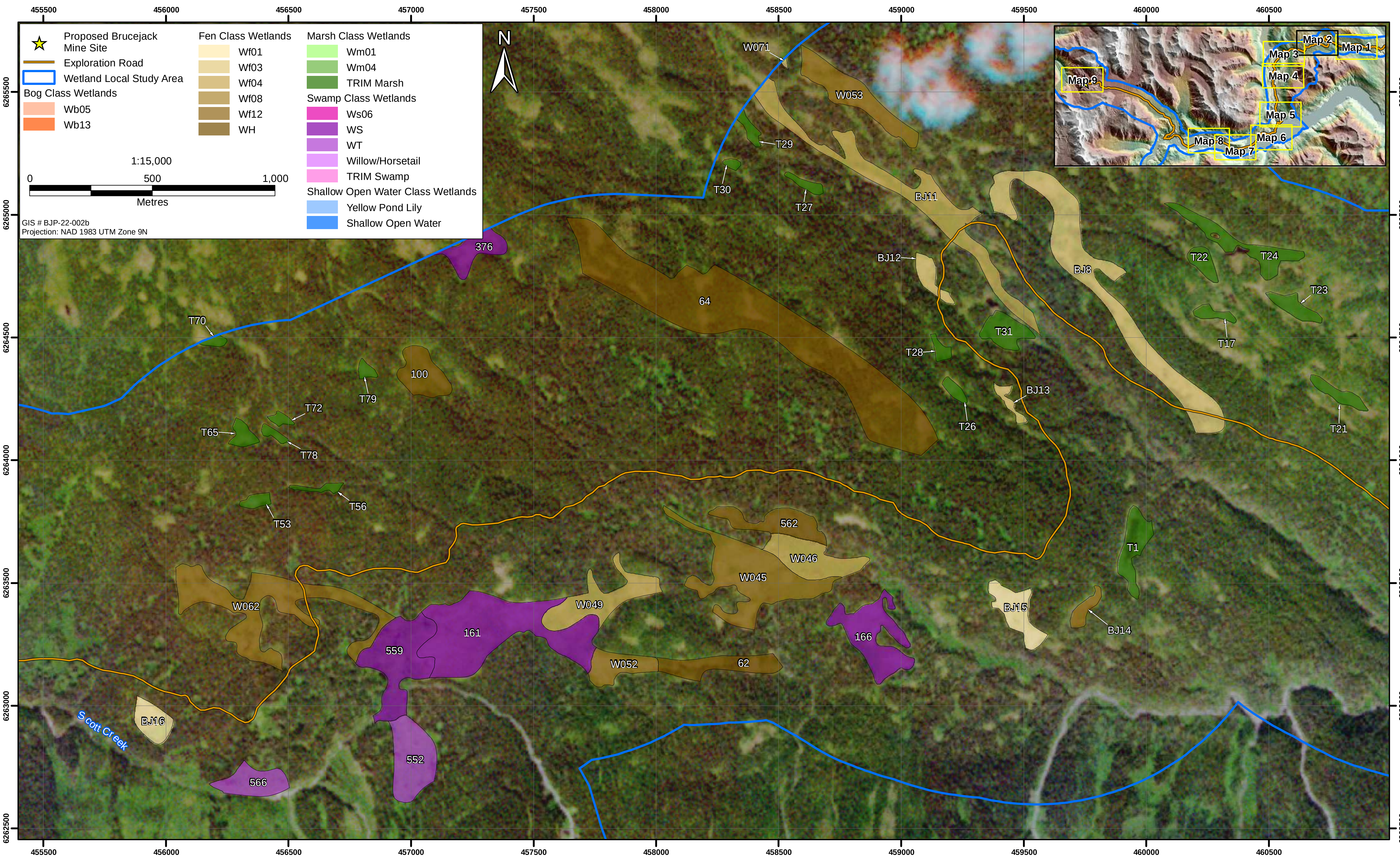
[1] WH - Wetland Herb, WS - Wetland Shrub, and WT - Wetland Tree generalized ecosystem types as described in the TEM (Rescan 2013a)
[2] TRIM Marsh and TRIM Swamp wetlands mapped by TRIM and classified as Marsh or Swamp



PRETIVM Rescan an ERM company

Figure 3.2-1

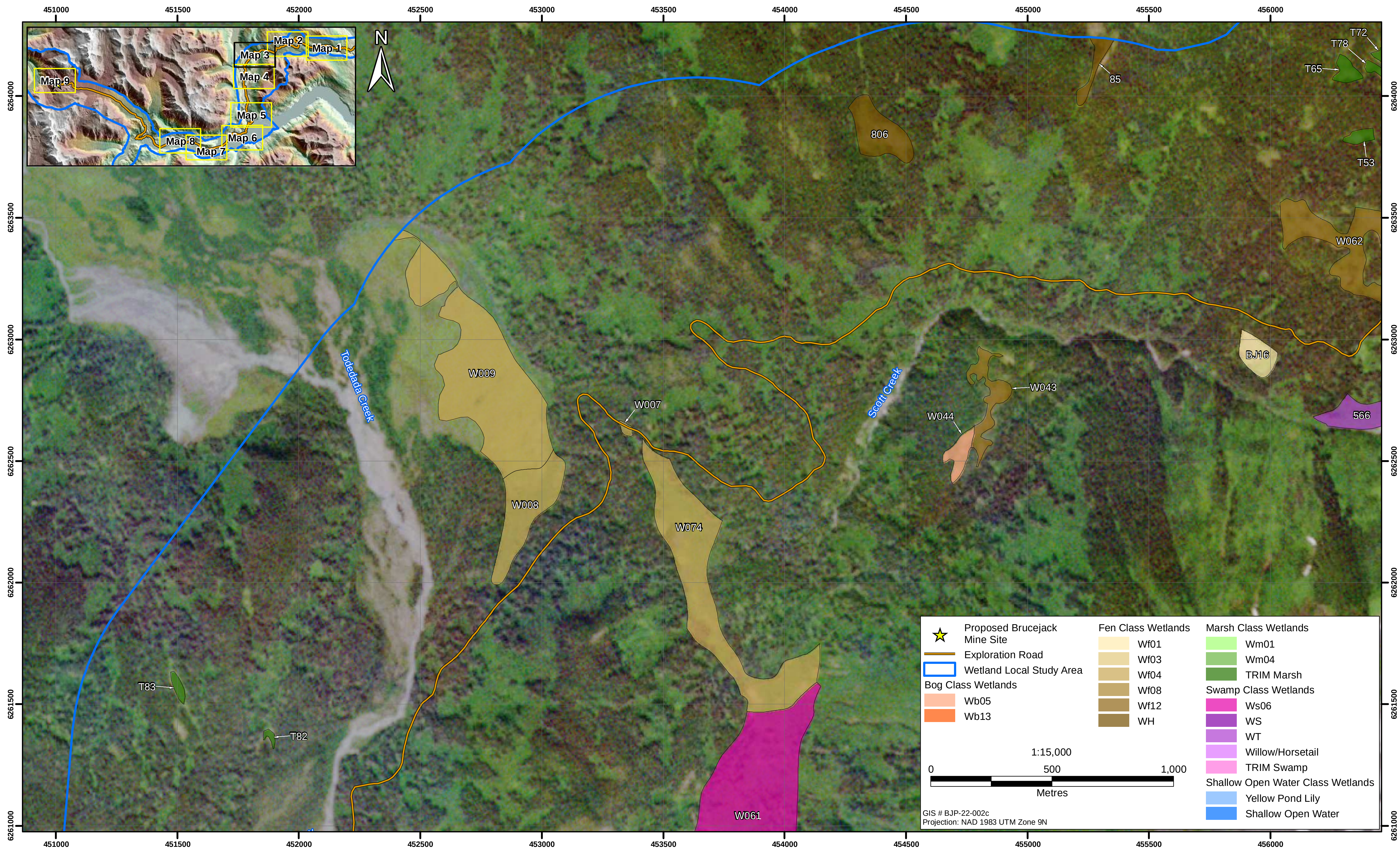
Wetland Distribution in the Brucejack LSA Map 1



PRETIVM
Rescan an ERM company

Figure 3.2-2

Wetland Distribution in the Brucejack LSA Map 2



PRETIVM Rescan an ERM company

Figure 3.2-3

Wetland Distribution in the Brucejack LSA
Map 3

PROJECT #0194150-0003 GIS # BJP-22-002d May 23, 2013

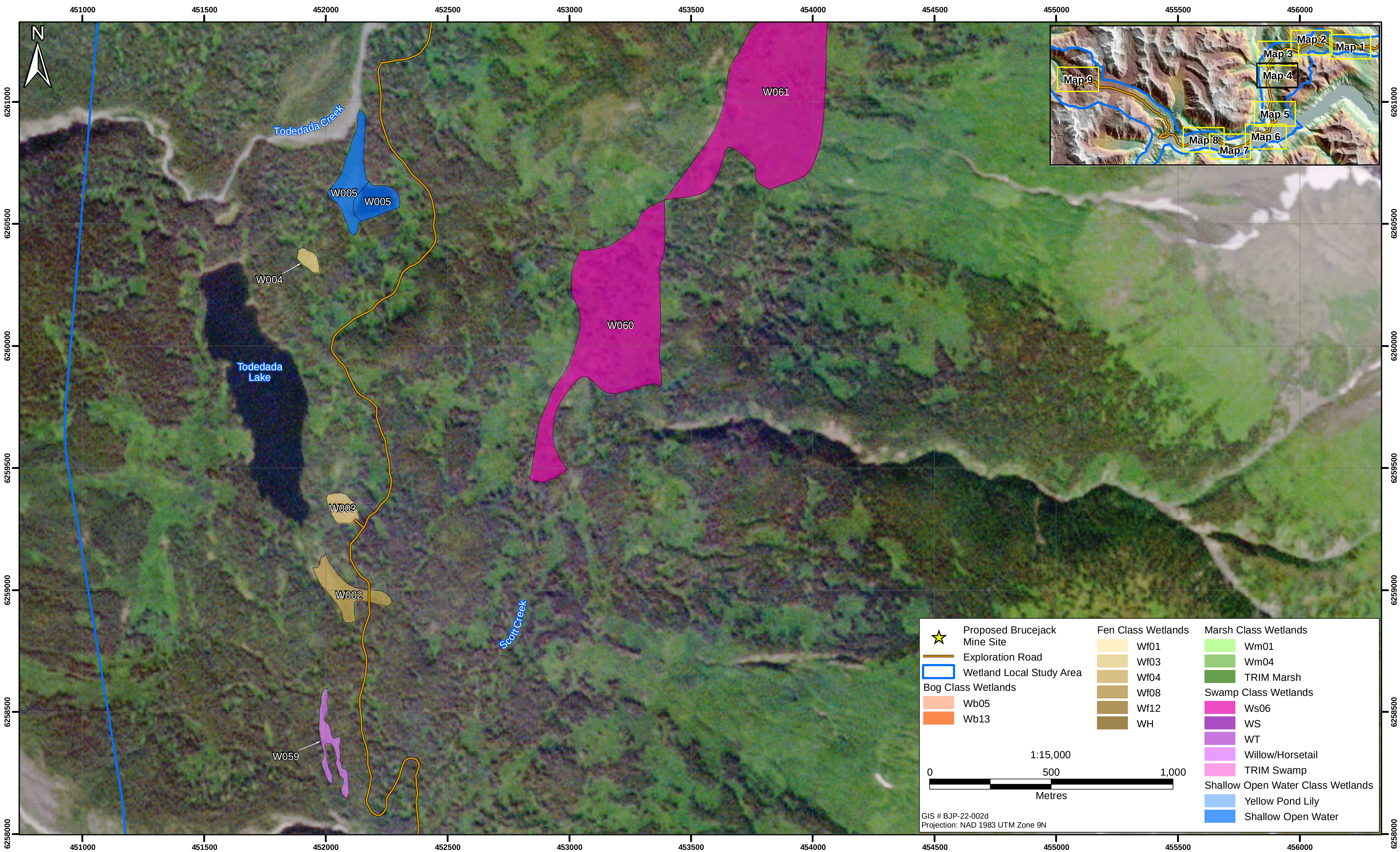


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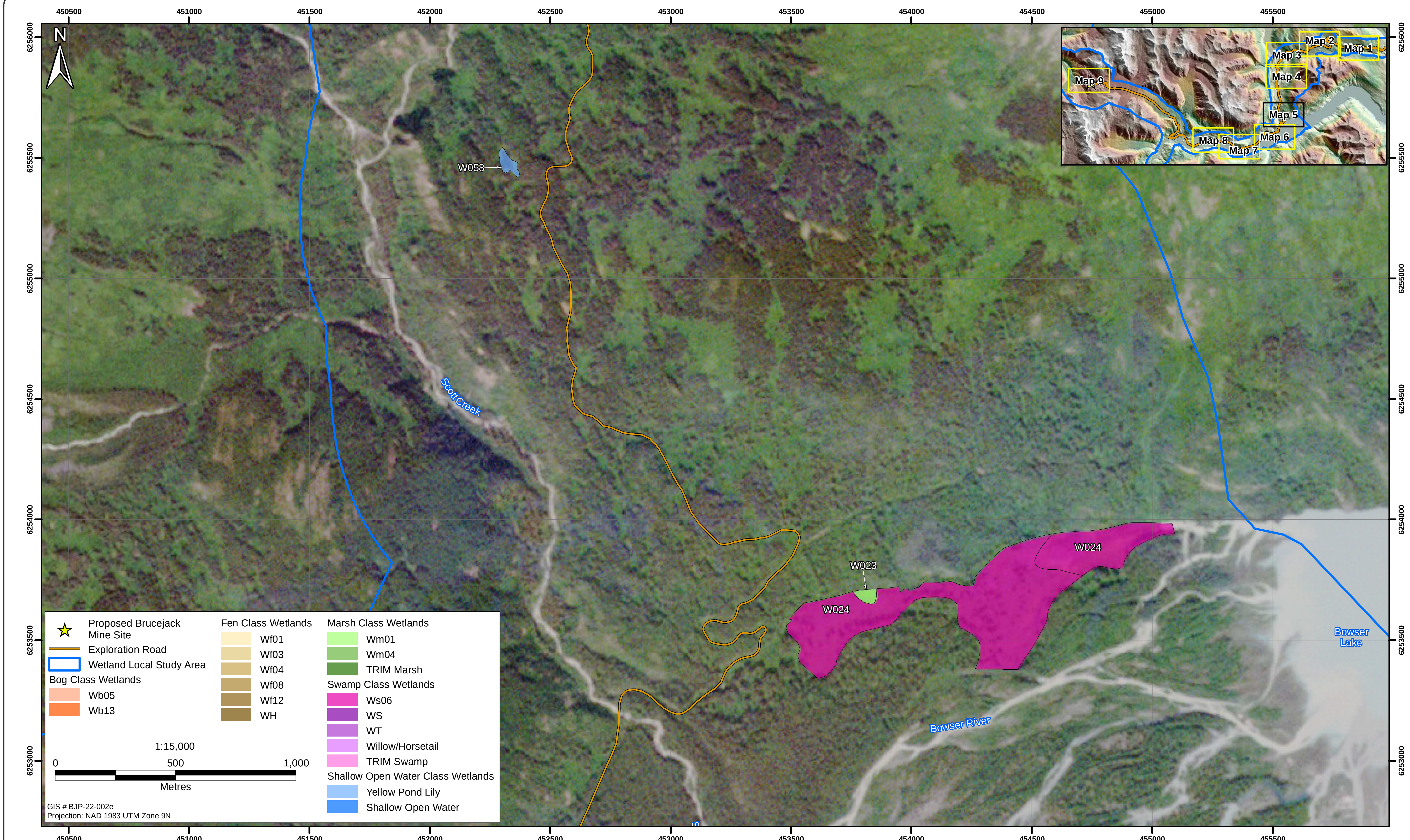
Figure 3.2-4

