Terrestrial Wildlife and Vegetation Effects Assessment

2012

Part 1: Vegetation and Ecological Communities

Front Page
Photograph: Drummond's Thistle (*Cirsium drummondii*)
Source: C. Bjork, July 19, 2008

Recommended Citation:

Hilton, S., L. Andrusiak, R. Krichbaum, L. Simpson, and C. Bjork. 2013. Part 1 Vegetation and Ecological Communities. Terrestrial Vegetation and Wildlife Report. Site C Clean Energy Project. Report to BC Hydro, Vancouver, BC.

Preface

This Technical Data Report summarizes the results of the Terrestrial Vegetation and Wildlife baseline studies conducted for the Site C Clean Energy Project (Project) between 2005 and 2012. The purpose of the terrestrial vegetation and wildlife baseline studies was to identify and collect site specific data on the occurrence, abundance, and habitat of key vegetation and wildlife indicators. These data were used to analyse the potential effects of the project on vegetation and wildlife as described in the **Section 13 Vegetation** and **Section 14 Wildlife** of the EIS.

Scope

The Project design was advanced and the understanding of potential effects changed during the eight years of data collection. Adjustments to baseline surveys and target species were made in response to these changes. A brief summary of the baseline data collection program is provided below to aid understanding of this report. Surveys were conducted based on Resource Inventory Standard Committee methodologies where available.

Initial baseline data collection in 2005 encompassed a technical study area defined as a four kilometre corridor centered on the Peace River between Hudson's Hope and the Alberta border. An issues scoping identified the need for additional data on the occurrence and habitat use of: raptor and heron nests, amphibians, owls, breeding birds, butterflies, waterfowl and water associated birds, bats, ungulates, vascular plants, and rare ecosystems. Within these species groups, species at risk and species of management concern became the focus of data collection efforts. These species groups were also identified as potential key indicators for a future effects assessment.

In 2006, a transmission line right-of-way (TL) between the proposed dam site and the Peace Canyon dam substation was added to the Project and the technical study area. The boundary for data collection was selected to be 500 metres on either side of the TL. Terrestrial Ecosystem Mapping of habitats within the TL and technical study areas was also completed. Baseline studies continued to be focused on key indicators identified in 2005.

Surveys in 2008 focused on addressing identified data gaps and reconnaissance surveys for dragonflies were added to the study program. Technical Advisory Committee meetings were held with Regulators and First Nations to initiate conversation regarding the Project and potential impacts to vegetation and wildlife and to further guide collection of the baseline data.

The committee recommended that additional species-specific surveys be conducted on rare plants and bird species of provincial and federal conservation concern. An additional recommendation was for surveys to be conducted in the broader region outside of the technical study area.

The survey programs of 2009 and 2010 initiated species-specific surveys on swallows, select raptors, Common Nighthawk, marsh birds, non-migratory game birds, and furbearers as recommended by the Technical Advisory Committee. The survey area was expanded to collect baseline data in the region outside the Peace River Valley to allow for comparisons between species occurrence and habitat use within and outside the Project activity zone.

A two-year study was launched in 2010 to gather detailed data on moose, elk and mule-deer populations, movement patterns, and habitat use in the Peace River Valley. Studies of the fisher population were initiated in 2011 and two years of data collection were completed within the Peace River Valley and adjacent areas. In 2011, additional baseline surveys were initiated at quarry sites that were added to the Project.

In the final year of baseline surveys (2012), habitat mapping at quarry sites and surveys of birds on migration were completed. Valued Components and key indicators that would be used to assess potential effects of the Project were also finalized in 2012. Two valued components were selected: Vegetation and Ecological Communities and Wildlife Resources; under each component key indicators were defined.

Approach

A considerable amount of information has been collected and analyzed in the past eight years. This Technical Data Report has been structured to present a standardized summary of the baseline data, methods, results, and effects assessment. Some methodologies and study areas for key indicators changed over the duration of the survey program in response to changes in the Project layout, data collection standards, and shifts in objectives. The full report is divided into seven different Parts with each Part focusing on one key indicator group. Baseline data on Vegetation and Ecological Communities including habitat mapping are presented in **Part 1** of the Technical Data Report. Data on Wildlife Resources have been divided over six parts representing five species groups as follows: **Part 2 Butterflies and Dragonflies, Part 3 Amphibians and Reptiles**, **Part 4 Migratory Birds**, **Part 5 Non-migratory Game Birds**, **Part 6 Raptors**, and **Part 7 Mammals**.

Within each Part, the reporting structure is as follows:

- Introduction of the key indicator species within the group
- A review of historical data prior to the onset of the Project baseline
- A description of the methods used to collect the data
- Summary of results
- Potential effects of the Project which includes a quantification of the potential habitat losses
- Recommended mitigation measures
- Residual effects characterization

Following the requirements of the Project EIS Guidelines, an assessment of the significance of residual effects, an assessment of cumulative effects, and recommendations for follow-up programs are presented in the Site C Clean Energy Environmental Impact Statement supported by data presented in this report.

Quantification of habitat loss for key indicators was achieved through the development and application of species models, which are presented in each relevant Part. Models were developed for individual key indicators or species groups. Species models summarise life history requirements and habitat uses and assign ratings for each unique habitat mapped in the Project area. Habitat loss was derived from comparisons of the amount of suitable habitat within and without the Project.

A number of preliminary reports regarding baseline findings have been submitted previously to BC Hydro. Some of the information provided in these reports has been updated within this report with additional information and analysis. Where any differences appear, the information presented in the Technical Data Report supersedes any previous submissions.

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Abbreviations and Acronyms

BC .... British Columbia
BEC .... Biogeoclimatic Ecosystems Classification
BWBSmw1 .... Peace Moist, Warm Boreal White and Black Spruce
BWBSwk1 .... Murray wet, cool Boreal White and Black Spruce
CDC .... Conservation Data Centre
ESSFmv2 .... Bullmoose Moist, Very Cold Engelmann Spruce-subalpine Fir
GIFs .... Ground Inspection Forms
GIS .... Geographic Information Systems
GPS .... Global Positioning System
HAF .... Hart Foothills Ecosection
LAA .... Local Assessment Area
NHR .... Northern Hart Ranges Ecosection
OGMAs .... Old-Growth Management Areas
PAZ .... Project Activity Zone
PEL .... Peace Lowlands Ecosection
PEM .... Predictive Ecosystem Mapping
Project .... Site C Clean Energy Project
SARA .... Species at Risk Act
SBSwk2 .... Finlay-Peace Wet, Cool Sub-boreal Spruce
TEM .... Terrestrial Ecosystem Mapping
TFL .... Tree Farm License
TL .... Transmission Line Right-of-Way
TRIM .... Terrain Resource Information System
VRI .... Vegetation Resources Inventory

Acknowledgements

- 2008 rare plant survey coordination and herbarium review by Curtis Bjork
- 2011 and 2012 rare plant fieldwork and rare plant effects assessment completed by Randy Krichbaum (Eagle Cap Consulting Ltd.)
- Ecosystem Mapping completed by Lorraine Andruisak, Kyle Simpson, and Polly Unnila (Polar Geoscience Ltd.)

1 BASELINE CONDITIONS

1.1 Ecosystem Mapping

British Columbia (BC) has a large and diverse landscape with varied topography and associated climates. The movement of large tectonic plates has created mountain ranges and interior plateaus that dominate the provincial landscape. This topography interacts with prevailing winds—i.e., southward-moving arctic air with northward-moving moist tropical air—to create a series of wet and dry regions. Each of these regions supports vegetation and wildlife communities that may be unique to only that particular area.

Recognizing the diverse habitats that occur, the provincial government developed a system to classify the province's landbase. The ecoregion classification system was first introduced in 1985 and has been updated several times. The most current version is the 2011 third edition (Demarchi 2011). The system classifies the province's landbase at five levels:

- **Ecodomains**: areas with very broad uniform climate characteristics
- **Ecodivisions**: areas with very broad uniform climate and physiographic characteristics
- **Ecoprovinces**: areas mapped at a provincial scale with similar landforms and regular climate processes
- **Ecoregions**: areas mapped at a regional scale that show major physiographic variation and minor macroclimate variation
- **Ecosections**: areas mapped at a sub-regional level that show minor physiographic and microclimate variation

Complimentary to the ecoregion classification system is the Biogeoclimatic Ecosystems Classification (BEC) program developed by the BC Ministry of Forests, which delineates ecological zones at the landscape scale. Each of the zones can be further divided into ecosystem units that have distinct vegetation, soils, and climate characteristics and can be used to provide an indication of the vegetation communities and associated wildlife populations that may be present.

The Peace River—from Hudson's Hope to the Alberta border—lies within the Peace River Basin Ecoregion, one of the three ecoregions that make up the Boreal Plains Ecoprovince. The Peace Lowland Ecosection is the only ecosection occurring within the Peace River Basin; most of the Site C Clean Energy Project (the Project) is situated within this ecosection. Much of the area is quite flat with plateaus, rolling plains, and lowlands. Elevations range from a low of 427 metres on the Peace River at the BC and Alberta border up to 975 metres north of Moberly Lake and along a portion of its boundary with the Kiskatinaw Plateau Ecosection (Demarchi 2011). The

Peace Lowland Ecosection has the mildest climate and lowest snowfall within the ecoprovince, likely due to its relatively lower elevation (Demarchi 2011).

The Peace Lowland Ecosection is underlain by a succession of Cretaceous shales and sandstones that have been tilted gently to the northeast, east, and southeast (Farstad et al. 1965). It was heavily glaciated during the Wisconsin time period—12,000 to 110,000 years ago—resulting in deposits of till in a pattern of parallel grooves and ridges (drumlins). A large glacial lake formed as the glaciers receded and deposited another layer of silt (Demarchi 2011).

The Peace Lowland Ecosection is somewhat poorly drained with large areas of muskeg and small streams meandering across the plateaus. Several larger rivers—including the Peace, Halfway, Moberly, Pine, Beatton, and Kiskatinaw—have cut through the till and bedrock layers to form deeply incised valleys with discontinuous benches covered with a mantle of fluviatile debris. Smaller tributary streams have incised similar valleys with smaller benches veneered—less than two metres in depth—with thinner sediment mantles. Some small or intermittent streams draining onto gentle slopes on either the former lake bottom or benches have deposited fans of poorly-sorted sediment.

Most of the West Pine proposed quarry site lies within the Hart Foothills Ecosection. This ecosection is characterized by low, rounded mountains and wide valleys on the east side of the Hart Ranges of the Rocky Mountains (Demarchi 2011). The Moberly, Pine, Sukunka, Wolverine, and Murray rivers flow through this ecosection and drain into the Peace River.

A small portion of the local assessment area (LAA) lies within the Halfway Plateau Ecosection, a rolling upland drained by the Halfway River and Cache Creek (Demarchi 2011). Charlie Lake is the only large lake within the ecosection. Another small portion of the LAA is within the Peace Foothills Ecosection. The Peace Foothills is located on the side of the Rocky Mountains and is divided by Williston Reservoir. It is an area of rounded blocky mountains with a strong rain shadow (Demarchi 2011).

The Peace River Valley lies within the Peace moist, warm Boreal White and Black Spruce subzone variant (BWBSmw1) (DeLong et al. 1990). Trembling aspen (*Populus tremuloides*) is the dominant tree cover in large areas due to past history of frequent fires and recent anthropogenic disturbance. White spruce (*Picea glauca*) is present on moist to wetter sites where there has been limited fire history. Lodgepole pine (*Pinus contorta*) occurs as a seral species on drier and poorer sites. Balsam poplar (*Populus balsamifera* ssp.) grows on wetter depressional sites and riparian floodplains. Black spruce (*Picea mariana*) forests—often with a minor component of tamarack (*Larix laricina*)—is present on organic soils. The upland forest has an estimated natural disturbance interval of 100 years with fire as the major agent of disturbance (DeLong 2011). Alluvial forests on major rivers are also disturbed by flooding. The natural disturbance interval of flooding in the region is judged to be about 200 years (DeLong 2011).

Other subzone variants present in the LAA include the Murray wet, cool Boreal White and Black Spruce (BWBSwk1), the Finlay-Peace wet, cool Sub-boreal Spruce (SBSwk2), and the Bullmoose moist, very cold Engelmann spruce-subalpine fir (ESSFmv2). The BWBSwk1 has a slightly wetter and cooler climate than the BWBSmw1. White and black spruces are the dominant conifers but lodgepole pine and aspen form large expanses of seral forest after disturbance.

Tree species in the SBSwk2 are similar to those in the BWBSmw1. Oak fern (*Gymnocarpium dryopteris*) is common on mesic sites. The moss layer is generally well-developed and consists primarily of red-stemmed feathermoss (*Pleurozium schreberi*) and knight's plume (*Ptilium crista-castrensis*). The ESSFmv2 occurs above the SBSwk2 (DeLong et al. 1994). Forests are dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) with minor amounts of lodgepole pine and black spruce. White-flowered rhododendron (*Rhododendron albiflorum*) and black huckleberry (*Vaccinium membranaceum*) are the dominant shrubs.

The major settlements adjacent to the Peace River are the cities of Fort St. John and Taylor and the town of Hudson's Hope. Smaller communities are also present—mostly along Highway 29, which runs from east to west along the north bank of the river. Agriculture—both field crops and livestock—is a major influence and much of the original lowland habitat along the river has been converted to agricultural crops (DeLong et al. 1990). Most of the agricultural activity takes place on extensive areas of private, BC Hydro, or Crown-leased land on the north bank of the river. Agricultural activity on the south bank is minimal due to road access limitations, although extensive areas on the south bank are within the Agricultural Land Reserve (BC Hydro and Power Authority 1991).

Additional human uses adjacent to the Peace River include industrial activities such as oil and gas extraction and exploration, timber harvest, hydroelectric power generation, and transportation by railway and road. Trapping and hunting occur in most areas and the Peace River itself is used for recreational boating and fishing.

The Peace River area has long been occupied by Aboriginal peoples. The Athapaskans—Beaver and Sekanni—were the original groups to settle the area, with the Algonkian Crees arriving from further east shortly before the Europeans landed (Benke and Cushing 2005). Hunting, fishing, trapping, and gathering are activities done by many members of the various communities (Candler 2012; Bouchard and Kennedy 2011; Bouchard and Kennedy 2012a; Bouchard and Kennedy 2012b; Nesoo Watchie Resource Management Ltd 2011).

The Aboriginal people of the Peace River Valley gather a wide variety of plants as a food source. Saskatoon berries (*Amelanchier alnifolia*), blueberries and huckleberries (*Vaccinium* spp.), cranberries (*Viburnum edule*), raspberries (*Rubus idaeus*), gooseberries (*Ribes* spp.), and choke cherries (*Prunus virginiana*) are all gathered (Candler 2012; Bouchard and Kennedy 2011; Bouchard and Kennedy 2012a; Bouchard and Kennedy 2012b; Nesoo Watchie Resource Management Ltd 2011). Other plant species—such as cow parsnip (*Heracleum maximum*) and Labrador tea (*Ledum groenlandicum*)—are used in traditional medicines (Nesoo Watchie Resource Management Ltd 2011); poplar (*Populus* spp.) is commonly used in structural applications such as the construction of tipis and meat drying racks (Bouchard and Kennedy 2011).

Geological, climate, and anthropogenic processes have all shaped the current ecological habitats and associated seral stages found along the Peace River. Habitat mapping—e.g., Terrestrial Ecosystem Mapping (TEM) and Predictive Ecosystem Mapping (PEM)—can be used to provide quantitative information about the physical and vegetation characteristics of the area of interest and the potential impacts of proposed Project activities. In addition, the mapped areas can be themed to depict habitat suitability for a number of wildlife species.

1.1.1 Methods

Habitat mapping prepared for the assessment of the Project uses TEM as well as broad habitat mapping, which was formed from a combination of PEM and upgrades to existing biophysical mapping (Lea and Lacelle 1989; Thompson et al. 1980). The TEM was prepared for the assessment of the Project where the locations of large Project activity zone (PAZ) are well defined. This includes the dam site, reservoir, transmission line, and some quarry sites.

PAZ for a number of proposed roads and ancillary sites have had minor design adjustments in the past year and will likely continue to be adjusted until the final design is complete. Therefore, broad habitat mapping was prepared from existing biophysical mapping and was upgraded and merged with PEM to provide habitat information for PAZ that undergo numerous revisions. The methods to produce the TEM and the broad habitat mapping are described below.

1.1.1.1 Terrestrial Ecosystem Mapping

The TEM has two components, bioterrain and ecosystems. Bioterrain characteristics include parent materials, terrain expression—e.g., gullying—and drainage. Ecosystems are defined as sites with distinct vegetation communities and physical characteristics such as slope, aspect, and moisture. Polygon boundaries are drawn on aerial imagery around areas with distinct bioterrain and ecosystem types**.** Each polygon is labelled with a number; the ecosystem and bioterrain information for that polygon is stored in a database. The polygon linework is digitized so it can be analyzed spatially using Geographic Information Systems (GIS) software.

The TEM boundary includes the Peace River, the proposed transmission line, and several ancillary sites (**Map 1**). The mapping extends from Hudson's Hope to the Alberta border, encompassing much of the Peace River valley including the river—floodplain and the ascending slopes—extending approximately two kilometres on either side of the river's centre. Three of the larger drainages—Cache Creek, Halfway River and Moberly River—were also mapped for up to 10 kilometres of their length beginning at their confluence with the Peace River. The proposed transmission line was mapped within a 500-metre buffer on either side of the transmission line centreline. Ancillary sites totalling 4,347 hectares were added to the mapping project in 2012 and consisted of additional uplands south of the proposed dam site, additional coverage in the Cache, Halfway, Moberly and Farrell drainages, and the West Pine quarry site, located on the Pine River.

An initial review of existing studies was done to assemble background information. Existing 1:50,000 biophysical mapping for the regional area (Lea and Lacelle 1989; Thompson et al. 1980) was obtained and reviewed. Efforts were made to obtain plot data from the existing biophysical mapping projects, but only small portions of that data could be located. Soils mapping was also obtained (Farstad et al. 1965).

The delineation of polygons began on hardcopy aerial photographs (1987, 1988, 1997, 2002) (see **Appendix A** for a complete list of photos). The study area was expanded in 2011 to accommodate revised PAZ and the additional mapping was completed on 2011 digital photos using three-dimensional mapping software (PurVIEW). Provincial forest cover mapping and Vegetation Resources Inventory (VRI) mapping at 1:20,000 were used to provide tree cover and disturbance history. Aerial photographs were viewed in stereo by a qualified bioterrain mapper who delineated polygons corresponding to bioterrain characteristics. The photos were then viewed by qualified ecosystem mappers who subdivided the bioterrain polygons into smaller polygons according to the characteristics of the ecosystems within them. Bioterrain and ecosystem data for each polygon were entered into a standard TEM map database.

The TEM was produced at 1:20,000 scale following methodology described in *Terrain Classification System for British Columbia* (Howes and Kenk 1997), *Guidelines and Standards for Terrain Mapping in British Columbia* (Resources Inventory Committee 1996), and *Standard for Terrestrial Ecosystem Mapping in British Columbia* (Resources Inventory Committee 1998). During the course of the mapping project the province instituted a number of changes to the provincial ecosystem classification of the BWBS, including a new field guide released in 2011. For consistency, all the TEM followed the regional field guide for the BWBSmw1 (DeLong et al. 1990) and the draft seral guide (BC Ministry of Forests 2002) as only these were available when most of the TEM was drafted[1]. In early 2006—after preliminary mapping and the first session of field truthing—four additional ecosystem units were released by the provincial government for the BWBSmw1: 09, 10, 11, and Wf02. These new units were incorporated into the mapping where appropriate. The new 10 site series—Wb06—was mapped as Tamarck Sedge (TS) as defined in DeLong (1990).

The bioterrain mapping component identified 13 different types of surficial materials within the mapped area. A description of each type of material is provided below, following definitions in Howes and Kenk (1997).

- **Anthropogenic** (A) - Artificial materials or geological materials so modified by human activity that their original physical properties—e.g., structure, cohesion, consolidation—have been drastically altered. Anthropogenic materials were rarely mapped.
- **Colluvium** (C) - Materials that have reached their present positions as a result of direct, gravity-induced movement not involving an agent of transportation such as water or ice, although the moving material may have contained water or ice. Colluvium was frequently mapped on the steep valley sides. Moderate slopes and hummocks were the most frequently mapped surface expressions. Slow mass movement was the most common geomorphological process and drainage was usually rapid to well.

[1] Most of the TEM fieldwork was completed in 2006 with additional TEM sampling at some of the ancillary sites in 2012.

- **Weathered Bedrock** (D) – Weathered bedrock has been modified in situ by mechanical and chemical weathering. In the study area, weathered bedrock is found as a discontinuous very thin veneer (Dx) overlying gently sloping or undulating bedrock outcrops. It typically contains a high proportion of angular coarse fragments with varying amounts of interstitial silty sand. It is non-cohesive and rapidly to very rapidly drained.
- **Eolian** (E) – Eolian sediments were transported and deposited by wind. They typically occur as a thin cap (Ev) over other materials but may locally thicken into a blanket or dune. These deposits typically consist of silt and fine sand and often form the Ah horizon in Chernozemic soils.
- **Fluvial** (F) - Materials transported and deposited by streams and rivers—synonymous with alluvial. Fluvial materials were the most common mapped surficial materials. Plains and terraces were the most commonly mapped surface expressions. Anastomosing channelling—the reconnection of two streams that previously branched out—was the most common geomorphological process and drainage was usually moderately well to imperfect.
- **Glaciofluvial** (FG) - Materials that exhibit clear evidence of having been deposited by glacial meltwater streams either directly in front of or in contact with glacier ice. Glaciofluvial materials were mapped less often than glaciolacustrine materials. Plain and undulating surface expressions were most commonly mapped. Gullying and meltwater channelling were the most common geomorphological processes and drainage was generally moderate to well.
- **Lacustrine** (L) - Sediments that have settled from suspension and underwater gravity flows—such as turbidity currents—in bodies of standing fresh water or sediments that have accumulated at their margins through the action of waves. Veneers were the most commonly mapped surface expression. Meandering channelling was the most common geomorphological process and drainage was most often imperfect.
- **Glaciolacustrine** (LG) - Lacustrine materials deposited in or along the margins of glacial lakes. Includes sediments that were released by the melting of floating ice. Glaciolacustrine materials were frequently mapped. Plains and blankets were the most commonly mapped surface expression. Irregularly sinuous channeling was the most common geomorphological process and drainage was usually moderately well.
- **Morainal** (M) - Material deposited directly by glacier ice without modification by any other agent of transportation. Gentle slopes and blankets were the most commonly mapped

surface expression. Gully erosion was the most common geomorphological process, and morainal materials were typically well-drained.

- **Organic** (O) – Sediments composed largely of organic materials resulting from the accumulation of vegetative matter. They contain at least 30% organic matter by weight—17% or more organic carbon. Organic materials were mapped in association with wetlands and low-gradient watercourses. Blankets and veneers were the most commonly mapped surface expressions. Surface seepage was the most common geomorphological process and drainage was usually poor.
- **Rock** (R) – Bedrock outcrops and rock covered by a thin mantle—up to 10 centimeres thick—of unconsolidated or organic materials. Rock was rarely mapped and slow mass movement was the most common geomorphological process.
- **Undifferentiated** (U) – A layered sequence of more than three types of surficial material outcropping on a steep, erosional (scarp) slope. Undifferentiated materials generally were found with moderately steep surface expression. Gullying and slow mass movement were the most common geomorphological processes and drainage typically well to moderate.
- **Volcanic** (V) - Unconsolidated sediments of volcanic origin. Volcanic materials were rarely mapped and were most often found on moderate slope surface expression. Slow mass movement was the only geomorphological process mapped and polygons were generally well-drained.

In total, 7,242 ecosystem polygons were mapped. This included a number of new or non-correlated ecosystem units (**Table 1.1.1**). Generic wetland units were used as several wetland ecosystem units differing in their dominant sedge species proved to be too difficult to distinguish on air photos. Plot data for the new or non-correlated units were provided to Regional Ecologist Craig DeLong for review. This review and subsequent discussions resulted in the final list of units in **Table 1.1.1** in addition to the standard ecosystem units described in the field guides.

Table 1.1.1 New and non-correlated map units used

Site Series	Map Code	Name
00	AS	Sw-At-Soopolallie
$07, $05	SH: ep, SC: ep	Ep-Red-osier Dogwood seral association
09	Fm02	ActSw - Red-osier Dogwood – floodplain
00	SE	Sedge Wetland
10	TS	Tamarack - Sedge Fen
00	WH	Willow - Horsetail - Sedge - Riparian Wetland
00	WS	Willow-Sedge Wetland
00	WW	Wolf willow-Fuzzy-spiked Wildrye

While occurrences of a given site series unit have the same vegetation potential for supporting specific climax vegetation communities, actual site conditions can vary considerably. Site modifiers were used to indicate ecosystems occurring in environmental conditions that are not typical for that ecosystem unit. Site modifiers identify particular topography, moisture, and soil conditions present within the polygon. Up to two site modifiers can be used in a polygon map label. Site modifiers used in the TEM are listed below (**Table 1.1.2**).

Table 1.1.2 Mapped site modifiers

Modifier	Definition
a	occurring on active floodplain
b	occurring on gravel bars
c	coarse-textured soils
d	deep soils
f	fine-textured soils
g	gullying occurring, or in a gully bottom
h	hummocky terrain
j	gentle to moderate slope, <25% slope
k	cool aspect (285-135 deg.), 25-100% slope
m	medium-textured soils
n	fan or cone
p	peaty material at the surface
q	very steep (>100% slope) cool aspect (285-135 deg.)
r	ridge
s	shallow soils (20-100 cm to bedrock)
t	terrace
v	very shallow soils (<20 cm to bedrock)
w	warm aspect slope (135 to 285 deg.; slope 25-100%)
y	moister than average
z	Very steep (>100% slope) warm aspect (135-285 deg.)

One new project-specific modifier—b—was defined for the project and approved by TEM correlator Corey Erwin, Victoria. The b modifier was used to identify sites where the 09 floodplain ecosystem occurred as sparse to dense balsam poplar regenerating on river gravel bars (**Photograph 1.1.1**). Those sites had a very sparse herb layer and are subject to frequent disturbance by floodwaters.

Photograph 1.1.1 Gravel bars revegetating with balsam poplar

The vegetation conditions within each polygon will vary considerably depending on the forest age, species composition, and history of disturbance. Human activities such as agriculture, timber harvest, and oil and gas development are extensive. Seismic lines are prominent features of the landscape when viewed from the air, as are gas wells and their associated infrastructure. Active timber harvest is ongoing with mapped polygons continuously being converted from older forests to younger forests. Although no large fires occurred during field sampling, the landscape around the Peace River is greatly influenced by periodic fires. Fire return interval and fire history greatly affect the ecosystems that will develop in any particular area. As such, there is a complex array of early through late seral and even climax vegetation communities. Structural stage and seral unit definitions were used to describe the current state of map polygons.

Structural stages describe the existing dominant stand appearance or physiognomy for the ecosystem unit (Resources Inventory Committee 1998). Standard TEM structural stage definitions were used to describe seral stages of mapped ecosystems (**Table 1.1.3**).

Table 1.1.3 Sturctural stage definitions

Structural Stage	Definition
1	**Sparse/bryoid**: less than 20 years since major disturbance unless disclimax ecosystem
1a	**Sparse**: less than 10% vegetation cover
1b	**Bryoid**: bryophyte and lichen-dominated communities—greater than 50% of total vegetation cover
2	**Herb**: less than 20-years-old unless disclimax
2a	**Forb-dominated**: dominated by non-graminoid herbs
2b	**Graminoid-dominated**: dominated by grasses, sedges, reeds, and rushes
2d	**Dwarf Shrub**: dominated by dwarf woody species
3	**Shrub**: shrubs less than 10 metres tall, less than 20-years-old for forested sites
3a	**Low Shrub**: shrubs less than two metres tall
3b	**Tall Shrub**: shrubs two to 10 metres tall
4	**Pole /Sapling**: trees greater than 10 metres tall, usually less than 40-years-old
5	**Young Forest**: trees greater than 10 metres tall, 40- to 80-years-old
6	**Mature Forest**: trees greater than 10 metres tall, 80- to 140-years-old
7	**Old Forest**: trees greater than 10 metres tall, greater than 140-years-old

Source: modified from (Resources Inventory Committee 1998)

Seral ecosystems describe present vegetation where the plant association is not in a climax or near-climax state (Resources Inventory Committee 1998). Seral associations have been described in the draft seral field guide for the BWBSmw1 (BC Ministry of Forests 2002)[2]. Seral associations are normally dominated by aspen with balsam poplar as the dominant in the SH (07). There is no set rule for distinguishing between seral versus nonseral ecosystems. Instead the distinction is based on a combination of the percentage of coniferous versus deciduous tree cover and the degree of development of the moss layer. Seral sites within the Peace River valley typically have a poorly developed moss layer and less than 20% coniferous tree cover.

[2] The seral association for the 06 site series has b**een mapped as the 01 due to difficulty in distinguishing the two, which have the same vegetation list in the** draft seral field guide and also overlap in slopes, slope positions and soil textures (BC Ministry of Forests 2002).

In addition to the regular 2-letter uppercase site series code, seral associations are identified in the mapping with a two-letter lowercase seral association code. According to the provincial mapcodes list the seral association for the 05 site series is mapped with the 06 ecosystem code, while the regular ecosystem codes for the BWBSmw1 05 and 06 site series are SO and SC, respectively.

A new seral association of the 07 and 05 was defined for this project in consultation with Regional Ecologist Craig DeLong. The new association—: ep—was created to identify gently sloping or cool aspect sites dominated by paper birch (*Betula papyrifera*).

Field sampling was conducted following methodology described in the *Field Manual for Describing Terrestrial Ecosystems* (BC Ministry of Environment, Lands and Parks and BC Ministry of Forests 1998). Additional plots were done in conjunction with other wildlife and vegetation studies. Plots from the BC Ministry of Forests data archives were also obtained where available and used for the mapping. The survey intensity target level was 4: 15 to 25% of polygons inspected.

It was noted during field sampling that the ecosystem units of the BWBSmw1 as described in the provincial site guides (DeLong et al. 1990; BC Ministry of Forests 2002) did not correspond well to the ecosystems found in the Peace River Valley. Regionally most of the BWBSmw1 is gently sloped terrain and the ecosystems found in the steep incised valleys and gullies of the Peace River corridor differ from the ecosystems in more typical BWBSmw1. The Peace River itself has an enormous influence on the ecosystems that develop within its flood zone. The presence and location of gravel bars and floodplain communities is dependent on frequency, duration, timing, and intensity of flooding; the recent flood history determines structural stage in the riparian forests (Benjankar et al. 2011).

The Peace Canyon dam has changed the river's normal flood regime and ecosystems along the river banks are undergoing successional changes that would not normally occur in an unregulated system (Benke and Cushing 2005). It is unclear how succession could progress over time as it is dependent on the flow management regime of the Peace Canyon dam. Future changes in water use may result in additional changes to the successional processes along the Peace River.

A number of the indicator plant species described in the field guide to distinguish different site series were either present within the majority of ecosystems of the valley or else missing altogether, making it difficult to identify the site series in the field. In other cases, there was a good deal of overlap in characteristics between site series adjacent on the edatopic grid and some units were defined as having a broad range of characteristics—e.g., the 04 unit could be submesic to hygric. A summary of some of the issues and solutions adopted are described below:

- Some plant species listed as indicator species in either the seral guide or the nonseral regional field guide are rare or absent in the study area. These include tall bluebells (*Mertensiana paniculata*), cow-parsnip (*Heracleum maximum*), oak fern, velvet-leaved blueberry (*Vaccinium myrtilloides*), devil's club (*Oplopanax horridus*), tall larkspur (*Delphinium glaucum*), and western mountain-ash (*Sorbus scopulina*). A project-specific list of indicator species was developed to assist in field classification
- The BWBSmw1 regional field guide key (DeLong et al. 1990) suggested using western mountain-ash and oak fern to distinguish between the 05 and 06 units but this was problematic in the study area where oak fern was very rare and western mountain-ash was not found at all. Other plant species—such as paper birch—were used instead.
- The WW non-correlated grassland ecosystem unit was listed in the provincial mapcodes list as Fuzzy-spiked Wildrye-Coyote willow. Coyote or sandbar willow (*Salix exigua*) is a species found in moist floodplain habitats, not the steep dry warm aspects where the WW ecosystem occurs. One of the more common shrubs in the WW unit is the wolf-willow or silverberry (*Elaeagnus commutata*). The ecosystem name for the WW was revised to include wolf-willow rather than coyote willow.
- The nonseral ecosystems of the corridor study area seemed to generally have a considerably sparser moss layer than described in the regional field guide.
- The 04 and 08 ecosystem units were described as common in the regional field guide but were rarely mapped or found within the Peace River Valley. They were mapped much more frequently on the upland plateau along the transmission line. Conversely, the 07 ecosystem unit was listed as uncommon in the field guide but was found extensively on the lower slopes and river terraces of the valley. Upland habitats make up most of the BWBWmw1; the ecosystems as described in the regional field guide may not closely match the ecosystems in the Peace River Valley.

A working legend and draft toposequence diagrams—diagrams showing ecosystem classification by slope, aspect, and slope position—were revised several times in the field. Post-field review of the plots and revisions to the working legend and site descriptions were required.

Field data were entered digitally using standard government software (VENUS, GRAVITI). The bioterrain and ecosystem information in the map database and the map linework were edited based upon the field data and upon the results of initial quality assurance (QA) reviews.

Quality control was completed by third party ecology and bioterrain specialists and through in-house QA routines. The QA contractors reviewed air photos, field plot data, expanded legend, working legend, and draft ecosystem maps. In-house quality assurance included cross-checking plot Universal Transverse Mercator (UTM) locations with digital map data to ensure plots were located in the correct polygons, ensuring plant species name codes were consistent with the most recent codes as listed in VENUS 5, using VENUS validation tools to identify errors, and using the provincial government's quality control software DC Tools to locate errors in the map database. Quality assurance of digital data followed *Standard for Terrestrial Ecosystem Mapping (TEM) – Digital Data Capture in British Columbia* (Resources Inventory Committee 2000), *Quality Assurance Guidelines: Terrestrial Ecosystem Mapping – Digital Data Capture (TEM-DDC) Review Draft* (Erwin and Filatow 2003) and *Standard for Digital Terrain Data Capture in British Columbia* (BC Ministry of Environment 2007).

The final TEM map was produced in ARCINFO export format. A seamless coverage of the entire TEM-mapped area was produced with one polygon .e00 coverage for ecosystems and one corresponding database for ecosystem units including all core attributes. A point coverage containing plot locations was created. The plot points were linked to the VENUS database with feature codes and unique identifiers linking point data to the attribute data base. The total TEM project area includes portions of 31 TRIM map sheets.

Final map linework includes ecosection, variant, bioterrain and ecosystem unit. An expanded legend providing detailed descriptions of mapped ecosystem units (**Appendix A**) and a bioterrain legend (**Appendix B**) were prepared. A list of the ecosystem units mapped in the TEM is provided in **Table 1.1.4**.

Table 1.1.4 Mapped ecosystem units

BEC Variant	Map Code	Site Series	Ecosystem Name[a]
BWBSmw1	AM	01	SwAt - Step moss
	AM: ap	$01	$At - Creamy peavine
	AMy: ap	$01	$At - Creamy peavine, moist
	AMk: ap	$01	$At - Creamy peavine, cool aspect
	AMw: ap	$01	$At - Creamy peavine, warm aspect
	AS	00	SwAt – Soopolallie
	BL	04	Sb - Lingonberry - Coltsfoot
	BL: al	$04	$At - Labrador tea
	BT	08	Sb - Labrador tea – Sphagnum
	Fm02	09	ActSw - Red-osier dogwood

BEC Variant	Map Code	Site Series	Ecosystem Name[a]
	LL	02	Pl - Lingonberry - Velvet-leaved blueberry
	LL: ak	$02	$At - Kinnikinnick
	SC	06	Sw - Currant – Bluebells
	SC: ab	$05	$At – Black Twinberry
	SC: ep	$05	$Ep – red-osier dogwood
	SE	00	Sedge Wetland
	SH	07	Sw - Currant – Horsetail
	SH: ac	$07	$Ac – Cow parsnip
	SH: ep	$07	$Ep – Ep-Dogwood
	SO	05	Sw - Currant - Oak fern
	SW	03	Sw - Wildrye – Peavine
	SW: as	$03	$At - Soopolallie
	TS	10	Tamarack - Sedge – Fen
	WH	00	Willow – Horsetail – Sedge – Riparian Wetland
	WS	00	Willow – Sedge – Wetland
	WW	00	Fuzzy-spiked Wildrye – Wolf-willow
SBSwk2	SO	01	Sxw - Oak fern
	LH	02	Pl - Huckleberry - Cladina
	SC	03	Sxw - Huckleberry - Highbush-cranberry
	BF	04	SbPl - Feathermoss
	SD	05	Sxw - Devil's club
	SH	06	Sxw - Horsetail
	Fm02	Fm02	ActSw - Red-osier dogwood
	Wf02	Wf02	Scrub birch - Water sedge
	Wf13	Wf13	Narrow-leaved cotton-grass - Shore sedge
ESSFmv2	FR	01	Bl - Rhododendron - Feathermoss
	FL	02	Bl - Lingonberry
	AF	00	Alder - Fern avalanche track
Nonvegetated/ Anthropogenic Units *All Subzone Variants*	CB	00	Cutbank
	CF	00	Cultivated field (including pastures)
	ES	00	Exposed soil
	GB	00	Gravel bar
	GP	00	Gravel pit
	LA	00	Lake
	MI	00	Mine
	OW	00	Shallow open water
	PD	00	Pond
	RE	00	Reservoir
	RI	00	River
	RN	00	Railway
	RO	00	Rock
	RW	00	Rural
	RY	00	Reclaimed Garbage dump
	RZ	00	Road surface
	UR	00	Urban

[a] $ indicates seral association

Normally an ecosystem must make up at least 20% of a polygon to be included in the polygon label[3]. Some of the ecosystem units are of particular importance to wildlife resources being studied in other programs and, therefore, were included within the map label if 10% or more of that particular habitat was part of the polygon. This was applied to:

- Cutbanks: important as roosting habitat for bats and nesting habitat for swallows
- Wetlands and waterbodies: important for amphibians and waterfowl
- WW grasslands: habitat for rare butterflies

The two most common nonvegetated/anthropogenic ecosystems are cultivated field (CF) and cutbank (CB). Cultivated fields cover extensive areas of the river terraces. Cutbanks are present on steep slopes adjacent to the river, often complexed with the sparsely-vegetated Fuzzy-spiked Wildrye-Wolf-willow (WW) unit. Many of the cutbanks are actively eroding and failed slopes and slumping are common.

1.1.2 Broad Habitat Mapping

Updates to the original biophysical mapping produced in the 1980s were required to ensure the mapping accurately depicts current conditions. The original biophysical maps were based on 1:50,000 scale National Topographic System maps, which do not match 1:20,000 Terrain Resource Information Management (TRIM) maps due to the differences in scale. Since the digital Vegetation Resource Inventory (VRI) mapping was TRIM-referenced and was more detailed—finer scale—that linework was used as the base for polygon delineation and habitat and ecosystem information from the biophysical maps was assigned to the VRI polygons to create 1:20,000 scale broad habitat mapping.

The original 1:50,000 biophysical mapping was converted to a 20-metre raster grid surface of unique identifiers in order to assign the biophysical habitat information to the updated habitat mapping. The unique identifiers were then used as the raster input for the Zonal Statistics tool, which creates a statistical summary of values from the raster surface by input polygon dataset—from the VRI. The principal biophysical value overlapping each individual VRI polygon was assigned to that polygon, while secondary and tertiary values from the biophysical mapping that overlapped polygons were used to determine secondary and tertiary characteristics for complex

[3] An ecosystem polygon can be mapped containing up to three different ecosystems within it. These are listed as 'deciles' with the highest proportion listed first.

polygons. Pre-processing of the biophysical habitat information included shifting the linework slightly to better match the VRI polygons. Zonal statistics were used instead of a direct overlay to avoid creating additional linework. In a similar manner, the slope and aspect values from the TRIM Digital Elevation Model raster grid surface were also added to the new polygons to generate the slope and aspect site modifiers.

The structural stage was assigned to the new polygons based on canopy closure, tree height, tree age (Resources Inventory Committee 1998), land cover classification scheme, and data obtained on recently harvested areas from the VRI. Seral map units were assigned if the total percentage of deciduous species—including balsam poplar, trembling aspen, or paper birch—was greater than 75% (Resources Inventory Committee 1998). The ecosystem unit map codes used for the TEM were assigned to the new polygons within the BWBSmw1 using land cover classification, biophysical habitat, tree species, and site index. Ecosystem units for the additional subzones within the new mapping—ESSFmv2, BWBSwk1, BWBSwk2, SBSwk1—were assigned based upon the most recent field guides (DeLong 2004; DeLong et al. 1994) and the provincial map code database.

There were no VRI data available for a 22,373 hectares area south of the Peace River within Tree Farm License (TFL) 48; PEM for the TFL (Rosen et al. 1999) was obtained and incorporated into the updates. The TFL48 PEM was provided as two separate coverages: one for ecosystem and another for structural stage. These two coverages were cleaned—i.e., small polygons were removed—and overlaid with each other to produce one layer. Where the TEM and broad habitat mapping overlapped, the TEM was given precedence as it was thought to be the most accurate.

Field sampling was conducted in areas outside the TEM to improve the accuracy of the broad habitat mapping. Targeted sites included polygons with complex ecosystem labels, polygons where land use had likely changed since the mapping was completed, polygons with habitat units difficult to characterize from the input data, and polygons for which input data are limited. Field sampling methods followed BC Ministry of Environement, Land and Parks and BC Ministry of Forests (1998) standards and included the completion of Ground Inspection Forms (GIFs) and visual plots. Sampling was well distributed but was limited by private lands access and road accessibility. The survey intensity level was R (reconnaissance) due to the size of the previously mapped biophysical area—greater than 1,000,000 hectares.

The bioterrain and ecosystem information in the broad habitat mapping database was edited based on results from the pooled field data. Only systemic edits were made. An accuracy assessment was then performed following provincial standard methods (Meidinger 2000). All field plots collected during field-truthing were compared to their map polygons and classified based on their level of correlation[4]. Accuracy was assessed as correct, acceptable, or incorrect; based on the classification, a score was assigned to each comparison and the total score was divided by the total possible score to give the percent accuracy (**Table 1.1.5**).

Table 1.1.5 Accuracy assessment matrix

Accurracy	Description	Score
Correct	A match of the map code between the plot and the polygon	1.0
Acceptable	Map code of the plot shared a border on the edatopic grid with the map code of the polygon—e.g., moist sites share a border with medic sites of the same nutrient regime	0.5
Incorrect	—	0.0

1.1.2 Results

TEM-targeted field sampling took place September 2 to 12 in 2005, July 13 to 21, August 9 to 16, and September 9 to 21 in 2006, and June 16 to 22, 2012. Additional GIF and visual plots were done in 2006, 2010, and 2011 in conjunction with other surveys—rare plants, bats, birds, amphibians. There are 7,295 polygons in the entire TEM area; field plots were completed in 2,673 polygons for a visitation level of 37%, exceeding the target survey intensity of 15 to 25% for level 4 sampling (Resources Inventory Committee 1998). The LAA is 86,424 hectares in size and almost entirely—99%—in the BWBSmw1. Of the total LAA, 59,103 hectares—68%—is TEM. Field-truthing within the LAA portion of the TEM totalled 134 full plots, 670 GIF plots, and 1,992 visual plots.

The TEM reliability was influenced by a number of factors including poor access to the south side of the river where roads were limited, large areas of private land where permissions to access were required, and limited detail in the forest cover maps, particularly young seral forest typed as non-productive brush. There were limited data collected for bioterrain field-truthing—283 polygons checked within the entire TEM-mapped area. The reliability of the bioterrain mapping should be considered low, but this is not expected to affect the interpretations made from the ecosystem mapping as field-truthing visitation for the ecosystem mapping was considerably higher.

One hundred eight plots—58 GIF plots and 50 visual inspections—were completed between August 18 and August 23, 2010 as part of the map-truthing of the broad habitat mapping. Most

[4] No one-to-one edits (plot to polygon) were completed, so that all the plots could be used in the accuracy assessment.

sampling occurred in mesic to wet forested sites, both seral and non-seral. Sampling targeted wet forest site series—04-BL, 08-BT—and the 05-SO since these units were difficult to characterize in the mapping. The drier units—02-LL and 03-SW—and riparian units—09-Fm02—were not sampled as they are uncommon on the plateau, which is where the sampling was focused. All structural stages were sampled except structural stage 7, which is rare on the landscape.

The overall broad habitat map accuracy calculated from the 2010 field plots was 70.4% (**Table 1.1.6**). Most mapping accuracy projects focus on forested site series as the non-forested units are generally easier to differentiate. The accuracy of broad habitat mapping forested units—69%—exceeds the minimum requirement of 65% for mapping projects and wildlife habitat modeling (Meidinger 2000).

Table 1.1.6 Broad habitat mapping accuracy assessment results

Plot Type		Field vs. Map			Accuracy
		Correct	Acceptable	Incorrect	
Forested	Non Seral	24	25	3	70.2%
	Seral	16	7	6	67.2%
	Total	**40**	**32**	**9**	**69.1%**
Non-forested		19	2	6	74.1%
Grand Total		**59**	**34**	**15**	**70.4%**

The 07-SH and $07-SH:ac units had the poorest accuracy at 35% and the 05-SO unit had relatively poor accuracy at 43%. There was a common error related to differentiating the 04-BL and the 08-BT; these units are located adjacent to each other on the edatopic grid and this error may have contributed to the high number of acceptable classifications for non-seral forested units in **Table 1.1.6**.

The TFL48 mapping was previously assessed by Rosen et al. (2001) as 84% reliability overall and 85% within the BWBSmw. Field truthing in 2010 found only 70% accuracy in the TFL48 portion of the study area, although only five plots were done.

A primary source of error in the classification of many seral units appears to be a result of tree species composition. In a large proportion of the map polygons, the VRI indicates a component of balsam poplar but this species was often absent in the associated field plot. This discrepancy may be due to the fact that balsam poplar acts as a pioneer species in younger forest stands, but disappears as the stand approaches climax. Since balsam poplar often indicates moister sites, map polygons where the VRI identified balsam poplar as present may have been classified as moist or wet, while field plots classified climax polygons as mesic sites based on the lack of this species and other attributes.

1.1.2.1 Habitats within the LAA

Over 30% of the LAA was mapped as \$01 forested in the BWBSmw1 in the first decile (**Table 1.1.7**)[5]. This well-drained, mesic, aspen-dominated forest dominates most of the valley slopes. Moister ecosystems such as the \$05 aspen unit were most commonly found on lower slopes, as were smaller amounts of moist balsam poplar forest (\$07). The Fm02 poplar floodplain unit is present in the valley bottom adjacent to the Peace River and its larger tributaries. Dry aspen forest (\$03) was mapped on warm aspects, mainly on the north side of the river. Shrubby aspen forest (AS) complexed with grassland slopes (WW) and eroding cutbanks (CB) were mapped in gullies and on the steepest, driest warm aspect slopes.

Table 1.1.7 Mapped ecosystem areas in local assessment area – first decile[6]

BEC Variant	Ecosystem Type	Map Code	Site Series	Broad Habitat Mapping Area (ha)	TEM Area (ha)	Grand Total Area (ha)	Percent of Total Mapped LAA (%)
BWBSmw1	Forested Ecosystems	AS	00	53.6	1,764.6	1,818.2	2.1
		AM	01	2,717.1	2,887.6	5,604.7	6.5
		AM:ap	\$01	8,581.9	18,152.5	26,734.3	30.9
		LL	02	64.9	601.4	666.3	0.8
		LL:ak	\$02	167.9	369.1	537.1	0.6
		SW	03	481.4	1,955.7	2,437.1	2.8
		SW:as	\$03	1,042.4	3,312.7	4,355.1	5.0
		BL	04	1,840	470.3	2,310.3	2.7
		BL:al	\$04	436	742.4	1,178.3	1.4
		SO	05	26.4	1,196.5	1,223	1.4
		SC:ab	\$05	1,991.90	615.5	2,607.4	3.0
		SC:ep	\$05	0	309.2	309.2	0.4
		SC	06	2,661.1	281.1	2,942.1	3.4
		SH	07	343.5	1,270.5	1,613.9	1.9
		SH:ac	\$07	413.4	1,000.8	1,414.1	1.6
		SH:ep	\$07	0	6	6	<0.1
		BT	08	1,267.7	858.8	2,126.5	2.5
		Fm02	09	0	2,689.4	2,689.4	3.1
		TS	10	948.2	320.4	1268.5	1.5

[5] Deciles are the percentage assigned to the components of each map polygon. A polygon can have up to three deciles wich add up to 100 percent.

[6] A complete summary of the area of ecosystems within the LAA across all deciles is presented in **Appendix C**.

BEC Variant	Ecosystem Type	Map Code	Site Series	Broad Habitat Mapping Area (ha)	TEM Area (ha)	Grand Total Area (ha)	Percent of Total Mapped LAA (%)
	Nonvegetated/ Anthropogenic Ecosystems	CB	00	23	903.8	926.8	1.1
		CF	00	2,134.1	6,966.3	9,100.4	10.5
		ES	00	0	58	58	0.1
		GB	00	0	878.4	878.4	1.0
		GP	00	18.2	153.3	171.5	0.2
		LA	00	150.5	36.4	186.9	0.2
		MI	00	0	25.1	25.1	0.0
		OW	00	0	45.7	45.7	0.1
		PD	00	0	20.3	20.3	0.0
		RE	00	0	8.2	8.2	0.0
		RI	00	247.8	5,996.9	6,244.7	7.2
		RN	00	0	110.3	110.3	0.1
		RW	00	0	173.2	173.2	0.2
		RZ	00	88.8	56.6	145.4	0.2
		UR	00	263.4	475.9	739.3	0.9
	Wetlands and Grasslands	SE	00	259.9	647.4	907.4	1.0
		WH	00	0	987.9	987.9	1.1
		WS	00	182.9	159.6	342.5	0.4
		WW	00	576.5	1,866.8	2,443.3	2.8
	Total			**26,982.5**	**58,374.6**	**85,357.1**	**98.8**
BWBSwk1	Forested Ecosystems	SM	01	17.5	0	17.5	<0.1
		SM:hc	$01	17.3	0	17.3	<0.1
		SW	04	51.9	0	51.9	0.1
		SW:ss	$04	106.3	0	106.3	0.1
	Total			**193**	**0**	**193**	**0.2**
ESSFmv2	Forested Ecosystem	AF	00	0	14.5	14.5	<0.1
		FR	01	145.4	7.6	153	0.2
		FL	02	0	17.3	17.3	<0.1
	Total			**145.4**	**39.3**	**184.8**	**0.2**
SBSwk2	Forested Ecosystems	AF	00	0	7.3	7.3	<0.1
		Fm02	00	0	35.6	35.6	<0.1
		SO	01	0	241.5	241.5	0.3
		LH	02	0	75.8	75.8	0.1
		SC	03	0	63.6	63.6	0.1
		BF	04	0	63.6	63.6	0.1
		SD	05	0	77.9	77.9	0.1
		SH	06	0	56.9	56.9	0.1

BEC Variant	Ecosystem Type	Map Code	Site Series	Broad Habitat Mapping Area (ha)	TEM Area (ha)	Grand Total Area (ha)	Percent of Total Mapped LAA (%)
	Nonvegetated/ Anthropogenic Ecosystems	GB	00	0	3.7	3.7	<0.1
		GP	00	0	12.4	12.4	<0.1
		RI	00	0	7	7	<0.1
		RN	00	0	12.8	12.8	<0.1
		RZ	00	0	11.4	11.4	0
	Wetlands	Wf02	Wf02	0	16.6	16.6	<0.1
		Wf13	Wf13	0	2.6	2.6	<0.1
	Total			**0**	**688.8**	**688.8**	**0.8**
Grand Total				**27,321**	**59,102.7**	**86,423.7**	**100.0**

Lodgepole pine forests (02) were rare and generally occurred only on coarse-textured, gently-sloped terraces. The WH riparian wetland was the most common wetland type and was mapped along the shores and backchannels of the Peace River. Sedge and willow wetlands (SE, WS) were rare in the river valley.

Approximately 10% of the LAA was mapped as cultivated field (CF) in the first decile. One percent was mapped as gravel bar (GB), but neither the extent nor the location of this unit can be specified as it varies with the level of the river at any particular time.

Almost 45% of the LAA was mapped as deciduous forest in the first decile (**Chart 1.1.1**). Coniferous forest made up an additional 23%. Anthropogenic or human-created ecosystems accounted for 12%. Only 3% of the LAA is floodplain forest and over 7% is water—mostly the Peace River.

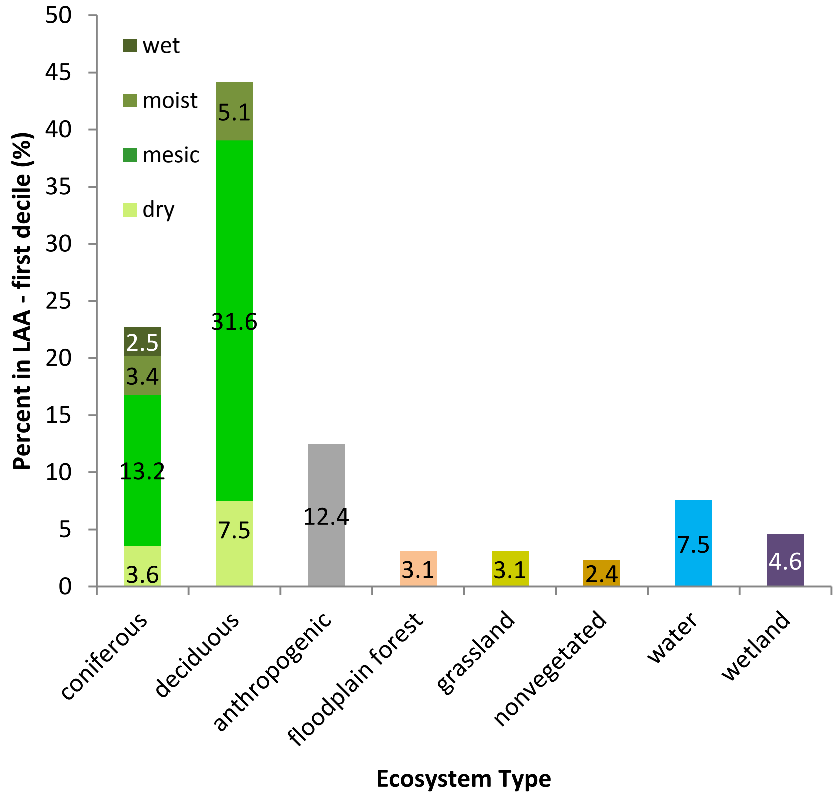

Chart 1.1.1 Mapped relative area of ecosystem types in LAA – first decile

Polygons mapped as structural stage 5 (young forest)—in the first decile made up over 29% of the LAA. Only about 225 hectares were mapped as structural stage 7—old forest—in the first decile. A summary of structural stages mapped—first decile only—is presented in **Table 1.1.8**. Complete summaries of structural stages across all deciles in the LAA are presented in **Appendix C**.

Table 1.1.8 Mapped structural stage area in LAA – first decile

BEC Variant	Structural Stage	Broad habitat mapping Area (ha)	TEM Area (ha)	Total Mapped Area (ha)	Percent of LAA Area (%)
BWBSmw1	None[a]	750.5	6,923.7	7,674.2	8.9
	1	41.3	2,040.9	2,082.2	2.4
	2	2,993.3	9,322.1	12,315.4	14.3
	3	4,462.0	7,184.8	11,646.8	13.5
	4	538.0	8,636.0	9,174.0	10.6
	5	8,624.5	16,047.2	24,671.7	28.5
	6	8,662.4	8,004.1	16,666.5	19.3
	7	910.4	215.8	1,126.2	1.3
	Total	**26,982.5**	**58,374.6**	**85,357.1**	**98.8**
BWBSwk1	3	1.9	—	1.9	<0.1
	5	191.1	—	191.1	0.2
	Total	**193.0**	**—**	**193.0**	**0.2**
ESSFmv2	3	15.5	14.5	30	<0.1
	5	111.0		111	0.1
	6	19.0	24.8	43.8	0.1
	Total	**145.4**	**39.3**	**184.8**	**0.2**
SBSwk2	None[a]	0.0	43.7	43.7	0.1
	1	0.0	3.7	3.7	<0.1
	2	0.0	2.6	2.6	<0.1
	3	0.0	90.2	90.2	0.1
	4	0.0	28.6	28.6	<0.1
	5	0.0	289.9	289.9	0.3
	6	0.0	221.1	221.1	0.3
	7	0.0	9.1	9.1	0
	Total	**0.0**	**688.8**	**688.8**	**0.8**
Grand Total		**27,321.0**	**59,102.7**	**86,423.7**	**100.0**

[a] River, Lake, Pond, Open Water, Urban, Railway, Reservoir, Road, and Rural are mapped without structural stages.

1.1.2.2 Regional Ecosystem Representation

The LAA makes up approximately 9% of the total area mapped using both TEM and broad habitat mapping (**Table 1.1.9**). Over 95% of the floodplain forest within the entire mapped area occurs within the LAA. Other ecosystem types more commonly mapped in the LAA include dry forests, moist coniferous forest, nonvegetated—primarily CB—and grassland. Ecosystems that were under-represented in the LAA include moist deciduous forest, mesic coniferous forest and anthropogenic ecosystems – mainly Cultivated Field. Cutbanks, dry forest and grassland are found mostly on the warm aspect breaks of the Peace River valley and floodplain forests were mostly mapped on the same valley bottom. Mesic coniferous forest and agricultural fields dominate the plateau areas above the valley in the surrounding areas outside the LAA. It should be noted the amounts reflect the different mapping methodologies used across the two areas as well as intrinsic differences in ecosystem availability.

Table 1.1.9 Mapped general ecosystem types – all deciles

Ecosystem type	Site Series	Total mapped (ha)	LAA (ha)	Percent (%) total withinLAA
Dry coniferous forest	02, 03	13,243.8	3,116.6	23.5
Dry deciduous forest	$02, $03	31,057.6	6,482.4	20.9
Mesic coniferous forest	01, 04, 06	210,411.6	11,372.2	5.4
Mesic deciduous forest	$01, $04	248,661.2	27,268.9	11.0
Moist coniferous forest	05, 07	7,286.5	2,970.6	40.8
Moist deciduous forest	$05, $07	102,605.9	4,393.5	4.3
Wet coniferous forest	08	28,481.8	2,125.7	7.5
Floodplain forest	Fm02	2,831.8	2,699.2	95.3
Grassland	WW	8,735.3	2,667.1	30.5
Wetland	TS, SE, WS, WH Wf02, Wf13	22,524	3,964.9	17.6
Nonvegetated	CB, ED, GB	3,597.5	2,057.3	57.2
Anthropogenic	CF, GP, MI, RN, RW, RY, RZ, UR	286,398	10,757.6	3.8
Water	RI, RE, OW, PD	17,884.7	6,517.1	36.4
Other (avalanche path)		30.6	30.6	100.0
Grand Total		**983,750.2**	**86,423.7**	**8.8**

1.2 At-risk and Sensitive Ecological Communities

An ecological community can be defined as a natural plant community and its associated environmental site characteristics including soil, landform, nutrient, and moisture regimes. At-risk ecological communities are defined and ranked by the BC Conservation Data Centre (CDC) and placed on the provincial red- or blue-list according to the degree of threat, trend in area of occupancy, number of protected and managed occurrences, intrinsic vulnerability, specificity of habitat requirements, and other considerations (BC Conservation Data Centre 2004). Forest or wetland plant communities listed by the CDC are usually associated with one or more forest or wetland site series. The association indicates that the site series has the potential to support the community in question but the community will not necessarily be present at each occurrence of the site series.

Sensitive ecological communities are those that may not be Red- or Blue-listed but are ecologically particularly fragile (Resource Information Standards Committee 2006). Sensitive communities defined for the Project for assessment purposes include old-growth forest and Old-Growth Management Areas (OGMAs), tufa seeps, grasslands, wetlands, and communities ranked 1 or 2 for Goal 2 of the Conservation Framework that are not Red- or Blue-listed. Goal 2 emphasizes the prevention of species and ecosystems from becoming at risk in order to protect species and communities that are neither secure nor at risk (BC Ministry of Environment 2009).

1.2.1 Methods

1.2.1.1 Ecological Communities at Risk

The Peace River Valley is a unique feature on the landscape and plant communities associated with the river valley may also be unique in the region. Two Red-listed and 15 Blue-listed communities are defined for the BWBSmw, BWBSwk1, ESSFmv2, and SBSwk2 subzone variants (**Table 1.2.1**). Twelve potentially occur in the BWBSmw subzone, four in the SBSwk2, one in the ESSFmv2, and six in the BSBSwk1 subzone (BC Conservation Data Centre 2011).

Table 1.2.1 Red- or blue-listed ecological communities potentially in the local assessment area

Ecological Community Common Name	Scientific Name	BC Status	BEC Unit	TEM Ecosystem Unit
Arctic rush - Nuttall's alkaligrass - Seablite	*Juncus arcticus - Puccinellia nuttalliana - Suaeda calceoliformis*	Red	BWBSmw	00/SE

Ecological Community Common Name	Scientific Name	BC Status	BEC Unit	TEM Ecosystem Unit
Mat muhly - Arctic rush - Nevada bluegrass	*Muhlenbergia richardsonis - Juncus arcticus - Poa secunda* ssp. *juncifolia*	Red	BWBSmw	00/SE
Scrub birch / Water sedge	*Betula nana / Carex aquatlilis*	Blue	BWBSmw ESSFmv2 SBSwk2	00/SE Wf02 Wf02
Tamarack / Water sedge / Golden fuzzy fen moss	*Larix laricina / Carex aquatilis / Tomentypnum nitens*	Blue	BWBSmw BWBSwk1 SBSwk2	10/TS Wb06 Wb06
Tamarack / Buckbean / Shore sedge	*Larix laricina / Menyanthes trifoliata – Carex limosa*	Blue	BWBSmw	10/TS
White spruce / Oak fern – Wild sarsaparilla	*Picea glauca / Gymnocarpium dryopteris – Aralia nudicaulis*	Blue	BWBSmw	05
White spruce - Black spruce / Labrador tea / Glow moss	*Picea glauca – Picea mariana / Rhododendron groenlandicum / Aulacomnium palustre*	Blue	BWBSmw BWBSwk1	08/BT Ws15
Black spruce / Common horsetail / Peat-mosses	*Picea mariana / Equisetum arvense / Sphagnum spp.*	Blue	BWBSmw BWBSwk1	08/BT Wb09
Black spruce / Lingonberry / Peat-mosses	*Picea mariana / Vaccinium vitis-idaea / Sphagnum* spp.	Blue	BWBSmw	08/BT
Balsam poplar – White spruce / Mountain alder – red-osier dogwood	*Populus balsamifera – Picea glauca / Alnus incana – Cornus stolonifera*	Blue	BWBSmw	Fm02
Common cattail marsh	*Typha latifolia* Marsh	Blue	BWBSmw	SE/00
White spruce / Red swamp currant / Horsetails	*Picea glauca / Ribes triste / Equisetum* spp.	Blue	BWBSmw BWBSwk1	07 06
White spruce – Subalpine fir / Black huckleberry / Red-stemmed feathermoss	*Picea glauca – Abies lasiocarpa / Vaccinium membranaceum / Pleurozium schreberi*	Blue	BWBSwk1	05
White spruce – Lodgepole pine / Soopolallie / Showy aster	*Picea glauca – Pinus contorta / Shepherdia canadensis / Eurybia conspicua*	Blue	BWBSwk1	04
Lodgepole pine / Black huckleberry / Reindeer lichens	*Pinus contorta / Vaccinium membranaceum / Cladina* spp.	Blue	SBSwk2	02
Narrow-leaved cotton-grass – Shore sedge	*Eriophorum angustifolium – Carex limosa*	Blue	SBSwk2	Wf13
Subalpine fir / Alders / Horsetails	*Abies lasiocarpa / Alnus* spp. / *Equisetum* spp.	Blue	ESSFmv2	06

Terrestrial Ecosystem Mapping for the Peace River Valley was initiated in 2006. The ecosystem units used were consistent with the available field guides for the BWBS (BC Ministry of Forests 2002; DeLong et al. 1990) but the province updated the BWBS biogeoclimatic zone classification units in 2011 (DeLong et al. 2011). The 2011 field guide includes a crosswalk table linking the new units to those in the earlier guides. The 2011 site series that the CDC had associated with each listed community was correlated with the corresponding ecosystem unit that had already been mapped in the LAA (**Table 1.2.1**). Only nonseral ecosystem units were considered as potential habitat for those at-risk ecological communities defined as coniferous forests.

Brief descriptions of each of the at-risk ecological communities are provided below.

1.2.1.1.1 Arctic rush - Nuttall's alkaligrass - Seablite

This community is Red-listed and found in the BWBSmw, only in the Peace River Valley. It was first described in 1975 from the Bear Flat area (Brayshaw et al. 1975). It has not been correlated with a particular site series by the CDC and a Conservation Status Assessment is not available. A site description of this wet grassland comes from the CDC (2012j):

> This ecological community is a wet alkaline grassland. It is a hygric community on saline seeps, occurring on solonetzic gleysols on heavy lacustrine deposits, and so far has been found only along the Peace River, on southwest-facing slopes, where erosional features such as slumps and slides occur (H. Roemer, pers. comm. 2008). It occurs with the Mat muhly – Arctic rush – Nevada bluegrass ecological community.

1.2.1.1.2 Mat muhly - Arctic rush - Nevada bluegrass

This community is Red-listed and exclusive to the BWBSmw1 and Peace River Valley. It has not been correlated with a particular site series. The CDC (2012i) provides a site description for this non-forested community:

> This community occurs on poorly drained (subhygric) more or less alkaline heavy clay soils (lacustrine) along the Peace River. It has been found on southwest-facing slopes, where seepage is common on erosional features such as slumps and slides (H. Roemer, pers. comm. 2008).
>
> This ecosystem tends to occur on fine-textured lacustrine materials where alkaline conditions of seepage water influence vegetation establishment on eroding slopes. It may also occur in southern Yukon.

1.2.1.1.3 Scrub birch / Water sedge

The Scrub birch/Water sedge community is Blue-listed and is found in the BWBSmw, ESSFmv2, SBSwk2, and a variety of other biogeoclimatic zones across the province. It is threatened by industrial activities, pollution, and climate change (BC Conservation Data Centre 2012a). DeLong et al. (2011) provides a description for this wetland habitat:

> The Scrub birch – Water sedge Fen site association is uncommon in the BWBS, but can be extensive in large peatlands where there is some water table

> fluctuation and the surface becomes aerated by mid-season. Common soil types are terric and typic mesisols and fibrisols. Peat depths are frequently between one and two metres but deep sedge-derived peat to four metres occurs. These sites are often hummocked, with shrubs rooting on elevated microsites. Scrub birch and water sedge are the characteristic species but bog willow [*Salix pedicellaris*] and beaked sedge [*Carex utriculata*] dominate on wetter sites. The moss layer is variable and can be diverse, absent, or dominated by *Tomentypnum nitens* [no common name], *Sphagnum* spp. [peat-mosses], or *Drepanocladus* spp. [Drepanocladus mosses]. Some drier sites will have scattered, stunted trees (white spruce or black spruce most commonly).

1.2.1.1.4 Tamarack / Water sedge / Golden fuzzy fen moss

The Tamarack/Water sedge/Golden fuzzy fen moss community is Blue-listed and occurs in the BWBSmw, BWBSmw1 K-1, and SBSwk2. It is a relatively common boreal wetland but occurs in small patches and is threatened by industrial activities and climate change (BC Conservation Data Centre 2012b). The CDC (2012k) provides a site description for this forested wetland:

> This bog forest typically occurs in mountainous terrain along the margins of true domed bogs, or along slow-moving streams and seepage areas in more subdued terrain. It is characterized by its dependency on this groundwater flow (unlike classic bog forests) where a pattern of hummocks and hollows, high water tables and sluggish groundwater contributes to the characteristic vegetation type. Typically, soils are mesisols developed over deep woody or sedge peats.
>
> This bog/poor fen ecosystem has an open canopy of tamarack, and a moderate to dense shrub layer predominantly of scrub birch, Labrador tea and sometimes black spruce. The dense herbaceous layer is dominated by water sedge and Sitka sedge [*Carex sitchensis*] and other sedge species [*Carex* spp.], marsh cinquefoil [*Comarum palustre*], and a variety of low woody species such as bog cranberry [*Oxycoccus oxycoccos*], cloudberry [*Rubus chamaemorus*], creeping-snowberry [*Gaultheria hispidula*], bog-rosemary [*Andromeda polifolia*], and crowberry [*Empetrum nigrum*]. The high cover of bryophytes includes poor *Sphagnums*, *Tomentypnum nitens* and *Aulacomnium palustre*. It is one of the more common wetland types throughout its range.

1.2.1.1.5 Tamarack / Buckbean / Shore sedge

The Tamarack/Buckbean/Shore sedge community is Blue-listed and found in the BWBSmw1 as the Wf18 wetland. It is threatened by industrial development, associated roads, and climate change (BC Conservation Data Centre 2012c). DeLong et al. (2011) provides a site association description for this forested wetland:

> The Tamarack – Scrub birch – Buckbean Fen Site Association occurs only at low elevations in the eastern BWBS (BWBSmk and mw). This uncommon unit occurs in patterned fens with strongly mounded organic soils. The sparse to open (8–27% cover) canopy is dominated by tamarack, and the dense (> 60% cover) understorey is dominated by scrub birch, sedge spp., and buckbean. The moss layer is a variable mix of *Sphagnum* spp., *Tomentypnum nitens*, and *Dreplanoclus* spp. This unit is related to the Wf07 and Wf08 ecosystems of patterned fens but occurs where sufficient topography exists to support tamarack shrubs.

1.2.1.1.6 White spruce / Oak fern – Wild sarsaparilla

The White spruce/Oak fern – Wild sarsaparilla community is Blue-listed and found in the BWBSmw and BWBSwk1. It is declining due to timber harvest and impacts from oil and gas exploration and extraction (BC Conservation Data Centre 2012e). The site association is described by the CDC (2012l) as follows:

> This forested ecosystem typically occurs in cooler microclimates due to cold air drainage or cool aspect, often on mid to lower slope positions, where cool conditions, subhygric and nutrient rich conditions are primary ecosystem drivers. Soils are medium to fine-textured with medium coarse fragment content.
>
> This ecosystem is typically represented by a sparse to open canopy of white spruce with a well-developed to dense understory of shrub species and regenerating white spruce. Western mountain-ash [*Sorbus scopulina*] and black twinberry [*Lonicera involucrate*] dominate this layer, accompanied by highbush-cranberry [*Viburnum edule*], prickly rose [*Rosa acicularis*], Sitka alder [*Alnus viridis*], currants [*Ribes* spp.], and at some sites, high to moderate cover of devil's club [*Oplopanax horridus*]. The herb layer is often dense, dominated by oak fern and red-osier dogwood. Other common species include twinflower [*Linnaea borealis*], dwarf red raspberry [*Rubus pubescens*], and wild sarsaparilla, with a variety of other species such as sweet coltsfoot [*Petasites frigidus*], common

> miterwort [*Mitella nuda*], pink wintergreen [*Pyrola asarifolia*], one-sided wintergreen [*Orthilia secunda*], horsetails and others. Step moss [*Hylocomium splendens*], red-stemmed feathermoss, and sometimes knight's plume [*Ptilium crista-castrensis*] and *Mnium* spp. . . . [leafy mosses] . . . comprise the often dense bryophyte layer. This ecosystem is one of the more productive within its range.

1.2.1.1.7 White spruce - Black spruce / Labrador tea / Glow moss

The White spruce - Black spruce/Labrador tea/Glow moss community is Blue-listed and found in the BWBSmw and BWBSwk1, associated with the Ws15 wetland type. It is threatened by industrial activities that affect the hydrological regime (BC Conservation Data Centre 2012g). A site description of the Ws15 is available in DeLong et al. (2011):

> SwSb – Labrador tea – Glow moss are poor swamps uncommon in the BWBSdk, BWBSmk and BWBSmw. They typically occur around the edges of peatlands in the transition to upland forests on fine-textured gleysols or organic soils with some groundwater contact from upland sources. White spruce characteristically dominates the open, poor-productivity forest but black spruce is frequently abundant. The understorey is often a well-developed mix of bog species on raised hummocks and wet upland species in hollows. Labrador tea, scrub birch and bilberry willow [*Salix myrtillifolia*] are common shrubs. Lingonberry, alpine bearberry [*Arctous alpinus*], crowberry, and common mitrewort establish on raised sites, while lower-lying areas typically have horsetail species and sweet coltsfoot. The moss layer is very well developed, with *Aulacomnium palustre*, step moss, and *Tomentypnum nitens* the most common species.

1.2.1.1.8 Black spruce / Common horsetail / Peat-mosses

The Black spruce / Common horsetail / Peat-mosses community is found in the BWBSmw and BWBSwk1. It is threatened by climate change and by industrial activities that affect hydrological regimes (BC Conservation Data Centre 2012g). A site description of the Wb09 is available from the CDC (2012m):

> This bog forest is uncommon in the cold to cool northern and central landscapes of the province. It tends to occur as small patches in palustrine basins or as linear systems at the edges of larger peatlands. It occurs on sites with a typical pattern of hummocks above the water table, and hollows with standing water persisting throughout much of the growing season. Hummocks are never flooded and

consequently support the more strongly bog-dependent species. Soils vary from mesisols (on deep sphagnum peats) to organic veneers over fine-textured gleysols (Banner et al. 1993; MacKenzie and Moran 2004; DeLong et al. 2011).

This bog forest is somewhat transitional to swamp forests. The bog-affiliated species occur commonly and abundantly on hummocks and swamp-affiliated species occur in low-lying areas around these hummocks. The canopy consists of sparse to dense black spruce. The understory is dominated by Labrador tea, with scrub birch and willow species [*Salix* spp.] occurring commonly. Black spruce may be regenerating in the understory. Herbaceous species are dominated by horsetails, sedges and various less commonly occurring species such as red-osier dogwood, and the low woody lingonberry, bog cranberry and crowberry. The bryophyte layer is continuous on hummocky areas and is dominated by *Sphagnum* species of poor sites, *Aulocomnium palustre*, red-stemmed feathermoss and *Tomenthypnum nitens* (Banner et al. 1993; MacKenzie and Moran 2004; DeLong et al. 2011).

1.2.1.1.9 Black spruce / Lingonberry / Peat-mosses

The Black spruce/Lingonberry/Peat-mosses community is Blue-listed and found in the BWBSmw. It is threatened by changes in hydrological regimes from industrial activities and by climate change (BC Conservation Data Centre 2012h). DeLong et al. (2011) describes the community as the Wb03:

The Wb03 represents the climax condition of long-term peatland succession in boreal climates. Climatic conditions in the BWBSmk are favourable to true bog formation and therefore the Wb03 is widespread in suitable terrain. The Wb03 is less common in other subzones. Many Wb03 sites are underlain with permafrost and have a domed surface shape. Deep blankets of acidic *Sphagnum* peat are typical and there is little or no surface water present. Soil types are fibrisols or organic cryosols. Stunted black spruce, usually less than 10 metres tall, forms a sparse to open canopy over an open herb layer and continuous *Sphagnum* blanket (except variations described below). Labrador tea, cloudberry and lingonberry are the most abundant understorey species. Sites are hummocky, but because of luxuriant *Sphagnum* growth, hollows are generally no wetter than hummocks and support few minerotrophic indicators.

There are two variations of the Wb03:

> Wb03.1 Black spruce – lingonberry – peat-moss (Reindeer lichen variation): 'Over mature' bogs can experience drying of surface peat and subsequent death of *Sphagnum* followed by an increase in ground lichens (*Cladonia* and *Cladina*) on some sites.
>
> Wb03.2 Black spruce – lingonberry – peat-moss (Feathermoss variation): 'Terrestrialized' bogs occur due to lowered water table and subsequent increase in tree cover, which shades out *Sphagnum*, and feather mosses become dominant. This variation is floristically similar to the Sb – Lingonberry – Step moss site series but occurs on deep peat soils."

1.2.1.1.10 Balsam poplar – White spruce / Mountain alder – Red-osier dogwood

The Blue-listed Balsam poplar – White spruce / Mountain alder – Red-osier dogwood community is found in the BWBSmw as the 112 site association. A conservation status report for this community has not been released by the BCCDC. The 112 site association is described by the CDC (2012n):

> This association occurs in the northeastern interior of British Columbia, typically on the middle bench of large, active floodplains along major rivers. Less commonly, it is present along smaller rivers and streams. River processes of frequent, prolonged flooding, erosion, and deposition maintain the medium to coarse textured soils. Level growing sites tend to support deciduous tree growth, while drier slightly elevated microsites support conifer growth. This ecosystem is found at elevations ranging from 240 to 960 metres (Barton et al. 1998; Teversham et al. 1998; DeLong et al. 2011).
>
> This broadleaved riparian forest association is common in large river valleys of the northeastern interior of British Columbia. Balsam poplar dominates the open to closed canopy, with variable cover of white spruce. Scattered white spruce or balsam poplar regeneration is generally present. Mountain alder and red-osier dogwood are prominent in the lush shrub layer, with prickly rose and highbush-cranberry generally forming significant components. Ground cover development varies depending on recent flood history but horsetail species tend to characterize these sites. The moss layer is generally sparse, but better developed on sites without a recent flood history (Barton et al. 1998; Teversham et al. 1998; DeLong et al. 2011).

This ecosystem was mapped as the Fm02 floodplain unit. The existing upstream dams—Peace Canyon and WAC Bennett—have changed the Peace River's natural flood regime and ecosystems along the river's banks are undergoing successional changes that would not normally occur in an unregulated system (Benke and Cushing 2005). These successional changes are resulting in many Fm02 polygons showing signs of converting over time into more mesic ecosystems as seasonal flooding no longer or rarely occur.

1.2.1.1.11 Common cattail marsh

The common cattail marsh is Blue-listed and found in the BWBSmw and in a wide variety of other biogeoclimatic zones across the province. A conservation status report for this community has not been released by the CDC. It is described as the Wm05 in MacKenzie and Moran (2004). DeLong et al. (2011) provides a site description for the Wm05:

> Cattail marshes are uncommon in the BWBS, occurring only in the warmest areas of the zone (BWBSmw and coastal influenced BWBSdk). No sites have been sampled; the following description is from site observations. Wm05 occur most commonly in protected lake embankments and potholes but also on decomposing peat of flooded fens. These sites often have organic veneers of well-decomposed, smelly muck. Soil types can be humisols or humic gleysols. Water depths may be up to one metre in the spring but recede in late summer, sometimes to the surface. Common cattail dominates, often with few other rooted plants present, especially where nutrient levels are high and common cattail growth is profuse. Occasionally there is significant cover of beaked sedge, soft-stemmed bulrush [*Schoenoplectus tabernaemontani*], or duckweed spp. [*Lemna* spp.]

1.2.1.1.12 White spruce / Red swamp currant / Horsetails

The White spruce/Red swamp currant/Horsetails community is Blue-listed and found in the BWBSmw and BWBSwk1. This riparian forest is threatened by land uses that change the hydrological regime and by climate change (BC Conservation Data Centre 2012f). The BC Ministry of Forests site guide to the BWBS (DeLong et al. 2011) describes the community as the 111 site association:

> White spruce - Red swamp currant - Horsetail forests are mostly localized on high fluvial benches along streams and rivers. White spruce - Red swamp currant - Horsetail forests can also occur on level and depressional morainal and lacustrine landforms, where drainage is impeded, but these tend to be small in

> area. Soils are subject to fluctuating water tables as evidenced by mottles/gleying in the soil profile. The productive white spruce canopy is typically open with a sparse white spruce regeneration layer beneath. The moderately well-developed to dense undergrowth includes gooseberries [*Ribes* spp.] and currants, willows, prickly rose, tall bluebells [*Mertensia paniculata*], and fireweed [*Epilobium angustifolium*]. A ground cover including horsetails, twinflower, and common miterwort is well-developed to dense. A sparse to dense moss cover is composed of feathermosses, often with patches of leafy mosses.

1.2.1.1.13 Lodgepole pine / Black huckleberry / Reindeer lichens

The Lodgepole pine / Black huckleberry / Reindeer lichens community is Blue-listed and found in the SBSwk2 where it is associated with the 02 site series. It is threatened by forest harvesting and insect attacks (BC Conservation Data Centre 2012d). DeLong et al. (2011) provides a brief summary of some of the attributes of the 02 forest:

> The 02 forest is dominated by lodgepole pine and occur on glaciofluvial to fluvial parent materials. The soils in these areas are typically quite coarse. These forests typically occur on level to upper slopes on poor to very poor soils. As a result of the slope position these forests are subxeric to xeric in terms of moisture. Along with the lodgepole pine, black huckleberry and Sitka alder are found in the understory, with an herbaceous layer consisting of bunchberry [*Cornus Canadensis*], green wintergreen [*Pyrola chlorantha*] and one-sided wintergreen.

1.2.1.1.14 Sub-alpine fir / Alders / Horsetails

The Blue-listed Sub-alpine fir / Alders / Horsetails community is found in the ESSFmv2 variant where it is associated with the 06 site series. A conservation status report for this community has not been released by the CDC. DeLong (2004) describes the 06 site series:

> This site series is forested with Engelmann spruce [*Picea engelmannii*] and lodgepole pine. The parent material is morainal and fluvial with coarse to medium-textured soils. Common shrubs in this ecosystem are mountain alder, white-flowered rhododendron [*Rhododendron albiflorum*], red raspberry [*Rubus idaeus*] and black gooseberry [*Ribes lacustre*]. Meadow horsetail [*Equisetum pretense*], bunchberry, oak fern and common horsetail make up the abundant herbaceous cover. Sites tend to be subhygric to hydric with medium to rich soils.

1.2.1.1.15 Narrow-leaved cotton-grass – Shore sedge

DeLong (2004) provides a description of the Blue-listed Wf13 ecosystem:

> Narrow-leaved cotton-grass – Shore sedge fens occur at higher elevations (1200–1800 m) of the ESSF zone in depressions or gradual seepage slopes where standing water persists for most of the short growing season. The Wf13 appears to be relatively common (at least locally) but has not been extensively sampled. A community dominated by narrow-leaved cotton-grass with shore sedge is typical but some sites may have poor sedge [*Carex magellanica*] instead of shore sedge. Grasses such as bluejoint reedgrass [*Calamagrostis canadensis*] and mountain hairgrass [*Vahlodea atropurpurea*] and the forb white mountain marsh-marigold [*Caltha leptosepala*] are commonly abundant. The moss layer is well developed and is often diverse, with no one species dominating. Soils are deep peat deposits of fibric or mesic cotton-grass remains. Typic mesisols and fibrisols are common soil types.

1.2.1.1.16 White spruce – subalpine fir / Black huckleberry / Red-stemmed feathermoss

DeLong et al. (2011) provides a description of the site association for the Blue-listed community:

> “White spruce – Subalpine fir – Black huckleberry – Feathermoss forests are common, widespread, and often relatively large. They generally occur in mid to upper slope positions but are occasionally on level sites. Soils are generally medium to fine textured and are derived primarily from morainal and glaciofluvial parent materials. The open canopy is dominated by lodgepole pine, occasionally mixed with white spruce. Regeneration is generally sparse but can be a moderately well-developed mixture of white spruce and subalpine fir. The sparse to dense undergrowth includes black huckleberry, Sitka alder, highbush-cranberry, fireweed, and prickly rose. A sparse to dense ground cover includes bunchberry, twinflower, pink wintergreen, and heart-leaved arnica [*Arnica cordifolia*]. The sparse to dense moss layer is dominated by red-stemmed feathermoss.”

1.2.1.1.17 White spruce – lodgepole pine / Soopolallie / Showy aster

The White spruce – lodgepole pine / Soopolallie / Showy aster community is associated with the 103 unit in the BWBSwk1. It is threatened by conversion to anthropogenic uses, burning, and climate change (BC Conservation Data Centre 2012d). DeLong et al. (2011) provides a site description for the 103:

White spruce - Lodgepole pine - Soopolallie - Fuzzy-spiked wildrye forests are common especially on extensive (glacio) fluvial plains and can be large in area. They most often occur on level (glacio) fluvial deposits but can also occur on steeper warm, colluvial or morainal slopes. Soils are generally coarse to medium textured and well to rapidly drained. The sparse to open canopy is composed of white spruce and/or lodgepole pine. A sparse to moderately well-developed regeneration layer of white spruce is typical, but may be entirely absent. A sparse to dense undergrowth contains dry site indicators soopolallie and fuzzy-spiked wildrye as well as prickly rose and highbush-cranberry. Twinflower and lingonberry dominate the sparse to well-developed ground cover, and false toad-flax [*Geocaulon lividum*] is often conspicuous. Usually a carpet of feathermoss covers the ground, with step moss and red-stemmed feathermoss the dominant species.

Field sampling was done to verify ecosystem units within the TEM area (see **Section 1.1**). Field sampling methods followed BC MELP and BC MoF (1998) standards. Sampling sites were distributed across the study area, limited by access to private lands and road accessibility. Certain site series / structural stage combinations were difficult to access within the TEM-mapped areas and as a result were assessed within the broad habitat mapping.

The Bear Flat area was targeted for sampling, as the two Red-listed communities have been found there in the past. *Juncus arcticus* – *Puccinellia nuttalliana* – *Suaeda calceoliformis* was identified by Hans Roemer in 1981 in this area, (C. Cadrin, pers. comm. 2010) and *Muhlenbergia richardsonis* – *Juncus arcticus* – *Poa secunda* ssp. *juncifolia* was described by Brayshaw et al. (1975). Limited information is available to describe both these communities and their listing by the BCCDC as “at-risk” is based on these early surveys.

During targeted sampling for at-risk communities, plots matching any site series correlated with an at-risk community were evaluated for their conservation status following methods outlined in RISC (2006). Data on any existing disturbances, adjacent land use, known threats, alien species present, fragmentation, landscape context, ecological integrity and condition were collected. All data were recorded in the field on a BCCDC Conservation Evaluation Form.

1.2.1.2 Sensitive Ecological Communities

1.2.1.2.1 Conservation Framework Communities

There are two yellow-listed communities, both in the SBSwk2, that are ranked as priority 2 under Goal 2 of the Conservation Framework. These two communities are included within the assessment and are described below.

- The Hybrid white spruce / Oak fern (*Picea engelmannii x glauca / Gymnocarpium dryopteris)* community is associated with the 01 site series in the SBSwk2. DeLong (2004) gives a brief summary of the components of the 01.

> "This site series is composed of hybrid spruce and subalpine fir. The parent material is morainal and fluvial with coarse to moderately fine soils. Common shrubs in this ecosystem are black gooseberry, highbush-cranberry, black huckleberry and devil's club. Bunchberry, oak fern, one-sided wintergreen and twinflower make up the abundant herbaceous layer. Sites tend to be submesic to mesic with poor to medium nutrient regimes."

- The Hybrid white spruce / Devil's club (*Picea engelmannii x glauca / Oplopanax horridus*) community is associated with the 05 site series in the SBSwk2. DeLong (2004) gives a brief summary of the components of the 05.

> "This site series has a low tree cover of subalpine fir and hybrid spruce. The abundant shrub cover is made up of devil's club, thimbleberry [Rubus parviflorus] and black gooseberry. Herbaceous cover is high and made up of oak fern, three-leaved foamflower [Tiarella trifoliata], queen's cup [Clintonia uniflora] and bunchberry. This site series is typically on lower slopes and has a mesic to subhygric moisture regime and a medium to rich nutrient regime."

1.2.1.2.2 Grasslands

Grassland makes up about 1.8% of BC's landbase (Fontaine and Douglas 1999), making it one of the province's rarest ecosystem types. The Peace Lowland grasslands stand out as having a unique assembly of vascular plant species within the flora of British Columbia. The source of this flora is in great part eastern and central North American, having migrated into the region unimpeded along the central North American Plains and through the arc of boreal forest that spreads across the continent (Cannings 1999).

Most of the gently-sloped native grasslands in the Boreal Plains ecoprovince have been converted to agriculture and the majority of the remaining grasslands are located on the steep, south aspect river breaks where cultivation is difficult (Grasslands Conservation Council of BC 2012). The slopes of the Peace River Breaks expose ice-age glaciolacustrine deposits and old continental sediments, both of which are often only loosely consolidated. These sedimentary layers erode rapidly, resulting in gradual to rapid slumping. This fast erosion may help to maintain grassland communities through prolonged periods of cooler, wetter climate that could otherwise favour tree and shrub growth by periodically killing off woody plants when slumps disturb or severs them at the roots. Continual moderate erosion may also maintain the south- and west-facing slopes that, due to their full exposure to sun during high temperatures in summer, and to their fast-draining soils, may make conditions too harsh for growth of trees and some shrubs.

The soils of the Peace Lowland grasslands are alkaline and nutrient-rich. Many plants are fully dependent on soils of high pH and rich in calcium, magnesium and other macronutrients (Kruckeberg 2004). Soils derived from high-pH sedimentary rock in British Columbia appear to generally support greater numbers of plant species than acidic, nutrient-poor soils derived from granite and other acidic, siliceous rocks.

The vegetation of the Peace Lowland grasslands is like that of the Alberta aspen parklands. The small area of representation of this continental-type grassland in British Columbia makes the Peace Lowland grasslands a conservation priority in the province. Forty-eight vascular plants (**Table 1.2.2**) of low-elevation upland herbaceous communities (grassland, rock outcrops and persistent erosional slopes) in the BC Peace Lowland are disjunct by at least 200 km from nearest known populations. The disjunction is usually from southern or central Alberta, mostly occurring no closer than the prairies situated well to the south of Edmonton.

Table 1.2.2 Vascular plants disjunct in the Peace Lowlands grasslands

Scientific Name	English Name
Achnatherum occidentale	stiff needlegrass
Achnatherum richardsonii	spreading needlegrass
Apocynum cannabinum	hemp
Arnica fulgens	arnica
Artemisia dracunculus	tarragon

Scientific Name	English Name
Artemisia herriotii	western mugwort
Artemisia ludoviciana ssp. *ludoviciana*	western mugwort
Astragalus multiflorus	Loose-flower milk-vetch
Atriplex nuttallii	Gardner's sagebrush
Carex duriuscula	narrow-leaved sedge
Carex inops ssp. heliophila	long-stoloned sedge
Carex rupestris ssp. rupestris	curly sedge
Carex torreyi	Torrey's sedge
Carex xerantica	dry-land sedge
Chenopodium pratericola	desert goosefoot
Crataegus columbiana sensu lato	red hawthorn
*Drymocallis glandulosa (*syn*. Potentilla glandulosa)*	sticky cinquefoil
Elymus alaskanus	Alaskan wheatgrass
Elymus lanceolatus	thickspike wheatgrass
Erigeron subtrinervis	three-nerved daisy
Geum triflorum var. *triflorum*	old man's whiskers
Grindelia squarrosa ssp. *quasiperennis*	curly-cup gumweed
Hesperostipa curtiseta	short-awned porcupinegrass
Lappula occidentalis var. occidentalis	western stickseed
Linum lewisii var. lewisii	western blue flax
Lithospermum incisum	yellow gromwell
Lomatium foeniculaceum var. *foeniculaceum*	fennel-leaved desert-parsley
Monarda fistulosa ssp. *menthifolia*	wild bergamot
Monarda fistulosa ssp. *mollis*	wild bergamot
Nassella viridula	green needlegrass
Opuntia fragilis	brittle prickly-pear cactus
Orobanche fasciculata	clustered broomrape
Orthocarpus luteus	yellow owl-clover
Oxytropis monticola ssp. *monticola*	Nelson's oxytrope
Pascopyrum smithii	western bluegrass
Penstemon gracilis	slender penstemon
Physaria didymocarpa ssp. *didymocarpa*	common twinpod
Potentilla hippiana	woolly cinquefoil
Potentilla pulcherrima	pretty cinquefoil
Prenanthes racemosa ssp. *multiflora*	purple rattlesnake-root

Scientific Name	English Name
Ranunculus rhomboideus	prairie buttercup
Rosa arkansana var. *arkansana*	Arkansas rose
Sedum stenopetalum	worm-leaved stonecrop
Selaginella rupestris	rock selaginella
Silene drummondii var. *drummondii*	Drummond's campion
Solidago missouriensis	Missouri goldenrod
Symphyotrichum ericoides ssp. *pansum*	tufted white prairie aster

1.2.1.2.3 Tufa Seeps and Marl Fens

Tufa seeps (**Photograph 1.2.1**) are unusual habitats formed as mosses hyper-accumulate calcium carbonate and other calcareous minerals on groundwater seeps. The stems and leaves of the mosses become coated as carbonate-laden water seeps over the mosses, encasing them in stone. For this system to continue, the mosses must grow quickly, and as their older parts die off, they leave hollow casings. The end product of this process is a spongy, light-weight rock. Tufa is made of basically the same material as travertine, the precipitate mineral that forms stalagmites and other delicate formations in the darkness of limestone caves.

In order to form tufa the seepage emerges to the surface in well-lit sites, allowing the growth of the mosses that make the precipitate spongy rather than solid. This spongy texture of tufa makes it an ideal growing surface for many plants and lichens. The nutrient-richness of the rock is easily accessed by vegetation due to the spongy, friable texture. Tufa may be dripping wet and actively accumulating, or may be the dry remnants of former seeps. Wet and dry tufas support two almost completely different sets of plant and lichen species. Wet, actively accumulating tufa is densely covered in thick mats of bryophytes almost to the exclusion of all else, while dry tufa tends to be more species rich, especially for lichens. One Blue-listed moss species, *Amblyodon dealbatus* [no common name], a Blue-listed lichen *Lempholemma polyanthes* [no common name] and a Red-listed lichen *Leptogium tenuissimum* [no common name] were found at tufa sites in the LAA (see Section 1.3).

Actively accumulating tufa is uncommon or rare in British Columbia, being limited to hot springs as well as some cold springs that form on steep slopes in extremely calcareous regions. Cold-spring tufa may be rarer in British Columbia, known from very few sites. Dry tufa of old, extinct springs is less rare, and can be found in regions where there is no current tufa accumulation. Dry tufa is threatened by collectors, who gather tufa for garden use. Tufa is favoured by rock gardeners because its porous nature and extreme calcareousness allows them to cultivate a wider array of rock garden plants. Natural tufa outcrops are therefore of high conservation value. One tufa outcrop near Hudson's Hope was historically mined for lime (BC Ministry of Energy 2011).

Photograph 1.2.1 Tufa seep

Marl fens are a special class of calcareous fens, also called rich fens. There is little written about calcareous fens in British Columbia, and some have used the term 'rich fen' to refer to fens with high concentration of nitrogen, while the term is supposed to be used to refer to fens rich in calcium and magnesium. Calcareous fens are highly variable in their plant species composition, owing to variability in their chemistry and hydrology. Marl fens are a step further toward high-pH extremes. This is the result of massive accumulation of marl, which is calcium carbonate or other calcareous minerals that are accumulated in large quantities, filtered out of alkaline water by some aquatic plants, algae, and single-celled organisms. Marl is visible as lumpy grayish masses on submerged aquatic plants.

Marl accumulations on aquatic plants may be seen in any open water in calcareous or neutral fens throughout British Columbia, but it is only in landscapes with extremely high-pH soils that marl accumulates enough to form a marl fen (**Photograph 1.2.2**). Additionally, the climate must be dry and boreal. In wetter climates, the marl would wash away rather than hyper-accumulating, as it does in calcareous fens on the BC coast. In warmer climates where it is dry enough for marl to hyper-accumulate, the ground water tends to carry too much salt, resulting in salt-flats rather than marl fens.

Photograph 1.2.2 Marl fen

The end effect of these processes is the presence of open, shallow pools of whitish gray marl, surrounded by fen and bog vegetation. The vegetation surrounding each marl pool exhibits zonation, such that the first band of plants outward from the marl pool are extreme calciphiles, most of which grow on hummocks. Outward from that, the second band is of strong and moderate calciphiles in hummocks and carpeting vegetation. Third is a band of calcareous-fen vegetation, with more moss cover. Fourth is a zone of *Sphagnum* in both hummocks and carpets, and much of this vegetation has cover of shrubs and small, stunted trees. Fifth is a zone of muskeg-forest type vegetation with a thick moss layer involving *Sphagnum* species, *Helodium blandowii, Tomenthypnum nitens* (no common names), and various herbs and small shrubs growing under a thin canopy of tamarack and black spruce. The overall effect of this zonation is a rich mix of plant species crowded into a very small area.

Calcareous fens in general are uncommon in British Columbia, since most portions of the province are lacking in the calcareous substrates that allow these wetlands to form. Very few of these calcareous fens have marl pools, and many of the known marl accumulations lack fen vegetation.

Marl fens are of high conservation priority, not only for the rarity of their vegetation type, but also because they so often harbour rare species (Minnesota Department of Natural Resources 2011). Leete (1993) and Eggers and Reed (1997) rank calcareous fens as the rarest wetland type in North America.

1.2.1.2.4 Old-growth Forest and Old-growth Management Areas

The main stand-replacing disturbance in the uplands BWBS is fire; with a historical fire cycle of about 100 years. Large fires were historically common and forested areas were replaced with aspen, spruce or lodgepole pine, creating large patches of even-aged stands (DeLong et al. 2011). Although few vertebrates appear to perceive old-growth as discrete patches (Bunnell 1999b), old forests provide valuable habitat for plant and animal species that prefer large-diameter trees, multi-layered stands, high densities of snags and other characteristics that require many years to develop.

Four Landscape Units (LUs) within the LAA have legally designated Old-growth Management Areas, or OGMAs. Those LUs include the Lower Moberly, Septimus, Kiskatinaw and Hudson’s Hope. Old-growth is defined for coniferous forests in the LAA at 140 years, 100 years for deciduous stands and 120 years for mixed stands (DeLong 2002). Some of the LUs did not have enough old-growth forest to meet their specified targets, so recruitment stands that will become old were included in OGMAs.

1.2.1.2.5 Wetlands

Wetlands cover about 6% of the province and perform essential hydrological and ecological functions (BC Ministry of Forests 2000). Four different types of wetland ecosystems occur within the LAA. These include bogs, fens, marshes and swamps. Brief definitions are provided by MacKenzie and Moran (2004):

- Bogs are nutrient-poor areas with acidic soils, dominated by mosses in the *Sphagnum* genus.
- Fens have moderate amounts of nutrients and are usually dominated by sedges and mosses. The water level is at the rooting zone in these wetlands.
- Marshes can be permanent or seasonally flooded. Emergent vegetation such as sedges is the main vegetation type in marshes.
- Swamps have water inflows and are nutrient-rich wetlands. They are able to support trees and larger shrubs.

There are many definitions of bogs versus fens, but generally, bogs have only rainwater (as opposed to mineral-rich ground water) available to most of the plants that occupy them. This is usually due to the fast vertical growth of *Sphagnum* moss, which dominates almost all bogs. The living and decaying *Sphagnum* provides the rooting substrate for bog plants, and *Sphagnum* is strongly acidifying of its surrounding environment. The abundance of anions in bogs locks up most of the alkaline nutrients that enter a bog environment, so not only are bogs highly acidic, but they are usually very nutrient poor. However, in highly calcareous regions, as with the Peace Lowland, the very high pH of the surrounding environment mitigates somewhat for the acidifying influence of *Sphagnum*. Fens, by contrast, have their vegetation able to root in groundwater-influenced peat, and their vegetation is often floating, or flooded for a part of the year. This access to groundwater for the vegetation of fens introduces, on average, greater nutrient availability and higher pH.

Some specific wetland communities are considered at-risk and are included on the provincial Red or Blue list. Wetlands are vulnerable to changes in hydrological regime, pollutants, siltation, compaction by livestock and vehicles, and the effects of exotic vegetation species such as reed canarygrass (*Phalaris arundinacea*) (Cox and Cullington 2009; MacKenzie and Moran 2004). Wetlands were mapped in the LAA as six vegetated ecosystem units and two water units, listed in (**Table 1.2.3**) below.

Table 1.2.3 Wetland ecosystems mapped in the LAA

Subzone variant	Site Series	Map Code	Description
BWBSmw1	00	SE	Sedge Wetland
	10	TS	Tamarack - Sedge Fen
	00	WH	Willow - Horsetail – Sedge Riparian Wetland
	00	WS	Willow-Sedge Wetland
SBSwk2	Wf02	Wf02	Scrub birch-Water sedge
	Wf13	Wf13	Narrow-leaved cotton-grass-Shore sedge
All	00	OW	Shallow open water
	00	PD	Pond

1.2.1.2.6 Wetland Function

Wetland function in terms of wildlife habitat was assessed for particular wetlands by querying field data from site visits for a variety of different wildlife and habitat surveys, including bird surveys, rare plant transects, waterfowl surveys, amphibian surveys, and ecosystem map-truthing.

1.2.2 Results

1.2.2.1 At-Risk Ecological Communities

A summary of the areas of mapped ecosystem units associated with one or more ecological communities at risk is presented in **Table 1.2.4**. Note that because some mapped ecosystem units are associated with more than one ecological community, the total areas are not additive.

Table 1.2.4 Ecosystem units in the LAA associated with at-risk ecological communities.

At-Risk Ecological Community Common Name	BC Status	BEC Unit	Associated Ecosystem Unit	Area (ha) of Ecosystem Unit Mapped in LAA
Arctic rush - Nuttall's alkaligrass - Seablite	Red	BWBSmw	00/SE	1168.9
Mat muhly - Arctic rush - Nevada bluegrass	Red	BWBSmw	00/SE	1168.9
Common cattail marsh	Blue	BWBSmw	00/SE	1168.9
Scrub birch / Water sedge	Blue	BWBSmw	00/SE	1168.9
		BWBSmw	00/WS	363.4
		ESSFmv2	Wf02	0
		SBSwk2	Wf02	0
Tamarack / Water sedge / Golden fuzzy fen moss	Blue	BWBSmw	10/TS	1404.5
		BWBSwk1	Wb06	0
		SBSwk2	Wb06	0
Tamarack / Buckbean / Shore sedge	Blue	BWBSmw	10/TS	1404.5
White spruce / Oak fern – Wild sarsaparilla	Blue	BWBSmw	05/SO	1214.7
White spruce - Black spruce / Labrador tea / Glow moss	Blue	BWBSmw	08/BT	2051.4
		BWBSwk1	Ws15	0
Black spruce / Common horsetail / Peat-mosses	Blue	BWBSmw	08/BT	2051.4
		BWBSwk1	Wb09	0
Black spruce / Lingonberry / Peat-mosses	Blue	BWBSmw	08/BT	2051.4
Balsam poplar – White spruce /	Blue	BWBSmw	Fm02	2663.6

At-Risk Ecological Community Common Name	BC Status	BEC Unit	Associated Ecosystem Unit	Area (ha) of Ecosystem Unit Mapped in LAA
Mountain alder – red-osier dogwood				
White spruce / Red swamp currant / Horsetails	Blue	BWBSmw	07	1698.6
		BWBSwk1	06	0
Lodgepole pine / Black huckleberry / Reindeer lichens	Blue	SBSwk2	02	70.4
Narrow-leaved cotton-grass – Shore sedge	Blue	SBSwk2	Wf13	8.5
Subalpine fir / Alders / Horsetails	Blue	ESSFmv2	06	0
White spruce – Subalpine fir / Black huckleberry / Red-stemmed feathermoss	Blue	BWBSwk1	05	0
White spruce – Lodgepole pine / Soopolallie / Showy aster	Blue	BWBSwk1	04	51.9

The characteristics of some ecological communities located on the slopes and floodplains within the Peace River valley do not match those observed in more typical plateau areas of the BWBSmw subzone. The rare ecological community descriptions are based on the regional site series guide produced by MoF (C. Cadrin, pers. comm. 2010), and this guide does not always adequately describe ecosystems found in the localized conditions of the Peace River valley.

Some ecological communities listed for the BWBSmw1 are poorly defined. For instance, the two Red-listed communities are not associated with a defined site series. Although both of these communities had been described from the Bear Flat area, only general locations of the previous observations were available (C. Cadrin, pers. comm. 2010). Surveys at Bear Flat were not successful at finding them.

One field plot in Bear Flat (potholes) identified a potentially rare ecological feature (plot ECAR 5). This site is not included in the BCCDC list of at-risk communities but should be considered unique. This unusual ecological feature was identified as a seepage site, with alkaline water (i.e., high-pH) percolating through the soil and pooling on the surface. This created a unique ecological community, characterized by plants tolerant of the alkaline water. The conservation evaluation of this site identified ecological integrity as fair and landscape context as fair due to cattle grazing at the site and agricultural activities on adjacent lands. Despite these conditions, the site is considered to be in good ecological condition.

During rare plant survey work, an unusual saline wetland area was observed at Watson's Slough. This wetland resembled the Nuttall's alkaligrass - Foxtail Barley (*Puccinellia nuttalliana - Hordeum jubatum*) community that is Red-listed by the BCCDC, although the CDC does not list the community as occurring in the BWBS subzone.

1.2.2.2 Sensitive Ecological Communities

Native grassland was mapped in the LAA as the WW Fuzzy-spiked Wildrye - Wolf willow unit in structural stage 2 (see **Section 1.1**). The WW unit was often mapped in complex polygons with cutbanks and the dry stunted aspen community - AS Aspen-Soopolallie.

The WW ecosystem generally occurs on steep slopes and is subject to erosion, which may be exacerbated by activities such as road-building and livestock grazing. The WW grasslands are dominated by yarrow (*Achillea millefolium*), Columbia needlegrass (*Achnatherum nelsonii* var. *dorei*), spreading needlegrass (*Achnatherum richardsoni*), slender wheatgrass (*Elymus trachycaulis*), long-stoloned sedge (*Carex inops* ssp. *heliophila*), blunt sedge (*Carex obtusata*), thickspike wildrye (*Elymus lanceolatus*), false melic (*Schizachne purpurascens*), junegrass (*Koeleria macrantha*), slender wheatgrass (*Elymus trachycaulis*) and hay sedge (*Carex siccata*). Rare vascular plants found in WW polygons during field surveys include riverbank anemone (*Anemone virginiana* var. *cylindroidea*), western mugwort (*Artemisia herriotii*), plains reedgrass (*Calamagrostis montanensis*), spike-oat (*Helictotrichon hookeri*), and slender penstemon (*Penstemon gracilis*).

The only marl fen found in the LAA occurred at the base of a terrace (Watson Slough), where groundwater seepage would carry large amounts of calcium and/or magnesium, depositing them at this lower-elevation bench. Studies in Minnesota found similar associations where marl fens occurred primarily in groundwater discharge zones at the bases of terrace escarpments (Minnesota Department of Natural Resources 2011). The river bench is high enough above the river to escape natural flooding, so the marl has had thousands of years to accumulate without getting washed away.

1.2.2.2.1 Summary

Based on a review of the ecosystem mapping and Landscape Unit planning, there are 12,075 hectares of legal OGMAs, 2,667 hectares of grassland, 3,965 ha of wetland, 7 tufa seeps, 1 marl fen and 1,135 hectares of old-growth forest—structural stage 7—within the LAA (**Table**

1.2.5). Five of the six known tufa seeps are on the banks of the Peace River and one is on the existing power line. The only known marl fen in the LAA is at Watson Slough. There are 305 hectares of potentially sensitive ecological communities within the LAA in the SBSwk2 01 and 05 site series (**Map 1.4.3** and **Map 1.4.4**).

Table 1.2.5 Sensitive ecosystems within the LAA

Sensitive Ecosystem	Variable	Area (ha) in LAA
Hybrid white spruce / Oak fern	Area of 01 site series in SBSwk2	231
Hybrid white spruce / devil's club	Area of 05 site series in SBSwk2	74.3
Wetlands	Area of BWBSmw1 -Sedge (SE) wetland	1,168.9
	Area of BWBSmw1 -Willow-Horsetail-Sedge (WH) Riparian	1,009.5
	Area of BWBSmw1 -Willow-Sedge (WS) wetland	363.4
	Area of BWBSmw1 -Tamarack-Sedge (TS)	1,404.5
	Area of SBSwk2 - Scrub birch-Water sedge (Wf02)	10
	Area of SBSwk2 -Narrow-leaved cotton-grass-Shore sedge (Wf13)	8.5
	Area of Open Water	75.3
	Area of Pond	33.5
	Total wetland area	**4,073.6**
Tufa Seeps/Marl Fens	Number of sites located	8
Grassland	Area of Fuzzy-spiked Wildrye-Wolf-willow (WW) ecosystem unit in ecosystem mapping	2,667.1
Old growth Forests	Area of structural stage 7 in ecosystem mapping	1,135
Legal OGMA	Area within OGMA boundaries provided by BC Geographic Data Warehouse	12,075.1

1.2.2.3 Wetland Function

The wetland functions associated with habitat (provision of biodiversity) are described below for two specific wetland sites - Watson Slough and the Bear Flat potholes – and for more generic wetland types within the LAA.

1.2.2.3.1 Watson Slough

Watson Slough is a permanently flooded wetland complex located on the north side of the Peace River west of Bear Flat. The site provides a variety of wetland ecosystem types including shallow open water, Tamarack-Sedge, and cattail marsh. Rare wetland types present at the slough include a marl fen and a saline wetland.

Some portions of the slough have been affected by human activity, namely the upper portions at margins of cultivated fields on the plateau, and at the southern edge, along the margins of the highway. Between these disturbance areas the habitats are in good condition. A power line traverses one of the marl fens, but the supporting poles are located beyond the margins of this habitat. The wetlands are highly diverse in their hydrology and soils, and consequently have a highly complex mix of vegetation types.

Rare plant species recorded at Watson Slough include riverbank anemone (*Anemone virginiana* var *cylindroidea*), Drummond's thistle (*Cirsium drummondii*), rivergrass (*Scolochloa festucacea)*, meadow arnica (*Arnica chamissonis* ssp *incana)*, Hall's willowherb (*Epilobium halleanum*), dwarf clubrush (*Trichophorum pumilum*), slender wedgegrass (*Sphenopholis intermedia*), Hudson Bay sedge (*Carex heleonastes*), many-headed sedge (*Carex sychnocephala*), tender sedge (*Carex tenera*), marsh muhly (*Muhlenbergia glomerata*), northern bog bedstraw *(Galium labradoricum),* little bluestem (*Schizachyrium scoparium*), slender mannagrass *(Glyceria pulchella),* spike-oat *(Helictotrichon hookeri),* autumn willow *(Salix serissima) a*nd an unusual water-hemlock (*Cicuta* sp.) that may be a previously undescribed species [see section 1.3 Rare Plants for details], The Watson Slough wetland complex is the only known location in the LAA for Hudson Bay sedge, many-headed sedge, slender mannagrass, marsh muhly, autumn willow, and dwarf clubrush.

Listed bird species recorded at Watson Slough during field surveys include the SARA-listed Common Nighthawk (*Chordeiles minor*), Red-listed Yellow Rail (*Coturnicops noveboracensis*) and Nelson's Sparrow (*Ammodramus nelsoni*) and the Blue-listed Le Conte's Sparrow (*Ammodramus leconteii*), and Surf Scoter (*Melanitta perspicillata*). Other avian species observed in this wetland include Great Gray Owl (Strix nebulosa), Great Horned Owl (*Bubo* *virginianus*), Boreal Owl (*Aegolius funereus*), and Northern Saw-whet Owl (*Aegolius acadicus*). There is also a published record of the Red-listed Cape May Warbler (*Setophaga tigrina*) breeding at the slough (Preston and Pomeroy 2008). The site has undergone various enhancements for waterfowl habitat including ditching and construction of nesting islands. Between 33 and 39 breeding pairs of waterfowl were recorded annually at the slough from 2005-2008 (D. Kroeker, Ducks Unlimited Canada, pers. comm. 2009).

Amphibians and reptiles noted at Watson Slough are wood frog (*Lithobates sylvaticus*), boreal chorus frog (*Pseudacris maculata*), the Blue-listed western toad (*Anaxyrus boreas*) and common gartersnake (*Thamnophis sirtalis*). Mammals observed during various field surveys include elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), muskrat (*Ondatra zibethicus*), black bear (*Ursus americanus*), and red squirrel (*Tamiasciurus hudsonicus*). The Blue-listed prairie bluet damselfly (*Coenagrion angulatum*) was observed at Watson Slough in 2012.

1.2.2.3.2 Bear Flat

The Bear Flat area south and east of Highway 29 is characterized by a number of wetlands associated with small ponds or ‘potholes’. Amphibians noted in the ponds at Bear Flat include wood frogs, boreal chorus frogs and long-toed salamander (*Ambystoma macrodactylum*). Waterfowl – Mallard (*Anas platyrhynchos*), Green-winged Teal (*Anas crecca*), Common Goldeneye (*Bucephala clangula*) and American Wigeon (*Anas americana*) - were observed during field surveys.

An unusual alkaline seep site was documented at one pond. The BC Conservation Data Centre’s has records of two wetland at-risk ecological communities within the vicinity but these communities could not be located during field surveys in 2011.

1.2.2.3.3 Other Wetland Habitats

The Sedge Wetland (SE) ecosystem unit was used to map organic wetlands dominated by herbaceous species, often mapped in complexes with Open Water (OW) and Pond (PD) ecosystem units on the uplands above the Peace River valley. Rare plant species that were found in SE habitats include meadow arnica (*Arnica chamissonis* ssp. *incana)*, many-headed sedge (*Carex sychnocephala)*, tender sedge (*Carex tenera*), European water-hemlock (*Cicuta virosa)*, small-fruited willowherb (*Epilobium leptocarpum)*, and purple-stemmed aster (*Symphyotrichum puniceum* var. *puniceum),* and the moss *Amblystegium tenax* [no common name]. Sedge wetlands are used by amphibians, beaver, and muskrats, and may provide growing-season feeding habitat for bears and deer. Waterfowl may breed if there is sufficient open water at the wetland. Dragonflies and damselflies breed in the shallow water of sedge wetlands and the abundant insect life also provides foraging opportunities for bats.

The Willow-Sedge (WS) wetland map unit was used to identify shrubby wetlands on mineral soils and was mapped mainly on the uplands above the Peace River valley. Like the other wetland types described above, the WS wetlands support a variety of amphibians and invertebrates. Moose (*Alces americana*) browse the shrubs in WS wetlands throughout the year, and beaver and waterfowl may use it if sufficient open water is present. The rare purple-stemmed aster was located in WS habitat.

The Tamarack-Sedge (10/TS) wetland map unit is a bog on deep, peaty soils on gentle slopes and depressions. Rare vascular plant species located in the TS habitat type include Hudson Bay sedge (*Carex heleonastes*), Hall's willowherb (*Epilobium halleanum*), northern bog bedstraw (*Galium labradoricum*), autumn willow *(Salix serissima),* and purple-stemmed aster. Autumn willow only occurred on the margins of TS forest, in its ecotone with open marsh habitat. Northern bog bedstraw was found only in the portions of TS habitat where it had full sun. The Blue-listed mosses *Sphagnum balticum, Tayloria lingulata* and *Pohlia sphagnicola* [no common names] were also found in TS. TS wetlands may have less open water available to support amphibian and dragonfly use than other wetland types.

A complicated array of microhabitats occurs in the densely vegetated margins of sloughs, backchannels and river shorelines in the BWBSmw1, usually mapped as the Willow-Horsetail (WH) riparian wetland along the Peace River. In open habitats downslope from the riparian forests and shrubby vegetation, and upslope from open water, there is generally a fringe of dense sedge, grass and forb vegetation occupying a band of periodically flooded, muddy ground. Under natural, unregulated hydrology, these shorelines would be flooded during the spring freshet, and exposed during the remainder of the growing season. The flood-scouring and deposition of fresh silt annually would renew the herbaceous cover, and prevent the spread of woody plants into this habitat. Under current regulated conditions on the Peace River, the herbaceous vegetation of this habitat is flooded frequently throughout the growing season, which may have the same overall effect of depositing fresh silt and preventing growth of woody plants. The WH wetlands generally grade into treed riparian ecosystems such as the Balsam poplar – White spruce / Mountain alder – red-osier dogwood (Fm02) that establish slightly upslope.

Many of the native plants of British Columbia are dependent on this herbaceous river shoreline habitat, which is limited to shores of larger rivers. The WH is sometimes poor in species diversity in its more deeply flooded portions, where swamp horsetail (*Equisetum fluviatile)* and common spike-rush (*Eleocharis palustris* sensu lato*)* are often the only species present. In the less often flooded portions of this habitat, the species diversity can be very high and with an unpredictable mix of species. Rare vascular plants found in this habitat are fox sedge, arctic rush (*Juncus arcticus* ssp. *alaskanus)*, slender wedgegrass (*Sphenopholis intermedia),* tender sedge and western mugwort.

Shorebirds such as Spotted Sandpiper were observed foraging in WH wetlands, as were waterfowl such as Canada Goose (*Branta canadensis*) and Green-winged Teal. The slow-moving backchannels provide breeding habitat for dragonflies and damselflies, and amphibians such as western toad. The herbaceous vegetation also provides foraging opportunities for ungulates and beaver.

1.3 Rare Plants

For this study, “rare plants” were defined to include the following vascular plants, mosses, and lichens:

- species listed on Schedule 1 of the *Canadian Species at Risk Act* (SARA) as amended (Government of Canada 2002);
- species assigned a status of Extinct, Extirpated, Endangered, Threatened, or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2012); and
- species on the British Columbia Ministry of Environment’s provincial Red or Blue lists (BC Conservation Data Centre 2011).

1.3.1 Methods

Three seasons of detailed site-specific fieldwork (2008, 2011, and 2012) were undertaken in the LAA. The collected data were analyzed in the office and lab between the field portions of the study. Rare plant sites reported from previous botanical work in the Project vicinity were also included in the assessment process. Sources for this additional information were:

- a reconnaissance-level study conducted in 2005 to locate and document rare plant resources in the general Project vicinity (LGL Limited 2006);
- rare plant data collected during the 2006 ecosystem mapping work; and
- British Columbia Conservation Data Centre (CDC) element occurrence data for tracked rare plants within the Local Assessment Area (BC Conservation Data Centre 2012o).

There are currently no formal BC RISC standards for conducting rare plant surveys, other than for the collection of voucher specimens (Resources Inventory Committee 1999). However, a number of organizations in North America have developed guidelines for these studies, and the methods used for the rare plant work are based on a synthesis of several of these guidelines (Bizecki-Robson 1998; Whiteaker et al. 1998; Alberta Native Plant Council 2000; California Native Plant Society 2001; Henderson 2009; Penny and Klinkenberg 2012).

1.3.1.1 Pre-field Review Methods

Each year’s rare plant investigation began with the development of a study plan to guide the methods, survey coverage, and timing of the work for that year. The first step was to prepare a list of rare vascular plants either already known to occur in the Project vicinity, or with a global range that is likely to include the Project vicinity. The following sources were consulted:

- BCCDC records of known BC- and SARA-listed rare plant occurrences within the vicinity of the LAA (BC Conservation Data Centre (BCCDC) 2012a, 2012b, 2012c);
- internal data from the previous years' Site C rare plant surveys (where applicable);
- the report from the reconnaissance-level botanical survey performed in 2005 (LGL Limited 2006);
- species distribution maps on the Electronic Atlas of the Flora of British Columbia website (Klinkenberg 2012);
- published floras (e.g. Hitchcock et al. 1955; Flora of North America Editorial Committee 2007; Lawton 1971; Goward et al. 1994; Cody 1996; Goward 1999; Douglas et al. 2001);
- online databases (NatureServe 2011; BC Conservation Data Centre 2012q); and
- visits to established regional herbaria (including herbaria at the Royal British Columbia Museum, the University of British Columbia, the University of Alberta, the Royal Alberta Museum, and the Canadian National Museum).

These data were compiled to produce a list of target rare plant species with potential for occurrence within the LAA. It should be noted that the target list is used as a working guideline and can never be an exhaustive list of all potential rare plants for a given area. For this reason, botanists consider all described plant taxa while conducting surveys.

In order to better predict where undiscovered target rare species might exist in the LAA, botanists compared the habitat preferences of each target species with the ecosystem types found in the study area. All known rare plant occurrences were plotted using GIS, which were then referenced against the habitat mapping layers and aerial imagery, in order to correlate occurrence with ecosystem and land cover type. Queries were also run on the data to associate various terrain features with rare plant locations. These data were used to identify areas of possible high-suitability rare plant habitat in the LAA, and thus guide placement of survey sites and transects.

In 2011 and 2012, the previous years' survey sites were also used to determine survey coverage gaps. Unsurveyed areas were prioritized for sampling during the field season. Individual survey transects were chosen to provide a representative coverage of all habitats within the study area, with particular emphasis on those habitats determined to contain a higher probability of target species occurrence. Finally, once the survey sites were selected, the phenologies of the target species were reviewed to determine the optimum survey periods for each habitat.

The completed field plan for each year specified the target plant species and their likely habitats, the areas to be surveyed that season, and the timing window for those surveys. A work schedule was developed based on the phenologies of the target species. The plans were reviewed and refined throughout the field seasons as new information became available (e.g., when ancillary sites were added, or when field studies revealed new high-suitability rare plant habitats).

In order to refine their search images for the target taxa, the surveyors studied photographs, herbarium specimens, and species descriptions. In addition, they reviewed similar data for species that might be confused with the target taxa. For certain particularly difficult groups of species, tables of summary identification characteristics were prepared for field use. The goals were to maximize detectability of the target species and to reduce observer bias during the surveys.

Because the 2008 fieldwork also opportunistically collected mosses and lichens, target rare species lists were developed for these taxonomic groups following the 2008 surveys.

1.3.1.2 Field Surveys

The field work for all three years used the same general pedestrian survey methods, differing slightly in the types of transects walked and the specific data collected. All surveys were performed using either intuitive-controlled or targeted-meander search patterns (Krichbaum 1998; Whiteaker et al. 1998).

The intuitive-controlled search pattern is designed to locate the majority of rare plant occurrences within a limited geographic area. This protocol is appropriate for linear features, such as power line corridors and access roads, as well as irregularly shaped areas of limited size, including construction materials source areas, borrow pits, etc. Intuitive-controlled surveys provide thorough overall coverage of an area, but they can be time-consuming because of the detailed work required.

When using the intuitive-controlled search pattern:

- surveyors walk variable-width transects that are spaced relatively close together (typically so that the edge of the transect just surveyed is still visible to the surveyor or their partner—this distance varies based on the habitat surveyed and the detectability of the target species);

- surveyors attempt to locate all rare plant occurrences or high-suitability rare plant habitat within a defined unit in a systematic way (e.g., by walking in a zig-zag pattern along linear features, or in a contour pattern in a polygon feature); and
- surveyors attempt to traverse a representative cross-section of all low-suitability rare plant habitat within the unit.

In contrast, the targeted-meander search pattern is employed to locate the most rare plant occurrences in the least amount of time. It is used in relatively large areas where an intuitive controlled protocol would not be feasible, such as the proposed reservoir.

When using the targeted-meander search pattern:

- surveyors walk a transect oriented directly toward an area of high-suitability rare plant habitat or a unique landform feature, with no attempt made to keep transects closely spaced;
- surveyors specifically target a particular habitat or feature, and do not attempt to locate all high-suitability rare plant habitats that might be present in the area; and
- surveyors traverse low-suitability rare plant habitat in an opportunistic manner, making no attempt to visit a representative cross-section within the area.

Both survey techniques are habitat-directed; that is, they preferentially cover high-suitability ecosystems over the more common low-suitability habitats (MacDougall & Loo 2002). Both survey methods are also floristic in nature: meaning that all plant taxa encountered are recorded and identified to a level necessary to determine their rarity (Alberta Native Plant Council 2012). Furthermore, both search patterns are variable-intensity, such that when a rare plant occurrence or high-suitability rare plant habitat is located, the surveyors increase the intensity of their survey by narrowing the spacing of the transect pattern they are walking. Depending on the kind of habitat being surveyed and the detectability of the target rare species, this can require very close, hands-and-knees survey work in certain areas.

With both intuitive-controlled and targeted-meander techniques, the surveyors constantly monitor all areas traversed for changes in habitat and plant association, as well as for previously unrecorded plant species (common and rare). Lists are kept of all vascular plants and plant communities observed; unknown species are collected for later identification in the lab when doing so would not compromise the viability of the populatoin; global positioning system (GPS) units are used to mark location points as appropriate; and notes and photographs are taken to record plants of interest, landforms and unique features, habitat quality and disturbance, and areas requiring further survey.

For all three survey years, when target rare plants were found during the field work, element occurrence data were recorded on a BCCDC rare plant survey form (BC Conservation Data Centre 2012p). This information was later transcribed into digital format to facilitate analysis of the sites. Digital photographs were taken of both the individual plants and of the surrounding habitat. Consistent with both the RISC guidelines and the rare plant survey guidelines on the BC E-Flora website (Resources Inventory Committee 1999; Penny and Klinkenberg 2012), a voucher specimen was collected when doing so would not compromise the viability of the population. In addition, in 2011 and 2012, the boundary of each occurrence (and subpopulation where applicable) was recorded into the GPS units to facilitate mitigation planning.

Survey efforts in 2008 were directed at areas within the Peace River corridor (both above and below the proposed dam site), and also included some transects in and near the existing transmission line corridor. Transects bisected multiple TEM units, with non-target polygons being surveyed on the way to the targeted sites. The goal for the 2008 season was to survey a representative cross-section of the major habitat types at each survey location, with particular emphasis on those habitats thought to contain the highest potential for rare plant occurrence. A GIF (BC Ministry of Environment, Lands and Parks and BC Ministry of Forests 1998) was used to record information about each TEM polygon encountered.

The 2011 rare plant field surveys focused on areas where direct disturbance of vegetation was anticipated, as per the 2011PAZ. This included the following proposed facilities: the dam site, transmission line corridor, the reservoir, and four construction materials source areas.

Intuitive-controlled surveys were performed in many sections of the transmission line corridor between the dam site and the Peace Canyon Dam-—of the approximately 73 kilometres of transmission line corridor proposed for Project use, 33 kilometres (45%) were surveyed in 2011. The 85th Ave. Industrial Lands and Wuthrich materials source areas were also surveyed at the intuitive-controlled level, due to their relatively small size. Targeted-meander survey transects were completed at selected locations in the dam site, in the reservoir along the Peace and Halfway rivers, and at the Bullhead Mountain[7] and West Pine materials source areas.

The 2012 survey methods were identical to those used in 2011, although different areas were targeted. The goal in 2012 was to address the survey gaps from previous years, and to survey proposed Project facilities that had been added to the PAZ since the 2011 fieldwork (access roads, materials source areas, etc.). Intuitive-controlled surveys were carried out along linear features, including portions of the existing access roads proposed for upgrade, new proposed access roads, the transmission line corridor, and the Highway 29 realignment areas. Targeted-meander searches were conducted in selected locations of the proposed dam site, and the Area E and Portage Mountain proposed materials source areas. **Table 1.3.1** provides a summary of the effort for all three years of site-specific rare plant surveys.

Table 1.3.1 Rare plant field survey summary

Year	Dates	Botanist-Field-Days[a]	Transects Surveyed[b]	No. of Botanists
2008	Jul 15–25 Sept 14–21	32	50	2
2011	Jul 4–13 Jul 19–27 Aug 3–12 Aug 18–28 Sept 22–29	86	118	2
2012	Jun 19–27 Jul 13–22 Aug 8–17	54	71	2

[a] Number of days the survey crew was in the field multiplied by the number of botanists on the crew
[b] Number of transects walked in the season multiplied by the number of botanists on the crew

1.3.1.3 Data Analysis Methods

Collected data on all known rare plant occurrences in the Project vicinity were compiled into a single, spatially enabled relational database (\\PostgreSQL Global Development Group 2012;

[7] Bullhead Mountain has since been removed from consideration as a source area

Refractions Research 2012). Layers from the ecossytem mapping work were imported, as well as VRI data obtained from the BC Ministry of Forests, Lands and Natural Resource Operations (2012). Base vector layers were obtained and added to the database from the TRIM (BC Crown Registry and Geographic Base 2012), supplemented with CanVec data where gaps in the TRIM data existed (Natural Resources Canada 2012c). Colour relief hillshades were prepared from the 1:50,000 scale Canadian Digital Elevation Data (Natural Resources Canada 2012a). The hillshade layers, along with CanImage Landsat 7 orthoimages (Natural Resources Canada 2012b), were added to the database to serve as raster underlays.

The Project rare plant spatial database was cross-referenced to two other non-spatial datasets to aid in the analysis. The first of these was the dataset of all BC plant species codes and selected attributes maintained by the Biogeoclimatic Ecosystem Classification Program (BC Forest Service Research Branch 2012). This dataset served as the reference for scientific and common names used for the study. The second cross-referenced dataset was the full attribute export from the BCCDC's Species and Ecosystems Explorer (BC Conservation Data Centre 2011). This dataset served as the reference for the conservation statuses of the study area plants. Both cross-referenced datasets were downloaded and updated periodically throughout the course of the study to reflect the latest revisions. **Table 1.3.2** presents all of the datasets used in the analysis.

Table 1.3.2 Datasets used in the rare plant effects assessment

Dataset	Contents	Last Updated
Rare Plant Occurrence Data 2012	Rare plant site data collected during 2012 site-specific field surveys	2012-09-28
Rare Plant Occurrence Data 2011	Rare plant site data collected during 2011 site-specific field surveys	2012-09-28
Rare Plant Occurrence Data 2008	Rare plant site data collected during 2008 site-specific field surveys	2011-01
General Site Data 2006	Rare plant data collected during ecosystem mapping in 2006	2012-09-28
General Site Data 2005	Rare plant data collected during LGL 2005 reconnaissance-level rare plant survey of Project vicinity	2006-04
Habitat Mapping Units	TEM ecosystem polygons with full attributes	2012-10-17

Dataset	Contents	Last Updated
Vegetation Resource Inventory	Ecosystem polygons from the Vegetation Resources Inventory Program	Unknown
BC Terrain Resource Information Management base layers	Various BC Terrain Resource Information Management (TRIM) layers	various dates
CanVec	Various CanVec base layers	various dates
Canadian Digital Elevation Data	1:50,000 Digital Elevation Data	various dates
CanImage	1:50,000 Landsat 7 Orthoimages	2003-04-10
Site C Proposed Project Facilities	Proposed facilities for the Site C Project	2012-10-01
BC Plant Species Codes	British Columbia plant species codes and selected attributes: Version 7	2012-03
BC CDC Ecosystem Explorer Export	Full attribute export of all BC CDC tracked taxa	2012-09-11

1.3.2 Results

The final list of target rare plants is presented in **Appendix D**. It includes 119 vascular plants, 44 mosses, and 42 lichens. It should be noted that although the species listed in **Appendix D** received the most focus during the investigation, all taxa meeting the definition of "rare plants" described above were considered during the field surveys, even if they were not thought to have potential for occurrence within the LAA.

In total, 781 vascular plant taxa were recorded in the LAA over the three site-specific field study years (**Appendix F**; **Map 1.4.5** and **Map 1.4.6**). One hundred seven (107) mosses and 217 lichens were found during the 2008 field surveys.

1.3.2.1 <u>BC-Listed Vascular Plants</u>

Thirty-nine provincially red- or blue-listed vascular plant taxa are known to occur within the LAA (**Table 1.3.3**). This includes occurrences found during the 2008, 2011, and 2012 site-specific surveys, as well as records from previous botanical work in the area. Of these 39 taxa, 11 are red-listed and the remaining 28 are blue-listed. No SARA Schedule 1 plant taxa were found.

Likewise, no plant species ranked by COSEWIC as Extinct, Extirpated, Endangered, Threatened, or Special Concern were located. Species accounts for each of the 39 BC-listed vascular plant species known in the LAA are presented in **Appendix G**.

Table 1.3.3 Rare vascular plants found within the LAA

Scientific Name	Authority	Common Name	BC List	Previous[a]	2008	2011	2012	Total
Anemone virginiana var. *cylindroidea*	Boivin	riverbank anemone	Blue	11	6	5	5	27
Arnica chamissonis ssp. *incana*	(A. Gray) Maguire	meadow arnica	Blue	1	1	2	0	4
Artemisia herriotii	Rydb.	western mugwort	Red	24	8	8	0	40
Atriplex gardneri var. *gardneri*	(Moquin-Tandon) D. Dietrich	Gardner's sagebrush	Red	2	0	0	0	2
Calamagrostis montanensis	(Scribn.) Scribn.	plains reedgrass	Blue	4	2	2	2	10
Carex heleonastes	L. f.	Hudson Bay sedge	Blue	0	1	0	0	1
Carex sychnocephala	Carey	many-headed sedge	Blue	0	1	0	0	1
Carex tenera	Dewey	tender sedge	Blue	0	6	0	0	6
Carex torreyi	Tuckerm.	Torrey's sedge	Blue	2	0	1	0	3
Carex vulpinoidea	Michx.	fox sedge	Blue	0	1	0	0	1
Carex xerantica	Bailey	dry-land sedge	Red	3	0	0	1	4
Chrysosplenium iowense	Rydb.	Iowa golden-saxifrage	Blue	1	1	0	0	2
Cicuta virosa	L.	European water-hemlock	Blue	0	1	7	2	10
Cirsium drummondii	T. & G.	Drummond's thistle	Red	3	2	2	4	11
Eleocharis elliptica	Kunth	elliptic spike-rush	Blue	1	0	0	0	1

Scientific Name	Authority	Common Name	BC List	Previous[a]	2008	2011	2012	Total
Epilobium halleanum	Hausskn.	Hall's willowherb	Blue	0	2	0	0	2
Epilobium saximontanum	Hausskn.	Rocky Mountain willowherb	Red	2	0	0	0	2
Galium labradoricum	(Wieg.) Wieg.	northern bog bedstraw	Blue	4	1	1	0	6
Glyceria pulchella	(Nash) K. Schum	slender mannagrass	Blue	1	0	0	0	1
Helictotrichon hookeri	(Scribn.) Henrard	spike-oat	Blue	18	2	1	2	23
Juncus arcticus ssp. *alaskanus*	Hult.	arctic rush	Blue	0	1	3	0	4
Juncus confusus	Cov.	Colorado rush	Red	2	0	0	0	2
Lomatium foeniculaceum var. *foeniculaceum*	(Nutt.) Coult. & Rose	fennel-leaved desert-parsley	Red	2	0	0	0	2
Malaxis brachypoda	(A. Gray) Fern.	white adder's-mouth orchid	Blue	0	1	0	0	1
Muhlenbergia glomerata	(Willd.) Trin.	marsh muhly	Blue	0	1	0	0	1
Oxytropis campestris var. *davisii*	Welsh	Davis' locoweed	Blue	1	4	5	0	10
Pedicularis parviflora ssp. *parviflora*	Sm. ex Rees	small-flowered lousewort	Blue	0	1	0	0	1
Penstemon gracilis	Nutt.	slender penstemon	Red	8	1	0	0	9
Polypodium sibiricum	Siplivinskij	Siberian polypody	Red	0	0	0	2	2
Rosa arkansana var. *arkansana*	T.C. Porter	Arkansas rose	Blue	1	0	0	0	1
Salix petiolaris	Sm.	meadow willow	Blue	0	1	0	0	1

Scientific Name	Authority	Common Name	BC List	Previous[a]	2008	2011	2012	Total
Salix serissima	(L.H. Bailey) Fern.	autumn willow	Blue	0	1	0	0	1
Schizachyrium scoparium	(Michx.) Nash	little bluestem	Red	5	0	0	0	5
Selaginella rupestris	(L.) Spreng	rock selaginella	Red	1	0	0	0	1
Silene drummondii var. *drummondii*	Hook.	Drummond's campion	Blue	5	0	1	2	8
Sphenopholis intermedia	(Rydb.) Rydb.	slender wedgegrass	Blue	0	2	1	0	3
Symphyotrichum puniceum var. *puniceum*	(L.) Á. Löve & D. Löve	purple-stemmed aster	Blue	0	6	18	7	31
Trichophorum pumilum	(Vahl) Schinz & Thell.	dwarf clubrush	Blue	0	1	0	0	1
Utricularia ochroleuca	R.W. Hartman	ochroleucous bladderwort	Blue	0	0	1	0	1
Total BC-Listed				**102**	**55**	**58**	**27**	**242**
Cicuta sp. nov.	not described	no common name	-	0	1	0	0	1
Elymus sp. nov.	not described	no common name	-	0	2	0	0	2
Erigeron pacalis ined.	not described	no common name	-	0	1	0	0	1
Erigeron sp. nov. (aff cespitosus)	not described	no common name	-	0	2	0	0	2
Platanthera aplectra ined.	not described	no common name	-	0	2	0	0	2
Rorippa calycina	(Engelmann) Rydberg	persistent-sepal yellowcress	-	0	3	0	0	3
Total non-BC-Listed				**0**	**11**	**0**	**0**	**11**

[a] The column 'Prev' indicates the total number of occurrences known previous to the site-specific studies. This includes data from earlier general botanical studies in the Project vicinity, and BCCDC element occurrence records.

The 39 BC-listed vascular taxa are distributed in a total of 242 occurrences. Some of these occurrences were further divided into subpopulations, for a total of 334 distinct subpopulations[8].

Spatial analysis of the frequency of occurrences shows that certain TEM units contain higher or lower numbers of rare plant subpopulations than would be expected if the subpopulations were randomly distributed (**Figure 1.3.1**). Seven TEM unit types contained rare plant subpopulation totals that were greater than three times the expected random frequencies: CB (Cut Bank); PD (Pond); RN (Railroad Bed); SE (Sedge Wetland); TS (Tamarack–Sedge Bog); WS (Willow–Sedge Wetland); and WW (Fuzzy-spiked Wildrye – Wolf Willow Slope)[9].

Likewise, a spatial analysis comparing the total area of rare plant occurrences per TEM unit with the expected area if distribution was random yielded similar results (Error! Reference source not found.). When analyzed in this way, five TEM unit types contained total rare plant areas that were more than three times greater than the expected random distribution. Four of these (CB, SE, TS, and WS) were the same units identified as high-suitability rare plant habitat in the analysis of occurrence frequencies described above. The fifth TEM unit type, BT (Black Spruce – Labrador Tea – Sphagnum Bog), was not identified as a high-suitability rare plant habitat in the preceding analysis.

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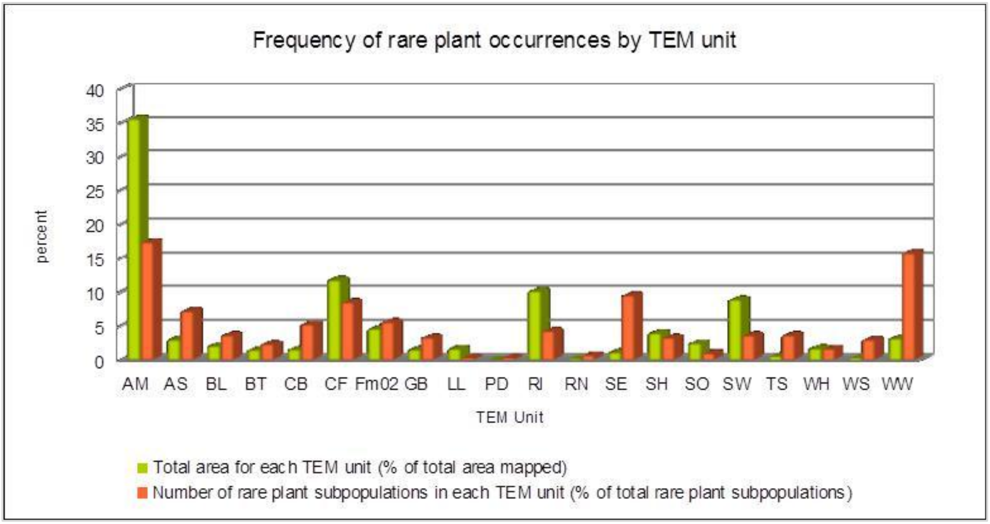
[8] Natureserve uses a habitat-based decision tree for delineating most rare plant Element Occurrences (http://www.natureserve.org/explorer/decision_tree.htm). In summary, if two distinct groupings of a particular rare plant are located closer than a certain distance apart, they are considered to be a single Element Occurrence, and the smaller groupings are called subpopulations or sub-occurrences.

[9] Based on the number of subpopulations in each TEM unit (expressed as a percentage of the total observed in all units), versus the total mapped area of each TEM unit (expressed as a percentage of the total area mapped).



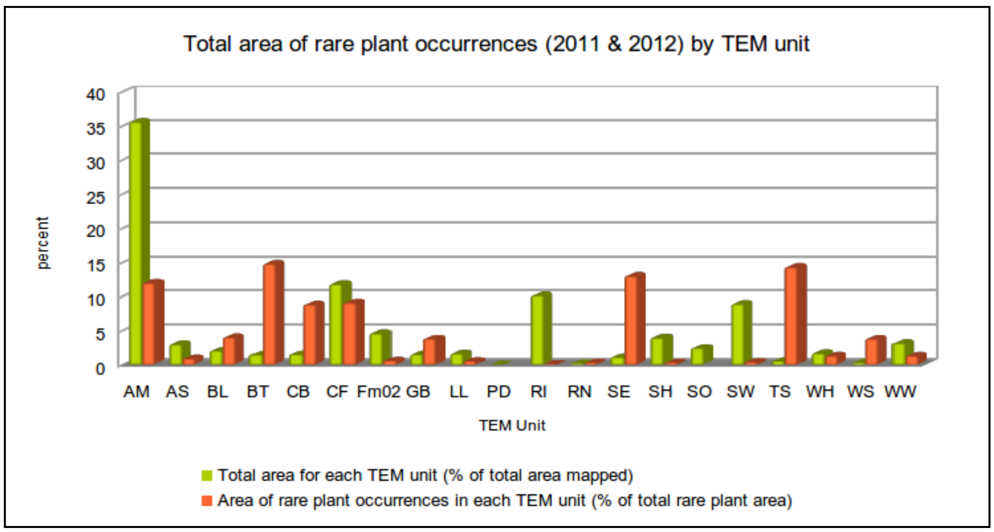


Figure 1.3.1 Frequency of rare plant occurrences by TEM unit

Care must be exercised when interpreting these results, as certain limitations exist (total subpopulation numbers were too low to determine statistical significance, survey transect location was biased towards assumed high-suitability habitats, etc.). Given the large differences in expected versus observed rare plant frequencies and areas, these TEM unit types likely represent the highest suitability rare plant habitats in the LAA.

When analyzed by general habitat types, a similar pattern of rare plant habitat affinity emerges (**Table 1.3.4**). Nearly half of the 2008, 2011, and 2012 BC-listed vascular plant occurrences in the LAA (49.3%) were reported to occur in wetland habitats. An additional 20.7% of the occurrences were found in upland forest. A further 19.3% were located on riparian cobble bars, and the remaining 10.7% were found in open grassland habitat.

Table 1.3.4 Rare vascular plant occurences by general habitat type

General Habitat Type	Number of Rare Occurrences	Percent of total
Wetland	69	49.3%
Upland Forest	29	20.7%
Riparian Cobble Bar	27	19.3%
Upland Grassland	15	10.7%

1.3.2.2 Other Vascular Plants of Interest

As well as the 39 BC-listed vascular plant species discussed above, one other described rare vascular plant was found that is likely of conservation concern. This species—*Rorippa calycina* (persistent-sepal yellowcress)—was not known from BC prior to the 2008 Project rare plant surveys, and therefore is not assigned a status by the BCCDC. However, the species is considered rare throughout its known range. Additional details on persistent-sepal yellowcress are presented in **Appendix G**.

Five other potential vascular plant taxa were found that appear to be undescribed species (see bottom of (**Table 1.3.3**). Research to determine the taxonomic authenticity of these five potential species is ongoing, although it is not expected that any will be formally described and accepted as valid taxonomic entities for several years.

1.3.2.3 BC-Listed Rare Mosses

Three BC-listed moss species were identified within the study area during the 2008 field surveys (**Table 1.3.5**). The three species, all Blue-listed, were found in five occurrences. No SARA Schedule 1 mosses were reported, nor were any COSEWIC Extinct, Extirpated, Endangered, Threatened, or Special Concern moss species located.

Table 1.3.5 Rare BC-listed mosses found within the LAA

Scientific Name	Authority	Common Name	BC List	Provincial Rank	Occurrences	Habitat
Aloina bifrons	(De Not.) Delg.	None	Blue	S2S3	1	Open cutbank
Amblyodon dealbatus	(Hedw.) B.S.G.	None	Blue	S3	1	Tufa seep

Scientific Name	Authority	Common Name	BC List	Provincial Rank	Occurrences	Habitat
Pohlia sphagnicola	(Bruch & Schimp.) Lindb. & Arnell	None	Blue	S2S3	3	Bogs

1.3.2.4 BC-Listed Rare Lichens

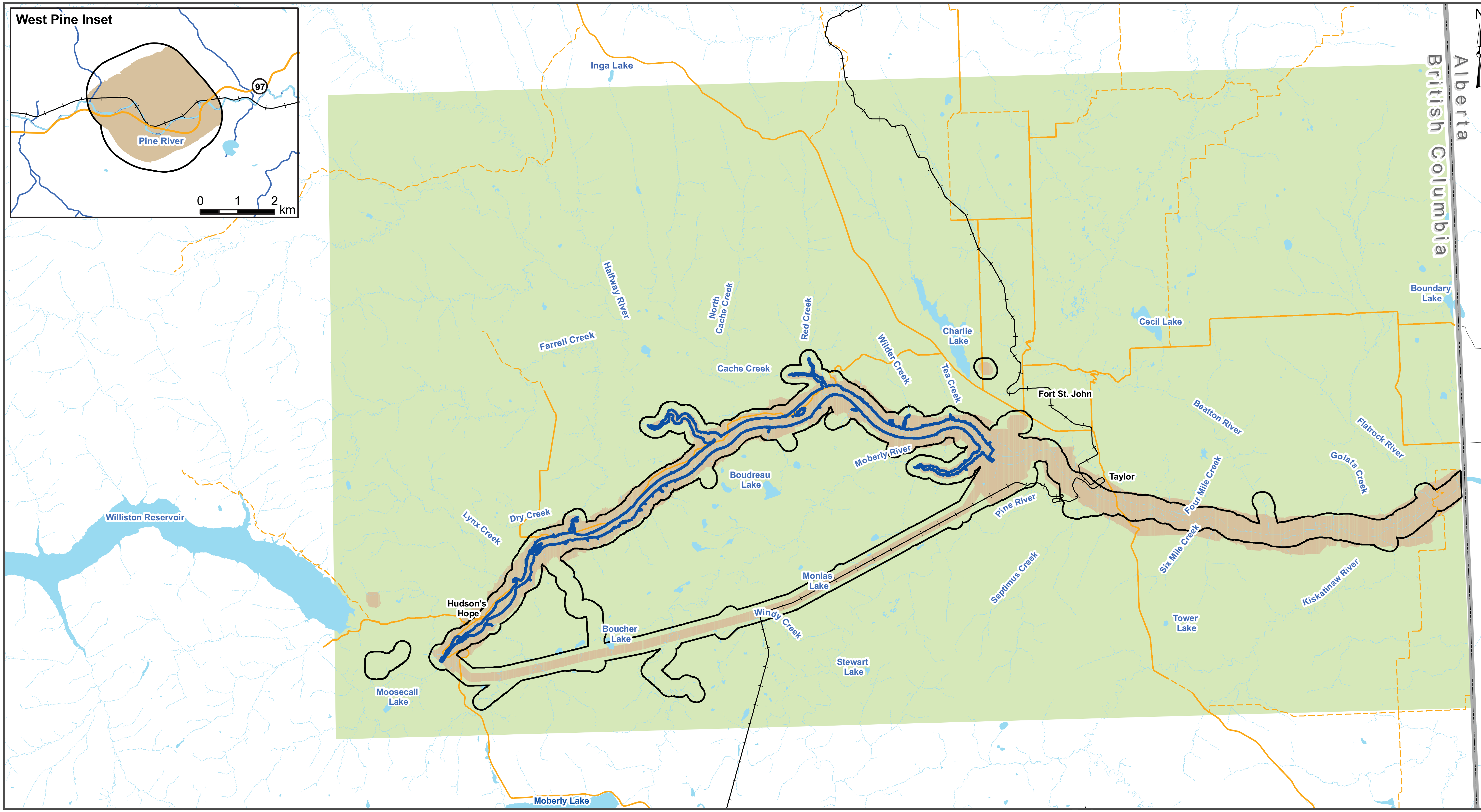
The 2008 surveys documented 29 occurrences of 10 BC-listed lichen species (**Table 1.3.6**). The 29 occurrences were scattered throughout the study area, principally in non-wetland habitats. No SARA Schedule 1 lichens were found. Likewise, no COSEWIC Extinct, Extirpated, Endangered, Threatened, or Special Concern lichens were located.

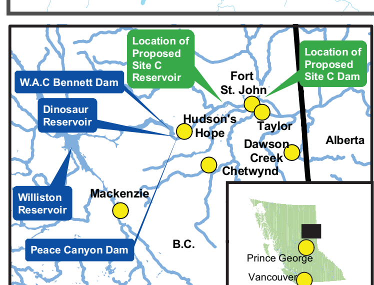
Table 1.3.6 Rare BC-listed lichens found in the LAA

Scientific Name	Authority	Common Name	BC List	Provincial Rank	Occurrences	Habitat
Collema multipartitum	Sm.	protracted tarpaper	Red	S2	2	gravelly slope crests
Lempholemma polyanthes	(Bernh.) Malme	mourning phlegm	Blue	S2S3	1	dry tufa
Leptogium intermedium	(Arnold) Arnold	Fourty-five vinyl	Blue	S2S3	2	old-growth humid forest
Leptogium tenuissimum	(Dickson) Korber	birdnest vinyl	Red	S2?	1	dry tufa
Peltigera evansiana	Gyelnik	peppered pelt	Red	S2	5	forests
Phaeophyscia hirsuta	(Mereschk.) Moberg	smiling shadow	Red	S2	2	riparian forests
Phaeophyscia kairamoi	(Vain.) Moberg	five o'clock shadow	Blue	S3	3	riparian forests
Physcia stellaris	(L.) Nyl.	immaculate rosette	Blue	S3	10	forests

Scientific Name	Authority	Common Name	BC List	Provincial Rank	Occurrences	Habitat
Ramalina sinensis	Jatta	threadbare ribbon	Blue	S2S3	1	dry forests
Squamarina lentigera	(Weber) Poelt	snow white dimple	Red	S1S3	2	open grasslands

1.4 Maps





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Proposed Reservoir Area (461.8 m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August 2006.
5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2012.

LEGEND
- Proposed Reservoir
- Gravel Road
- Paved Road
- Rail Line
- Provincial/Territorial Boundary

Wildlife Data
- Terrestrial Ecosystem Mapping
- Broad Habitat Mapping
- Wildlife Resources, Vegetation and Ecological Communities Local Assessment Area (LAA)

1:450,000

0 5 km

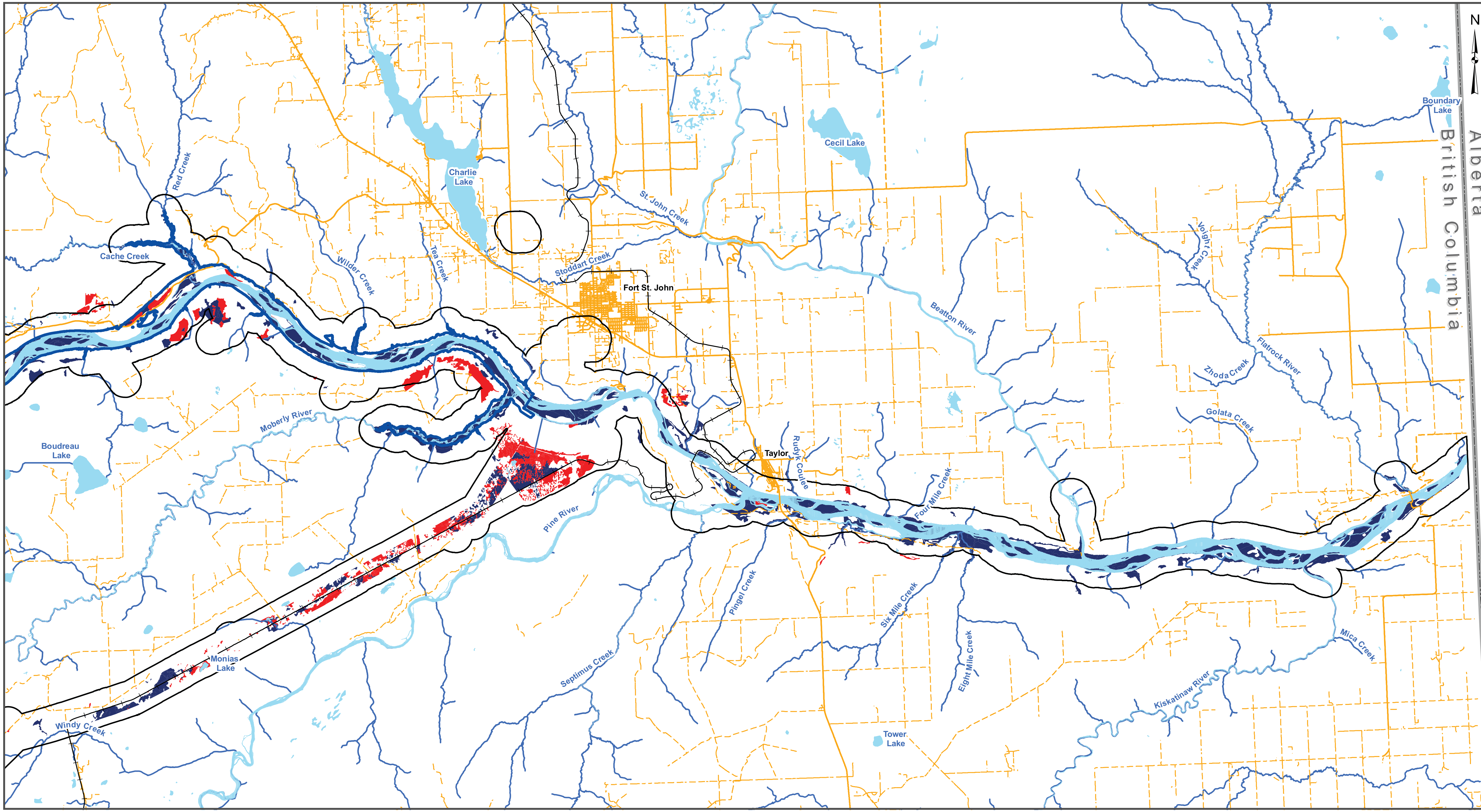
BC hydro

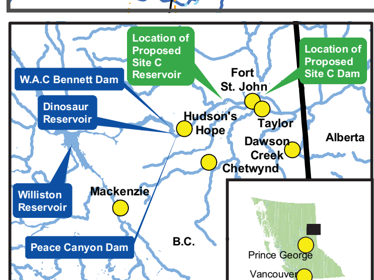
SITE C CLEAN ENERGY PROJECT

MAP 1. ECOSYSTEM MAPPNG EXTENTS

DATE	JANUARY 4, 2013	DWG NO	1016-C14-B4539-1	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Proposed Reservoir Area (461.8 m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August 2006.
5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2012.

LEGEND

- Proposed Reservoir
- Gravel Road
- Paved Road
- Rail Line
- Provincial/Territorial Boundary

Wildlife Data

- Site Series Associated with Blue-listed Ecological Community
- Site Series Associated with Red-listed Ecological Community
- Wildlife Resources, Vegetation and Ecological Communities Local Assessment Area (LAA)

1:225,000

0 5 km

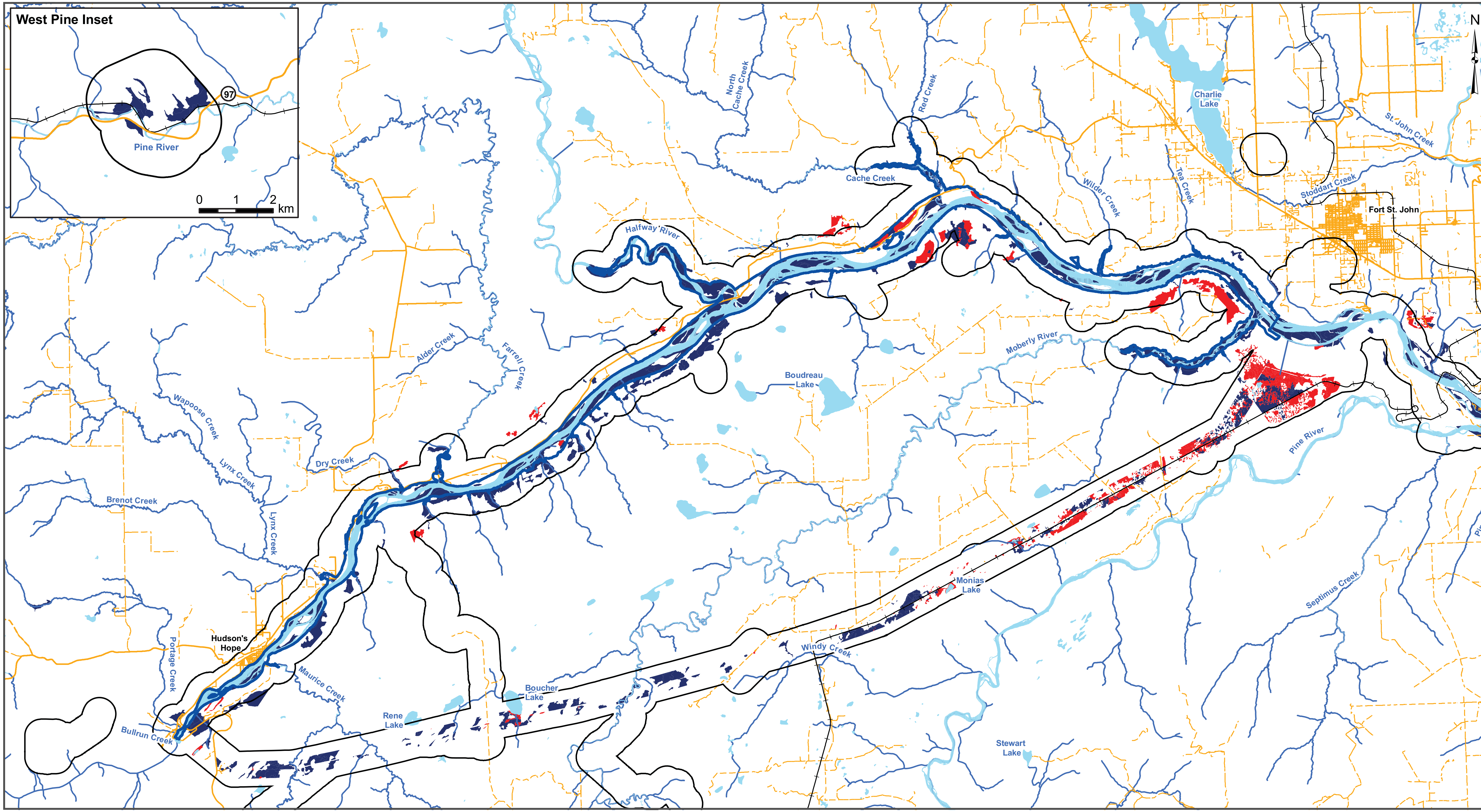
BC hydro

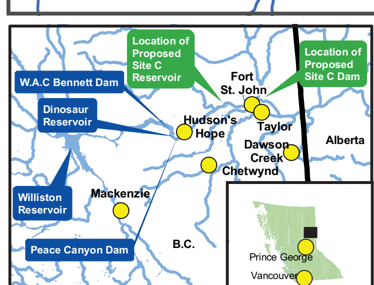
SITE C CLEAN ENERGY PROJECT

MAP 1.4.1. SITE SERIES ASSOCIATED WITH RARE ECOLOGICAL COMMUNITIES WITHIN THE LAA - EAST

DATE	JANUARY 3, 2013	DWG NO	1016-C14-B4539-2	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Proposed Reservoir Area (461.8 m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August 2006.
5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2012.