Wetland Distribution in the Brucejack LSA Map 4

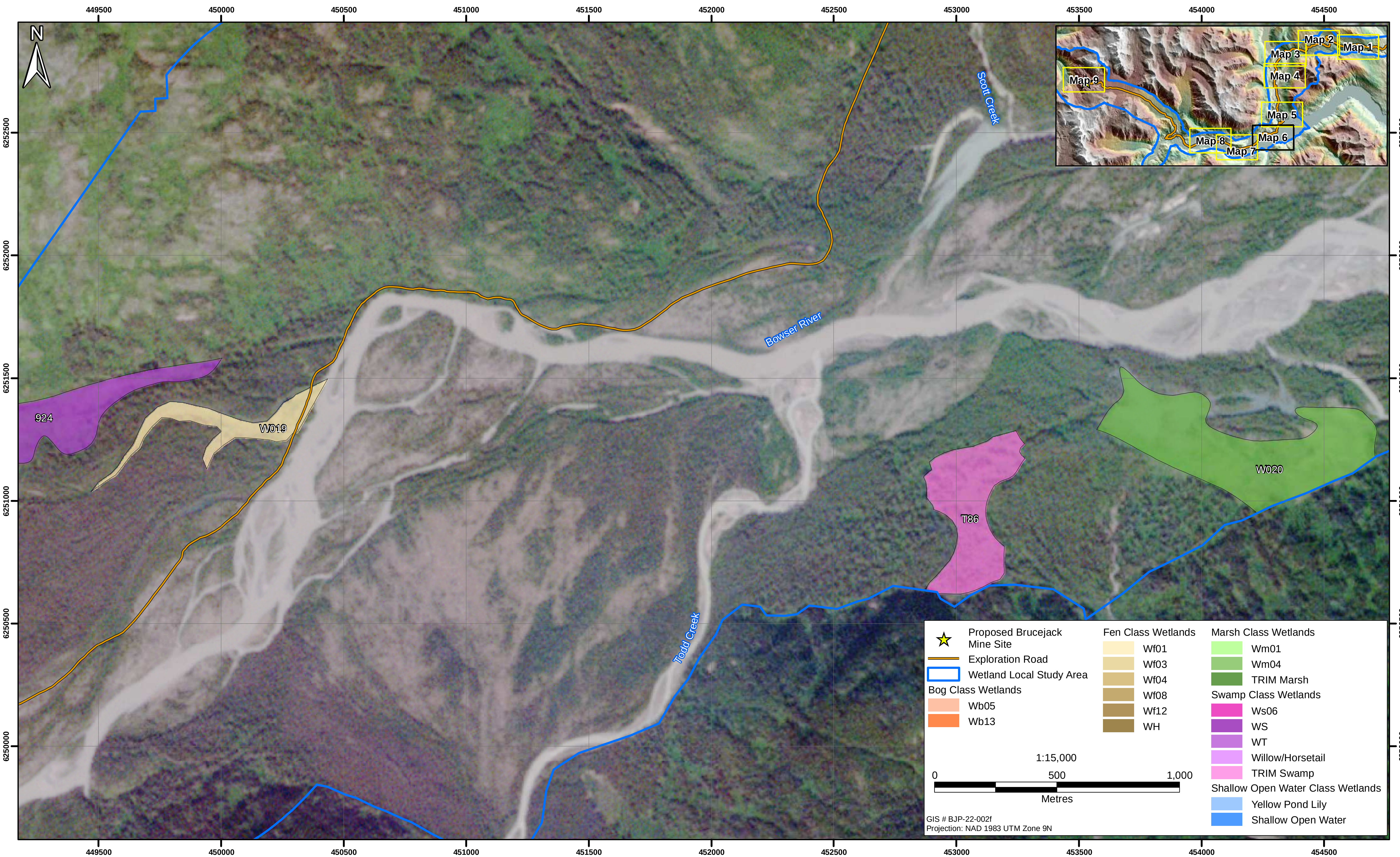


PRETIVM

Rescan an ERM company

Figure 3.2-5

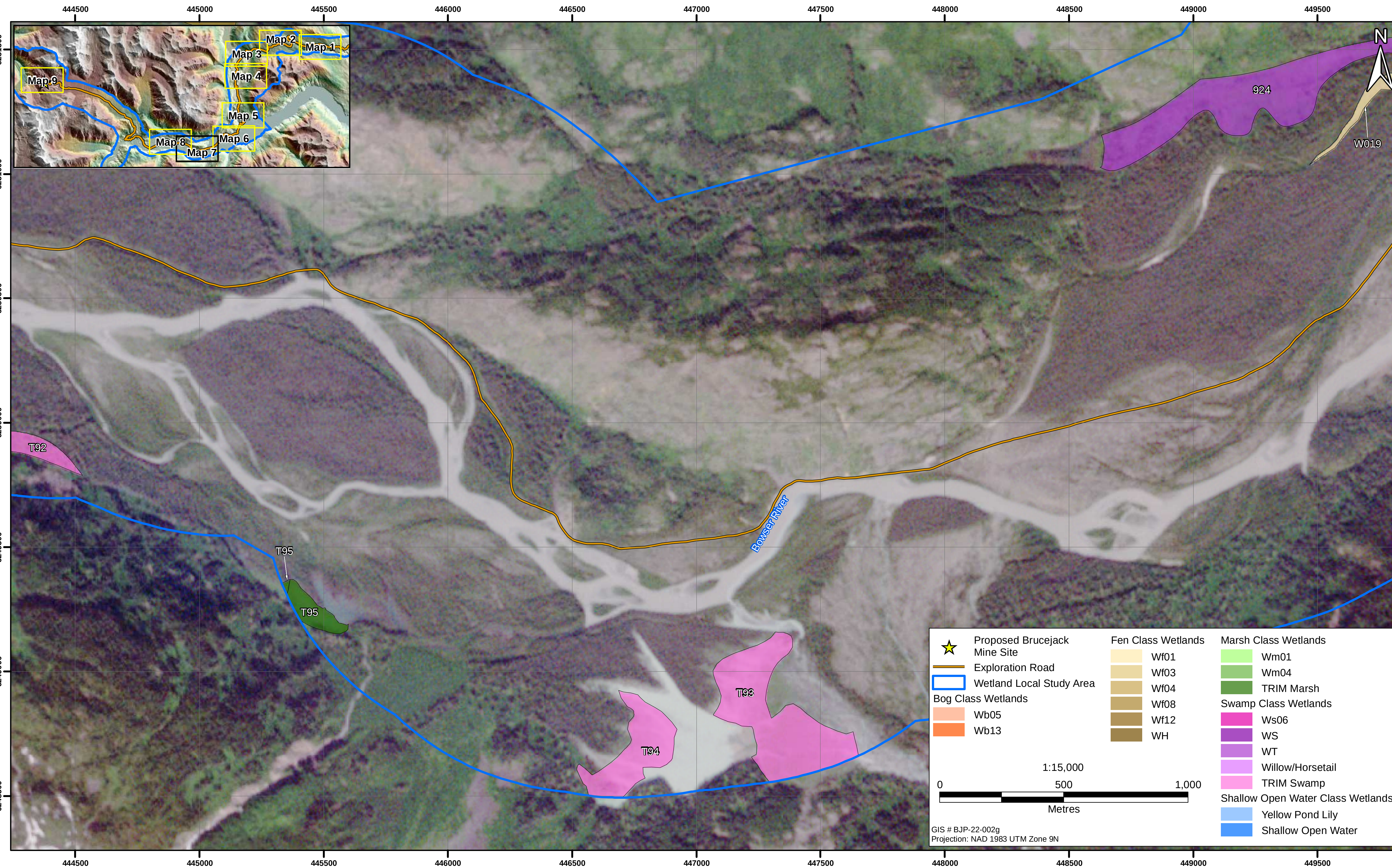
Wetland Distribution in the Brucejack LSA Map 5



PRETIVM Rescan an ERM company

Figure 3.2-6

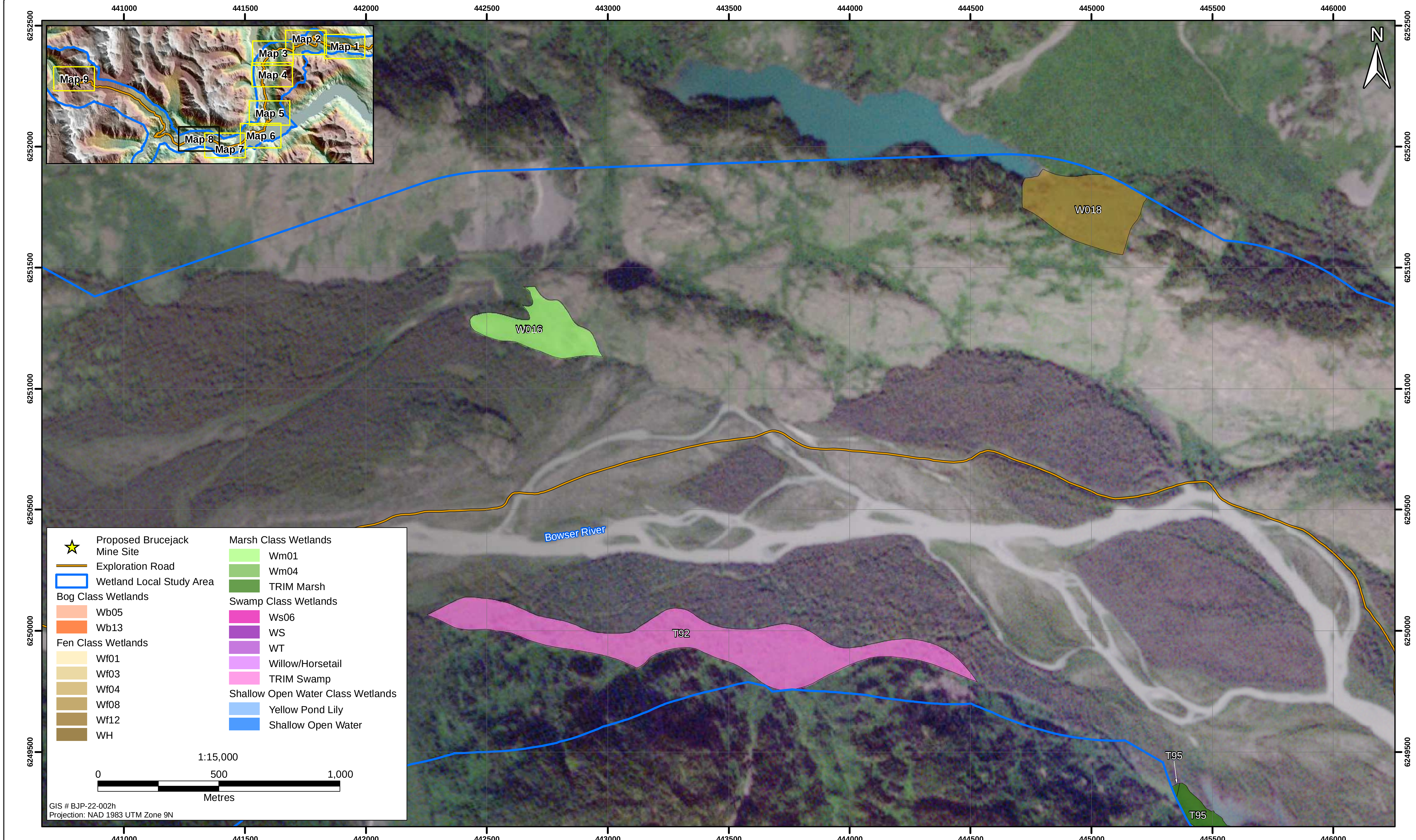
Wetland Distribution in the Brucejack LSA Map 6



PRETIVM Rescan an ERM company

Figure 3.2-7

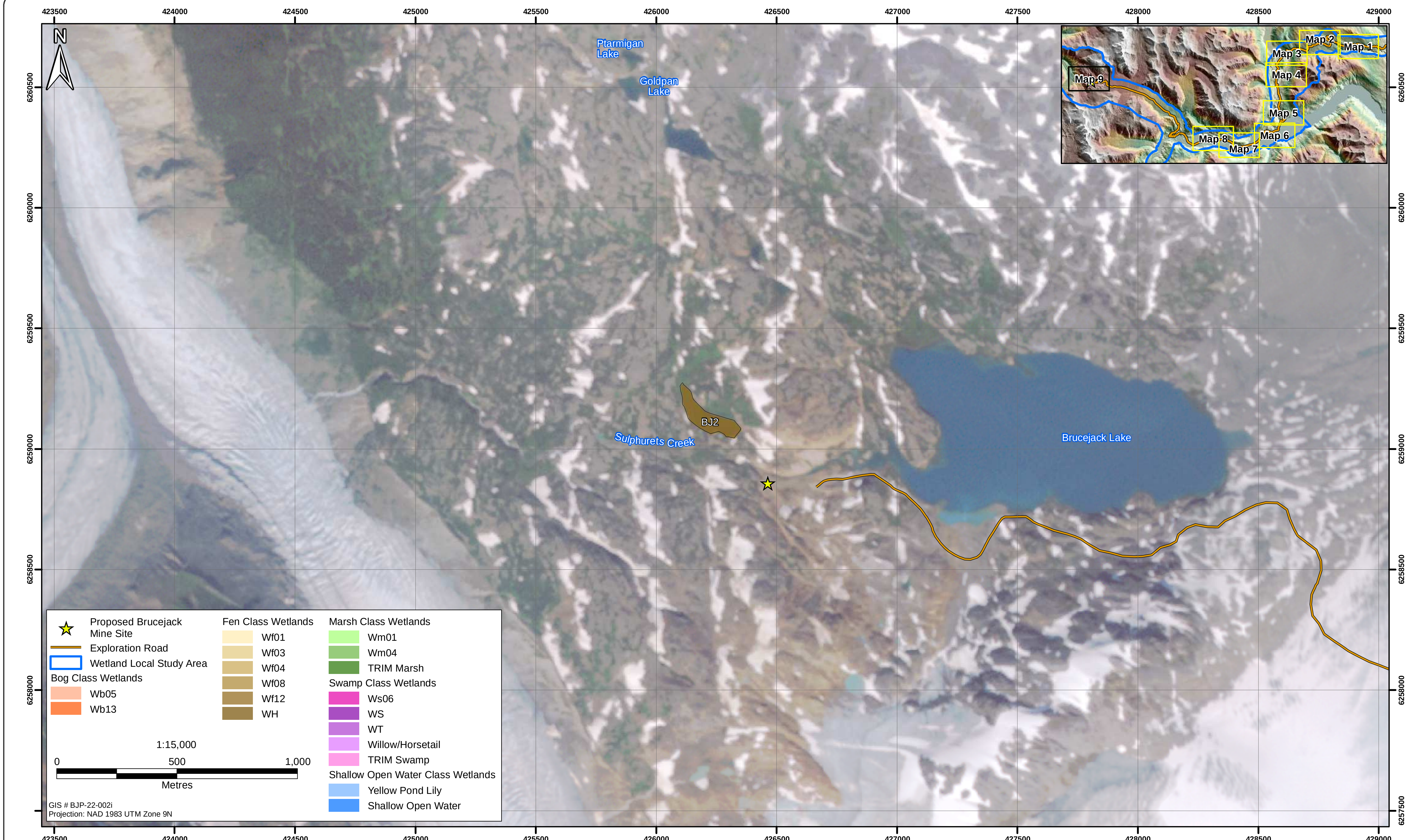
Wetland Distribution in the Brucejack LSA Map 7



PRETIVM Rescan an ERM company

Figure 3.2-8

Wetland Distribution in the Brucejack LSA Map 8



PRETIVM Rescan an ERM company

Figure 3.2-9

Wetland Distribution in the Brucejack LSA Map 9

3.3 WETLAND FUNCTION

Wetland function is a process or series of processes that occur within a wetland. Examples include the ability to regulate water levels to attenuate flow, filter water to improve water quality, and provide aquatic and terrestrial habitat for aquatic and semi-aquatic species. Wetland function is separated into four primary categories (hydrology, biochemical, ecological, and habitat; Milko 1998; Hanson et. al 2008). The majority of wetlands identified in the LSA include fens, marshes, and swamps; thus discussion on wetland function will be focused on these wetland classes. The following is a description of the primary wetland functions identified in the LSA.

3.3.1 Hydrological Function

Hydrologic function is defined as a wetlands contribution to ground and surface water resources. The hydrologic function of wetlands in the LSA is varied because of the variety of wetland classes and landscape position. Physical features of wetlands and geographical properties such as wetland class, landscape position, and hydrodynamic index both influence and are influenced by wetland hydrologic function.

Determining in a quantitative manner the hydrologic function of discreet wetlands requires multiyear studies, which are beyond the scope of the baseline program. However, broad generalizations of wetland function across all wetland classes can be made by comparing site parameters to information presented in Hanson et. al 2008.

Fen, marsh, and swamp hydrological functions are related to their hydrogeomorphic positions. For example, wetlands adjacent to river systems (fluvial hydrogeomorphic position) typically have flood control functions, whereas terrestrial based wetlands do not. Wetland hydrogeomorphic position was evenly distributed between basin and hollows, fluvial, and seepage slopes: this means the primary hydrological function is not associated with specific wetlands but rather includes many different components.

3.3.2 Biochemical Function

The wetland biochemical function is defined as a wetland's contribution to the quality of surface and groundwater of an area. Water, sediment, and vegetation components of a wetland influence its biological function. Accurately describing biochemical function is not possible given site specific interactions between wetland components (water, soil and vegetation), landscape position, and environmental factors such as salinity, precipitation, and climate (Almas and Singh, 2001; and Brunham and Bendell 2010). Therefore rather than describing specific biochemical functions one aspect of biochemical function was selected for study. Samples of vegetation tissue were collected and analysed for metal content to use as a point of reference for monitoring potential changes in biochemical function. Vegetation tissue was selected for monitoring because wetland plants are connected to wetland soil and water systems and metals with accumulation in plants are an important contributor to water quality. Metals results were below the detection limit in more than 50% of samples for Al, Sb, As, Be, Bi, Cd, Cr, Pb, Li, Hg, Se, Tl, Sn, U, and V; these results will not be discussed further.

No provincial or federal tissue metal guidelines are available for sample comparison; therefore sample results were compared against each other to determine significant differences between same sites. Box plots of the remaining metal parameters were prepared and used to identify sample sites with outliers beyond the 5% and 95% confidence intervals (Figure 3.3-1). No outliers were identified at any site meaning all of these sites are suitable future monitoring sites. The number of parameters below the detection limit exceeds what has been observed at other projects within the region suggesting that wetlands in the Brucejack LSA contain fewer metals than other wetlands in the region (Rescan 2010).

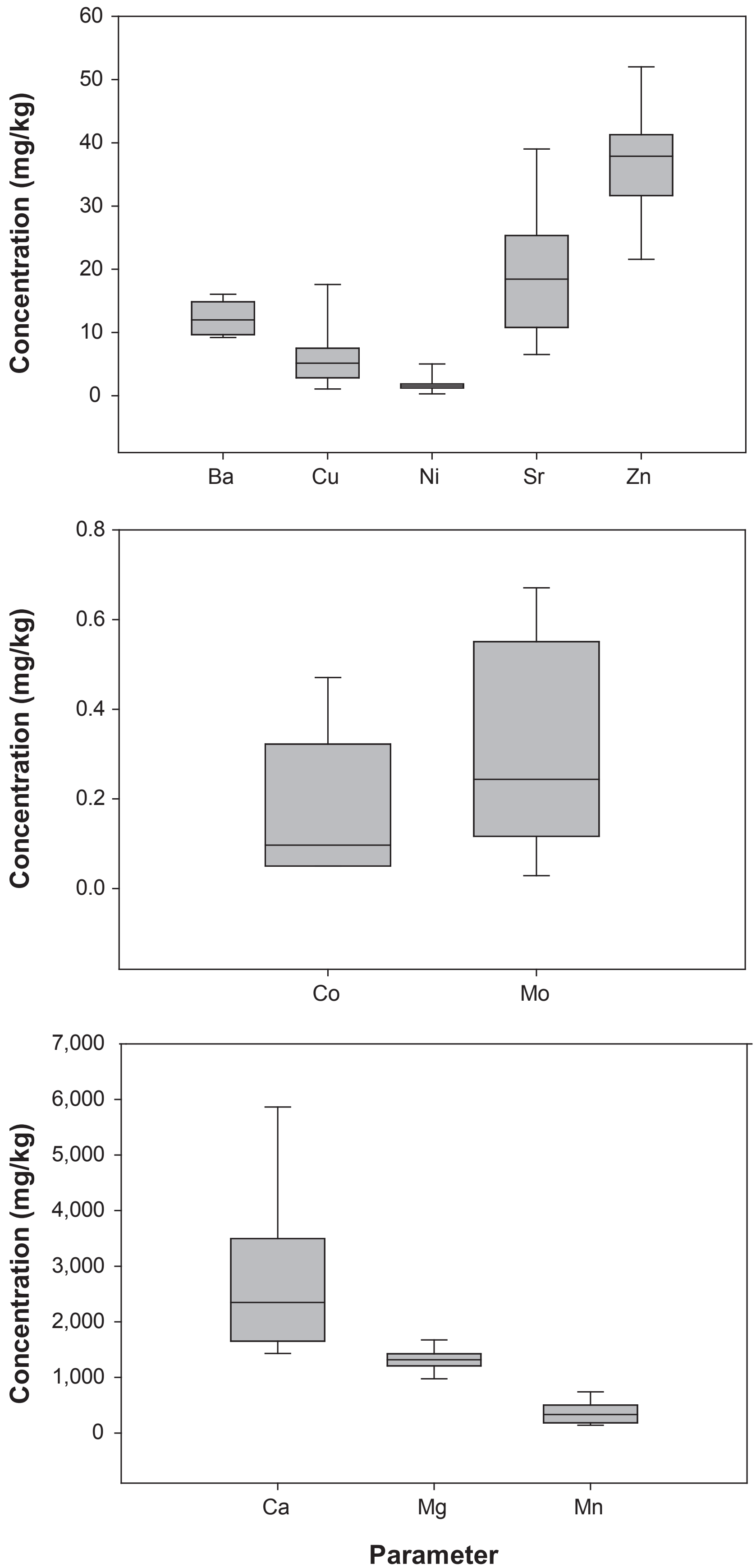


Figure 3.3-1

Vegetation Tissue Metal Concentration Box Plots

3.3.3 Ecological Function

Wetland ecological function is defined as the relationship between a wetland and surrounding ecosystems (Milko 1998). Aspects of the wetland ecosystem function include rare or unique wetlands and wetland complexes. Approximately 66% of all wetlands surveyed were found to exist as a complex with other wetland classes or associations (Appendix 1).

A search for provincially listed wetlands within the Project area BEC zones in the Skeena Stikine Forest District identified a number of listed wetlands (Table 2.5-5). Wetland classification results identified that three of the listed wetland associations were observed in the LSA. These communities are summarized in Table 3.3-1.

Table 3.3-1. Summary of Listed Wetlands

Listed Wetland	Wetland Association Name	Class	BEC Sub Zone where Listed	Number of Occurrences[1]	Total Area (ha)
Wb13	Shore sedge – Buckbean – Peat moss	Bog	ICH	1	0.5
Wf08	Shore sedge – Buckbean – Hook-moss	Fen	ESSF	1	11.7
Wm04	Common spike rush	Marsh	ESSF	1	29.3

[1] *As the primary decile*

3.3.4 Habitat Function

Wetland habitat function includes both terrestrial and aquatic habitat components and is defined as a wetland’s contribution to the wildlife habitat within a given region. Wetlands in the LSA maintain local and regional biodiversity by providing a wide range of aquatic and terrestrial habitat types, as confirmed by the variety of wildlife observed during the wetland field survey (Table 3.3-2). Incidental wildlife observations included a number of mammalian, avian, and herptofauna species. Approximately 50% of all wildlife observations were western toad, which are a species of conservation concern listed both provincially and federally as at risk (COSEWIC 2002; BC CDC 2006; Rescan 2013). Detailed wildlife survey results are available in the Wildlife Characterization Baseline Report (Rescan 2013).

Table 3.3-2. Wetland Survey: Incidental Wildlife Observations

Plot	Genus	Species	Common Name	Observation
W011	*Ursus*	*arctos horribilis*	Grizzle Bear	1
W016	*Branta*	*canadensis*	Canada Goose	1
W020	*Alces*	*Alces*	Moose	1
W023	*Alces*	*Alces*	Moose	1 bull, 5 cows, 1 young
W029	*Anaxyrus*	*boreas*	Western Toad	1
W030	*Anaxyrus*	*boreas*	Western Toad	5 juvenile toads
W031	*Anaxyrus*	*boreas*	Western Toad	2 juvenile toads
W035	*Ursus*	*americanus*	black bear	1
W039	*Alces*	*Alces*	Moose	1
BJ17	*Anaxyrus*	*boreas*	Western Toad	1

4. Summary

Rescan Engineers and Scientists

4. Summary

A total of 91 wetland ecosystem surveys were completed in the Brucejack LSA in June and September 2012. These wetland surveys resulted in the mapping of 517.8 ha of wetlands classified into 20 distinct ecological communities including WH, WS, and WT TEM identified communities and TRIM Marsh and Swamp TRIM identified communities.

The most common wetland classes were fen, marsh, and swamp with fen and swamp accounting for 58% of the total wetland area. This is also true for the number of vegetation communities identified; fens and swamps accounted for 11 of the 18 identified communities. The Wetland Herb and Ws06 vegetation communities accounted for the largest area and TRIM Marsh accounted for the largest number of occurrences.

The primary wetland functions were identified and quantified, where possible, for wetlands in the LSA. Wetland function identification relied heavily on scientific literature describing wetland function for specific wetland classes because quantifying functional components is difficult given the multitude of interactions between the physical, chemical, biological, and geographical properties of wetlands. Wetlands in the LSA were identified to generally have three High hydrology functions for marshes and Low to moderate (Hanson et. al. 2008) functioning for fens and swamps. The marsh High hydrological functions include: 1) water flow moderation; 2) erosion control; and 3) water quality treatment.

Wetlands in the LSA were identified to have potential for a variety of biochemical functions; however, these functions are difficult to quantify because of the myriad site specific variables that influence the level of functionality. Therefore, rather than quantifying the degree of function, wetland tissue samples were collected and analysed for metal concentration to provide a point of reference for potential future monitoring of this aspect of biochemical function. Generally results were similar between sites making all sites sampled suitable for use in potential future monitoring programs.

Wetland ecology within the Brucejack LSA is important as a number of listed wetlands were identified as potentially occurring. Indeed, classification results show that listed wetland types do exist in the LSA, specifically the Wb13, Wf08, and Wm04. Wetland complexes, another important component of functioning wetland ecology, were identified at approximately 66% of all wetlands surveyed. Wetland complexes are important because they provide areas where the functionality of a wetland is improved because the ecosystem contains multiple wetland classes or associations which offer a diversity of niche communities benefiting multiple species.

Wetlands in the LSA maintain local and regional biodiversity by providing a wide range of aquatic and terrestrial habitat. Wildlife observations included a number of mammalian, avian, and herptofauna species including the western toad, a COSEWIC species of special concern listed by under SARA (COSEWIC 2002).

Within the LSA, wetlands cover a small but important component of the landscape. They are the connection between wetter aquatic habitats and drier upland habitats. The also carry out a number of processes specific to wetlands such as regulating flood waters, improving water quality, and offering semi-aquatic wildlife habitat. The information collected in this baseline study will inform aspects of an environmental assessment and be used to develop potential mitigation and monitoring plans such that effects to wetlands as a result of the Project are avoided or mitigated.