LEGEND

- Proposed Reservoir
- Gravel Road
- Paved Road
- Rail Line

Wildlife Data

- Site Series Associated with Blue-listed Ecological Community
- Site Series Associated with Red-listed Ecological Community
- Wildlife Resources, Vegetation and Ecological Communities Local Assessment Area (LAA)

1:225,000

0 5 km

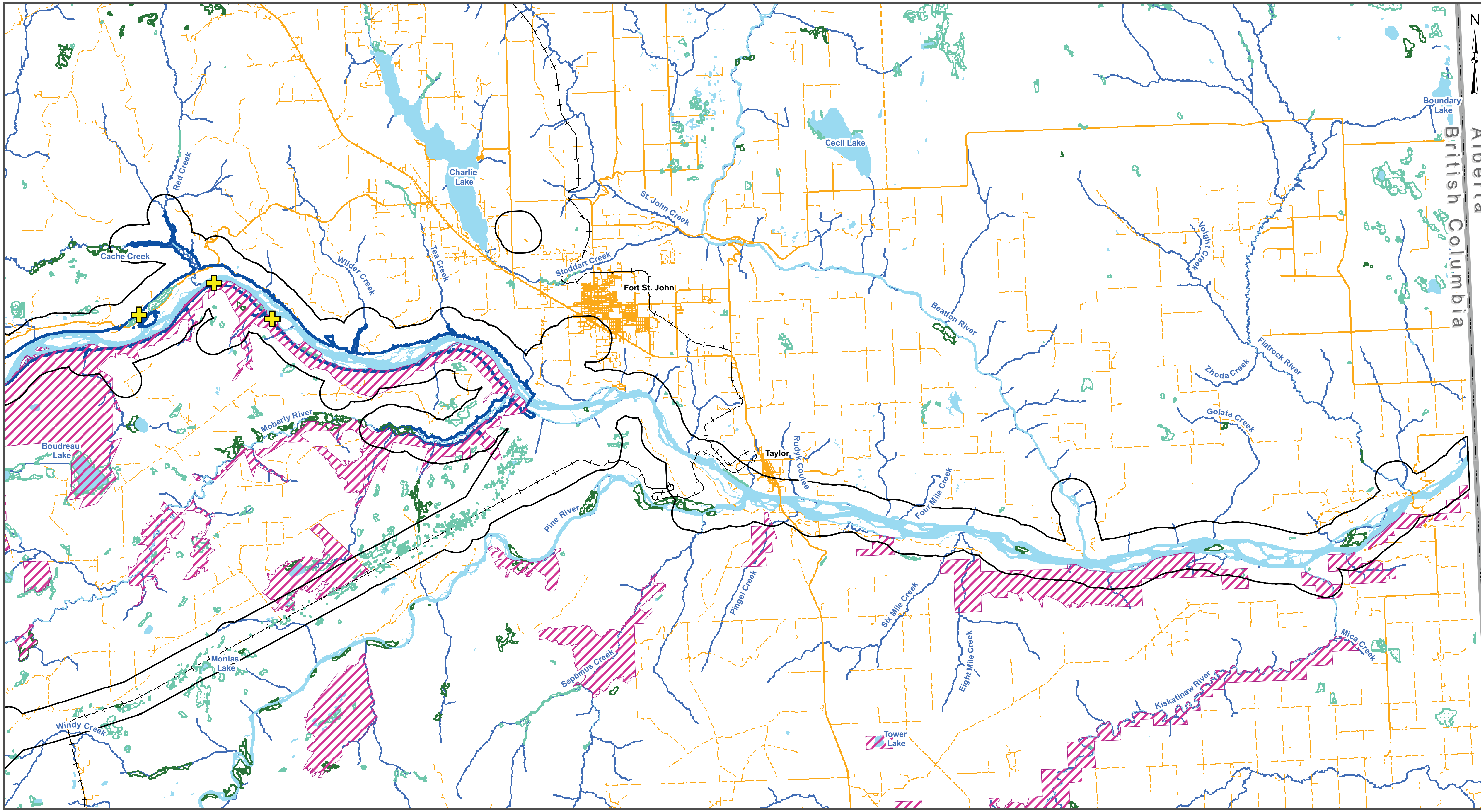
BC hydro

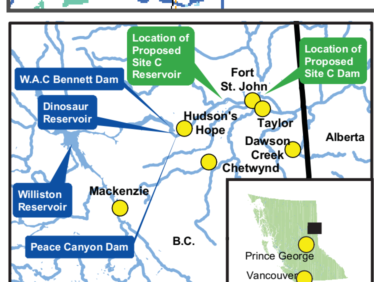
SITE C CLEAN ENERGY PROJECT

MAP 1.4.2. SITE SERIES ASSOCIATED WITH RARE ECOLOGICAL COMMUNITIES WITHIN THE LAA - WEST

DATE	JANUARY 3, 2013	DWG NO	1016-C14-B4539-2	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Proposed Reservoir Area (461.8 m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August 2006.
5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2012.

LEGEND
- Proposed Reservoir
- Gravel Road
- Paved Road
- Rail Line
- Provincial/Territorial Boundary

Wildlife Data
- Tufa Seep or Marl Fen
- Wetland
- Legal OGMA
- Structural Stage 7
- Conservation Framework Priority 2 Ecosystem
- Wildlife Resources, Vegetation and Ecological Communities Local Assessment Area (LAA)

1:225,000

0 5 km

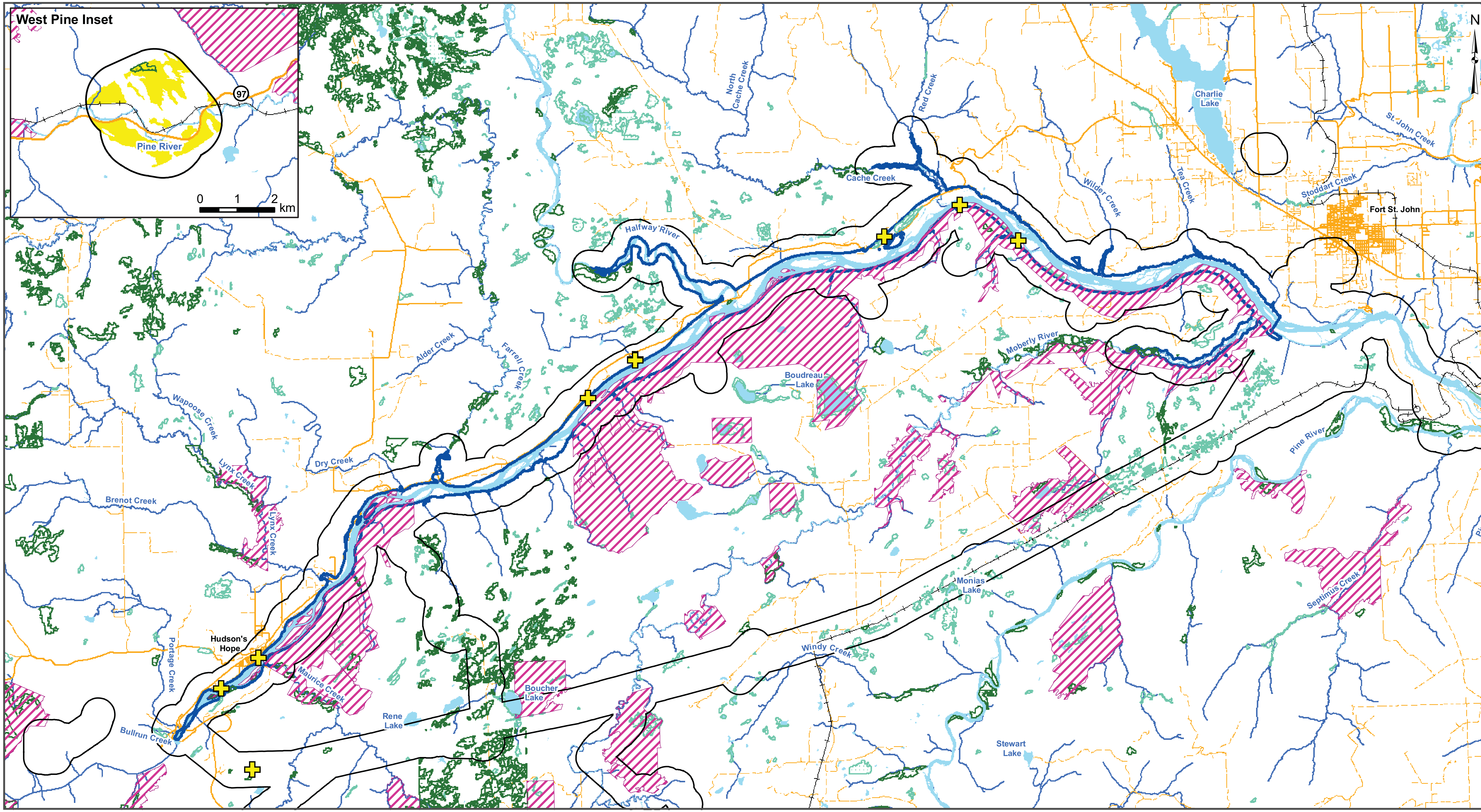
SITE C CLEAN ENERGY PROJECT

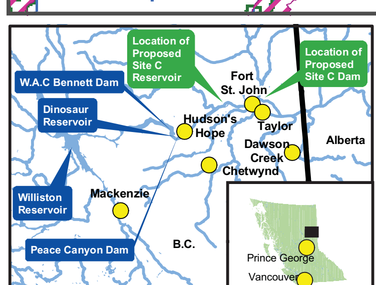
BC hydro

MAP 1.4.3. SENSITIVE ECOSYSTEMS - EAST

DATE	JANUARY 3, 2013	DWG NO	1016-C14-B4539-3	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification





LEGEND

- Proposed Reservoir
- Gravel Road
- Paved Road
- Rail Line

Wildlife Data

- Tufa Seep or Marl Fen
- Wetland
- Legal OGMA
- Structural Stage 7
- Conservation Framework Priority 2 Ecosystem
- Wildlife Resources, Vegetation and Ecological Communities Local Assessment Area (LAA)

Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Proposed Reservoir Area (461.8 m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August 2006.
5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2012.

1:225,000

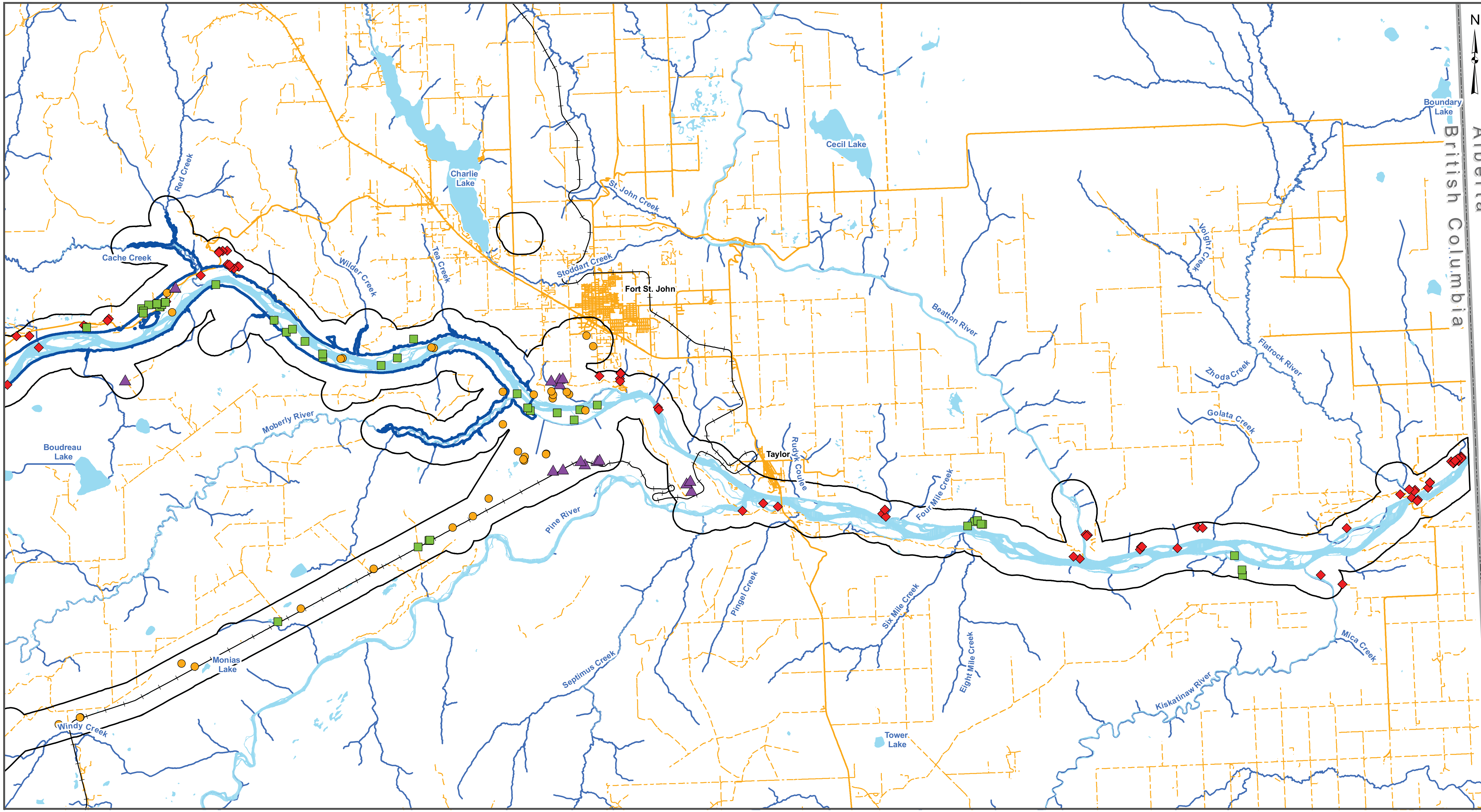
0 5 km

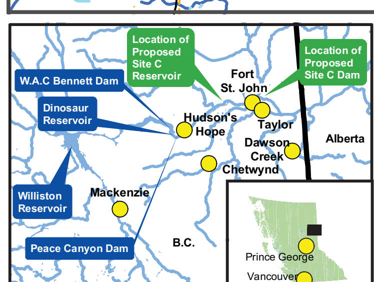
SITE C CLEAN ENERGY PROJECT

MAP 1.4.4. SENSITIVE ECOSYSTEMS - WEST

DATE	JANUARY 3, 2013	DWG NO	1016-C14-B4539-3	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Proposed Reservoir Area (461.8 m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August 2006.
5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2012.

LEGEND
- Proposed Reservoir
- Gravel Road
- Paved Road
- Rail Line
- Provincial/Territorial Boundary

Wildlife Data
- Rare Plant Location - Previously Reported
- Rare Plant Location - 2008
- Rare Plant Location - 2011
- Rare Plant Location - 2012
- Wildlife Resources, Vegetation and Ecological Communities Local Assessment Area (LAA)

1:225,000

0 5 km

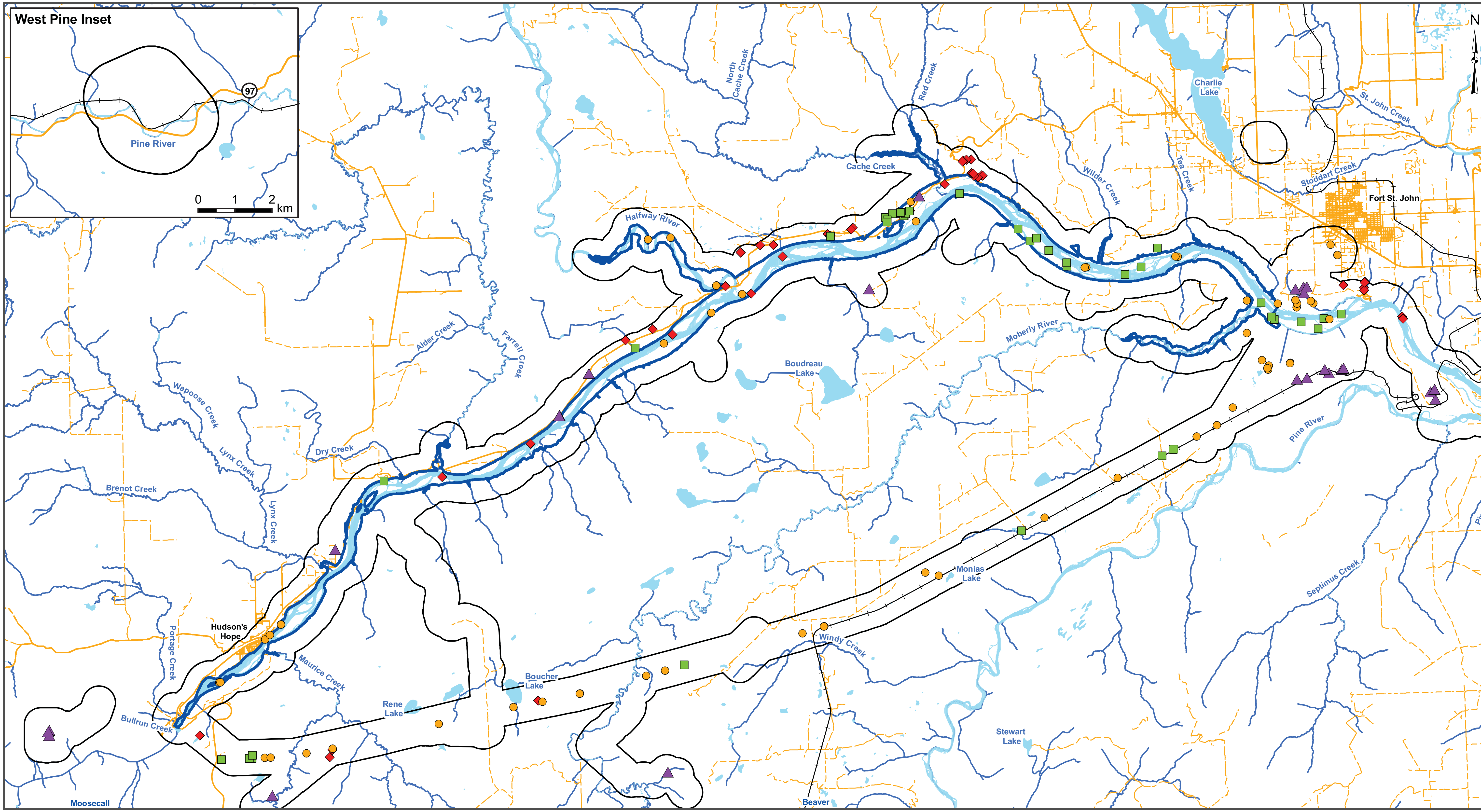
BC hydro

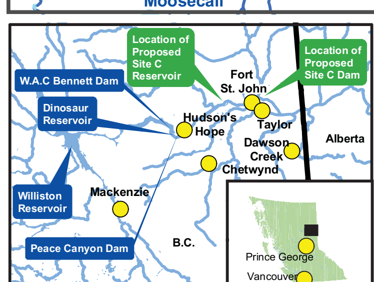
SITE C CLEAN ENERGY PROJECT

MAP 1.4.5. RARE PLANT LOCATIONS - EAST

DATE	JANUARY 3, 2013	DWG NO	1016-C14-B4539-4	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Proposed Reservoir Area (461.8 m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August 2006.
5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2012.

LEGEND
- Proposed Reservoir
- Gravel Road
- Paved Road
- Rail Line

Wildlife Data
- Rare Plant Location - Previously Reported
- Rare Plant Location - 2008
- Rare Plant Location - 2011
- Rare Plant Location - 2012
- Wildlife Resources, Vegetation and Ecological Communities Local Assessment Area (LAA)

1:225,000

0 5 km

BC hydro

SITE C CLEAN ENERGY PROJECT

MAP 1.4.6. RARE PLANT LOCATIONS - WEST

DATE	JANUARY 3, 2013	DWG NO	1016-C14-B4539-4	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification

2 POTENTIAL EFFECTS

The main effect of the Project on rare plants, at-risk ecological communities, and sensitive ecological communities is the direct loss of habitat through habitat alteration and fragmentation. Effects to terrestrial ecosystems and rare plants from the Project include:

- extirpation of existing occurrences
- reduction in the extent or vigour of known or potential occurrences

For the Project, the majority of adverse effects on terrestrial ecosystems and rare plants would be expected to occur during the construction phase. Habitat alteration through clearing of vegetation and grubbing during site preparation would be predominant during the early stages. As construction proceeds, water diversions associated with dam construction have the potential to change flow regimes on the Peace River, which may affect occurrences along the river margins. In the final stages of construction, reservoir filling would affect the occurrence of terrestrial ecosystems and rare plants through inundation of existing habitats. Occurrences within the reservoir would be inundated, while those near the new shoreline could experience changes to their supporting habitats.

Clearing activities have the potential to have indirect effects on nearby occurrences and habitat not directly located within the Project activity zone. These indirect effects are listed below.

- Increased competition with invasive plant species introduced or dispersed by site clearing activities. Disturbance may result in the establishment and spread of invasive exotic species. Weed seeds may be dispersed accidentally by machinery and establish in newly disturbed areas where native vegetation has been stripped. Once established, seeds from new populations may be carried by wildlife, domestic stock, wind and water to new locations. Invasive exotic species can often out-compete native vegetation, especially on disturbed sites.
- Contamination from road salt, herbicide, silt, or accidental spills of industrial fluids. The use of herbicides to control vegetation around and within Project PAZ may alter species composition within ecosystems. Run-off from Project roads may be contaminated with salt or other de-icing materials, oil and other fluids from machinery, or silt. Plant species that are more tolerant to the chemicals used are expected to replace species that are more sensitive, which may change the species composition of at-risk communities.

- Changes to hydrologic regimes (drying of wetlands, flooding of uplands, etc.) due to vegetation clearing, road building and ground disturbance nearby. Changes in hydrologic regime will result from the construction of the reservoir and from alteration of drainage patterns around roads and Project infrastructure. Changes in the amount, timing and duration of water supply will affect the characteristics of soils and the plant communities that grow on them. Some ecosystems, such as the floodplain and riparian communities, are adapted to fluctuating flows and periodic inundation (Rood and Goater 2007; Whited et al. 2007) and it is difficult to predict the effects of reservoir operations on them.
- Increased dust deposition on leaves and floral parts due to vegetation clearing and grubbing activities.
- Increased incidental human disturbance from foot and vehicle traffic.

During the operations phase, most of the adverse effects to terrestrial ecosystems and known rare plant occurrences would have already occurred but other direct and indirect effects are possible. Maintenance of the various Project facilities—including roads—could affect nearby occurrences due to vegetation management activities. Some Project components—such as the transmission line right-of-way—will be maintained in a grass-shrub successional stage. Periodic brushing and herbicides will be used to limit tree growth. Elimination of the tree layer will prevent development or recovery of forested rare ecosystems.

Operation of the dam is expected to result in changes to the surface water regime downstream. These conditions would be similar to the conditions currently experienced downstream of the Peace Canyon Dam (see Volume 2 Appendix D Surface Water Regime) and would be dampened by flow attenuation and tributary inputs – especially from the Pine River. The operational releases of the Peace Canyon Dam are bounded by the minimum flow requirement of 283 m^3/s and the maximum licensed discharge of 1,982 m^3/s. The proposed minimum flow for the Project is 390 m^3/s and the proposed maximum turbine discharge capacity is about 2,520 m^3/s. The range of operational releases is 1,699 m^3/s under existing conditions and would be approximately 2,130 m^3/s with the Project. The measurable changes are greatest in the approximate 16 km section of the Peace River between the dam and the Pine River confluence. With more frequent high and low flows, and associated wetted and dewatered areas, shoreline occurrences and habitat could be altered.

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For rare plants, it is difficult to predict in what manner a particular species will be affected since the disturbance responses for most rare plants have not been documented and certain rare plant species will tolerate a high level of ground or vegetation disturbance. Other rare plant taxa require an undisturbed environment and quickly decline when the habitat is degraded or disturbed. Because no empirical data on disturbance response for any of the rare plants could be located, it was assumed any Project-related activity that would change any environmental parameter within an occurrence would have an effect. While this is likely a conservative assumption, the analysis takes a precautionary approach in the absence of scientific consensus.

2.1 Habitat Alteration and Fragmentation

Habitat alteration for vegetation is defined as a permanent removal or loss of habitat or a reduction in habitat suitability. Direct effects include the loss or degradation of known occurrences as well as the loss of potential habitat where occurrences may develop (i.e. the site series associated with at-risk ecological communities, or habitats that are suitable for supporting rare plants).

Project components and related activities expected to cause habitat alteration include:

- **Dam, Generating Station and Spillways:** site clearing and preparation, temporary and permanent access roads, waste treatment and management facilities, refueling, truck washing sites, relocating surplus materials, sand and gravel source pits, Stage 1 and 2 channelization and diversion works, utilities movement and installation, infrastructure maintenance, and dam operations.
- **Reservoir:** Existing infrastructure relocation, shoreline protection, road upgrades and winter road construction, vegetation clearing, water management during construction and operations, and debris management.
- **Transmission Line:** vegetation removal, access construction and RoW improvement, tower installation, decommissioning and reclamation, substation upgrades, and vegetation maintenance during operations.
- **Highway 29 Realignment:** vegetation removal, temporary and permanent road construction, relocating/removing infrastructure and surplus materials, bridge construction and shoreline protection.
- **Construction Access Roads:** Site preparation, earthworks, drainage, and railway construction.
- **Quarried and Excavated Materials:** Site preparation, earthworks, and operations.
- **Worker Accommodation**: Temporary accommodation.

Project-related effects to individual rare plants are largely dependent on their location relative to the various Project components. How an occurrence responds to disturbance is an important determinant in predicting the size of the effect. Certain rare plant species will tolerate (and occasionally even thrive on) a high level of ground or vegetation disturbance. Other rare plant taxa require an undisturbed environment, and quickly decline when the habitat is degraded or disturbed.

The size of the individual occurrence is also a factor in determining how the population will respond to a given disturbance. Assuming that ground disturbance within the population creates an adverse effect, an occurrence containing one individual rare plant or a small extent of a sensitive ecosystem would likely be more heavily affected than an occurrence with thousands of plants or spread out over several hectares or more.

It is difficult to predict in what manner a particular species will be affected, since disturbance responses for most rare plants have not been documented. Because no empirical data on disturbance response could be located for any of the 39 BC-listed rare plants, it was assumed that any Project-related activity that would change any environmental parameter within an occurrence would have an adverse interaction. While this is likely a conservative assumption, this analysis takes a precautionary approach in the absence of scientific consensus.

Potential Project effects to terrestrial ecosystems – including at-risk and sensitive ecological communities – and to rare plants were quantified through spatial analysis. The proposed Project activity zones were used to generate overlay polygons, within which direct project effects to occurrences and to suitable habitat would be expected to occur. For rare plants, specific TEM units that have a greater potential for supporting rare plants were summarized to determine amounts that would be directly affected by both the construction and operations phases of the Project.

2.1.1 Terrestrial Ecosystems

The areas of terrestrial ecosystems that overlap with Project construction and operations – including erosion impact - are presented in **0**. The ecosystems most affected are the valley bottom forest and riparian wetland types that overlap with the reservoir. Two particular issues for that appendix are noted below.

- **0** shows that 83% of the available Gravel Bar ecosystem will be affected, but the confidence in this amount is low. These features vary in size, shape and location from year to year, depending on the height of the river and year the photos were taken; therefore, mapping accuracy is low for determining the current extent of gravel bars on the Peace River.
- **0** shows a high proportional effect within some of the SBSwk2 ecosystem units. Relatively little of the SBSwk2 was mapped within the LAA and most of what was mapped was

immediately around the PAZ. Although the percent of the mapped ecosystems within the PAZ may be high, the actual size of the area affected is not large.

Fragmentation of existing habitats will also occur as a result of the Project. The term 'fragmentation' is often used loosely to describe a variety of processes that operate at multiple scales. Habitat loss, edge effects, habitat subdivision and habitat isolation, among others, have all been included under the umbrella of 'fragmentation' (Lindenmayer and Fischer 2006) and the complexity of the interactions of those processes do not lend themselves to simple analyses (Bunnell 1999a; Ewers and Didham 2006). Fragmentation involves the 'separation' of habitat patches into one or more pieces, a process that requires that some portion of the original habitat patch be lost - transformed into less favourable or inhospitable habitat. Habitat loss is thus an integral part of fragmentation and it is difficult to assess effects of fragmentation separately from those of habitat loss (ibid). Assessment of fragmentation is further complicated by the effects of scale. What may be a habitat 'patch' to a moss species is unlikely to be perceived as a patch by a hawk. Definition of patches for analysis of fragmentation is often based upon conveniently available boundaries which may or may not be relevant to the organism(s) under consideration.

The abiotic conditions affecting plant communities may be modified by reductions in patch size, and local populations of clonal species may be more prone to extirpation in smaller, isolated patches (Cully et al. 2003; Holt et al. 1995) as they are more vulnerable to chance events. Larger patches offer more diversity of microclimates and may thus have higher biodiversity than smaller patches (ibid). It should be noted that some plants and plant communities occur naturally in small, scattered patches where a particular suite of environmental conditions is present. Natural selection has made those species adapted to thrive in isolated and patchy habitats that are naturally fragmented (Bunnell 1999a).

Recognizing the complexity of assessing fragmention many of the issues resulting in a reduction of patch size are addressed under habitat alteration. This includes the reservoir and most other Project components. For this report fragmentation as a result of the Project has been assessed by quantifying the amount of new permanent road to be constructed (Table 2.11.8). Road construction is often cited as a cause of fragmentation of natural habitat (Reed et al. 1996; Findlay and Bourdages 2000; Carr et al. 2002; Hansen and Clevenger 2005), and the construction of the road itself replaces a portion of the original habitat with nonvegetated road surface, roadbed material, and any associated drainage structures. Road construction has other consequences beyond loss of habitat. Corridors such as roads are colonization sites and dispersal routes for exotic species—in part because of reduced competition from native species not adapted to the conditions of disturbed habitat (Vankat and Roy 2002). Weed seeds are carried by vehicles and distributed along roadsides (Hansen and Clevenger 2005; Parendes and Jones 2000; Watkins et al. 2003). Habitat edges close to roadsides may function like corridors to facilitate further spread of exotics away from roads and into undisturbed areas (Vankat and Roy 2002).

Table 2.11.8 Length of new permanent road associated with the Project

Description	Linear length (km)
Hwy Realignment	30.2
Jackfish Lake Road extension	32.6
Old Fort Road	1.0
TOTAL	**63.7**

Most of the linear disturbances associated with the Project are located along existing roadways, existing railway line, existing transmission line corridor, or within habitat already affected by human activities—such as Cultivated Field—so the extent of new fragmentation is limited. Of the approximate 64 km of new permanent roads that would be constructed by the Project, nearly half is associated with the realignment of Highway 29 where the new alignments would pass through a number of cultivated fields. The other half is associated with access to the south along an extension of the Jackfish Lake Road. This new segment would be built adjacent to the existing corridor for the transmission line and railway. It passes through a variety of terrestrial habitats—including a number of wetlands in the eastern portion—as it approaches the dam site.

2.1.1.1 At-risk Ecological Communities

Summaries of the areas within PAZ that were mapped as ecosystem units associated with at-risk communities are presented in Table 2.1.1. Losses due to construction on BWBSmw1 forested sites associated with at-risk communities include 27% of the 05/SO, 44% of the 07/SH, and 42% of the 09/Fm02 mapped within the LAA. Other notable issues due to construction in the BWBSmw1 include construction within wetlands - over 12% of the available 00/SE, which is associated with 4 listed ecological communities, and 13% of the 00/WS wetland associated with one listed ecological community. It should be noted that a portion of this loss is due to the transmission line footprint. If the line is constructed to pass over the wetlands and towers are not placed within them there may be little loss, although indirect interactions from changes in hydrology or sediment runoff are still possible.

Table 2.1.1 Areas of ecosystem units associated with at-risk communities within construction and operations PAZ

Ecosystem Unit (associated rare community)	Total area in LAA (ha)	Hectares in PAZ							Phase
		Dam	Reservoir	TL	HWY	Roads	Quarry	Total	
BWBSmw1									
00/SE (Arctic rush - Nuttall's alkaligrass – Seablite) (Mat muhly - Arctic rush - Nevada bluegrass) (Common cattail marsh) (Scrub birch / Water sedge)	1,169	40	47	35	0	19	1	142	Construction
		0	<1	54	0	0	0	55	Operations
00/WS (Scrub birch / Water sedge)	363	3	28	14	0	5	0	50	Construction
		0	0	16	0	0	0	16	Operations
05/SO (White spruce / Oak fern – Wild sarsaparilla)	1,215	22	296	4	<1	5	0	328	Construction
		0	117	4	0	0	0	121	Operations
07/SH (White spruce / Red swamp currant / Horsetails)	1,699	18	716	5	<1	3	<1	743	Construction
		0	18	5	0	0	0	23	Operations

Ecosystem Unit (associated rare community)	Total area in LAA (ha)	Hectares in PAZ Dam	Reservoir	TL	HWY	Roads	Quarry	Total	Phase
08/BT (White spruce - Black spruce / Labrador tea / Glow moss) (Black spruce / Common horsetail / Peat-mosses) (Black spruce / Lingonberry / Peat-mosses)	2,051	7	13	54	0	19	<1	93	Construction
		0	<1	58	0	0	0	58	Operations
09/Fm02 (Balsam poplar – White spruce / Mountain alder – red-osier dogwood)	2,664	36	1,080	0	1	<1	0	1,117	Construction
		0	18	0	0	0	0	18	Operations
10/TS (Tamarack / Water sedge / Golden fuzzy fen moss)	1,405	13	13	32	0	9	<1	68	Construction
		0	0	47	0	0	0	47	Operations
BWBSwk1									
04/SW (White spruce – Lodgepole pine / Soopolallie / Showy aster)	52	0	0	0	0	0	23	23	Construction
SBSwk2									
00/Wf13 (Narrow-leaved cotton-grass – Shore sedge)	9	0	0	0	0	<1	<1	<1	Construction
02/LH (Lodgepole pine / Black huckleberry / Reindeer lichens)	70	0	0	0	0	0	25	25	Construction

Although **Table 2.1.1** shows high proportions of some ecosystems in the BWBSwk1 and SBSwk2 affected by Project construction, only small amounts of those subzones were mapped within the LAA. As stated above the high proportions affected are a function of the small areas mapped. The habitat alteration in those subzones is due only to construction so there are no anticipated operations effects once the Project is built. Additional habitat loss during operation of the Project will occur from anticipated bank erosion.

2.1.1.2 Sensitive Ecological Communities

2.1.1.2.1 Tufa Seeps and Marl Fens

Five of the seven known tufa sites and the single marl fen will be inundated by the reservoir and will be lost. One tufa site will be crossed by the proposed transmission line and one tufa site will be immediately outside the reservoir footprint, although it may be affected indirectly.

2.1.1.2.2 Old-growth

A summary of area (in hectares) of structural stage 7 within the LAA and potentially affected by the Project is presented in **Table 2.1.2**. Project construction and operations will remove less than 5% of the old-growth mapped in the LAA.

Table 2.1.2 Area of structural stage 7 affected by the Project

Total area (ha) in LAA	Dam	Reservoir	TL	Highway	Roads	Quarry	Total	Phase
1,135	0	39	0	0	0	4	43	Construction
		3	0	0	0	0	3	Operations

2.1.1.2.3 Grasslands

A summary of area (in hectares) of grassland potentially affected by the Project is presented in **Table 2.1.3**. Slightly over 10% of the grassland mapped in the LAA will be lost due to the Project, mostly due to construction of the reservoir – 86 ha - with an additional 101 ha expected to be lost during operations due to bank erosion.

Table 2.1.3 Area of grassland affected by the Project

Total area (ha) in LAA	Dam	Reservoir	TL	Highway	Roads	Quarry	Total	Phase
2,667	44	86	8	27	4	0	169	Construction
	0	101	7	0	0	0	108	Operations

2.1.1.2.4 Wetlands

A summary of the total area (in hectares) of wetlands within the LAA and potentially affected by the Project is presented in **Table 2.1.4**. The total area of wetlands directly affected due to Project construction is approximately 675 ha. The greatest proportional loss to vegetated wetlands is to the WH riparian wetland, primarily found along the margins and backchannels of the Peace River. An additional 121 ha of wetland has the potential to be affected during operations. It should be noted that a portion of this loss is due to the transmission line footprint. If the line is constructed to pass over the wetlands and towers are not placed within them there may be little direct change, although indirect interactions from changes in hydrology or sediment runoff are still possible.

Table 2.1.4 Wetland area affected by the Project

Ecosystem Unit	Total area (ha) in LAA	Hectares in PAZ							Phase
		Dam	Reservoir	TL	HWY	Roads	Quarry	Total	
BWBSmw1									
00/OW Open water	75	2	14	<1	0	<1	0	17	Construction
		0	0	1	0	0	0	1	Operations
00/PD Pond	34	0	4	<1	0	<1	<1	5	Construction
		0	<1	2	0	0	0	2	Operations
00/SE Sedge Wetland	1,169	40	47	35	0	19	1	142	Construction
		0	<1	54	0	0	0	55	Operations
00/WH Willow - Horsetail - Sedge - Riparian Wetland	1,010	1	391	<1	0	0	0	392	Construction
		0	<1	<1	0	0	0	1	Operations
00/WS Willow-Sedge Wetland	363	3	28	14	0	5.0	0	50	Construction
		0	0	16	0	0.0	0	16	Operations
10/TS Tamarack - Sedge - Fen	1,405	13	13	32	0	9	<1	68	Construction
		0	0	47	0	0	0	47	Operations
SBSwk2									
00/Wf13 Narrow-leaved cotton-grass-Shore sedge	9	0	0	0	0	<1	<1	<1	Construction

2.1.2 Rare Plants

In total, 142 BC-listed vascular plant occurrences have the potential to be directly affected during construction and operations. The remaining 100 occurrences known within the LAA are not expected to directly interact with the Project, although various indirect interactions are possible. One hundred twenty-two known rare plant occurrences could be lost during construction, with an additional 20 occurrences potentially lost during operations (**Table 2.1.5** and **Table 2.1.6**).

Table 2.1.5 Rare vascular plant occurrences potentially affected during construction

Species	Dam	Reservoir	TL	HWY	Roads	Quarry	Total
Anemone virginiana var. *cylindroidea* (riverbank anemone)	2	8	0	2	0	1	13
Arnica chamissonis ssp. *incana* (meadow arnica)	0	2	2	0	0	0	4
Artemisia herriotii (western mugwort)	0	15	0	0	0	0	15
Calamagrostis montanensis (plains reedgrass)	3	0	0	0	0	1	4
Carex heleonastes (Hudson Bay sedge)	0	1	0	0	0	0	1
Carex sychnocephala (many-headed sedge)	0	1	0	0	0	0	1
Carex tenera (tender sedge)	0	5	0	0	0	0	5
Carex torreyi (Torrey's sedge)	0	0	0	0	0	1	1
Carex xerantica (dry-land sedge)	0	0	0	0	0	1	1
Chrysosplenium iowense (Iowa golden-saxifrage)	0	1	1	0	0	0	2
Cicuta virosa (European water-hemlock)	1	0	2	0	3	0	6
Cirsium drummondii (Drummond's thistle)	2	4	1	0	0	0	7
Epilobium halleanum (Hall's willowherb)	0	1	0	0	0	0	1
Epilobium saximontanum (Rocky Mountain willowherb)	0	1	0	0	0	0	1
Galium labradoricum (northern bog bedstraw)	0	1	2	0	0	0	3

Species	Dam	Reservoir	TL	HWY	Roads	Quarry	Total
Glyceria pulchella (slender mannagrass)	0	1	0	0	0	0	1
Helictotrichon hookeri (spike-oat)	2	0	0	0	0	1	3
Juncus arcticus ssp. *alaskanus* (arctic rush)	0	4	0	0	0	0	4
Malaxis brachypoda (white adder's-mouth orchid)	0	0	1	0	0	0	1
Muhlenbergia glomerata (marsh muhly)	0	1	0	0	0	0	1
Oxytropis campestris var. *davisii* (Davis' locoweed)	0	8	0	0	0	0	8
Pedicularis parviflora ssp. *parviflora* (small-flowered lousewort)	0	0	1	0	0	0	1
Polypodium sibiricum (Siberian polypody)	0	0	0	0	0	2	2
Salix serissima (autumn willow)	0	1	0	0	0	0	1
Schizachyrium scoparium (little bluestem)	0	1	0	0	0	0	1
Silene drummondii var. *drummondii* (Drummond's campion)	0	1	0	0	0	2	3
Sphenopholis intermedia (slender wedgegrass)	1	2	0	0	0	0	3
Symphyotrichum puniceum var. *puniceum* (purple-stemmed aster)	2	3	14	0	7	0	26
Trichophorum pumilum (dwarf clubrush)	0	1	0	0	0	0	1
Utricularia ochroleuca (ochroleucous bladderwort)	0	0	0	0	1	0	1
Total	**13**	**63**	**24**	**2**	**11**	**9**	**122**

The reservoir will remove 63 known rare vascular plant occurrences, the most of any of the Project components. Many species were principally found in this area and include riverbank anemone, western mugwort, tender sedge, arctic rush, and Davis' locoweed. The Watson Slough wetland complex is the only known location in the LAA of six rare taxa that includes Hudson Bay sedge, many-headed sedge, slender mannagrass, marsh muhly, autumn willow, and dwarf clubrush.

The dam site will affect 13 known rare plant occurrences. Two of the species - spike-oat and plains reedgrass - are restricted to grassland habitats, while the other five species were found in varied habitats. It is expected that habitat conversion would result in the extirpation of most of the rare plant occurrences within the dam footprint. However, depending on the extent and intensity of the vegetation clearing in this area, some occurrences may survive. The viability of these populations would likely be reduced, due to direct and indirect interactions from intensive nearby industrial activities. As construction proceeds, loss from incidental construction activities, dust deposition, additional vegetation clearing, and other construction-related activities would further reduce the viability of these remaining occurrences.

Nine rare vascular plant occurrences are known from the proposed quarry locations. Specifically, the occurrences are located at the 85th Ave. Industrial Lands, Area E, and Portage Mountain sites. No occurrences were documented at the Del Rio, West Pine, and Wuthrich sites. Because these areas contain primarily dry or mesic habitats, all of the rare species found are upland associates. One of the species - Siberian polypody -was not found anywhere else in the LAA. The species was found only on cliffs at the Portage Mountain site. During construction, ground within the quarry areas would be greatly disturbed from blasting and other extraction activities. It is expected that all of the rare plant occurrences within the designated quarry locations would be extirpated as extraction proceeded. Occurrences immediately adjacent to activities would likely receive direct and indirect losses from dust deposition, habitat conversion due to edge effects, and other incidental disturbances related to materials extraction. Although certain rare plant species might survive, it is expected that habitat suitability would be reduced within the immediate area around construction sites, leading to reduced viability for any rare plant occurrences present.

Only two known rare vascular plant occurrences are situated in the highway realignment component. These are both riverbank anemone occurrences associated with upland habitats. Direct interactions to rare plant occurrences are expected to begin with vegetation clearing and grubbing to prepare the highway realignment sections. Construction activities could alter adjacent suitable rare plant habitat due to increased dust, altered hydrology, and increased competition from invasive plants. Finally, revegetation and reclamation efforts may alter community structure, affecting the quality of rare plant habitat.

The roads portion of the construction direct-effects zone contains 11 known rare plant occurrences which comprise three different wetland species - European water-hemlock, purple-stemmed aster, and ochroleucus bladderwort. Interactions with rare plants during the construction phase of the roads facilities are similar to those described above for the highway realignments.

Twenty-four BC-listed vascular plant occurrences are known along the transmission line right-of-way. The majority of these are located in wetland habitats within and adjacent to the existing cleared right-of-way. Over half of the 24 occurrences are purple-stemmed aster, which occurs in large numbers within the cleared right-of-way. Two species (white adder's-mouth orchid and small-flowered lousewort) were found nowhere else in the LAA.

Construction interactions with rare plants along the transmission line are particularly complex and difficult to predict due to the diffuse and transitory nature of the activities. It is expected that many of the rare plant occurrences will be affected during the initial vegetation clearing and widening of the right-of-way. However, many of the existing occurrences are located in the currently cleared right-of-way, and would be expected to at least partially survive clearing if it is similar to the current ongoing maintenance along the line. Tower placement and line stringing activities could interact with existing rare plant occurrences and potential habitat both directly (trampling, hydrologic modification, etc.) and indirectly (increased invasive species potential, increased dust deposition, etc.). The level of interaction depends on where the activities occur. In addition, reclamation and restoration activities would alter community structure, thereby altering the suitability of the rare plant habitat and affecting the viability of some occurrences.

The 20 additional occurrences potentially affected during operations (**Table 2.1.6**) are mostly located downstream of the dam along the river margin. Eight occurrences are western mugwort and three are riverbank anemone. Seven occurrences are comprised of six other river corridor-associated species. Only two additional known rare plant occurrences are located along the existing transmission line right-of- way, but are outside the construction zone of influence. These two species are Hall’s willowherb and northern bog bedstraw.

Rare plant issues downstream are primarily related to changes in the hydrologic regime. Changes to daily and seasonal flow patterns could affect downstream vegetation, potentially altering the viability of rare plant occurrences and changing the suitability of the habitat. In addition, indirect interactions on downstream rare plant occurrences could result from sedimentation, introduction of invasive species from upstream areas disturbed by the Project, and changes to water quality. These indirect interactions are expected to lessen with distance from the dam site. Table 2.1.7 summarizes the rare plant occurences potentially affected during operations.

Table 2.1.6 Rare vascular plant occurrences potentially afftected during operations

Species	TL	Downstream	Total
Anemone virginiana var. *cylindroidea* (riverbank anemone)	0	3	**3**
Artemisia herriotii (western mugwort)	0	8	**8**
Atriplex gardneri var. *gardneri* (Gardner's sagebrush)	0	1	**1**
Eleocharis elliptica (elliptic spike-rush)	0	1	**1**
Epilobium halleanum (Hall's willowherb)	1	0	**1**
Epilobium saximontanum (Rocky Mountain willowherb)	0	1	**1**
Galium labradoricum (northern bog bedstraw)	1	0	**1**
Juncus confusus (Colorado rush)	0	2	**2**
Oxytropis campestris var. *davisii* (Davis' oxytrope)	0	1	*1*
Penstemon gracilis (slender penstemon)	0	1	**1**
TOTAL	**2**	**18**	**20**

In total, 1,433 hectares of habitat that has a greater potential for supporting rare plants – based on TEM units – would be directly affected by the Project. These eight TEM units had the highest frequency of rare plant occurrence and provide the greater probability of other unknown occurrences. Of this total, 1,163 hectares are expected to be directly affected during construction and an additional 270 hectares affected during the operations phase. Loss along the transmission line may be overstated as the line will pass over some habitats (e.g., wetlands) with no direct clearing, providing towers are not placed within the habitats themselves. As most of the suitable rare plant habitat would already have been inundated, rare plant interactions during the operations phase would be limited to the area between the shoreline and the erosion impact line. Here, remaining suitable habitat would be directly affected by slumping along the shoreline and hydrologic changes to the habitat. In addition, indirect interactions may occur from increased dust deposition, increased spread of invasive plants, and increased wildlife and recreational use.

3 MITIGATION MEASURES

3.1 Mitigation

The application of mitigation of the potential adverse effects to terrestrial ecosystems—including at-risk and sensitive ecosystems—and rare plant occurrences employs four general categories of mitigation: 1) avoidance of habitat loss, 2) effect reduction, and 3) compensatory mitigation.

Avoidance of habitat loss is the avoidance of direct or indirect impacts to known rare plant occurrences and sensitive ecosystems through the modification of Project facilities placement, or of construction and operations methods. Through the implementation of these measures, effects to a specific occurrence are eliminated within the site-specific areas where they are applied. Complete avoidance of a rare plant occurrence or habitat is feasible, where placement of select new temporary access roads; some existing access road sections where vegetation disturbance is planned; areas along the transmission line corridor; and some limited-activity areas at the dam site.

Effect reduction is the lessening of direct and indirect impacts to rare and sensitive through the targeted modification of construction and operations methods and possibly translocation. Translocation, which is the removal of live rare plant individuals or propagules—seeds, spores, shoots, etc.—from the Project activity zone, and their subsequent re-establishment at another location. This can occur directly—the individual is removed and then immediately transplanted to the new habitat—or indirectly—through an intermediary nursery or seed bank.

Compensatory mitigation is the protection and enhancement of off-site suitable rare and sensitive occurrences as compensation for habitat lost or degraded due to the Project. This can be in-kind—off-site habitat that is similar to that lost within the Project activity zone—or out-of-kind—off-site habitat that is different than that lost within the Project activity zone. Compensatory mitigation is most appropriate for areas where avoidance and reduction are not feasible, such as: the reservoir; intensive work areas at the dam site; and quarries. Within compensatory mitigation basic research into the distribution or taxonomy of rare plant species that are affected by the Project can also be explored. The additional knowledge gained will assist in the development of more effective protection and recovery strategies for these rare plant species throughout their range.

The BC Ministry of Environment's Conservation Framework program provides a set of tools that prioritize and select appropriate conservation actions for rare species and ecosystems in the province (BC Ministry of Environment 2012a). The relevant Conservation Framework outputs for the vascular plant species expected to be directly affected by the Project are presented in Table

3.1.1. The Conservation Framework priorities and action groups were used to tailor the mitigation measures to each affected vascular species.

Table 3.1.1 Rare vascular plant occurrences expected to be directly affected by the Site C Project

Species	Total[1]	BC List	CF Priority[2]	CF Action Groups[3]
Atriplex gardneri var. *gardneri* (Gardner's sagebrush)	1	Red	1	Plan; Private Land; Hab Protect; Hab Restore; COSEWIC; Wildlife Act; Status Rpt; Inventory
Cirsium drummondii (Drummond's thistle)	7	Red	1	Inventory; Status Rpt; Plan; Wildlife Act; COSEWIC; Hab Restore; Hab Protect; Private Land
Juncus confusus (Colorado rush)	2	Red	1	Inventory; Status Rpt; Wildlife Act; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore
Schizachyrium scoparium (little bluestem)	1	Red	1	Inventory; Status Rpt; Wildlife Act; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore
Anemone virginiana var. *cylindroidea* (riverbank anemone)	16	Blue	2	Inventory
Carex sychnocephala (many-headed sedge)	1	Blue	2	Monitor Trend
Carex torreyi (Torrey's sedge)	1	Blue	2	Inventory
Chrysosplenium iowense (Iowa golden-saxifrage)	2	Blue	2	Inventory
Epilobium halleanum (Hall's willowherb)	2	Blue	2	Inventory
Epilobium saximontanum (Rocky Mountain willowherb)	2	Red	2	Inventory
Galium labradoricum (northern bog bedstraw)	4	Blue	2	Inventory
Helictotrichon hookeri (spike-oat)	3	Blue	2	Inventory
Oxytropis campestris var. *davisii* (Davis' locoweed)	9	Blue	2	No New Actn
Penstemon gracilis (slender penstemon)	1	Red	2	Inventory; Status Rpt; Wildlife Act

Species	Total[1]	BC List	CF Priority[2]	CF Action Groups[3]
Polypodium sibiricum (Siberian polypody)	2	Red	2	Inventory
Salix serissima (autumn willow)	1	Blue	2	Inventory
Symphyotrichum puniceum var. *puniceum* (purple-stemmed aster)	26	Blue	2	Inventory
Arnica chamissonis ssp. *incana* (meadow arnica)	4	Blue	3	No New Actn
Carex heleonastes (Hudson Bay sedge)	1	Blue	3	No New Actn
Carex tenera (tender sedge)	5	Blue	3	No New Actn
Carex xerantica (dry-land sedge)	1	Red	3	Inventory
Cicuta virosa (European water-hemlock)	6	Blue	3	No New Actn
Eleocharis elliptica (elliptic spike-rush)	1	Blue	3	No New Actn
Glyceria pulchella (slender mannagrass)	1	Blue	3	No New Actn
Juncus arcticus ssp. *alaskanus* (arctic rush)	4	Blue	3	No New Actn
Malaxis brachypoda (white adder's-mouth orchid)	1	Blue	3	No New Actn
Trichophorum pumilum (dwarf clubrush)	1	Blue	3	No New Actn
Utricularia ochroleuca (ochroleucous bladderwort)	1	Blue	3	Taxonomy
Calamagrostis montanensis (plains reedgrass)	4	Blue	4	Inventory
Muhlenbergia glomerata (marsh muhly)	1	Blue	4	Inventory

Species	Total[1]	BC List	CF Priority[2]	CF Action Groups[3]
Pedicularis parviflora ssp. *parviflora* (small-flowered lousewort)	1	Blue	4	No New Actn
Silene drummondii var. *drummondii* (Drummond's campion)	3	Blue	4	No New Actn
Sphenopholis intermedia (slender wedgegrass)	3	Blue	4	No New Actn
Artemisia herriotii (western mugwort)	23	Red	6	No New Actn
Total (34 species)	**142**			

Table Notes: Expected direct impacts based on variable width buffer zone around Project facilities.
Total[1]: Total number of occurrences potentially affected during construction or operation
CF Priority[2]: Highest assigned priority of the three BC Conservation Framework goals
CF Action Groups[3]: Conservation action(s) required for the species according to the BC Conservation Framework (BC Ministry of Environment 2012a):

COSEWIC (Send to COSEWIC): Send to COSEWIC for assessment as a first step to listing under the federal *Species at Risk Act* as Extirpated, Endangered, Threatened, or Special Concern or for assessment at a higher or lower risk category.

Hab Protect (Ecosystem and habitat protection): Use legislation, policies and guidelines to protect the ecological community or species' habitat. For example, *Forest & Range Practices Act*, protected areas, land use orders, stewardship, and best management practices. For species, may require research on habitat needs or inventory to determine suitable areas for protection.

Hab Restore (Ecosystem and habitat restoration): Apply management and/or restoration techniques to maintain or restore the ecological community or species' habitat. Includes invasive species control, maintaining or restoring natural processes and key structures, fire suppression and prescribed burning.

Inventory (Inventory): Inventory the species or ecological community to confirm or determine status rank. May require research on inventory techniques.

Monitor Trend (Monitor trends): Monitor the species, its habitat, or the ecological community at an interval appropriate to the life history of the organism, or the successional development of the ecological community. May require research on monitoring techniques.

No New Actn (No new action): Existing management is effective; no additional conservation action is warranted. Assess whether ongoing programs need to be maintained. May require effectiveness evaluation of existing activities and monitoring of the species, habitat, or ecological community.

Plan (Planning): Includes preparing a Management Plan or Recovery Strategy and Action Plan, landscape planning, or updating an existing plan; also includes implementing and monitoring effectiveness of the plan and

Species	Total[1]	BC List	CF Priority[2]	CF Action Groups[3]

monitoring the effect on the species' population or habitat or an ecological community. May require research on threats, habitat use, mitigation or recovery techniques.

Private Land (Private land stewardship): This group contains a subset of ecosystems and species from the ecosystem and habitat protection and restoration action groups that are of conservation concern but occur on private land and /or in situations outside the scope of more traditional legislation, policies, and formal guidelines.

Status Rpt (Compile status report): Compile or update a status report. May require research on threats, trends, habitat use, life history or demography.

Taxonomy (Review taxonomy and classification): Invest in taxonomic studies to determine taxonomic validity for species or invest in classification and correlation of newly identified ecological communities.

Wildlife Act (List under Wildlife Act): List under *Wildlife Act* as an Extirpated, Endangered or Threatened species. Includes describing residences as per the provisions of the act where warranted.

3.2 Mitigation for Habitat Alteration and Fragmentation

3.2.1 Avoidance of Habitat Loss

The potential adverse effects of permanent habitat loss cannot be avoided for construction of the reservoir and much of the dam, generating station, and spillways although they can be somewhat reduced for other Project components—e.g., transmission line and roads—during final design.

Project design to date has located new proposed roads and other linear disturbances along existing disturbed areas as much as possible to minimize the effects of habitat loss. During final design transmission towers and temporary roads will be placed away from wetlands and known rare plant occurrences where feasible. All known occurrences will be provided as inputs during the final design phase for consideration. If there is limited or no existing data to help facilitate avoidance measures then supplemental pre-construction surveys will be conducted. If avoidance is not feasible, other mitigation measures will be considered, including effect reduction and compensation.

An Environmental Protection zone will be established to protect occurrences located adjacent to construction areas. Signage will be added where necessary to indicate the boundaries of the exclusion area. Construction personnel will be required to attend a field-based orientation session where the exclusion areas will be explained, and the importance of avoiding disturbance within them will be stressed. This will part of the Environmental Training Management Plan (**Volume 5, Section 35.2.2.8**).

A Soil Management, Site Restoration, and Revegetation plan (**Volume 5, Section 35.2.2.19**) will be developed. The plan will take into account the location of known occurrences, and will suggest the seed mixes and methods to avoid indirect loss or alteration to nearby occurrences.

Temporary construction access roads will be closed and reclaimed following construction. During construction, access roads will be controlled to limit use. A spatial database of known rare plant occurrences in the vicinity of Project facilities will be maintained and consulted to avoid effects during operations and maintenance activities. The database will be actively updated as new information becomes available.

3.2.2 Effect Reduction

Areas within the Project activity zone have already experienced varying levels of habitat fragmentation from forestry, agriculture, oil and gas, and urban development. Efforts have been made during Project design to use existing access corridors, plan for deactivation of temporary access roads, and minimize disturbance to help limit additional fragmentation. Project components where this has occurred are listed below.

- **Substation and Transmission Lines to Peace Canyon Dam**: constructing the new transmission lines adjacent to the existing line, and using the existing corridor and maintenance access roads.
- **Highway 29 Realignment:** using portions of existing roads and selecting borrow sites that already exist or would be eventually covered by the reservoir.
- **Quarried and Excavated Construction Materials:** further developing existing quarry sites (e.g., Wuthrich, Del Rio, and West Pine) and using a site that has already been affected by development (85th Avenue Industrial Lands).
- **Construction Access Roads:** use of existing infrastructure for moving material, upgrading existing access roads and deactivation of temporary roads used for reservoir clearing, and placing the south bank access to the Dam Site along the existing transmission line corridor.

The construction methods used will take into account the location of known occurrences and high-suitability habitat. Where complete avoidance is not feasible, effect reduction will be considered. This can include timing construction activities to winter months, and surface protection measures such as placing ramps to reduce vehicle compaction within occurrences or using rubber-tired versus tracked equipment to minimize ground disturbance.

The indirect effects associated with increased dust deposition are expected to be diffuse and are not considered to threaten the continued viability of any known rare plant occurrences. Fugitive dust from construction activities will be minimized through the application of an Air Quality Monitoring and Dust Control Plan (**Volume 5, Section 35.2.2.7**).

Construction and maintenance activities in and around watercourses and wetlands will conform to BC Hydro's regulator-accepted practices including *Approved Work Practices for Managing Riparian Vegetation* (BC Hydro et al. 2003). An Agreement between BC Hydro, BC Ministry of Environment, and Fisheries and Oceans Canada (BC Hydro et al. 2009) identifies other accepted work practices that are to be developed and available for use in the near future. Additional guidance will be used from *Standards and Best Practices for Instream Works* (BC Ministry of Water, Land and Air Protection 2004) and the *Land Development Guidelines for the Protection of Aquatic Habitat* (Chilibeck et al. 1992), which are designed to reduce sedimentation and avoid introduction of deleterious substances to aquatic environments.

Maintaining surface flow patterns is important in the retention of functioning wetlands. Construction activities will be designed and carried out in a manner that seeks to maintain the hydrology of adjacent wetlands, particularly where known rare plant occurrences are present. Measures will be implemented to maintain existing hydrological patterns as much as possible if roads cannot avoid wetlands. Culverts will be installed under access roads to maintain hydrological balance, and sedimentation barriers will be installed as needed.

Stormwater management will be designed to control run-off and direct it away from work areas where excavation, spoil placement, and staging activities occur. Consideration for maintaining recharge levels to wetlands will be given when diverting water around work sites, providing there is not expected to be a measureable increase in sediment transport to these sensitive areas. Surface water quality management will be addressed in the Erosion Prevention and Sediment Control Management Plan (**Volume 5 Section 35.2.2.9**), Fisheries and Aquatic Habitat Management Plan (**Volume 5 Section 35.2.2.10**) and Emergency Response Plan (**Volume 5 Section 35.2.1.1**).

A hierarchal decision matrix has been developed for reservoir clearing to reduce erosion potential along steep, unstable slopes and along riparian zones for all defined watercourses. Specifically the decision matrix includes:

- Retention of all trees in on steep, unstable slopes that would be highly susceptible to landslides if the vegetation was removed.
- Retention of non-merchantable trees and vegetation in riparian areas within a 15-metre buffer from the high water mark. Merchantable trees may still be removed using clearing practices to maintain a 15-metre machine-free zone.

These same standards will be employed in other work areas and will follow BC Hydro's approved work practices.

All activities that involve potentially harmful or toxic substances such as oil, fuel, antifreeze, and concrete will follow approved work practices and consider the provincial BMP guidebook *Develop with Care* (BC Ministry of Environment 2012b). All construction machinery and vehicles will be properly maintained to ensure harmful fluids do not leak into aquatic environments or other sensitive areas. Prior to initiating construction activities in proximity to any water body, the hydraulic, fuel, and lubrication systems of all equipment will be checked to ensure systems are in good condition and free of leaks. Biodegradable hydraulic fluids will be considered for machines used for instream works. All machines will have a spill kit and operators will be educated its use. Maintenance and refuelling will be conducted at a designated area at an approved distance from watercourses. BC Hydro's fuel handling and storage management plan (**Volume 5, Section 35.2.2.11**) will include appropriate planning for fuel handling and storage, spill prevention, and emergency response.

A Vegetation and Invasive Plant Management Plan (**Volume 5, Section 35.2.2.22**) will be developed and implemented during the entire construction phase (including restoration) and integrated during operations. The plan will be designed using the locations of known rare plant or sensitive site occurrences and locations of high-suitability habitats as inputs. Weed control efforts will be coordinated with the rare plant botanists to ensure that effects to occurrences are avoided or reduced.

Disturbed sites will be replanted quickly with ground cover, shrubs, or trees that are regionally appropriate once erosion concerns have been addressed. This will be part of BC Hydro's Soil Management, Site Restoration and Re-vegetation Plan (Volume 5, Section 35.2.2.19). Additional mitigation measures to reduce the spread of invasive species are described below.

- Prior to work commencing, surveys will be conducted to identify invasive species populations. Treatment will be initiated as required.
- All vehicles entering and leaving work sites will be washed thoroughly with special attention to wheel wells, tire treads, and tracks where mud and seeds of noxious weeds may be lodged.
- Wash areas will be located away from any waterbody and riparian areas.
- Used wash water will be treated to prevent seed dispersal.

BC Hydro has considerable experience managing and maintaining an extensive transmission line network within the province, including the existing transmission corridor along which the new lines will be constructed. The *Integrated Vegetation Pest Management Plan for Transmission Line Rights-of-Way* (BC Hydro 2010) will be followed in order to reduce or avoid the spread of invasive species during the operations phase of the transmission line and the *Pest Management Plan For Management of Vegetation at BC Hydro Facilities* (BC Hydro 2012) will be used to manage invasive species at other Project facilities.

An experimental rare plant translocation program will be considered for suitable rare plant species found within the reservoir and other areas where Project components are certain to remove the populations. The translocation program will follow the BC Ministry of Environment's *Guidelines for Translocation of Plant Species at Risk in British Columbia* (Maslovat 2009).

Translocation of endangered plants is generally thought to have a low likelihood of success and should be considered a follow-up monitoring opportunity rather than a means to relocate occurrences to prevent their loss.

3.2.3 Compensatory Mitigation

BC Hydro owned lands west of Wilder Creek have been identified as a location where mitigation to offset loss of vegetation and ecological resources and wildlife habitat might be implemented. The Wilder Creek Mitigation plan (**Appendix H**) has been developed to: establishe riparian wetland habitat, create additional pothole wetlands, establish riparian vegetation along the reservoir shore, provide littoral habitat for fish, establish old field/grassland habitat, retain and improve existing grain and oilseed fields and manage agriculture lands for winter ungulate use.

A survey of habitat enhancement projects in the RAA will be conducted to identify projects that might provide compensation for rare and sensitive habitats and protect occurrences of rare plants (e.g., wetlands). If suitable habitat enhancement projects can be found, the proponent will provide assistance (financial or in-kind) to the managing organization. The inventories will also identify areas that are under threat from development or in need of habitat enhancement. Where opportunities exist, the proponent will consider direct purchase – if offered for sale - and management of these lands to enhance or retain rare plant values. The proponent will also consider contributing to other protection options where direct purchase is not feasible.

The proponent will fund or undertake targeted surveys in the RAA to locate additional occurrences of the 18 directly affected rare plant species that the Conservation Framework identifies as requiring additional inventories. Full element occurrence data will be collected and transmitted to the BCCDC for each additional occurrence found.

The proponent will fund or undertake a study in an attempt to clarify the taxonomy of ochroleucus bladderwort. This is the only species of the 34 directly affected taxa for which the Conservation Framework identifies further taxonomic research as being required for its conservation. The study plan will be developed in consultation with the BCCDC and may include field, herbaria, and genetic work.

4 RESIDUAL EFFECTS

Although the mitigation measures summarized above would reduce the effect to Vegetation and Ecological Communities, a residual adverse effect remain. This is particularly the case with the reservoir, dam site and quarries, where the direct effect of habitat alteration and fragmentation cannot be avoided or reduced. The characterization of the residual project effect assumes that the specific mitigation measures described above are all implemented.

4.1 Characterization of Residual Effects

Table 4.1.1 summarizes the characterization of the residual adverse effect. It should be noted that residual effects to rare plants and terrestrial ecosystems are addressed as an overall group. Individual characterizations for each affected rare plant species or ecosystem would yield varying results depending primarily on the number of known occurrences, and their locations.

Table 4.1.1 Characterization of residual effects: habitat alteration and fragmentation

Key Indicator	Characterization Criteria	Characterization	Rationale for Characterization
Construction			
Terrestrial Ecosystems	Direction	Negative	The overall loss of known occurrences and suitable habitat will not be fully mitigated; therefore the total number of occurrences and amount of suitable habitat in the LAA will decrease.
	Magnitude	High	Mitigation may allow for the creation or enhancement of some habitats but cannot address loss of older, established riparian forests, tufa seeps, or marl fens.
	Geographic Extent	Regional	The size and location of the Project affects habitats associated with the Peace River, many of which are uncommon within the Region.
	Duration	Permanent	Many of the known sites will be lost permanently within the reservoir. Habitat compensation will address loss to some habitats but cannot re-create all.
	Frequency	Once	The largest loss of habitat will occur with the filling of the reservoir, considered a one-time occurrence.
	Reversibility	Irreversible	Loss of the tufa seeps and marl fen is not reversible.
	Context	Low and High resilience	Many types are ecologically fragile with little resistance to imposed stresses, whereas some plants thrive with disturbance.
	Probability	High	Expected based on the size and locations of thePAZ.
	Confidence	Moderate	Habitat mapping provides a quantitative assessment of habitat loss when overlaid with Project components. The effectiveness of mitigation measures is dependent on finding appropriate sites for land management or acquisition.
Rare Plants	Direction	Negative	The overall loss of rare plant occurrences and suitable habitat will not be fully mitigated; therefore the total number of occurrences and amount of suitable habitat in the LAA will

Key Indicator	Characterization Criteria	Characterization	Rationale for Characterization
			decrease.
	Magnitude	High	At least 35% of the known rare plant occurrences in the LAA are expected to be extirpated by the Project (based on the 85 occurrences known within the reservoir, dam site, and quarry sites).
	Geographic Extent	Regional	Some of the occurrences are only known within PAZ but may be found within the LAA or RAA.
	Duration	Permanent	Rare plant conditions within certain Project components (reservoir, dam site, quarries) are not expected to return to baseline for the life of the Project.
	Frequency	Once	The largest loss of habitat will occur with clearing and from the filling of the reservoir, considered a one-time occurrence.
	Reversibility	Irreversible	Rare plant conditions would not return to baseline conditions within certain areas (reservoir, dam site, quarries) for the life of the Project.
	Context	Low and high resilience	Areas along the Peace River and tributaries already experience periodic flood events; areas along the existing transmission line corridor already experience regular vegetation maintenance. Some plants however prefer stable environments.
	Probability	High	Expected based on the size and locations of the PAZ.
	Confidence	Low	Although general predictions of adverse rare plant effects are sound, the specific disturbance responses for the rare plants in the LAA are unknown; prediction of higher suitability habitat is considered generally accurate but is also subject to limitations (discussed in the baseline section); certain mitigation measures (principally translocation) are considered experimental, and the success rate is difficult to predict; distribution data within BC are incomplete for many of the affected rare plant taxa.

Key Indicator	Characterization Criteria	Characterization	Rationale for Characterization
Operation			
Terrestrial Ecosystems	Direction	Negative	The overall loss of known occurrences and suitable habitat will not be fully mitigated; therefore the total number of occurrences and amount of suitable habitat in the LAA will decrease.
	Magnitude	Low	Majority of the effect is during construction with less than 10% additional loss during operations.
	Geographic Extent	Local	
	Duration	Long-term	Effects would occur during the life of the Project, although should stabilize over time.
	Frequency	Continuous	
	Reversibility	Reversible	
	Context	High resilience	Disturbance would generally occur in areas where disturbance is presently observed (flooding and bank slumping).
	Probability	High	
	Confidence	Moderate	Habitat mapping provides a quantitative assessment of habitat loss when overlaid with Project components. The extent of long-term habitat disturbance depends on resilence of plant communities.
Rare Plants	Direction	Negative	The overall loss of rare plant occurrences and suitable habitat will not be fully mitigated; therefore the total number of occurrences and amount of suitable habitat in the LAA will decrease.
	Magnitude	Low	Because most of the loss of rare plant occurrences would occur during the construction phase, the additional loss during operations would not exceed the 10% threshold
	Geographic Extent	Local	The majority of direct and indirect project effects during operations to rare plants are expected to occur downstream of the dam and is dependent on duration and extent of high water.
	Duration	Long-term	Many of the operations effects to rare plants would re-occur on a periodic basis (vegetation maintenance along roadways, transmission line right-of-way, changes in the hydrologic regime downstream, etc); these could impede return to baseline rare plant conditions (or possibly support).
	Frequency	Continuous	Downstream changes to the flow regime

Key Indicator	Characterization Criteria	Characterization	Rationale for Characterization
			could occur on a daily, monthly, or yearly basis; indirect effects to rare plants and habitat near Project facilities could occur on a periodic basis, but specific effects would not necessarily occur in a regular pattern; vegetation maintenance along roadways and in the transmission line right-of-way would occur on a yearly (or greater) basis
	Reversibility	Reversible	Rare plant conditions could return to baseline in certain areas, depending on the extent of the operations effects.
	Context	High resilience	Areas along the Peace River and tributaries already experience periodic flood events; areas along the existing transmission line corridor already experience regular vegetation maintenance.
	Probability	High	Although operations effects to rare plants are less certain than the construction effects, there is a high probability that additional effects to rare plant occurrences and suitable habitat will occur during the operations phase.
	Confidence	Low	Hydrology modelling does provide an indication of the level of flooding, but how the downstream populations respond to the changes in hydrology is unknown. Although general predictions of adverse rare plant effects are sound, the specific disturbance responses for the rare plants in the Local Assessment Area are unknown; prediction of adverse effects on high-suitability habitat is considered generally accurate, but is also subject to limitations (discussed in the baseline section); certain mitigation measures (principally translocation) are considered experimental, and the success rate is difficult to predict; distribution data within BC is incomplete for many of the affected rare plant taxa

The confidence in the characterization of the effect on rare plants is low because although general predictions of adverse effects are sound, the specific disturbance responses for some of the species in the LAA are unknown; certain mitigation measures—principally translocation—are considered experimental and the success rate is difficult to predict; and, distribution data within BC is incomplete for many of the affected rare plant taxa.

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APPENDIX A TERRESTRIAL ECOSYSTEM MAPPING EXPANDED LEGEND

Expanded Legend for the Peace River Terrestrial Ecosystem Mapping Project

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Prepared for:

BC Hydro and Power Authority

Burnaby, BC

December 2012

A.1 Introduction

Terrestrial ecosystem mapping of the Peace River Corridor at 1:20,000 was requested by BC Hydro and Power Authority as base mapping for strategic planning. Terrestrial ecosystem mapping (TEM) can be used as the basis for a number of types of interpretive maps, including wildlife habitat, rare ecosystems, rare plants, and resources important to First Nations.

The purpose of the expanded legend is to describe and define the ecosystem units mapped for the Project, with notes on their use by wildlife. Each ecosystem is illustrated with a photo (where available), its physical characteristics are described and the dominant and associate plant species are listed for each potential structural stage of the ecosystem. Data for the expanded legend came from field-truthing done in the summers of 2005 and 2006, and from the regional field guides (DeLong et al. 1990; BC Ministry of Forests 2002).

A.2 Study Area

The study area is located in northeastern British Columbia. The mapped Peace River corridor area extends for approximately 2 km north and south along the river (62,000 ha in area; Figure 1). Geographically, the core river corridor refers to the entire river valley including the floodplain and the ascending slopes extending approximately 2 km on either side of the river.

Midway through the mapping project, a second area was added to the study area. This new area consisted of a transmission line corridor located on the south side of the river. This corridor extends east and north from the Peace Canyon dam to an area about 14 km southwest of Taylor. Both the river valley and transmission line corridor are located entirely within the BWBSmw1 subzone variant.

Ancillary sites (4634 ha) were added to the mapping project in 2012 and consisted of additional uplands south of the proposed dam site, generating station and spillway, Wuthrich quarry and 85th Avenue Industrial Lands near Fort St. John, small areas in the drainages of the Halfway River, Cache Creek and Farrell Creek, and West Pine quarry, located on the Pine River. The total project area totals 68,711 ha and includes portions of 31 TRIM map sheets.

The Peace River corridor, transmission line, and most of the ancillary sites are located within the Peace Lowlands (PEL) ecosection in the Peace River Basin Ecoregion (Demarchi 2011), and are found entirely within the Boreal White and Black Spruce moist, warm Peace subzone variant (BWBSmw1) within the Peace Forest District in the Northern Interior Forest Region). The climate is moderate and continental, with moderately warm summers and relatively cold winters (Farstad et al. 1965).

The West Pine quarry is located within the Central Canadian Rocky Mountains Ecoregion (Demarchi 2011) in the Prince George Forest District. It includes two subzone variants: the Sub-boreal Spruce Finlay-Peace wet, cool (SBSwk2) at low elevations and a small portion of Engelmann Spruce-Subalpine Fir Bullmoose moist, very cold (ESSFmv2) at higher elevations at the western edge of the study area. The SBSwk2 lies within the Hart Foothills (HAF) ecosection, while the ESSFmv2 lies within the Northern Hart Ranges (NHR) ecosection.

A.3 Ecosystem Units and Map Codes

Ecosystem units used in the mapping of the Peace River Corridor were developed from a number of sources. Most of the forested sites in the BWBSmw1 (01 to 08) were described in DeLong (1990), and the corresponding seral units ($01 to $07) in BC MoF (2002). Two-letter mapcodes for those units, and for several noncorrelated or ‘00’ units (‘AS’, ‘SE’, ‘TS’, ‘WH’ and ‘WW’) were listed in the provincial mapcodes database (BC MSRM 2003). There were significant differences between the units as described in DeLong (1990) and MoF (2002) and the ecosystems found in the project area. Those differences have been described below.

Midway through the project, in 2006, several new wetland site series for the BWBSmw1 were released by BC MoF. Those new site series included the 09, 10 and 11 site series as well as the Scrub birch-Sedge Wf02 ecosystem, with the new ‘10’ site series developed as the previously non-correlated ‘TS’ unit. The new site series were incorporated into the final mapping. One new seral association, the birch-dogwood or ‘ep’, was defined for the project. The ep seral association can occur in the 05 or 07 site series.

Regional ecologist Craig DeLong reviewed the preliminary classification of ecosystems for the study area. He approved the retention of the ‘TS’ code for the 10 site series, and suggested the use of the ‘ep’ seral association to describe birch-dominated sites in the 07 and 05 units (C. DeLong, pers. comm. 2006). Several different types of floodplain and wetland communities as described in MacKenzie and Moran (2004) were located in the study area during field truthing. However, the majority of these non-forested communities could not be adequately distinguished using air photos, therefore the non-forested floodplain communities have been grouped together as the Willow-Horsetail (WH) map unit, and the wetlands grouped as Shrub Wetlands (WS) and Sedge Wetlands (SE).