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Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

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Appendix 1
Wetland Ecosystem Survey Data

Engineers and Scientists

Appendix 1. Wetland Ecosystem Survey Data

Plot	Surveyor	Photo Numbers	Northing	Easting	Aspect	Elevation	Slope	Soil Moisture Regime	Hydrodynamic Index	Soil Nutrient Regime	Meso Slope Position	Hydrogeomorphic Position	Mineral Soil Drainage	Mineral Soil Texture	Organic Soil Moisture	Organic Soil Texture	Organic Horizon Thickness	Humus Form	Rooting Depth	Von Post	Coarse Fragment Content
W002	RD RW	1-17	6259024	452030	160	697	3	W	Sl	D	Depression	Basins and Hollows	Poorly	-	Perhumid	Mesic	90	-	40	5	<20
W003	RD RW	35-40	6259312	452095	-1	691	0	VW	St	C	Depression	Basins and Hollows	Very Poorly	-	Humid	Fibric	90	-	35	4	<20
W004	RD RW	45-53	6260346	451925	320	677	2	VW	St	C	Toe-Depression	Basins and Hollows	Poorly	-	Humid	Fibric	90	-	40	3	<20
W005	RD RW	62-70, 200-208	6260624	452059	-1	651	0	W	Mo	D	Depression	Fluvial	Imperfectly	Sandy	Subaquic	Gleysol	0	Mull	30	-	<20
W007	RD RW	9-15	6262637	453344	-1	657	0	W	Mo	D	Depression	Basins and Hollows	Poorly	Clayey	Perhumid	Mesic	10	-	25	5	<20
W008	RD RW	16-22	6262439	453041	-1	618	0	W	Mo	D	Level	Fluvial	Poorly	Loamy	Perhumid	Mesic	8	-	40	-	<20
W009	RD RW	34-51	6262682	452931	-1	611	0	W	Mo	D	Level	Basins and Hollows	Poorly	Loamy	Perhumid	Mesic	20	-	60	2	20-35
W016	RD RW	1-8	6251253	442642	-1	438	0	VW	Mo	C	Level	Fluvial	Poorly	Silty	Humid	Fibric	6	-	15	3	20-35
W018	RD RW	19-28	6251702	444867	-1	717	0	VW	St	B	Depression	Basins and Hollows	Very Poorly	Sandy	Humid	Fibric	110	-	20	3	<20
W019	RD RW	29-36	6251356	449969	-1	400	0	VM	Mo	C	Level	Fluvial	Imperfectly	Silty	Subaquic	Mesic	0	Mull	25	5	<20
W020	RD RW	37-66	6251257	454491	-1	380	0	VW	Sl	D	Depression	Fluvial	Poorly	Silty	Perhumid	Fibric	2	Moder	20	3	<20
W023	RD RW	67-74	6253678	453833	-1	379	0	VW	Sl	D	Depression	Fluvial	Very Poorly	Clayey	Humid	Fibric	12	-	40	3	-
W024	RD RW	75-84	6253692	453896	-1	380	0	W	Sl	D	Level	Fluvial	Poorly	Silty	Perhumid	Humic	2	-	15	8	<20
W043	RD RW	89-106, 15-29, 45-51	6262761	454866	270	848	3	VW	Sl	C	Mid Slope	Seepage Slopes	Very Poorly	Silty	Humid	Mesic	70	-	40	5	<20
W044	RD RW	120-127	6262595	454758	173	853	1	W	Sl	C	Depression	Seepage Slopes	Very Poorly	Clayey	-	Mesic	47	-	40	5	<20
W045	RD RW	1-7	6263586	458371	-1	956	0	VW	St	C	Depression	Basins and Hollows	Poorly	Sandy	Humid	Mesic	90	-	60	5	-
W046	RD RW	8-14	6263634	458459	40	964	3	W	Mo	C	Depression	Basins and Hollows	Poorly	Clayey	Perhumid	Mesic	42	-	50	5	<20
W049	RD RW	30-44	6263435	457806	310	985	4	VM	Sl	D	Mid Slope	Seepage Slopes	Imperfectly	Silty	Perhumid	Mesic	100	-	20	5	<20
W052	RD RW	52-58	6263162	457948	250	993	3	VW	Sl	B	Mid Slope	Seepage Slopes	Very Poorly	Sandy	Perhumid	Mesic	100	Moder	35	3	20-35
W053	RD RW	59-66	6265527	458733	180	985	3	VW	Sl	C	Mid Slope	Seepage Slopes	Poorly	Loamy	Perhumid	Mesic	90	-	50	5	-
W056	RD RW	84-94	6264222	465908	-1	746	0	VW	St	B	Depression	Basins and Hollows	Very Poorly	-	Humid	Fibric	110	-	20	2	-
W058	RD RW	22-32	6255470	452356	-1	608	0	W	Mo	D	Depression	Basins and Hollows	Very Poorly	Clayey	Humid	Humic	95	-	38	9	<20
W059	RD RW	33-42	6258377	452041	-1	665	0	W	Mo	D	Depression	Basins and Hollows	Poorly	-	Humid	Humic	9	-	40	6	<20
W060	RD RW	43-52	6259907	453137	-1	609	0	W	Mo	C	Depression	Basins and Hollows	Very Poorly	Loamy	Perhumid	Mesic	3	-	38	5	<20
W061	RD RW	53-58	6260706	453581	-1	626	0	VW	Mo	C	Depression	Fluvial	Very Poorly	Loamy	Humid	Fibric	7	-	47	3	<20
W062	RD RW	59-93	6263549	456096	152	1001	7	VW	Sl	C	Mid Slope	Seepage Slopes	Poorly	Loamy	Perhumid	Mesic	90	-	30	5	<20
W071	RD RW	47-60	6266700	457505	163	983	6	W	Mo	C	Lower Slope	Seepage Slopes	Poorly	-	Subaquic	Mesic	25	-	24	5	-
W074	RD RW	1-7	6262262	453518	-1	642	0	W	Mo	D	Level	Basins and Hollows	Poorly	Clayey	Perhumid	Humic	2	Mull	50	2	<20
BJ2	WB/SM	21-29	6259070	426287	-1	1350	0	W	St	C	Lower Slope	Fluvial	Rapidly	Loamy	Aquic	Mesic	55	-	-	3	20-35
BJ8	WB/SM	82-130	6264263	460214	187	930	3	W	Sl	C	Mid Slope	Seepage Slopes	Rapidly	Loamy	Peraquic	Mesic	120	Mull	-	6	<20
BJ11	WB/SM	131-141	6264864	459319	-	899	-	W	Mo	C	Depression	Fluvial	Very Poorly	Clayey	Aquic	Mesic	120	Mull	-	5	<20
BJ12	WB/SM	147-159	6264639	459205	-	910	-	W	Sl	C	Mid Slope	Seepage Slopes	Mod. Well	Loamy	Aquic	Mesic	120	Mull	-	5	-
BJ13	WB/SM	163-170	6264290	459425	65	917	1	W	Sl	C	Mid Slope	Seepage Slopes	Rapidly	Loamy	Aquic	Mesic	80	Mull	-	5	<20
BJ14	WB/SM	171-177	6263445	459781	-	888	-	W	st	C	Mid Slope	Seepage Slopes	Mod. Well	Loamy	Aquic	Mesic	150	Moder	-	6	<20
BJ15	WB/SM	178-184	6263378	459465	153	878	3	W	Sl	C	Mid Slope	Seepage Slopes	Mod. Well	Loamy	Aquic	Mesic	150	Mull	-	5	<20
BJ16	WB/SM	190-199	6262944	455959	280	838	3	W	St	C	Mid Slope	Seepage Slopes	Mod. Well	Clayey	Aquic	Mesic	110	Mull	-	4	<20
161	-	-	6263298	457353	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34a	-	-	6264324	462514	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34b	-	-	6264730	462246	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T16	-	-	6264437	461210	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T17	-	-	6264597	460271	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T18	-	-	6264419	461570	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T19	-	-	6264550	461321	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T20	-	-	6264281	461671	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T21	-	-	6264271	460784	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T22	-	-	6264806	460233	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 1. Wetland Ecosystem Survey Data

Plot	Water Colour	pH	Conductivity	Percent Open Water	Structural Stage	Wetland Class	Wetland Association	Decile 1	Wetland Class Decile 1	Wetland Association Decile 2	Decile 2	Wetland Class Decile 2	Wetland Association Decile 2	Decile 3	Wetland Class Decile 3	Wetland Association Decile 3	Tall Tree Cover	Tree Shrub Cover	Forb Cover	Moss Cover	Area (ha)	Mapping Data Source
W002	Green Brown Clear	6.7	11	5	2b	Fen	Wf04	60	fen	Wf04	40	fen	Wf12	-	-	-	0	3	68	50	2.864655526	Modified TEM
W003	Green Brown Clear	6.8	13	20	2b	Fen	Wf03	50	fen	Wf03	40	SOW	SOW	10	fen	Wf04	0	0	60	60	1.24959324	Digitized
W004	Green Brown Clear	7.3	22	30	2b	Fen	Wf03	50	fen	Wf03	30	fen	Wf04	20	SOW	SOW	0	+	60	35	0.611606021	Digitized
W005	Green Brown Clear	6.4	30	10	2b	SOW	SOW	40	SOW	SOW	30	fen	Wf04	30	marsh	Wm01	0	0	90	0	3.451194908	TEM
W007	Green Brown Clear	6.8	25	10	3b	Fen	Wf04	100	fen	Wf04	-	-	-	-	-	-	1	85	70	10	0.240362169	Digitized
W008	Green Brown Clear	7.5	94	15	3b	Fen	Wf04	60	fen	Wf04	40	fen	Wf03	-	-	-	0	80	40	5	6.928276813	TEM
W009	Green Brown Clear	7.3	421	<5	2b	Fen	Wf04	60	fen	Wf04	40	fen	Wf03	-	-	-	0	0	80	50	23.99413638	Modified TEM
W016	Green Brown Clear	6.9	143	40	2b	Marsh	Wm01	40	marsh	Wm01	40	SOW	SOW	20	swamp	Ws06	0	3	80	5	7.570325218	TEM
W018	Green Brown Clear	7.2	200	10	2b	Fen	Wf08	60	fen	Wf08	40	fen	Wf04	-	-	-	0	0	80	30	11.71229786	TEM
W019	Green Brown Clear	-	-	-	2b	Marsh	Wf01	100	marsh	Wf01	-	-	-	-	-	-	0	1	50	0	7.457485202	TEM
W020	Green Brown Clear	7.8	313	5	2b	Marsh	Wm04	40	marsh	Wm04	30	marsh	Wm01	30	swamp	Ws06	0	0	80	0	29.33357043	TEM
W023	Green Brown Clear	7.9	49	30	2b	Marsh	Wm01	100	Marsh	Wm01	-	-	-	-	-	-	0	0	90	0	0.438779324	Modified TEM
W024	Green Brown Clear	7.4	79	20	3b	Swamp	Ws06	90	swamp	Ws06	10	marsh	Wm01	-	-	-	0	70	40	15	26.56323785	Modified TEM
W043	Yellow-Deep Brown Turbid	5	10	40	2b	Fen	Wf12	50	fen	Wf12	30	fen	Wf50	20	fen	Wf04	0	40	60	40	2.718795569	Digitized
W044	Green Brown Clear	5.6	10	5	4c	Bog	Wb05	100	bog	Wb05	-	-	-	-	-	-	0	37	60	50	1.325417226	Digitized
W045	Green Brown Clear	6	0	<1	2b	Fen	Wf12	50	fen	Wf12	50	fen	Wf04	-	-	-	0	0	85	50+	10.15564803	TEM
W046	Yellow-Deep Brown Turbid	5	30	0	3a	Fen	Wf04	100	fen	Wf04	-	-	-	-	-	-	0	60	50	40	4.315120969	TEM
W049	Yellow-Deep Brown Turbid	5.6	0	0	-	Fen	Wf04	60	fen	Wf04	40	fen	Wf12	-	-	-	0	80	60	60	5.052448652	TEM
W052	Green Brown Clear	4.8	0	5	2b	Fen	Wf12	90	fen	Wf12	10	fen	Wf04	-	-	-	0	0	80	65	2.620034386	TEM
W053	Yellow-Deep Brown Turbid	5.2	0	5	2b	Fen	Wf12	90	fen	Wf12	10	fen	Wf04	-	-	-	0	0	80	25	5.006942039	TEM
W056	Yellow-Deep Brown Turbid	3.2	10	0	2b	Bog	Wb13	100	bog	Wb13	40	SOW	SOW	-	-	-	0	0	40	90	0.467009191	Digitized
W058	Green Brown Clear	6.7	50	20	-	SOW	YPL	60	SOW	YPL	40	swamp	Ws01	-	-	-	0	40	60	30	0.521053346	Digitized
W059	Yellow-Deep Brown Turbid	5.3	20	<5	3b	Swamp	/illow/Horseta	100	swamp	Willow/Horsetail	-	-	-	-	-	-	0	40	70	50	1.724695984	Digitized
W060	Green Brown Clear	6.2	90	<5	3a	Swamp	Ws06	50	swamp	Ws06	50	SOW	SOW	-	-	-	0	25	75	15	25.7920652	Modified TEM
W061	Yellow-Deep Brown Turbid	7.5	40	<1	3b	Swamp	Ws06	50	swamp	Ws06	30	SOW	SOW	20	marsh	Wm01	0	+	90	0	31.38971576	TEM
W062	Yellow-Deep Brown Turbid	5.9	0	<1	2b	Fen	Wf12	60	fen	Wf12	30	fen	Wf04	10	fen	Wf50	0	+	75	50	11.33485917	TEM
W071	Green Brown Clear	5.5	10	<5	3b	Fen	Wf03	60	fen	Wf03	40	fen	Wf04	-	-	-	0	65	35	50	0.068707876	TEM
W074	Green Brown Turbid	8.7	50	<5	3b	Fen	Wf04	40	fen	Wf04	40	fen	Wf04	20	fen	Wf03	0	80	40	0	18.18880061	TEM
BJ2	-	8.8	10	2	2a	Fen	Wf12	100	fen	Wf12	-	-	-	-	-	-	0	1	90	55	1.985703571	Modified TRIM
BJ8	Tea Coloured	5.7	10	1	-	Fen	Wf03	90	fen	Wf03	10	fen	Wf04	-	-	-	0	5	8	100	14.14981711	TEM
BJ11	-	6.1	10	0	2b	Fen	Wf04	60	fen	Wf04	40	fen	Wf03	-	-	-	0	40	95	80	10.61574867	TEM
BJ12	Yellow-Deep Brown Turbid	-	-	-	-	Fen	Wf03	80	fen	Wf03	20	fen	Wf04	-	-	-	0	10	80	100	1.301946182	TRIM
BJ13	-	5.2	0	2	-	Fen	Wf03	100	fen	Wf03	-	-	-	-	-	-	0	5	60	99	0.622509256	Digitized
BJ14	Tea Coloured	4.9	0	1	-	Fen	Wf12	100	fen	Wf12	-	-	-	-	-	-	0	5	75	90	0.886238532	TRIM
BJ15	Green Brown Clear	-	-	-	-	Fen	Wf01	60	fen	Wf01	30	fen	Wf03	10	fen	Wf04	0	10	95	60	2.845688417	TRIM
BJ16	Tea Coloured	-	-	-	-	Fen	Wf01	50	fen	Wf01	30	fen	Wf04	20	fen	Wf03	0	15	90	60	1.96298412	TEM
161	-	-	-	-	-	Swamp	WS	6	WS	WS	3	WH	2b	1	OW		-	-	-	-	14.01873003	TEM
34a	-	-	-	-	-	Fen	WH	5	WH	WH	3	09	5	2	05	6	-	-	-	-	22.73021539	Modified TEM
34b	-	-	-	-	-	Fen	WH	5	WH	WH	3	09	5	2	05	6	-	-	-	-	14.88322514	Modified TEM
T16	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	1.342595016	Modified TRIM
T17	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.648845407	TRIM
T18	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.473125559	Modified TRIM
T19	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.508800691	TRIM
T20	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	1.222816416	Modified TRIM
T21	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	1.102338445	TRIM
T22	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	1.019682543	TRIM

Appendix 1. Wetland Ecosystem Survey Data

Plot	Surveyor	Photo Numbers	Northing	Easting	Aspect	Elevation	Slope	Soil Moisture Regime	Hydrodynamic Index	Soil Nutrient Regime	Meso Slope Position	Hydrogeomorphic Position	Mineral Soil Drainage	Mineral Soil Texture	Organic Soil Moisture	Organic Soil Texture	Organic Horizon Thickness	Humus Form	Rooting Depth	Von Post	Coarse Fragment Content
T23	-	-	6264624	460605	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T24	-	-	6264882	460388	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T25	-	-	6264148	461888	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T26	-	-	6264286	459218	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T27	-	-	6265125	458613	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T28	-	-	6264451	459163	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T29	-	-	6265349	458382	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T30	-	-	6265209	458311	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T31	-	-	6264527	459424	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T1	-	-	6263646	459949	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	-	-	6264352	457048	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
376	-	-	6264855	457257	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
85	-	-	6264125	455274	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
806	-	-	6263853	454389	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
566	-	-	6262689	456357	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
552	-	-	6262783	457003	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
559	-	-	6263184	456952	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	-	-	6263164	458259	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
166	-	-	6263282	458891	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
562	-	-	6263744	458489	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64	-	-	6264527	458409	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T53	-	-	6263835	456368	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T56	-	-	6263887	456629	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T65	-	-	6264103	456314	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T70	-	-	6264484	456200	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T72	-	-	6264168	456468	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T78	-	-	6264108	456439	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T79	-	-	6264367	456817	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T82	-	-	6261366	451881	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T83	-	-	6261571	451503	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T86	-	-	6250966	453062	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
924	-	-	6251305	449222	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T92	-	-	6249953	443371	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T93	-	-	6248822	447322	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T94	-	-	6248680	446750	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T95	-	-	6249243	445456	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W005	RD RW	62-70, 200-208	6260624	452059	-1	651	0	W	Mo	D	Depression	Fluvial	Imperfectly	Sandy	Subaquic	Gleysol	0	Mull	30	-	<20
W024	RD RW	75-84	6253692	453896	-1	380	0	W	Sl	D	Level	Fluvial	Poorly	Silty	Perhumid	Humic	2	-	15	8	<20
T12	-	-	6264491	465302	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T12	-	-	6264458	465319	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T95	-	-	6249345	445349	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 1. Wetland Ecosystem Survey Data

Plot	Water Colour	pH	Conductivity	Percent Open Water	Structural Stage	Wetland Class	Wetland Association	Decile 1	Wetland Class Decile 1	Wetland Association Decile 2	Decile 2	Wetland Class Decile 2	Wetland Association Decile 2	Decile 3	Wetland Class Decile 3	Wetland Association Decile 3	Tall Tree Cover	Tree Shrub Cover	Forb Cover	Moss Cover	Area (ha)	Mapping Data Source
T23	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	1.235644455	Modified TRIM
T24	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	3.278370845	Modified TRIM
T25	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.704029391	TRIM
T26	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.516612777	Modified TRIM
T27	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.532341539	TRIM
T28	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.486513913	TRIM
T29	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.600351449	Modified TRIM
T30	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.239266882	TRIM
T31	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	2.039236634	TRIM
T1	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	2.553997877	Modified TRIM
100	-	-	-	-	-	Fen	WH	6	WH	WH	2	WS	3a	2	09	5	-	-	-	-	3.042263374	TEM
376	-	-	-	-	-	Swamp	WS	5	WS	WS	4	WH	2b	1	08	5	-	-	-	-	2.495749214	TEM
85	-	-	-	-	-	Fen	WH	4	WH	WH	3	WS	3a	3	09	5	-	-	-	-	1.110356051	TEM
806	-	-	-	-	-	Fen	WH	4	WH	WH	4	WS	3a	2	09	5	-	-	-	-	4.101158663	TEM
566	-	-	-	-	-	Swamp	WT	10	WT	WT	-	-	-	-	-	-	-	-	-	-	2.783741392	TEM
552	-	-	-	-	-	Swamp	WT	8	WT	WT	2	06	6	-	-	-	-	-	-	-	4.946378784	TEM
559	-	-	-	-	-	Swamp	WS	7	WS	WS	2	WH	2b	1	OW		-	-	-	-	7.265026333	TEM
62	-	-	-	-	-	Fen	WH	7	WH	WH	3	09	5	-	-	-	-	-	-	-	3.278783672	TEM
166	-	-	-	-	-	Swamp	WS	5	WS	WS	4	WH	2b	1	08	5	-	-	-	-	5.623035521	TEM
562	-	-	-	-	-	Fen	WH	10	WH	WH	-	-	-	-	-	-	-	-	-	-	3.380012224	TEM
64	-	-	-	-	-	Fen	WH	4	WH	WH	4	05	5	2	09	5	-	-	-	-	30.48747121	TEM
T53	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.5663464	TRIM
T56	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.448428649	Modified TRIM
T65	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.80722978	Modified TRIM
T70	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.331479373	Modified TRIM
T72	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.35694128	TRIM
T78	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.386720194	Modified TRIM
T79	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.394877245	TRIM
T82	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.179736458	TRIM
T83	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.400912592	TRIM
T86	-	-	-	-	-	Swamp	TRIM Swamp	100	Swamp	TRIM Swamp	-	-	-	-	-	-	-	-	-	-	15.22323326	Modified TRIM
924	-	-	-	-	-	Swamp	WT	4	WT	WT	3	OW		3	04	6	-	-	-	-	19.48102221	TEM
T92	-	-	-	-	-	Swamp	TRIM Swamp	100	Swamp	TRIM Swamp	-	-	-	-	-	-	-	-	-	-	28.31980464	Modified TRIM
T93	-	-	-	-	-	Swamp	TRIM Swamp	100	Swamp	TRIM Swamp	-	-	-	-	-	-	-	-	-	-	15.55640377	Modified TRIM
T94	-	-	-	-	-	Swamp	TRIM Swamp	100	Swamp	TRIM Swamp	-	-	-	-	-	-	-	-	-	-	7.334340855	TRIM
T95	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	2.173482635	TRIM
W005	Green Brown Clear	6.4	30	10	2b	SOW	SOW	40	SOW	SOW	30	fen	Wf04	30	marsh	Wm01	0	0	90	0	2.068233816	TEM
W024	Green Brown Clear	7.4	79	20	3b	Swamp	Ws06	90	swamp	Ws06	10	marsh	Wm01	-	-	-	0	70	40	15	7.182496679	Modified TEM
T12	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.010260948	TRIM
T12	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.309861977	TRIM
T95	-	-	-	-	-	Marsh	TRIM Marsh	100	Marsh	TRIM Marsh	-	-	-	-	-	-	-	-	-	-	0.099010838	TRIM

Appendix 2

Wetland Habitat Information Form

Rescan™
Engineers and Scientists

Rescan
Engineers & Scientists

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO	X:	Y:	DATE

PROJECT ID	SURV.
MAPSHEET	PLOT #

UTM ZONE	NORTH	EAST

ASPECT	ELEVATION

SLOPE %	SMR	HDI	SNR

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☐ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☐ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☐ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly

MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)

MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☐ Mesic	☐ Humic	___________ cm
HUMUS FORM			ROOTING DEPTH
☐ Mor	☐ Moder	☐ Mull	Depth ______ cm Type ___________

VON POST	

1	2	3	4	5	6	7	8	9	10

COARSE FRAGMENT CONTENT

☐ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM	COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3
BGC UNIT	WETLAND CLASS
SITE SERIES	ASSOCIATION
STRUCTURAL STAGE	MODIFIER

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

WB-RES10-01 100510

WETLAND MAP

Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

NOTES

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.

TREE / SHRUB	%	FORB	%	FORB cont'd	%
				BRYOP.	%

☐ COMPLETE ☐ PARTIAL

WATER COLOUR
- ☐ Tea Coloured
- ☐ Yellow-Deep Brown Turbid
- ☐ Green-Brown Clear
- ☐ Green-Brown Turbid
- ☐ Blue-Green Clear

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER

SOIL PROFILE	WILDLIFE OBSERVATIONS	
	SPECIES	FEATURE

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

Appendix 3

Wetland Ecosystem Vegetation Species List

Rescan™ Engineers and Scientists

Appendix 3. Wetland Ecosystem Vegetation Species List

Plot	Genus	Species	%	Plot	Genus	Species	%
W001	Salix	barclayi	30	W007	Carex	sp	5
W001	Carex	aquatilis	45	W007	Equisetum	arvense	20
W001	Athyrium	filix-femina	7	W007	Comarum	palustre	5
W001	Senecio	triangularis	5	W007	Athyrium	filix-femina	5
W001	Equisetum	sp	3	W007	Calamagrostis	sp	5
W001	Aulacommium	palustre	-	W007	Aulacommium	palustre	5
W002	Salix	barclayi	3	W008	Salix	bebbiana	50
W002	Rubus	arcticus	-	W008	Salix	glauca	30
W002	Abies	lasiocarpa	-	W008	Carex	aquatilis	20
W002	Kalmia	microphylla	-	W008	Equisetum	arvense	20
W002	Empetrum	nigrum	-	W008	Aulacommium	palustre	3
W002	Eriophorum	angustifolium	20	W008	Plagiomnium	sp	2
W002	Carex	aquatilis	30	W009	Carex	aquatilis	80
W002	Gentiana	amarella	2	W009	Aulacommium	palustre	40
W002	Viola	sp	10	W009	Tomenthypnum	nitens	-
W002	Carex	sp	3	W009	Plagiomnium	sp	-
W002	Calamagrostis	sp	5	W010	Salix	glauca	50
W002	Leptarrhena	pyrolifolia	-	W010	Carex	aquatilis	35
W002	Aulacommium	palustre	20	W010	Equisetum	arvense	15
W002	Sphagnum	squarrosum	20	W010	Aulacommium	palustre	50
W003	Kalmia	microphylla	-	W010	Tomenthypnum	nitens	30
W003	Carex	aquatilis	50	W011	Salix	barclayi	10
W003	Carex	limosa	5	W011	Carex	aquatilis	40
W003	Calamagrostis	sp	5	W011	Equisetum	variegatum	20
W003	Sphagnum	capillifolium	30	W011	Eriophorum	angustifolium	20
W003	Sphagnum	squarrosum	20	W011	Platanthera	dilatata	-
W003	Sphagnum	angustifolium	5	W011	Aulacommium	palustre	50
W003	Tomenthypnum	nitens	5	W011	Marchantic	sp	20
W003	Plagiomnium	sp	5	W012	Salix	barclayi	5
W004	Salix	barclayi	-	W012	Rubus	arcticus	15
W004	Carex	aquatilis	40	W012	Lonicera	involucrata	-
W004	Carex	sp	10	W012	Spiraea	sp	20
W004	Viola	sp	1	W012	Carex	aquatilis	20
W004	Comarum	palustre	2	W012	Comarum	palustre	-
W004	Leptarrhena	pyrolifolia	7	W012	Carex	sp	5
W004	Sphagnum	squarrosum	25	W012	Eriophorum	augustifolium	5
W004	Sphagnum	sp	10	W012	Platanthera	dilatata	-
W005	Carex	aquatilis	60	W012	Sphagnum	angustifolium	70
W005	Carex	rostrata	30	W012	Aulacommium	palustre	5
W005	Carex	sp	-	W012	Menziesia	ferruginea	-
W006	Rubus	sp	-	W013	Carex	aquatilis	90
W006	Salix	barclayi	50	W014	Salix	sitchensis	25
W006	Salix	sp	20	W014	Spiraea	douglasii	40
W006	Carex	aquatilis	10	W014	Ribes	laxiflorum	10
W006	Equisetum	sp	15	W014	Lonicera	involucrata	5
W007	Abies	lasiocarpa	1	W014	Epilobium	angustifolium	2
W007	Salix	barclayi	80	W014	Equisetum	arvense	3
W007	Alnus	crispa	5	W014	Viola	glabella	-
W007	Rubus	sp	-	W014	Lilium	columbianum	-
W007	Carex	aquatilis	40				