Some important differences were noted between the existing field guides and the vegetation present within the river valley. Most notable was the rarity of oak fern (*Gymnocarpium dryopteris*) and tall bluebells, which are listed as indicator species in the field guides. Moss development is an important criterion for distinguishing seral from non-seral sites. Moss layers were generally sparse within the Peace River valley itself, even on the non-seral sites. Additional information is provided in the project report.

Ecosystem units for the SBSwk2 and ESSFmv2 were mapped as described in DeLong (2004) and DeLong (1994), respectively. Two-letter mapcodes and seral codes and non-correlated site series were obtained from the provincial mapcode database (BC Ministry of Environment 2006).

A.4 BWBSmw1 - Forested Ecosystems

A.4.1 AM: SwAt - Step moss (01)

The AM unit is typically submesic to mesic forest on gentle slopes with deep, moderately fine to coarse - textured soil. Nutrient regimes range from poor to rich, and the unit can occur on fluvial, glaciofluvial, morainal or lacustrine parent materials (DeLong et al. 1990). Assumed modifiers: d, f, j.

Map Symbol with Mapped Site Modifiers:

- **AMa –** the ecosystem occurs on an active floodplain
- **AMat –** the ecosystem occurs on an active floodplain and on a terrace

- **AMay –** the ecosystem occurs on an active floodplain and is moister than average
- **AMg -** the ecosystem occurs on gullied terrain or in a gully
- **AMgh –** the ecosystem occurs on gullied terrain that is also hummocky
- **AMgk** - the ecosystem occurs on gullied terrain or in a gully, on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)
- **AMgs –** the ecosystem occurs on gullied terrain on shallow soils
- **AMgw** - the ecosystem occurs on gullied terrain or in a gully, on a warm aspect (aspect of135 - 285^{o} on a slope that is 25-100%)
- **AMgy**– the ecosystem occurs on gullied terrain or in a gully and is moister than average
- **AMh –** the ecosystem occurs on hummocky terrain
- **AMhk**– the ecosystem occurs on hummocky terrain on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)
- **AMhr** – the ecosystem occurs on hummocky, ridged terrain
- **AMhw**– the ecosystem occurs on hummocky terrain on a warm aspect (aspect of135 - 285 o on a slope that is 25-100%)
- **AMhy**– the ecosystem occurs on hummocky terrain and is moister than average
- **AMk -** the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)
- **AMks**– the ecosystem occurs on a cool aspect (aspect of 285-135o on a slope that is 25-100%) on shallow soils
- **AMn –** the ecosystem occurs on a fan or cone
- **AMr –** the ecosystem occurs on ridged terrain
- **AMrs –** the ecosystem occurs on ridged terrain on shallow soils
- **AMs –** the ecosystem occurs on shallow soils
- **AMt** - the ecosystem occurs on a terrace

- **AMty–** the ecosystem occurs on a terrace and is moister than average
- **AMw -** the ecosystem occurs on a warm aspect (aspect of135 - 285^{o} on a slope that is 25-100%)
- **AMy –** the ecosystem is moister than average

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Paper birch Prickly rose Trembling aspen Twinflower White spruce	Prickly rose Step moss Trembling aspen Twinflower White spruce	Asters Prickly rose Step moss Trembling aspen Twinflower White spruce	Asters Bunchberry Creamy peavine Highbush cranberry Prickly rose Soopolallie Step moss Trembling aspen Twinflower White spruce	Asters Bunchberry Creamy peavine Highbush cranberry Prickly rose Soopolallie Step moss Trembling aspen Twinflower White spruce

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	American vetch Black gooseberry Creamy peavine Soopolallie	Highbush cranberry Red-osier dogwood Saskatoon Soopolallie Trembling aspen	Creamy peavine Highbush cranberry One-sided wintergreen Red-osier dogwood Red-stemmed feathermoss Saskatoon	Balsam poplar Common snowberry Dwarf red raspberry Paper birch Red-osier dogwood Tall bluebells Wild sarsaparilla	Balsam poplar Dwarf red raspberry Paper birch Red-osier dogwood Tall bluebells Trembling aspen
Plots	KS103	0107664, B1-06, C1-12, SK093, TKS017	0107663, 0107658, 0107671, BC001, C2-01, D1-08, DT022, DT026, E1-05, E1-07, JG033, JG352, JG575, JG636, K2-02, KS015, KS019, LA040, LA237, LS019, LS026, SK369, WB048, WB275, X2-10	A1-05, E2-06, JG006, JG116, K1-12a, K2-16, LA041, LS039, LS060, LS127, RP123, SK009, SK095, SK097, SK373, T1-01, WB227, WB262, WB274, WB300, WB323, WB336, WB346, X2-11	No project plots; vegetation list prepared from other sources

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	In the project area, the AM was found mainly on mid-slope and level, moderately well-drained to well-drained sites, with mesic to submesic moisture regimes and medium nutrient regimes. Parent materials were mainly fluvial and glaciolacustrine. The AM was very variable in terms of vegetation.				

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

A.4.2 AM ap: $At - Creamy peavine (seral association) (01)

Typic AM:ap occurs on gentle slopes (usually <20%) on fine to coarse soils, on glaciofluvial, fluvial, morainal or lacustrine surficial materials. It has a medium to rich nutrient regime and a submesic to mesic moisture regime (BC Ministry of Forests 2002). Assumed modifiers: d, f, j.

Map Symbol with Mapped Site Modifiers:

AMa:ap – the ecosystem occurs on an active floodplain

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
AMac:ap – the ecosystem occurs on an active floodplain on coarse textured soils **AMag:ap –** the ecosystem occurs on an active floodplain in a gully **AMat:ap –** the ecosystem occurs on an active floodplain on a terrace **AMc:ap** – the ecosystem occurs on coarse textured soils on a terrace **AMct:ap** – the ecosystem occurs on coarse textured soils on a terrace **AMg:ap -** the ecosystem occurs on gullied terrain or in a gully **AMgh:ap** - the ecosystem occurs on gullied and hummocky terrain **AMgn:ap** - the ecosystem occurs on gullied terrain and on a fan or cone **AMgs:ap** - the ecosystem occurs on gullied terrain on shallow soils **AMh:ap** - the ecosystem occurs on hummocky terrain **AMhr:ap** - the ecosystem occurs on hummocky, ridged terrain **AMn:ap** – the ecosystem occurs on a fan or cone **AMq:ap** - the ecosystem occurs on a very steep cool aspect (aspect of 285- 135o on a slope that is >100%) **AMr:ap** - the ecosystem occurs on ridged terrain or on a ridge crest **AMrs:ap** - the ecosystem occurs on ridged terrain with shallow soils **AMs:ap** - the ecosystem occurs on shallow soils **AMt:ap** - the ecosystem occurs on a terrace					

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Prickly rose Showy aster Trembling aspen	Creamy peavine Prickly rose Saskatoon Showy aster Trembling aspen	Trembling aspen Saskatoon Prickly rose Showy aster Bunchberry	Trembling aspen Prickly rose Wild sarsaparilla Showy aster Bluejoint reedgrass Bunchberry Creamy peavine Red raspberry Highbush cranberry Birch-leaved spirea	Trembling aspen Prickly rose Wild sarsaparilla Showy aster Bluejoint reedgrass Bunchberry Creamy peavine Red raspberry Highbush cranberry Birch-leaved spirea
Associated Plant Species	Balsam poplar Bedstraws Creamy peavine Red raspberry Saskatoon Soopolallie	Bedstraws Common snowberry Dwarf red raspberry Highbush cranberry Soopolallie	Soopolallie Willows Common snowberry Northern bedstraw	Saskatoon Balsam poplar White spruce Soopolallie	Saskatoon Balsam poplar White spruce Soopolallie

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	BC014a, BC373, BC385, BC468, Farrah3, LA039, LA202, LA295, LA317, SK424	0107642, al-2, BC038, BC465, BC466, DT031, G1-04, J1-04, JG098, KS005, KS037, LA011, LA032, LA292, LA302, LA308, LS051, SK1010, SK022, SK353, SK392, SK540, SK618, WB042, WB044, WB050, WB051, WB212, WB241, WB356	0107637, 0107640, 0107641, 0107647, 0107669, BC009, BC026, BC044, DT001, DT009, DT019, DT030, DT038, DT039, DT041, farrah1, JG127, KS036, KS039, LA020, LA034, LA245, LA256, LS018, LS020, LS070, LS118, SK001, SK051, SK053, SK076, SK087, TKS095, WB004, WB007, WB010, WB017, WB041, WB049, WB099, WB258, WB351, WB352	3-3000, BC377B, JG017, JG113, KS016, LS054, LS112, RP127, SK013, SK354, SK427, SK477, WB260, WB306, WB310, WB342, WB347	No project plots; it is unlikely that the seral unit exists in structural stage 7.

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	The AM:ap was the ecosystem most commonly mapped in the study area. It was found on mesic sites with medium nutrient regimes, mainly on glaciolacustrine or glaciofluvial surficial materials. Drainage was mainly moderately-well to well. The AM: ap provides cover for ungulates and bears and habitat for a variety of birds. In structural stages >4, it may provide bats with roost sites.				

A.4.3 AM y: ap $At - Creamy peavine (seral association) (01), moister than typic

Typic AM y:ap is typically found on gentle slopes with deep, fine-textured soils. This unit represents permanent trembling aspen stands with a mesic to subhygric moisture regime. Medium nutrient regime. Assumed modifiers: d, f, j.

Map Symbol with Mapped Site Modifiers:

AMay:ap - the ecosystem occurs on an active floodplain and is moister than average

AMgy:ap - the ecosystem occurs on gullied terrain and is moister than average

AMhy:ap - the ecosystem occurs on hummocky terrain and is moister than average

AMny:ap - the ecosystem occurs on a fan or cone and is moister than average

AMsy:ap - the ecosystem occurs on shallow soils and is moister than average

AMty:ap - the ecosystem occurs on a terrace and is moister than average

Structural Stage	**3 - Shrub**	**4 - Pole-sapling**	**5 - Young Forest**	**6 - Mature Forest**	**7 - Old Forest**
Dominant Plant Species	Balsam poplar Prickly rose Trembling aspen	Balsam poplar Prickly rose Red-osier dogwood Trembling aspen	Balsam poplar Prickly rose Red-osier dogwood Saskatoon Trembling aspen	Balsam poplar Red-osier dogwood Trembling aspen Bunchberry	Balsam poplar Red-osier dogwood Trembling aspen Bunchberry

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Fireweed Highbush cranberry Horsetails Northern gooseberry Red-osier dogwood White spruce Willows	Highbush cranberry Northern gooseberry Showy aster Northern bedstraw Wild strawberry	Bunchberry Common snowberry Creamy peavine Highbush cranberry Northern gooseberry Showy aster White spruce Wild sarsaparilla Wild strawberry Willow	Common snowberry Highbush cranberry Northern gooseberry Tall bluebells Red raspberry	Common snowberry Highbush cranberry Northern gooseberry Tall bluebells Red raspberry
Plots	BC353, WB329	BC372, LA037, LA254, Q2-02, SK351, SK524	0107652, D1-01, DT036, DT037, fawcet1, JG665, KS017, LA013, LA259, LS114, LS115, SK008, SK017, SK102, WB014, WB016	BC395, LS056, SK018, WB343, WB355	No project plots; it is unlikely that the seral unit exists in structural stage 7.

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	Plots were allocated to AMy:ap if moisture-indicating plants, such as red-osier dogwood or *Ribes* spp. were present and their percent cover totalled over 5%. The seral 06 unit is not distinguished from the seral 01 unit according to the draft seral field guide (BC Ministry of Forests 2002), but it is possible that the AMy:ap is actually the seral 06. The AMy:ap was found mainly on level sites or on cool aspects, predominantly on moderately well-drained sites.				

A.4.4 AM k:ap $At - Creamy peavine (seral association) (01), cool aspect

Typic AMk :ap occurs on steep slopes (>25%) on north facing aspects (135-285 degrees) and sometimes in gullies; these deciduous forest generally occur on deep fine-textured lacustrine surficial materials and less frequently on coarse-textured glaciofluvial and colluvial surficial materials. This unit represents permanent trembling aspen stands with a mesic moisture regime.

Map Symbol with Mapped Site Modifiers:

AMgk:ap - the ecosystem occurs on gullied terrain on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

AMhk: ap - the ecosystem occurs on hummocky terrain on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

AMks:ap – the ecosystem occurs on shallow soils on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

AMkv:ap – the ecosystem occurs on very shallow soils on a cool aspect (aspect of 285-135o on a slope that is 25-100%)

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Trembling aspen Willow Showy aster	Trembling aspen Willow Spreading dogbane Highbush cranberry Showy aster	Trembling aspen Prickly rose Soopolallie Highbush cranberry Showy aster	Trembling aspen Prickly rose Soopolallie Showy aster	Trembling aspen Prickly rose Soopolallie Showy aster

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Saskatoon Red-osier dogwood Wild sarsaparilla	Prickly rose	Red-osier dogwood Wild sarsaparilla Creamy peavine	Highbush cranberry Northern bedstraw Creamy peavine	Highbush cranberry Northern bedstraw Creamy peavine
Plots	BC011	KS006, WB043	0107648, BC010, H1-06a, H1-09, K1-04, K2-06a, L1-02, LA009, LA010, SK048, WB252	SK047, SK612, WB046, WB213	No project plots; it is unlikely that the seral unit exists in structural stage 7.
Comments	In the project area, the AMk:ap was found on upper to lower slopes (mostly mid-slope), with submesic to mesic moisture regimes and medium nutrient regimes. Slopes averaged 29%.				

A.4.5 AM w:ap $At - Creamy peavine (seral association) (01), warm aspect

Typic AMw :ap occurs on steep slopes (>25%) on south-facing aspects (135-285 degrees); these deciduous forest generally occur on deep, medium-textured glaciofluvial and undifferentiated surficial materials; these sites occur on upper to lower meso slope positions and are generally well to moderately well-drained; this unit represents permanent trembling aspen stands with a mesic moisture regime.

Map Symbol with Mapped Site Modifiers:

AMgw: ap – the ecosystem occurs on warm aspect (aspect of 135 - 285 o on a slope that is 25-100%) sites on gullied terrain

AMhw:ap – the ecosystem occurs on hummocky terrain on a warm aspect (aspect of135 - 285 ^{o} on a slope that is 25-100%)

AMnw:ap- the ecosystem occurs on a fan or cone on a warm aspect (aspect of135 - 285 ^{o} on a slope that is 25-100%)

AMsw:ap- the ecosystem occurs on shallow soils on a warm aspect (aspect of135 - 285 o on a slope that is 25-100%)

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Trembling aspen Saskatoon Prickly rose Common snowberry	Trembling aspen Saskatoon Prickly rose Common snowberry	Trembling aspen Saskatoon Prickly rose	Trembling aspen Grasses Saskatoon Prickly rose	Trembling aspen Grasses Saskatoon Prickly rose
Associated Plant Species	Snowberry Northern bedstraw Grasses Willow	Showy aster American vetch	Pin cherry Northern bedstraw Creamy peavine Showy aster	White spruce Showy aster Creamy peavine Northern bedstraw	White spruce Showy aster Creamy peavine Northern bedstraw
Plots	J1-02, LA015, SK023, WB003	0107636, 0107643, al-1, BC025, BC040, LA030, LS074, LS105	BC037, BC041, DT007, J1-07	LS125	No project plots; it is unlikely that the seral unit exists in structural stage 7.

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	The AMw:ap was found on slopes averaging 35% on sites that were generally submesic with medium nutrient regimes. Drainage ranged from rapid to moderately-well.				

A.4.6 LL: Pl - Lingonberry - Velvet-leaved blueberry (02)

Typically subxeric forest on gentle slopes with deep, medium to coarse - textured soil. The LL unit normally occurs on glaciofluvial or fluvial soils and has a poor to medium nutrient regime (DeLong et al. 1990). Assumed modifiers c, d, j.

Map Symbol with Mapped Site Modifiers:

LLk - the ecosystem occurs on a cool aspect (aspect of 285-135^o on a slope that is 25-100%)

LLr- the ecosystem occurs on ridged terrain

LLs- the ecosystem occurs on shallow soils

LLt- the ecosystem occurs on a terrace

LLw - the ecosystem occurs on a warm aspect (aspect of135 - 285^o on a slope that is 25-100%)

Structural Stage	**3 - Shrub**	**4 - Pole-sapling**	**5 - Young Forest**	**6 - Mature Forest**	**7 - Old Forest**
Dominant Plant Species	Birch-leaved spirea Kinnikinnick Lodgepole pine Soopolallie Trembling aspen Twinflower	Birch-leaved spirea Kinnikinnick Lodgepole pine Northern bedstraw Prickly rose Soopolallie Twinflower White spruce	Birch-leaved spirea Lodgepole pine Prickly rose Soopolallie Twinflower Lingonberry White spruce	Creamy peavine Kinnikinnick Lodgepole pine Prickly rose Saskatoon Soopolallie White spruce	*Cladina* Kinnikinnick Lodgepole pine White spruce

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Red-stemmed feathermoss White spruce	Lingonberry Red-stemmed feathermoss Wild lily-of-the-valley	Bunchberry Creamy peavine Kinnikinnick Red-stemmed feathermoss Step moss Wild lily-of-the-valley	Common juniper Paper birch Red-stemmed feathermoss Trembling aspen	Common juniper Prickly rose Red-stemmed feathermoss Saskatoon Step moss Trembling aspen
Plots	No project plots; vegetation list prepared from other sources	0107657, LA243, BC358	0107631, LA008, BC360, JG570, SK565, WB232, WB409, WB410, WB001	SK006, SK014, SK365, SK564, BC362	No project plots; vegetation list prepared from other sources
Comments	The LL ecosystem was not common in the study area. When it was found, it occurred mainly on well-drained level to gentle slopes with a xeric to submesic moisture regime and a poor to medium nutrient regime. Velvet-leaved blueberry was rare in the study area.				

A.4.7 LL: ak: $At - Kinnikinnick (seral association) (02)

Typically subxeric to submesic forest on gentle slopes with deep, coarse - textured soil. This unit normally is found on fluvial or glaciofluvial parent materials with poor to medium nutrient regimes (BC Ministry of Forests 2002). Assumed modifiers c, d, j.

Map Symbol with Mapped Site Modifiers:

LLgw:ak - the ecosystem occurs on gullied terrain and on a warm aspect (aspect of135 - 285 ^{o} on a slope that is 25-100%)

LLh:ak - the ecosystem occurs on hummocky terrain

LLr:ak - the ecosystem occurs on a fan or cone

LLt:ak - the ecosystem occurs on a fan or cone

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Trembling aspen Saskatoon Kinnikinnick	Trembling aspen Kinnikinnick	Trembling aspen Prickly rose Soopolallie	Trembling aspen Kinnikinnick	Trembling aspen Kinnikinnick
Associated Plant Species	White spruce Wild strawberry	White spruce Saskatoon Rocky Mountain juniper Soopolallie Creamy peavine American vetch	Common juniper White spruce Kinnikinnick Willows Creamy peavine Twinflower	Common juniper White spruce Willows Creamy peavine Twinflower	Common juniper White spruce Willows Creamy peavine Twinflower
Plots	KS034, TKS116	LA019, LA035	LA004, LA006	No project plots; vegetation list prepared from other sources	No project plots; it is unlikely that the seral unit exists in structural stage 7.
Comments	The LL:ak unit was rare in the study area. It was found on level sites that were submesic to xeric, and well to moderately well-drained, with poor to medium nutrient regimes.				

A.4.8 SW: Sw - Wildrye - Peavine (03)

Typically submesic to mesic forest on gentle slopes with deep, medium to coarse - textured soils. The 03 unit normally occurs on sites with a poor to medium nutrient regime, and can occur on a variety of parent materials (DeLong et al. 1990). Assumed modifiers c, d, j.

Map Symbol with Mapped Site Modifiers:

SWg- the ecosystem occurs on gullied terrain or in a gully

SWgh - the ecosystem occurs on hummocky, gullied terrain

SWgk - the ecosystem occurs on gullied terrain or in a gully, on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SWgs - the ecosystem occurs on gullied terrain on shallow soils

SWgw- the ecosystem occurs on gullied terrain or in a gully, on a warm aspect (aspect of 135 - 285 ^{o} on a slope that is 25-100%)

SWk - the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SWks –the ecosystem occurs on shallow soils on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SWn - the ecosystem occurs on a fan or cone

SWq - the ecosystem occurs on a very steep cool aspect (aspect of 285-135^{o} on a slope that is >100%)

SWr – the ecosystem occurs on ridged terrain or on a ridge crest

SWs - the ecosystem occurs on shallow soils

SWt- the ecosystem occurs on a terrace

SWw- the ecosystem occurs on a warm aspect (aspect of135 - 285 ^{o} on a slope that is 25-100%)

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Common snowberry Grasses Paper birch	Lodgepole pine Step moss White spruce	Lodgepole pine Prickly rose Saskatoon Soopolallie Trembling aspen White spruce	Bunchberry Fuzzy-spiked wildrye Lodgepole pine Prickly rose Soopolallie Step moss Trembling aspen Twinflower White spruce	Prickly rose Soopolallie Step moss White spruce Wild sarsaparilla

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Showy aster Prickly rose	Showy aster Prickly rose	Bunchberry Creamy peavine Northern bedstraw Red-stemmed feathermoss Showy aster Step moss Wild lily-of-the-valley	Balsam poplar Creamy peavine Highbush cranberry Pink wintergreen Red-stemmed feathermoss Wild sarsaparilla	Balsam poplar Creamy peavine Highbush cranberry Northern gooseberry Saskatoon Trembling aspen
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	0107639, 0107645, B1-04, B2-03, BC049, DT013, DT016, DT023, DT024, H1-12a, JG009, JG012, JG037, JG046, JG057, JG150, JG558, LA187, LS063, LS116, SK004, WB236	BC018, H1-13, JG044, JG100, JG118, LA002, LS123, RP194, SK592, WB239, WB316, WB322	WB219

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	In the study area, this unit was usually found on level sites or on mid to upper slopes on cool aspects. This ecosystem was uncommon in the study area. Nutrient regimes were generally poor to medium, and moisture regimes were submesic to mesic.				

A.4.9 SW: as: $At - Soopolallie (seral association) (03)

Typically submesic forest on gentle slopes. This unit normally occurs on fluvial, glaciofluvial, morainal or lacustrine parent materials with coarse to fine-textured soils, on mid-to upper slopes or level sites (BC Ministry of Forests 2002). Assumed modifiers c, d, j.

Map Symbol with Mapped Site Modifiers:

SWf:as – the ecosystem occurs on fine-textured soils

SWfk:as – the ecosystem occurs on fine-textured soils and on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SWg:as - the ecosystem occurs on gullied terrain or in a gully

SWgh:as - the ecosystem occurs on gullied terrain and hummocky terrain

SWgk:as - the ecosystem occurs on gullied terrain on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SWgs:as - the ecosystem occurs on gullied terrain on shallow soils

SWgw:as – the ecosystem occurs on gullied terrain on a warm aspect (aspect of 135 - 285^{o} on a slope that is 25-100%)

SWh:as - the ecosystem occurs on hummocky terrain

SWhw:as - the ecosystem occurs on hummocky terrain on a warm aspect (aspect of 135 - 285^{o} on a slope that is 25-100%)

SWk:as - the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SWks:as - the ecosystem occurs on shallow soils on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SWn:as - the ecosystem occurs on a fan or cone

SWq:as - the ecosystem occurs on a very steep cool aspect (aspect of 285- 135^{o} on a slope that is >100%)

SWr:as- the ecosystem occurs on a ridge crest or on ridged terrain

SWs:as –the ecosystem occurs on shallow soils

SWsw:as - the ecosystem occurs on shallow soils on a warm aspect (aspect of 135 - 285^{o} on a slope that is 25-100%)

SWt:as - the ecosystem occurs on a terrace

SWw:as- the ecosystem occurs on a warm aspect (aspect of 135 - 285^{o} on a slope that is 25-100%)

SWz:as – the ecosystem occurs on a very steep warm aspect (aspect of 135 - 285 ^{o} on a slope that is >100%)

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Fuzzy-spiked wildrye Prickly rose Soopolallie Trembling aspen	Prickly rose Saskatoon Soopolallie Trembling aspen	Prickly rose Soopolallie Trembling aspen	Fuzzy-spiked wildrye Prickly rose Soopolallie Trembling aspen	Fuzzy-spiked wildrye Prickly rose Soopolallie Trembling aspen
Associated Plant Species	Balsam poplar Fireweed Palmate coltsfoot Showy aster Wild strawberry Willow	Birch-leaved spirea Creamy peavine Northern bedstraw Showy aster White spruce	Creamy peavine Highbush cranberry Northern bedstraw Saskatoon Showy aster Wild strawberry	Creamy peavine Highbush cranberry Northern bedstraw Showy aster White spruce Wild sarsaparilla Wild strawberry	Creamy peavine Highbush cranberry Northern bedstraw Showy aster White spruce Wild sarsaparilla Wild strawberry

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	LA246, SK397, SK420, SK454, SK541	0107638, BC470, CD007, G1-08, JG508, JG611, LA038, LA233, SK091, SK092, SK363	DT014, H1-05, KS018, KS030, KS033, LA005, LA218, LS007, LS438, SK005, SK052, TKS056, TKS069, TKS093, WB353	BC351, BC376, K1-11, RP193, SK089, SK400, SK588, WB214	No project plots; it is unlikely that the seral unit exists in structural stage 7.
Comments	The SW:as unit was found in the study area on a variety of slope positions from crest to toe, and on level sites. It occurred on mesic to submesic sites with medium moisture regimes and moderately well-drained to well-drained.				

A.4.10 BL: Sb - Lingonberry - Coltsfoot (04)

The 04 ecosystem can be found on a very wide range of moisture conditions (submesic to hygric)(DeLong et al. 1990). Typically black spruce forest on gently sloping sites with deep, fine to coarse- textured soils. The 04 unit is found on morainal, lacustrine or (glacio) fluvial parent materials and has a very poor to poor nutrient regime (DeLong et al. 1990). Assumed modifiers d, f, j.

Map Symbol with Mapped Site Modifiers:

BLg- the ecosystem occurs on gullied terrain

BLh - the ecosystem occurs on hummocky terrain

BLt - the ecosystem occurs on a terrace

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Black spruce Lodgepole pine Bunchberry Step moss Twinflower	Black spruce Bunchberry Lodgepole pine Twinflower	Black spruce Bunchberry Knight's plume Lodgepole pine Prickly rose Red-stemmed feathermoss Step moss White spruce	Black spruce Bunchberry Labrador tea Lodgepole pine Red-stemmed feathermoss Step moss	Black spruce Bunchberry Labrador tea Lodgepole pine Red-stemmed feathermoss Step moss
Associated Plant Species	Horsetails Labrador tea Willows	Horsetails Labrador tea Willows	Creamy peavine Dwarf blueberry Fireweed Horsetails Lingonberry Paper birch Twinflower	Horsetails Prickly rose Saskatoon	Highbush cranberry Saskatoon

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	BC047, BC049, BC355, DT104, JG013, JG104, LA237, WB236	3-3001, JG117, WB344	No project plots; vegetation list prepared from other sources
Comments	This ecosystem was uncommon in the Peace Valley but was mapped along the powerline corridor on the plateau. This site was usually found on level sites (up to 15% slope) with mesic to subhygric moisture regimes and poor to medium nutrient regimes, on lacustrine or glaciofluvial materials.				

A.4.11 BL: al $At - Labrador tea (seral association) (04)

Typically submesic to hygric forest on gently sloping sites or depressions with deep, fine to coarse- textured soils. The :al seral association normally occurs on morainal or fluvial parent materials with very poor to poor nutrient regimes (BC Ministry of Forests 2002).

Map Symbol with Mapped Site Modifiers:

BLg:al – the ecosystem occurs on gullied terrain or in a gully

BLh:al – the ecosystem occurs on hummocky terrain

BLk:al - the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

BLw:al – the ecosystem occurs on a warm aspect (aspect of135 - 285^{o} on a slope that is 25-100%)

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Bluejoint Bunchberry Highbush cranberry Soopolallie Trembling aspen	Bluejoint Bunchberry Creamy peavine Dwarf red raspberry Highbush cranberry Prickly rose Redstemmed feathermoss Soopolallie Step moss Trembling aspen Velvet-leaved blueberry	Bunchberry Highbush cranberry Prickly rose Trembling aspen	Dwarf red raspberry Prickly rose Soopolallie Trembling aspen Willows	Bluejoint Bunchberry Creamy peavine Dwarf red raspberry Highbush cranberry Prickly rose Redstemmed feathermoss Soopolallie Step moss Trembling aspen Velvet-leaved blueberry

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Labrador tea Paper birch Prickly rose	Black spruce Dwarf blueberry Fuzzy-spiked wildrye Kinnikinnick Labrador tea Lingonberry	Twinflower Tall bluebells Labrador tea One-sided wintergreen Bluejoint reedgrass Lodgepole pine Paper birch Dwarf red raspberry	Balsam poplar Highbush cranberry Labrador tea	Black spruce Dwarf blueberry Fuzzy-spiked wildrye Kinnikinnick Labrador tea Lingonberry
Plots	SK519	No project plots; vegetation list prepared from other sources	WB047, WB328	WB354	No project plots; it is unlikely that the seral unit exists in structural stage 7.
Comments	The BL:al unit was found on level, moderately well-drained sites with subhygric to hygric moisture regimes and poor to medium nutrient regimes. The BL:al was mapped very rarely within the project area, and mainly along the powerline on the plateau.				

A.4.12 SO: Sw - Currant - Oak fern (05)

Typically mesic to subhygric forest on gently sloping moisture-receiving sites with deep, medium to fine- textured soils. The SO unit is found on a variety of parent materials (DeLong et al. 1990) and typically has a rich nutrient regime. Assumed modifiers d, f, j.

Map Symbol with Mapped Site Modifiers:

SOg- the ecosystem occurs on gullied terrain or in a gully

SOgk - the ecosystem occurs on gullied terrain or in a gully, on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SOgs - the ecosystem occurs on gullied terrain or on shallow soils

SOgw - the ecosystem occurs on gullied terrain or in a gully, on a warm aspect (aspect of135 - 285 o on a slope that is 25-100%)

SOh - the ecosystem occurs on hummocky terrain

SOk- the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SOn- the ecosystem occurs on a fan or cone

SOr – the ecosystem occurs on ridged terrain

SOt – the ecosystem occurs on a terrace

SOw - the ecosystem occurs on a warm aspect (aspect of 135 - 285 o on a slope that is 25-100%)

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Bunchberry Common snowberry Green alder Highbush cranberry Paper birch Prickly rose Red-osier dogwood Twinflower White spruce	Balsam poplar Black gooseberry Bunchberry Common mitrewort Common snowberry Creamy peavine Dwarf red raspberry Highbush cranberry Paper birch Prickly rose Red-osier dogwood Step moss Tall bluebells White spruce Wild sarsaparilla	Balsam poplar Black gooseberry Bunchberry Common mitrewort Common snowberry Creamy peavine Highbush cranberry Paper birch Prickly rose Red-osier dogwood Step moss Twinflower White spruce Wild sarsaparilla	Balsam poplar Bunchberry Common snowberry Highbush cranberry Paper birch Prickly rose Red-osier dogwood Red-stemmed feathermoss Step moss Twinflower White spruce Wild sarsaparilla	Balsam poplar Black gooseberry Bunchberry Common snowberry Highbush cranberry Paper birch Prickly rose Red-osier dogwood Red-stemmed feathermoss Step moss Twinflower White spruce Wild sarsaparilla

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Red raspberry Rough-fruited fairybells Wild strawberry Willows	Baneberry Blunt-fruited sweet-cicely Horsetails Rough-fruited fairybells Sweet coltsfoot Violets Wild strawberry	Asters Bedstraws Black twinberry Blunt-fruited sweet-cicely Choke cherry Dwarf red raspberry Horsetails Oak fern Red raspberry Saskatoon Tall bluebells Wild lily-of-the-valley Willows	Asters Baneberry Bedstraws Black twinberry Choke cherry Creamy peavine Dwarf red raspberry Horsetails Oak fern One-sided wintergreen Red raspberry Saskatoon Soopolallie Tall bluebells Wild strawberry	Asters Bedstraws Choke cherry Common mitrewort Creamy peavine Creamy peavine Devil's club Dwarf red raspberry Horsetails Oak fern Red raspberry Saskatoon Sitka alder Soopolallie Wild strawberry

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	SK639	JG154	C1-14a, DT020, F1-07, K1-01, LA028, N1-07, SK044, SK045, WB271	0107654, A1-06, BC006, BC380-1, D2-09, JG047, JG130, JG548, K1-14, L2-05, LS001, RP142, RP195, SK090, SK099, WB257, WB261, WB320, X1-03	0107656, LS036, LS113, WB220, WB333
Comments	Paper birch was commonly found within this unit, but devil's club and oak fern were rare. This unit was uncommon in the project area, and was generally found on gentle slopes or on cool aspects on well to moderately-well-drained sites.				

A.4.13 SC :ab: $At - Black twinberry (seral association) (05)

The draft seral guide (BC Ministry of Forests 2002) calls this unit the $At-Oak fern, but the 2003 provincial mapcodes list refers to it as the $At-Black twinberry. Typically, the seral 05 unit is found on gentle slopes with mesic to subhygric moisture regimes and medium to rich nutrient regimes, on fluvial or morainal parent materials (BC Ministry of Forests 2002).

Map Symbol with Mapped Site Modifiers:

SCg:ab - the ecosystem occurs on gullied terrain or in a gully

SCgk:ab - the ecosystem occurs on gullied terrain or in a gully, on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SCgw: ab – the ecosystem occurs on gullied terrain or in a gully, on a warm aspect (aspect of 135 - 285^{o} on a slope that is 25-100%)

SCh:ab – the ecosystem occurs on hummocky terrain

SCk:ab - the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SCs:ab – the ecosystem occurs on shallow soils

SCt:ab – the ecosystem occurs on a terrace

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Common horsetail Canada goldenrod	Balsam poplar Trembling aspen Red-osier dogwood Prickly rose Bunchberry	Balsam poplar Red-osier dogwood Prickly rose Bunchberry	Balsam poplar Prickly rose Common snowberry Bunchberry	Balsam poplar Prickly rose Common snowberry Bunchberry

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Balsam poplar Trembling aspen Willows Narrow-leaved hawkweed	Balsam poplar Trembling aspen Willows	Willows Mountain alder Highbush-cranberry Black gooseberry Common snowberry Wild sarsaparilla Wild lily-of-the-valley Showy aster	White spruce Trembling aspen Paper birch Soopolallie Highbush-cranberry Red-osier dogwood Saskatoon Black gooseberry Red raspberry Choke cherry Common horsetails Creamy peavine Northern bedstraw Wild lily-of-the-valley One-sided wintergreen Pink wintergreen Baneberry	Trembling aspen Paper birch Willows Soopolallie Wild sarsaparilla Black gooseberry Highbush cranberry Creamy peavine Showy aster Red raspberry

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	KS027, LS069, SK046, SK073	LS065, SK603	No project plots; it is unlikely that the seral unit exists in structural stage 7.
Comments	Typic SC:ab does not occur in the project area. This seral ecosystem occurs closer to the Rocky Mountains. Plots allocated to this ecosystem did not "fit" into seral ecosystem /01 or /07. In the study area, the SC:ab was found primarily on moderately well-drained cool aspects with mesic to subhygric moisture regimes and medium to rich nutrient regimes. In the shrub stage, several weedy species have invaded.				

A.4.14 SC :ep: $Paper birch- red-osier dogwood (seral association) (05)

Typically moist to wet sites with coarse, unstable soils on cool aspect slopes (noncorrelated unit).

Map Symbol with Mapped Site Modifiers:

SCan:ep - the ecosystem occurs on an active floodplain and on a fan or cone

SCck:ep - the ecosystem occurs on coarse-textured soils on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SCg:ep - the ecosystem occurs on gullied terrain

SCgk:ep - the ecosystem occurs on gullied terrain on a cool aspect (aspect of 285-135^o on a slope that is 25-100%)

SCk:ep - the ecosystem occurs on a cool aspect (aspect of 285-135^o on a slope that is 25-100%)

SCt:ep - the ecosystem occurs on a terrace

SCw:ep - the ecosystem occurs on a warm aspect (aspect of 135-285^o on a slope that is 25-100%)

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Alder Bluejoint reedgrass Paper birch	Paper birch Wild sarsaparilla	Alder Highbush cranberry Paper birch Prickly rose Red-osier dogwood	Bunchberry Dwarf red raspberry Highbush cranberry Paper birch Prickly rose Wild sarsaparilla	Bunchberry Dwarf red raspberry Highbush cranberry Paper birch Prickly rose Wild sarsaparilla

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Black gooseberry Fuzzy-spiked wildrye Red-osier dogwood Trembling aspen	One-sided wintergreen Prickly rose Trembling aspen White spruce	Black gooseberry Bunchberry White spruce	Balsam poplar Birch-leaved spirea Black gooseberry White spruce	Balsam poplar Birch-leaved spirea Black gooseberry White spruce
Plots	RP164, WB312	LA026, LS062	C1-09, M2-11, KS-25, L1-12a, LA230, WB209, WB334	M2-13a, WB259, WB319	No project plots; it is unlikely that the seral unit exists in structural stage 7.
Comments	This seral ecosystem was defined for the project and is based upon a similar unit defined by Lea and Lacelle (1989). The SC:ep was found mainly on rich, cool aspect, mid to lower slopes that were well-drained to moderately well-drained. Moisture regimes were mainly mesic to subhygric.				

A.4.15 SC:Sw - Currant - Bluebells (06)

Typically mesic to subhygric forest on gently sloping, moisture-receiving sites with deep, fine- textured soils

The $06 has been merged with the $01 based on advice from the regional ecologist (C. DeLong, pers. comm. 2006).

Map Symbol with Mapped Site Modifiers:

SCg - the ecosystem occurs on gullied terrain

SCh - the ecosystem occurs on hummocky terrain

SCk - the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

SCn - the ecosystem occurs on a fan or cone

SCt - the ecosystem occurs on a terrace

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Balsam poplar White spruce Willow	Balsam poplar Step moss White spruce Willow	Balsam poplar Black twinberry Prickly rose Red-osier dogwood Step moss Twinflower White spruce Willow	Balsam poplar Common snowberry Highbush cranberry Prickly rose Red-osier dogwood Red-stemmed feathermoss Step moss Twinflower White spruce Wild sarsaparilla	Balsam poplar White spruce Wild sarsaparilla

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Soopolallie Wild strawberry	Red-osier dogwood Trembling aspen	Black gooseberry Dwarf red raspberry One-sided wintergreen Trembling aspen	Dwarf red raspberry Paper birch Sweet-scented bedstraw Trembling aspen Wild strawberry	Prickly rose Wild lily-of-the-valley
Plots	JG619, SK012	JG609	B1-15, DT104, JG011, JG022, KS020, SK447, SK475, WB011	0107650, A2-15, LA033, M2-08, N1-10, SK015, SK094, SK096, SK098, WB270, WB317	SK007
Comments	The SC unit was usually found on gentle slopes with a medium nutrient regime and a mesic to subhygric moisture regime. Tall bluebells was rare in the study area.				

A.4.16 SH: Sw - Currant - Horsetail (07)

Typically subhygric to hygric forest on gentle slopes with deep, coarse to fine- textured soils. The SH normally has a medium to very rich nutrient regime and occurs on lacustrine or fluvial parent materials.

Map Symbol with Mapped Site Modifiers:

SHa– the ecosystem occurs on an active floodplain

SHat – the ecosystem occurs on an active floodplain on a terrace **SHg** – the ecosystem occurs on gullied terrain or in a gully **SHk** – the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%) **SHp** – the ecosystem occurs on a peaty material **SHat** – the ecosystem occurs on an active floodplain on a terrace **SHt** – the ecosystem occurs on a terrace

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Balsam poplar Highbush cranberry Bunchberry Horsetails Red-osier dogwood Step moss Trembling aspen White spruce	Bunchberry Highbush cranberry Horsetails Prickly rose Red-osier dogwood White spruce	Balsam poplar Bunchberry Common snowberry Horsetails Prickly rose Red-osier dogwood White spruce	Balsam poplar Highbush cranberry Horsetails Prickly rose Red-osier dogwood White spruce	Balsam poplar Highbush cranberry Bunchberry Common snowberry Horsetails Prickly rose Red-osier dogwood White spruce Wild sarsaparilla

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Fireweed Peavines Prickly rose Red raspberry Twinflower Willows	Balsam poplar Black twinberry Black gooseberry Dwarf red raspberry Grasses Trembling aspen Twinflower Wild sarsaparilla	Black twinberry Dwarf red raspberry Highbush cranberry Peavines Twinflower	Asters Bedstraws Black twinberry Common snowberry Paper birch Prickly rose Red raspberry Red raspberry Twinflower Wild sarsaparilla	Bedstraws Black twinberry Common snowberry Mountain alder Paper birch Red raspberry Red swamp currant

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	LS002	BC002	CD201, KS012	0107633, 0107661, 0107670, E2-01, H2-17, KS010, KS028, LA042, LA183, LA234, LS108, LS119, N2-04, RP121, SK042, TKS010, WB228, WB336, X1-08	H2-08, LS030, RP147, SK591a, WB207, WB221, WB222
Comments	In the study area, the SH was typically found on level sites with subhygric to hygric moisture regimes and medium to rich nutrient regimes, on imperfectly to moderately well-drained soils. The SH was found mainly on fluvial parent materials, and was mapped on the lower slopes of the Peace River valley and on the islands in the river. The 07 is a rich forested site that produces large-diameter white spruce and balsam poplar if undisturbed. Fishers, marten, bats and cavity-nesting birds find shelter in cavities of large trees. The lush herb and shrub layer of the 07 make it an attractive foraging habitat for ungulates and bears.				

A.4.17 SH ac: $Ac - Cow parsnip (seral association) (07)

The SH:ac typically occurs on rich, lower slopes with medium to coarse-textured soils on fluvial, morainal or lacustrine parent materials with rich nutrient regimes and subhygric to hygric moisture regimes(BC Ministry of Forests 2002).

Map Symbol with Mapped Site Modifiers:

SHf:ac – the ecosystem occurs on fine textured soils

SHg:ac – the ecosystem occurs on gullied terrain or in a gully

SHgk:ac - the ecosystem occurs on gullied terrain or in a gully, on a cool aspect (aspect of 285-135o on a slope that is 25-100%)

SHh:ac – the ecosystem occurs on hummocky terrain

SHk:ac – the ecosystem occurs on a cool aspect (aspect of 285-135o on a slope that is 25-100%)

SHn:ac – the ecosystem occurs on a fan or cone

SHs:ac – the ecosystem occurs on shallow soil

SHt:ac – the ecosystem occurs on a terrace

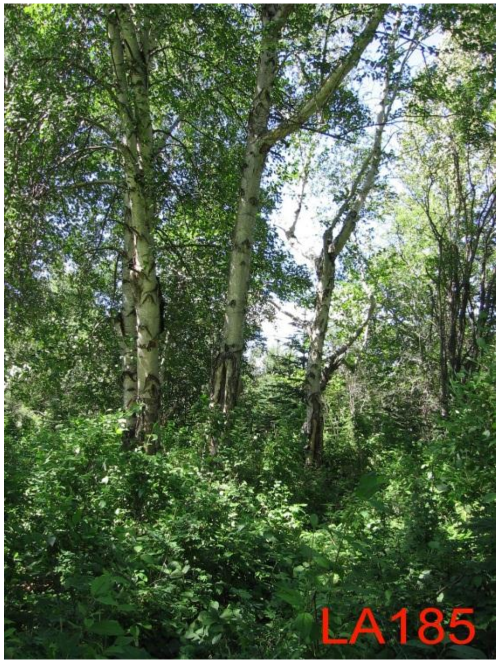
Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Balsam poplar Grasses Horsetails Red raspberry Red-osier dogwood Willows	Balsam poplar Common horsetail Common snowberry Highbush cranberry	Balsam poplar Grasses Highbush cranberry Horsetails Prickly rose Red-osier dogwood Wild sarsaparilla	Alder Balsam poplar Common snowberry Horsetails Prickly rose Red raspberry Red-osier dogwood Wild sarsaparilla	Balsam poplar Prickly rose Highbush cranberry Dwarf red raspberry

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Alder Bedstraws Bluejoint reedgrass Canada goldenrod Common snowberry Prickly rose Star-flowered false Solomon's-seal Yarrow	Asters Bunchberry Paper birch Red raspberry Trembling aspen White spruce	Alder Bedstraws Coltsfoot Creamy peavine Dwarf red raspberry Paper birch Red raspberry Saskatoon White spruce Willows	Bedstraws Bluejoint reedgrass Dwarf red raspberry Grass spp. Highbush cranberry Star-flowered false Solomon’s-seal White spruce Wild lily-of-the-valley Willows	Bedstraws Bluejoint reedgrass Dwarf red raspberry Grass spp. Star-flowered false Solomon’s-seal White spruce Wild lily-of-the-valley

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	CD085, DT108, JG667, KS002, LA014, LA036, LS034, LS117, SK030, SK077, SK082, SK426, SK538, TKS009, WB013	SK085, SK470	B1-09, DT003, DT011, DT017, DT116, KS004, KS009, KS026, LA021, LA197, LA232, LS033, LS124, SK440, SK537, SK539, SK553, TKS004, WB211, WB215	0107646, 0107662, BC369, DT033, JG632, KS001, KS041, LA023, LA332, LA342, LS057, LS065, RP128, RP140, RP144, RP177, SK049, SK081, SK088, WB015, WB223, WB301	LS010

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	A typic SH :ac forest has an open tree canopy with a well-developed shrub and herb layers. Generally prickly rose, red-osier dogwood and horsetails or bluejoint are the dominant species. Bluejoint replaces common horsetail on drier sites. The moss and lichen cover is absent or poorly developed. Several herbs (coltsfoot, showy aster, wild strawberry, pink wintergreen, northern bedstraw) commonly occur with a cover less than 1%. In the study area, SH:ac sites were mainly found on level fluvial sites with subhygric to hygric moisture regimes, medium to rich nutrient regimes, and were imperfectly to moderately well-drained. The $07 is a rich forested site that produces large-diameter balsam poplar if undisturbed. Fishers, marten, bats, and cavity-nesting birds find shelter in cavities of large trees. The lush herb and shrub layer of the $07 make it an attractive foraging habitat for ungulates and bears. Plots originally classified as $07 that were on active floodplains were reassigned to the new 09 (Fm02) ecosystem, defined in 2006.				

A.4.18 SH ep: $Ep - (seral association) (07)



Typic SH:ep mainly occurs on level or toe sites with medium to coarse-textured soils.

Map Symbol with Mapped Site Modifiers:

SHa:ep – the ecosystem occurs on an active floodplain

SHt:ep – the ecosystem occurs on a terrace

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Horsetails Paper birch Prickly rose Red raspberry	Horsetails Paper birch Prickly rose Red raspberry Saskatoon	Horsetails Paper birch Prickly rose Red raspberry Saskatoon	Paper birch Prickly rose Red raspberry Red-osier dogwood	Paper birch Prickly rose Red raspberry Red-osier dogwood
Associated Plant Species	Balsam poplar Trembling aspen Black gooseberry Red-osier dogwood Bluejoint reedgrass	Balsam poplar Highbush cranberry Pink wintergreen Sweet-scented bedstraw White spruce Wild lily-of-the-valley Wild sarsaparilla	Balsam poplar Highbush cranberry Pink wintergreen Sweet-scented bedstraw White spruce Wild lily-of-the-valley Wild sarsaparilla	Balsam poplar Sweet-scented bedstraw White spruce	Balsam poplar Highbush cranberry Pink wintergreen Sweet-scented bedstraw White spruce Wild lily-of-the-valley Wild sarsaparilla

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	LA185, LS016, LS044	LS041, WB208	No project plots; it is unlikely that the seral unit exists in structural stage 7.
Comments	The :ep seral association was defined in this project to represent seral 07 units where the balsam poplar had been replaced by paper birch as the dominant seral tree species. As in the more typical :ac unit, the :ep unit was found mainly on fluvial surficial materials on level, subhygric to hygric rich sites.				

A.4.19 BT: Sb - Labrador tea - Sphagnum (08)

Typically a forested organic wetland with deep, peaty soil. The BT unit normally has a poor to very poor nutrient regime and occurs on organic or fluvial parent materials (DeLong et al. 1990), often on cold sites underlain by permafrost. Assumed modifiers d, j, p.

Map Symbol with Mapped Site Modifiers:

BTg – the ecosystem occurs on gullied terrain or in a gully

BTh – the ecosystem occurs on hummocky terrain

BTs – the ecosystem occurs on shallow soils **BTt:** The ecosystem occurs on a terrace

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Black spruce Labrador tea Lingonberry Sphagnum mosses Tamarack Willows	Black spruce Black twinberry Labrador tea Red-stemmed feathermoss Step moss Tamarack	Black spruce Labrador tea Red-stemmed feathermoss Step moss Tamarack	Black spruce Tamarack Bunchberry Common mitrewort Horsetails Knight's plume Labrador tea Sedges Step moss Willows	Black spruce Horsetails Knight's plume Knight's plume Labrador tea Step moss

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Black twinberry Bunchberry Cloudberry Common mitrewort Grey reindeer lichen Horsetails Paper birch Twinflower	Common mitrewort Dwarf red raspberry Horsetails Prickly rose Sedges Tall bluebells Willows	Bunchberry Common mitrewort False Solomon's-seal Horsetails Lingonberry Prickly rose	Black twinberry Dwarf red raspberry Large-leaved avens Prickly rose Soopolallie Tall bluebells Twinflower White spruce	Black twinberry Bunchberry Highbush cranberry Prickly rose Willows
Plots	BC387, JG014, LA242, LS121, SK359, SK459, SK467, WB238	JG046a, JG063, JG099, JG115, JG140, JG153, WB341	BC046, BC354-1, G1-10, JG013, JG040, JG129, LS126, SK451, WB036, WB308, WB309, WB327, WB337, WB404	A-SK338, BC379, JG055, JG108, WB305, WB318, WB411	No project plots; vegetation list prepared from other sources

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	This site was rarely mapped in the Peace River Valley but was common along the powerline route on the plateau. It was generally found on poorly drained, level to depressional sites (0-12% slope) on organic surficial materials, with subhygric to subhydric moisture regimes and poor to medium nutrient regimes.				

A.4.20 Fm02: Cottonwood-Spruce-Red-osier dogwood (09)

Typically a medium bench floodplain found on sandy or gravelly fluvial materials adjacent to streams and rivers. Typically an open canopy of P. balsamifera with a sparse to well-developed understorey, subject to short flood durations followed by continual subirrigation (MacKenzie and Moran 2004).This unit is a new for the BWBSmw1, and was defined by the MoF in 2006. No assumed modifiers are listed in BECdb (BC Ministry of Environment 2006) for this unit.

Map Symbol with Mapped Site Modifiers:

Fm02a - the ecosystem occurs on an active floodplain

Fm02ab –the ecosystem occurs on a gravel bar on an active floodplain

Fmo2ac - the ecosystem occurs on an active floodplain on coarse-textured soils

Fmo2af - the ecosystem occurs on an active floodplain on fine-textured soils

Fm02ag – the ecosystem occurs on an active floodplain on a terrace

Fm02ap – the ecosystem occurs on an active floodplain on a terrace

Fm02at – the ecosystem occurs on an active floodplain on a terrace

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	American vetch Balsam poplar Bluejoint reedgrass Canada goldenrod Highbush cranberry Horsetails Prickly rose Red raspberry Red-osier dogwood Star-flowered false Solomon's-seal Sweet-scented bedstraw Yarrow	Balsam poplar Grasses Horsetails Mountain alder	Balsam poplar Horsetails Prickly rose Red-osier dogwood Grasses	Balsam poplar Bedstraws Common snowberry Horsetails Prickly rose Red raspberry Red-osier dogwood Star-flowered false Solomon's seal Wild sarsaparilla	Balsam poplar Horsetails Prickly rose Wild sarsaparilla

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Common snowberry Creamy peavine Northern gooseberry Wild sarsaparilla	Canada goldenrod Prickly rose Red-osier dogwood Sweet-scented bedstraw	Alder Canada goldenrod Red raspberry White spruce	Canada goldenrod Highbush cranberry White spruce Wild lily-of-the-valley	Alder Common snowberry Red-osier dogwood Sweet-scented bedstraw White spruce
Plots	BC005, Cloudy1, Cloudy2, Cloudy3, LA318, LA319, LA328, LS428, LS431, norma1, SK079, SK083, WB256, WB400, WB408, WB412	CD066, SK057	KS022, LA316, LS427, liza1, SK080, SK560, WB205	0107649, 0107668, farrah2, KS024, LA027, LS110, RP132, WB201, WB278, WB280, willy1	WB206

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Comments	The 09 unit was found on fluvial surficial materials with submesic to hygric moisture regimes and medium to rich nutrient regimes. Plots in this unit were mostly moderately well-drained to well-drained, and located adjacent to the Peace River or its tributaries. The 09 unit can produce large-diameter balsam poplar in its older structural stages. Large old balsam poplars provide valuable habitat for cavity-users such as bats, marten, fisher and a number of bird species.				

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

A.4.21 TS: Tamarack-Sedge (10)

Typically a bog on deep, peaty soils on gentle slopes and depressions, slightly richer than the 08 BT. Subhydric to hydric moisture regime. Defined in MacKenzie and Moran (2004).

Map Symbol with Mapped Site Modifiers:

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
TSh – the ecosystem occurs on hummocky terrain					

Structural Stage	2 - Herb	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Sedges	Tamarack Sedges Labrador tea Scrub birch	Tamarack Scrub birch Labrador tea Willows Bluejoint reedgrass Sedges	Tamarack Scrub birch Willows Sedges	Tamarack Sedges	Tamarack Sedges

Structural Stage	2 - Herb	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Tamarack Willows Arrow-leaved coltsfoot Red swamp currant Golden fuzzy fen moss	Black spruce Willows Arrow-leaved coltsfoot Bluejoint reedgrass Marsh cinquefoil Golden fuzzy fen moss	Peat mosses Arrow-leaved coltsfoot	Red-osier dogwood Black spruce Labrador tea	Black spruce Labrador tea White spruce	Black spruce Willows
Plots	No project plots; vegetation list prepared from other sources	0107666, BC356, BC363, BC420, JG075, RP164a, RP183, SK003, SK357, SK358, SK366, SK370, SK531, SK572, WB231, WB233, WB235, WB403	BC370, BC386	A-SK336, LA236, RP184	A-SK303, A-SK304, RP156, WB311	No project plots: plot data from other sources

Structural Stage	2 - Herb	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
	The 10 ecosystem (Wb06) was formerly known as the noncorrelated TS Lt-Sedge unit, and permission was obtained from the Regional Ecologist to continue to map this unit using the ‘TS’ code rather than ‘Wb06’ (C.DeLong, pers. comm. 2006). In the project area, this ecosystem was generally found on level to depressional sites with a subhygric to hydric moisture regime and a poor to medium nutrient regime.					

A.4.22 AS: SwAt - Soopolallie (00)

This unit is noncorrelated but has been described in the provincial mapcodes list as xeric to submesic aspen forest on warm aspect, significant slopes with deep, medium-textured soils. This ecosystem may be a reflection of a history of frequent fires on dry, warm slopes.

Map Symbol with Mapped Site Modifiers:

ASc – the ecosystem occurs on coarse-textured soils

ASck - the ecosystem occurs on coarse-textured soils on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

ASg - the ecosystem occurs on gullied terrain or in a gully

ASgh – the ecosystem occurs on gullied and hummocky terrain

ASgk – the ecosystem occurs on gullied terrain on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

ASgq – the ecosystem occurs on gullied terrain on very steep cool aspect (aspect of 285-135^{o} on a slope that is >100%)

ASgs – the ecosystem occurs on gullied terrain on shallow soils

ASgz - the ecosystem occurs on gullied terrain or in a gully, on a very steep warm aspect (aspect of 135 - 285^{o} on a slope that is >100%)

ASh – the ecosystem occurs on hummocky terrain

ASj – the ecosystem occurs on gentle slopes (<25%)

ASk – the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

ASks - the ecosystem occurs on shallow soils on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

ASn - the ecosystem occurs on a fan or cone

ASr – the ecosystem occurs on ridged terrain or on a ridge crest

ASs – the ecosystem occurs on shallow soils

ASt – the ecosystem occurs on a terrace

ASz - the ecosystem occurs on a very steep warm aspect (aspect of135 - 285^{o} on a slope that is >100%)

Structural Stage	2 - Herb	3 - Shrub
Dominant Plant Species	Fuzzy-spiked wildrye Prickly rose	Saskatoon Trembling aspen Choke cherry Prickly rose Common snowberry Spreading dogbane
Associated Plant Species	Common snowberry Showy aster saskatoon	Showy aster Soopolallie
Plots	No project plots; plants extrapolated from other structural stages.	BC021, KS032, LA007,
Comments	The AS unit was mostly found on subxeric sites on moderately well-drained to well-drained sites. Although the provincial mapcodes list has this noncorrelated unit occurring in structural stages up to 7, the aspen in this unit are stunted due to lack of moisture. The Regional Ecologist approved mapping the AS unit up to structural stage 3 (C. DeLong, pers. comm. 2006). Aspen stands originally mapped as AS units in structural stages >3 were reclassified as AMw:ap or SWw:as ecosystems.	

A.5 BWBSmw1- Nonforested Ecosystems

A.5.1 WH: Willow-Horsetail-Sedge riparian wetland (00)

This noncorrelated unit is described in the provincial mapcodes list as a riparian wetland on coarse to fine-textured fluvial soils. Subhygric to hygric moisture regime.

Map Symbol with Mapped Site Modifiers:

WHa - the ecosystem occurs on an active floodplain

WHac - the ecosystem occurs on an active floodplain on coarse-textured soils

WHaf - the ecosystem occurs on an active floodplain on fine-textured soils

Structural Stage	2 - Herb	3 - Shrub	4 - Pole-sapling
Dominant Plant Species	Bluejoint reedgrass Horsetails Sedges Willows Common spike-rush	Alders Bluejoint reedgrass Grasses Horsetails Red-osier dogwood Sedges Common spike-rush Willows	Alders Horsetails Red raspberry Red-osier dogwood Pacific Willow Common spike-rush
Associated Plant Species	Large-leaved avens Alders	Balsam poplar Bedstraws Canada goldenrod Red raspberry Stinging nettle	Grasses Stinging nettle

Plots	LA167, KS040, RP126, RP141, SK407, WB272, WB273	0107660, A-SK332, BC003, JG002, JG688, KS011, KS021, LA181, LA334, LS107, LS111, LS420, LS422, LS429, LS437, SK029, SK064, SK536, TKS002, TKS008, WB200, WB210, WB217, WB277, WB279, WB281, WB401, WB402, WB405, WB406, WB407, WB415	KS003
Comments	This unit includes the Fl01 Alder-Horsetail Floodplain, Red-osier dogwood floodplain, At-Red-osier dogwood floodplain, Fl03 Willow-Red-osier dogwood –Horsetail floodplain, and Fl05 Willow-Bluejoint Floodplain units from MacKenzie and Moran (2004). Merging the non-forested floodplain units was appropriate for this scale of mapping. This is a diverse unit that is heavily influenced by flood regimes. Soils range from coarse gravel to fine silt, and vegetation varies from a near total cover of horsetails and sedges to dense willow thickets. The WH unit was mapped on level floodplains adjacent to the Peace River and its tributaries, and occasionally along some of the larger creeks. Moisture regimes were generally subhygric to hygric, and nutrient regimes ranged from poor to rich.		

A.5.2 SE: Sedge Wetland (00)

Typically a sedge wetland (marsh or fen) with a deep to thin peat layer. Description from MacKenzie and Moran (2004); includes Wm01 and Wf01. Medium to rich nutrient regime; hydric moisture regime. Assumed modifiers: d, j, p.

Map Symbol with Mapped Site Modifiers:

SEh - the ecosystem occurs on hummocky terrain

Structural Stage	2 - Herb	3 - Shrub
Dominant Plant Species	Beaked sedge Water sedge Marsh cinquefoil Bluejoint reedgrass	Scrub birch Sedges Grasses Peat mosses Willows Bluejoint reedgrass
Associated Plant Species	Willows Small bedstraw Foxtail barley Swamp horsetail Arrow-leaved coltsfoot Marsh skullcap Richardson’s water moss Scrub birch	Bluegrass Marsh cinquefoil

Structural Stage	2 - Herb	3 - Shrub
Plots	LA 240, CD202, JG134, LA244b, LA247, LA249, LA250, LA313, LS008, LS058, RP117, RP118, RP125, RP139, RP153, RP182, WB224, WB226, WB229, WB240, 0107665, 0107667, 0107672, WB3013, 3-3002, BC050, BC367, BC412, BC413, BC414, BC416, BC440, BC444, BC461, JG003, SK350, SK352, SK360, SK361b, SK362, SK368, SK374, SK377, SK379, SK380, SK385, SK387, SK390, SK391, SK393, SK394, SK395, SK396, SK402, SK403, SK404, SK410, SK411, SK416, SK419, SK422, SK432, SK436, SK437, SK456, SK520	BC397, KS029, SK408, SK409, SK442
Comments	The SE wetland unit was mapped on level to depressional sites on organic surficial materials with subhygric to hydric moisture regimes. Nutrient regimes were generally medium to rich, and sites were poorly to very poorly drained. Sedge fens provide spring foraging habitat for bears and ungulates, and foraging sites for bats if open water is also present.	

A.5.3 WS: Willow Sedge Wetland (00)

Typically a swamp (noncorrelated unit); includes Ws03 and Ws06 in MacKenzie and Moran (2004).

Map Symbol with Mapped Site Modifiers:

WSh - the ecosystem occurs on hummocky terrain

Structural Stage	2 - Herb	3 - Shrub

Structural Stage	2 - Herb	3 - Shrub
Dominant Plant Species	Sedges Bluejoint wheatgrass Willows	Bluejoint wheatgrass Sedges Willows spp.
Associated Plant Species	Asters	Arrow-leaved coltsfoot Horsetails Marsh cinquefoil Red-osier dogwood Scrub birch Sedges White spruce
Plots	KS023, SK084, SK399, SK460, SK479	A-SK301, A-SK316, A-SK318, LA031, BC441, CD118, JG005, LA012, LA198, LS109, SK071, SK455, SK482, SK526, SK529, SK530

Structural Stage	**2 - Herb**	**3 - Shrub**
Comments	Within the project area, the WS unit was found on level to depressional sites with subhygric to subhydric moisture regimes and medium to rich nutrient regimes. Swamps provide spring forage for bears, deer and elk, nesting habitat for waterfowl and wetland birds, and moose foraging habitat.	

A.5.4 WW: Fuzzy-spiked wildrye – Wolf-willow (00)

Typically sparsely vegetated sites on warm aspects on deep, medium-textured soils (noncorrelated unit). Assumed modifiers: d, m, w. There are no tree or moss layers.

Map Symbol with Mapped Site Modifiers:

WWg - the ecosystem occurs on gullied terrain or in a gully

WWgh - the ecosystem occurs on gullied or hummocky terrain.

WWgk - the ecosystem occurs on gullied terrain on a cool aspect slope (aspect of 285-135^o on a slope that is 25-100%)

WWgq - the ecosystem occurs on gullied terrain or in a gully on a very steep cool aspect (aspect of 285-135^o on a slope that is >100%)

WWgs - the ecosystem occurs on gullied terrain or in a gully

WWgz - the ecosystem occurs on gullied terrain or in a gully, on a very steep warm aspect (aspect of 135 - 285 ^{o} on a slope that is >100%)

WWh - the ecosystem occurs on hummocky terrain

WWj – the ecosystem occurs on a gentle slope (<25%)

WWjs – the ecosystem occurs on gentle slopes (<25%) on shallow soils

WWq –the ecosystem occurs on a very steep cool aspect (aspect of 285-135^o on a slope that is >100%)

WWr - the ecosystem occurs on a ridge crest or on ridged terrain

WWs - the ecosystem occurs on shallow soils

WWsz- the ecosystem occurs on shallow soils on a very steep warm aspect (aspect of 135 - 285 ^{o} on a slope that is >100%)

WWt - the ecosystem occurs on a terrace

WWz - the ecosystem occurs on a very steep warm aspect (aspect of 135 - 285 o on a slope that is >100%)

Structural Stage	2 - Herb	3 - Shrub
Dominant Plant Species	Altai fescue Fuzzy-spiked wildrye Prairie sagewort Spreading needlegrass Stiff needlegrass Thickspike wheatgrass Blunt sedge False melic Columbia needlegrass	Altai fescue American vetch Columbia needlegrass Spreading needlegrass Common snowberry Stiff needlegrass Thickspike wheatgrass Fuzzy-spiked wildrye Prairie sagewort False melic Blunt sedge Prickly rose Saskatoon Wolf-willow (silverberry)
Associated Plant	Chokecherry Nodding onion	Asters Grasses

Species	Poaceae Prickly pear Saskatoon Snowberry Wheatgrass Yarrow	Trembling aspen Yarrow Spreading dogbane
Plots	0107634, 0107635, 0107644, LA029, LA034, RP108, RP110, RP111, RP114, RP115, RP133, RP151, RP159, RP160, RP174, RP175, RP178, RP179, RP196, RP199, SK543, WB242	JG539, RP135, SK050, SK101, SK544, TKS132, WB005, LA022
Comments	This unit is listed in the provincial mapcodes list as 'Fuzzy-spiked Wildrye-Coyote willow', however, coyote or sandbar willow *Salix exigua* is a species found in moist floodplain habitats, not steep dry warm aspects. We have used a revised version of the ecosystem unit name that includes wolf-willow (*Elaeagnus commutatus*) rather than coyote willow. Wolf-willow is also known as silverberry. This unit was mapped extensively on steep, south aspects on the north bank of the river, often complexed with AS and CB units. It was distinguished from the AS unit by its lack of tree species. The WW unit was found on mid to upper slopes, on xeric to subxeric sites with poor nutrient regimes, usually on colluvial surficial materials. Prickly pear cactus is often present in this unit at the east end of the study area (Clayhurst).	

A.6 SBSwk2 – Forested Ecosystems

A.6.1 SO: Sxw – Oak fern (01)

Typically a spruce forest on gentle slopes with deep, medium-textured soils.

Assumed modifiers: d, j, m.

Map Symbol with Mapped Site Modifiers:

SOg – the ecosystem occurs on gullied terrain or in a gully

SOgs – the ecosystem occurs on gullied terrain on shallow soils

SOs – the ecosystem occurs on shallow soils

SOr – the ecosystem occurs on ridged terrain

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Bunchberry Sitka mountain-ash Trembling aspen Douglas maple Paper birch Balsam poplar Trembling aspen Fireweed Birch-leaved spirea False Solomon's-seal Queen's cup	Hybrid white spruce Subalpine fir Trembling aspen Bunchberry Douglas maple False Solomon's-seal Black gooseberry Highbush cranberry Prickly rose Creamy peavine Black huckleberry Three-leaved foamflower Oak fern	Hybrid white spruce Subalpine fir False Solomon's-seal Black gooseberry Highbush cranberry Black huckleberry Three-leaved foamflower	Hybrid white spruce Subalpine fir Red-stemmed feathermoss Knight's plume Step moss Black huckleberry	Hybrid white spruce Subalpine fir Black huckleberry Thimbleberry Oak fern Bunchberry Five-leaved bramble Three-leaved foamflower Red-stemmed feathermoss Knight's plume Step moss

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Hybrid white spruce Subalpine fir Heart-leaved arnica Oak fern	Heart-leaved arnica Saskatoon Rattlesnake plantain Red-stemmed feathermoss Knight's plume Step moss	Devil's club Oak fern Trembling aspen Birch-leaved spirea Clasping twistedstalk Red-stemmed feathermoss Knight's plume Step moss	False Solomon's-seal Highbush cranberry Devil's club Clasping twistedstalk Black gooseberry	Douglas maple Sitka alder Highbush cranberry Palmate coltsfoot False Solomon's-seal Devil's club Black gooseberry One-sided wintergreen Clasping twistedstalk Stiff clubmoss
Plots	LAV1238, LAV1236	LAV1237, LAV240, LAV1240, LAV1239	LAV1235, LAG1223	LAG1224	No project plots; vegetation list prepared from other sources
Comments	This ecosystem provides cover for ungulates, berry feeding habitat for bears, and migratory bird nesting habitat.				

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

A.6.2 LH: Pl – Huckleberry – Cladina (02)

Typically pine forest on gentle slopes to level sites; deep coarse-textured soils

Assumed modifiers: c, d, j.

Map Symbol with Mapped Site Modifiers:

LHrs – the ecosystem occurs on ridged terrain on shallow soils

LHsw – the ecosystem occurs on shallow soils on a warm aspect (aspect of 135-285 ^{o} on a slope that is 25 – 100%)

LHs – the ecosystem occurs on shallow soils

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Sitka alder Trembling aspen Black huckleberry Bunchberry	Lodgepole pine Subalpine fir Hybrid white spruce Trembling aspen Black huckleberry Bunchberry	Lodgepole pine Subalpine fir Hybrid white spruce Black huckleberry Bunchberry	Lodgepole pine Subalpine fir Hybrid white spruce Black huckleberry Bunchberry	Lodgepole pine Subalpine fir Hybrid white spruce Black huckleberry Bunchberry One-sided wintergreen Crane's-bill mosses

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Lodgepole pine Subalpine fir Hybrid white spruce	Red-stemmed feathermoss Green wintergreen	Red-stemmed feathermoss Green wintergreen	Red-stemmed feathermoss Green wintergreen	Sitka alder Cladina lichens Freckle pelt lichen Green wintergreen Leafy liverworts
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This ecosystem provides cover for ungulates, berry feeding habitat for bears, and migratory bird nesting habitat.				

A.6.3 SC: Sxw – Huckleberry – Highbush cranberry (03)

Typically spruce forests on warm aspect slopes; deep, coarse-textured soil.

Assumed modifiers: c, d, w.

Map Symbol with Mapped Site Modifiers:

SCgs – the ecosystem occurs on gullied terrain on shallow soils

SCr – the ecosystem occurs on ridged terrain

SCrs – the ecosystem occurs on ridged terrain on shallow soils

SCs – the ecosystem occurs on shallow soils

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Dominant Plant Species	Black huckleberry Birch-leaved spirea Sitka alder Trembling aspen	Lodgepole pine Hybrid white spruce Subalpine fir Black huckleberry Birch-leaved spirea Trembling aspen	Lodgepole pine Hybrid white spruce Subalpine fir Black huckleberry Birch-leaved spirea Red-stemmed feathermoss Knight's plume	Lodgepole pine Hybrid white spruce Subalpine fir Black huckleberry Birch-leaved spirea Red-stemmed feathermoss Knight's plume	Lodgepole pine Hybrid white spruce Subalpine fir Black huckleberry Birch-leaved spirea Western mountain-ash Bunchberry Five-leaved bramble Twinflower Red-stemmed feathermoss Knight's plume

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Associated Plant Species	Lodgepole pine Hybrid white spruce Subalpine fir Red-stemmed feathermoss Knight's plume	Red-stemmed feathermoss Knight's plume False Solomon's-seal	Trembling aspen One-sided wintergreen Stiff clubmoss Heart-leaved arnica False Solomon's-seal	Trembling aspen One-sided wintergreen Stiff clubmoss Heart-leaved arnica False Solomon's-seal	One-sided wintergreen Heart-leaved arnica False Solomon's-seal Highbush cranberry Sitka alder Black gooseberry Stiff clubmoss
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This ecosystem provides cover and food habitat for ungulates and bears, migratory bird nesting habitat and bat roosting habitat.				

A.6.4 BF: SbPl – Feathermoss (04)

Typically black spruce forest on gentle slopes, or aspects, with deep, coarse- textured soils; poor nutrient regime.

Assumed modifiers: c, d, j.

Map Symbol with Mapped Site Modifiers:

BFg – the ecosystem occurs on gullied terrain **or in a gully**

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Dominant Plant Species	Fireweed Bunchberry Sitka alder Trailing raspberry Prickly rose Western mountain-ash Trembling aspen	Hybrid white spruce Lodgepole pine Black spruce Fireweed Bunchberry Sitka alder Trailing raspberry Prickly rose Western mountain-ash Trembling aspen	Hybrid white spruce Lodgepole pine Black spruce Bunchberry Trailing raspberry Prickly rose Knight's plume Red-stemmed feathermoss	Hybrid white spruce Lodgepole pine Black spruce Bunchberry Trailing raspberry Prickly rose Knight's plume Red-stemmed feathermoss	Hybrid white spruce Lodgepole pine Black spruce Prickly rose Black huckleberry Labrador tea Bunchberry Twinflower Dwarf scouring-rush Common miterwort Oak fern Trailing raspberry Palmate coltsfoot Five-leaved bramble Knight's plume Red-stemmed feathermoss

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Associated Plant Species	Hybrid white spruce Lodgepole pine Black spruce Knight's plume Red-stemmed feathermoss	Knight's plume Red-stemmed feathermoss	Fireweed Sitka alder Western mountain-ash Trembling aspen	Fireweed Stiff clubmoss Freckle pelt lichen Sitka alder Western mountain-ash Trembling aspen	One-sided wintergreen Black gooseberry Highbush cranberry Fireweed Freckle pelt lichen Stiff clubmoss Sitka alder Western mountain-ash
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This ecosystem provides cover for ungulates and bears, migratory bird nesting habitat and bat roosting habitat.				

A.6.5 SD: Sxw – Devil's club (05)

Typically spruce forest on moisture- receiving sites; gentle slope; deep, medium - textured soil.

Assumed modifiers: d, j, m.

Map Symbol with Mapped Site Modifiers:

None

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Dominant Plant Species	Five-leaved bramble Three-leaved foamflower Queen's cup Thimbleberry Mountain sweet-cicely	Hybrid white spruce Subalpine fir Five-leaved bramble Three-leaved foamflower Queen's cup Thimbleberry Mountain sweet-cicely	Hybrid white spruce Subalpine fir Five-leaved bramble Three-leaved foamflower Queen's cup Knight's plume Red-stemmed feathermoss Leafy mosses	Hybrid white spruce Subalpine fir Five-leaved bramble Three-leaved foamflower Queen's cup Knight's plume Red-stemmed feathermoss Leafy mosses	Hybrid white spruce Subalpine fir Oak fern Five-leaved bramble Three-leaved foamflower Queen's cup Bunchberry False Solomon's-seal Trailing raspberry Knight's plume Red-stemmed feathermoss Leafy mosses

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Associated Plant Species	Hybrid white spruce Subalpine fir Knight's plume Red-stemmed feathermoss Leafy mosses	Knight's plume Red-stemmed feathermoss Leafy mosses	Devil's club Stiff clubmoss Mountain sweet-cicely	Devil's club Stiff clubmoss Mountain sweet-cicely	Devil's club Stiff clubmoss Clasping twistedstalk Mountain sweet-cicely Thimbleberry Black gooseberry
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This ecosystem provides cover for ungulates and bears, migratory bird nesting habitat and bat roosting habitat, as well as living habitat for western toads.				

A.6.6 SH: Sxw – Horsetail (06)

Typically moist spruce forests on level sites or depressions; coarse-textured soils.

Assumed modifiers: c, j.

Map Symbol with Mapped Site Modifiers:

None

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Dominant Plant Species	Trembling aspen Black twinberry Step moss Leafy mosses Knight's plume Red-stemmed feathermoss Prickly rose Common horsetail Meadow horsetail Bunchberry Trailing raspberry Twinflower Common miterwort Oak fern Red-osier dogwood Black gooseberry	Hybrid white spruce Subalpine fir Black twinberry Prickly rose Common horsetail Meadow horsetail Bunchberry Trailing raspberry Twinflower Common miterwort Oak fern Red-osier dogwood Step moss Leafy mosses Knight's plume Red-stemmed feathermoss	Hybrid white spruce Subalpine fir Trembling aspen Prickly rose Red-osier dogwood Common horsetail Meadow horsetail Bunchberry Trailing raspberry Twinflower Common miterwort Oak fern Step moss Leafy mosses Knight's plume Red-stemmed feathermoss	Hybrid white spruce Subalpine fir Prickly rose Common horsetail Meadow horsetail Bunchberry Trailing raspberry Twinflower Common miterwort Oak fern Step moss Leafy mosses Knight's plume Red-stemmed feathermoss	Hybrid white spruce Subalpine fir Black twinberry Highbush cranberry Red-osier dogwood Prickly rose Common horsetail Meadow horsetail Bunchberry Trailing raspberry Twinflower Common miterwort Oak fern Five-leaved bramble Step moss Leafy mosses Knight's plume Red-stemmed feathermoss

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Associated Plant Species	Hybrid white spruce Subalpine fir	Tall bluebells Sweet-scented bedstraw Clasping twistedstalk False Solomon's-seal Cow-parsnip Black gooseberry	Black twinberry Tall bluebells Sweet-scented bedstraw Clasping twistedstalk False Solomon's-seal Cow-parsnip Black gooseberry	Trembling aspen Black twinberry Tall bluebells Sweet-scented bedstraw Clasping twistedstalk False Solomon's-seal Cow-parsnip Black gooseberry	Tall bluebells Sweet-scented bedstraw Clasping twistedstalk False Solomon's-seal Cow-parsnip Black gooseberry
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This ecosystem may provide high-suitability food habitat for ungulates and bears, and living habitat for amphibians when close to waterbodies.				

A.6.7 Fm02: ActSw – Red-osier dogwood (Fm02)

Riparian community that occurs on sandy or gravelly fluvial materials adjacent to streams and rivers (MacKenzie and Moran 2004).

Assumed modifiers: none.

Map Symbol with Mapped Site Modifiers:

Fm02a – the ecosystem occurs on an active floodplain

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Dominant Plant Species	Red-osier dogwood Trembling aspen Balsam poplar Horsetails	Red-osier dogwood Balsam poplar Trembling aspen Horsetails	Red-osier dogwood Balsam poplar Trembling aspen Horsetails	Red-osier dogwood Balsam poplar Horsetails	Red-osier dogwood Balsam poplar Horsetails
Associated Plant Species	Prickly rose Balsam poplar Twinberry	Prickly rose Twinberry	Prickly rose Hybrid white spruce Twinberry	Prickly rose Hybrid white spruce Trembling aspen Twinberry	Prickly rose Hybrid white spruce Twinberry
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources

Structural Stage	3 – Shrub	4 – Pole-sapling	5 – Young Forest	6 – Mature Forest	7 – Old Forest
Comments	This ecosystem can provide high suitability food habitat for deer and moose, and early-season food habitat for bears. It is used as denning habitat by fishers and other furbearers and provides food for beaver when adjacent to suitable streams. Bats roost in live and dead balsam poplars and cavity-nesting birds are common.				

A.7 SBSwk2 – Nonforested Ecosystems

A.7.1 Wf02: Scrub birch – Water sedge (Wf02)

Typically a shrubby peatland with a fluctuating water table.

Assumed modifiers: none.