Appendix 3. Wetland Ecosystem Vegetation Species List

Plot	Genus	Species	%	Plot	Genus	Species	%
W015	*Spiraea*	*douglasii*	70	W022	*Alnus*	*crispa*	-
W015	*Lonicera*	*involucrata*	5	W022	*Salix*	*barclayi*	15
W015	*Salix*	*sitchensis*	5	W022	*Platanthera*	*dilatata*	-
W015	*Carex*	*aquatilis*	30	W022	*Carex*	*lenticularis*	20
W015	*Calamagrostis*	*sp*	10	W022	*Carex*	*sp*	5
W015	*Viola*	*sp*	-	W022	*Juncus*	*sp*	10
W015	*Sphagnum*	*angustifolium*	-	W022	*Equisetum*	*arvense*	5
W016	*Salix*	*glauca*	3	W022	*Epilobium*	*sp*	-
W016	*Carex*	*aquatilis*	60	W022	*Viola*	*sp*	-
W016	*Carex*	*rostrata*	10	W023	*Salix*	*sitchensis*	50
W016	*Carex*	*sitchensis*	10	W023	*Carex*	*aquatilis*	40
W016	*Aulacommium*	*palustre*	5	W024	*Salix*	*lasiocarpa*	35
W017	*Salix*	*sitchensis*	20	W024	*Salix*	*sitchensis*	25
W017	*Alnus*	*crispa*	10	W024	*Cornus*	*stolonifera*	10
W017	*Salix*	*glauca*	20	W024	*Viburnum*	*opulus*	-
W017	*Carex*	*aquatilis*	10	W024	*Athyrium*	*filix-femina*	5
W017	*Carex*	*lenticularis*	5	W024	*Equisetum*	*arvense*	10
W017	*Carex*	*sp*	5	W024	*Galium*	*sp*	-
W017	*Equisetum*	*arvense*	5	W024	*Epilobium*	*sp*	-
W017	*Juncus*	*sp*	-	W024	*Carex*	*sitchensis*	20
W017	*Erigeron*	*angustifolium*	2	W024	*Carex*	*aquatilis*	5
W017	*Leptarrhena*	*pyrolifolia*	3	W024	*Plagiomnium*	*medium*	10
W017	*Carex*	*sitchensis*	10	W024	*Tomenthypnum*	*nitens*	2
W017	*Aulacommium*	*palustre*	30	W024	*Aulacommium*	*palustre*	3
W017	*Marchantic*	*polymorpha*	10	W025	*Salix*	*glauca*	20
W018	*Salix*	*barclayi*	-	W025	*Spiraea*	*douglasii*	20
W018	*Carex*	*rostrata*	10	W025	*Alnus*	*crispa*	-
W018	*Carex*	*aquatilis*	10	W025	*Carex*	*aquatilis*	40
W018	*Comarum*	*palustre*	15	W025	*Viola*	*sp*	-
W018	*Menyanthes*	*trifoliata*	25	W025	*Comarum*	*palustre*	-
W018	*Carex*	*sitchensis*	20	W026	*Picea*	*mariana*	15
W018	*Sphagnum*	*angustifolium*	2	W026	*Abies*	*lasiocarpa*	3
W018	*Aulacommium*	*palustre*	3	W026	*Vaccinium*	*ovalifolium*	7
W018	*Tomenthypnum*	*nitens*	25	W026	*Rubus*	*chamaemorus*	3
W019	*Salix*	*sitchensis*	1	W026	*Salix*	*barclayi*	20
W019	*Carex*	*rostrata*	5	W026	*Lonicera*	*involucrata*	-
W019	*Carex*	*sitchensis*	45	W026	*Viburnum*	*edule*	3
W019	*Carex*	*lenticularis*	-	W026	*Spiraea*	*douglasii*	2
W019	*Carex*	*lenticularis*	-	W026	*Carex*	*aquatilis*	25
W020	*Carex*	*rostrata*	30	W026	*Equisetum*	*arvense*	10
W020	*Carex*	*sitchensis*	30	W026	*Viola*	*adunca*	2
W020	*Epilobium*	*sp*	-	W026	*Comarum*	*palustre*	1
W020	*Juncus*	*sp*	-	W026	*Epilobium*	*angustifolium*	-
W020	*Carex*	*aquatilis*	20	W026	*Lycopodum*	*columbianum*	1
W021	*Trichophorum*	*caespitosum*	40	W026	*Dryopteris*	*sp*	1
W021	*Equisetum*	*variegatum*	10	W026	*Cornus*	*canadensis*	1
W021	*Juncus*	*sp*	-	W026	*Platanthera*	*dilatata*	-
W021	*Carex*	*sitchensis*	-	W026	*Sphagnum*	*capillaceum*	40
W022	*Salix*	*sitchensis*	30	W026	*Sphagnum*	*girgensohnii*	30
W022	*Actaea*	*sp*	5				

Appendix 3. Wetland Ecosystem Vegetation Species List

Plot	Genus	Species	%	Plot	Genus	Species	%
W027	*Spiraea*	*douglasii*	-	W032	*Sphagnum*	*sp*	20
W027	*Picea*	*mariana*	-	W033	*Salix*	*barclayi*	80
W027	*Kalmia*	*microphylla occidentalis*	15	W033	*Carex*	*sitchensis*	20
W027	*Rubus*	*chamaemorus*	5	W033	*Carex*	*aquatilis*	20
W027	*Eriophorum*	*augustifolium*	15	W034	*Salix*	*sp*	-
W027	*Carex*	*aquatilis*	30	W034	*Carex*	*sitchensis*	25
W027	*Trichophorum*	*caespitosum*	5	W034	*Carex*	*sp*	20
W027	*Carex*	*spp*	10	W034	*Eriophorum*	*angustifolium*	-
W027	*Drosera*	*rotundifolia*	-	W034	*Viola*	*sp*	-
W027	*Menyanthes*	*trifoliata*	5	W034	*Calamagrostis*	*sp*	-
W027	*Sphagnum*	*angustifolium*	60	W034	*Sphagnum*	*angustifolium*	30
W027	*Sphagnum*	*squarrosum*	20	W034	*Sphagnum*	*sp*	25
W028	*Salix*	*barclayi*	50	W035	*Salix*	*barclayi*	40
W028	*Spiraea*	*douglasii*	30	W035	*Salix*	*commutata*	10
W028	*Carex*	*sitchensis*	30	W035	*Salix*	*glauca*	10
W028	*Sphagnum*	*squarrosum*	40	W035	*Carex*	*sitchensis*	60
W029	*Rubus*	*chamaemorus*	10	W035	*Equisetum*	*arvense*	7
W029	*Carex*	*sitchensis*	30	W035	*Equisetum*	*variegatum*	3
W029	*Viola*	*adunca*	20	W035	*Platanthera*	*dilatata*	-
W029	*Calamagrostis*	*sp*	10	W035	*Aulacommium*	*palustre*	35
W029	*Carex*	*aquatilis*	20	W036	*Salix*	*commutata*	30
W029	*Sphagnum*	*squarrosum*	50	W036	*Salix*	*barclayi*	50
W030	*Spiraea*	*douglasii*	5	W036	*Carex*	*aquatilis*	35
W030	*Rubus*	*chamaemorus*	-	W036	*Equisetum*	*arvense*	5
W030	*Carex*	*sitchensis*	25	W036	*Aulacommium*	*palustre*	20
W030	*Viola*	*adunca*	5	W037	*Carex*	*aquatilis*	80
W030	*Eriophorum*	*angustifolium*	5	W038	*Salix*	*sitchensis*	80
W030	*Calamagrostis*	*sp*	3	W038	*Carex*	*sitchensis*	40
W030	*Trichophorum*	*caespitosum*	2	W038	*Equisetum*	*arvense*	-
W030	*Comarum*	*palustre*	-	W038	*Aulacommium*	*palustre*	10
W030	*Carex*	*aquatilis*	20	W039	*Salix*	*barclayi*	15
W030	*Leptarrhena*	*pyrolifolia*	-	W039	*Salix*	*commutata*	5
W031	*Spiraea*	*douglasii*	5	W039	*Carex*	*aquatilis*	35
W031	*Rubus*	*chamaemorus*	5	W039	*Equisetum*	*arvense*	10
W031	*Alnus*	*crispa*	-	W039	*Carex*	*sitchensis*	35
W031	*Carex*	*aquatilis*	35	W040	*Carex*	*aquatilis*	80
W031	*Viola*	*adunca*	5	W040	*Equisetum*	*arvense*	-
W031	*Comarum*	*palustre*	5	W040	*Carex*	*rostrata*	5
W031	*Carex*	*sp*	5	W040	*Carex*	*sitchensis*	5
W031	*Carex*	*sitchensis*	-	W041	*Salix*	*barclayi*	-
W031	*Sphagnum*	*capillaceum*	30	W041	*Menyanthes*	*trifoliata*	30
W031	*Sphagnum*	*angustifolium*	50	W041	*Carex*	*aquatilis*	20
W032	*Salix*	*sp*	-	W041	*Carex*	*sitchensis*	5
W032	*Carex*	*aquatilis*	30	W041	*Carex*	*rostrata*	5
W032	*Carex*	*spp*	20	W041	*Hippuris*	*vulgaris*	5
W032	*Eriophorum*	*angustifolium*	20	W041	*Carex*	*sp*	-
W032	*Calamagrostis*	*sp*	10	W041	*Comarum*	*palustre*	-
W032	*Sphagnum*	*angustifolium*	20	W041	*Equisetum*	*filix-femina*	-

Appendix 3. Wetland Ecosystem Vegetation Species List

Plot	Genus	Species	%	Plot	Genus	Species	%
W042	*Salix*	*sp*	-	W048	*Polytrichum*	*sp*	5
W042	*Eriophorum*	*angustifolium*	20	W048	*Plagiomnium*	*sp*	-
W042	*Carex*	*sp*	30	W049	*Salix*	*barclayi*	70
W042	*Calamagrostis*	*sp*	10	W049	*Salix*	*sp*	10
W042	*Calamagrostis*	*leptosepala*	10	W049	*Carex*	*sp*	50
W042	*Sphagnum*	*fuscum*	20	W049	*Senecio*	*triangularis*	10
W042	*Sphagnum*	*sp*	10	W049	*Petasites*	*sp*	10
W043	*Kalmia*	*microphylla occidentalis*	40	W049	*Equisetum*	*sp*	5
W043	*Eriophorum*	*angustifolium*	60	W049	*Valeriana*	*sitka*	5
W043	*Carex*	*aquatilis*	15	W049	*Sphagnum*	*angustifolium*	40
W043	*Carex*	*spp*	5	W049	*Sphagnum*	*squarrosum*	10
W043	*Calamagrostis*	*sp*	5	W050	*Carex*	*sp*	20
W043	*Carex*	*pauciflora*	5	W050	*Eriophorum*	*angustifolium*	20
W043	*Sphagnum*	*fuscum*	10	W050	*Carex*	*aquatilis*	10
W043	*Sphagnum*	*angustifolium*	20	W050	*Caltha*	*leptosepala*	20
W043	*Sphagnum*	*sp*	10	W050	*Leptarrhena*	*pyrolifolia*	5
W044	*Vaccinium*	*ovalifolium*	2	W050	*Sphagnum*	*angustifolium*	40
W044	*Carex*	*aquatilis*	60	W050	*Sphagnum*	*sp*	20
W044	*Sphagnum*	*angustifolium*	40	W050	*Polytrichum*	*sp*	10
W044	*Sphagnum*	*capillaceum*	10	W051	*Salix*	*barclayi*	50
W045	*Carex*	*aquatilis*	30	W051	*Carex*	*sp*	50
W045	*Eriophorum*	*angustifolium*	30	W051	*Senecio*	*triangularis*	5
W045	*Calamagrostis*	*sp*	20	W051	*Equisetum*	*sp*	5
W045	*Carex*	*sp*	5	W051	*Valeriana*	*sitchensis*	5
W045	*Sphagnum*	*angustifolium*	40	W051	*Plagiomnium*	*medium*	10
W045	*Polytrichum*	*commune*	10	W051	*Rhizomnium*	*glacile*	10
W046	*Salix*	*barclayi*	50	W051	*Tomenthypnum*	*nitens*	20
W046	*Salix*	*sp*	-	W051	*Aulacommium*	*palustre*	10
W046	*Carex*	*aquatilis*	50	W052	*Carex*	*aquatilis*	30
W046	*Sphagnum*	*angustifolium*	20	W052	*Carex*	*sp*	20
W047	*Carex*	*aquatilis*	40	W052	*Eriophorum*	*angustifolium*	30
W047	*Eriophorum*	*angustifolium*	20	W052	*Sphagnum*	*angustifolium*	50
W047	*Carex*	*sp*	5	W053	*Carex*	*aquatilis*	40
W047	*Calamagrostis*	*sp*	-	W053	*Eriophorum*	*angustifolium*	20
W047	*Caltha*	*leptosepala*	-	W053	*Carex*	*sp*	10
W047	*Senecio*	*triangularis*	-	W053	*Caltha*	*leptosepala*	10
W047	*Sphagnum*	*angustifolium*	40	W053	*Sphagnum*	*angustifolium*	20
W047	*Aulacommium*	*palustre*	20	W053	*Sphagnum*	*squarrosum*	15
W047	*Polytrichum*	*sp*	5	W054	*Salix*	*barclayi*	80
W048	*Kalmia*	*microphylla occidentalis*	20	W054	*Carex*	*aquatilis*	10
W048	*Carex*	*aquatilis*	10	W054	*Valeriana*	*sitchensis*	10
W048	*Eriophorum*	*angustifolium*	20	W054	*Petasites*	*sp*	10
W048	*Trichophorum*	*caespitosum*	5	W054	*Senecio*	*triangularis*	5
W048	*Sphagnum*	*angustifolium*	30	W054	*Tomenthypnum*	*nitens*	10
W048	*Sphagnum*	*sp*	10	W054	*Plagiomnium*	*medium*	5

Appendix 3. Wetland Ecosystem Vegetation Species List

Plot	Genus	Species	%
W055	*Spiraea*	*douglasii*	10
W055	*Rubus*	*chamaemorus*	3
W055	*Kalmia*	*microphylla occidentalis*	7
W055	*Carex*	*aquatilis*	30
W055	*Carex*	*nigromarginata*	5
W055	*Eriophorum*	*angustifolium*	30
W055	*Caltha*	*leptosepala*	5
W055	*Leptarrhena*	*pyrolifolia*	5
W055	*Carex*	*sp*	-
W055	*Cornus*	*canadensis*	-
W055	*Platanthera*	*dilatata*	-
W055	*Galium*	*sp*	-
W055	*Carex*	*pauciflora*	2
W055	*Carex*	*sitchensis*	3
W055	*Sphagnum*	*angustifolium*	30
W055	*Tomenthypnum*	*nitens*	30
W055	*Sphagnum*	*sp*	5
W056	*Carex*	*aquatilis*	40
W056	*Comarum*	*palustre*	-
W056	*Sphagnum*	*fuscum*	30
W056	*Sphagnum*	*capillaceum*	30
W056	*Sphagnum*	*angustifolium*	30
W057	*Salix*	*commutata*	15
W057	*Salix*	*glauca*	60
W057	*Alnus*	*crispa*	5
W057	*Equisetum*	*arvense*	30
W057	*Equisetum*	*variegatum*	40
W057	*Platanthera*	*dilatata*	-
W057	*Aulacommium*	*palustre*	30
W057	*Drepanocladus*	*uncinatus*	10
W058	*Alnus*	*crispa*	10
W058	*Salix*	*sitchensis*	30
W058	*Carex*	*aquatilis*	10
W058	*Viola*	*palustris*	5
W058	*Athyrium*	*filix-femina*	5
W058	*Senecio*	*triangularis*	10
W058	*Dryopteris*	*expansa*	30
W058	*Aulacommium*	*palustre*	20
W058	*Plagiomnium*	*medium*	10
W058	*Rhizomnium*	*sp*	-
W059	*Salix*	*sitchensis*	30
W059	*Salix*	*barclayi*	10
W059	*Equisetum*	*sp*	5
W059	*Dryopteris*	*expansa*	20
W059	*Senecio*	*triangularis*	5
W059	*Viola*	*palustris*	1
W059	*Comarum*	*palustre*	1
W059	*Carex*	*lenticularis*	1
W059	*Veronica*	*sp*	2
W059	*Sphagnum*	*squarrosum*	20
W059	*Aulacommium*	*palustre*	20
W059	*Plagiomnium*	*medium*	10
W060	*Salix*	*glauca*	5
W060	*Salix*	*sitchensis*	20
W060	*Carex*	*aquatilis*	20
W060	*Carex*	*sitchensis*	30
W060	*Equisetum*	*arvense*	10
W060	*Comarum*	*palustre*	-
W060	*Calamagrostis*	*canadensis*	10
W060	*Aulacommium*	*palustre*	10
W061	*Salix*	*sitchensis*	-
W061	*Carex*	*aquatilis*	60
W061	*Carex*	*sitchensis*	30
W061	*Veronica*	*sp*	-
W062	*Salix*	*sp*	-
W062	*Carex*	*aquatilis*	30
W062	*Eriophorum*	*angustifolium*	30
W062	*Leptarrhena*	*pyrolifolia*	10
W062	*Caltha*	*leptosepala*	5
W062	*Carex*	*dioica ssp.gynocrates*	-
W063	*Salix*	*barclayi*	65
W063	*Carex*	*aquatilis*	60
W063	*Caltha*	*leptosepala*	5
W063	*Sphagnum*	*squarrosum*	30
W063	*Plagiomnium*	*sp*	10
W063	*Aulacommium*	*palustre*	10
W063	*Barberea*	*sp*	-
W064	*Salix*	*barclayi*	5
W064	*Carex*	*aquatilis*	30
W064	*Eriophorum*	*angustifolium*	30
W064	*Leptarrhena*	*pyrolifolia*	10
W064	*Equisetum*	*sp*	-
W064	*Carex*	*sp*	10
W064	*Sphagnum*	*squarrosum*	40
W064	*Tomenthypnum*	*nitens*	10
W065	*Carex*	*aquatilis*	25
W065	*Eriophorum*	*angustifolium*	25
W065	*Leptarrhena*	*pyrolifolia*	5
W065	*Caltha*	*leptosepala*	5
W065	*Carex*	*sp*	5
W065	*Sphagnum*	*angustifolium*	40
W065	*Tomenthypnum*	*nitens*	30
W065	*Plagiomnium*	*sp*	5
W066	*Salix*	*barclayi*	25
W066	*Salix*	*commutata*	5
W066	*Equisetum*	*arvense*	10
W066	*Carex*	*aquatilis*	30

Appendix 3. Wetland Ecosystem Vegetation Species List

Plot	Genus	Species	%	Plot	Genus	Species	%
W067	*Salix*	*barclayi*	*15*	W073	*Spiraea*	*douglasii*	*40*
W067	*Salix*	*glauca*	*15*	W073	*Carex*	*aquatilis*	*40*
W067	*Carex*	*aquatilis*	*15*	W073	*Carex*	*sitchensis*	*10*
W067	*Equisetum*	*arvense*	-	W073	*Comarum*	*palustre*	-
W067	*Equisetum*	*variegatum*	*7*	W073	*Calamagrostis*	*canadensis*	*10*
W067	*Aulacommium*	*palustre*	*15*	W074	*Salix*	*barclayi*	*50*
W067	*Marchantic*	*polymorpha*	-	W074	*Carex*	*aquatilis*	*30*
W067	*Tomenthypnum*	*nitens*	*30*	W074	*Equisetum*	*arvense*	*10*
W067	*Aulacommium*	*sp*	*30*	*BJ1*	*Salix*	*arctica*	-
W067	*Plagiomnium*	*sp*	-	*BJ1*	*Arctostaphylos*	*uva-ursi*	-
W068	*Kalmia*	*microphylla occidentalis*	-	*BJ1*	*Salix*	*sp*	-
W068	*Salix*	*barclayi*	-	*BJ1*	*Lupinus*	*sp*	-
W068	*Carex*	*aquatilis*	*35*	*BJ1*	*Poa*	*sp*	-
W068	*Carex*	*dioica ssp.gynocrates*	*0.5*	*BJ2*	*Salix*	*stolonifera*	*1*
W068	*Leptarrhena*	*pyrolifolia*	-	*BJ2*	*Eriophorum*	*angustifolium*	*65*
W068	*Carex*	*nigromarginata*	*10*	*BJ2*	*Leptarrhena*	*pyrolifolia*	*5*
W068	*Sphagnum*	*angustifolium*	*78*	*BJ2*	*Carex*	*sp*	*15*
W068	*Sphagnum*	*squarrosum*	-	*BJ2*	*Vahlodea*	*atropurpurea*	*5*
W068	*Polytrichum*	*sp*	*1*	*BJ2*	*Carex*	*gynocrates*	-
W069	*Carex*	*limosa*	-	*BJ2*	*Drepanocladus*	*sp*	-
W069	*Carex*	*aquatilis*	-	*BJ2*	*Tomenthypnum*	*nitens*	-
W069	*Eriophorum*	*angustifolium*	-	*BJ5*	*Salix*	*stolonifera*	*<1*
W070	*Carex*	*aquatilis*	*20*	*BJ5*	*Salix*	*barclayi*	*<1*
W070	*Eriophorum*	*angustifolium*	*35*	*BJ5*	*Carex*	*eleocharis*	*25*
W070	*Caltha*	*leptosepala*	*5*	*BJ5*	*Equisetum*	*variegatum*	*15*
W070	*Carex*	*sp*	*5*	*BJ5*	*Poa*	*sp*	*<1*
W070	*Drepanocladus*	*uncinatus*	*5*	*BJ5*	*Vahlodea*	*atropurpurea*	*<1*
W070	*Sphagnum*	*sp*	-	*BJ5*	*Petasites*	*sp*	*<1*
W071	*Salix*	*barclayi*	*65*	*BJ5*	*Tomentella*	*nitellina*	*10*
W071	*Carex*	*aquatilis*	*30*	*BJ5*	*Barbliphozia*	*sp*	*30*
W071	*Petasites*	*sp*	*2*	*BJ5*	*Sphagnum*	*sp*	*50*
W071	*Equisetum*	*arvense*	-	BJ6	*Salix*	*stolonifera*	*8*
W071	*Senecio*	*triangularis*	*3*	BJ6	*Salix*	*barclayi*	*7*
W071	*Drepanocladus*	*uncinatus*	*30*	BJ6	*Salix*	*reticulata*	*5*
W071	*Aulacommium*	*palustre*	*5*	BJ6	*Petasites*	*sp*	*<1*
W071	*Aulacommium*	*turgidum*	*15*	BJ6	*Equisetum*	*variegatum*	*60*
W071	*Plagiomnium*	*sp*	-	BJ6	*Carex*	*limosa*	*<1*
W072	*Salix*	*barclayi*	-	BJ6	*Sanguisorba*	*officinalis*	*<1*
W072	*Carex*	*aquatilis*	*40*	BJ6	*Arnica*	*sp*	*5*
W072	*Caltha*	*leptosepala*	*5*	BJ6	*Artemisia*	*sp*	*5*
W072	*Eriophorum*	*angustifolium*	*10*	BJ6	*Bistort*	*alpine*	*2*
W072	*Carex*	*sp*	*5*	BJ6	*Aster*	*sibiricus*	*5*
W072	*Carex*	*limosa*	*5*	BJ6	*Parnassia*	*palustris*	*2*
W072	*Caltha*	*leptosepala*	*5*	BJ6	*Carex*	*albonigra*	*1*
W072	*Drepanocladus*	*uncinatus*	*30*	BJ6	*Tomenthypnum*	*nitens*	*10*
W072	*Sphagnum*	*angustifolium*	*30*	BJ6	*Moss*	*spp*	*80*
W072	*Sphagnum*	*sp*	*10*				

Appendix 3. Wetland Ecosystem Vegetation Species List

Plot	Genus	Species	%
BJ7	*Salix*	*stolonifera*	*5*
BJ7	*Empetrum*	*nigrum*	*<1*
BJ7	*Carex*	*arcta*	*30*
BJ7	*Leptarrhena*	*pyrolifolia*	*1*
BJ7	*Caltha*	*leptosepala*	*5*
BJ7	*Petasites*	*frigidus*	*2*
BJ7	*Juncus*	*drummondii*	*40*
BJ7	*Equisetum*	*variegatum*	*20*
BJ7	*Carex*	*dioica*	*10*
BJ7	*Carex*	*sp*	*<1*
BJ7	*Aster*	*sp*	*<1*
BJ7	*Antennaria*	*umbrinella*	*<1*
BJ7	*Poa*	*sp*	*<1*
BJ7	*Sphagnum*	*sp*	*5*
BJ7	*Moss*	*spp*	*70*
BJ7	*Leutkea*	*sp*	*<1*
BJ8	*Kalmia*	*microphylla*	*<1*
BJ8	*Salix*	*barclayi*	*2*
BJ8	*Valeriana*	*sp*	*<1*
BJ8	*Picea*	*sp*	*2*
BJ8	*Poa*	*sp*	*10*
BJ8	*Eriophorum*	*angustifolium*	*20*
BJ8	*Carex*	*aquatilis*	*40*
BJ8	*Viola*	*sp*	*1*
BJ8	*Valeriana*	*sitchensis*	*1*
BJ8	*Aster*	*sp*	*3*
BJ8	*Equisetum*	*arvense*	*1*
BJ8	*Platanthera*	*dilatata*	*<1*
BJ8	*Carex*	*limosa*	*2*
BJ8	*Trientalis*	*arctica*	*1*
BJ8	*Vahlodea*	*atropurpurea*	*<1*
BJ8	*Carex*	*dioica*	*4*
BJ8	*Caltha*	*leptosepala*	*<1*
BJ8	*Senecio*	*triangularis*	*-*
BJ8	*Sphagnum*	*sp*	*95*
BJ8	*Tomenthypnum*	*nitens*	*5*
BJ9	*Salix*	*barclayi*	*3*
BJ9	*Picea*	*sp*	*2*
BJ9	*Carex*	*aquatilis*	*60*
BJ9	*Trientalis*	*arctica*	*<1*
BJ9	*Platanthera*	*dilatata*	*<1*
BJ9	*Caltha*	*leptosepala*	*1*
BJ9	*Leptarrhena*	*pyrolifolia*	*<1*
BJ9	*Valeriana*	*sitchensis*	*<1*
BJ9	*Eriophorum*	*angustifolium*	*5*
BJ9	*Carex*	*limosa*	*1*
BJ9	*Vahlodea*	*atropurpurea*	*4*
BJ9	*Sphagnum*	*sp*	*100*
BJ9	*Tomenthypnum*	*nitens*	*4*
BJ10	*Salix*	*barclayi*	*-*
BJ10	*Carex*	*aquatilis*	*-*
BJ10	*Leptarrhena*	*pyrolifolia*	*-*
BJ10	*Caltha*	*leptosepala*	*-*
BJ14	*Salix*	*barclayi*	*2*
BJ10	*Eriophorum*	*angustifolium*	*-*
BJ10	*Vahlodea*	*atropurpurea*	*-*
BJ10	*Sanguisorba*	*officinalis*	*-*
BJ10	*Trientalis*	*arctica*	*-*
BJ10	*Platanthera*	*dilatata*	*-*
BJ10	*Sphagnum*	*sp*	*-*
BJ11	*Salix*	*barclayi*	*35*
BJ11	*Picea*	*sp*	*5*
BJ11	*Carex*	*aquatilis*	*85*
BJ11	*Eriophorum*	*angustifolium*	*5*
BJ11	*Leptarrhena*	*pyrolifolia*	*1*
BJ11	*Poa*	*sp*	*1*
BJ11	*Equisetum*	*arvense*	*1*
BJ11	*Sanguisorba*	*officinalis*	*1*
BJ11	*Platanthera*	*dilatata*	*<1*
BJ11	*Trientalis*	*arctica*	*1*
BJ11	*Viola*	*sp*	*<1*
BJ11	*Senecio*	*triangularis*	*<1*
BJ11	*Sphagnum*	*sp*	*50*
BJ11	*Tomenthypnum*	*nitens*	*20*
BJ11	*Drepanocladus*	*sp*	*10*
BJ12	*Salix*	*barclayi*	*10*
BJ12	*Carex*	*aquatilis*	*50*
BJ12	*Caltha*	*leptosepala*	*3*
BJ12	*Equisetum*	*arvense*	*<1*
BJ12	*Leptarrhena*	*pyrolifolia*	*1*
BJ12	*Eriophorum*	*angustifolium*	*20*
BJ12	*Viola*	*sp*	*<1*
BJ12	*Trientalis*	*arctica*	*1*
BJ12	*Platanthera*	*dilatata*	*<1*
BJ12	*Vahlodea*	*atropurpurea*	*5*
BJ12	*Sphagnum*	*sp*	*100*
BJ13	*Picea*	*sp*	*2*
BJ13	*Salix*	*barclayi*	*3*
BJ13	*Equisetum*	*arvense*	*1*
BJ13	*Carex*	*dioica*	*2*
BJ13	*Carex*	*aquatilis*	*40*
BJ13	*Caltha*	*leptosepala*	*1*
BJ13	*Leptarrhena*	*pyrolifolia*	*<1*
BJ13	*Comandra*	*pallida*	*1*
BJ13	*Trientalis*	*arctica*	*1*
BJ13	*Vahlodea*	*atropurpurea*	*<1*
BJ13	*Leutkea*	*sp*	*1*
BJ13	*Platanthera*	*dilatata*	*<1*
BJ13	*Senecio*	*triangularis*	*-*
BJ13	*Aster*	*sp*	*<1*
BJ13	*Sanguisorba*	*officinalis*	*4*
BJ13	*Poa*	*palustris*	*1*
BJ13	*Eriophorum*	*angustifolium*	*12*
BJ13	*Tomenthypnum*	*nitens*	*5*
BJ13	*Sphagnum*	*sp*	*90*
BJ13	*Polytricum*	*sp*	*2*
BJ13	*Lycopodum*	*sp*	*2*