Map Symbol with Mapped Site Modifiers:

None

Structural Stage	2-Herb	3 - Shrub
Dominant Plant Species	Water sedge Sphagnum mosses	Scrub birch Water sedge Sphagnum mosses
Associated Plant Species	Scrub birch Bluejoint reedgrass Sitka sedge White bog orchid	Bog willow Barclay's willow Bluejoint reedgrass Sitka sedge White bog orchid
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This sedge wetland provides early-season feeding habitat for bears, moose and deer, feeding habitat for bats and insectivorous birds, and breeding habitat for dragonflies and amphibians if open water is present.	

A.7.2 Wf13: Narrow-leaved cotton-grass – Shore sedge (Wf13)

Typically occurs in depressions or on seepage slopes where standing water is present for most of the growing season.

Assumed modifiers: none.

Map Symbol with Mapped Site Modifiers:

None

Structural Stage	2-Herb	3 - Shrub
Dominant Plant Species	Shore sedge Water sedge Narrow-leaved cotton-grass white mtn. marsh-marigold Glow moss Peat mosses	Bog willow Barclay's willow Shore sedge Water sedge Narrow-leaved cotton-grass Glow moss Peat mosses
Associated Plant Species	Bog willow Barclay's willow Poor sedge Sitka sedge Mountain hairgrass	white mtn. marsh-marigold Poor sedge Sitka sedge Mountain hairgrass
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources

A.7.2 Wf13: Narrow-leaved cotton-grass – Shore sedge (Wf13)

Typically occurs in depressions or on seepage slopes where standing water is present for most of the growing season.

Assumed modifiers: none.

Map Symbol with Mapped Site Modifiers:

None

Structural Stage	**2-Herb**	**3 - Shrub**
Comments	This sedge wetland provides early-season feeding habitat for bears, moose and deer, feeding habitat for bats and insectivorous birds, and breeding habitat for dragonflies and amphibians if open water is present.	

A.7.3 AF: Alder – Fern avalanche track (00)

Dense shrub- or herb-dominated ecosystem in moderate to steep slopes where periodic snow and rock slides have prevented coniferous forest establishment.

Assumed modifiers: d.

Map Symbol with Mapped Site Modifiers:

AFs – the ecosystem occurs on shallow soils

Structural Stage	**2-Herb**	**3 - Shrub**

Structural Stage	2-Herb	3 - Shrub
Dominant Plant Species	Lady fern Cow parsnip Sedges	Sitka alder Lady fern
Associated Plant Species	Sitka alder Stinging-nettle Sitka valerian Indian hellebore	Willows Indian hellebore Sitka valerian
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	Avalanche tracks may provide foraging habitat for bears and ungulates.	

A.8 ESSFmv2 – Forested Ecosystems

A.8.1 FR: Bl – Rhododendron – Feathermoss (01)

Typically a subalpine fir forest on gentle slopes with medium-textured soils.

Assumed modifiers: d, j, m.

Map Symbol with Mapped Site Modifiers:

FRs – the ecosystem occurs on shallow soils

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	White-flowered rhododendron Black huckleberry Bunchberry Black gooseberry	Engelmann spruce Subalpine fir White-flowered rhododendron Black huckleberry Bunchberry Knight's plume Red-stemmed feathermoss Step moss	Engelmann spruce Subalpine fir White-flowered rhododendron Black huckleberry Bunchberry Knight's plume Red-stemmed feathermoss Step moss	Engelmann spruce Subalpine fir White-flowered rhododendron Black huckleberry Bunchberry Knight's plume Red-stemmed feathermoss Step moss	Engelmann spruce Subalpine fir White-flowered rhododendron Black huckleberry Bunchberry Five-leaved bramble Twinflower Knight's plume Red-stemmed feathermoss Step moss

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Associated Plant Species	Engelmann spruce Subalpine fir Knight's plume Red-stemmed feathermoss Step moss	Black gooseberry One-sided wintergreen	Black gooseberry Stiff clubmoss One-sided wintergreen Heart-leaved arnica	Black gooseberry Stiff clubmoss One-sided wintergreen Heart-leaved arnica	Black gooseberry Stiff clubmoss One-sided wintergreen Heart-leaved arnica
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This mesic forest provides growing-season cover for ungulates and bears.				

A.8.2 FL: Bl – Lingonberry (02)

Typically subalpine fir forest on deep, coarse-textured soils; gentle slopes.

Assumed modifiers: c, d, j.

Map Symbol with Mapped Site Modifiers:

None

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Dominant Plant Species	Black huckleberry White-flowered rhododendron Mountain alder Sitka alder Bunchberry	Lodgepole pine Engelmann spruce Black huckleberry White-flowered rhododendron Red-stemmed feathermoss Knight's plume Mountain alder Sitka alder Bunchberry	Lodgepole pine Engelmann spruce Black huckleberry White-flowered rhododendron Bunchberry Red-stemmed feathermoss Knight's plume	Lodgepole pine Engelmann spruce Black huckleberry White-flowered rhododendron Lingonberry Bunchberry Red-stemmed feathermoss Knight's plume	Lodgepole pine Engelmann spruce Black huckleberry White-flowered rhododendron Bunchberry Twinflower Lingonberry Red-stemmed feathermoss Knight's plume Dicranum mosses Step moss
Associated Plant Species	Lodgepole pine Engelmann spruce Red-stemmed feathermoss Knight's plume	One-sided wintergreen Lingonberry	Mountain alder Sitka alder One-sided wintergreen Lingonberry	Mountain alder Sitka alder One-sided wintergreen Cladonia lichens Peltigera lichens	Mountain alder Sitka alder One-sided wintergreen Cladonia lichens Peltigera lichens

Structural Stage	3 - Shrub	4 - Pole-sapling	5 - Young Forest	6 - Mature Forest	7 - Old Forest
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	This dry forest unit provides growing-season cover for ungulates and bears and nesting habitat for a variety of birds.				

A.9 ESSFmv2 – NonForested Ecosystems

A.9.1 AF: Alder – Fern avalanche track (00)

Dense shrub- or herb-dominated ecosystem in moderate to steep slopes where periodic snow and rock slides have prevented coniferous forest establishment.

Assumed modifiers: d.

Map Symbol with Mapped Site Modifiers:

None

Structural Stage	2-Herb	3 - Shrub
Dominant Plant Species	Lady fern Sitka valerian Cow parsnip Sedges	Sitka alder Lady fern Sitka valerian
Associated Plant Species	Sitka alder Stinging-nettle Indian hellebore	Willows Indian hellebore
Plots	No project plots; vegetation list prepared from other sources	No project plots; vegetation list prepared from other sources
Comments	Avalanche tracks can provide high-quality growing season food habitat for bears	

A.10 Nonvegetated/Sparsely Vegetated/Anthropogenic Units

A.10.1 CB: Cutbank (00)

A nonvegetated or sparsely vegetated part of a road corridor or river course situated upslope of the road or river, which is created by excavation and/or erosion of the hillside.

Map Symbol with Mapped Site Modifiers:

CBg - the ecosystem occurs on gullied terrain or in a gully

CBgk - the ecosystem occurs on gullied terrain or in a gully, on a cool aspect (aspect of 285-135° on a slope that is 25-100%)

CBgq - the ecosystem occurs on gullied terrain or in a gully, on a very steep cool aspect (aspect of 285-135° on a slope that is >100%)

CBgw - the ecosystem occurs on gullied terrain or in a gully, on a warm aspect (aspect of135 - 285 ° on a slope that is 25-100%)

CBgz - the ecosystem occurs on gullied terrain or in a gully, on a very steep warm aspect (aspect of 135 - 285 ° on a slope that is >100%)

CBh – the ecosystem occurs on hummocky terrain

CBk – the ecosystem occurs on a cool aspect (aspect of 285-135° on a slope that is 25-100%)

CBks – the ecosystem occurs on a cool aspect (aspect of 285-135^{o} on a slope that is 25-100%) and on shallow soils
CBs - the ecosystem occurs on shallow soils
CBsw - the ecosystem occurs on shallow soils on a warm aspect (aspect of135 - 285^{o} on a slope that is 25-100%)
CBw - the ecosystem occurs on a warm aspect (aspect of 135 - 285^{o} on a slope that is 25-100%)
CBq - the ecosystem occurs on a very steep cool aspect (aspect of 285-135^{o} on a slope that is >100%)
CBz - the ecosystem occurs on a very steep warm aspect (aspect of 135 - 285^{o} on a slope that is >100%)

Structural Stage	1 - Nonvegetated/sparse
Dominant Plant Species	none
Associated Plant Species	Wolf-willow (silverberry) Yarrow Sweet clover Perennial sow-thistle Long-leaved mugwort Spreading dogbane Paper birch Pasture sage
Plots	WB243, RP137
Comments	This unit was mapped extensively on steep slopes north and south of the river. Due to its steepness, instability and lack of vegetation it has little value for most wildlife species. However, some species such as Bank Swallows and Belted Kingfishers may use it for nesting, and bats may roost in crevices. If adjacent to flowing water, cutbanks may be used for bank dens by beavers.

A.10.2 CF: Cultivated Field (00)

A flat or gently rolling, nonforested open area subject to human agricultural practices. This unit was mapped extensively both north and south of the river.

Map Symbol with Mapped Site Modifiers: CFj

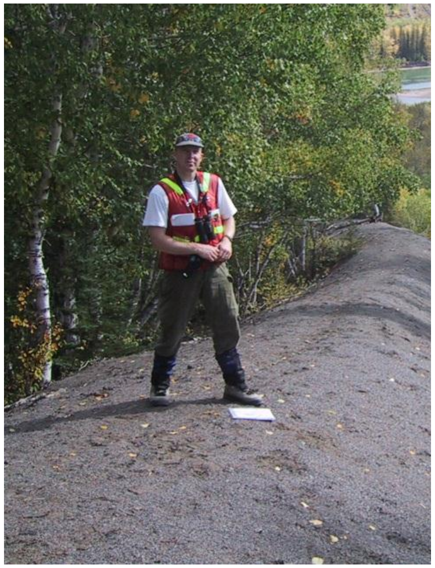
CFn - the ecosystem occurs on a fan or con

CFs - the ecosystem occurs on shallow soils

CFt - the ecosystem occurs on a terrace

Comments: Cultivated fields may be valuable as foraging habitat for ungulates, especially deer and elk. Within the study area, the CF unit was mapped on sites that had undergone human intervention for agricultural practices, including crops and cattle grazing. Those practices included draining, seeding, plowing and clearing. It did not include sites where periodic brushing was used to maintain early seral stages for non-agricultural purposes (e.g. transmission line ROWs).

A.10.3 ES: Exposed Soil (00)



Map Symbol with Mapped Site Modifiers:

ESg -the ecosystem occurs on gullied terrain or in a gully

ESgk -the ecosystem occurs on gullied terrain or in a gully and on a steep cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

ESk -the ecosystem occurs on a steep cool aspect (aspect of 285-135^{o} on a slope that is 25-100%)

ESn - the ecosystem occurs on a fan or cone

ESt - the ecosystem occurs on a terrace

ESw - the ecosystem occurs on a warm aspect

Structural Stage	1 - Nonvegetated/sparse
Dominant Plant Species	none

Associated Plant Species	Balsam poplar Willow Sweet clover
Plots	No project plots; vegetation list prepared from other sources
Comments	Exposed soil has little wildlife value.

A.10.4 GB: Gravel Bar (00)

An elongated landform generated by waves and currents and usually running parallel to the shore. It is composed of unconsolidated small rounded cobbles, pebbles, stones and sand.

Map Symbol with Mapped Site Modifiers: none

Structural Stage	**1 - Nonvegetated/sparse**
Dominant Plant Species	none
Associated Plant Species	Balsam poplar

	Willow Alfalfa Grasses Meadow arnica Asters Sweet clover
Plots	RP124
Comments	Gravel bars may be used as loafing sites for waterfowl and foraging areas for shorebirds, and may assist terrestrial wildlife species in crossing the river

A.10.5 LA: Lake (00)

A naturally occurring static body of water, greater than 2 m deep in some portion. The boundary for the lake is the natural high water mark.

Map Symbol with Mapped Site Modifiers: none

Comments: Lakes may provide foraging and nesting habitat for waterfowl, and foraging habitat for moose, bats and furbearers such as mink and beaver. Lakes were rarely mapped in the project area. Smaller bodies of water (PD and OW) were more common.

A.10.6 GP: Gravel Pit (00)

An area used for the extraction of sand and gravel.

Map Symbol with Mapped Site Modifiers: none

Comments: Little value for most wildlife. Bank Swallows may nest in steep walls of gravel pits.

A.10.7 MI: Mine (00)

An unvegetated area used for the extraction of mineral ore and other materials.

Map Symbol with Mapped Site Modifiers: none

Comments: Mine sites have little wildlife value. Cliff-nesting birds may occasionally nest on steep-sided pit walls of inactive pit mines.

A.10.8 OW: Shallow open water (00)

A wetland composed of permanent shallow open water and lacking extensive emergent plant cover. The water is less than 2 m deep.

Map Symbol with Mapped Site Modifiers: none

Comments: Open water wetlands may provide foraging and nesting habitat for waterfowl, amphibian breeding habitat, and foraging habitat for moose, bats and furbearers such as mink and beaver.

A.10.9 PD: Pond (00)

A small body of water greater than 2 m deep, but not large enough to be classified as a lake

Map Symbol with Mapped Site Modifiers: none

Comments: Ponds may provide foraging and nesting habitat for waterfowl, amphibian breeding habitat and foraging habitat for moose, bats and furbearers such as mink and beaver.

A.10.10 RE: Reservoir (00)

An artificial basin created by the impoundment of water behind a human-made structure such as a dam, berm, dyke or wall.

Map Symbol with Mapped Site Modifiers: none

Comments: Reservoirs provide habitat for waterfowl, amphibians and aquatic mammals such as otters and beaver. Bats and other aerial insectivores forage over the water.

A.10.11 RI: River (00)

A watercourse formed when water flows between continuous, definable banks.

Map Symbol with Mapped Site Modifiers: none

Comments: the Peace, Pine, Halfway and Moberly rivers provide security and foraging habitat for waterfowl and beaver, and foraging habitat for mink, bats, and fish-eating birds such as kingfishers. Amphibians use river backchannels for living and breeding.

RN: Railway surface (00)

A roadbed with fixed rails for possibly single or multiple rail lines.

Map Symbol with Mapped Site Modifiers: none

Comments: little value for wildlife

A.10.13 RO: Bedrock (00)

A gentle to steep bedrock escarpment or outcropping, with little soil development and sparse vegetative cover.

Map Symbol with Mapped Site Modifiers: none

Comments: Small mammals and bats may find den and roost sites in the crevices of rocky outcrops.

RY: Reclaimed Mine (00)

A mined area that has plant communities composed of a mixture of agronomic or native grasses, forbs, and shrubs.

Map Symbol with Mapped Site Modifiers: none

Comments: This unit was used to map a reclaimed garbage dump.

A.10.15 RZ: Road Surface (00)

An area cleared and compacted for the purpose of transporting goods and services by vehicles.

Map Symbol with Mapped Site Modifiers: none

Comments: Roads have little wildlife value, and are a source of mortality to most wildlife. Ungulates may travel on plowed roads when the snow is deep elsewhere.

A.10.16 RW: Rural (00)

Any area in which residences and other human developments are scattered and intermingled with forest, range, farmland and native vegetation and cultivated crops.

Map Symbol with Mapped Site Modifiers: none

Comments: Few wildlife species will use habitat in close proximity to human activities. Ungulates such as deer and elk may occasionally forage on crops, haystacks and ornamental plants. Buildings may provide roost sites for bats. Passerine birds may forage in gardens and feed at bird feeders, especially during the winter months, and may nest in or on buildings or ornamental plants.

A.10.17 UR: Urban/Suburban (00)

An area in which residences and other human developments form an almost continuous covering of the landscape. These areas include cities and towns, subdivisions, commercial and industrial parks, and similar developments.

Map Symbol with Mapped Site Modifiers: none

Comments: Urban/suburban areas have little value for most wildlife. However, buildings may provide roost sites for bats. Passerine birds may forage in gardens and feed at bird feeders, especially during the winter months.

A.11 **Citations**

A.11.1 References

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APPENDIX B BIOTERRAIN MAP LEGEND

B.1 Terrain Unit Symbols

Simple Terrain Units: e.g., texture ----> gFt - J <---- process

surficial material / _surface expression

Note: Two or three letters may be used to describe any characteristic other than surficial material, or letters may be omitted if information is lacking.

Composite Units: Two or three groups of letters are used to indicate that two or three kinds of terrain are present within a map unit.

e.g., Mv · Rs indicates that "Mv" and "Rs" are of roughly equal extent

Mv/Rs indicates that "Mv" is more extensive than "Rs" (about 2/1 or 3/2)

Mv//Rs indicates that "Mv" is much more extensive than "Rs" (about 3/1 or 4/1)

Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock:

e.g., $\frac{\text{Mv}}{\text{Rr}}$ indicates that "Mv" overlies "Rr".

$/\frac{\text{Mv}}{\text{Rr}}$ indicates that "Rr" is partially buried by "Mv"

B.2 Materials

A	Anthropogenic materials	Artificial materials, and materials modified by human actions such that their original physical appearance and properties have been drastically altered.
C	Colluvium	Products of gravitational slope movements; materials derived from local bedrock and major deposits derived from drift; includes talus and landslide deposits.
C1	Slope wash	Slope wash is a result of rainfall events in which non-channelized overland flow carries surface material downslope. Typical texture is silty sand or sandy silt with generally less than 5% coarse fragments.
D	Weathered bedrock	Bedrock modified in situ by mechanical and chemical weathering.
E	Eolian sediments	Sand and silt transported and deposited by wind; includes loess.
F	Fluvial materials	Sands and gravels transported and deposited by streams and rivers; floodplains, terraces and alluvial fans.
F^A	"Active" fluvial materials	Active deposition zone on modern floodplains and fans; active channel zone.
F^G	Glaciofluvial materials	Sands and gravels transported and deposited by meltwater streams; includes kames, eskers and outwash plains.
L	Lacustrine sediments	Fine sand, silt and clay deposited in lakes.
L^G	Glaciolacustrine sediments	Fine sand, silt and clay deposited in ice-dammed lakes.
M	Till	Material deposited by glaciers without modification by flowing water. Typically consists of a mixture of pebbles, cobbles and boulders in a matrix of sand, silt and clay; diamicton.
O	Organic materials	Material resulting from the accumulation of decaying vegetative matter; includes peat and organic soils.
R	Bedrock	Outcrops, and bedrock within a few centimetres of the surface.
U	Undifferentiated materials	Different surficial materials in such close proximity that they cannot be separated at the scale of the mapping.
V	Volcanic materials	Unconsolidated pyroclastic sediments

B.3 Texture

B.3.1 Specific Clastic Terms

c	clay	< 2μm	k	cobbles	64 - 256 mm
z	silt	62.5 - 2μm	b	boulders	> 256 mm
s	sand	2 mm - 62.5μm	a	blocks	angular boulders
p	pebbles	2 - 64 mm			

B.3.2 Common Clastic Terms

f	fines	any or all of c, z, and fine s
d	mixed fragments	pebbles and larger clasts in a matrix of fines
g	gravel	any or both of p and k
r	rubble	angular gravel
x	angular fragments	mix of both r and a
m	mud	mix of both c and z
y	shells	shell or shell fragments

B.3.3 Organic Terms

e	fibric
u	mesic
h	humic

B.4 Surface Expression

a	moderate slope(s)	predominantly planar slopes; 15-26^{O} (27-49%)
b	blanket	material >1-2m thick with topography derived from underlying bedrock (which may not be mapped) or surficial material
c	cone	a fan-shaped surface that is a sector of a cone; slopes 15^{O} (27%) and steeper
d	depression	enclosed depressions
f	fan	a fan-shaped surface that is a sector of a cone; slopes 3-15^{O} (5-27%)
h	hummocky	steep-sided hillocks and hollows; many slopes 15^{O} (27%) and steeper
j	gentle slope(s)	predominantly planar slopes; 3-15^{O} (5-27%)
k	moderately steep slope	predominantly planar slopes; 26-35^{O} (49-70%)
m	rolling topography	linear rises and depressions; <15^{O} (27%)
p	plain	0-3^{O} (0-5%)
r	ridges	linear rises and depressions with many slopes 15^{O} (27%) and steeper
s	steep slope(s)	slopes steeper than 35^{O} (70%)
t	terrace(s)	stepped topography and benchlands
u	undulating topography	hillocks and hollows; slopes predominantly <15^{O} (27%)
v	veneer	material <1-2m thick with topography derived from underlying bedrock (may not be mapped) or surficial material; may include outcrops of underlying material
w	variable thickness	material of variable thickness with topography derived from underlying bedrock (may not be mapped) or surficial material
x	thin veneer	a subset of v (veneer), where there is a dominance of surficial materials about 10-25 centimeters thick

B.5 Geological Processes, Sub-Classes And Subtypes

B	Braiding channel	Channel zone with many diverging and rejoining channels; channels are laterally unstable.
D	Deflation	Removal of sand and silt particles by wind action.
E	Glacial meltwater channels	Areas crossed by meltwater channels that are too small or too numerous to map individually.
F	Failing	Slope experiencing slow mass movement, such as sliding or slumping (unknown or unspecified activity).
H	Kettled	Area includes numerous small depressions and/or lakes where buried blocks of ice melted.
I	Irregularly sinuous channel	Channel displays irregular turns and bends.
J	Anastamosing channel	Channels diverge and converge around semi-permanent islands.
L	Surface seepage	Zones of active seepage often found along the base of slope positions.
M	Meandering channel	Channel characterized by regular turns and bends.
R	Rapid mass movement	Slope or parts of slope affected by processes such as debris flows, debris slides and avalanches, and rockfall.
U	Inundated	Areas submerged in standing water from a seasonally high watertable.
V	Gullying	Slope affected by gully erosion.

B.5.1 Mass Movement Sub-Classes

-F"	Slow mass movement (initiation zone)	-R"	Rapid mass movement (initiation zone)
-Fe	Earthflow	-Rb	Rockfall
-Fm	Slump in bedrock	-Rd	Debris flow
-Fs	Debris slide	-Rf	Debris fall
-Fu	Slump in surficial material	-Rr	Rockslide
-Fx	Slump-earthflow	-Rs	Debris slide
		-Rt	Debris torrent

B.5.2 Mass Movement and Gullying Subtypes

-F1	Active slow mass movement	V1	Single gully
-F2	Inactive slow mass movement	V2	Gully sidewall

B.6 Soil Drainage Classes

x	extremely rapidly drained	water is removed from the soil very rapidly in relation to supply
r	rapidly drained	water is removed from the soil rapidly in relation to supply
w	well drained	water is removed from the soil readily but not rapidly
m	moderately well drained	water is removed from the soil somewhat slowly in relation to supply
i	imperfectly drained	water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season
p	poorly drained	water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen
v	very poorly drained	water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen

Where two drainage classes are shown:

if the symbols are separated by a comma, e.g., “w, i”, then no intermediate classes are present;

if the symbols are separated by a dash, e.g., "w-i", then all intermediate classes are present.

APPENDIX C AREA (HA) OF ECOSYSTEMS MAPPED IN THE LAA

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
			BWBSmw1			
01/AM			3	655.8	62.1	717.9
01/AM			4	2.6	60.3	62.8
01/AM			5	598.6	575.1	1173.6
01/AM			6	830.9	559.5	1390.4
01/AM			7	78.9		78.9
01/AM	c	w	5		1.1	1.1
01/AM	g		4		5.5	5.5
01/AM	g		5		60.0	60.0
01/AM	g		6		13.2	13.2
01/AM	g	h	4		6.3	6.3
01/AM	g	k	5		125.8	125.8
01/AM	g	k	6		20.4	20.4
01/AM	g	s	6		29.2	29.2
01/AM	g	w	4		14.6	14.6
01/AM	g	w	5		46.1	46.1
01/AM	g	w	6		20.7	20.7
01/AM	h		4		11.5	11.5
01/AM	h		6		37.0	37.0
01/AM	h	k	6		33.2	33.2
01/AM	h	r	4		2.0	2.0
01/AM	h	w	4		15.6	15.6
01/AM	h	y	5		70.7	70.7
01/AM	k		3	26.8	2.7	29.5
01/AM	k		4	1.4	110.7	112.1
01/AM	k		5	126.3	212.1	338.4
01/AM	k		6	233.7	402.6	636.3
01/AM	k		7	58.1		58.1
01/AM	k	s	6		16.6	16.6
01/AM	n		5		14.0	14.0

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
01/AM	n		6		1.1	1.1
01/AM	r		4		5.9	5.9
01/AM	r		5		1.4	1.4
01/AM	r	s	6		6.8	6.8
01/AM	s		5		46.8	46.8
01/AM	t		3		99.0	99.0
01/AM	t		4		6.3	6.3
01/AM	t		5		92.4	92.4
01/AM	t		6		11.6	11.6
01/AM	t	y	5		5.4	5.4
01/AM	w		3	6.3		6.3
01/AM	w		4		6.6	6.6
01/AM	w		5	87.7	18.6	106.3
01/AM	w		6	21.0	10.2	31.2
01/AM	y		4		8.2	8.2
01/AM	y		6		9.7	9.7
01$/ AM:ap					2.4	2.4
01$/ AM:ap			2		3.8	3.8
01$/ AM:ap			3	1324.4	1348.8	2673.2
01$/ AM:ap			4	174.5	2479.8	2654.3
01$/ AM:ap			5	3080.6	4222.2	7302.8
01$/ AM:ap			6	2650.1	1398.2	4048.3
01$/ AM:ap			7	397.6		397.6
01$/ AM:ap		w	3		1.9	1.9
01$/ AM:ap		y	4		0.7	0.7
01$/ AM:ap		y	5		2.7	2.7
01$/ AM:ap	c		3		17.2	17.2
01$/ AM:ap	c		5		12.2	12.2
01$/ AM:ap	c	k	6		3.2	3.2
01$/ AM:ap	c	t	4		5.3	5.3
01$/ AM:ap	c	w	4		0.9	0.9

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
01$/ AM:ap	c	w	5		5.3	5.3
01$/ AM:ap	g		3		36.8	36.8
01$/ AM:ap	g		4		134.5	134.5
01$/ AM:ap	g		5		257.8	257.8
01$/ AM:ap	g		6		33.7	33.7
01$/ AM:ap	g	h	4		3.1	3.1
01$/ AM:ap	g	k	3		14.5	14.5
01$/ AM:ap	g	k	4		122.9	122.9
01$/ AM:ap	g	k	5		361.7	361.7
01$/ AM:ap	g	k	6		26.2	26.2
01$/ AM:ap	g	n	5		5.2	5.2
01$/ AM:ap	g	s	4		3.0	3.0
01$/ AM:ap	g	s	5		1.1	1.1
01$/ AM:ap	g	w	3		13.1	13.1
01$/ AM:ap	g	w	4		93.7	93.7
01$/ AM:ap	g	w	5		142.4	142.4
01$/ AM:ap	g	w	6		2.3	2.3
01$/ AM:ap	g	y	3		7.4	7.4
01$/ AM:ap	g	y	4		24.7	24.7
01$/ AM:ap	g	y	5		58.7	58.7
01$/ AM:ap	g	y	6		14.6	14.6
01$/ AM:ap	h		3		83.3	83.3
01$/ AM:ap	h		4		213.0	213.0
01$/ AM:ap	h		5		183.4	183.4
01$/ AM:ap	h		6		35.7	35.7
01$/ AM:ap	h	k	3		3.4	3.4
01$/ AM:ap	h	k	4		21.9	21.9
01$/ AM:ap	h	k	5		31.2	31.2
01$/ AM:ap	h	k	6		10.2	10.2
01$/ AM:ap	h	r	4		3.9	3.9
01$/ AM:ap	h	w	3		1.2	1.2

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
01$/ AM:ap	h	w	4		89.1	89.1
01$/ AM:ap	h	w	5		15.7	15.7
01$/ AM:ap	h	y	4		31.2	31.2
01$/ AM:ap	h	y	5		38.6	38.6
01$/ AM:ap	h	y	6		11.5	11.5
01$/ AM:ap	k		3	20.6	59.6	80.2
01$/ AM:ap	k		4	3.9	213.9	217.8
01$/ AM:ap	k		5	414.1	929.1	1343.2
01$/ AM:ap	k		6	147.4	156.2	303.6
01$/ AM:ap	k		7	0.0		0.0
01$/ AM:ap	k	s	4		8.2	8.2
01$/ AM:ap	k	s	5		3.2	3.2
01$/ AM:ap	k	s	6		23.8	23.8
01$/ AM:ap	k	v	3		1.6	1.6
01$/ AM:ap	k	v	4		2.5	2.5
01$/ AM:ap	k	y	3		5.3	5.3
01$/ AM:ap	k	y	5		24.8	24.8
01$/ AM:ap	k	y	6		6.3	6.3
01$/ AM:ap	n		3		28.2	28.2
01$/ AM:ap	n		4		17.2	17.2
01$/ AM:ap	n		5		59.9	59.9
01$/ AM:ap	n	w	4		13.2	13.2
01$/ AM:ap	n	y	3		3.3	3.3
01$/ AM:ap	n	y	5		7.9	7.9
01$/ AM:ap	n	y	6		3.8	3.8
01$/ AM:ap	q		5		11.1	11.1
01$/ AM:ap	r		3		15.6	15.6
01$/ AM:ap	r		4		38.1	38.1
01$/ AM:ap	r		5		38.1	38.1
01$/ AM:ap	r		6		2.6	2.6
01$/ AM:ap	r	s	5		5.7	5.7

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
01$/ AM:ap	s		3		3.8	3.8
01$/ AM:ap	s		4		46.8	46.8
01$/ AM:ap	s		5		103.1	103.1
01$/ AM:ap	s		6		4.1	4.1
01$/ AM:ap	s	w	3		1.4	1.4
01$/ AM:ap	s	w	4		24.7	24.7
01$/ AM:ap	s	w	5		34.6	34.6
01$/ AM:ap	t		3		127.9	127.9
01$/ AM:ap	t		4		866.3	866.3
01$/ AM:ap	t		5		385.9	385.9
01$/ AM:ap	t		6		112.2	112.2
01$/ AM:ap	t	y	5		67.3	67.3
01$/ AM:ap	t	y	6		60.5	60.5
01$/ AM:ap	w		3	43.3	39.5	82.7
01$/ AM:ap	w		4		398.7	398.7
01$/ AM:ap	w		5	252.1	427.1	679.2
01$/ AM:ap	w		6	33.8	62.2	96.0
01$/ AM:ap	w	y	4		0.7	0.7
01$/ AM:ap	w	y	5		15.3	15.3
01$/ AM:ap	y		3		122.3	122.3
01$/ AM:ap	y		4		237.2	237.2
01$/ AM:ap	y		5		564.7	564.7
01$/ AM:ap	y		6		167.0	167.0
01$/ AM:ap	y		7		4.5	4.5
00/AS			2	45.4	1.7	47.1
00/AS			3	2.9	437.4	440.3
00/AS			4		3.9	3.9
00/AS	c		3		3.3	3.3
00/AS	c	k	3		5.6	5.6
00/AS	g		2		0.4	0.4
00/AS	g		3		409.3	409.3

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
00/AS	g		4		3.7	3.7
00/AS	g	h	2		5.8	5.8
00/AS	g	h	3		11.0	11.0
00/AS	g	j	2		1.0	1.0
00/AS	g	j	3		122.7	122.7
00/AS	g	j	4		0.6	0.6
00/AS	g	k	3		17.4	17.4
00/AS	g	s	3		56.4	56.4
00/AS	g	s	4		2.3	2.3
00/AS	g	z	3		47.1	47.1
00/AS	h		3		47.3	47.3
00/AS	h	j	3		44.5	44.5
00/AS	h	k	3		4.8	4.8
00/AS	j		2		2.0	2.0
00/AS	j		3		167.9	167.9
00/AS	j		4		7.5	7.5
00/AS	j	s	3		21.5	21.5
00/AS	k		3		105.7	105.7
00/AS	k		4		1.8	1.8
00/AS	k	s	3		4.3	4.3
00/AS	n		3		6.7	6.7
00/AS	r		3		11.8	11.8
00/AS	r	s	4		1.0	1.0
00/AS	s		3		72.0	72.0
00/AS	s		4		1.0	1.0
00/AS	z		3		94.0	94.0
04/BL			3	262.2	4.6	266.9
04/BL			4	15.2	72.2	87.4
04/BL			5	763.4	223.9	987.2
04/BL			6	786.0	162.8	948.8
04/BL			7	13.3		13.3

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
04/BL	g		4		0.4	0.4
04/BL	g		6		2.4	2.4
04/BL	h		5		2.6	2.6
04/BL	t		5		13.8	13.8
04$/BL:al			3	84.4	120.9	205.3
04$/BL:al			4	6.9	220.2	227.1
04$/BL:al			5	191.6	529.2	720.8
04$/BL:al			6	150.6	94.1	244.7
04$/BL:al			7	1.8		1.8
04$/BL:al	g		3		4.5	4.5
04$/BL:al	g		5		4.5	4.5
04$/BL:al	h		6		2.1	2.1
08/BT			3	678.5	75.0	753.5
08/BT			4		283.8	283.8
08/BT			5	369.6	194.4	564.0
08/BT			6	219.4	206.6	426.0
08/BT			7	0.2		0.2
08/BT	g		6		2.1	2.1
08/BT	h		3		0.6	0.6
08/BT	s		6		0.8	0.8
08/BT	t		3		2.3	2.3
08/BT	t		4		6.1	6.1
08/BT	t		6		12.1	12.1
00/CB			1	6.4	57.6	64.0
00/CB	g		1		24.7	24.7
00/CB	g	k	1		32.6	32.6
00/CB	g	q	1		17.1	17.1
00/CB	g	s	1		2.2	2.2
00/CB	g	w	1		336.6	336.6
00/CB	g	z	1		3.5	3.5
00/CB	h	w	1		1.7	1.7

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
00/CB	k		1	2.8	100.8	103.7
00/CB	k	s	1		1.9	1.9
00/CB	q		1		2.7	2.7
00/CB	s		1		0.9	0.9
00/CB	s	w	1		5.0	5.0
00/CB	w		1	20.2	417.8	437.9
00/CB	z		1		58.1	58.1
00/CF			1		14.5	14.5
00/CF			2	2138.9	4396.1	6534.9
00/CF			3	32.2	127.3	159.5
00/CF	a		1		6.2	6.2
00/CF	a		2		106.2	106.2
00/CF	g		2		8.6	8.6
00/CF	g		3		0.4	0.4
00/CF	g	w	2		2.6	2.6
00/CF	h		2		10.0	10.0
00/CF	j		2		23.1	23.1
00/CF	k		2		0.0	0.0
00/CF	n		2		233.4	233.4
00/CF	n		3		2.4	2.4
00/CF	s		2		16.6	16.6
00/CF	t		2		2108.4	2108.4
00/CF	t		3		29.0	29.0
00/CF	w		2		3.1	3.1
00/ES			1	2.9	41.4	44.3
00/ES	g		1		5.5	5.5
00/ES	g	k	1		10.2	10.2
00/ES	k		1		8.2	8.2
00/ES	n		1		1.1	1.1
00/ES	w		1		1.0	1.0
09/Fm02	a		3		391.4	391.4

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
09/Fm02	a		4		188.1	188.1
09/Fm02	a		5		444.9	444.9
09/Fm02	a		6		866.4	866.4
09/Fm02	a		7		14.2	14.2
09/Fm02	a	b	2		21.5	21.5
09/Fm02	a	b	3		646.4	646.4
09/Fm02	a	c	3		21.1	21.1
09/Fm02	a	c	4		21.7	21.7
09/Fm02	a	c	5		16.9	16.9
09/Fm02	a	c	6		12.7	12.7
09/Fm02	a	f	3		6.1	6.1
09/Fm02	a	f	4		2.0	2.0
09/Fm02	a	n	6		9.0	9.0
09/Fm02	j		6		1.1	1.1
00/GB			1	0.0	891.4	891.4
00/GP			1	18.2	154.1	172.3
00/LA				150.7	43.7	194.4
02/LL			3	2.0	4.5	6.5
02/LL			4		104.4	104.4
02/LL			5	55.2	199.2	254.4
02/LL			6	2.1	109.3	111.4
02/LL			7	5.6	5.6	11.2
02/LL	g		6		6.4	6.4
02/LL	k		5		13.0	13.0
02/LL	r		4		3.3	3.3
02/LL	t		4		3.4	3.4
02/LL	t		5		22.4	22.4
02/LL	t		6		75.3	75.3
02/LL	w		4		1.2	1.2
02/LL	w		6		7.3	7.3
02$/LL:ak			3	1.0	36.4	37.4

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
02$/LL:ak			4	0.5	68.1	68.6
02$/LL:ak			5	121.9	59.9	181.8
02$/LL:ak			6	18.5	22.2	40.7
02$/LL:ak			7	25.9		25.9
02$/LL:ak	g	k	4		12.4	12.4
02$/LL:ak	g	w	4		3.4	3.4
02$/LL:ak	h		4		4.7	4.7
02$/LL:ak	h		5		7.6	7.6
02$/LL:ak	k		4		3.5	3.5
02$/LL:ak	r		4		1.0	1.0
02$/LL:ak	t		3		7.8	7.8
02$/LL:ak	t		4		89.1	89.1
02$/LL:ak	t		5		17.6	17.6
00/MI			1		25.1	25.1
00/OW					75.3	75.3
00/PD					33.5	33.5
00/RE				0.1	8.2	8.3
00/RI				248.6	5946.8	6195.4
00/RN				3.7	110.3	114.0
00/RO			1		0.0	0.0
00/RO	w		1		0.3	0.3
00/RW					204.0	204.0
00/RZ				88.8	122.9	211.7
00/RZ	g				1.4	1.4
05$/SC:ab			3	102.8	13.3	116.1
05$/SC:ab			4	124.3	27.3	151.6
05$/SC:ab			5	502.9	58.2	561.1
05$/SC:ab			6	1253.5	101.2	1354.7
05$/SC:ab			7	7.4		7.4
05$/SC:ab	c		5		0.6	0.6
05$/SC:ab	c		6		0.8	0.8

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
05$/SC:ab	c	k	5		0.9	0.9
05$/SC:ab	c	k	6		0.9	0.9
05$/SC:ab	c	w	5		2.6	2.6
05$/SC:ab	g		4		7.0	7.0
05$/SC:ab	g		5		11.2	11.2
05$/SC:ab	g	k	3		2.1	2.1
05$/SC:ab	g	k	4		1.1	1.1
05$/SC:ab	g	k	5		84.3	84.3
05$/SC:ab	g	k	6		13.9	13.9
05$/SC:ab	g	s	5		3.0	3.0
05$/SC:ab	g	w	3		2.4	2.4
05$/SC:ab	g	w	5		8.4	8.4
05$/SC:ab	h		3		2.5	2.5
05$/SC:ab	k		3		14.1	14.1
05$/SC:ab	k		4		21.5	21.5
05$/SC:ab	k		5	0.5	91.5	92.0
05$/SC:ab	k		6		146.9	146.9
05$/SC:ab	k		7	0.4		0.4
05$/SC:ab	t		3		2.1	2.1
05$/SC:ab	t		4		2.9	2.9
05$/SC:ab	w		5		5.9	5.9
05$/SC:ep			3		4.2	4.2
05$/SC:ep			4		28.7	28.7
05$/SC:ep			5		45.9	45.9
05$/SC:ep			6		39.2	39.2
05$/SC:ep	c	k	4		6.2	6.2
05$/SC:ep	g		4		5.4	5.4
05$/SC:ep	g		5		1.8	1.8
05$/SC:ep	g	k	3		1.1	1.1
05$/SC:ep	g	k	4		17.8	17.8
05$/SC:ep	k		3		5.0	5.0

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
05$/SC:ep	k		4		26.4	26.4
05$/SC:ep	k		5		105.7	105.7
05$/SC:ep	n		5		2.8	2.8
05$/SC:ep	t		4		3.6	3.6
05$/SC:ep	w		3		39.8	39.8
05$/SC:ep	w		5		11.8	11.8
06/SC			3	101.9	1.6	103.5
06/SC			4	28.6		28.6
06/SC			5	934.5	27.2	961.7
06/SC			6	1490.9	68.9	1559.8
06/SC			7	105.1	7.4	112.6
06/SC	g		5		13.5	13.5
06/SC	g		6		4.4	4.4
06/SC	g	k	5		2.1	2.1
06/SC	g	k	6		15.2	15.2
06/SC	g	w	5		20.2	20.2
06/SC	h		5		5.8	5.8
06/SC	h		6		7.5	7.5
06/SC	k		4		17.5	17.5
06/SC	k		5		5.3	5.3
06/SC	k		6		7.6	7.6
06/SC	n		5		20.5	20.5
06/SC	t		6		51.8	51.8
06/SC	w		4		0.6	0.6
06/SC	w		6		4.3	4.3
00/SE			2	253.1	780.4	1033.5
00/SE			3	6.7	125.1	131.7
00/SE	h		2		3.7	3.7
07/SH			3	68.4	28.7	97.0
07/SH			4	0.2	48.0	48.2
07/SH			5	203.4	154.6	358.0

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
07/SH			6	56.9	689.9	746.8
07/SH			7	18.5	103.4	121.9
07/SH	a		6		0.0	0.0
07/SH	g		6		2.7	2.7
07/SH	k		4		3.6	3.6
07/SH	k		6		11.8	11.8
07/SH	p		4		35.0	35.0
07/SH	p		5		4.6	4.6
07/SH	p		6		4.5	4.5
07/SH	t		3		2.9	2.9
07/SH	t		5		18.2	18.2
07/SH	t		6		216.1	216.1
07/SH	t		7		24.0	24.0
07/SH	w		6		3.4	3.4
07$/SH:ac			3	18.3	110.2	128.4
07$/SH:ac			4	8.1	62.4	70.4
07$/SH:ac			5	89.3	267.6	356.9
07$/SH:ac			6	115.2	292.9	408.1
07$/SH:ac			7	179.3	1.4	180.7
07$/SH:ac	f		4		4.9	4.9
07$/SH:ac	g		3		5.3	5.3
07$/SH:ac	g		4		3.2	3.2
07$/SH:ac	g		5		3.4	3.4
07$/SH:ac	g		6		12.2	12.2
07$/SH:ac	g	w	6		0.3	0.3
07$/SH:ac	h		3		25.2	25.2
07$/SH:ac	h		6		5.8	5.8
07$/SH:ac	k		5		9.1	9.1
07$/SH:ac	k		6		12.2	12.2
07$/SH:ac	n		5		4.9	4.9
07$/SH:ac	n		6		7.6	7.6

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
07$/SH:ac	s		5		19.1	19.1
07$/SH:ac	t		3		23.1	23.1
07$/SH:ac	t		4		24.3	24.3
07$/SH:ac	t		5		24.5	24.5
07$/SH:ac	t		6		83.7	83.7
07$/SH:ep			5		8.4	8.4
07$/SH:ep			6		7.9	7.9
05/SO			3	7.4	27.2	34.6
05/SO			4	2.4	32.1	34.5
05/SO			5	5.9	121.1	127.0
05/SO			6	1.7	160.7	162.4
05/SO			7	9.0	26.7	35.7
05/SO	c		5		1.5	1.5
05/SO	c		6		1.5	1.5
05/SO	c	k	6		0.8	0.8
05/SO	g		3		3.6	3.6
05/SO	g		5		64.5	64.5
05/SO	g		6		14.9	14.9
05/SO	g	k	4		2.7	2.7
05/SO	g	k	5		127.9	127.9
05/SO	g	k	6		39.9	39.9
05/SO	g	s	5		4.3	4.3
05/SO	g	w	5		3.9	3.9
05/SO	h		4		0.7	0.7
05/SO	h		6		0.7	0.7
05/SO	k		4		0.9	0.9
05/SO	k		5		237.8	237.8
05/SO	k		6		105.0	105.0
05/SO	n		5		7.0	7.0
05/SO	n		6		10.6	10.6
05/SO	r		5		20.1	20.1

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
05/SO	t		3		6.8	6.8
05/SO	t		5		57.0	57.0
05/SO	t		6		81.1	81.1
05/SO	t		7		6.4	6.4
05/SO	w		3		0.7	0.7
05/SO	w		5		13.0	13.0
05/SO	w		7		7.4	7.4
03/SW			3	19.6	78.5	98.1
03/SW			4	3.6	41.2	44.7
03/SW			5	100.0	413.7	513.7
03/SW			6	206.3	146.6	352.9
03/SW			7	0.6	11.0	11.6
03/SW	g		4		7.4	7.4
03/SW	g		5		35.7	35.7
03/SW	g		6		13.0	13.0
03/SW	g	h	6		3.5	3.5
03/SW	g	k	3		2.6	2.6
03/SW	g	k	4		3.1	3.1
03/SW	g	k	5		106.5	106.5
03/SW	g	k	6		175.0	175.0
03/SW	g	s	4		4.6	4.6
03/SW	g	s	5		4.6	4.6
03/SW	g	s	6		8.6	8.6
03/SW	g	w	4		8.1	8.1
03/SW	g	w	5		31.8	31.8
03/SW	g	w	6		8.4	8.4
03/SW	k		2		3.9	3.9
03/SW	k		3	19.6	3.1	22.7
03/SW	k		4		49.6	49.6
03/SW	k		5	13.3	126.9	140.2
03/SW	k		6	66.4	133.5	199.8

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
03/SW	k	s	4		12.2	12.2
03/SW	k	s	5		8.1	8.1
03/SW	k	s	6		7.8	7.8
0303/SW	n		4		3.4	3.4
03/SW	q		4		0.0	0.0
03/SW	r		3		5.9	5.9
03/SW	r		4		3.1	3.1
03/SW	s		3		0.9	0.9
03/SW	t		3		5.0	5.0
03/SW	t		4		4.3	4.3
03/SW	t		5		244.0	244.0
03/SW	t		6		42.1	42.1
03/SW	w		3	16.7	0.5	17.2
03/SW	w		4		16.3	16.3
03/SW	w		5	45.2	57.7	102.8
03/SW	w		6	0.1	20.0	20.1
03$/SW:as			3	67.0	51.6	118.6
03$/SW:as			4	119.0	280.8	399.9
03$/SW:as			5	177.6	492.9	670.5
03$/SW:as			6	203.8	115.8	319.6
03$/SW:as			7	6.2		6.2
03$/SW:as	f		5		21.5	21.5
03$/SW:as	f	k	4		1.4	1.4
03$/SW:as	g		3		3.1	3.1
03$/SW:as	g		4		33.2	33.2
03$/SW:as	g		5		46.1	46.1
03$/SW:as	g		6		2.4	2.4
03$/SW:as	g	h	3		7.9	7.9
03$/SW:as	g	h	5		11.5	11.5
03$/SW:as	g	k	3		12.4	12.4
03$/SW:as	g	k	4		34.4	34.4

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
03$/SW:as	g	k	5		184.2	184.2
03$/SW:as	g	k	6		6.3	6.3
03$/SW:as	g	w	3		17.3	17.3
03$/SW:as	g	w	4		82.1	82.1
03$/SW:as	g	w	5		48.9	48.9
03$/SW:as	g	w	6		5.3	5.3
03$/SW:as	h		3		3.8	3.8
03$/SW:as	h		4		31.0	31.0
03$/SW:as	h		5		34.1	34.1
03$/SW:as	h	k	4		10.7	10.7
03$/SW:as	h	w	3		15.2	15.2
03$/SW:as	h	w	4		29.0	29.0
03$/SW:as	h	w	5		68.8	68.8
03$/SW:as	k		3	35.9	11.4	47.3
03$/SW:as	k		4	9.9	192.1	202.0
03$/SW:as	k		5	171.1	360.3	531.5
03$/SW:as	k		6		49.4	49.4
03$/SW:as	k	s	4		21.9	21.9
03$/SW:as	k	s	5		39.5	39.5
03$/SW:as	n		4		5.2	5.2
03$/SW:as	n		5		3.5	3.5
03$/SW:as	q		5		11.5	11.5
03$/SW:as	r		3		1.3	1.3
03$/SW:as	r		4		9.4	9.4
03$/SW:as	r		5		22.9	22.9
03$/SW:as	r		6		5.4	5.4
03$/SW:as	s		4		0.0	0.0
03$/SW:as	s		6		19.1	19.1
03$/SW:as	s	w	3		7.9	7.9
03$/SW:as	s	w	4		28.1	28.1
03$/SW:as	s	w	5		25.3	25.3

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
03$/SW:as	t		3		4.8	4.8
03$/SW:as	t		4		25.9	25.9
03$/SW:as	t		5		207.4	207.4
03$/SW:as	w		3	82.0	36.7	118.8
03$/SW:as	w		4	27.4	250.2	277.6
03$/SW:as	w		5	121.4	146.5	267.9
03$/SW:as	w		6	5.2	4.8	10.0
003$/SW:as	z		4		17.4	17.4
03$/SW:as	z		5	0.1	22.9	23.0
10/TS			2		6.4	6.4
10/TS			3	625.4	334.1	959.5
10/TS			4	13.1	81.0	94.1
10/TS			5	144.1	10.4	154.5
10/TS			6	163.2	4.5	167.7
10/TS			7	2.4		2.4
10/TS	h		2		2.3	2.3
10/TS	h		3		17.6	17.6
00/UR				260.3	469.7	730.0
00/WH	a		2		34.7	34.7
00/WH	a		3		209.6	209.6
00/WH	a	c	2		174.0	174.0
00/WH	a	c	3		450.5	450.5
00/WH	a	f	2		63.2	63.2
00/WH	a	f	3		77.4	77.4
00/WS			2	65.9	16.0	81.8
00/WS			3	117.0	159.5	276.5
00/WS	c		3		0.7	0.7
00/WS	h		3		4.3	4.3
00/WW			2	513.6	424.8	938.5
00/WW			3	54.9	61.1	116.0
00/WW	g		2		696.2	696.2

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
00/WW	g		3		87.6	87.6
00/WW	g	h	2		8.8	8.8
00/WW	g	h	3		7.4	7.4
00/WW	g	j	2		67.9	67.9
00/WW	g	j	3		4.6	4.6
00/WW	g	k	2		25.0	25.0
00/WW	g	k	3		4.5	4.5
00/WW	g	q	2		15.5	15.5
00/WW	g	s	2		97.2	97.2
00/WW	g	s	3		4.2	4.2
00/WW	g	z	2		60.9	60.9
00/WW	h		2		41.4	41.4
00/WW	h	j	2		10.0	10.0
00/WW	h	k	2		1.6	1.6
00/WW	j		2		191.2	191.2
00/WW	j		3		8.9	8.9
00/WW	j	s	2		8.8	8.8
00/WW	j	s	3		0.9	0.9
00/WW	k		2		57.5	57.5
00/WW	k		3		6.3	6.3
00/WW	k	s	2		1.9	1.9
00/WW	q		3		0.7	0.7
00/WW	r		2		23.5	23.5
00/WW	r		3		3.6	3.6
00/WW	r	s	2		1.0	1.0
00/WW	s		2		71.9	71.9
00/WW	s		3		8.1	8.1
00/WW	s	z	2		2.5	2.5
00/WW	s	z	3		1.3	1.3
00/WW	z		2		91.3	91.3
00/WW	z		3		0.4	0.4

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
			BWBSwk1			
01/SM	k		5	17.5		17.5
01$/SM;hc	k		5	17.3		17.3
04/SW	k		3	1.9		1.9
04/SW	k		5	50.0		50.0
04$/SW:ss	w		5	106.3		106.3
			ESSFmv2			
00/AF			3		2.8	2.8
00/AF	k		3		14.4	14.4
02/FL	k		6		14.6	14.6
01/FR			5	22.5		22.5
01/FR	k		3	15.5		15.5
01/FR	k		5	88.5		88.5
01/FR	k		6	19.0		19.0
01/FR	k	s	6		7.6	7.6
			SBSwk2			
00/AF	k		3		9.8	9.8
00/AF	k	s	3		2.4	2.4
00/AF	w		3		1.2	1.2
04/BF			5		34.5	34.5
04/BF		w	5		2.3	2.3
04/BF	g	w	5		3.0	3.0
04/BF	k		5		4.5	4.5
04/BF	w		5		22.9	22.9
00/CF			2		1.1	1.1
Fm02	a		3		4.3	4.3
Fm02	a		5		17.3	17.3
Fm02	a		6		7.5	7.5
Fm02	a		4		4.3	4.3
Fm02	a		6		2.1	2.1
00/GB			1		2.9	2.9

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
00/GP					12.4	12.4
02/LH	k		4		5.7	5.7
02/LH	k		5		6.0	6.0
02/LH	r	s	5		3.2	3.2
02/LH	r	s	6		2.9	2.9
02/LH	s	w	5		1.1	1.1
02/LH	s	w	6		9.3	9.3
02/LH	w		4		0.7	0.7
02/LH	w		5		41.5	41.5
00/OW					1.6	1.6
00/RI					8.6	8.6
00/RN					8.6	8.6
00/RO			1		0.7	0.7
00/RO	w		1		2.3	2.3
00/RZ					14.9	14.9
03/SC			3		1.5	1.5
03/SC			4		10.7	10.7
03/SC			5		7.4	7.4
03/SC			6		5.0	5.0
03/SC	g	s	4		2.0	2.0
03/SC	j		3		3.8	3.8
03/SC	j		6		4.5	4.5
03/SC	k		5		7.0	7.0
03/SC	k		6		6.1	6.1
03/SC	r		5		5.8	5.8
03/SC	r		6		4.3	4.3
03/SC	r	s	6		2.3	2.3
03/SC	s		3		3.1	3.1
03/SC	s		5		4.6	4.6
05/SD			3		5.3	5.3
05/SD			4		3.8	3.8

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
05/SD			5		29.9	29.9
05/SD			6		14.9	14.9
05/SD			7		1.5	1.5
05/SD	k		5		5.9	5.9
05/SD	k		6		8.2	8.2
05/SD	w		7		4.8	4.8
06/SH			3		19.1	19.1
06/SH			4		3.8	3.8
06/SH			5		11.2	11.2
06/SH			6		8.0	8.0
06/SH			3		0.7	0.7
06/SH			4		4.8	4.8
06/SH			5		3.0	3.0
06/SH			6		6.8	6.8
01/SO			3		7.0	7.0
01/SO			4		2.8	2.8
01/SO			5		18.0	18.0
01/SO			6		22.3	22.3
01/SO			7		2.3	2.3
01/SO	g		6		11.9	11.9
01/SO	g	k	6		13.3	13.3
01/SO	g	s	5		4.6	4.6
01/SO	g	s	6		5.7	5.7
01/SO	k		3		1.5	1.5
01/SO	k		4		1.5	1.5
01/SO	k		5		4.8	4.8
01/SO	k		6		63.8	63.8
01/SO	k	s	6		15.3	15.3
01/SO	r		4		1.6	1.6
01/SO	r		5		1.2	1.2
01/SO	s		3		1.5	1.5

Site Series/ Map Code: Seral Code	Site Modifier 1	Site Modifier 2	Structural Stage	Area (ha) in Broad Habitat Mapping	Area (ha) in TEM	Grand Total Area (ha)
01/SO	s		5		0.5	0.5
01/SO	w		3		4.5	4.5
01/SO	w		4		2.0	2.0
01/SO	w		5		36.7	36.7
01/SO	w		6		8.1	8.1
00/Wf02			3		10.0	10.0
00/Wf13			3		1.8	1.8
00Wf13			2		6.7	6.7
Total						**86423.6**

APPENDIX D AREA (HA) OF ECOSYSTEMS WITHIN PAZ (ALL DECILES)[10]

Ecosystem Unit	Total in LAA	Hectares							% of Total ha in LAA	Phase
		Dam	Reservoir	TL	Highway	Roads	Quarry	Total in PAZ		
BWBSmw1										
00/AS SwAt – Soopolallie	1771.6	26.2	69.6	0.0	11.5	1.6	0.0	108.8	6.1	Construction
		0.0	43.3	0.0	0.0	0.0	0.0	43.3	2.4	Operations
00/CB Cutbank	1092.4	34.8	159.2	1.4	8.7	0.0	0.0	204.2	18.7	Construction
		0.0	123.3	1.6	0.0	0.0	0.0	124.8	11.4	Operations
00/CF Cultivated field	9260.2	115.4	572.5	38.3	180.6	8.9	173.0	1088.6	11.8	Construction
		0.0	75.6	120.7	0.0	0.0	0.0	196.2	2.1	Operations
00/ES Exposed soil	70.3	1.2	4.2	2.7	0.0	0.0	0.0	8.1	11.6	Construction
		0.0	4.0	2.7	0.0	0.0	0.0	6.7	9.6	Operations
00/GB Gravel bar	891.4	6.4	733.0	0.0	1.1	0.0	0.0	740.5	83.1	Construction
		0.0	3.7	0.0	0.0	0.0	0.0	3.7	0.4	Operations
00/GP Gravel pit	172.3	0.0	5.3	0.0	5.4	0.3	4.2	15.2	8.8	Construction
		0.0	3.5	0.0	0.0	0.0	0.0	3.5	2.0	Operations
00/LA Lake	194.4	0.0	0.0	0.3	0.0	0.1	0.0	0.4	0.2	Construction
		0.0	0.0	1.1	0.0	0.0	0.0	1.1	0.5	Operations
00/MI Mine	25.1	25.1	0.0	0.0	0.0	0.0	0.0	25.1	99.9	Construction
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Operations
00/OW Open water	75.3	1.6	13.6	0.9	0.0	0.3	0.0	16.5	21.9	Construction
		0.0	0.0	1.1	0.0	0.0	0.0	1.1	1.5	Operations
00/PD Pond	33.5	0.0	4.0	0.7	0.0	0.1	0.1	4.9	14.5	Construction

[10] Note that operations impacts are limited to the BWBSmw1 subzone variant

Ecosystem Unit	Total in LAA	Hectares Dam	Reservoir	TL	Highway	Roads	Quarry	Total in PAZ	% of Total ha in LAA	Phase
		0.0	0.4	1.8	0.0	0.0	0.0	2.2	6.7	Operations
00/RI River	6195.4	83.3	2959.7	0.9	0.0	0.0	0.0	3044.0	49.1	Construction
		0.0	11.9	0.8	0.0	0.0	0.0	12.7	0.2	Operations
00/RN Railway	114	11.4	0.0	0.0	0.0	0.4	0.0	11.7	10.3	Construction
		0.0	0.0	2.5	0.0	0.0	0.0	2.5	2.2	Operations
00/RO Rock	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	Construction
		0.0	0.2	0.0	0.0	0.0	0.0	0.2	72.2	Operations
00/RW Rural	204	1.4	10.9	0.0	1.1	0.0	0.6	14.1	6.9	Construction
		0.0	1.8	0.0	0.0	0.0	0.0	1.8	0.9	Operations
00/RZ Road	213.1	0.6	12.3	1.2	16.4	7.9	0.3	38.7	18.2	Construction
		0.0	8.0	0.9	0.0	0.0	0.0	8.9	4.2	Operations
00/SE Sedge Wetland	1168.9	39.9	47.0	34.7	0.0	19.0	1.1	141.8	12.1	Construction
		0.0	0.5	54.4	0.0	0.0	0.0	54.9	4.7	Operations
00/UR Urban	730	0.4	7.0	6.0	0.0	0.0	4.8	18.3	2.5	Construction
		0.0	0.9	6.0	0.0	0.0	0.0	6.9	0.9	Operations
00/WH Willow - Horsetail - Sedge - Riparian Wetland	1009.5	1.1	390.5	0.5	0.0	0.0	0.0	392.1	38.8	Construction
		0.0	0.8	0.3	0.0	0.0	0.0	1.1	0.1	Operations
00/WS Willow-Sedge Wetland	363.4	3.1	27.7	14.1	0.0	5.0	0.0	50.0	13.7	Construction
		0.0	0.0	15.5	0.0	0.0	0.0	15.5	4.3	Operations
00/WW Fuzzy-spiked Wildrye – Wolf-willow	2667.1	44.3	85.7	8.4	27.2	3.6	0.0	169.2	6.3	Construction
		0.0	101.0	7.4	0.0	0.0	0.0	108.4	4.1	Operations
01/AM SwAt - Step moss	5586.4	74.4	300.3	26.4	7.3	20.3	52.6	481.2	8.6	Construction
		0.0	147.2	26.8	0.0	0.0	0.0	174.0	3.1	Operations
$01/AM:ap At - Creamy peavine	25734.5	944.4	899.3	352.5	124.6	141.3	134.3	2596.4	10.1	Construction
		0.0	371.2	416.5	0.0	0.0	0.0	787.6	3.1	Operations

Ecosystem Unit	Total in LAA	Hectares							% of Total ha in LAA	Phase
		Dam	Reservoir	TL	Highway	Roads	Quarry	Total in PAZ		
02/LL Pl - Lingonberry - Velvet-leaved blueberry	620.3	0.0	21.1	16.7	11.7	2.2	0.4	52.1	8.4	Construction
		0.0	7.5	15.4	0.0	0.0	0.0	22.9	3.7	Operations
$02/LL:ak At - Kinnikinnick	501.5	3.0	60.4	4.7	3.7	0.4	6.4	78.7	15.7	Construction
		0.0	9.4	10.9	0.0	0.0	0.0	20.3	4.0	Operations
03/SW Sw - Wildrye – Peavine	2343.3	13.9	122.2	37.4	34.1	2.2	26.5	236.3	10.1	Construction
		0.0	127.4	36.4	0.0	0.0	0.0	163.8	7.0	Operations
$03/SW:as At - Soopolallie	4209.3	95.1	115.3	42.6	34.1	20.6	44.9	352.6	8.4	Construction
		0.0	115.3	39.7	0.0	0.0	0.0	155.0	3.7	Operations
04/BL Sb - Lingonberry - Coltsfoot	2322.8	2.9	0.7	39.9	13.4	24.1	0.8	81.8	3.5	Construction
		0.0	5.8	37.9	0.0	0.0	0.0	43.7	1.9	Operations
$04/BL:al At - Labrador tea	1410.9	37.1	8.5	69.6	0.6	30.9	0.4	147.1	10.4	Construction
		0.0	1.8	107.2	0.0	0.0	0.0	108.9	7.7	Operations
$05/SC:ab At – Black Twinberry	2618.4	0.7	49.9	8.4	0.3	4.6	0.0	64.0	2.4	Construction
		0.0	73.2	7.6	0.0	0.0	0.0	80.9	3.1	Operations
$05/SC:ep Ep – Red-osier dogwood	345.6	0.4	41.2	1.6	0.0	0.0	0.0	43.3	12.5	Construction
		0.0	28.2	1.3	0.0	0.0	0.0	29.5	8.5	Operations
05/SO Sw - Currant - Oak fern	1214.7	22.0	295.9	4.4	0.6	5.0	0.0	327.9	27.0	Construction
		0.0	117.3	3.5	0.0	0.0	0.0	120.8	9.9	Operations
06/SC Sw - Currant – Bluebells	2942.2	3.6	102.7	0.0	0.0	10.0	6.8	123.2	4.2	Construction
		0.0	6.0	0.0	0.0	0.0	0.0	6.0	0.2	Operations
07/SH Sw - Currant – Horsetail	1698.6	18.4	715.5	5.4	0.2	3.0	0.2	742.7	43.7	Construction
		0.0	18.1	4.9	0.0	0.0	0.0	23.0	1.4	Operations
$07/SH:ac Ac – Cow parsnip	1413.2	1.6	394.7	3.6	0.0	1.0	0.0	400.8	28.4	Construction
		0.0	11.3	4.4	0.0	0.0	0.0	15.6	1.1	Operations
$07/SH:ep Ep – Ep-	16.3	0	1.4	0.7	0.0	0.0	0.0	2.1	12.9	Construction

Ecosystem Unit	Total in LAA	Hectares							% of Total ha in LAA	Phase
		Dam	Reservoir	TL	Highway	Roads	Quarry	Total in PAZ		
Dogwood		0.0	0.0	0.6	0.0	0.0	0.0	0.6	3.5	Operations
08/BT Sb - Labrador tea – Sphagnum	2051.4	6.5	13.4	54.1	0.0	18.6	0.7	93.4	4.6	Construction
		0.0	0.4	57.9	0.0	0.0	0.0	58.3	2.8	Operations
09/Fm02 ActSw - Red-osier dogwood	2663.6	35.4	1079.9	0.0	1.1	0.1	0.0	1116.6	41.9	Construction
		0.0	18.0	0.0	0.0	0.0	0.0	18.0	0.7	Operations
10/TS Tamarack - Sedge - Fen	1404.5	12.9	13.1	32.1	0.0	9.1	0.4	67.5	4.8	Construction
		0.0	0.0	46.6	0.0	0.0	0.0	46.6	3.3	Operations
BWBSwk1										
04/SW Sw - Wildrye - Peavine	51.9	0	0.0	0.0	0.0	0.0	23.1	23.1	44.5	Construction
$04/SW:ss At - Soopolallie - Sarsaparilla	106.3	0	0.0	0.0	0.0	0.0	24.6	24.6	23.1	Construction
ESSFmv2										
01/FR Bl - Rhododendron - Feathermoss	153	0	0.0	0.0	0.0	0.0	13.2	13.2	8.6	Construction
SBSwk2										
00/Fm02 Cottonwood-Spruce-Red-osier dogwood	35.6	0	0.0	0.0	0.0	3.5	0.0	3.5	9.9	Construction
00/GB Gravel bar	2.9	0	0.0	0.0	0.0	0.4	0.0	0.4	15.2	Construction
00/GP Gravel pit	12.4	0	0.0	0.0	0.0	1.1	11.2	12.3	99.2	Construction
00/RI River	8.6	0	0.0	0.0	0.0	1.3	0.0	1.3	15.3	Construction
00/RN Railway	8.6	0	0.0	0.0	0.0	3.5	0.7	4.2	49.2	Construction

Ecosystem Unit	Hectares								% of Total ha in LAA	Phase
	Total in LAA	Dam	Reservoir	TL	Highway	Roads	Quarry	Total in PAZ		
00/RO Rock	3.1	0	0.0	0.0	0.0	0.0	2.5	2.5	79.5	Construction
00/RZ Road	14.9	0	0.0	0.0	0.0	1.5	0.2	1.7	11.2	Construction
00/Wf13 Narrow-leaved cotton-grass-Shore sedge	8.5	0	0.0	0.0	0.0	0.4	0.3	0.8	8.9	Construction
01/SO Spruce-Oak fern	231	0	0.0	0.0	0.0	0.0	19.9	19.9	8.6	Construction
02/LH Lodgepole pine-Huckleberry-Cladina	70.4	0	0.0	0.0	0.0	0.0	25.3	25.3	35.9	Construction
03/SC Spruce – Huckleberry – Highbush cranberry	68	0	0.0	0.0	0.0	0.0	6.9	6.9	10.2	Construction
04/BF Black spruce-Lodgepole pine-Feathermoss	67.3	0	0.0	0.0	0.0	0.0	30.2	30.2	44.9	Construction
05/SD Spruce-Devil's club	74.3	0	0.0	0.0	0.0	0.3	6.7	7.0	9.4	Construction
06/SH Spruce-Horsetail	57.3	0	0.0	0.0	0.0	8.6	0.0	8.6	14.9	Construction

APPENDIX E RARE PLANTS POTENTIALLY OCCURRING WITHIN THE SITE C LOCAL ASSESSMENT AREA

Species	English Name	BC List[1]	BC Status[2]	Global Status[3]
VASCULAR PLANTS				
Alopecurus magellanicus	alpine meadow-foxtail	Red	S1S3	G5
Anemone canadensis	Canada anemone	Blue	S2S3	G5
Anemone virginiana var. *cylindroidea*	riverbank anemone	Blue	S3	G5T4T5
Arctophila fulva	pendantgrass	Blue	S2S3	G5
Arnica chamissonis ssp. *incana*	meadow arnica	Blue	S2S3	G5T3T5
Artemisia alaskana	Alaskan sagebrush	Blue	S2S3	G4
Artemisia herriotii	western mugwort	Red	S2	G5T5
Astragalus bisulcatus	twin-pod milkvetch	none	NR	G5
Astragalus umbellatus	tundra milk-vetch	Blue	S2S3	G4
Atriplex gardneri var. *gardneri*	Gardner's sagebrush	Red	S1	G5T5
Boechera sparsiflora	stretching suncress	Red	S1	G5
Botrychium ascendens	upswept moonwort	Red	S2	G3
Botrychium crenulatum	dainty moonwort	Blue	S2S3	G3
Botrychium hesperium	western moonwort	Blue	S2S3	G4
Botrychium montanum	mountain moonwort	Red	S1	G3
Botrychium paradoxum	two-spiked moonwort	Red	S1	G3G4
Botrychium pedunculosum	stalked moonwort	Red	S2	G2G3
Botrychium simplex var. *compositum*	least moonwort	Blue	S2S3	G5TNR
Botrychium spathulatum	spoon-shaped moonwort	Red	S1	G3
Braya glabella ssp. *glabella*	smooth northern-rockcress	Red	S1S3	G5T5?
Calamagrostis montanensis	plains reedgrass	Blue	S3	G5
Carex bicolor	two-coloured sedge	Blue	S2S3	G5
Carex heleonastes	Hudson Bay sedge	Blue	S2S3	G4
Carex lapponica	Lapland sedge	Blue	S2S3	G4G5Q
Carex membranacea	fragile sedge	Blue	S2S3	G5
Carex rostrata	swollen beaked sedge	Blue	S2S3	G5
Carex rupestris ssp. *rupestris*	curly sedge	Blue	S2S3	G5T5?
Carex scoparia	pointed broom sedge	Blue	S2S3	G5
Carex sprengelii	Sprengel's sedge	Red	S1	G5
Carex sychnocephala	many-headed sedge	Blue	S3	G4
Carex tenera	tender sedge	Blue	S2S3	G5
Carex vulpinoidea	fox sedge	Blue	S2S3	G5
Carex xerantica	dry-land sedge	Red	S2	G5
Chamaerhodos erecta ssp. *nuttallii*	American chamaerhodos	Blue	S2S3	G5T4T5
Chenopodium hians	gaping goosefoot	Red	S2	G5
Chrysosplenium iowense	Iowa golden-saxifrage	Blue	S2S3	G3?
Cicuta sp. nov.	no common name	none	NR	NR
Cicuta virosa	European water-hemlock	Blue	S2S3	G4G5

Species	English Name	BC List[1]	BC Status[2]	Global Status[3]
Cirsium drummondii	Drummond's thistle	Red	S2	G5
Descurainia sophioides	northern tansymustard	Red	S1S3	G5
Draba cinerea	gray-leaved draba	Blue	S2S3	G5
Draba lactea	milky draba	Blue	S2S3	G4
Drosera linearis	slenderleaf sundew	Red	S1	G4
Eleocharis elliptica	elliptic spike-rush	Blue	S2S3	G5
Elymus lanceolatus ssp. *psammophilus*	sand-dune wheatgrass	Blue	S2S3	G5TNR
Elymus sp. nov.	no common name	none	NR	NR
Epilobium halleanum	Hall's willowherb	Blue	S2S3	G5
Epilobium saximontanum	Rocky Mountain willowherb	Red	S1S3	G5
Erigeron cespitosus var. *nov.*	no common name	none	NR	NR
Erigeron pacalis ined.	no common name	none	NR	NR
Galium labradoricum	northern bog bedstraw	Blue	S3	G5
Gentianella tenella ssp. *tenella*	slender gentian	Red	S1S3	G4G5T4
Glyceria pulchella	slender mannagrass	Blue	S2S3	G5
Gymnocarpium jessoense ssp. *parvulum*	Nahanni oak fern	Blue	S3	G5T4
Helianthus nuttallii ssp. *rydbergii*	Nuttall's sunflower	Red	S1	G5T5
Helictotrichon hookeri	spike-oat	Blue	S2S3	G5
Hesperostipa spartea	porcupinegrass	Red	S2	G5
Impatiens aurella	orange touch-me-not	Blue	S2S3	G4?
Juncus albescens	whitish rush	Blue	S2S3	G5
Juncus arcticus ssp. *alaskanus*	arctic rush	Blue	S2S3	G5T4T5
Juncus confusus	Colorado rush	Red	S1	G5
Juncus stygius	bog rush	Blue	S2	G5
Lomatium foeniculaceum var. *foeniculaceum*	fennel-leaved desert-parsley	Red	S1	G5T5
Lupinus kuschei	Yukon lupine	Blue	S2S3	G3G4
Luzula nivalis	arctic wood-rush	Blue	S2S3	G5
Luzula rufescens	rusty wood-rush	Blue	S2S3	G5
Malaxis brachypoda	white adder's-mouth orchid	Blue	S2S3	G4Q
Micranthes nelsoniana var. *carlottae*	dotted saxifrage	Blue	S3	G5T3?
Muhlenbergia glomerata	marsh muhly	Blue	S3	G5
Ophioglossum pusillum	northern adder's-tongue	Blue	S2S3	G5
Oxytropis campestris var. *davisii*	Davis' oxytrope	Blue	S3	G5T3
Oxytropis maydelliana	Maydell's locoweed	Blue	S2S3	G5
Packera ogotorukensis	Ogotoruk Creek butterweed	Red	S1S3	G3G5
Pedicularis parviflora ssp. *parviflora*	small-flowered lousewort	Blue	S3	G4T4
Pedicularis verticillata	whorled lousewort	Blue	S2S3	G4
Penstemon gormanii	Gorman's penstemon	Blue	S2S3	G4
Penstemon gracilis	slender penstemon	Red	S2	G5
Physaria arctica	arctic bladderpod	Blue	S2S3	G4
Physaria didymocarpa ssp. *didymocarpa*	common twinpod	Blue	S2S3	G5T4
Pinguicula villosa	hairy butterwort	Blue	S2S3	G4

Species	English Name	BC List[1]	BC Status[2]	Global Status[3]
Piptatherum canadense	Canada mountain-ricegrass	Red	SH	G5
Plantago eriopoda	alkali plantain	Blue	S3	G5
Platanthera aplectra	no common name	none	NR	NR
Poa sp nov	no common name	none	NR	NR
Polemonium boreale	northern Jacob's-ladder	Blue	S2S3	G5
Polygala senega	Seneca-snakeroot	Red	SH	G4G5
Polypodium sibiricum	Siberian polypody	Red	SH	G5?
Potamogeton perfoliatus	perfoliate pondweed	Blue	S2S3	G5
Potentilla nivea var. *pentaphylla*	five-leaved cinquefoil	Blue	S2S3	G5T4
Prenanthes racemosa	purple rattlesnake-root	Red	SH	G5
Pyrola elliptica	white wintergreen	Blue	S2S3	G5
Ranunculus cardiophyllus	heart-leaved buttercup	Red	S1	G4G5
Ranunculus pedatifidus ssp. *affinis*	birdfoot buttercup	Blue	S2S3	G5T5
Ranunculus rhomboideus	prairie buttercup	Red	S1	G5
Rorippa calycina	persistent-sepal yellowcress	-	NR	G3
Rosa arkansana var. *arkansana*	Arkansas rose	Blue	S2S3	G5T4T5
Rumex arcticus	arctic dock	Blue	S3	G5
Salix petiolaris	meadow willow	Blue	S2S3	G5
Salix raupii	Raup's willow	Red	S1	G2
Salix serissima	autumn willow	Blue	S2S3	G4
Sarracenia purpurea ssp. *purpurea*	common pitcher-plant	Blue	S2S3	G5T5
Saussurea angustifolia var. *angustifolia*	northern sawwort	Red	SH	G5T5
Schizachyrium scoparium	little bluestem	Red	S1	G5
Selaginella rupestris	rock selaginella	Red	S1	G5
Senecio sheldonensis	Mount Sheldon butterweed	Blue	S2S3	G2G3
Silene drummondii var. *drummondii*	Drummond's campion	Blue	S3	G5T5
Silene ostenfeldii	Taimyr campion	Blue	S2S3	G4?
Silene repens	pink campion	Red	S1S3	G5
Sphaeralcea coccinea	scarlet globe-mallow	Red	S1	G5?
Sphenopholis intermedia	slender wedgegrass	Blue	S3	G5
Sphenopholis obtusata	prairie wedgegrass	Red	S1	G5
Stuckenia vaginata	sheathing pondweed	Blue	S2S3	G5
Symphyotrichum puniceum var. *puniceum*	purple-stemmed aster	Blue	S3	G5T5
Tephroseris palustris	marsh fleabane	Red	S1S3	G5
Thermopsis rhombifolia	prairie golden bean	Red	S1	G5
Tofieldia coccinea	northern false asphodel	Blue	S2S3	G5
Townsendia hookeri	Hooker's townsendia	Red	S2	G5
Trichophorum pumilum	dwarf clubrush	Blue	S2S3	G5
Utricularia ochroleuca	ochroleucous bladderwort	Blue	S2S3	G4?
MOSSES				
Acaulon muticum var. *rufescens*	rounded pygmy-moss	Red	S1	G4G5T4
Aloina bifrons	no common name	Blue	S2S3	G3
Amblyodon dealbatus	short-tooth hump-moss	Blue	S3	G3G5

Species	English Name	BC List[1]	BC Status[2]	Global Status[3]
Atrichum tenellum	slender smoothcap	Blue	S2S3	G4G5
Barbula convoluta var. *gallinula*	lesser bird's-claw beard-moss	Red	S1	G5T2?Q
Bartramia halleriana	Haller's apple-moss	Red	S2	G4G5
Brachythecium calcareum	no common name	Blue	S3	G3G4
Brotherella sp. unknown	no common name	-	NR	NR
Bryum sp. unknown	no common name	-	NR	NR
Bryum stenotrichum	no common name	Blue	S2S3	NR
Bryum uliginosum	cernuous thread-moss	Blue	S2S3	G3G5
Dicranum sp. unknown	no common name	-	NR	NR
Didymodon rigidulus var. *icmadophilus*	no common name	Blue	S2S3	G5TNR
Encalypta mutica	no common name	Blue	S2S3	G3
Encalypta spathulata	no common name	Blue	S2S3	G4
Grimmia teretinervis	no common name	Red	S1S2	G3G5
Isopterygium sp. nov.	no common name	-	NR	NR
Meesia longiseta	no common name	Blue	S3	G4?
Myurella sibirica	no common name	Red	S2	G4?
Orthothecium alpestre	no common name	none	NR	NR
Orthothecium speciosum var. *elegans*	no common name	none	NR	NR
Pohlia sphagnicola	no common name	Blue	S2S3	G2G3
Schistidium boreale	no common name	Blue	S2S3	NR
Schistidium confertum	compact grimmia	Red	S1	NR
Schistidium pulchrum	no common name	Blue	S2S3	NR
Schistidium robustum	robust grimmia	Blue	S2S3	NR
Scorpidium turgescens	no common name	none	NR	NR
Sphagnum contortum	twisted peat-moss	Blue	S3	G5
Sphagnum wulfianum	no common name	Blue	S2S3	G5
Splachnum vasculosum	rugged collar-moss	Blue	S2S4	G3G5
Stegonia latifolia var. *latifolia*	no common name	Blue	S3?	G5T4T5
Stegonia latifolia var. *pilifera*	no common name	Red	S1S2	G5T5?
Tayloria froelichiana	no common name	Blue	S2S3	G3G5
Tayloria serrata	no common name	none	NR	NR
Tayloria splachnoides	no common name	Red	S1	G2G3
Tetraplodon urceolatus	no common name	Red	S1	G3G5
Timmia megapolitana	no common name	none	NR	NR
Timmia sibirica	no common name	Red	S1	G5?
Tortella humilis	no common name	Red	S1	G5
Tortella inclinata	bent crisp-moss	none	NR	NR
Tortula sp. nov.? cf. mucronifolia	no common name	none	NR	NR
Unknown genus, Dicranaceae	no common name	none	NR	NR
Unknown genus, Mniaceae	no common name	none	NR	NR
Weissia brachycarpa	no common name	Red	S1S2	NR
LICHENS				

Species	English Name	BC List[1]	BC Status[2]	Global Status[3]
Acarospora terricola	no common name	none	NR	NR
Anaptychia crinalis	electrified millipede	Red	S2	G5
Anaptychia ulotrichoides	cryptic centipede	Blue	S2S3	G5?
Bacidia rosellizans	no common name	none	NR	NR
Buellia elegans	no common name	none	NR	NR
Caloplaca ulcerosa	no common name	none	NR	NR
Cladonia grayi	Gray's pixie-cup	Red	S1	GU
Cladonia parasitica	fence-rail thatch	Red	S1S2	G3G5
Collema bachmanianum	tar tarpaper	Red	S2	NR
Collema multipartitum	protracted tarpaper	Red	S2	NR
Fulgensia bracteata	goldnugget sulphur	Blue	S3?	G5?
Fulgensia desertorum	desert sulphur	Red	S1S2	G3G5
Fulgensia subbracteata	no common name	none	NR	NR
Heterodermia speciosa	powdered centipede	Red	S1	G5?
Lempholemma polyanthes	chewing-gum tar	Blue	S2S3	NR
Leptogium intermedium	fourty-five vinyl	Blue	S2S3	NR
Leptogium plicatile	starfish vinyl	Blue	S3?	G3?
Leptogium pseudofurfuraceum	concentric vinyl	Blue	S2S3	NR
Leptogium schraderi	wrinkled vinyl	Red	S1	NR
Leptogium tenuissimum	lilliput vinyl	Red	S2?	NR
Pachyphiale fagicola	no common name	none	NR	NR
Peltigera degenii	frog pelt	Red	S2	G3G5
Peltigera evansiana	peppered pelt	Red	S2	G4
Phaeophyscia adiastola	granulated shadow	Red	S1	G4?
Phaeophyscia hirsuta	powdered shadow	Red	S2	G3
Phaeophyscia hispidula	whiskered shadow	Red	S2	G4G5
Phaeophyscia kairamoi	whiskered shadow	Blue	S3	G3G4
Phaeophyscia nigricans	one-horse shadow	Red	S1	G4
Physcia dimidiata	frosted rosette	Red	S2?	G5?
Physcia sp. nov.	no common name	none	NR	NR
Physcia stellaris	black-eyed rosette	Blue	S3	G5
Physcia tribacia	beaded rosette	Red	S1S2	G4?
Physciella chloantha	downside shade	Blue	S3	G5?
Punctelia perreticulata	galactic speckleback	Red	S2	NR
Ramalina sinensis	burning bush	Blue	S2S3	G4G5
Solorina sp. nov.	no common name	none	NR	NR
Solorinella asteriscus	no common name	none	NR	NR
Squamarina cartilaginea	pea-green dimple	Red	S1	NR
Squamarina lentigera	snow-white dimple	Red	S1S3	G3G5
Usnea cavernosa	pitted beard	Blue	S2S3	G3G5
Usnea glabrata	lustrous beard	Blue	S3	NR
Xanthoparmelia camtschadalis	vagabond rockfrog	none	NR	NR

Table Notes:

Species	English Name	BC List[1]	BC Status[2]	Global Status[3]

No SARA Schedule 1 or COSEWIC Extinct, Extirpated, Endangered, Threatened, or Special Concern species are thought to have potential for occurrence in the study area.

BC List[1] (BC Conservation Data Centre 2012)**:**

Red List: Includes any ecological community, and indigenous species and subspecies that is extirpated, endangered, or threatened in British Columbia. Extirpated elements no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered elements are facing imminent extirpation or extinction. Threatened elements are likely to become endangered if limiting factors are not reversed. Red-listed species and sub-species may be legally designated as, or may be considered candidates for legal designation as Extirpated, Endangered or Threatened under the Wildlife Act. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.

Blue List: Includes any ecological community, and indigenous species and subspecies considered to be of special concern (formerly vulnerable) in British Columbia. Elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk, but are not Extirpated, Endangered or Threatened.

BC Status[2] and Global Status[3]: Provincial and global statuses are BCCDC and NatureServe rankings. 'S' ranks refer to the taxon's status in BC, while 'G' ranks refer to the taxon's global status. 'T' ranks are reserved for infraspecific taxa (subspecies and varieties). The number or letter following the 'S', 'G', or 'T' rank indicates the taxon's degree of rarity based on the following scale (NatureServe 2011):

X: Presumed Extinct—Not located despite intensive searches and virtually no likelihood of rediscovery.
H: Possibly Extinct—Missing; known from only historical occurrences but still some hope of rediscovery.
1: Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
2: Imperiled—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
3: Vulnerable—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
4: Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
5: Secure—Common; widespread and abundant.
NR: Not ranked

E.1 Literature Cited

BC Conservation Data Centre. 2012. BC Species and Ecosystems Explorer. Province of British Columbia. Available at: http://a100.gov.bc.ca/pub/eswp/.

NatureServe. 2011. NatureServe Explorer: An Online Encyclopedia of Life [web Application]. Version 7.1. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

APPENDIX F VASCULAR PLANTS FOUND DURING THE 2008, 2011, AND 2012 SITE C RARE PLANT SURVEYS

Species	Common Name	2008	2011	2012
Abies lasiocarpa	subalpine fir	X	X	X
Acer glabrum var. *douglasii*	Douglas maple		X	X
Acer negundo	box-elder		X	
Achillea alpina	Siberian yarrow	X	X	X
Achillea millefolium	yarrow	X		
Achillea millefolium var. *lanulosa*	yarrow	X	X	X
Achnatherum nelsonii ssp. *dorei*	Columbia needlegrass	X	X	X
Achnatherum occidentale	stiff needlegrass	X		
Achnatherum richardsonii	spreading needlegrass	X	X	X
Aconitum delphiniifolium	mountain monkshood	X	X	
Actaea rubra	baneberry	X	X	X
Adoxa moschatellina	moschatel			X
Agoseris aurantiaca ssp. *aurantiaca*	orange agoseris		X	X
Agropyron cristatum ssp. *pectinatum*	crested wheatgrass		X	X
Agrostis capillaris	colonial bentgrass		X	
Agrostis exarata	spike bentgrass	X	X	X
Agrostis gigantea	redtop	X	X	
Agrostis scabra	hair bentgrass	X	X	X
Agrostis stolonifera	creeping bentgrass	X	X	
Alisma triviale	American water-plantain	X	X	X
Allium cernuum	nodding onion	X		
Allium cernuum var. *cernuum*	nodding onion		X	X
Allium schoenoprasum	wild chives	X		
Allium schoenoprasum var. *sibiricum*	wild chives		X	
Alnus incana ssp. *tenuifolia*	mountain alder	X	X	X
Alnus viridis ssp. *crispa*	green alder	X	X	X
Alopecurus aequalis	little meadow-foxtail	X	X	X
Alopecurus pratensis	meadow-foxtail		X	
Amelanchier alnifolia	saskatoon	X	X	X
Amerorchis rotundifolia	round-leaved orchis	X	X	X
Anaphalis margaritacea	pearly everlasting	X	X	X
Andromeda polifolia	bog-rosemary	X	X	X
Androsace septentrionalis	northern fairy-candelabra	X	X	X
Anemone cylindrica	long-headed anemone	X	X	X

Species	Common Name	2008	2011	2012
Anemone multifida var. *multifida*	cut-leaved anemone	X	X	X
Anemone multifida var. *saxicola*	cut-leaved anemone		X	
Anemone patens ssp. *multifida*	prairie crocus	X	X	X
Anemone virginiana var. *cylindroidea*	riverbank anemone	X	X	X
Angelica genuflexa	kneeling angelica	X	X	X
Antennaria howellii ssp. *canadensis*	Howell's pussytoes	X		
Antennaria howellii ssp. *howellii*	Howell's pussytoes		X	
Antennaria microphylla	white pussytoes			X
Antennaria neglecta	field pussytoes	X	X	X
Antennaria parvifolia	Nuttall's pussytoes	X		
Antennaria pulcherrima	showy pussytoes	X		
Antennaria pulcherrima ssp. *pulcherrima*	showy pussytoes		X	X
Antennaria racemosa	racemose pussytoes			X
Antennaria rosea	rosy pussytoes	X	X	X
Antennaria umbrinella	umber pussytoes			X
Apocynum androsaemifolium var. *androsaemifolium*	spreading dogbane	X	X	X
Apocynum cannabinum	hemp	X		
Aquilegia brevistyla	blue columbine	X		X
Aquilegia formosa ssp. *formosa*	Sitka columbine		X	X
Arabis pycnocarpa var. *pycnocarpa*	hairy rockcress	X	X	X
Aralia nudicaulis	wild sarsaparilla	X	X	X
Arctagrostis latifolia ssp. *arundinacea*	polargrass		X	
Arctium sp.	burdock	X		X
Arctostaphylos uva-ursi	kinnikinnick	X	X	X
Arnica chamissonis ssp. *chamissonis*	meadow arnica		X	X
Arnica chamissonis ssp. *foliosa*	meadow arnica	X	X	
Arnica chamissonis ssp. *incana*	meadow arnica	X	X	
Arnica cordifolia	heart-leaved arnica	X	X	X
Arnica latifolia	mountain arnica		X	
Artemisia biennis	biennial wormwood	X	X	X
Artemisia borealis ssp. *borealis*	northern wormwood		X	
Artemisia campestris	northern wormwood	X		
Artemisia campestris ssp. *pacifica*	northern wormwood		X	X
Artemisia dracunculus	tarragon	X	X	X
Artemisia frigida	prairie sagewort	X	X	X
Artemisia herriotii	western mugwort	X	X	

Species	Common Name	2008	2011	2012
Aruncus dioicus	goatsbeard		X	X
Asparagus officinalis	garden asparagus	X	X	
Astragalus agrestis	field milk-vetch	X		
Astragalus alpinus	alpine milk-vetch	X		
Astragalus alpinus var. *alpinus*	alpine milk-vetch		X	X
Astragalus americanus	American milk-vetch	X	X	X
Astragalus australis	southern milk-vetch	X	X	X
Astragalus canadensis	Canadian milk-vetch	X		
Astragalus cicer	chick-pea milk-vetch	X	X	X
Astragalus eucosmus	elegant milk-vetch	X		
Astragalus laxmannii var. *robustior*	standing milk-vetch	X	X	X
Astragalus tenellus	pulse milk-vetch	X	X	X
Athyrium filix-femina	lady fern	X		
Athyrium filix-femina ssp. *cyclosorum*	lady fern		X	X
Avena fatua	wild oat	X		
Avena sativa	common oat		X	X
Axyris amaranthoides	Russian pigweed		X	
Beckmannia syzigachne	American sloughgrass	X	X	X
Betula nana	scrub birch	X	X	
Betula neoalaskana	Alaska paper birch	X	X	X
Betula occidentalis	water birch	X	X	
Betula papyrifera	paper birch	X	X	X
Betula pumila	low birch	X		
Betula pumila var. *glandulifera*	low birch		X	X
Bidens cernua	nodding beggarticks	X	X	X
Boechera divaricarpa	uplifting suncress		X	X
Boechera retrofracta	dangling suncress	X	X	X
Botrychium lunaria	common moonwort			X
Botrychium minganense	Mingan moonwort		X	
Botrychium pinnatum	northwestern moonwort		X	
Botrychium virginianum	rattlesnake fern	X	X	X
Brassica napus	turnip		X	X
Bromus carinatus	California brome	X	X	
Bromus ciliatus	fringed brome	X	X	X
Bromus inermis	smooth brome	X		
Bromus inermis ssp. *inermis*	smooth brome		X	X
Bromus porteri	Porter's brome	X		

Species	Common Name	2008	2011	2012
Bromus pumpellianus	Pumpelly brome	X	X	X
Bromus vulgaris	Columbia brome			X
Calamagrostis canadensis var. *canadensis*	bluejoint reedgrass	X	X	X
Calamagrostis canadensis var. *langsdorfii*	bluejoint reedgrass	X	X	X
Calamagrostis lapponica	Lapland reedgrass	X		
Calamagrostis montanensis	plains reedgrass	X	X	X
Calamagrostis purpurascens var. *purpurascens*	purple reedgrass		X	X
Calamagrostis rubescens	pinegrass	X		
Calamagrostis stricta ssp. *inexpansa*	slimstem reedgrass	X	X	X
Calamagrostis stricta ssp. *stricta*	slimstem reedgrass	X	X	X
Calla palustris	wild calla	X	X	X
Callitriche palustris	spring water-starwort	X	X	X
Caltha natans	floating marsh-marigold		X	
Campanula rotundifolia	common harebell	X	X	X
Canadanthus modestus	great northern aster	X	X	X
Capsella bursa-pastoris	shepherd's purse	X	X	X
Cardamine oligosperma var. *oligosperma*	little western bittercress	X		
Cardamine pensylvanica	Pennsylvanian bittercress	X	X	X
Carex aquatilis var. *aquatilis*	water sedge	X	X	X
Carex arcta	northern clustered sedge		X	X
Carex atherodes	awned sedge	X	X	X
Carex athrostachya	slender-beaked sedge		X	X
Carex atratiformis	black sedge	X	X	X
Carex aurea	golden sedge	X	X	X
Carex bebbii	Bebb's sedge		X	X
Carex brevior	short-beaked sedge			X
Carex brunnescens	brownish sedge		X	X
Carex canescens ssp. *canescens*	grey sedge		X	X
Carex capillaris	hairlike sedge	X	X	X
Carex chordorrhiza	cordroot sedge		X	X
Carex concinna	low northern sedge	X	X	X
Carex cordillerana	mountain-range sedge		X	
Carex crawfordii	Crawford's sedge	X	X	X
Carex cusickii	Cusick's sedge		X	X
Carex deflexa	bent sedge	X		

Species	Common Name	2008	2011	2012
Carex deweyana	Dewey's sedge	X		
Carex deweyana var. *deweyana*	Dewey's sedge		X	X
Carex diandra	lesser-panicled sedge	X	X	X
Carex disperma	soft-leaved sedge	X	X	X
Carex douglasii	Douglas' sedge	X		
Carex duriuscula	narrow-leaved sedge	X		X
Carex eburnea	bristle-leaved sedge		X	
Carex filifolia	thread-leaved sedge	X		X
Carex foenea	bronze sedge	X	X	X
Carex garberi	Garber's sedge	X		
Carex garberi ssp. *garberi*	Garber's sedge		X	
Carex gynocrates	yellow bog sedge	X	X	X
Carex heleonastes	Hudson Bay sedge	X		
Carex hoodii	Hood's sedge	X		
Carex illota	sheep sedge	X		
Carex inops ssp. *heliophila*	long-stoloned sedge	X	X	X
Carex interior	inland sedge		X	X
Carex laeviculmis	smooth-stemmed sedge		X	
Carex lasiocarpa	slender sedge	X		
Carex lasiocarpa ssp. *americana*	slender sedge			X
Carex lenticularis var. *limnophila*	Hind's sedge		X	X
Carex lenticularis var. *lipocarpa*	Kellogg's sedge	X		
Carex leptalea	bristle-stalked sedge	X		
Carex leptalea ssp. *leptalea*	bristle-stalked sedge		X	X
Carex limosa	shore sedge	X	X	X
Carex livida var. *radicaulis*	pale sedge			X
Carex loliacea	ryegrass sedge	X	X	X
Carex macloviana	Falkland Island sedge	X	X	X
Carex magellanica ssp. *irrigua*	poor sedge	X	X	
Carex media	Scandinavian sedge		X	X
Carex microglochin	few-seeded fen sedge	X		X
Carex microptera	small-winged sedge		X	X
Carex obtusata	blunt sedge	X	X	X
Carex pachystachya	thick-headed sedge		X	X
Carex peckii	Peck's sedge		X	X
Carex pellita	woolly sedge	X	X	X
Carex petasata	pasture sedge			X

Species	Common Name	2008	2011	2012
Carex prairea	prairie sedge			X
Carex praticola	meadow sedge		X	X
Carex retrorsa	long-bracted sedge	X	X	X
Carex richardsonii	Richardson's sedge		X	X
Carex rossii	Ross' sedge	X	X	X
Carex sartwellii	Sartwell's sedge	X		
Carex sartwellii var. *sartwellii*	Sartwell's sedge		X	X
Carex siccata	hay sedge	X	X	X
Carex stipata	awl-fruited sedge	X		
Carex sychnocephala	many-headed sedge	X		
Carex tenera	tender sedge	X		
Carex tenuiflora	sparse-flowered sedge		X	X
Carex torreyi	Torrey's sedge		X	
Carex tracyi	Tracy's sedge		X	
Carex utriculata	beaked sedge	X	X	X
Carex vaginata	sheathed sedge	X	X	X
Carex vesicaria	lesser bladder sedge		X	
Carex viridula	green sedge	X		
Carex viridula ssp. *viridula*	green sedge		X	
Carex vulpinoidea	fox sedge	X		
Carex xerantica	dry-land sedge			X
Castilleja miniata	scarlet paintbrush	X	X	X
Castilleja rhexiifolia	alpine paintbrush	X		
Castilleja septentrionalis	sulphur paintbrush	X		
Centaurea diffusa	diffuse knapweed		X	
Cerastium arvense	field chickweed	X	X	X
Cerastium fontanum ssp. *triviale*	mouse-ear chickweed		X	
Cerastium nutans	nodding chickweed	X	X	X
Ceratophyllum demersum	common hornwort	X	X	
Chenopodium album	lamb's-quarters	X		
Chenopodium album ssp. *album*	lamb's-quarters		X	X
Chenopodium album ssp. *striatum*	lamb's-quarters		X	X
Chenopodium capitatum	strawberry-blite	X	X	X
Chenopodium desiccatum	narrow-leaved goosefoot		X	
Chenopodium pratericola	desert goosefoot	X		
Chenopodium rubrum var. *humile*	red goosefoot	X		
Chenopodium rubrum var. *rubrum*	red goosefoot	X		

Species	Common Name	2008	2011	2012
Chenopodium simplex	maple-leaved goosefoot	X	X	
Chimaphila umbellata ssp. *occidentalis*	prince's pine		X	X
Chrysosplenium iowense	Iowa golden-saxifrage	X		
Chrysosplenium tetrandrum	northern golden-saxifrage	X	X	X
Cicuta bulbifera	bulbous water-hemlock	X	X	X
Cicuta douglasii	Douglas' water-hemlock	X	X	X
Cicuta virosa	European water-hemlock	X	X	X
Cinna latifolia	nodding wood-reed	X	X	X
Circaea alpina	enchanter's-nightshade	X		
Circaea alpina ssp. *alpina*	enchanter's-nightshade		X	
Cirsium arvense	Canada thistle	X	X	X
Cirsium drummondii	Drummond's thistle	X	X	X
Cirsium foliosum	leafy thistle			X
Cirsium vulgare	bull thistle	X	X	X
Clematis occidentalis ssp. *grosseserrata*	Columbia bower	X	X	X
Clematis tangutica var. *tangutica*	golden clematis		X	
Clintonia uniflora	queen's cup		X	X
Coeloglossum viride	long-bracted frog orchid	X		
Coeloglossum viride var. *virescens*	long-bracted frog orchid		X	X
Collomia linearis	narrow-leaved collomia	X	X	
Comandra umbellata var. *umbellata*	bastard toad-flax	X	X	X
Comarum palustre	marsh cinquefoil	X	X	X
Conyza canadensis	horseweed	X	X	
Corallorhiza maculata	spotted coralroot	X	X	X
Corallorhiza trifida	yellow coralroot	X	X	X
Cornus canadensis	bunchberry	X	X	X
Cornus stolonifera	red-osier dogwood	X	X	X
Corydalis aurea	golden corydalis	X	X	X
Corydalis sempervirens	pink corydalis		X	X
Crepis tectorum	annual hawksbeard	X	X	X
Cryptogramma acrostichoides	parsley fern		X	
Cypripedium passerinum	sparrow's-egg lady's-slipper	X	X	
Cystopteris fragilis	fragile fern		X	X
Dactylis glomerata	orchard-grass		X	X
Danthonia intermedia	timber oatgrass	X	X	X
Danthonia spicata	poverty oatgrass		X	
Delphinium glaucum	tall larkspur	X	X	

Species	Common Name	2008	2011	2012
Deschampsia cespitosa ssp. *cespitosa*	tufted hairgrass	X	X	
Descurainia incana	Richardson's tansymustard	X	X	
Descurainia sophia	flixweed	X	X	X
Diphasiastrum complanatum	ground-cedar		X	X
Draba aurea	golden draba		X	X
Draba cana	lance-leaved draba		X	X
Draba nemorosa	woods draba			X
Dracocephalum parviflorum	American dragonhead	X	X	
Drosera linearis	slenderleaf sundew			X
Drosera rotundifolia	round-leaved sundew	X		
Drosera rotundifolia var. *rotundifolia*	round-leaved sundew		X	X
Dryas drummondii	yellow mountain-avens		X	X
Dryas drummondii var. *drummondii*	yellow mountain-avens		X	
Dryas drummondii var. *tomentosa*	yellow mountain-avens	X	X	
Dryas integrifolia ssp. *integrifolia*	entire-leaved mountain-avens		X	
Drymocallis convallaria	white cinquefoil	X	X	X
Dryopteris carthusiana	toothed wood fern	X	X	X
Dryopteris expansa	spiny wood fern	X		
Dryopteris fragrans	fragrant wood fern			X
Elaeagnus commutata	silverberry	X	X	X
Eleocharis acicularis	needle spike-rush	X	X	
Eleocharis mamillata	nipple spike-rush	X		
Eleocharis mamillata ssp. *mamillata*	nipple spike-rush			X
Eleocharis palustris	common spike-rush	X	X	X
Eleocharis quinqueflora	few-flowered spike-rush	X	X	
Elymus albicans	Montana wildrye	X	X	X
Elymus canadensis	Canada wildrye	X	X	
Elymus glaucus ssp. *glaucus*	blue wildrye	X	X	X
Elymus glaucus ssp. *virescens*	blue wildrye	X		X
Elymus hirsutus	hairy wildrye	X		
Elymus lanceolatus	thickspike wildrye	X		
Elymus lanceolatus ssp. *lanceolatus*	thickspike wildrye		X	X
Elymus repens	quackgrass	X	X	X
Elymus trachycaulus ssp. *subsecundus*	slender wheatgrass	X	X	X
Elymus trachycaulus ssp. *trachycaulus*	slender wheatgrass	X	X	X
Elymus violaceus	arctic wheatgrass	X		
Empetrum nigrum	crowberry		X	

Species	Common Name	2008	2011	2012
Epilobium angustifolium	fireweed	X	X	X
Epilobium ciliatum ssp. *ciliatum*	purple-leaved willowherb	X	X	X
Epilobium ciliatum ssp. *glandulosum*	purple-leaved willowherb	X	X	
Epilobium clavatum	club-fruited willowherb	X	X	
Epilobium halleanum	Hall's willowherb	X		
Epilobium hornemannii ssp. *hornemannii*	Hornemann's willowherb		X	X
Epilobium lactiflorum	white-flowered willowherb		X	X
Epilobium leptophyllum	narrow-leaved willowherb	X	X	X
Epilobium palustre	swamp willowherb	X	X	X
Equisetum arvense	common horsetail	X	X	X
Equisetum fluviatile	swamp horsetail	X	X	X
Equisetum hyemale	scouring-rush	X		
Equisetum hyemale ssp. *affine*	scouring-rush		X	X
Equisetum laevigatum	smooth scouring-rush	X	X	
Equisetum palustre	marsh horsetail	X	X	X
Equisetum pratense	meadow horsetail	X	X	X
Equisetum scirpoides	dwarf scouring-rush	X	X	X
Equisetum sylvaticum	wood horsetail	X	X	X
Equisetum variegatum ssp. *variegatum*	northern scouring-rush	X	X	
Erigeron acris	bitter fleabane	X		
Erigeron acris var. *kamtschaticus*	bitter fleabane	X	X	X
Erigeron caespitosus	tufted fleabane		X	X
Erigeron glabellus ssp. *pubescens*	smooth daisy	X	X	
Erigeron lonchophyllus	spear-leaved fleabane	X	X	
Erigeron peregrinus ssp. *peregrinus*	subalpine daisy		X	
Erigeron philadelphicus	Philadelphia fleabane	X	X	X
Erigeron strigosus	rough-stemmed fleabane	X		
Eriophorum angustifolium	narrow-leaved cotton-grass	X		
Eriophorum chamissonis	Chamisso's cotton-grass	X		
Eriophorum chamissonis var. *chamissonis*	Chamisso's cotton-grass			X
Eriophorum gracile	slender cotton-grass	X	X	
Eriophorum vaginatum	sheathed cotton-grass	X		
Eriophorum vaginatum ssp. *vaginatum*	sheathed cotton-grass		X	X
Eriophorum viridicarinatum	green-keeled cotton-grass			X
Erysimum cheiranthoides	wormseed mustard	X	X	
Erysimum inconspicuum	small wallflower	X	X	

Species	Common Name	2008	2011	2012
Euphrasia nemorosa	eastern eyebright	X	X	X
Eurybia conspicua	showy aster	X	X	X
Eurybia merita	arctic aster	X		
Eurybia sibirica	Siberian aster		X	X
Fallopia convolvulus	black bindweed	X	X	
Festuca idahoensis	Idaho fescue	X		
Festuca rubra	red fescue	X		
Festuca rubra ssp. *rubra*	red fescue		X	X
Festuca saximontana	Rocky Mountain fescue	X	X	X
Festuca subulata	bearded fescue	X		
Festuca trachyphylla	hard fescue		X	
Fragaria vesca	wood strawberry	X	X	X
Fragaria virginiana	wild strawberry		X	X
Fragaria virginiana var. *glauca*	wild strawberry	X	X	
Fragaria virginiana var. *platypetala*	wild strawberry		X	X
Galeopsis bifida	split-lip hemp-nettle	X	X	X
Galium boreale	northern bedstraw	X	X	X
Galium labradoricum	northern bog bedstraw	X	X	X
Galium trifidum ssp. *subbiflorum*	small bedstraw	X	X	X
Galium trifidum ssp. *trifidum*	small bedstraw	X	X	X
Galium triflorum	sweet-scented bedstraw	X	X	X
Gaultheria hispidula	creeping-snowberry	X	X	
Gentianella amarella	northern gentian	X		
Gentianella amarella ssp. *acuta*	northern gentian		X	X
Geocaulon lividum	false toad-flax	X	X	X
Geranium bicknellii	Bicknell's geranium	X	X	X
Geranium richardsonii	Richardson's geranium			X
Geum aleppicum	yellow avens	X	X	X
Geum macrophyllum	large-leaved avens	X	X	X
Geum macrophyllum ssp. *perincisum*	large-leaved avens			X
Geum rivale	water avens	X	X	X
Geum triflorum var. *triflorum*	old man's whiskers	X	X	
Glyceria borealis	northern mannagrass	X	X	X
Glyceria elata	tall mannagrass	X	X	X
Glyceria grandis	reed mannagrass	X	X	X
Glyceria striata	fowl mannagrass	X	X	X
Gnaphalium uliginosum	marsh cudweed	X	X	

Species	Common Name	2008	2011	2012
Goodyera oblongifolia	rattlesnake-plantain	X	X	X
Goodyera repens	dwarf rattlesnake orchid	X	X	X
Grindelia squarrosa var. *quasiperennis*	curly-cup gumweed	X		
Gymnocarpium dryopteris	oak fern	X	X	X
Hackelia deflexa	nodding stickseed	X		
Hackelia floribunda	many-flowered stickseed	X		
Halenia deflexa	spurred gentian	X		
Hedysarum alpinum	alpine hedysarum	X	X	X
Hedysarum boreale ssp. *mackenzii*	northern hedysarum	X	X	
Helictotrichon hookeri	spike-oat	X	X	X
Heracleum maximum	cow-parsnip	X	X	X
Hesperostipa comata ssp. *comata*	needle-and-thread grass		X	X
Hesperostipa curtiseta	short-awned porcupinegrass	X	X	X
Heuchera richardsonii	Richardson's alumroot	X	X	X
Hieracium albiflorum	white hawkweed		X	X
Hieracium praealtum	king devil		X	
Hieracium umbellatum	narrow-leaved hawkweed	X		
Hieracium umbellatum ssp. *umbellatum*	narrow-leaved hawkweed		X	X
Hierochloë hirta ssp. *arctica*	common sweetgrass	X	X	
Hippuris vulgaris	common mare's-tail	X	X	X
Hordeum jubatum ssp. *intermedium*	foxtail barley	X		
Hordeum jubatum ssp. *jubatum*	foxtail barley	X	X	X
Hordeum vulgare	common barley		X	
Impatiens noli-tangere	common touch-me-not	X	X	X
Juncus acuminatus	tapered rush	X	X	
Juncus alpinoarticulatus	alpine rush	X	X	X
Juncus arcticus ssp. *alaskanus*	arctic rush	X	X	
Juncus arcticus ssp. *sitchensis*	arctic rush	X	X	
Juncus balticus	Baltic rush	X	X	X
Juncus bufonius	toad rush	X	X	X
Juncus dudleyi	Dudley's rush	X	X	X
Juncus mertensianus	Mertens' rush		X	
Juncus nodosus	tuberous rush	X	X	X
Juncus stygius	bog rush			X
Juncus vaseyi	Vasey's rush		X	X
Juniperus communis	common juniper	X	X	X
Juniperus horizontalis	creeping juniper	X	X	X

Species	Common Name	2008	2011	2012
Koeleria macrantha	junegrass	X	X	X
Lactuca biennis	tall blue lettuce	X	X	
Lactuca serriola	prickly lettuce	X	X	X
Lappula occidentalis var. *occidentalis*	western stickseed	X		
Lappula squarrosa	bristly stickseed	X	X	X
Larix laricina	tamarack	X	X	X
Lathyrus ochroleucus	creamy peavine	X	X	X
Lemna minor	common duckweed	X	X	X
Lemna trisulca	ivy-leaved duckweed	X	X	X
Lepidium densiflorum	prairie pepper-grass	X	X	X
Leucanthemum vulgare	oxeye daisy		X	X
Leymus innovatus	fuzzy-spiked wildrye	X	X	X
Limosella aquatica	water mudwort	X	X	X
Linaria genistifolia ssp. *dalmatica*	Dalmatian toadflax	X	X	
Linaria vulgaris	butter-and-eggs		X	
Linnaea borealis	twinflower	X	X	X
Linum lewisii ssp. *lewisii*	western blue flax	X	X	X
Listera borealis	northern twayblade			X
Listera cordata	heart-leaved twayblade		X	X
Lithospermum incisum	yellow gromwell	X	X	
Lobelia kalmii	Kalm's lobelia	X	X	X
Lolium perenne	perennial ryegrass		X	
Lonicera dioica var. *glaucescens*	glaucous-leaved honeysuckle	X	X	X
Lonicera involucrata	black twinberry	X	X	X
Lotus corniculatus	birds-foot trefoil	X	X	
Lupinus polyphyllus ssp. *polyphyllus*	large-leaved lupine			X
Luzula parviflora	small-flowered wood-rush		X	X
Lycopodium annotinum	stiff club-moss	X	X	X
Lycopodium clavatum var. *clavatum*	running club-moss		X	
Lycopodium dendroideum	ground-pine		X	X
Lycopodium lagopus	ptarmigan club-moss		X	
Lycopus uniflorus	northern water horehound	X		
Lysimachia thyrsiflora	tufted loosestrife	X	X	X
Maianthemum canadense	wild lily-of-the-valley	X	X	X
Maianthemum racemosum	false Solomon's-seal	X		
Maianthemum racemosum ssp. *amplexicaule*	false Solomon's-seal		X	X
Maianthemum stellatum	star-flowered false Solomon's-	X	X	X

Species	Common Name	2008	2011	2012
	seal			
Maianthemum trifolium	three-leaved false Solomon's-seal	X	X	X
Malaxis brachypoda	white adder's-mouth orchid	X		
Matricaria discoidea	pineapple weed	X	X	X
Matteuccia struthiopteris	ostrich fern	X	X	
Medicago lupulina	black medic	X	X	X
Medicago sativa ssp. *falcata*	alfalfa	X		
Medicago sativa ssp. *sativa*	alfalfa	X	X	X
Melampyrum lineare	cow-wheat	X		
Melampyrum lineare var. *lineare*	cow-wheat		X	
Melilotus alba	white sweet-clover	X	X	X
Melilotus officinalis	yellow sweet-clover	X	X	X
Mentha arvensis	field mint	X	X	X
Menyanthes trifoliata	buckbean	X	X	X
Mertensia paniculata var. *paniculata*	tall bluebells	X	X	X
Micranthes nivalis	alpine saxifrage		X	
Mimulus guttatus	yellow monkey-flower	X	X	X
Minuartia dawsonensis	bog sandwort		X	
Minuartia rubella	boreal sandwort			X
Mitella nuda	common mitrewort	X	X	X
Moehringia lateriflora	blunt-leaved sandwort	X	X	X
Monarda fistulosa var. *menthaefolia*	wild bergamot	X	X	X
Moneses uniflora	single delight	X	X	X
Monotropa hypopithys	pinesap		X	X
Muhlenbergia glomerata	marsh muhly	X		X
Muhlenbergia richardsonis	mat muhly	X		X
Mulgedium pulchellum	blue lettuce		X	
Mycelis muralis	wall lettuce		X	X
Myosoton aquaticum	water chickweed	X		
Myriophyllum sibiricum	Siberian water-milfoil	X	X	X
Myriophyllum verticillatum	verticillate water-milfoil	X		
Nassella viridula	green needlegrass	X	X	
Oplopanax horridus	devil's club	X	X	X
Opuntia fragilis	brittle prickly-pear cactus	X	X	
Orobanche fasciculata	clustered broomrape	X	X	
Orthilia secunda	one-sided wintergreen	X		
Orthilia secunda var. *obtusata*	one-sided wintergreen		X	

Species	Common Name	2008	2011	2012
Orthilia secunda var. *secunda*	one-sided wintergreen		X	X
Orthocarpus luteus	yellow owl-clover	X	X	X
Oryzopsis asperifolia	rough-leaved ricegrass	X	X	X
Osmorhiza berteroi	mountain sweet-cicely	X	X	X
Osmorhiza depauperata	blunt-fruited sweet-cicely	X	X	
Oxycoccus oxycoccos	bog cranberry	X	X	X
Oxytropis campestris var. *cusickii*	field locoweed	X		
Oxytropis campestris var. *davisii*	Davis' locoweed	X	X	
Oxytropis campestris var. *spicata*	Nelson's oxytrope	X	X	
Oxytropis deflexa	pendant-pod locoweed	X		
Oxytropis deflexa var. *sericea*	silky oxytrope		X	
Oxytropis sericea	silky locoweed			X
Oxytropis sericea var. *speciosa*	pretty oxtrope		X	
Oxytropis splendens	showy locoweed	X	X	X
Packera indecora	rayless mountain butterweed	X	X	X
Packera paupercula	Canadian butterweed	X	X	X
Packera plattensis	plains butterweed	X	X	X
Packera streptanthifolia	Rocky Mountain butterweed		X	X
Parnassia palustris	northern grass-of-Parnassus	X	X	X
Parnassia parviflora	small-flowered grass-of-Parnassus		X	
Pascopyrum smithii	western wheatgrass	X		
Pedicularis groenlandica	elephant's-head lousewort			X
Pedicularis labradorica	Labrador lousewort		X	X
Pedicularis parviflora ssp. *parviflora*	small-flowered lousewort	X		X
Pellaea glabella ssp. *simplex*	simple cliff-brake			X
Penstemon gracilis	slender penstemon	X		
Penstemon procerus var. *procerus*	small-flowered penstemon	X	X	X
Persicaria amphibia	water smartweed	X		
Persicaria amphibia var. *stipulacea*	water smartweed		X	X
Persicaria lapathifolia	willow weed	X	X	
Petasites frigidus var. *palmatus*	palmate coltsfoot	X	X	X
Petasites frigidus var. *sagittatus*	arrow-leaved coltsfoot	X	X	X
Phalaris arundinacea	reed canarygrass	X	X	X
Phleum pratense	common timothy	X	X	X
Picea engelmannii	Engelmann spruce		X	
Picea engelmannii x glauca	hybrid white spruce		X	X
Picea glauca	white spruce	X	X	X

Species	Common Name	2008	2011	2012
Picea mariana	black spruce	X	X	X
Pinus contorta var. *latifolia*	lodgepole pine	X	X	X
Piperia elegans	elegant rein orchid		X	
Piperia unalascensis	Alaska rein orchid	X	X	X
Piptatherum micranthum	small-flowered ricegrass		X	X
Piptatherum pungens	short-awned ricegrass	X	X	X
Plantago major	common plantain	X	X	X
Platanthera aquilonis	northern green rein orchid	X	X	X
Platanthera dilatata	fragrant white rein orchid	X		
Platanthera dilatata var. *albiflora*	fragrant white rein orchid		X	
Platanthera huronensis	Great Lakes rein orchid	X	X	X
Platanthera obtusata	one-leaved rein orchid	X		
Platanthera obtusata ssp. *obtusata*	one-leaved rein orchid		X	X
Platanthera orbiculata	large round-leaved rein orchid	X	X	X
Platanthera sp.	orchid	X	X	X
Platanthera stricta	slender rein orchid		X	X
Poa alpina	alpine bluegrass	X		
Poa alpina ssp. *alpina*	alpine bluegrass		X	X
Poa annua	annual bluegrass	X	X	X
Poa compressa	Canada bluegrass	X	X	X
Poa cusickii ssp. *pallida*	Cusick's bluegrass	X		
Poa glauca	glaucous bluegrass	X		
Poa glauca ssp. *glauca*	glaucous bluegrass		X	
Poa nemoralis	wood bluegrass	X		
Poa nemoralis ssp. *interior*	interior bluegrass	X		
Poa palustris	fowl bluegrass	X	X	X
Poa pratensis	Kentucky bluegrass	X		
Poa pratensis ssp. *pratensis*	Kentucky bluegrass		X	X
Poa trivialis	rough bluegrass	X		
Polygonum achoreum	Blake's knotweed	X	X	X
Polygonum aviculare	common knotweed	X	X	X
Polygonum buxiforme	eastern knotweed	X	X	
Polypodium sibiricum	Siberian polypody		X	X
Populus balsamifera	balsam poplar	X	X	X
Populus tremuloides	trembling aspen	X	X	X
Potamogeton alpinus	northern pondweed			X
Potamogeton epihydrus	ribbon-leaf pondweed	X		

Species	Common Name	2008	2011	2012
Potamogeton foliosus	closed-leaved pondweed	X	X	X
Potamogeton gramineus	grass-leaved pondweed	X		X
Potamogeton natans	floating-leaved pondweed	X		
Potamogeton obtusifolius	blunt-leaved pondweed		X	
Potamogeton pusillus ssp. *tenuissimus*	small pondweed	X	X	X
Potamogeton richardsonii	Richardson's pondweed	X	X	X
Potentilla anserina	common silverweed	X	X	
Potentilla biennis	biennial cinquefoil	X		
Potentilla hippiana	woolly cinquefoil	X		
Potentilla norvegica	Norwegian cinquefoil	X	X	X
Potentilla pensylvanica	Pennsylvanian cinquefoil	X		
Potentilla pensylvanica var. *pensylvanica*	Pennsylvanian cinquefoil		X	X
Potentilla pulcherrima	pretty cinquefoil	X	X	X
Primula incana	mealy primrose	X		
Primula mistassinica	Mistassini primrose	X		
Prosartes trachycarpa	rough-fruited fairybells	X	X	X
Prunella vulgaris	self-heal	X	X	
Prunus pensylvanica	pin cherry	X		X
Prunus virginiana	choke cherry	X		
Prunus virginiana ssp. *melanocarpa*	choke cherry		X	X
Puccinellia distans	weeping alkaligrass	X	X	X
Puccinellia nuttalliana	Nuttall's alkaligrass	X	X	
Pyrola asarifolia	pink wintergreen	X	X	X
Pyrola chlorantha	green wintergreen	X	X	X
Pyrola minor	lesser wintergreen	X		X
Ranunculus acris	meadow buttercup		X	X
Ranunculus aquatilis	white water-buttercup	X		
Ranunculus aquatilis var. *aquatilis*	white water-buttercup			X
Ranunculus aquatilis var. *diffusus*	white water-buttercup		X	X
Ranunculus cymbalaria	shore buttercup	X	X	X
Ranunculus flammula	creeping spearwort	X		
Ranunculus gmelinii	small yellow water-buttercup	X	X	X
Ranunculus lapponicus	Lapland buttercup		X	X
Ranunculus macounii	Macoun's buttercup	X	X	X
Ranunculus occidentalis var. *occidentalis*	western buttercup		X	
Ranunculus pensylvanicus	Pennsylvania buttercup	X	X	

Species	Common Name	2008	2011	2012
Ranunculus sceleratus	celery-leaved buttercup	X		
Ranunculus sceleratus var. *multifidus*	celery-leaved buttercup		X	X
Ranunculus uncinatus	little buttercup		X	X
Rhinanthus minor	yellow rattle	X	X	X
Rhododendron albiflorum	white-flowered rhododendron		X	X
Rhododendron groenlandicum	Labrador tea	X	X	X
Ribes glandulosum	skunk currant	X		
Ribes hudsonianum var. *hudsonianum*	northern blackcurrant	X	X	X
Ribes hudsonianum var. *petiolare*	northern blackcurrant	X		
Ribes lacustre	black gooseberry	X	X	X
Ribes laxiflorum	trailing black currant	X		
Ribes oxyacanthoides ssp. *oxyacanthoides*	northern gooseberry	X	X	X
Ribes triste	red swamp currant	X	X	X
Rorippa calycina	persistent-sepal yellowcress	X		
Rorippa curvipes	blunt-leaved yellowcress	X		
Rorippa curvisiliqua	western yellowcress	X		
Rorippa palustris ssp. *hispida*	hispid yellowcress	X		
Rorippa palustris ssp. *palustris*	marsh yellowcress	X	X	X
Rosa acicularis	prickly rose	X		
Rosa acicularis ssp. *sayi*	prickly rose		X	X
Rosa nutkana	Nootka rose	X	X	X
Rosa woodsii ssp. *ultramontana*	prairie rose	X	X	
Rubus arcticus ssp. *acaulis*	nagoonberry	X	X	X
Rubus chamaemorus	cloudberry	X	X	X
Rubus idaeus	red raspberry	X		
Rubus idaeus ssp. *strigosus*	red raspberry		X	X
Rubus parviflorus	thimbleberry	X		
Rubus parviflorus var. *parviflorus*	thimbleberry		X	X
Rubus pedatus	five-leaved bramble		X	X
Rubus pubescens	dwarf red raspberry	X		
Rubus pubescens var. *pubescens*	dwarf red raspberry		X	X
Rumex britannica	greater water dock	X	X	X
Rumex crispus	curled dock	X	X	
Rumex maritimus	golden dock		X	X
Rumex occidentalis	western dock	X	X	X
Rumex triangulivalvis	willow dock		X	X
Sagittaria cuneata	arum-leaved arrowhead	X		X

Species	Common Name	2008	2011	2012
Salix alaxensis var. *alaxensis*	Alaska willow	X		
Salix alaxensis var. *longistylis*	Alaska willow	X		
Salix arbusculoides	northern bush willow	X	X	X
Salix athabascensis	Athabasca willow	X		
Salix barclayi	Barclay's willow		X	
Salix bebbiana	Bebb's willow	X	X	X
Salix candida	sage willow	X		X
Salix commutata	under-green willow	X		
Salix discolor	pussy willow	X	X	X
Salix drummondiana	Drummond's willow	X	X	X
Salix exigua	narrow-leaf willow	X		
Salix glauca	grey-leaved willow	X		
Salix interior	sandbar willow		X	X
Salix lasiandra var. *caudata*	whiplash willow	X		
Salix lasiandra var. *lasiandra*	Pacific willow	X	X	X
Salix maccalliana	MacCalla's willow	X	X	X
Salix melanopsis	dusky willow	X	X	
Salix myrtillifolia	bilberry willow	X	X	X
Salix pedicellaris	bog willow	X	X	X
Salix petiolaris	meadow willow	X		
Salix planifolia	plane-leaved willow	X	X	X
Salix prolixa	Mackenzie willow	X	X	X
Salix pseudomonticola	serviceberry willow	X	X	X
Salix pseudomyrsinites	tall blueberry willow	X	X	X
Salix pyrifolia	balsam willow		X	X
Salix scouleriana	Scouler's willow	X	X	X
Salix serissima	autumn willow	X		X
Salix sitchensis	Sitka willow		X	X
Salix vestita	rock willow	X		
Salsola tragus	Russian thistle		X	
Sambucus racemosa	red elderberry	X		X
Sanicula marilandica	black sanicle	X	X	
Saxifraga tricuspidata	three-toothed saxifrage		X	X
Schedonorus pratensis	meadow fescue	X		
Schizachne purpurascens	false melic	X	X	X
Schoenoplectus acutus	hard-stemmed bulrush		X	X
Schoenoplectus tabernaemontani	soft-stemmed bulrush	X	X	X

Species	Common Name	2008	2011	2012
Scirpus microcarpus	small-flowered bulrush	X	X	X
Scolochloa festucacea	rivergrass	X		
Scutellaria galericulata	marsh skullcap	X	X	X
Scutellaria lateriflora	blue skullcap	X		
Secale cereale	rye		X	
Sedum lanceolatum	lance-leaved stonecrop		X	X
Selaginella scopulorum	cliff selaginella			X
Senecio eremophilus	dryland ragwort	X		
Senecio eremophilus var. *eremophilus*	dryland ragwort		X	
Senecio vulgaris	common groundsel	X	X	
Shepherdia canadensis	soopolallie	X	X	X
Silene dioica	red campion		X	
Silene drummondii var. *drummondii*	Drummond's campion		X	X
Sisymbrium altissimum	tall tumble-mustard	X	X	
Sisymbrium loeselii	Loesel's tumble-mustard	X	X	
Sisyrinchium montanum	mountain blue-eyed-grass	X	X	X
Sium suave	hemlock water-parsnip	X	X	X
Solanum physalifolium	hairy nightshade		X	
Solidago canadensis	Canada goldenrod			X
Solidago lepida var. *salebrosa*	Western Canada goldenrod		X	X
Solidago missouriensis	Missouri goldenrod	X		X
Solidago multiradiata	northern goldenrod		X	
Solidago simplex var. *simplex*	spikelike goldenrod	X	X	X
Sonchus arvensis	perennial sow-thistle	X		
Sonchus arvensis ssp. *uliginosus*	perennial sow-thistle		X	
Sonchus asper	prickly sow-thistle	X		
Sonchus oleraceus	common sow-thistle	X	X	
Sorbus scopulina	western mountain-ash	X		
Sorbus scopulina var. *scopulina*	western mountain-ash		X	X
Sparganium angustifolium	narrow-leaved bur-reed	X	X	
Sparganium emersum	emersed bur-reed	X	X	X
Sparganium hyperboreum	northern bur-reed	X		
Sparganium natans	small bur-reed	X		
Sphenopholis intermedia	slender wedgegrass	X	X	
Spiraea betulifolia	birch-leaved spirea	X		
Spiraea betulifolia ssp. *lucida*	birch-leaved spirea		X	X
Spiranthes romanzoffiana	hooded ladies' tresses	X	X	X

Species	Common Name	2008	2011	2012
Spirodela polyrhiza	great duckweed	X	X	X
Stachys palustris	swamp hedge-nettle	X	X	
Stellaria borealis	boreal starwort	X		
Stellaria calycantha	northern starwort	X		
Stellaria crassifolia	thick-leaved starwort		X	
Stellaria crispa	crisp starwort		X	
Stellaria longifolia	long-leaved starwort	X	X	X
Stellaria longipes var. *longipes*	long-stalked starwort	X	X	X
Stellaria media	common chickweed	X	X	X
Streptopus amplexifolius var. *amplexifolius*	clasping twistedstalk	X	X	X
Streptopus amplexifolius var. *chalazatus*	clasping twistedstalk	X	X	X
Stuckenia filiformis ssp. *alpina*	slender-leaved pondweed	X		
Stuckenia filiformis ssp. *occidentalis*	slender-leaved pondweed	X		
Stuckenia pectinata	fennel-leaved pondweed	X	X	
Symphoricarpos albus	common snowberry	X	X	X
Symphoricarpos occidentalis	western snowberry	X	X	X
Symphyotrichum boreale	rush aster	X	X	X
Symphyotrichum ciliolatum	Lindley's aster	X	X	X
Symphyotrichum eatonii	Eaton's aster	X	X	
Symphyotrichum ericoides var. *pansum*	tufted white prairie aster	X	X	
Symphyotrichum laeve var. *geyeri*	smooth aster		X	
Symphyotrichum lanceolatum var. *hesperium*	western willow aster		X	X
Symphyotrichum puniceum var. *puniceum*	purple-stemmed aster	X	X	X
Symphyotrichum spathulatum var. *intermedium*	western mountain aster		X	
Symphyotrichum spathulatum var. *spathulatum*	western mountain aster	X		
Symphyotrichum subspicatum	Douglas' aster		X	
Tanacetum vulgare	common tansy			X
Taraxacum officinale	common dandelion	X	X	X
Thalictrum occidentale	western meadowrue	X		
Thalictrum sparsiflorum	few-flowered meadowrue	X		
Thalictrum venulosum	veiny meadowrue	X	X	X
Thinopyrum intermedium	intermediate wheatgrass		X	
Thinopyrum ponticum	tall wheatgrass	X		
Thlaspi arvense	field pennycress	X	X	X

Species	Common Name	2008	2011	2012
Tiarella trifoliata var. *trifoliata*	three-leaved foamflower		X	X
Torreyochloa pauciflora	weak false-manna	X		
Tragopogon dubius	yellow salsify	X	X	X
Triantha glutinosa	sticky false asphodel		X	X
Trichophorum cespitosum	tufted clubrush			X
Trichophorum pumilum	dwarf clubrush	X		
Trientalis europaea ssp. *arctica*	northern starflower		X	
Trifolium hybridum	alsike clover	X	X	X
Trifolium pratense	red clover	X	X	X
Trifolium repens	white clover	X	X	X
Triglochin maritima	seaside arrow-grass	X	X	X
Triglochin palustris	marsh arrow-grass	X	X	X
Tripleurospermum inodorum	scentless mayweed	X	X	
Trisetum spicatum	spike trisetum	X	X	X
Turritis glabra	tower mustard	X	X	X
Typha latifolia	common cattail	X	X	X
Urtica dioica	stinging nettle	X		
Urtica dioica ssp. *gracilis*	stinging nettle		X	X
Utricularia intermedia	flat-leaved bladderwort			X
Utricularia macrorhiza	greater bladderwort	X	X	X
Utricularia minor	lesser bladderwort	X		
Utricularia ochroleuca	ochroleucous bladderwort		X	
Vaccinium caespitosum	dwarf blueberry	X	X	X
Vaccinium membranaceum	black huckleberry		X	X
Vaccinium myrtilloides	velvet-leaved blueberry	X	X	X
Vaccinium vitis-idaea	lingonberry	X		
Vaccinium vitis-idaea ssp. *minus*	lingonberry		X	X
Valeriana dioica ssp. *sylvatica*	marsh valerian			X
Valeriana sitchensis	Sitka valerian			X
Veratrum viride	Indian hellebore		X	X
Verbascum thapsus	great mullein		X	
Veronica anagallis-aquatica	blue water speedwell	X	X	
Veronica beccabunga ssp. *americana*	American speedwell	X	X	X
Veronica peregrina	purslane speedwell	X		
Veronica peregrina var. *xalapensis*	purslane speedwell		X	X
Veronica scutellata	marsh speedwell		X	X
Viburnum edule	highbush-cranberry	X	X	X

Species	Common Name	2008	2011	2012
Vicia americana	American vetch	X	X	X
Viola adunca	early blue violet	X		
Viola adunca var. *adunca*	early blue violet		X	X
Viola canadensis	Canada violet	X		
Viola canadensis var. *rugulosa*	Canada violet		X	X
Viola macloskeyi	small white violet	X		
Viola nephrophylla	northern bog violet	X		
Viola orbiculata	round-leaved violet			X
Viola palustris	marsh violet	X		
Viola renifolia	kidney-leaved violet		X	X
Woodsia glabella	smooth cliff fern		X	
Woodsia scopulina	mountain cliff fern		X	X
x Elyhordeum macounii	Macoun's wildrye		X	X
Zannichellia palustris	horned pondweed	X		
Zizia aptera	heart-leaved Alexanders	X		
Zizia aptera var. *occidentalis*	heart-leaved Alexanders		X	

APPENDIX G RARE PLANT SPECIES ACCOUNTS

Please note that discussions of rare vascular plant occurrences in this section refer only to the site-specific field survey work completed in 2008, 2011, and 2012. Records of previously discovered rare plant occurrences contain insufficient locational data for these descriptions.

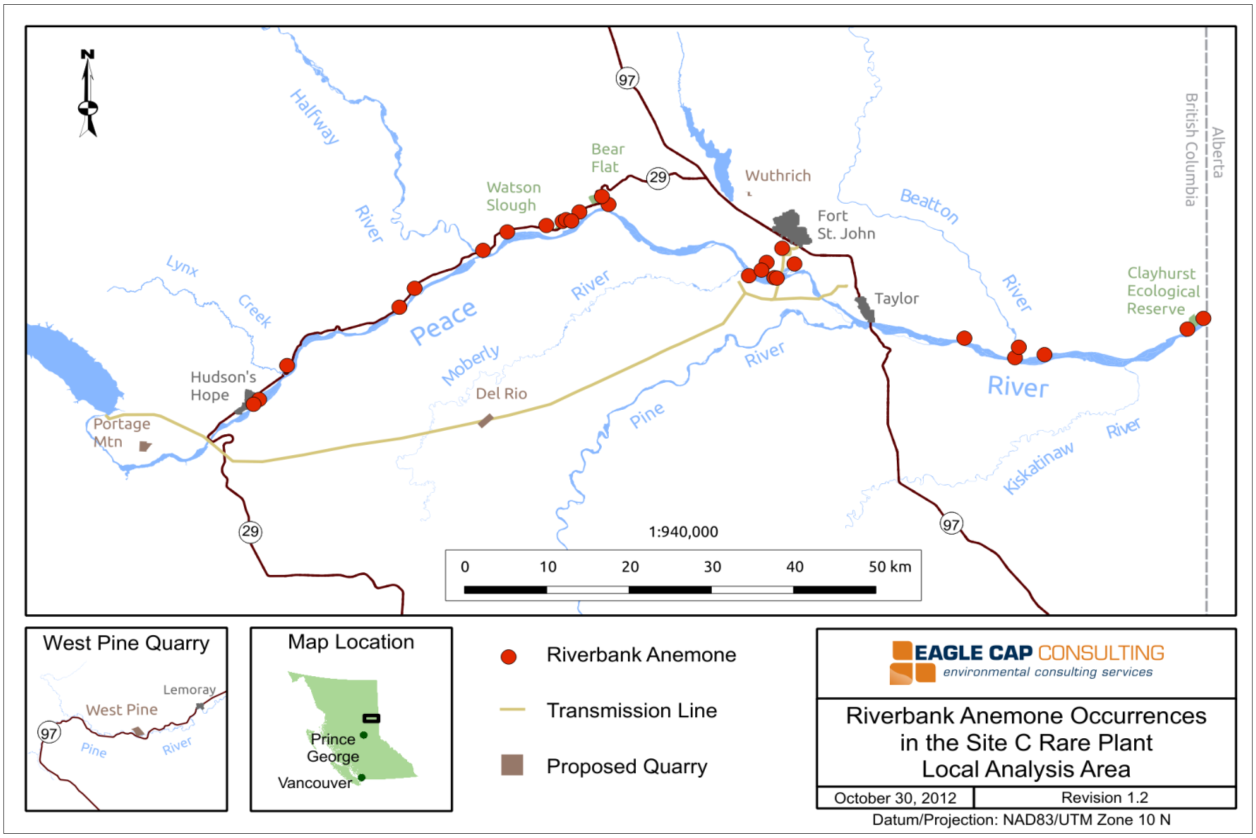
G.1 *Anemone virginiana* var. *cylindroidea* (riverbank anemone)

Riverbank anemone is a leafy perennial herb in the Ranunculaceae (buttercup family) (**Photograph G.1.1**). The taxon grows on mesic gravel bars, along streams and rivers, and in forests in the steppe and montane zones (Dutton et al. 1997; Douglas et al. 1999). In BC, the majority of recorded populations of riverbank anemone are located in the Peace Region, with a few occurrences also scattered across the central and southern parts of the province (Klinkenberg 2012; Douglas et al. 2002). Variety *cylindroidea's* global distribution extends through much of southern Canada to the Gaspé Peninsula in Québec, and also ranges south into New Brunswick and the states of Minnesota and New York (Dutton et al. 1997; NatureServe 2011).

Photograph G.1.1 Riverbank anemone

Riverbank anemone is currently ranked S3 (Vulnerable) in BC by the BCCDC, and is on the province's Blue list (BC Conservation Data Centre 2012b). Globally, variety *cylindroidea* is classed T4 (Apparently Secure) by NatureServe, although at the sub-national level Québec and New York also rank the taxon as S3 (Vulnerable) (NatureServe 2011).

Twenty-seven occurrences of riverbank anemone are reported for the Local Assessment Area (**Map G.1.1**). Eleven of these records date from earlier general studies in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a). Site-specific rare plant surveys in 2008, 2011, and 2012 documented 16 additional occurrences of riverbank anemone, located within the Peace River corridor and on the plateau north of the river. The taxon was most often observed along shorelines or in upland areas (frequently along roads or trails), where it was found scattered in the understory of open aspen forest or in mixed woodlands of aspen, balsam poplar and white spruce. Occasionally, riverbank anemone plants were discovered growing in full sun with grasses and low shrubs, near fence lines and road shoulders. Fourteen of the sixteen occurrences were relatively small, ranging in estimated size from 1 to 100 square metres, and containing relatively low numbers of riverbank anemone individuals (1–50 or 50–250, Abundance Classes A or B). The largest site covered approximately 900 square metres and contained 50–250 plants (Abundance Class B).



Map G.1.1 Riverbank anemone occurrences in the local assessment area

G.1.1 Literature Cited

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G.2 *Arnica chamissonis* ssp. *incana* (meadow arnica)

Meadow arnica (**Photograph G.2.1**) is a yellow-flowered perennial of the Asteraceae (sunflower family), found growing in moist meadows and forest openings in montane and subalpine areas (Douglas et al. 1998; Wolf 2006). Three subspecies of meadow arnica are recognized in BC, with the rare subspecies *incana* separated from the two common subspecies primarily based on the covering of dense, silvery hairs over the entire plant (Hitchcock et al. 1955; Douglas et al. 1998). Subspecies *incana* is known from numerous collections across the south, central, and northeast portions of the province (Douglas et al. 2002; Klinkenberg 2012; BC Conservation Data Centre 2012).

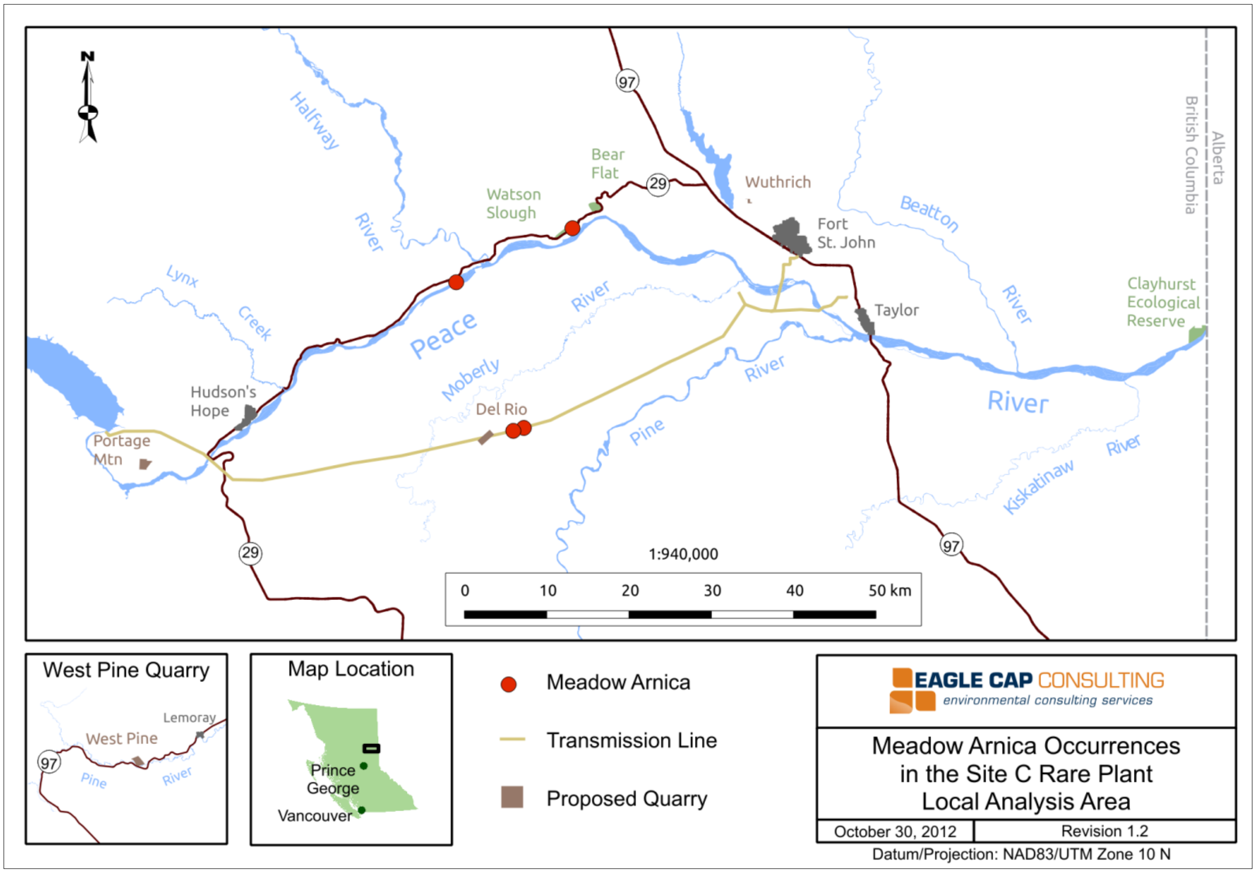
Photograph G.2.1 Meadow arnica

The subspecies' global distribution extends from Yukon south to California, and east into the Northwest Territories, Idaho and Utah (NatureServe 2011).

Meadow arnica (subspecies *incana)* is ranked S2S3 (Imperilled and Vulnerable) in BC, and is on the provincial Blue list (BC Conservation Data Centre 2012). The taxon's global status is

Apparently Secure (T4), and subspecies *incana* is not considered rare in any other states or territories (NatureServe 2011; Klinkenberg 2012).

Four occurrences of the rare subspecies of meadow arnica are reported for the Local Assessment Area (**Map G.2.1**). One of these records dates from an earlier general study in the vicinity (LGL Limited 2006). Site-specific rare plant surveys in 2008 and 2011 documented three additional occurrences of meadow arnica, located within the Peace River corridor and on the plateau between the Peace and Pine Rivers. The first of these, located above the Peace River at Watson Slough, comprised one to 50 meadow arnica plants (Abundance Class A) in a small area approximately 10 square metres in size. These plants were observed in the transition zone between a marsh and upland mixed forest. Another two occurrences of the taxon were later discovered along the proposed transmission line route near Jackfish Lake Road. One was situated in a willow-sedge wetland, where 50 to 250 individuals [Abundance Class B] were sparsely distributed over approximately 3,000 square metres. A smaller site was located nearby, where less than 50 individuals [Abundance Class A] were discovered in an estimated 20 square metres on a hillside in upland deciduous forest. In both cases, the meadow arnica were found in the partial shade of shrubby regrowth, in the cleared portion of the existing right-of-way.



Map G.2.1 Meadow arnica occurrences in the local assessment area

It should be noted that the recent treatment of *Arnica* in the authoritative Flora of North America did not accept subspecies *incana* as a legitimate taxon (Wolf 2006), and other botanists working on the Site C project have questioned its validity (LGL Limited 2006).

G.2.1 Literature Cited

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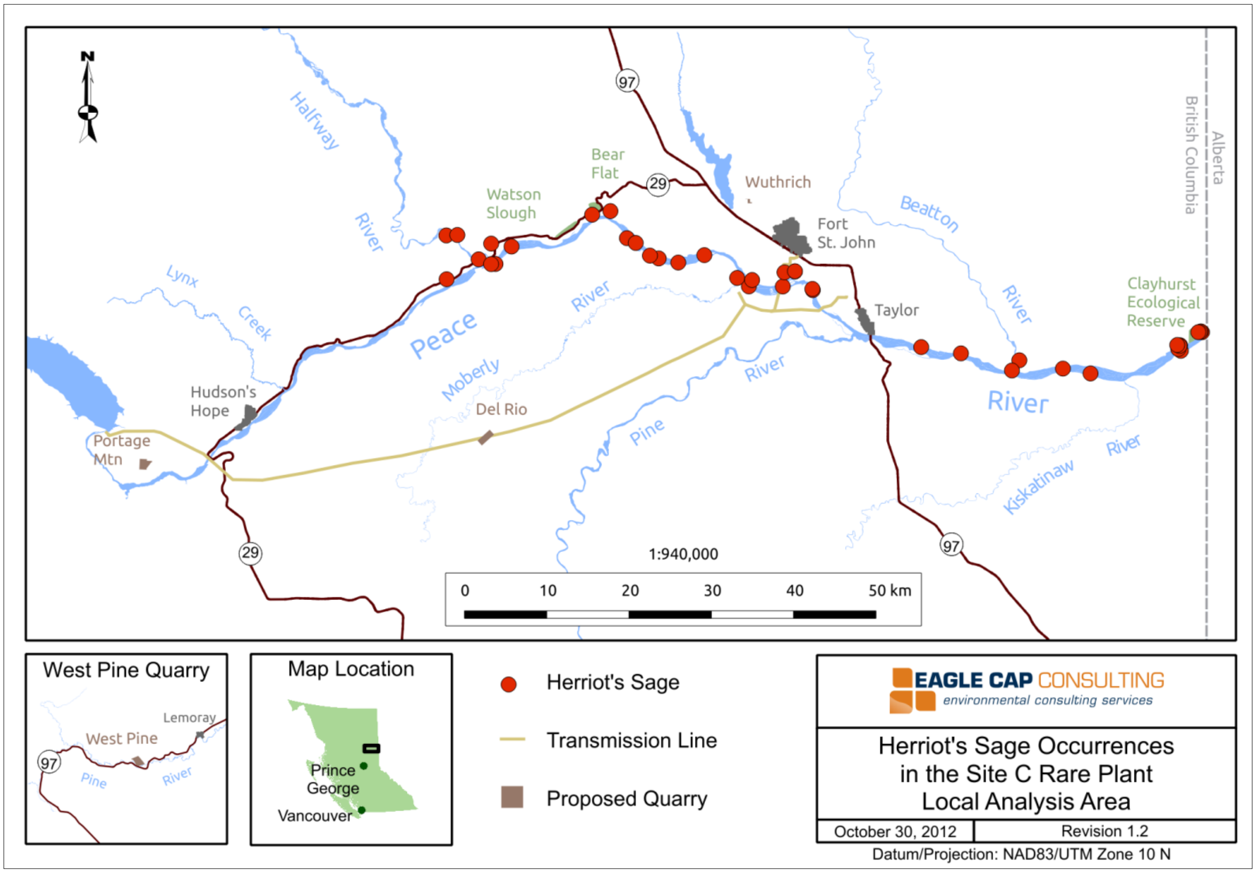
G.3 *Artemisia herriotii* (western mugwort)

Western mugwort, also known as Herriot's sage Photograph **G.3.1**) is an aromatic perennial herb in the Asteraceae (sunflower family) that grows on river flats and in open woods (Gray and Fernald 1950; Moss and Packer 1983). In BC, western mugwort is known only from the Peace River region (BC Conservation Data Centre 2012b). The taxon ranges across northern Alberta, and south in the US to Minnesota and South Dakota (Gray and Fernald 1950). Herriot's sage is ranked as an S2 (Imperilled) species in BC, and is on the provincial Red list. Globally the species is ranked G5 (Secure) (BC Conservation Data Centre 2012b).

Forty total occurrences of western mugwort are reported for the Local Assessment Area (**Map G.3.1**). Sixteen of these records date from earlier general studies in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a), and eight of these locations were noted by Keystone Wildlife Research during 2006 ecosystem mapping. Site-specific rare plant surveys in 2008 and 2011 documented 16 additional occurrences of western mugwort, located within the corridors of the Peace and Halfway Rivers. Large stands of western mugwort were found on riparian cut banks and on slumped sections of steep hillside above the Peace and Halfway river channels. At these sites, where soils were bare and loosely consolidated, the taxon formed a dominant component of the sparse, often weedy, vegetative cover, and individual western mugwort plants often measured well over one metre in height. The most extensive stand of western mugwort was estimated to cover roughly 100,000 square metres and to fall into Abundance Class E (2,500 to 10,000 plants). Other large sites ranged in size from approximately 1,000 to 20,000 square metres, and usually contained hundreds or thousands of plants (Abundance Classes B, C, or E).

Photograph G.3.1 Western mugwort

The remaining occurrences of western mugwort generally contained fewer, less robust plants, found scattered or clustered on sparsely-vegetated, relatively level areas of alluvial soils along both the Peace and Halfway Rivers. These locations included cobble bars and floodplains along the active river channel, and benches and sites of past slumping situated above or away from the main channel. Western mugwort constituted a small percentage of the understory in this kind of habitat, which was characterized by open, often early-seral mixed woodlands of balsam poplar, white spruce, willow and alder. Smaller sites ranged in actual or estimated size from 1 to 500 square metres, and contained from one to several hundred western mugwort plants (Abundance Classes A, B, or C).



Map G.3.1 Western mugwort occurrences in the Local Assessment Area

It should be noted that the taxonomy of western mugwort is uncertain, and little is known about the species' habitat requirements and global range. Western mugwort is not recognized in recent treatments such as *Illustrated Flora of British Columbia* and *Flora of North America*. The best published description of the species dates from 1950 (Gray and Fernald 1950). Herriot's sage is also briefly mentioned in the *Flora of Canada* (Scoggan 1979) and the name is listed as a synonym of *Artemisia tilesii* ssp. *elatior* (Telesius wormwood) in *Flora of Alberta* (Moss and Packer 1983).

G.3.1 Literature Cited

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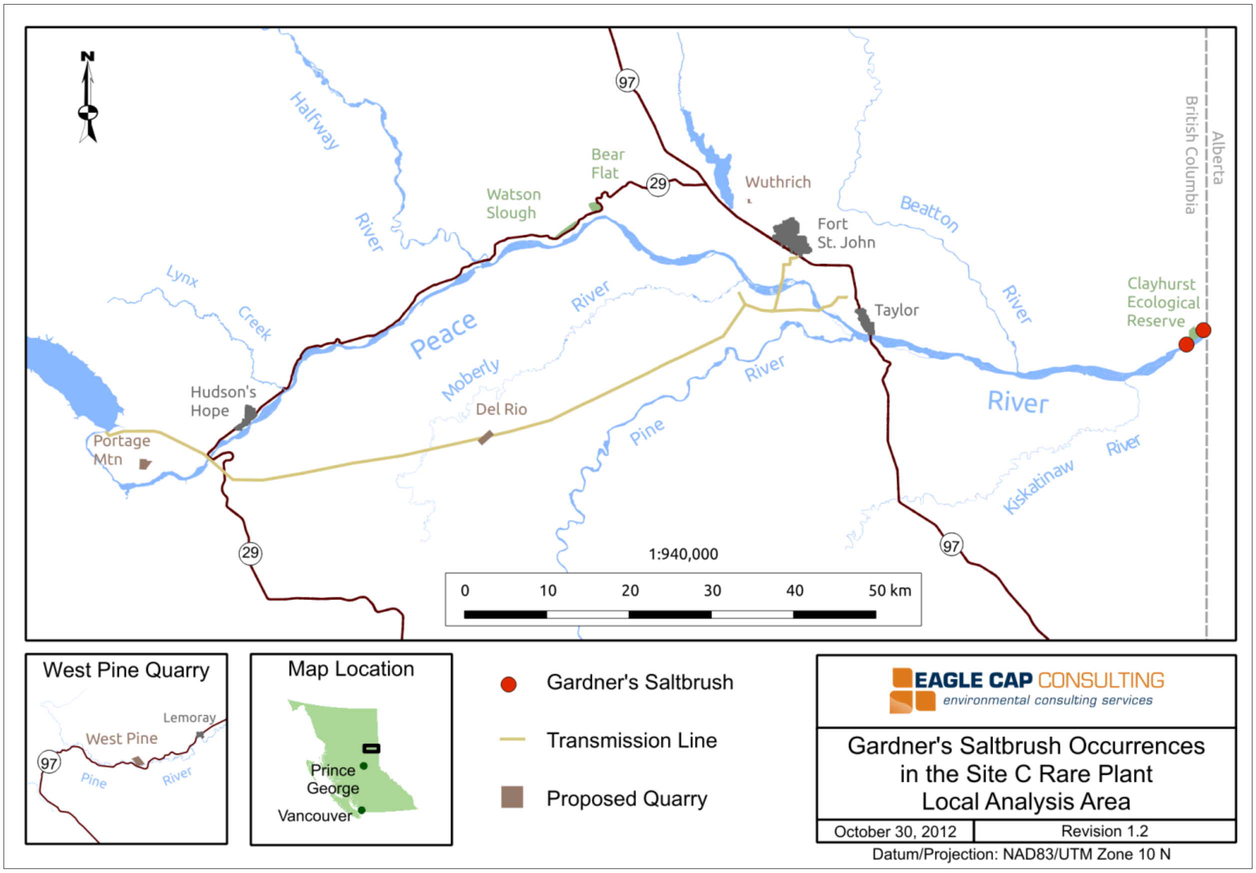
G.4 *Atriplex gardneri* var. *gardneri* (Gardner's sagebrush)

Gardner's sagebrush (also known as Gardner's saltbrush) is a short perennial subshrub in the Chenopodiaceae (goosefoot family) generally found growing on fine-textured saline substrates (Welsh 2004). In BC, variety *gardneri* is known only from a few locations along the Peace River near the Alberta border, where it occurs on dry, grassy slopes in the montane zone (Klinkenberg 2012; Douglas et al. 1998). The taxon extends east across NW Alberta in the Peace River region, and also stretches from southern Alberta, Saskatchewan, and Manitoba south to Utah and Colorado (Welsh 2004; NatureServe 2011).

Gardner's sagebrush is ranked S1 (Critically Imperilled) in BC, and is on the province's Red list (BC Conservation Data Centre 2012b). The taxon also has S1 status in Manitoba and Utah, but is considered Secure both globally (G5) and sub-nationally (S5) in all other jurisdictions where ranked (Saskatchewan, Montana, and Wyoming) (NatureServe 2011).

Two occurrences of Gardner's sagebrush are reported for the Local Assessment Area (**Map G.4.1**). Both of these sites were located during earlier general studies in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a).



Map G.4.1 Gardner's sagebrush occurrences in the Local Assessment Area

G.4.1 Literature Cited

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G.5 *Calamagrostis montanensis* (plains reedgrass)

Plains reedgrass (

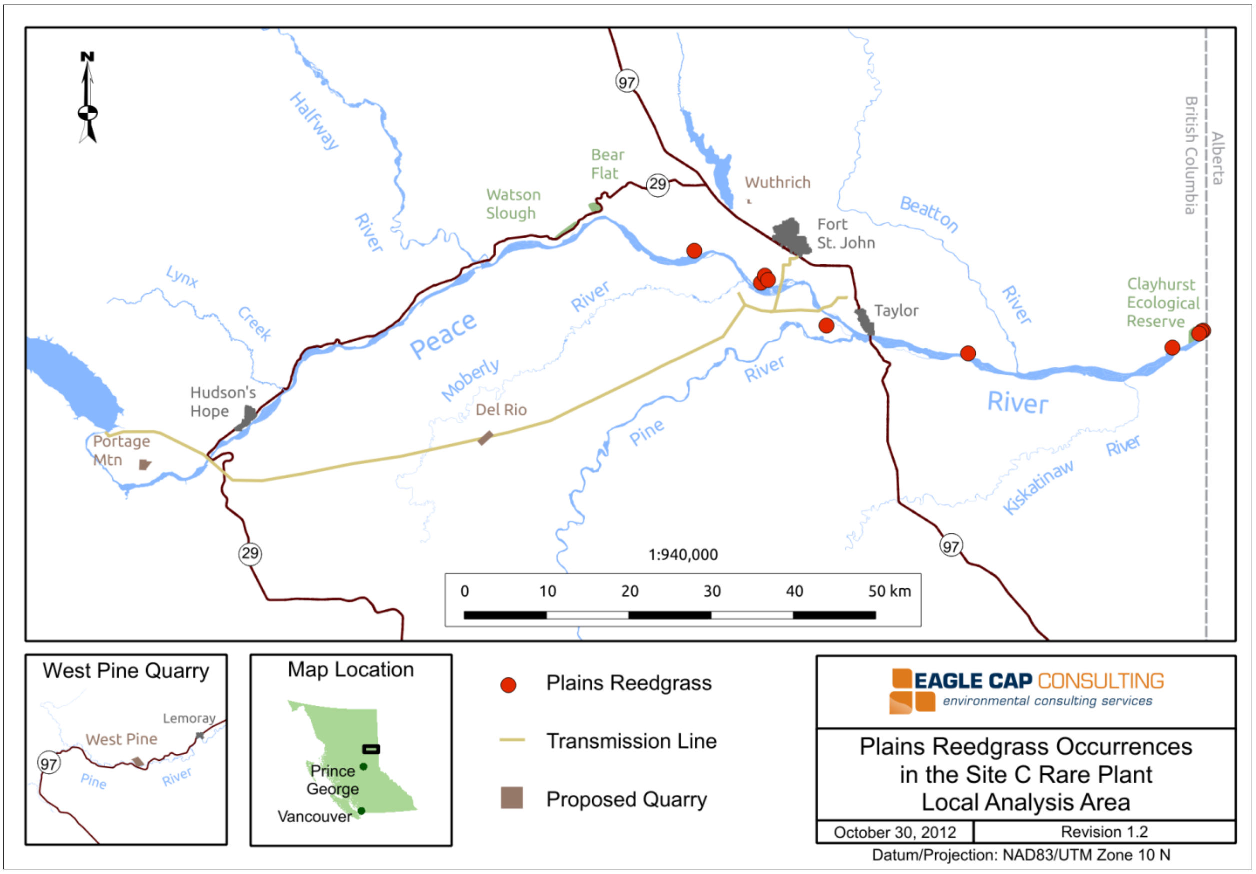
Photograph G.5.1**)** is a tufted perennial grass found on dry grassland slopes, shrub flats, and in open forests in the montane and steppe zones (Hitchcock et al. 1969; Douglas et al. 2001). The species is known from the southeast corner of BC as well as from the Peace River area, and is distributed across the prairie provinces to Manitoba, and south in the US to Minnesota, South Dakota, Colorado and Idaho (BC Conservation Data Centre 2007; BC Conservation Data Centre 2012b; NatureServe 2011; Klinkenberg 2012).