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Plot	Genus	Species	%
BJ14	*Kalmia*	*microphylla*	*1*
BJ14	*Vaccinium*	*ovalifolium*	*<1*
BJ14	*Picea*	*sp*	*2*
BJ14	*Carex*	*limosa*	*5*
BJ14	*Eriophorum*	*angustifolium*	*60*
BJ14	*Equisetum*	*arvense*	*2*
BJ14	*Senecio*	*triangularis*	*<1*
BJ14	*Viola*	*sp*	*4*
BJ14	*Trientalis*	*arctica*	*1*
BJ14	*Platanthera*	*pyrolifolia*	*<1*
BJ14	*Leptarrhena*	*pyrolifolia*	*1*
BJ14	*Aster*	*sp*	*1*
BJ14	*Agrostis*	*sp*	*2*
BJ14	*Carex*	*aquatilis*	*5*
BJ14	*Sphagnum*	*sp*	*85*
BJ14	*Tomenthypnum*	*nitens*	*5*
BJ15	*Salix*	*barclayi*	*8*
BJ15	*Picea*	*sp*	*2*
BJ15	*Carex*	*aquatilis*	*70*
BJ15	*Platanthera*	*dilatata*	*4*
BJ15	*Poa*	*palustris*	*5*
BJ15	*Eriophorum*	*angustifolium*	*15*
BJ15	*Trientalis*	*arctica*	*<1*
BJ15	*Carex*	*limosa*	*1*
BJ15	*Caltha*	*leptosepala*	*<1*
BJ15	*Sphagnum*	*sp*	*55*
BJ15	*Drepanocladus*	*sp*	*5*
BJ15	*Comarum*	*palustre*	*-*
BJ16	*Salix*	*barclayi*	*15*
BJ16	*Carex*	*aquatilis*	*80*
BJ16	*Eriophorum*	*angustifolium*	*5*
BJ16	*Platanthera*	*dilatata*	*<1*
BJ16	*Carex*	*limosa*	*1*
BJ16	*Sanguisorba*	*officinalis*	*<1*
BJ16	*Trientalis*	*arctica*	*1*
BJ16	*Viola*	*sp*	*<1*
BJ16	*Leptarrhena*	*pyrolifolia*	*1*
BJ16	*Poa*	*sp*	*<1*
BJ16	*Equisetum*	*arvense*	*<1*
BJ16	*Kobresia*	*myosuroides*	*1*
BJ16	*Sphagnum*	*sp*	*60*
BJ17	*Salix*	*spp*	*5*
BJ17	*Carex*	*aquatilis*	*44*
BJ17	*Epilobium*	*angustifolium*	*<1*
BJ17	*Equisetum*	*angustifolium*	*<1*
BJ17	*Geum*	*macrophyllum*	*<1*
BJ17	*Calamagrostis*	*canadensis*	*<1*
BJ17	*Carex*	*rostrata*	*<1*
BJ17	*Galium*	*boreale*	*<1*
BJ18	*Rubus*	*sp*	*<1*
BJ18	*Kalmia*	*microphylla*	*<1*
BJ18	*Salix*	*barclayi*	*2*
BJ18	*Picea*	*sp*	*3*
BJ18	*Calamagrostis*	*canadensis*	*20*
BJ18	*Trientalis*	*arctica*	*1*
BJ18	*Eriophorum*	*angustifolium*	*5*
BJ18	*Viola*	*sp*	*4*
BJ18	*Agrostis*	*sp*	*-*
BJ18	*Vahlodea*	*atropurpurea*	*5*
BJ18	*Carex*	*aquatilis*	*20*
BJ18	*Comarum*	*palustre*	*<1*
BJ18	*Platanthera*	*dilatata*	*<1*
BJ18	*Carex*	*limosa*	*<1*
BJ18	*Sphagnum*	*sp*	*-*
BJ18	*Tomenthypnum*	*nitens*	*-*
BJ18	*Pleurozium*	*schreberi*	*-*

Appendix 4
Vegetation Tissue Results

Rescan™
Engineers and Scientists

RESCAN ENVIRONMENTAL SERVICES
ATTN: Wade Brunham
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 06-JUL-12
Report Date: 03-AUG-12 11:45 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1174120

Project P.O. #: NOT SUBMITTED
Job Reference: 1042-008-03
C of C Numbers:
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1174120-1	L1174120-2	L1174120-3	L1174120-4	L1174120-5
	Description	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE
	Sampled Date	21-JUN-12	21-JUN-12	21-JUN-12	22-JUN-12	22-JUN-12
	Sampled Time					
	Client ID	W005- REP 1	W005- REP 2	W005- REP 3	W009- REP 1	W009- REP 2
TISSUE						
Physical Tests	% Moisture (%)	72.5	72.6	74.6	70.5	77.0
Metals	Aluminum (Al)-Total (mg/kg)	<10	<10	<10	<10	<10
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	9.98	13.5	11.8	11.1	8.65
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Cadmium (Cd)-Total (mg/kg)	0.775	1.00	1.74	<0.030	<0.030
	Calcium (Ca)-Total (mg/kg)	1930	1810	1430	4500	8520
	Chromium (Cr)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Cobalt (Co)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)-Total (mg/kg)	19.5	21.8	14.6	0.915	0.929
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	979	876	1020	1190	1390
	Manganese (Mn)-Total (mg/kg)	235	229	159	334	306
	Mercury (Hg)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.208	0.286	0.226	0.120	0.117
	Nickel (Ni)-Total (mg/kg)	6.21	5.59	4.29	<0.50	<0.50
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Strontium (Sr)-Total (mg/kg)	14.0	12.7	10.5	22.7	38.0
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	55.9	51.9	50.5	19.3	24.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1174120-6	L1174120-7	L1174120-8	L1174120-9	L1174120-10
	Description	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE
	Sampled Date	22-JUN-12	22-JUN-12	22-JUN-12	22-JUN-12	23-JUN-12
	Sampled Time					
	Client ID	W009- REP 3	W012- REP 1	W012- REP 2	W012- REP 3	W023- REP 1
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	73.5	68.3	67.8	69.6	68.2
Metals	Aluminum (Al)-Total (mg/kg)	<10	<10	<10	<10	<10
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	0.058	0.123	<0.050	<0.050	0.255
	Barium (Ba)-Total (mg/kg)	7.84	4.81	13.2	13.7	15.1
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Cadmium (Cd)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Calcium (Ca)-Total (mg/kg)	5060	1320	1580	1420	2650
	Chromium (Cr)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Cobalt (Co)-Total (mg/kg)	<0.10	<0.10	<0.10	0.10	0.12
	Copper (Cu)-Total (mg/kg)	0.967	7.02	6.75	6.54	9.60
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1120	1080	1180	1120	1540
	Manganese (Mn)-Total (mg/kg)	336	96.7	132	183	187
	Mercury (Hg)-Total (mg/kg)	<0.0050	0.0051	0.0079	0.0051	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.166	0.826	0.491	0.615	0.205
	Nickel (Ni)-Total (mg/kg)	<0.50	1.22	1.71	1.49	1.79
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Strontium (Sr)-Total (mg/kg)	20.2	5.41	6.89	5.90	18.4
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	39.9	19.0	21.0	22.6	32.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1174120-11	L1174120-12	L1174120-13	L1174120-14	L1174120-15
	Description	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE
	Sampled Date	23-JUN-12	23-JUN-12	24-JUN-12	24-JUN-12	24-JUN-12
	Sampled Time					
	Client ID	W023- REP 2	W023- REP 3	W025- REP 1	W025- REP 2	W025- REP 3
TISSUE						
Physical Tests	% Moisture (%)	68.8	68.6	74.1	72.8	75.2
Metals	Aluminum (Al)-Total (mg/kg)	<10	<10	<10	<10	<10
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	0.114	0.062	<0.050	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	15.1	18.3	13.6	6.33	9.43
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Cadmium (Cd)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Calcium (Ca)-Total (mg/kg)	2300	3440	2240	1360	2090
	Chromium (Cr)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Cobalt (Co)-Total (mg/kg)	0.12	0.11	0.47	0.53	0.17
	Copper (Cu)-Total (mg/kg)	8.02	7.51	7.72	6.40	5.46
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1360	1340	1250	1130	1400
	Manganese (Mn)-Total (mg/kg)	157	209	472	599	293
	Mercury (Hg)-Total (mg/kg)	<0.0050	<0.0050	0.0084	<0.0050	0.0053
	Molybdenum (Mo)-Total (mg/kg)	0.265	0.188	0.499	0.099	0.163
	Nickel (Ni)-Total (mg/kg)	2.08	1.59	2.24	1.86	1.28
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Strontium (Sr)-Total (mg/kg)	16.3	24.3	21.4	11.9	18.4
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	30.2	35.5	42.0	37.7	30.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1174120-16	L1174120-17	L1174120-18	L1174120-19	L1174120-20
	Description	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE
	Sampled Date	25-JUN-12	25-JUN-12	25-JUN-12	26-JUN-12	26-JUN-12
	Sampled Time					
	Client ID	W037- REP 1	W037- REP 2	W037- REP 3	W047- REP 1	W047- REP 2
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	74.5	70.4	72.7	79.1	73.7
Metals	Aluminum (Al)-Total (mg/kg)	<10	<10	<10	<10	<10
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	0.244	0.170	0.437	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	12.4	19.0	14.0	13.1	13.8
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Cadmium (Cd)-Total (mg/kg)	<0.030	<0.030	<0.030	0.041	<0.030
	Calcium (Ca)-Total (mg/kg)	3900	5100	4180	2010	1270
	Chromium (Cr)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Cobalt (Co)-Total (mg/kg)	<0.10	<0.10	<0.10	0.36	0.63
	Copper (Cu)-Total (mg/kg)	3.05	3.00	2.94	4.24	2.66
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1440	1420	1270	1540	1370
	Manganese (Mn)-Total (mg/kg)	166	191	162	709	562
	Mercury (Hg)-Total (mg/kg)	<0.0050	<0.0050	0.0058	<0.0050	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.198	0.226	0.318	0.311	0.989
	Nickel (Ni)-Total (mg/kg)	1.02	0.62	0.79	2.65	1.04
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Strontium (Sr)-Total (mg/kg)	21.1	29.9	23.4	13.2	7.42
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	50.6	44.8	40.9	47.6	28.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1174120-21	L1174120-22	L1174120-23	L1174120-24	L1174120-25
	Description	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE
	Sampled Date	26-JUN-12	26-JUN-12	26-JUN-12	26-JUN-12	27-JUN-12
	Sampled Time					
	Client ID	W047- REP 3	W055- REP 1	W055- REP 2	W055- REP 3	W058- REP 1
TISSUE						
Physical Tests	% Moisture (%)	80.7	71.7	74.5	75.7	78.8
Metals	Aluminum (Al)-Total (mg/kg)	<10	<10	<10	<10	<10
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	11.7	10.8	12.2	4.86	23.8
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Cadmium (Cd)-Total (mg/kg)	0.038	<0.030	<0.030	<0.030	0.084
	Calcium (Ca)-Total (mg/kg)	1900	1690	1420	1180	4480
	Chromium (Cr)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Cobalt (Co)-Total (mg/kg)	0.45	<0.10	0.15	<0.10	0.16
	Copper (Cu)-Total (mg/kg)	4.39	4.23	1.57	4.77	3.09
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1360	1170	1200	1390	1890
	Manganese (Mn)-Total (mg/kg)	669	498	257	448	426
	Mercury (Hg)-Total (mg/kg)	0.0054	<0.0050	<0.0050	0.0072	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.260	<0.050	<0.050	<0.050	0.103
	Nickel (Ni)-Total (mg/kg)	2.33	1.31	0.84	1.96	1.65
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Strontium (Sr)-Total (mg/kg)	12.0	11.5	12.2	8.05	60.4
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	0.038
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	42.9	36.6	33.9	34.6	44.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1174120-26	L1174120-27	L1174120-28	L1174120-29	L1174120-30
	Description	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE	PLANT- TISSUE
	Sampled Date	27-JUN-12	27-JUN-12	27-JUN-12	27-JUN-12	27-JUN-12
	Sampled Time					
	Client ID	W058- REP 2	W058- REP 3	W060- REP 1	W060- REP 2	W060- REP 3
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	76.6	82.7	73.2	67.3	69.9
Metals	Aluminum (Al)-Total (mg/kg)	20	<10	<10	20	<10
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	0.135	0.089	0.080
	Barium (Ba)-Total (mg/kg)	12.6	7.89	10.9	4.10	21.7
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Cadmium (Cd)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	0.034
	Calcium (Ca)-Total (mg/kg)	3230	1630	3490	1910	4190
	Chromium (Cr)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Cobalt (Co)-Total (mg/kg)	0.45	0.29	0.12	<0.10	0.16
	Copper (Cu)-Total (mg/kg)	1.71	2.16	8.94	3.53	9.21
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1590	1620	1520	1200	1590
	Manganese (Mn)-Total (mg/kg)	401	187	879	232	1140
	Mercury (Hg)-Total (mg/kg)	0.0055	0.0051	<0.0050	<0.0050	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.060	<0.050	0.651	0.909	0.462
	Nickel (Ni)-Total (mg/kg)	1.36	1.70	2.72	<0.50	1.53
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Strontium (Sr)-Total (mg/kg)	41.2	19.5	23.1	9.91	29.9
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	34.9	37.5	37.6	29.6	52.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Manganese (Mn)-Total	MB-LOR	L1174120-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -26, -27, -28, -29, -3, -30, -4, -5, -6, -7, -8, -9
Method Blank	Manganese (Mn)-Total	MB-LOR	L1174120-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -26, -27, -28, -29, -3, -30, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-DRY-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

ALS Test Code	Matrix	Test Description	Method Reference**
MET-DRY-MS-VA	Tissue	Metals in Tissue by ICPMS (DRY)	EPA 200.3, EPA 6020A

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Mass Spectrometry, adapted from US EPA Method 6020A. This digestion procedure was implemented on October 5, 2009

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Rescan™

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CHAIN OF CUSTODY RECORD

PROJECT NAME: BJ WETLANDS
PROJECT #: 1042-008-03
Laboratory Contact: AMBER SPRINGER
FIELD SCIENTISTS AND/OR ENGINEERS: (Print Name and Sign) RYAN DURAND for WADE BRUNHAM
Laboratory Address: ALS BURNABY
NUMBER OF CONTAINERS:
See list
Rescan Contact: WBRUNHAM@RESCAN.COM

STATION NUMBER	DATE	TIME	COMP. SAMPLE	GRAB SAMPLE	SAMPLE IDENTIFICATION (DEPTH, REPLICATE)	NUMBER OF CONTAINERS						
1 W005	6/21/2012				Plant x3		↓					
2 W009	6/22/2012				x3							
3 W012	6/22/2012				x3							
4 W023	6/23/2012				x3							L1174120
5 W025	6/24/2012				x3							
6 W037	6/25/2012				x3							
7 W047	6/26/2012				x3							
8 W055	6/26/2012				x2							
9 W058	6/27/2012				x3							
10 W060	6/27/2012				x2							
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												

Short Holding Time
Rush Processing

L1174120-COFC

Received by:	Date/Time	Relinquished by:	Date/Time	
Company:	D / M / Y	Company:	D / M / Y	Routine Analysis: ☑ Rush Analysis: ☐
Name: (Print and Sign)	/ /	Name: (Print and Sign)	/ /	Remarks: **COURIER COPY**
Received by:	**Date/Time**	**Received for Laboratory by:**	**Date/Time**	
Company:	D / M / Y	Company:	D / M / Y	
Name: (Print and Sign)	/ /	Name: Brittany (Print and Sign) 17.7°C	6 July 10:20	Page 1 of 1