Plains reedgrass is ranked S3 (Vulnerable) in BC, and is on the provincial Blue list (BC Conservation Data Centre 2012b). Across its global range, the taxon is considered Secure (G5), although Manitoba, Minnesota, and Wyoming also rank the species as S3 (Vulnerable) (NatureServe 2011).

Photograph G.5.1 Plains reedgrass

Ten occurrences of plains reedgrass are reported for the Local Assessment Area (**Map G.5.1**). Four of these records date from earlier studies in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a). Site-specific rare plant surveys in 2008, 2011, and 2012 documented 6 additional occurrences, located in the Peace River corridor between Wilder Creek and the confluence of the Beatton River. Five of these sites were discovered on steep, dry hillsides on the north side of the Peace River. In these locations the plains reedgrass was observed growing in scattered clusters, in small openings of grassland which were closely surrounded by low shrubs and mixed upland forest. Four of the sites were relatively small, ranging in estimated area from 75 to 200 square metres, and containing low numbers of plants (1–50 or 50–250, Abundance Classes A or B). The largest occurrence covered roughly 5,000 square metres and contained 250 to 1,000 individuals (Abundance Class C).

A fifth plains reedgrass site was located on a dry bench on the right bank of the Peace River, near the confluence with the Pine River. Although the area was crossed with various road tracks, the habitat was found to be dominated by native grasses. An estimated 80 plains reedgrass plants (Abundance Class B) were sparsely distributed over approximately 130 square metres, in clusters associated with scattered stands of shrubs.



Map G.5.1 Plains reedgrass occurrences in the Local Assessment Area

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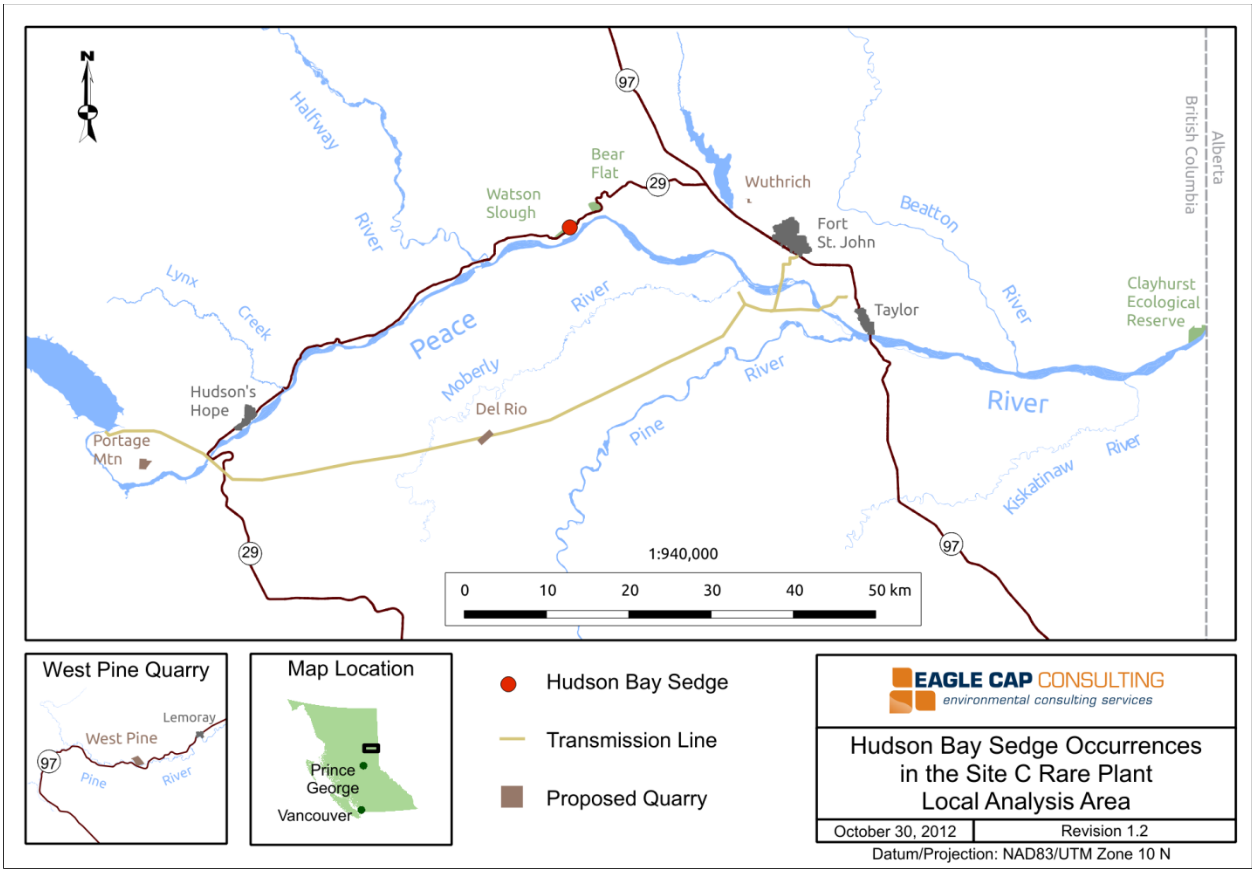
G.6 *Carex heleonastes* (Hudson Bay sedge)

Hudson Bay sedge, a perennial herb with small seed heads, is a member of the Cyperaceae (sedge family) that inhabits open wet habitats, such as damp meadows, marshy lowlands, and montane bogs and fens (Douglas et al. 2001; Ball and Reznicek 2002; Shackleford 2004). In BC, the taxon is known from various locations across the southern half of the province, and two collections in the far north near the border with Yukon Territory (BC Conservation Data Centre 2012; Klinkenberg 2012). Hudson Bay sedge occurs sporadically in almost all Canadian provinces and territories (excluding the maritime provinces), and in the US states of Michigan and Alaska, as well as throughout much of Eurasia (Ball and Reznicek 2002; Shackleford 2004; NatureServe 2011).

BC ranks the taxon as S2 (Imperilled) and includes it on the province's Blue list (BC Conservation Data Centre 2012). All other North American jurisdictions reporting a rank for the sedge also class it as Imperilled (S2), except for Yukon and Michigan where the species is considered Critically Imperilled (S1) (NatureServe 2011). Globally, Hudson Bay Sedge is ranked G4 (Apparently Secure), as it is much more abundant across large areas of Eurasia (Shackleford 2004; NatureServe 2011).

One occurrence of Hudson Bay sedge is reported for the Local Assessment Area (**Map G.6.1**). Site-specific rare plant surveys in 2008 recorded the taxon in only one location, north of the Peace River at Watson Slough. The sedge was discovered on mounds of peat mosses in open muskeg forest (50–250 plants [Abundance Class B] covering an estimated 100 square metres).



Map G.6.1 Hudson Bay sedge occurrences in the Local Assessment Area

G.6.1 Literature Cited

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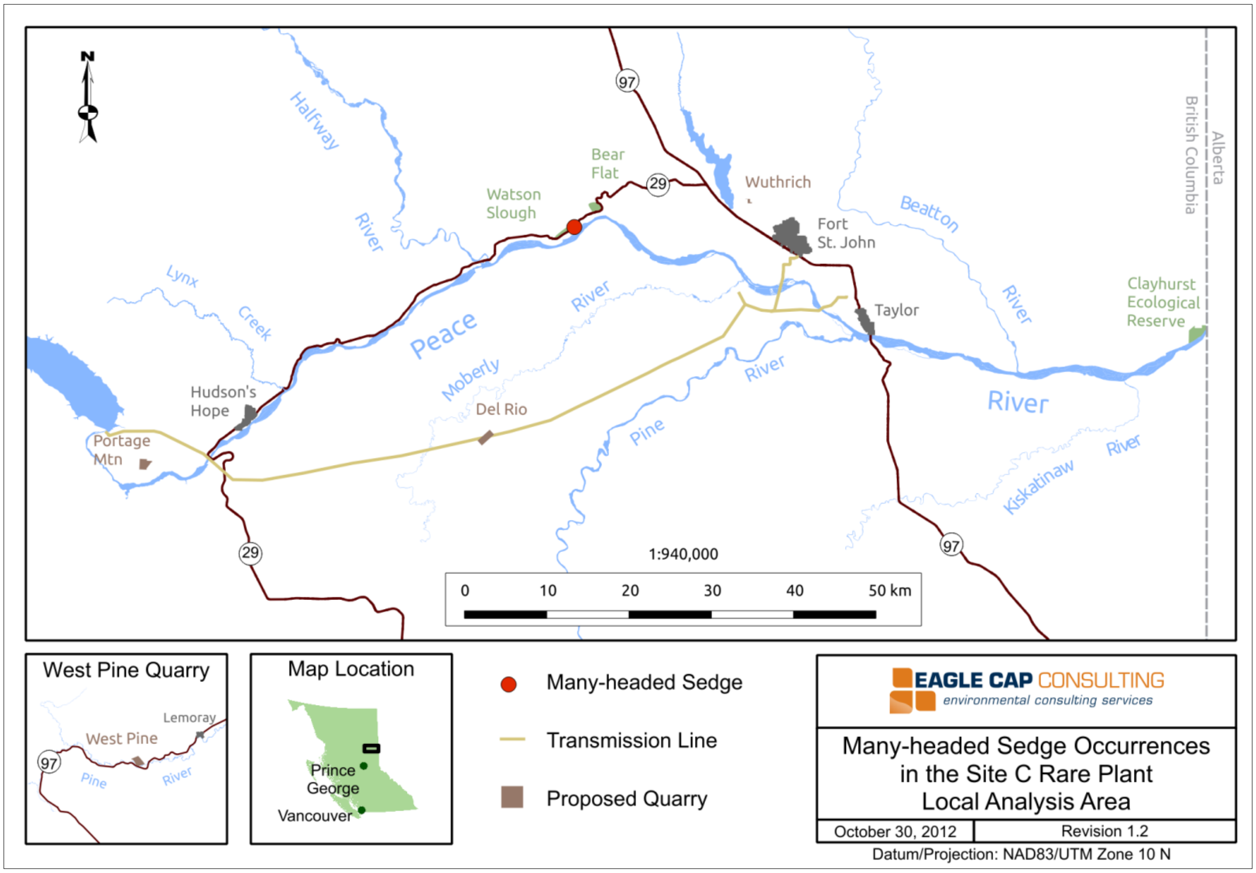
G.7 ***Carex sychnocephala*** **(many-headed sedge)**

Many-headed sedge is a leafy, tufted perennial herb of steppe and montane regions, found growing in wet or moist areas such as open banks, shorelines, and meadows (Douglas et al. 2001; Ball and Reznicek 2002). The species has been collected in scattered locations across the southern half of BC, and is also known from most Canadian provinces and territories (except Nunavut and the Maritime provinces) (NatureServe 2011; BC Conservation Data Centre 2012; Klinkenberg 2012). The sedge's range extends northwest into Alaska and south into twelve US states (Washington, Idaho, Montana, Colorado, North and South Dakota, Minnesota, Iowa, Missouri, Wisconsin, Michigan, and New York) (NatureServe 2011).

Many-headed sedge is classed S3 (Vulnerable) in BC, and is on the provincial Blue list (BC Conservation Data Centre 2012). The taxon's global listing is G4 (Apparently Secure), however its sub-national ranking varies widely across its range: S4 (Apparently Secure) in Ontario and Manitoba; S3 (Vulnerable) in Alberta and Iowa; S2 (Imperilled) in Yukon, Washington and Wisconsin; S1 (Critically Imperilled) in Québec and 6 US States including Alaska; and SH (Possibly Extirpated) in New York state. The remaining 5 jurisdictions have not yet ranked this species (NatureServe 2011).

One occurrence of many-headed sedge is reported for the Local Assessment Area (**Map G.7.1**).



Map G.7.1 Many-headed sedge occurrences in the Local Assessment Area

Site-specific rare plant surveys in 2008 observed the taxon in the open, drier sections of a marsh at the edge of Watson Slough. The plants were found growing in full sun with other sedge and grass species—1,000 to 2,500 plants (Abundance Class D) in an area of approximately 100 square metres.

G.7.1 Literature Cited

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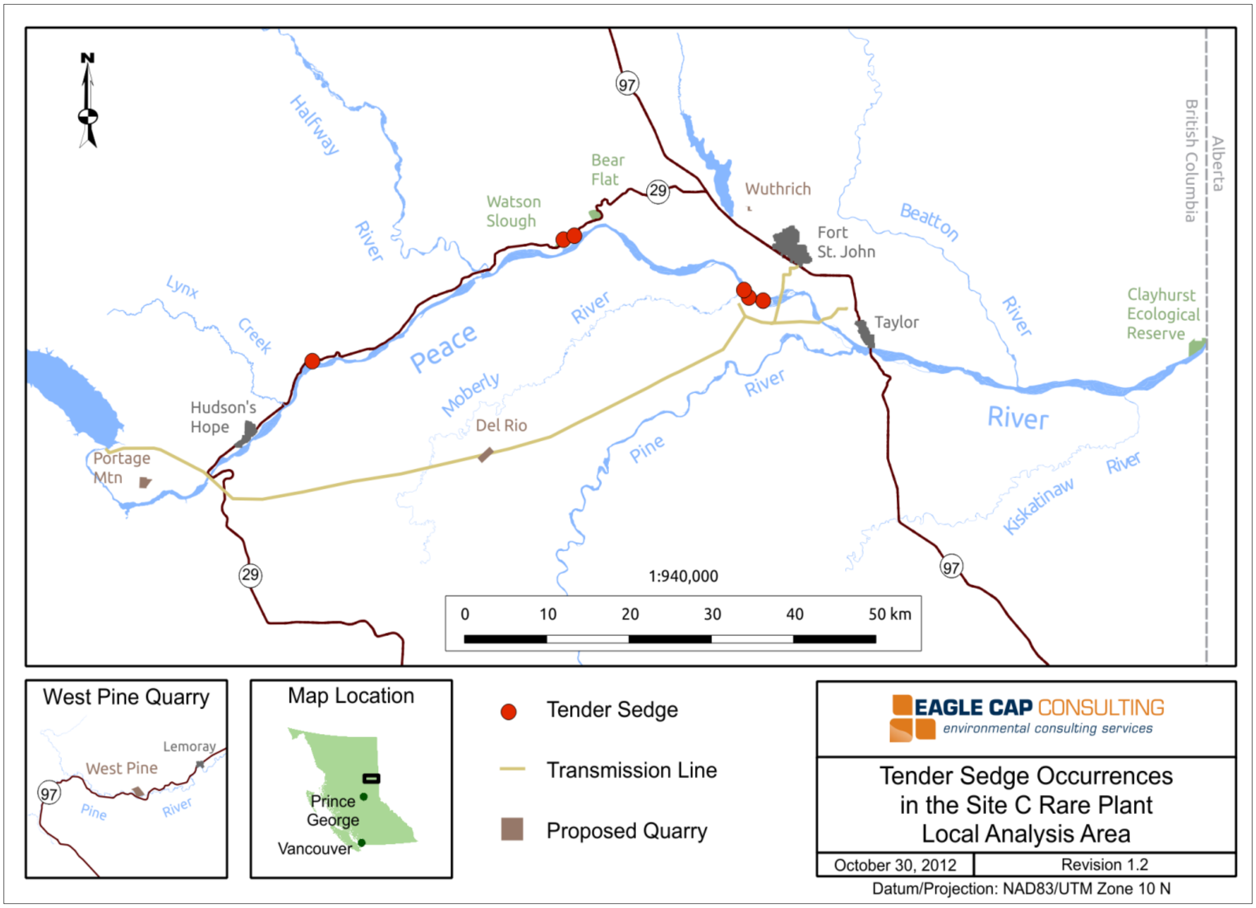
G.8 *Carex tenera* (tender sedge)

Tender sedge, a perennial herb with elongated heads, forms dense clumps in dry to moist open forests and meadows in the steppe and montane zones (Douglas et al. 2001; Ball and Reznicek 2002). In BC, the species is found occasionally throughout the province east of the Coast-Cascade Mountains, with one collection also reported from Vancouver Island (BC Conservation Data Centre 2012; Klinkenberg 2012). Tender sedge ranges east across Canada to Nova Scotia, and south in the eastern half of the US to Georgia, Alabama, Missouri and Oklahoma; in the western US the taxon occurs less frequently, but is reported from the states of Washington, Oregon, Montana, Wyoming, and New Mexico (Ball and Reznicek 2002; NatureServe 2011).

The species is ranked S2S3 (Imperilled and Vulnerable) in BC and is on the provincial Blue list (BC Conservation Data Centre 2012). Across its global range, tender sedge is considered Secure (G5), but is reportedly rare in a number of North American jurisdictions: S3 (Vulnerable) in Alberta, Québec, New Brunswick, Pennsylvania, Illinois and Iowa; S2 (Imperilled) in New Jersey and Wyoming; S1 (Critically Imperilled) in Nova Scotia, Virginia, West Virginia, and North Carolina; SH (Possibly Extirpated) in Maryland; and SX (Presumed Extirpated) in Washington, D.C. (NatureServe 2011).

Six occurrences of tender sedge are reported for the Local Assessment Area Map **G.8.1**). Site-specific rare plant surveys in 2008 documented the species along the Peace River in locations near Farrell Creek, at Watson Slough, and near the confluence of the Moberly River. The taxon was discovered in either sedge-fringe habitats along the river shoreline, or in open or shrubby wetlands nearby. The occurrences each contained hundreds of tender sedge plants (Abundance Class B or C) growing in a relatively small area (estimated at 100 square metres for each site).



Map G.8.1 Tender sedge occurrences in the Local Assessment Area

G.8.1 Literature Cited

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G.9 *Carex torreyi* (Torrey's sedge)

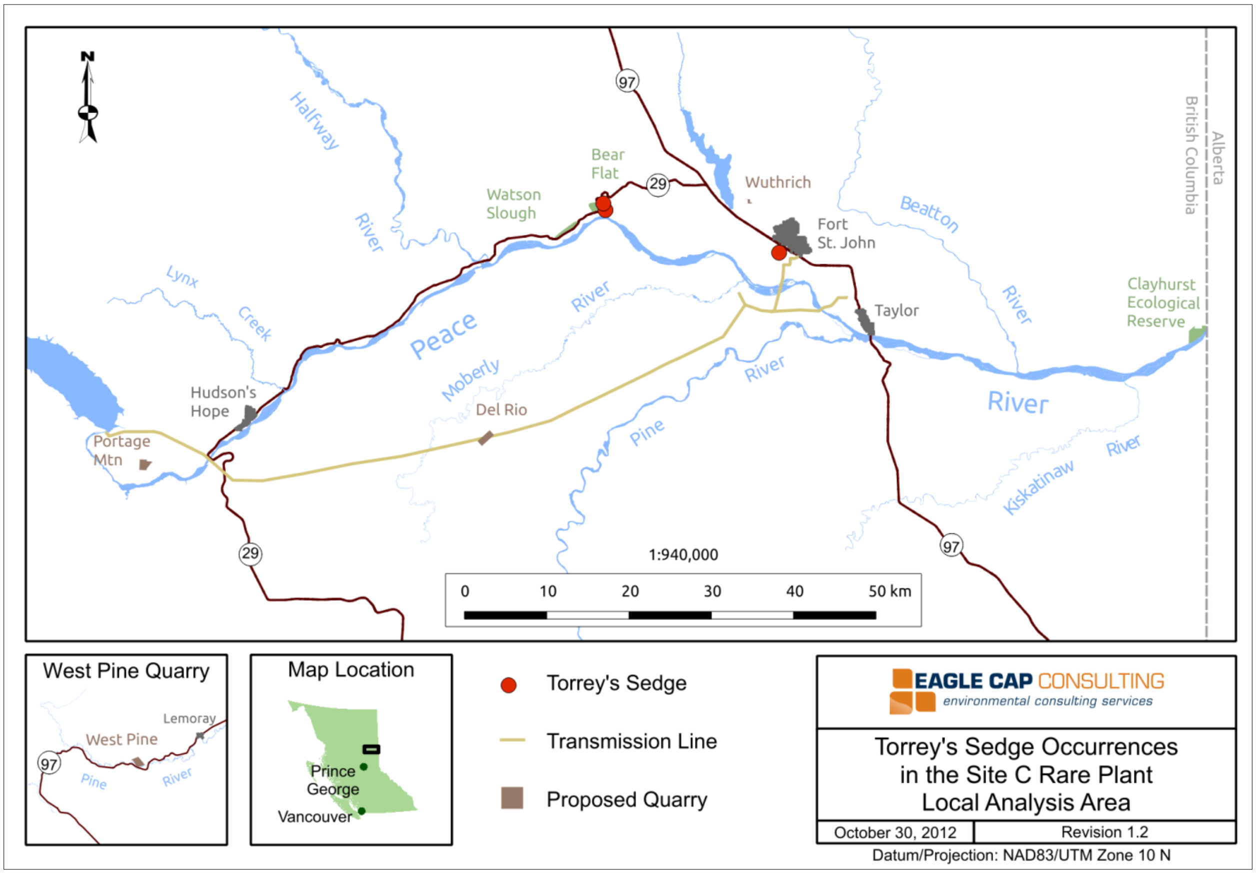
Torrey's sedge (**Photograph G.9.1)** is a soft-hairy perennial in the Cyperaceae (sedge family) found growing in montane meadows, shrublands, and moist woods (Douglas et al. 2001; Ball and Reznicek 2002). In BC the species is found only in the Peace River area, where it is known from a limited number of occurrences (BC Conservation Data Centre 2012; Klinkenberg 2012). Globally, Torrey's sedge is distributed east across Canada to Ontario, and south into Montana, Colorado, and Minnesota (NatureServe 2011).

Photograph G.9.1 Torrey's sedge

Torrey's sedge is ranked S2S3 (Imperilled and Vulnerable) in BC and is on the province's Blue list (BC Conservation Data Centre 2012). The species is ranked G4 (Apparently Secure) globally, although Colorado and Minnesota rank it S1 (Critically Imperilled) (NatureServe 2011).

Three occurrences of Torrey's sedge are reported for the Local Assessment Area (**Map G.9.1**). Two of these records date from an earlier general study in the vicinity (LGL Limited 2006). Site-specific rare plant surveys in 2011 identified an additional occurrence of Torrey's sedge (one plant), located at the 85th Avenue Industrial Lands proposed materials source area outside of

Fort St. John, in a mesic meadow between patches of upland deciduous forest. The general habitat in this area showed signs of heavy past disturbance from numerous activities.



Map G.9.1 Torrey's sedge occurrences in the Local Assessment Area

G.9.1 Literature Cited

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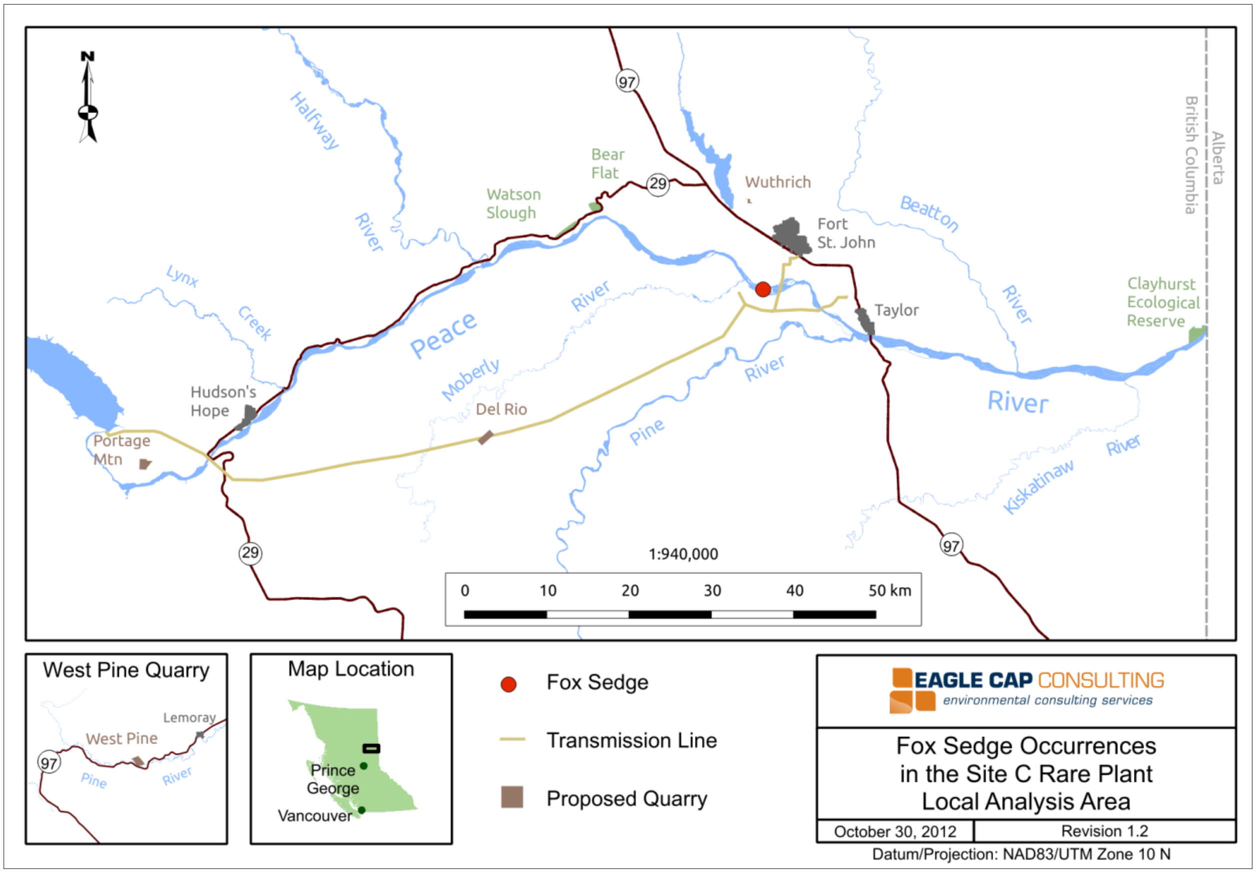
G.10 *Carex vulpinoidea* (fox sedge)

Fox sedge is a perennial herb bearing dense, bristly seed heads; the species inhabits a wide range of open, wet environments in the lowland, steppe and montane zones, including marshes, swamps, wet meadows and fields, roadside ditches, and streambanks (Douglas et al. 2001; Ball and Reznicek 2002). Although in BC the taxon has only been recorded in the Okanagan valley and across the extreme southern end of the province, in general fox sedge is found throughout most of North America (including northern Mexico), and also has been introduced into Europe and New Zealand (Ball and Reznicek 2002; NatureServe 2011; BC Conservation Data Centre 2012; Klinkenberg 2012).

Fox sedge is ranked S2S3 (Imperilled and Vulnerable) in BC, and is on the Blue list for the province (BC Conservation Data Centre 2012). Its global status is G5 (Secure), and of the 57 North American jurisdictions where it is known to occur, only seven rank the taxon at any degree of rarity (Manitoba S3 [Vulnerable]; Alberta, Saskatchewan, Prince Edward Island, Wyoming and California S2 [Imperilled]; and Newfoundland SH [Possibly Extirpated]) (Ball and Reznicek 2002; NatureServe 2011).

One occurrence of fox sedge is reported for the Local Assessment Area (**Map G.10.1**). Site-specific rare plant surveys in 2008 observed a single plant, on the right bank of the Peace River near the confluence with the Moberly River. The plant was growing with grasses and other sedges on the margin of a pool, in mixed riparian forest.



Map G.10.1 Fox sedge occurrences in the Local Assessment Area

G.10.1 Literature Cited

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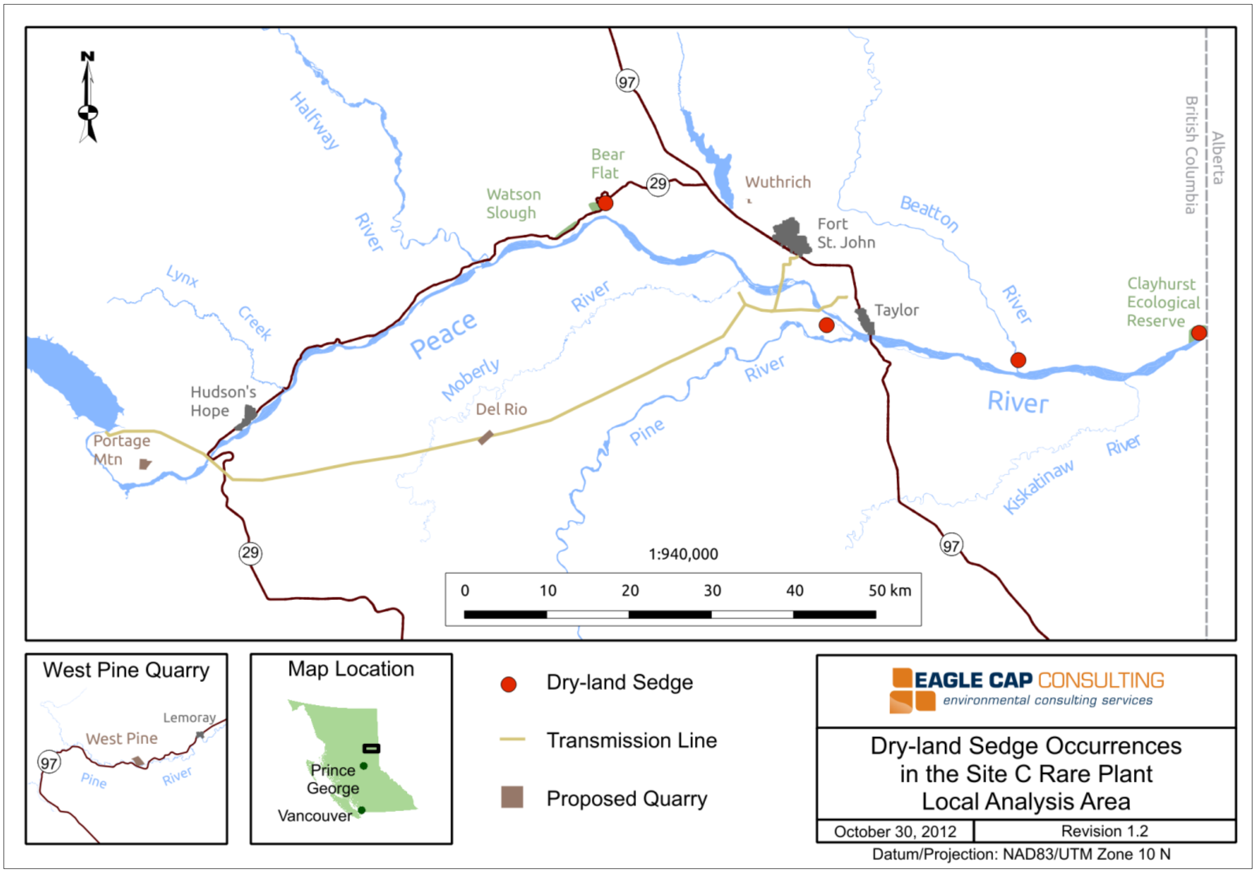
G.11 *Carex xerantica* (dry-land sedge)

Dry-land sedge—a perennial herb with silvery-gold heads—is found in xeric steppe and montane habitats such as dry grasslands and hillsides, open forests, and rock outcrops (Douglas et al. 2001; Ball and Reznicek 2002). The sedge has been collected in the Peace River area in BC, as well as scattered locations in the south-central and southeast parts of the province (BC Conservation Data Centre 2012b; Klinkenberg 2012). There is some disagreement on the taxon's global range. Douglas et al. (2001) note that dry-land sedge extends east from BC to Manitoba, and south to Minnesota and Nebraska; Ball & Reznicek (2002) show the species occurring as far east as Ontario and also in Wyoming; and NatureServe (2011) reports the sedge from as far north as Yukon and Alaska, and as far south as Arizona and New Mexico.

Dry-land sedge is classed as S2 (Imperilled) in BC, and is on the provincial Red list (BCCDC 2012d). Although globally the taxon is considered Secure (G5), all jurisdictions that provide a rank for the species indicate some degree of rarity: S1 (Critically Imperilled) in Alaska, Yukon and Wyoming; S2 (Imperilled) in Ontario, Nebraska, and New Mexico; and S3 (Vulnerable) in Alberta, Manitoba, and Minnesota. The remaining seven jurisdictions do not rank the sedge (Saskatchewan, Montana, North and South Dakota, Utah, Colorado, and Arizona) (NatureServe 2011).

Four occurrences of dry-land sedge are reported for the Local Assessment Area (**Map G.11.1**). Three of these records date from earlier studies in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a). Site-specific rare plant surveys in 2012 documented one additional occurrence, located on a dry bench on the right bank of the Peace River, near the confluence with the Pine River. Although the area was crossed with various road tracks, the habitat was found to be dominated by native grasses. An estimated 45 dry-land sedge plants (Abundance Class A) were sparsely distributed over approximately 130 square metres, in clusters associated with scattered stands of shrubs.



Map G.11.1 Dry-land sedge occurrences in the Local Assessment Area

G.11.1 Literature Cited

Ball, P.W. and A.A. Reznicek. 2002. *Carex*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico. Volume 23, Magnoliophyta: Commelinidae (in part): Cyperaceae*. Oxford University Press, New York, NY. Pp. 254–572.

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G.12 *Chrysosplenium iowense* (Iowa golden-saxifrage)

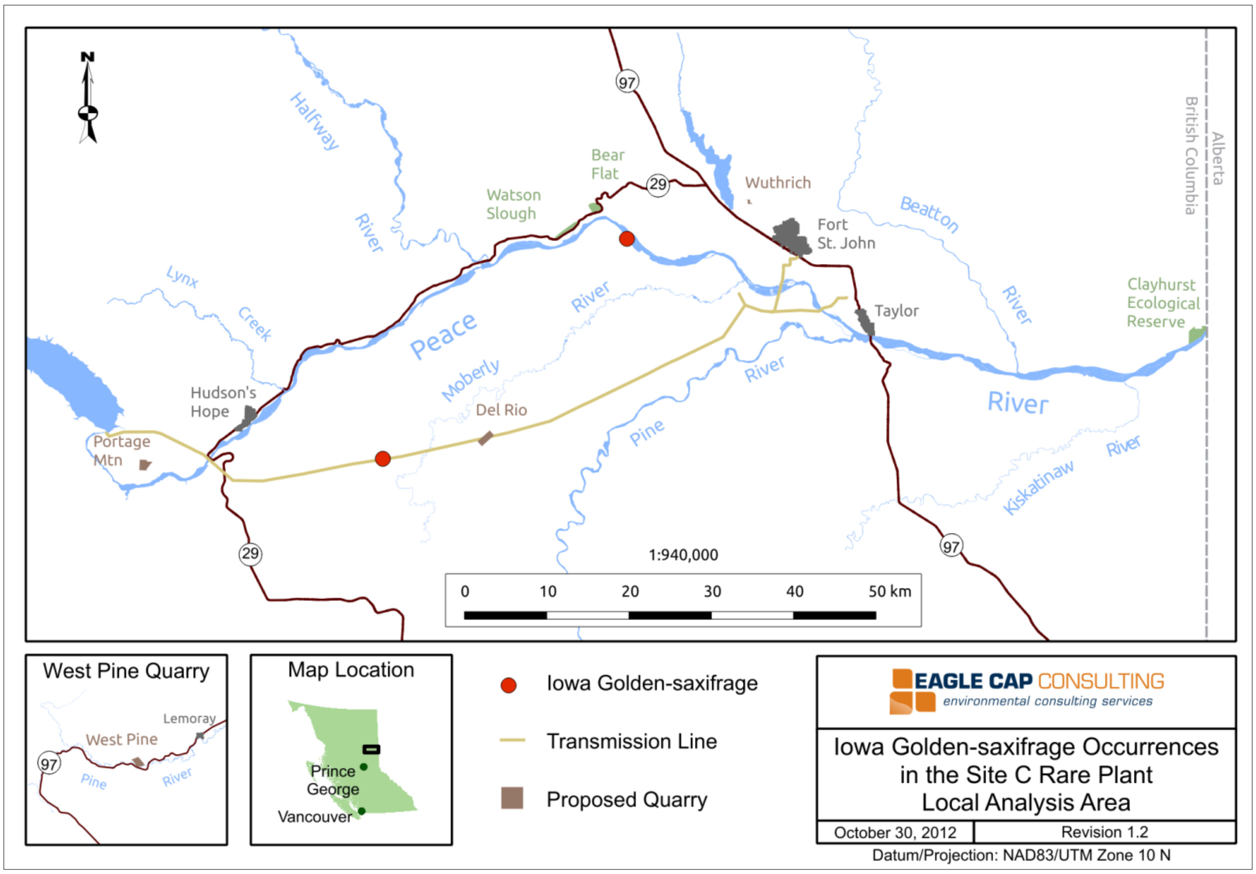
Iowa golden-saxifrage (**Photograph G.12.1**) is a delicate perennial herb in the Saxifragaceae (saxifrage family). The taxon grows in wet to moist montane environments, including bogs, marshes, seeps, stream banks, and wet meadows (Douglas et al. 2000; Freeman et al. 2002). In BC, Iowa golden-saxifrage is known from several scattered locations in the Rocky Mountains near the Alberta border: three sites south of Dawson Creek, one location in the Peace River area, and another near Golden (BC Conservation Data Centre 2012; Klinkenberg 2012). The species' range stretches north to the Northwest Territories and east to Manitoba, and disjunct populations occur in Southeast Minnesota and Northeast Iowa (Freeman et al. 2002; NatureServe 2011).

Photograph G.12.1 Iowa golden-saxifrage

Iowa golden-saxifrage is ranked S2S3 (Imperilled and Vulnerable) in BC, and is on the provincial Blue list (BC Conservation Data Centre 2012). The taxon's global rank is G3 (Vulnerable), and it is generally considered rare in all jurisdictions (S1 [Critically Imperilled] in

Saskatchewan, Manitoba, Minnesota); S2 [Imperilled] in Iowa; S3 [Vulnerable] in Alberta; and Not Ranked in the Northwest Territories) (NatureServe 2011).

Two occurrences of Iowa golden-saxifrage are reported for the Local Assessment Area (**Map G.12.1**). One of these locations was noted by Keystone Wildlife Research during ecosystem mapping of the project area in 2006. Site-specific rare plant surveys in 2008 discovered a second occurrence on the right bank of the Peace River, between Bear Flat and Wilder Creek. These plants were found growing on a gentle, shaded slope along a creek, in deciduous riparian forest (1–50 plants [Abundance Class A] in an estimated area of 10 square metres).



Map G.12.1 Iowa golden-saxifrage occurrences in the Local Assessment Area

G.12.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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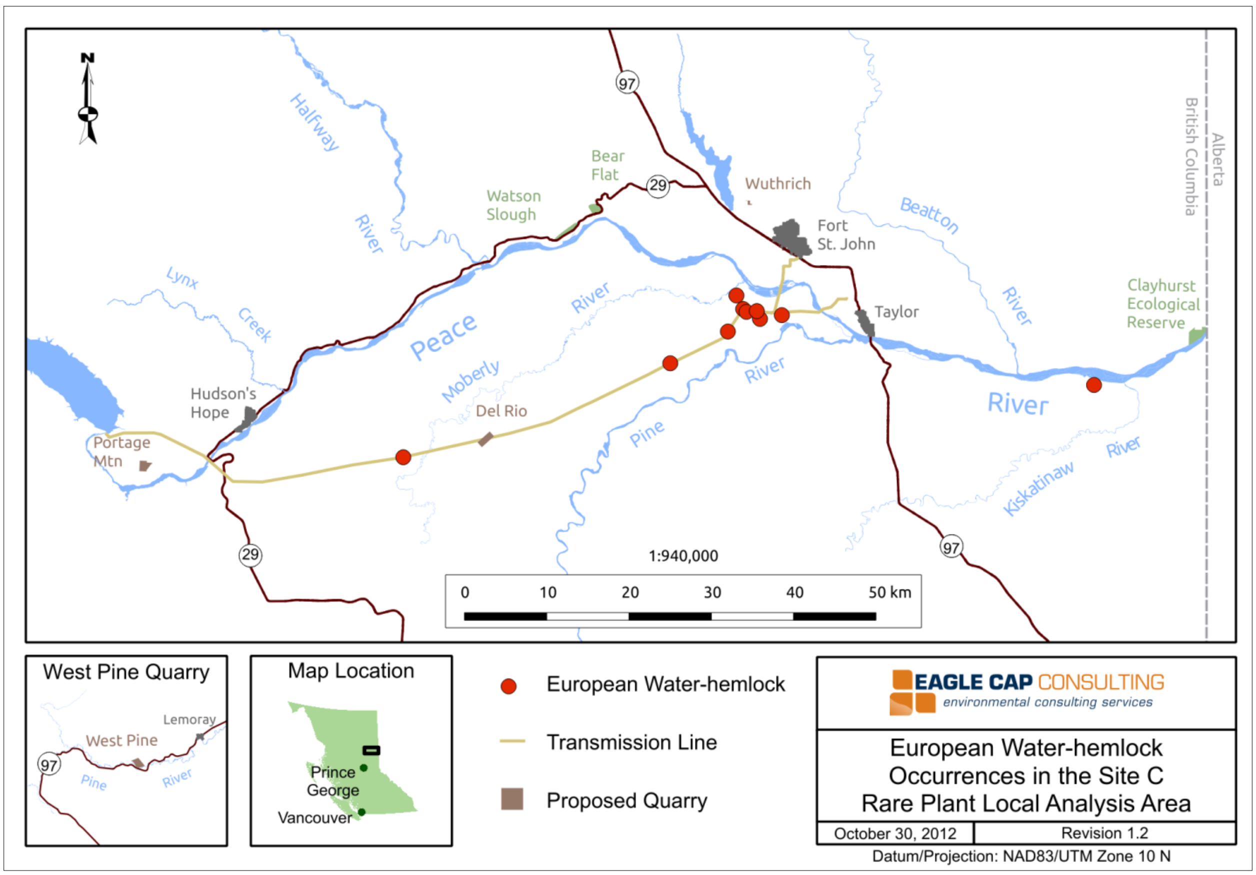
G.13 *Cicuta virosa* (European water-hemlock)

European water-hemlock (**Photograph G.13.1**)—a poisonous perennial herb of the Apiaceae (carrot family)—occurs in BC only in the montane northeast, where it is found along streams, around lakes and ponds, and in marshes and wet meadows (Moss and Packer 1983; Douglas et al. 1998; BC Conservation Data Centre 2012; Klinkenberg 2012). Globally, the taxon is found in most Canadian provinces and territories (excluding the maritime provinces), as well as in Alaska and throughout much of Eurasia (Moss and Packer 1983; US Department of Agriculture 2007; NatureServe 2011).

Photograph G.13.1 European water-hemlock

European water-hemlock is ranked S2S3 (Imperilled and Vulnerable) in BC and is on the Blue list for the province (BC Conservation Data Centre 2012). The species has a global rank of G4 (Apparently Secure), although Yukon, Alberta, and Québec rank European water-hemlock as S3 (Vulnerable) (NatureServe 2011).

Ten occurrences of European water-hemlock are reported for the Local Assessment Area (**Map G.13.1**). Site-specific rare plant surveys in 2008, 2011, and 2012 documented these locations south of the Peace River, particularly on the plateau between the Moberly and Pine rivers. The species was found scattered in sedge- and grass-dominated wetlands, often along quad tracks, and frequently within the existing transmission line right-of-way. Smaller occurrences contained 1–50 European water-hemlock plants (Abundance Class A) in areas estimated to be 10 to 500 square metres in size; larger sites contained 50–250 plants (Abundance Class B) over approximately 700 to 2,000 square metres. The most extensive occurrence consisted of 50–250 individuals (Abundance Class B) distributed across an area of roughly 10,000 square metres.



Map G.13.1 European water-hemlock occurrences in the Local Assessment Area

G.13.1 Literature Cited

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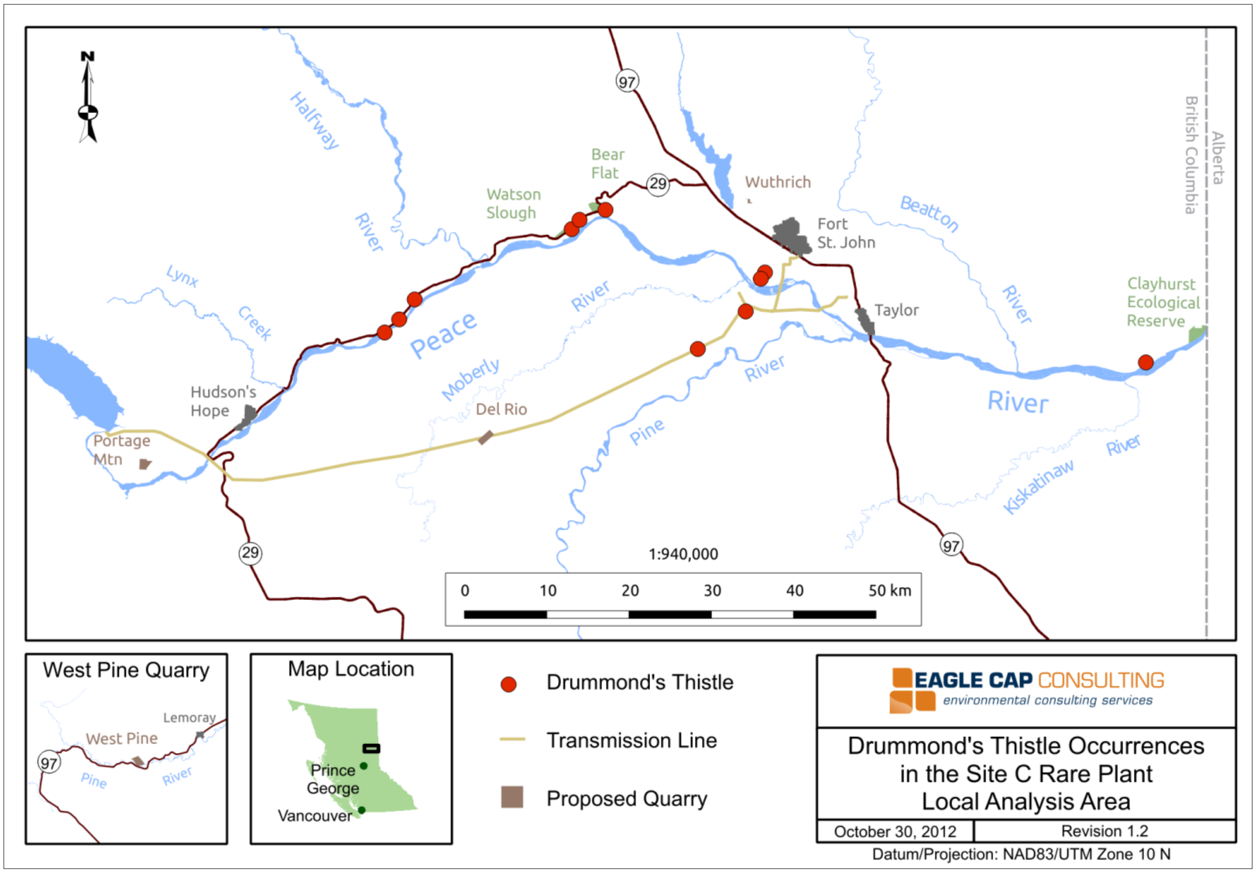
G.14 *Cirsium drummondii* (Drummond's thistle)

Drummond's thistle (**Photograph G.14.1**) is a stout biennial herb of the Asteraceae (sunflower family). The taxon grows in dry to moist soils of pastures, meadows, forest openings, prairies, and roadsides, in steppe and montane regions (Douglas et al. 1998; Keil 2006). In BC, Drummond's thistle is known only from the Peace River area (BC Conservation Data Centre 2012; Klinkenberg 2012). Its current global distribution extends into the Northwest Territories, across the prairie provinces to Ontario, and includes the US states of South Dakota and Wyoming. Historically the thistle has also been reported from Colorado, New Mexico, and Arizona (Keil 2006; NatureServe 2011).

Photograph G.14.1 Drummond's thistle

Drummond's thistle is ranked S2 (Imperilled) in BC and is on the provincial Red list (BC Conservation Data Centre 2012). The taxon is classed G5 (Secure) globally, although the thistle's sub-national rankings vary considerably: S1 (Critically Imperilled) in Ontario, S2 (Imperilled) in Wyoming, S3 (Vulnerable) in Saskatchewan, S4 (Apparently Secure) in Manitoba and South Dakota, and S5 (Secure) in Alberta (Keil 2006; NatureServe 2011).

Eleven occurrences of Drummond's thistle are reported for the Local Assessment Area (**Map G.14.1**). Two of these records date from an earlier general study in the vicinity (LGL Limited 2006), and one location was noted by Keystone Wildlife Research during 2006 ecosystem mapping. Site-specific rare plant surveys in 2008, 2011, and 2012 documented 8 additional occurrences of the taxon. These sites were discovered either within the Peace River corridor between Farrell Creek and Watson Slough, or on the plateaus above both the right and left banks of the Peace, near the Moberly and Pine River confluences. The Drummond's thistle plants were found growing in open areas with other herbs and scattered low shrubs, either within upland forest or along roadways near fence lines. In two cases, heavy grazing by cattle was evident; in one instance, the taxon was found in the existing cleared transmission line right-of-way. Occurrences tended to contain relatively low numbers of thistles and to cover relatively small areas of ground (one to 50 individuals [Abundance Class A] in areas approximately five to 100 square metres in size). The two largest sites consisted of approximately 150 and 100 individuals (Abundance Class B) scattered and clustered over approximately 1,100 square metres and 5,000 square metres, respectively.



Map G.14.1 Drummond's thistle occurrences in the Local Assessment Area

G.14.1 Literature Cited

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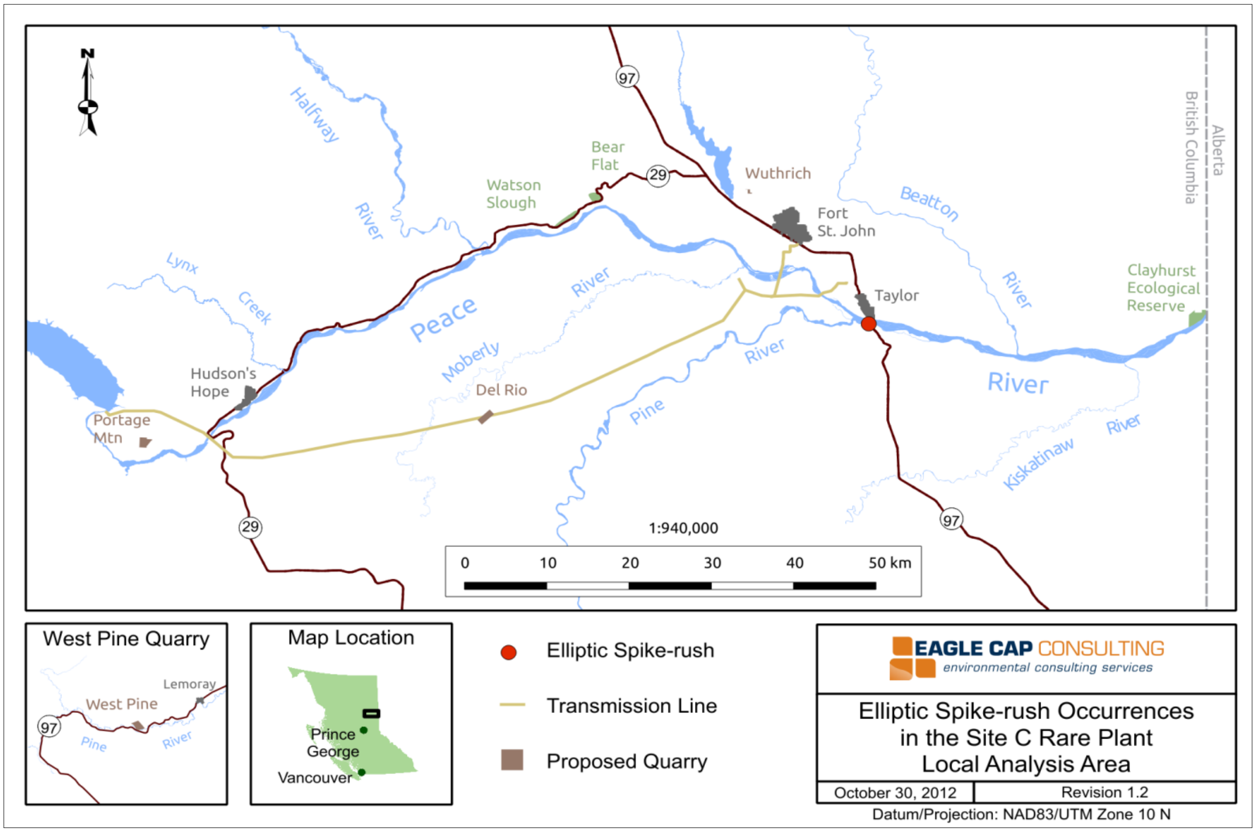
G.15 *Eleocharis elliptica* (elliptic spikerush)

Elliptic spikerush is a perennial with very small fruiting heads belonging to the Cyperaceae (sedge family). The taxon inhabits wet meadows and margins of lakes, pools, and streams in the steppe and montane zones (Douglas et al. 2001; Smith et al. 2002). The species is reported from numerous locations in southeast BC, and its range stretches north to the Northwest Territories, east to Newfoundland, and south into many northern and eastern US states (Smith et al. 2002; NatureServe 2011; BC Conservation Data Centre 2012; Klinkenberg 2012).

In BC, elliptic spikerush is listed as S2S3 (Imperilled and Vulnerable) and is on the provincial Blue list (BC Conservation Data Centre 2012). However, its global status is Secure (G5), and of the 33 remaining jurisdictions listed on the NatureServe website, only eight rank the taxon with any degree of rarity: S1 (Critically Imperilled) in Idaho and West Virginia; S2 (Imperilled) in Alberta, Saskatchewan, Québec, Pennsylvania, and New Jersey; and S3 (Vulnerable) in Illinois (NatureServe 2011).

Only one occurrence of elliptic spikerush is reported for the Local Assessment Area (**Map G.15.1**). The location was observed during an earlier general study in the vicinity (LGL Limited 2006).



Map G.15.1 Elliptic spike-rush occurrences in the Local Assessment Area

G.15.1 Literature Cited

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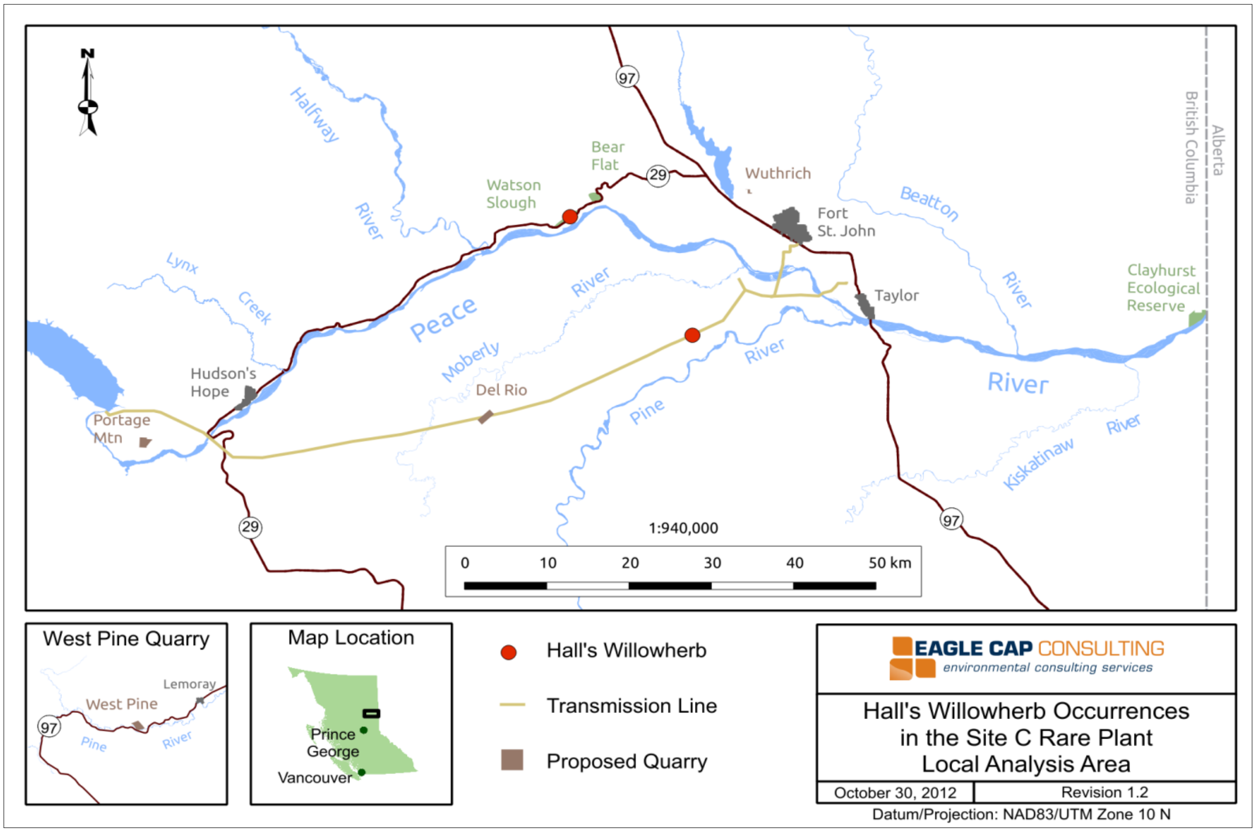
Volume 23: Magnoliophyta: Commelinidae (in Part): Cyperaceae. Oxford University Press, New York, NY. Pp. 4, 6, 7, 29, 60, 61, 121.

G.16 *Epilobium halleanum* (Hall's willowherb)

Hall's willowherb is a short, erect perennial in the Onagraceae (evening-primrose family). The species is found in various montane habitats such as open forests, wet meadows, and bogs (Cronquist et al. 1997; Douglas et al. 1999). It has been collected at one location in NW BC, and in numerous sites in the central and southern parts of the province. Globally, the taxon extends east to Saskatchewan and south through all of the western US states; is also reported from both South Dakota and Oklahoma (NatureServe 2011; BC Conservation Data Centre 2012; Klinkenberg 2012).

Hall's willowherb has a rank of S2S3 (Imperilled and Vulnerable) in BC, and is on the Blue list for the province (BC Conservation Data Centre 2012). The species is classified as G5 (Secure) globally, and only two other jurisdictions rank it as rare (S1 [Critically Imperilled] in Alberta and Oklahoma) (NatureServe 2011).

Two occurrences of Hall's willowherb are reported for the Local Assessment Area (**Map G.16.1**). Site-specific rare plant surveys in 2008 first discovered the taxon at Watson Slough, where an estimated 50–250 individuals (Abundance Class B) were found growing on mats of *Sphagnum* and other mosses in a small area of open muskeg forest (area estimated at 10 square metres). A second occurrence was located in a wet hollow adjoining a marsh, where 1–50 plants (Abundance Class A) were observed in a one-metre-square site in an aspen grove.



Map G.16.1 Hall's willowherb occurrences in the Local Assessment Area

G.16.1 Literature Cited

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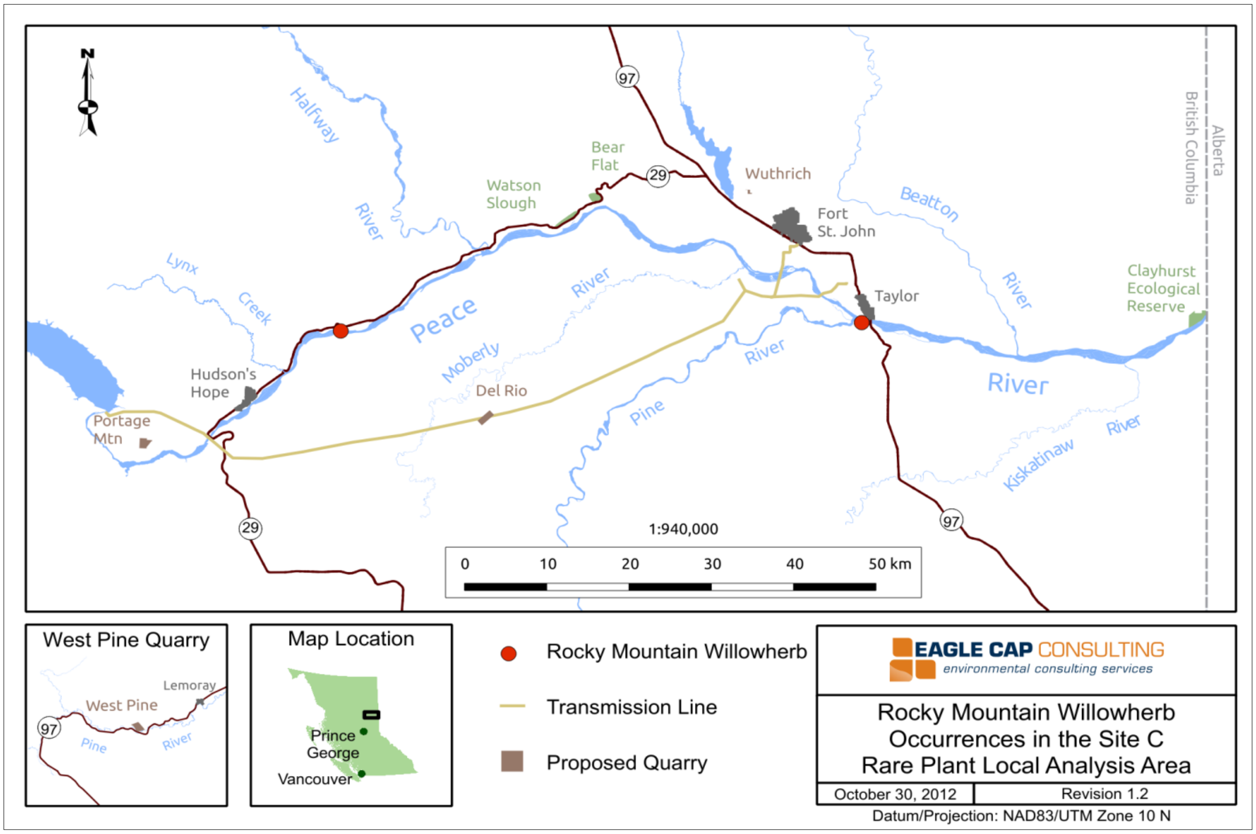
G.17 *Epilobium saximontanum* (Rocky Mountain willowherb)

Rocky Mountain willowherb is a small perennial in the Onagraceae (evening-primrose family) that grows in moist meadows and along stream banks in the mountains, occasionally occurring in disturbed areas, or habitats that dry out in late summer or fall (Cronquist et al. 1997; Douglas et al. 1999). In BC, the species is documented from two locations in the extreme southeast, near Crowsnest Pass. The taxon ranges from the Jasper area of the Alberta Rocky Mountains south throughout the western US as far east as South Dakota, Colorado, and New Mexico. Disjunct eastern populations are known from Ontario, Québec, and Newfoundland (Cronquist et al. 1997; NatureServe 2011; BC Conservation Data Centre 2012; Klinkenberg 2012).

Rocky Mountain willowherb is classed S1S3 (Critically Imperilled to Vulnerable) in BC, and is on the provincial Red list (BC Conservation Data Centre 2012). The taxon's global ranking is G5 (Secure); sub-nationally it is considered Critically Imperilled (S1) in Alberta and Newfoundland, and Vulnerable (S3) in Wyoming (NatureServe 2011).

Two occurrences of Rocky Mountain willowherb are reported for the Local Assessment Area (**Map G.17.1**). Both sites were located during an earlier general study in the vicinity (LGL Limited 2006).



Map G.17.1 Rocky Mountain willowherb occurrences in the Local Assessment Area

G.17.1 Literature Cited

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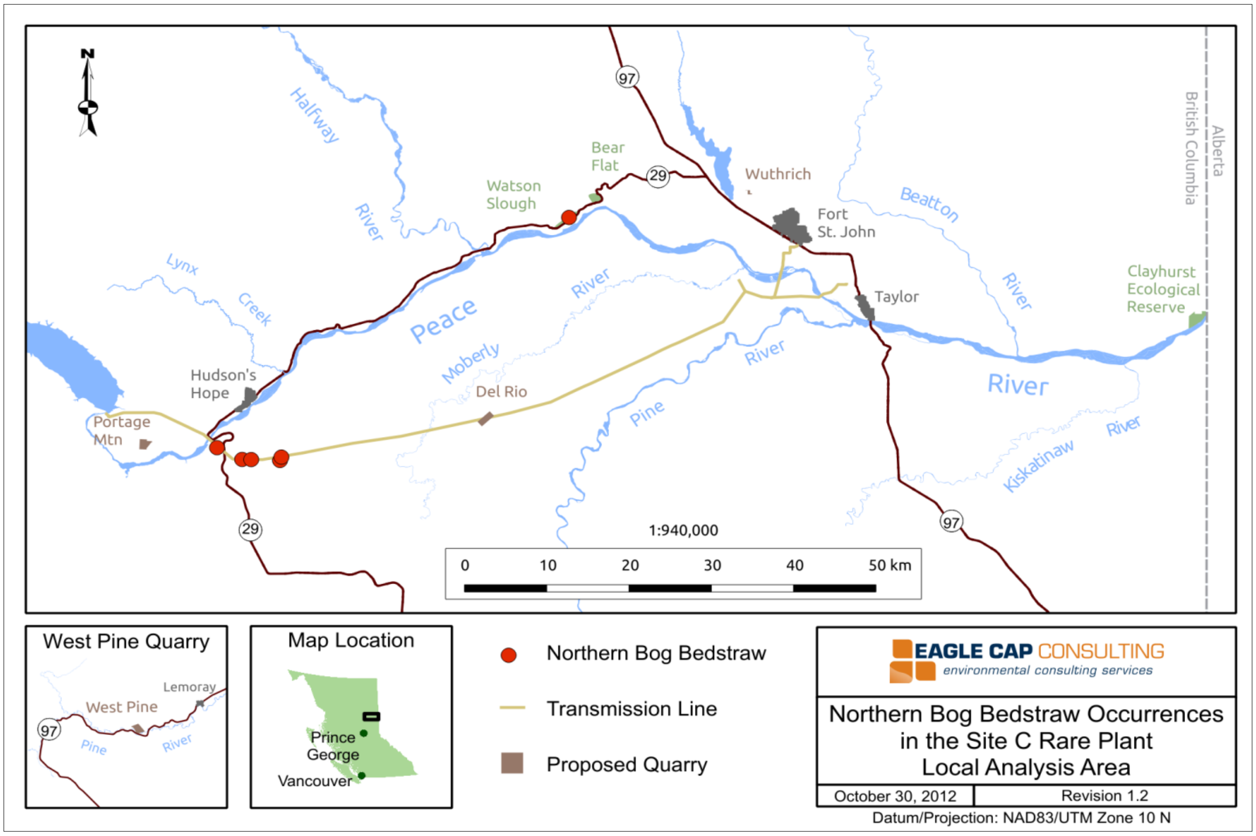
G.18 *Galium labradoricum* (northern bog bedstraw)

Northern bog bedstraw—a creeping perennial herb in the Rubiaceae (madder family)—is found growing in bogs, wet meadows, and moist woods in the montane zone (Moss and Packer 1983; Douglas et al. 1999). In BC the species is located primarily in the northeast section of the province, with one occurrence also reported from near Salmon Arm (BC Conservation Data Centre 2012; Klinkenberg 2012). Globally, northern bog bedstraw occurs in all Canadian provinces and territories except Yukon, and extends south into the US as far as North Dakota, Iowa, Illinois, and across the Midwest to New Jersey (Moss and Packer 1983; NatureServe 2011).

Northern bog bedstraw is an S3 (Vulnerable) species in BC, and is on the provincial Blue list (BC Conservation Data Centre 2012). The species is ranked G5 (Secure) globally, although along the southern edge of its range many jurisdictions indicate some degree of rarity for the taxon: S3 (Vulnerable) in Alberta and North Dakota; S2 (Imperilled) in Illinois, Massachusetts, Maine, New Brunswick and Nova Scotia; and S1 (Critically Imperilled) in Iowa, Ohio, Pennsylvania, New Jersey, Connecticut, Vermont, and Prince Edward Island (NatureServe 2011).

Six total occurrences of northern bog bedstraw are reported for the Local Assessment Area (**Map G.18.1**). Four of these locations were noted by Keystone Wildlife Research during ecosystem mapping of the project area in 2006. Site-specific rare plant surveys in 2008 and 2011 identified two additional northern bog bedstraw occurrences, each with 250–1000 plants (Abundance Class C), and covering an estimated 50,000 square metres and 5,000 square metres, respectively. The sites are approximately one half kilometre apart, in and near the cleared transmission line right-of-way between Maurice Creek and Highway 29. The bedstraw plants were growing with other herbs and sphagnum moss in shrubby, cleared muskeg and adjacent forested bog habitat. In 2011, the right-of-way appeared to have been recently mowed.



Map G.18.1 Northern bog bedstraw occurrences in the Local Assessment Area

G.18.1 Literature Cited

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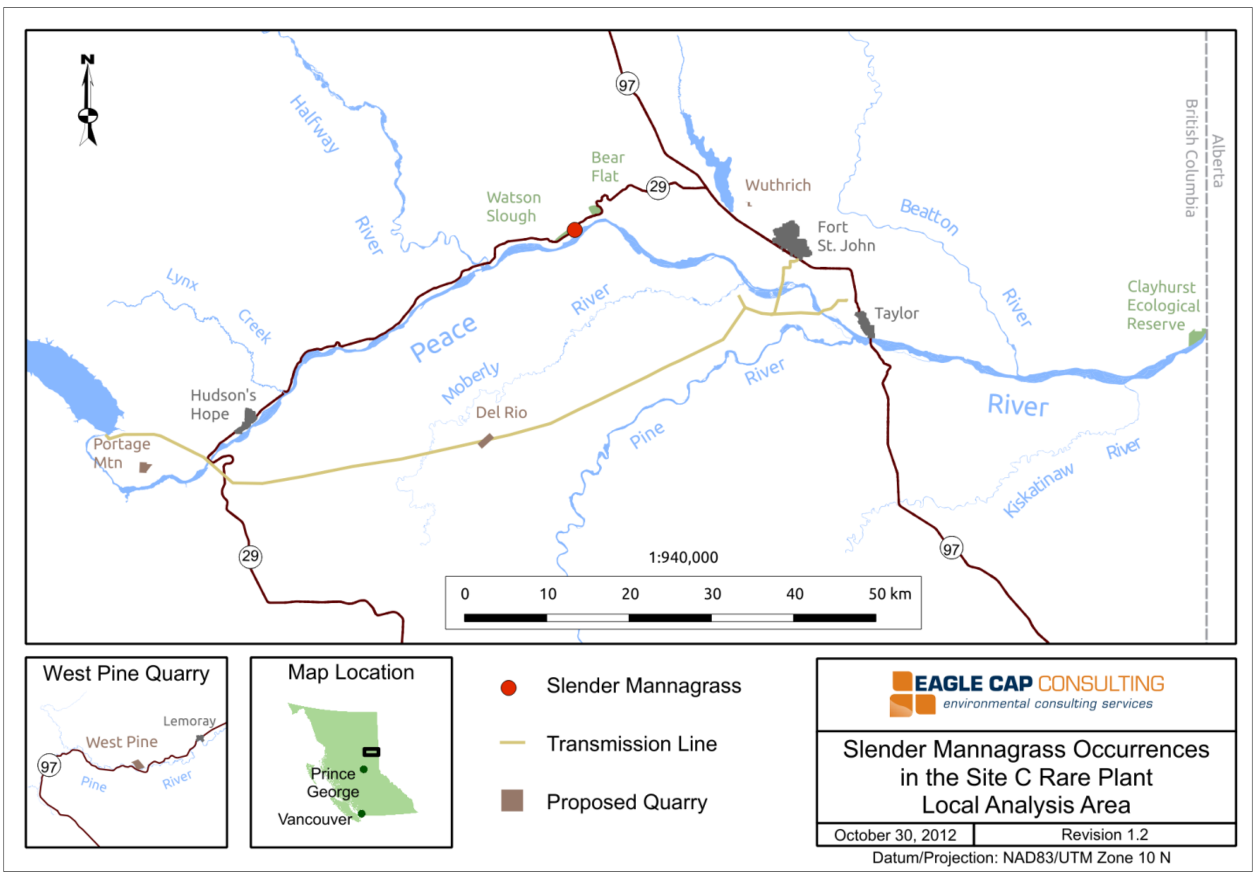
G.19 *Glyceria pulchella* (slender mannagrass)

Slender mannagrass is a rhizomatous perennial of the Poaceae (grass family). The species is found in wet montane areas, including marshes, bogs, ditches, stream banks, and shores of ponds and lakes (Douglas et al. 2001; Barkworth and Anderton 2007). The taxon has been collected in scattered locations across the eastern and northern parts of BC. Its global distribution continues east as far as Manitoba, and north into the Northwest Territories, Yukon, and Alaska (Barkworth and Anderton 2007; NatureServe 2011; BC Conservation Data Centre 2012; Klinkenberg 2012)

Slender mannagrass has a rank of S2S3 (Imperilled and Vulnerable) in BC, and is on the Blue list for the province (BC Conservation Data Centre 2012). The species' global rank is G5 (Secure); however, sub-nationally it is listed as S2 (Imperilled) in Manitoba and Alaska, and S3 (Vulnerable) in Alberta and Yukon Territory (NatureServe 2011).

One occurrence of slender mannagrass is reported for the Local Assessment Area (**Map G.19.1**). This location dates from an earlier study in the vicinity (BC Conservation Data Centre 2012).



Map G.19.1 Slender mannagrass occurrences in the Local Assessment Area

G.19.1 Literature Cited

Barkworth, M.E. and L.K. Anderton. 2007. *Glyceria*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico. Volume 24, Magnoliophyta: Commelinidae (in part): Poaceae, part 1*. Oxford University Press, New York, NY. Pp. 68–88.

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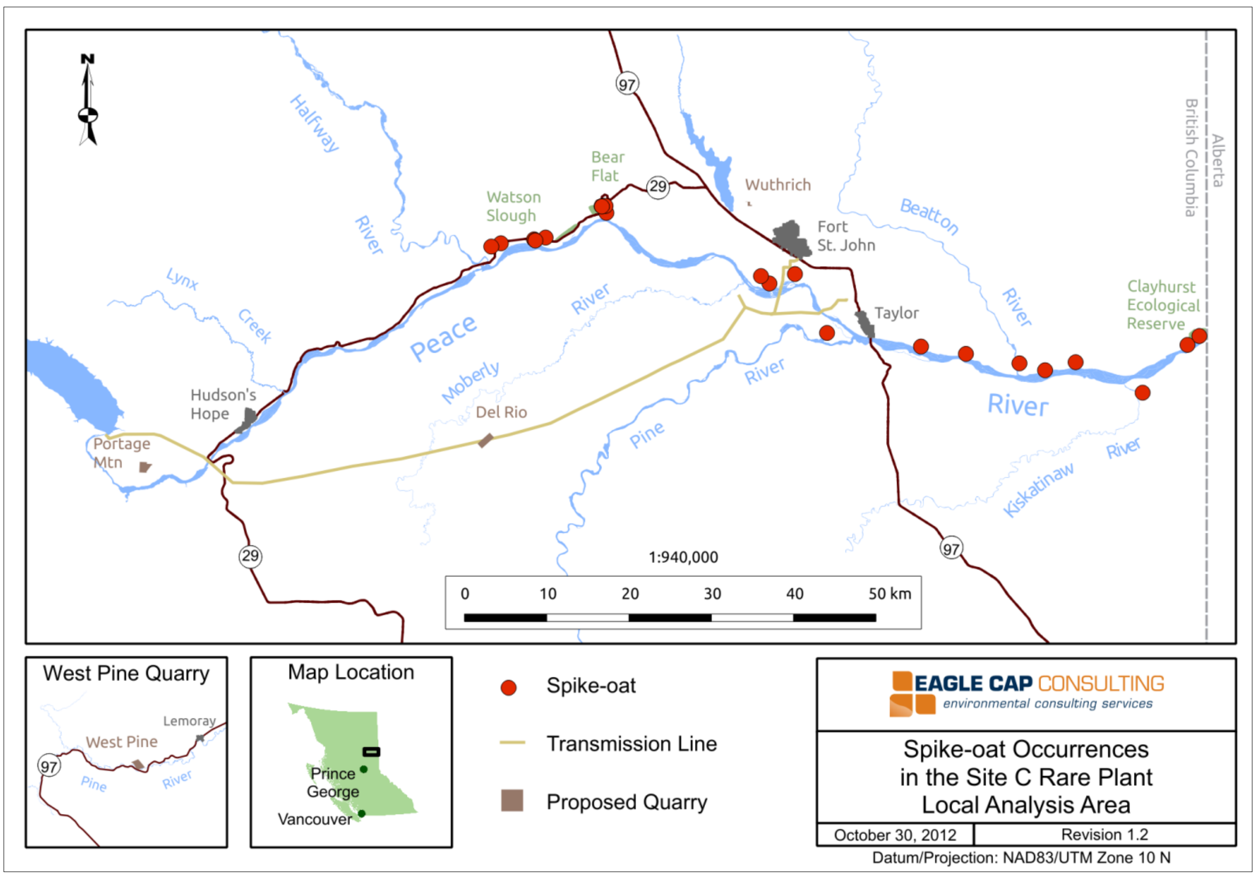
G.20 *Helictotrichon hookeri* (spike-oat)

Spike-oat (**Photograph G.20.1**), a bristly-headed perennial grass, inhabits mesic to dry open slopes, meadows, and forest clearings, in the montane and subalpine zones (Tucker 2007; Douglas et al. 2001). In BC, the species is found primarily in the Peace River area, but is also known from collections on the Queen Charlotte Islands and near Fort Nelson (BC Conservation Data Centre 2012b). The native distribution of spike-oat extends north into Yukon and the Northwest Territories, east to Manitoba, and south in the US through parts of Minnesota, South Dakota, Montana, Wyoming, Colorado, and New Mexico. The taxon is also found across much of Asia (Wu and Phillips 2006; Tucker 2007; NatureServe 2011). In addition, spike-oat is reported as an introduced species in Vermont and Québec (Magee and Ahles 2007; NatureServe 2011).

Photograph G.20.1 Spike oat

Spike-oat is ranked S2S3 (Imperilled and Vulnerable) by the BC Conservation Data Centre, and is on the province's Blue list (BC Conservation Data Centre 2012b). NatureServe ranks spike-oat G5 (Secure) globally—although in Wyoming the species is ranked S1 (Critically Imperilled), in Yukon S2 (Imperilled), and Minnesota S3 (Vulnerable) (NatureServe 2011).

Twenty-three occurrences of spike-oat are reported for the Local Assessment Area (**Map G.20.1**). Fourteen of these records date from earlier general studies in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a), and four were noted by Keystone Wildlife Research during 2006 ecosystem mapping. Site-specific rare plant surveys in 2008, 2011, and 2012 documented 5 additional occurrences of spike-oat, located in the Peace River corridor between the Halfway and Beatton Rivers. Four sites were discovered on steep, dry hillsides on the left bank of the Peace River. In these locations spike-oat was observed growing in openings of grassland, which were closely surrounded by low shrubs and mixed upland forest. The four occurrences contained from a few to several hundred spike-oat plants (Abundance Classes A, B, or C), and ranged in estimated area from 10 to 300 square metres.



Map G.20.1 Spike-oat occurrences in the Local Assessment Area

A fifth spike-oat occurrence was identified on a flat, dry bench on the right bank of the Peace River, near the confluence with the Pine River. Although the area was crossed with various road tracks, the habitat was found to be dominated by native grasses. An estimated 1,000 spike-oat individuals (Abundance Class C) were distributed over approximately 1,000 square metres.

G.20.1 Literature Cited

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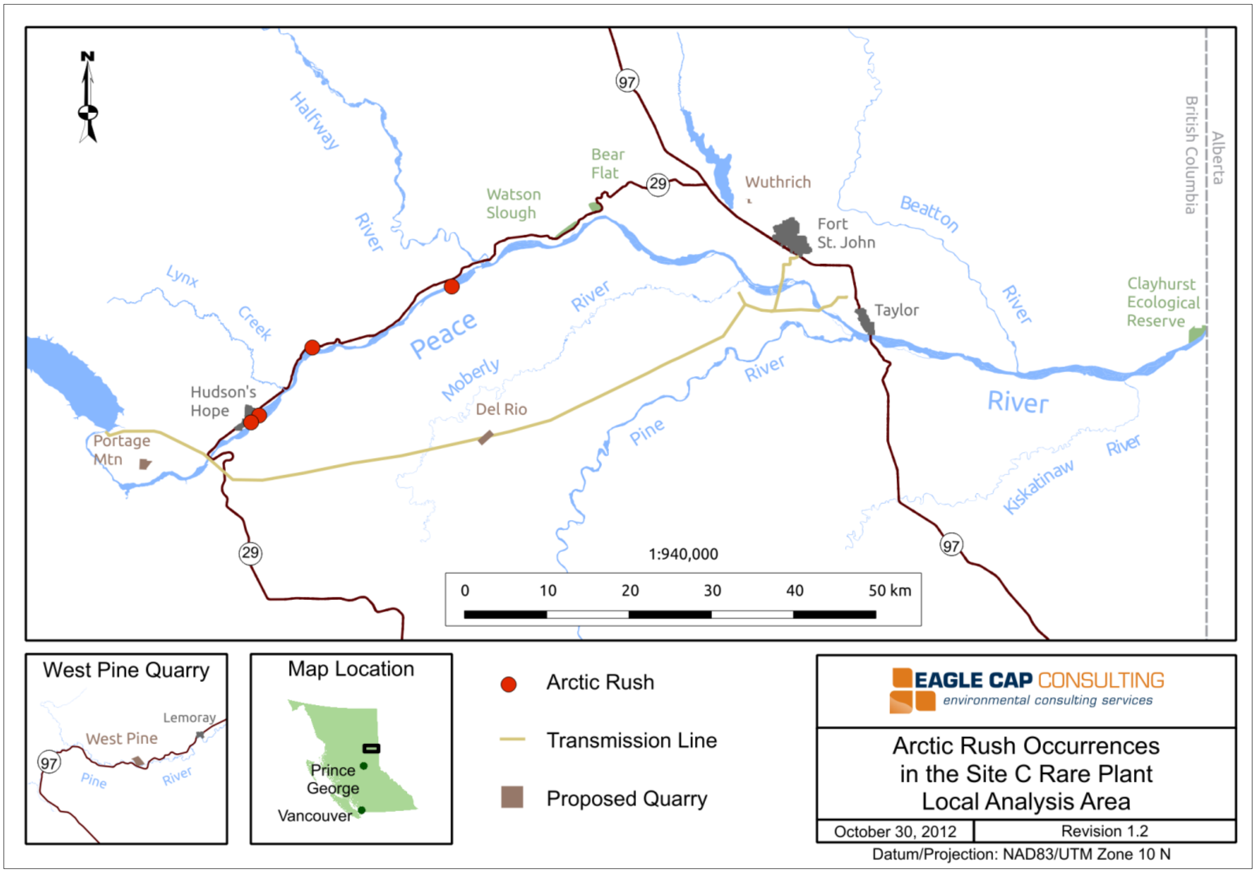
Wu, Z. and S.M. Phillips. 2006. *Helictotrichon*. *Flora of China* (22):317–322.

G.21 ***Juncus arcticus*** **ssp.** ***alaskanus*** **(arctic rush)**

Arctic rush is a wiry-stemmed perennial of the Juncaceae (rush family). The species grows in moist to dry meadows, along streams, and around lakes, from the lowlands into the mountains (Brooks and Clemants 2000; Douglas et al. 2001). The taxon occurs in northern BC and in scattered locations further south in the province (BC Conservation Data Centre 2012; Klinkenberg 2012). Arctic rush's global range stretches north into Alaska, Yukon, the Northwest Territories and Nunavut, and south into Manitoba and Ontario (NatureServe 2011).

Arctic rush is ranked S2S3 (Imperilled and Vulnerable) in BC and is on the provincial Blue list (BC Conservation Data Centre 2012). Globally, the taxon is ranked T4 (Apparently Secure) and is not considered rare in any of the other jurisdictions in which it occurs (NatureServe 2011).

Four total occurrences of arctic rush are reported for the Local Assessment Area (**Map G.21.1**). Site-specific rare plant surveys in 2008 and 2011 documented the locations along the banks of the Peace River, between Hudson's Hope and the confluence of the Halfway River. The rush was found growing with other herbs and scattered shrubby willows, generally on the cobbly river shoreline, but also along a small, spring-fed creek. All four occurrences consisted of low numbers of plants (1–50, Abundance Class A), covering estimated areas ranging in size from 1–100 square metres.



Map G.21.1 Arctic rush occurrences in the Local Assessment Area

G.21.1 Literature Cited

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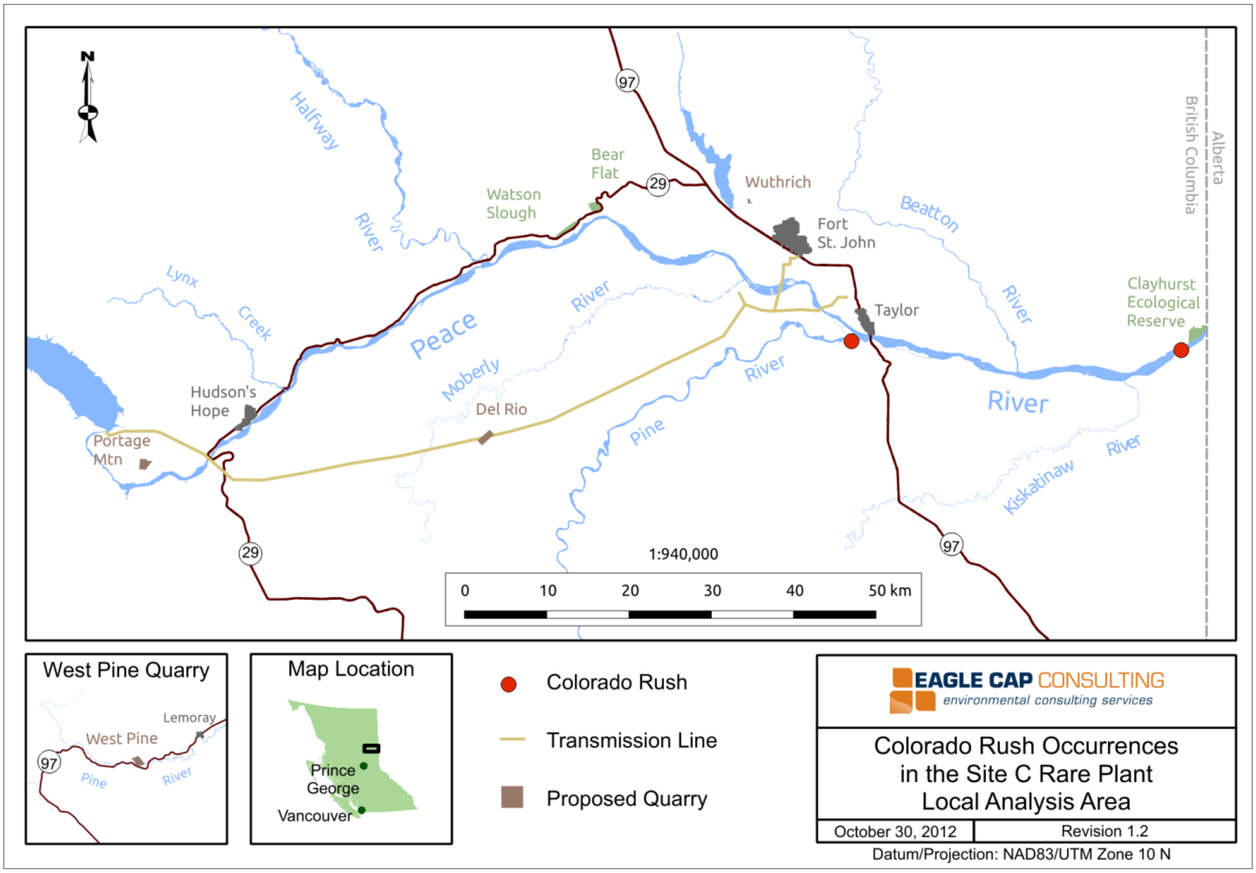
G.22 ***Juncus confusus* (Colorado rush)**

Colorado rush is a tufted perennial in the Juncaceae (rush family), found in various moist steppe and montane habitats such as open grasslands, meadows, stream banks, and woods (Brooks and Clemants 2000; Cronquist et al. 1977; Douglas et al. 2001). In BC, the species is known from occasional collections across the south-central and southern border areas (BC Conservation Data Centre 2012; Klinkenberg 2012). The rush has also been reported from a few locations in Alberta and Saskatchewan, but is more commonly found across the western US states, as far south as northern Arizona and New Mexico, and as far east as Colorado and South Dakota (Brooks and Clemants 2000; NatureServe 2011).

Colorado rush is considered Critically Imperilled (S1) in BC, and is on the Red list for the province (BC Conservation Data Centre 2012). The taxon's global status is G5 (Secure) based on its large US distribution, but the species is ranked as S2 (Imperilled) in Saskatchewan, and S3 (Vulnerable) in Alberta (NatureServe 2011).

Two occurrences of Colorado rush are reported for the Local Assessment Area (**Map G.22.1**). Both locations date from an earlier study in the vicinity (LGL Limited 2006).



Map G.22.1 Colorado rush occurrences in the Local Assessment Area

G.22.1 Literature Cited

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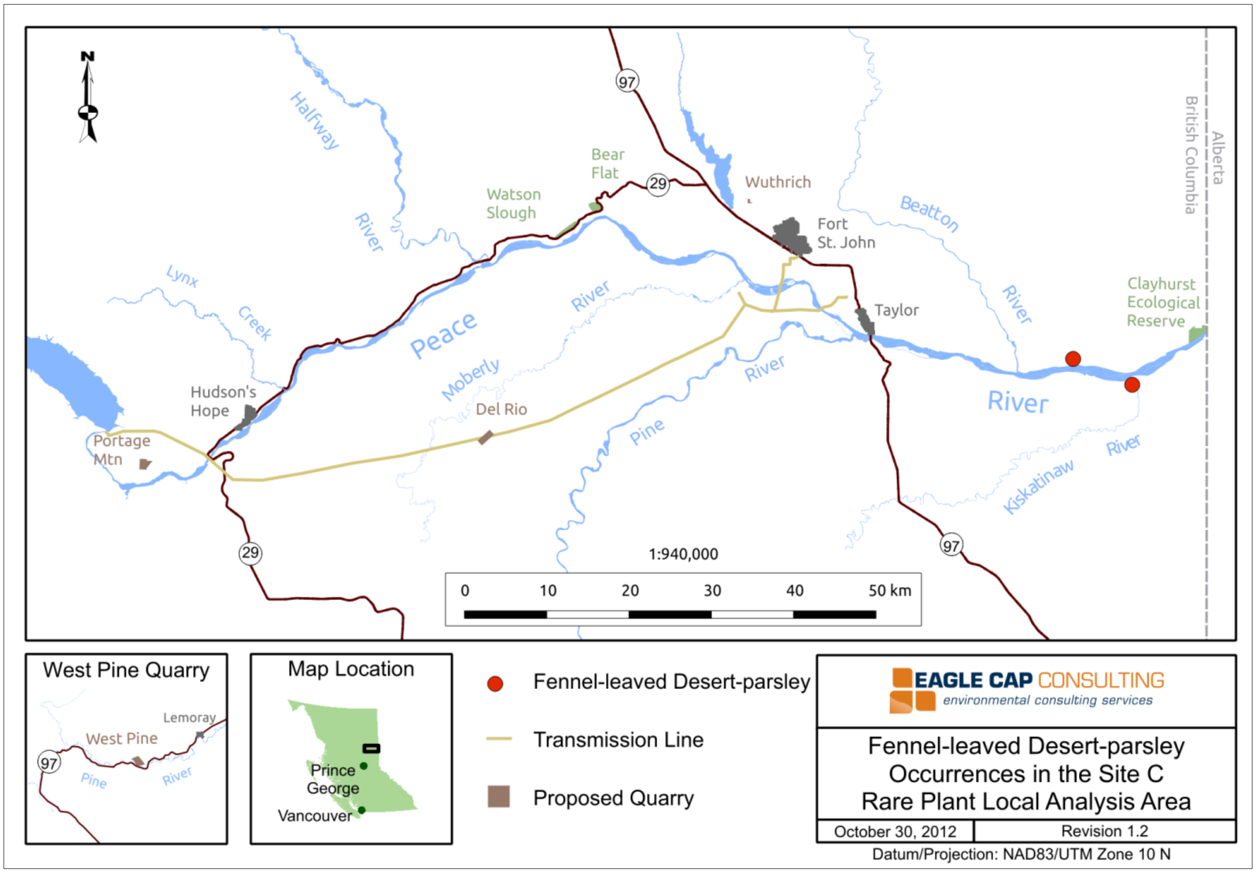
G.23 ***Lomatium foeniculaceum*** **var.** ***foeniculaceum*** **(fennel-leaved desert-parsley)**

Fennel-leaved desert-parsley is a yellow-flowered perennial of the Apiaceae (carrot family). It grows on dry slopes, prairies, and grassland, in steppe and montane regions (Hitchcock and Cronquist 1973; Moss and Packer 1983; Douglas et al. 1998). In BC the taxon is known from two occurrences in the Peace River area only (BC Conservation Data Centre 2012b; Klinkenberg 2012). Its global distribution continues east as far as Manitoba, and south through the central US into Texas (NatureServe 2011).

Fennel-leaved desert-parsley has a rank of S1 (Critically Imperilled) in BC, and is on the Red list for the province (BC Conservation Data Centre 2012b). The taxon's global rank is G5T5 (Secure). Only three other subnational jurisdictions report a rare status for the species or variety (Iowa S1 [Critically Imperilled]; Missouri S2 [Imperilled]; Manitoba S3 [Vulnerable]) (NatureServe 2011).

A single occurrence of fennel-leaved desert-parsley is reported for the Local Assessment Area (**Map G.23.1**). This location dates from an earlier study in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a).



Map G.23.1 Fennel-leaved desert-parsley occurrences in the Local Assessment Area

G.23.1 Literature Cited

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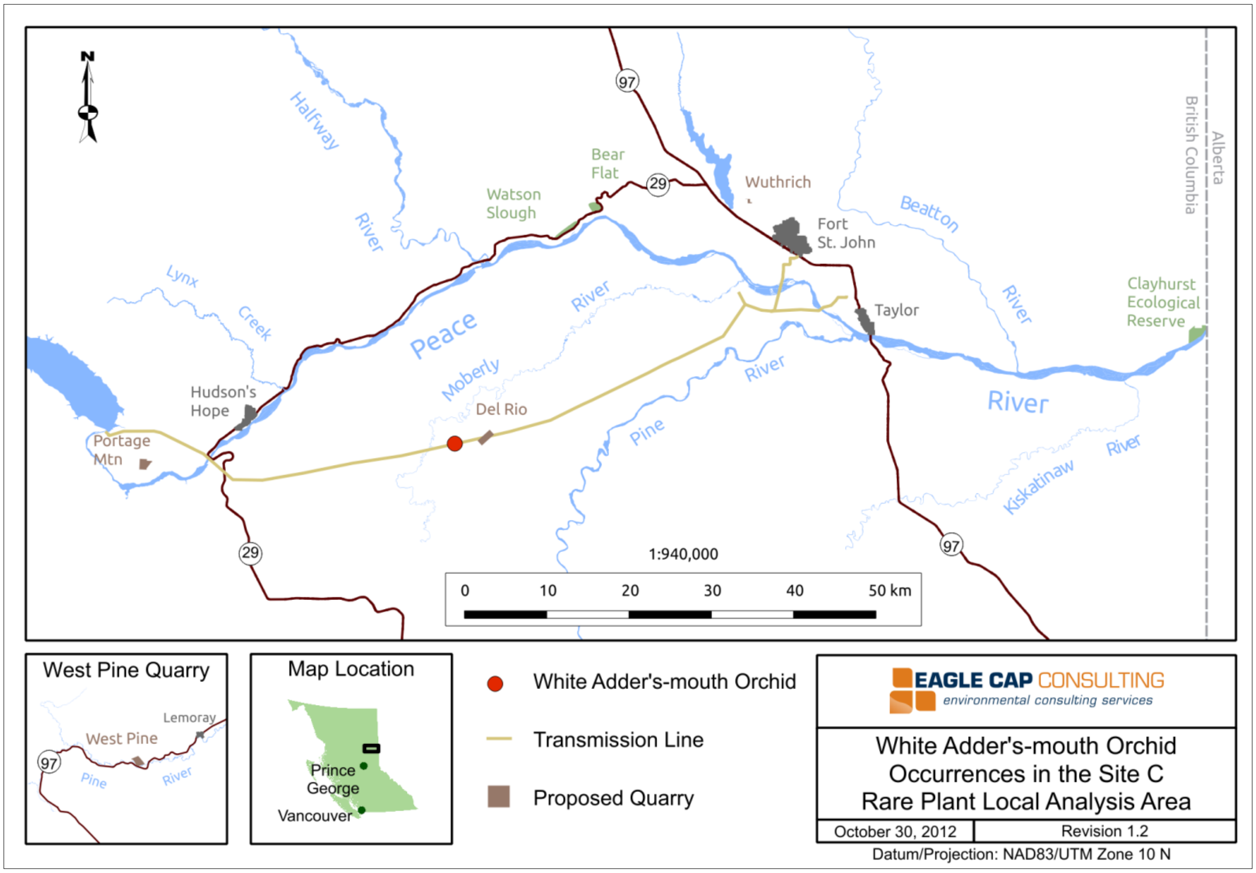
NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

G.24 *Malaxis brachypoda* (white adder's-mouth orchid)

White adder's-mouth orchid is a diminutive perennial in the Orchidaceae (orchid family). The taxon can be found along stream banks, on mud flats, and in bogs, fens, and moist forests, from the lowland to montane zones (Catling and Magrath 2000; Douglas et al. 2001). The species is distributed sporadically in BC, with population clusters in the southwest, central, and northeast parts of the province (BC Conservation Data Centre 2012; Klinkenberg 2012). The orchid's global range extends from south-coastal Alaska and extreme southern Yukon Territory across much of central and southern Canada to Newfoundland, and south into many mid-western and northeastern US states. Disjunct populations are also reported from California, Colorado, Texas, and Tennessee (Catling and Magrath 2000; NatureServe 2011).

White adder's-mouth orchid is ranked S2S3 (Imperilled and Vulnerable) in BC, and is on the province's Blue list (BC Conservation Data Centre 2012). The species' global status is Apparently Secure, but with a need for further inventory and review (G4Q) (NatureServe 2011). Of the sub-national jurisdictions that track the orchid's abundance, only Ontario and New York class the taxon as secure–otherwise its rank ranges from S3 (Vulnerable) to SH (Possibly Extirpated) (NatureServe 2011).

Only one occurrence of white adder's-mouth orchid is reported for the Local Assessment Area (**Map G.24.1**). Site-specific rare plant survey work in 2008 discovered the taxon on the plateau south of the Peace River, between the Moberly and Pine Rivers. The occurrence was located in the existing transmission line right-of-way east of Boucher Lake. Three plants were found growing in an estimated 10 square metres area, on a mossy flat in black spruce-balsam poplar forest.



Map G.24.1 White adder's-mouth orchid occurrences in the Local Assessment Area

G.24.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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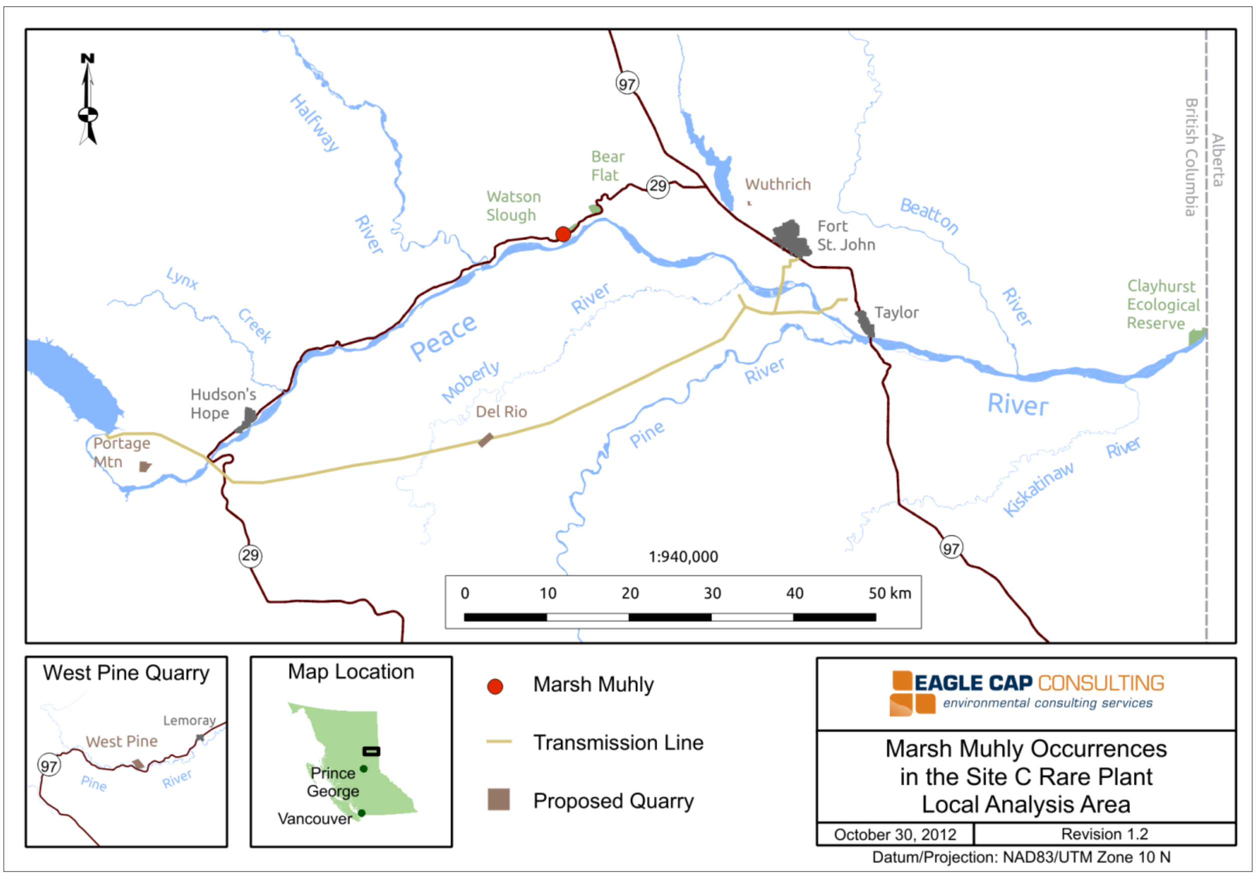
G.25 *Muhlenbergia glomerata* (marsh muhly)

Marsh muhly (**Photograph G.25.1**) is a perennial grass with reddish-purple flowering heads. It inhabits moist to wet lowland, steppe, or montane habitats, including bogs, fens, meadows, marshes, banks of streams and irrigation ditches, and margins of lakes and hot springs (Peterson 2003; Douglas et al. 2001). The species has been collected in northeastern BC, as well as numerous locations across the southern part of the province (BC Conservation Data Centre 2012; Klinkenberg 2012). Marsh muhly is distributed north into Yukon and the Northwest Territories, south to Nevada, and east across Canada and the northern US to the Atlantic coast, from Newfoundland to North Carolina (Peterson 2003; NatureServe 2011).

Photograph G.25.1 Marsh muhly

In BC, marsh muhly has a rank of S3 (Vulnerable), and is on the provincial Blue list. Because of its widespread distribution, marsh muhly has a global ranking of G5 (Secure) (NatureServe 2011). Sub-national ranking of the grass varies: the taxon has rare status in Yukon Territory and Prince Edward Island (S1 [Critically Imperilled]) but otherwise is considered Apparently Secure or Secure in Canada (S4 or S5) (NatureServe 2011; BC Conservation Data Centre 2012). Marsh muhly is generally not ranked sub-nationally in the US, except for some jurisdictions along the margin of its range that class the species as rare or possibly extirpated (NatureServe 2011).

A single occurrence of marsh muhly is reported for the Local Assessment Area (**Map G.25.1**). Site-specific rare plant surveys in 2008 located the species in the Peace River corridor at Watson Slough. The marsh muhly plants were found growing on tussocks in a fen, at the west end of the slough (250–1000 plants [Abundance Class C] in an area of approximately 10 square metres).



Map G.25.1 Marsh muhly occurrences in the Local Assessment Area

G.25.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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G.26 ***Oxytropis campestris* var. *davisii* (Davis' locoweed)**

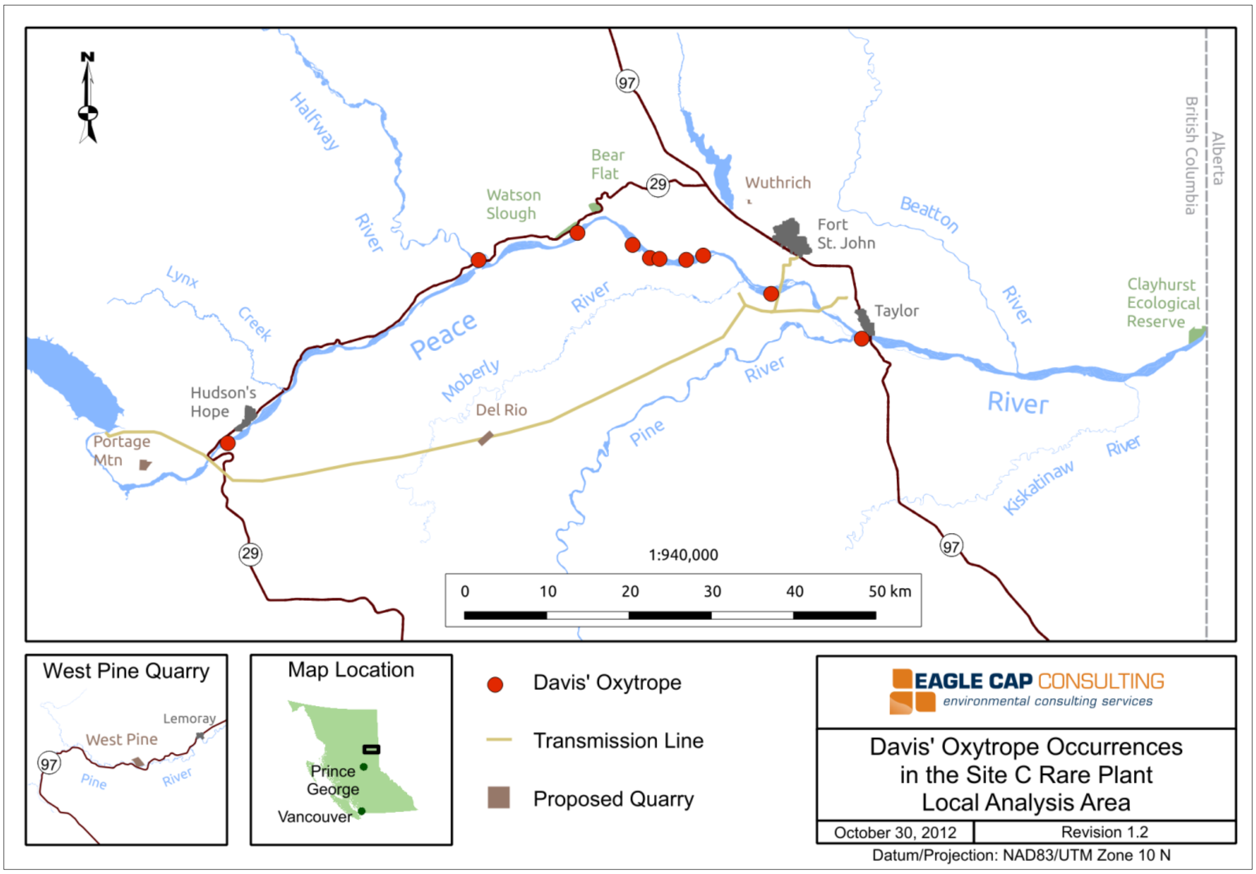
Davis' locoweed, also known as Davis' oxytrope Photograph **G.26.1**), is a small perennial in the Fabaceae (pea family) that grows on stream gravels and in mesic to dry meadows and forest openings in the montane zone (Welsh 1991; Douglas et al. 1999). Variety *davisii* is restricted to northeast BC and adjacent Alberta and the Northwest Territories, where it can be locally abundant (Welsh 1991; NatureServe 2011; BC Conservation Data Centre 2012).

Photograph G.26.1 Davis' locoweed

Davis' locoweed is classed S3 (Vulnerable) by the CDC, and is on the provincial blue-list (BC Conservation Data Centre 2012). Globally, the variety is also ranked as Vulnerable (T3), due to its limited range. Alberta lists Davis' locoweed as rare (S2 [Imperilled]); the Northwest Territories has not yet ranked the taxon (NatureServe 2011).

Ten occurrences of Davis' locoweed are reported for the Local Assessment Area (**Map G.26.1**). One of these records dates from an earlier study in the vicinity (LGL Limited 2006). Site-specific rare plant surveys in 2008 and 2011 documented an additional 9 occurrences, located in the

Peace River corridor between the Peace Canyon dam and the confluence of the Pine River. Davis' locoweed was found on islands, cobble bars, and shoreline in the active channel of the river, where the taxon was most often observed growing with other herbs in early-seral balsam poplar communities. Eight of the occurrences were small, ranging in estimated size from 10 to 500 square metres, and with 1–50 plants (Abundance Class A). One large site contained 250–1,000 individuals (Abundance Class C) scattered over an area of roughly 30,000 square metres. Davis' locoweed was frequently found growing with other closely related oxytropes and often had morphological characteristics that intergraded between these taxa.



Map G.26.1 Davis' locoweed occurrences in the Local Assessment Area

G.26.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

Douglas, G.W., D. Meldinger and J. Pojar (eds). 1999. *Illustrated Flora of British Columbia. Volume 3: Dicotyledons (Diapensiaceae Through Onagraceae)*. BC Ministry of Environment, Lands, and Parks and BC Ministry of Forests, Victoria, BC.

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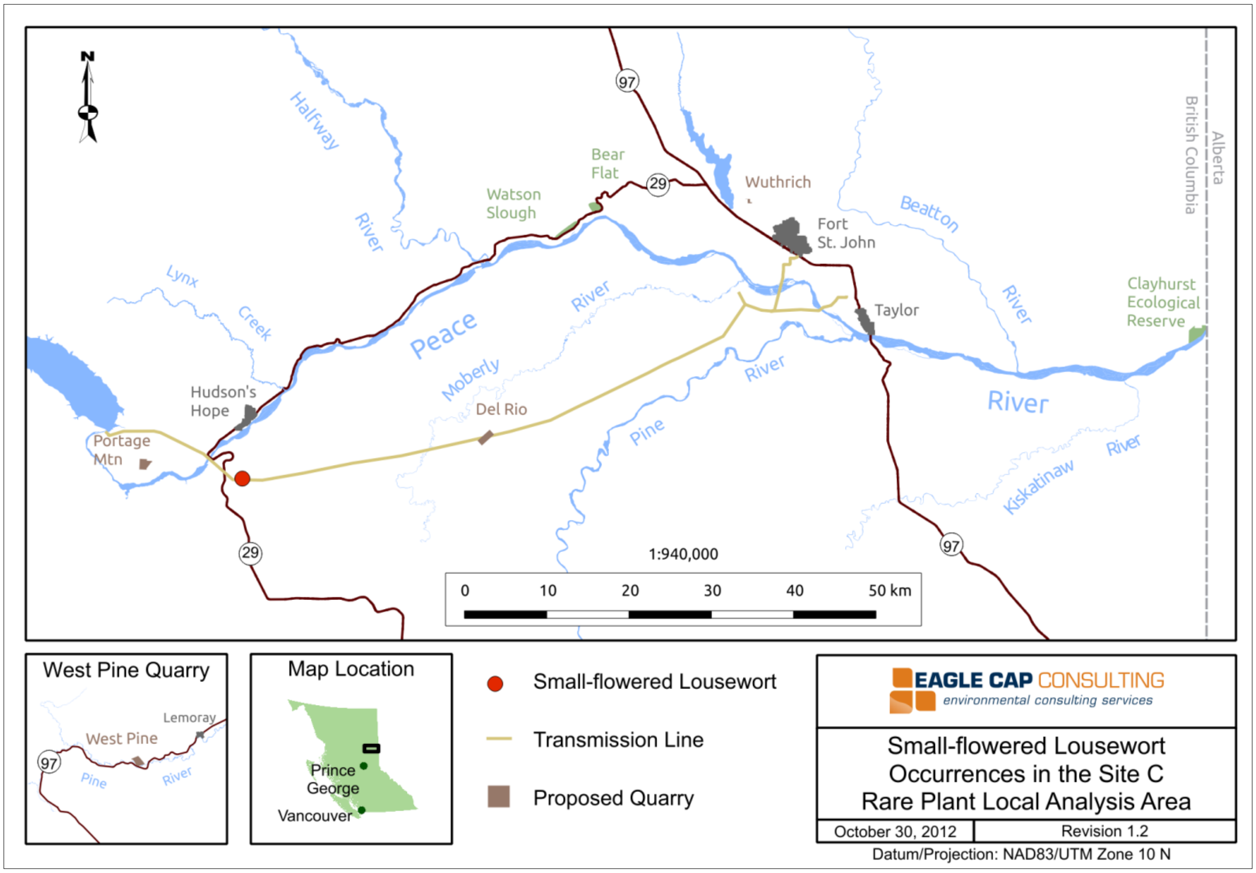
Welsh, S.L. 1991. *Oxytropis* DC.—names, basionyms, types, and synonyms—Flora North America Project. *Great Basin Naturalist* 51(4):377–396.

G.27 *Pedicularis parviflora* ssp. *parviflora* (small-flowered lousewort)

Small-flowered lousewort is a branching annual or biennial herb in the Scrophulariaceae (figwort family), that is found in wet montane and subalpine habitats such as bogs, fens, and meadows (Hitchcock et al. 1959; Douglas et al. 2000). In BC, the taxon has been reported from numerous scattered locations across the central and northern parts of the province (BC Conservation Data Centre 2012; Klinkenberg 2012). Globally it is distributed north into the Northwest Territories and Nunavut and east as far as Québec, and has also been collected in the US states of Alaska and Oregon (NatureServe 2011).

Small-flowered lousewort is classified S3 (Vulnerable) in BC, and is on the Blue list for the province (BC Conservation Data Centre 2012). The species and subspecies are both ranked Apparently Secure globally (G4T4). Other sub-national rankings include S3 (Vulnerable) status in Alberta and S4 (Apparently Secure) status in Ontario for the species, and S3 (Vulnerable) status in Alaska for the subspecies; the remainder of the jurisdictions with occurrences of small-flowered lousewort do not provide a rank (NatureServe 2011).



Map G.27.1 Small-flowered lousewort occurrences in the Local Assessment Area

One occurrence of small-flowered lousewort is reported for the Local Assessment Area (**Map G.27.1**). Site-specific rare plant survey work in 2008 resulted in the location of the taxon on the plateau south of the Peace River, between Highway 29 and Maurice Creek. The occurrence was located just outside of the existing transmission line right-of-way east of the highway, and contained two individuals in an estimated area of 100 square metres. The small-flowered lousewort plants were found growing in the understory of open muskeg forest.

G.27.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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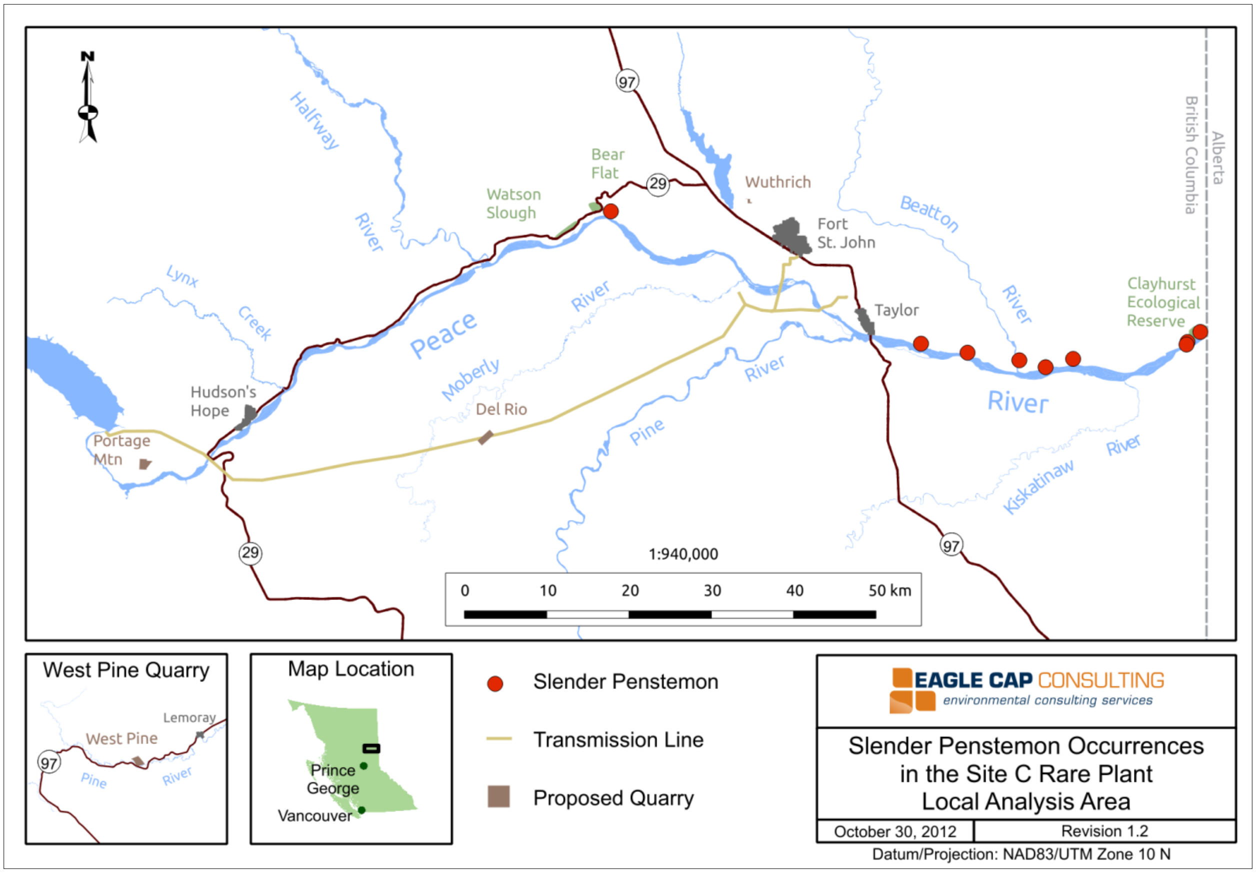
NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

G.28 *Penstemon gracilis* (slender penstemon)

Slender penstemon is a perennial herb of the Scrophulariaceae (figwort family) that inhabits mesic to dry plains and grasslands (Hitchcock et al. 1959; Douglas et al. 2000). The species is commonly found throughout much of the Great Plains and Midwestern regions of Canada and the US, but in BC is restricted to the Peace River area in the northeast part of the province (Hitchcock et al. 1959; NatureServe 2011; BC Conservation Data Centre 2012b; Klinkenberg 2012).

Slender penstemon is ranked S2 (Imperilled) in BC, and is on the province's Red list (BC Conservation Data Centre 2012b). The species' global status is Secure (G5) (NatureServe 2011). Of the remaining 17 jurisdictions where it is known to occur, only 4 rank slender penstemon with any degree of rarity (Alberta and Wyoming as S3 [Vulnerable], and Iowa and Michigan as S1 [Critically Imperilled]).

Nine occurrences of slender penstemon are reported for the Local Assessment Area (**Map G.28.1**). Eight of these records date from earlier studies in the vicinity (LGL Limited 2006; BC Conservation Data Centre 2012a). Site-specific rare plant surveys in 2008 identified one additional occurrence, in the Peace River corridor across from the mouth of Eight-Mile Creek. The 250–1,000 plants (Abundance Class C) were found growing in an estimated area of 10 square metres, near shrubs on an open grassland slope.



Map G.28.1 Slender penstemon occurrences in the Local Assessment Area

G.28.1 Literature Cited

BC Conservation Data Centre. 2012a. *Endangered species and ecosystems - non-sensitive occurrences (spatial data)*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: https://apps.gov.bc.ca/pub/dwds/home.so.

BC Conservation Data Centre. 2012b. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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Hitchcock, C.L., A. Cronquist, M. Ownbey and J.W. Thompson. 1959. *Vascular Plants of the Pacific Northwest: Part 4: Ericaceae through Campanulaceae*. University of Washington Press, Seattle, WA.

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NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

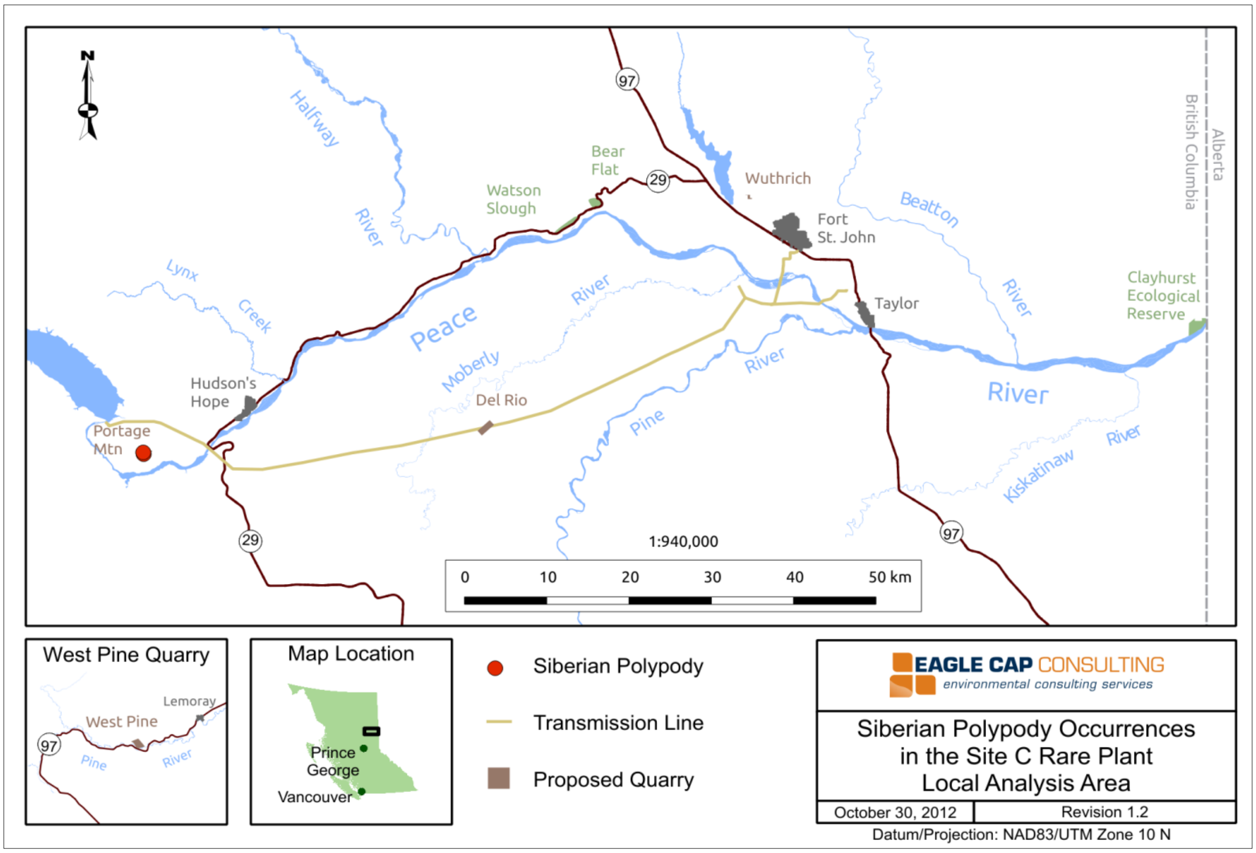
G.29 *Polypodium sibiricum* (Siberian polypody)

Siberian polypody (**Photograph G.29.1**) is a leathery-leaved evergreen fern in the Polypodiaceae (polypody family). The taxon grows in montane regions on dry to mesic rock outcrops (Haufler et al. 1993; Douglas et al. 2000). In BC, Siberian polypody is only known from two unconfirmed reports to the north and west of Fort St. John: one near the Beatton River and one near Williston Reservoir (BC Conservation Data Centre 2012; Klinkenberg 2012). The fern's global range extends across large portions of the boreal regions of Canada, Alaska, and Asia. The species has also been found in southern Greenland (Haufler et al. 1993).

Photograph G.29.1 Siberian polypody

Siberian polypody is on the Red list in BC, and is ranked SH to indicate that the species may be extirpated from the province (BC Conservation Data Centre 2012). Although Siberian polypody is considered Secure globally (G5), all of the North American jurisdictions that report a status for the taxon rank it as rare: SH (Possibly Extirpated) in Québec; S1 (Critically Imperilled) in Yukon and Ontario; S2 (Imperilled) in Alaska; and S3 (Vulnerable) in Alberta (NatureServe 2011).

Two occurrences of Siberian polypody are reported for the Local Assessment Area (**Map G.29.1**). Site-specific rare plant surveys in 2012 located the fern at the Portage Mountain proposed materials source area. The taxon was found growing on sparsely-vegetated dry cliffs, rock outcrops and boulders, within mixed upland forest. The occurrences contained hundreds of Siberian polypody individuals (Abundance Classes B and C) scattered across areas estimated at 300 and 1,800 square metres in size.



Map G.29.1 Siberian polypody occurrences in the Local Assessment Area

G.29.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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Haufler, C.H., M.D. Windham, F.A. Lang and S.A. Whitmore. 1993. *Polypodium*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico.*

Volume 2: Pteridophytes and Gymnosperms. Oxford University Press, New York, NY. Pp. 315–323.

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NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

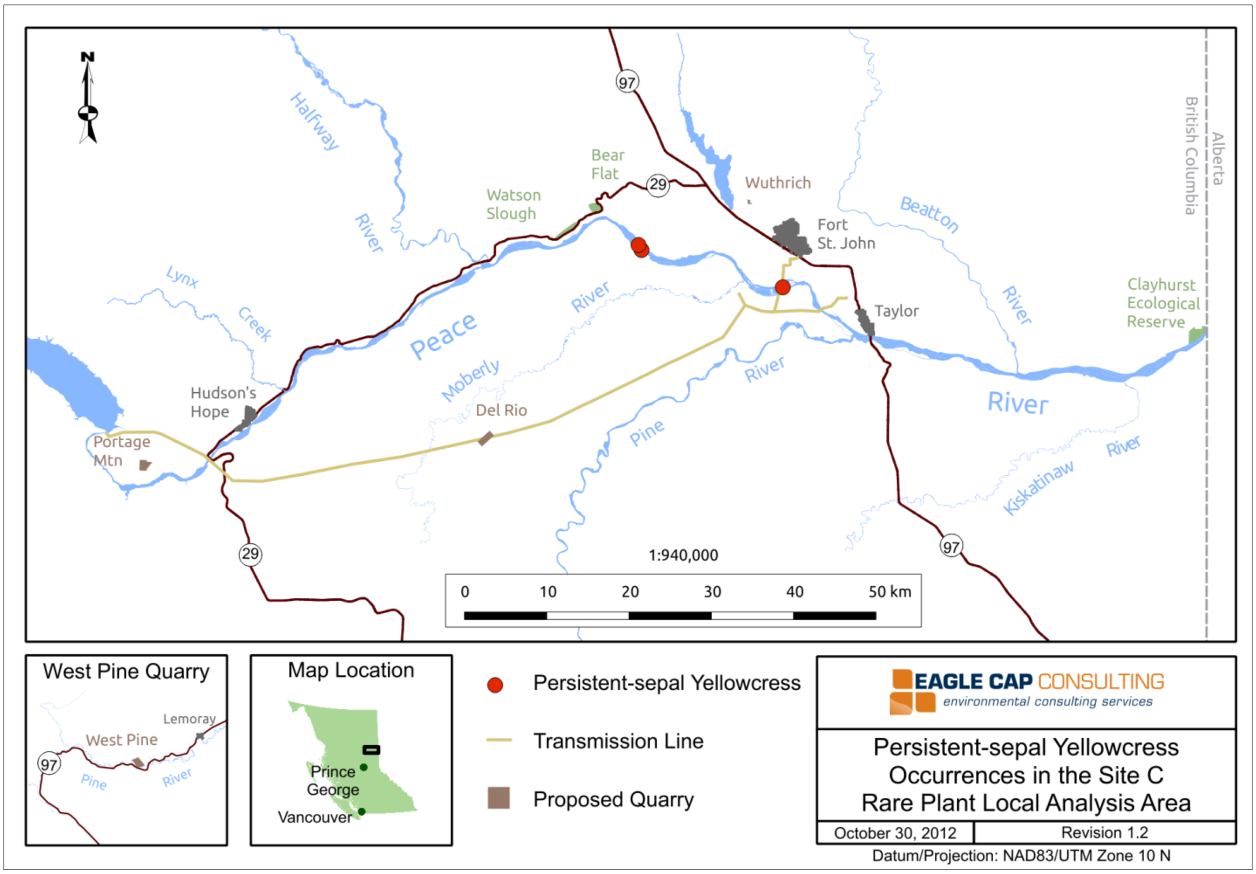
G.30 *Rorippa calycina* (persistent-sepal yellowcress)

Persistent-sepal yellowcress (**Photograph G.30.1**) is a spreading perennial herb in the Brassicaceae (mustard family). The species grows along streams and around lakes, reservoirs, and ponds (Al-Shehbaz 2010). Persistent-sepal yellowcress is currently known only from Wyoming, although historical records of the taxon exist from Montana, North Dakota, and Nebraska. A disjunct occurrence has also been documented in the Northwest Territories (Al-Shehbaz 2010; NatureServe 2011).

Photograph G.30.1 Persistent-sepal yellowcress

Because persistent-sepal yellowcress is not currently or historically known from BC, the species has not been assigned a status by the BCCDC. The taxon's global rank is G3 (Vulnerable), and all reported subnational rankings confer some degree of rarity: S3 (Vulnerable) in Wyoming, S1 (Critically Imperilled) in Montana, and SH (Possibly Extirpated) in North Dakota. No rank has been provided by the Northwest Territories or Nebraska (NatureServe 2011).

Three occurrences of persistent-sepal yellowcress are reported from the Local Assessment Area (**Map G.30.1**). Site-specific rare plant work in 2008 located the species along the right bank of the Peace River, between Bear Flat and the confluence of the Pine River. Each site was estimated to be 10 square metres in size, and to contain from 1–50 individuals (Abundance Class A). The persistent-sepal yellowcress plants were observed growing on open gravel bars with other herbs.



Map G.30.1 Persistent-sepal yellowcress occurrences in the Local Assessment Area

G.30.1 Literature Cited

Al-Shehbaz, I. 2010. *Rorippa*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico. Volume 7: Magnoliophyta: Dilleniidae*. Oxford University Press, New York, NY. Pp. 493–506.

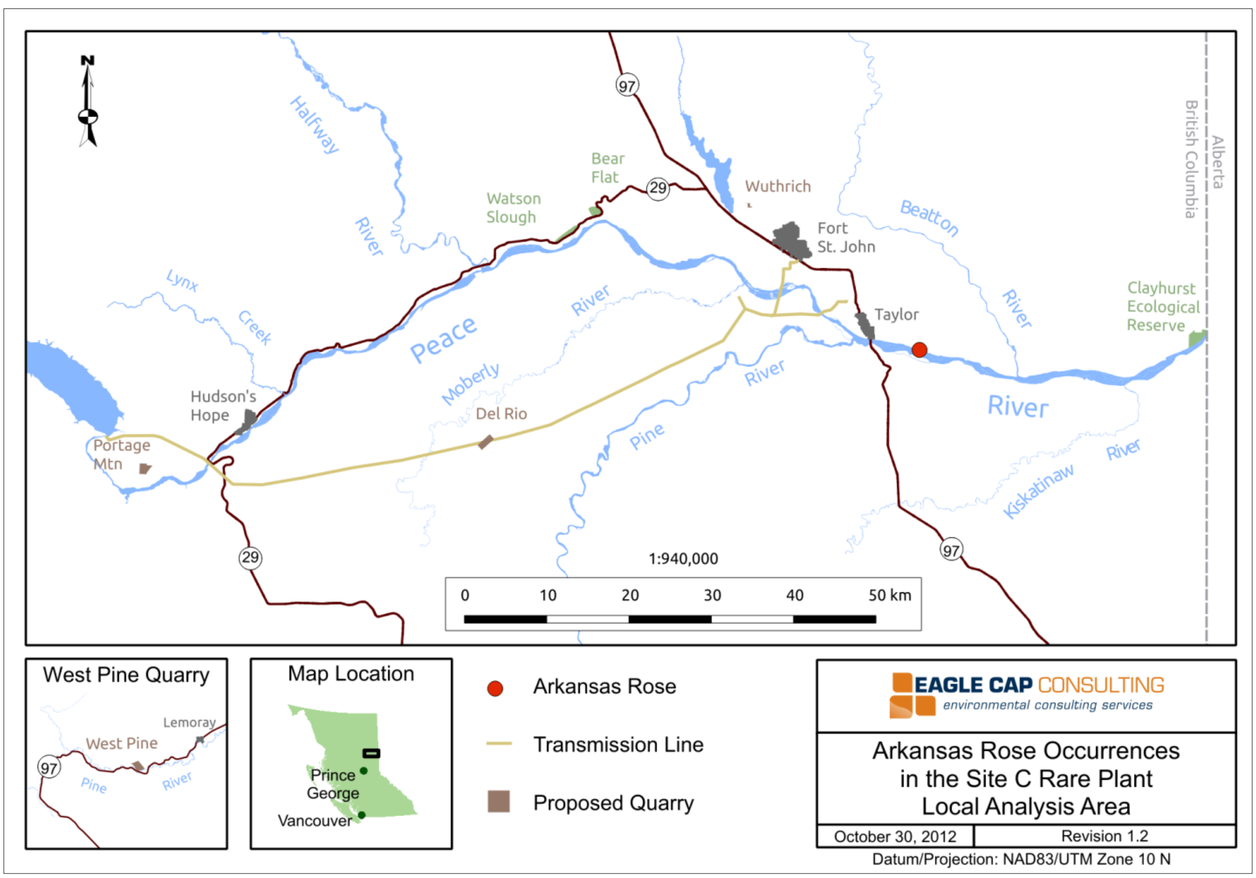
NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

G.31 ***Rosa arkansana* var. *arkansana* (Arkansas rose)**

Arkansas rose is a low shrub of the Rosaceae (rose family) found growing on prairies and in grasslands, thickets, and woodlands, in the steppe and montane zones (Moss and Packer 1983; Douglas et al. 1999). The taxon is known from several occurrences in BC, primarily in the Peace River region, but also in the extreme southeast corner of the province (BC Conservation Data Centre 2012; Klinkenberg 2012). Variety *arkansas*' global distribution continues east as far as Manitoba, and south through much of the central US into Texas (NatureServe 2011).

Arkansas rose has a rank of S2S3 (Imperilled and Vulnerable) in BC, and is on the Blue list for the province (BC Conservation Data Centre 2012). The taxon's global status is G5T4T5 (Apparently Secure to Secure), and no other subnational jurisdiction ranks variety *arkansas* as rare (NatureServe 2011).

A single occurrence of Arkansas rose is reported for the Local Assessment Area (Map 34). This location dates from an earlier study in the vicinity (BC Conservation Data Centre 2012).



Map G.31.1 Arkansas rose occurrences in the Local Assessment Area

G.31.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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Moss, E.H. and J.G. Packer. 1983. *Flora of Alberta: a manual of flowering plants, conifers, ferns and fern allies found growing without cultivation in the province of Alberta, Canada*. University of Toronto Press, Toronto, ON.

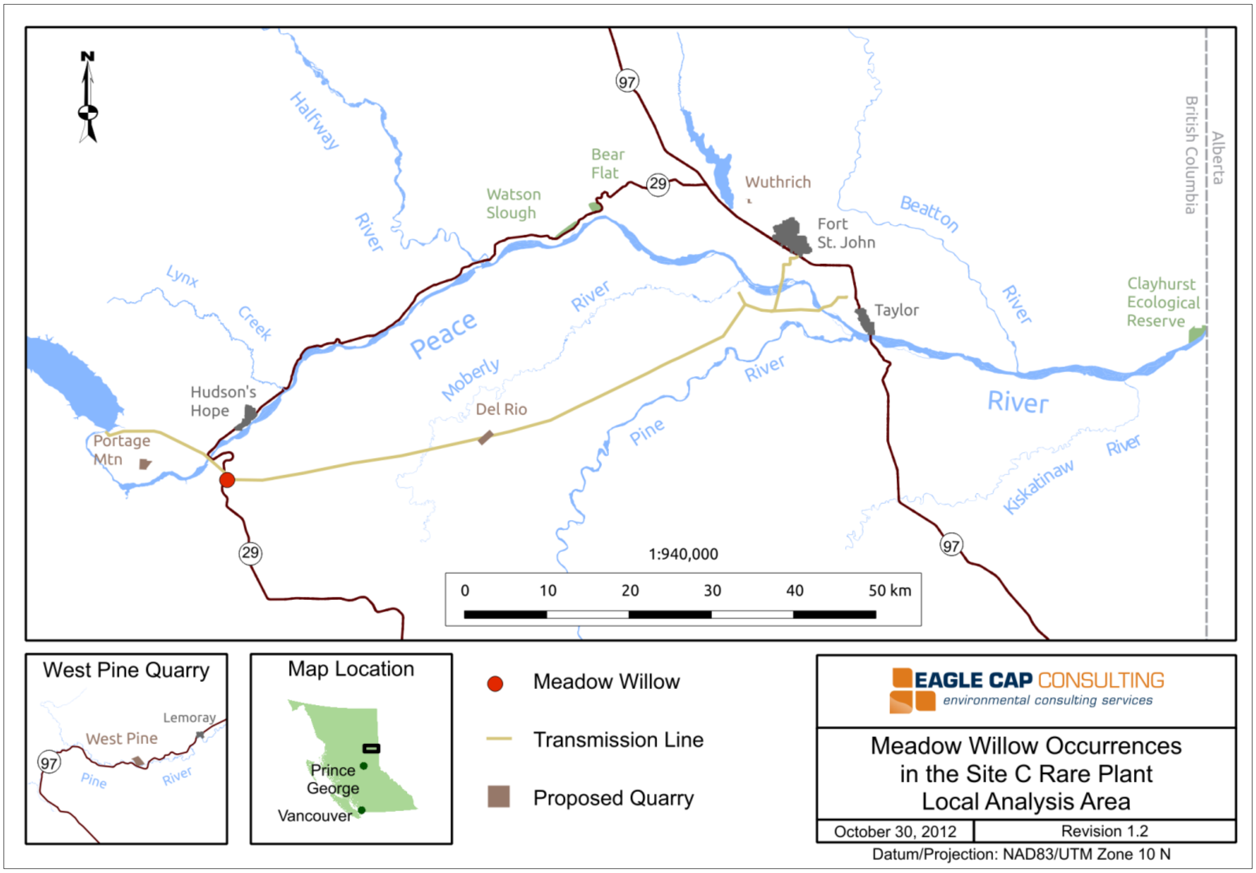
NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

G.32 *Salix petiolaris* (meadow willow)

Meadow willow is a narrow-leaved shrub in the Salicaceae (willow family). It grows in various wet montane habitats, such as thickets, deciduous woods, sedge meadows, and lake margins (Argus 2000; Douglas et al. 2000). In BC, the species occurs most often in the Peace River area in the northeast, but has also been collected in a few other eastern and northern locations (BC Conservation Data Centre 2012; Klinkenberg 2012). The willow's global distribution extends from the Northwest Territories south through the Canadian prairie provinces to Montana and Colorado, and east across Canada and the northern US to the Atlantic coast (Argus 2000; NatureServe 2011).

Meadow willow is classed as S2S3 in BC (Imperilled and Vulnerable), and is on the Blue list for the province (BC Conservation Data Centre 2012). The taxon's global status is Secure (G5). Subnationally, five jurisdictions along the southeastern boundary of its range also rank the willow as rare: Prince Edward Island and Missouri as S1 (Critically Imperilled), Ohio as S2 (Imperilled), and Nova Scotia and Illinois as S3 (Vulnerable) (NatureServe 2011).

A single occurrence of meadow willow is reported for the Local Assessment Area (**Map G.32.1**). Site-specific rare plant surveys in 2008 located the species south of the Peace River near Highway 29. Hundreds of individuals (Abundance Class C) were documented in an estimated area of 1,500 square metres. The meadow willow was growing with other tall deciduous shrubs along a road track in mixed upland forest.



Map G.32.1 Meadow willow occurrences in the Local Assessment Area

G.32.1 Literature Cited

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NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

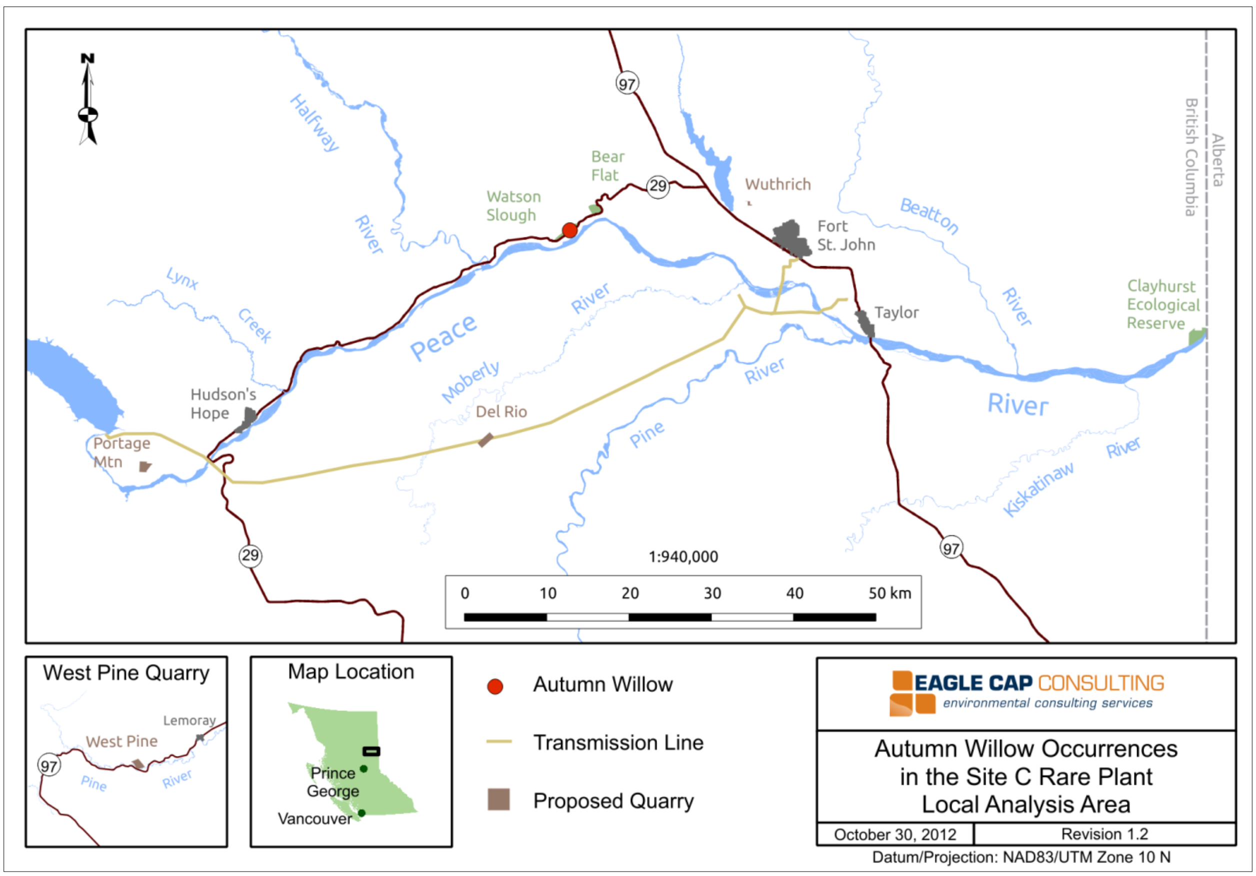
G.33 *Salix serissima* (autumn willow)

Autumn willow (**Photograph G.33.1**)—a shrub that sets fruit late in the growing season—is a member of the Salicaceae (willow family). The taxon is found in wet thickets, fens, bogs, meadows, and along lakes and stream shorelines, from lower elevations into the mountains (Argus 2000; Douglas et al. 2000). The species has been reported from scattered locations in northern BC (predominantly in the Peace River/Dawson Creek area), in addition to one record near the town of Williams Lake (BC Conservation Data Centre 2012; Klinkenberg 2012). Globally, autumn willow is known from the Northern Territories and Alberta across Canada to Newfoundland and New Brunswick. It occurs more sporadically in the US, from Montana through the northern Midwest into a number of northeastern states, and is also known from several disjunct populations in South Dakota, Wyoming, and Colorado (Argus 2000; NatureServe 2011).

Photograph G.33.1 Autumn willow

Autumn willow is ranked S2S3 (Imperilled and Vulnerable) in BC, and is on the province's Blue list (BC Conservation Data Centre 2012). While the species is listed as Apparently Secure globally (G4), along the margins of its range many subnational jurisdictions indicate some degree of rarity: S3 (Vulnerable) in Québec, Massachusetts, Connecticut, Ohio and Montana; S2 (Imperilled) in Newfoundland, New Jersey, Pennsylvania, and Indiana; and S1 (Critically Imperilled) in New Brunswick, Vermont, Illinois, South Dakota, Wyoming, and Colorado (NatureServe 2011).

One occurrence of autumn willow is reported for the Local Assessment Area (**Map G.33.1**). Site-specific rare plant surveys in 2008 located the taxon in the Watson Slough wetland complex. Approximately 50–250 individuals (Abundance Class B) were found scattered over roughly 20,000 square metres. The shrubs were observed in the transition zone between a marsh and open muskeg forest.



Map G.33.1 Autumn willow occurrences in the Local Assessment Area

G.33.1 Literature Cited

Argus, G.W. 2000. *Salix*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico, Volume 7, Magnoliophyta: Salicaceae to Brassicaceae*. Oxford University Press, New York, NY. Pp. 23–162.

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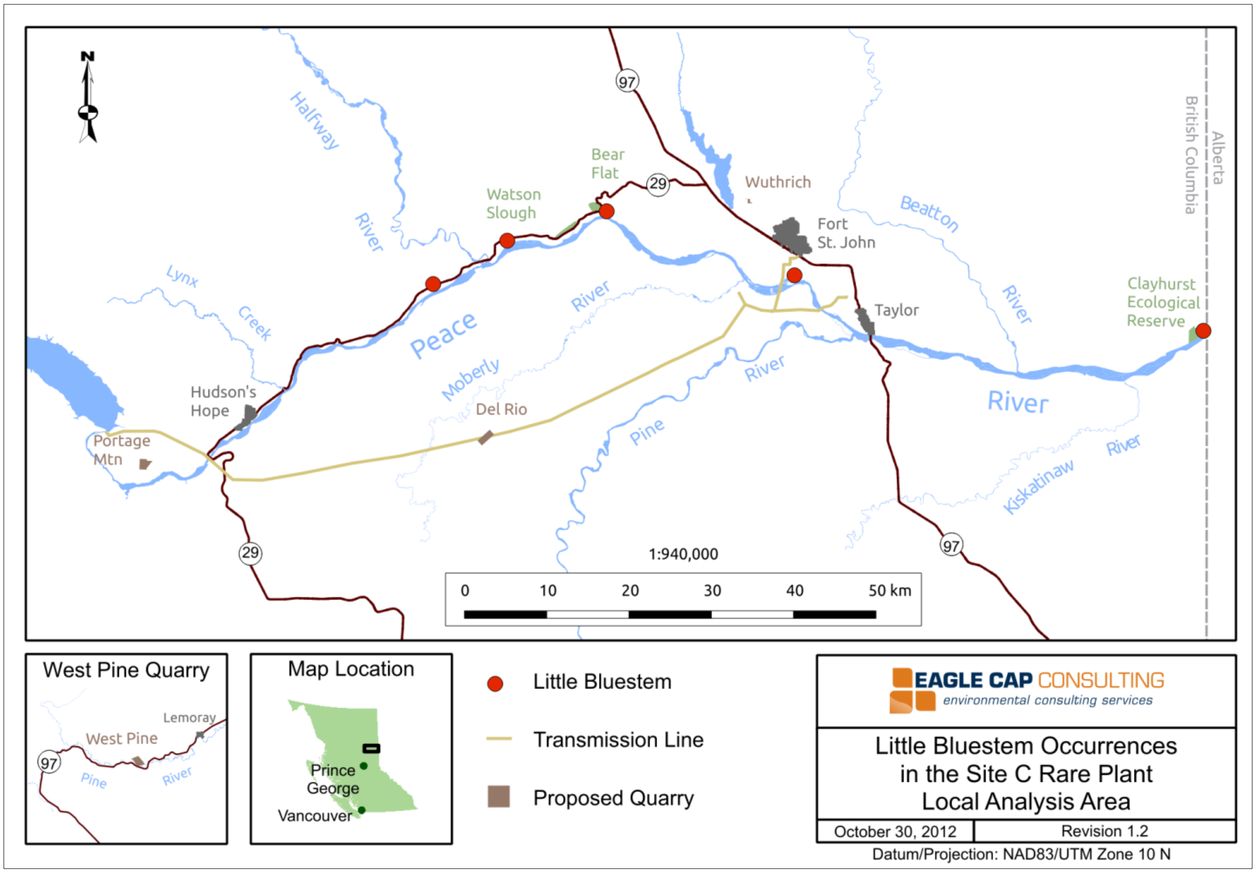
G.34 *Schizachyrium scoparium* (little bluestem)

Little bluestem is a tall, feathery-headed perennial grass of steppe and montane regions. The species inhabits mesic to dry grasslands, shrublands, open woods, rocky slopes, and canyons (Cronquist et al. 1977; Wipff 2000; Douglas et al. 2001). It has been collected at several sites along the Columbia River in extreme southeastern BC, as well as a few locations in the Northeast, along the Peace River and on Williston Reservoir (Wipff 2000; BC Conservation Data Centre 2012; Klinkenberg 2012). Little bluestem was one of the dominant grasses of the North American tall-grass prairie. Its native distribution extends from Alberta across Canada to New Brunswick and south through the continental US (except Oregon and Nevada) into central Mexico (NatureServe 2011; Cronquist et al. 1977; Wipff 2000).

Little bluestem is considered Critically Imperilled (S1) by the BCCDC, and is on the provincial Red list (BC Conservation Data Centre 2012). The taxon's global status is Secure (G5), and only three other subnational jurisdictions rank the grass as rare: (S2 [Imperilled] in New Brunswick and S3 [Vulnerable] in Alberta and Québec). Little bluestem has reportedly been introduced into both Nova Scotia and Hawaii (NatureServe 2011).

Five occurrences of little bluestem are reported for the Local Assessment Area (**Map G.34.1**). These sites date from an earlier study in the vicinity (LGL Limited 2006).



Map G.34.1 Little bluestem occurrences in the Local Assessment Area

G.34.1 Literature Cited

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LGL Limited. 2006. *Peace River wildlife surveys: 2005 habitat suitability modeling and wildlife inventory (draft final report)*. Prepared for BC Hydro Engineering Services, Burnaby, BC.

NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

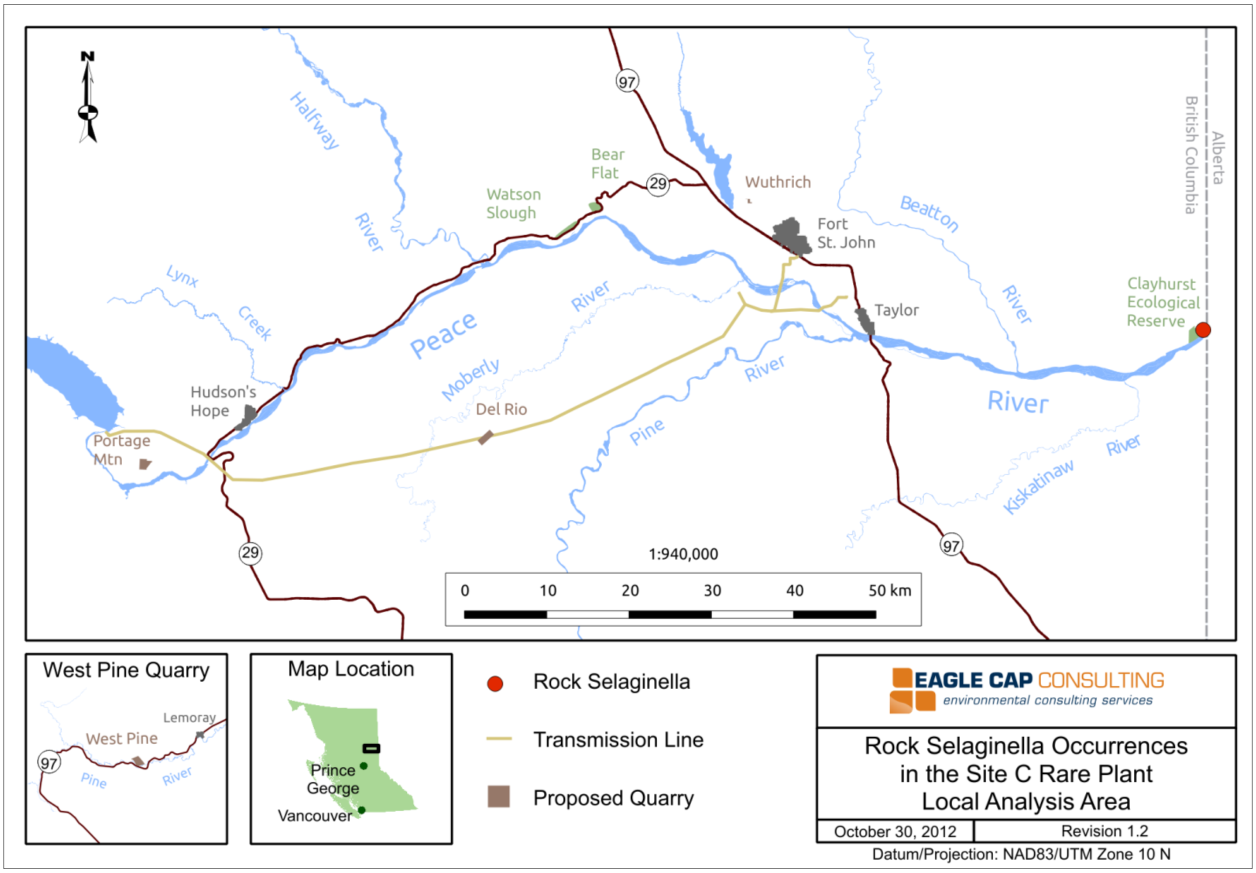
Wipff, J.K. 2000. *Schizachyrium*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico. Volume 25: Magnoliophyta: Commelinidae (in part): Poaceae, part 2*. Oxford University Press, New York, NY. Pp. 666–677.

G.35 *Selaginella rupestris* (rock selaginella)

Rock selaginella is a low, mat-forming perennial herb in the Selaginellaceae (spike-moss family). The species is found in dry, exposed, montane habitats, such as on rock outcrops and grassy ridges (Douglas et al. 2000; Valdespino 1993). Rock selaginella is restricted in BC to one site in the northeast part of the province, near the Peace River at the Alberta border (BC Conservation Data Centre 2012; Klinkenberg 2012). In contrast, the taxon has the largest distribution of its genus in North America. It occurs from northern Alberta across Canada through southern Ontario and Québec to Nova Scotia. In the US, the species is found as far south as southern Georgia and northeast Oklahoma, with disjunct occurrences in Wyoming, South Dakota and Nebraska. One additional population is known from Greenland (Valdespino 1993; NatureServe 2011).

Rock selaginella is classed S1 (Critically Imperilled) in BC, and is on the Red list for the province (BC Conservation Data Centre 2012). Its global status is Secure (G5), although some sub-national rankings around the margins of the taxon's range indicate various degrees of rarity—most notably S3 (Vulnerable) in Alberta, and S1 (Critically Imperilled) in New Brunswick, Nova Scotia, North Dakota, and Wyoming (NatureServe 2011).

The only known BC occurrence of rock selaginella is located in the Local Assessment Area (**Map G.35.1**). This site was revisited during an earlier study in the region (LGL Limited 2006).



Map G.35.1 Rock selaginella occurrences in the Local Assessment Area

G.35.1 Literature Cited

BC Conservation Data Centre. 2012. *Species summaries for tracked taxa*. BC Ministry of Environment, Lands, and Parks, Victoria, BC. Available at: http://a100.gov.bc.ca/pub/eswp/.

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NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

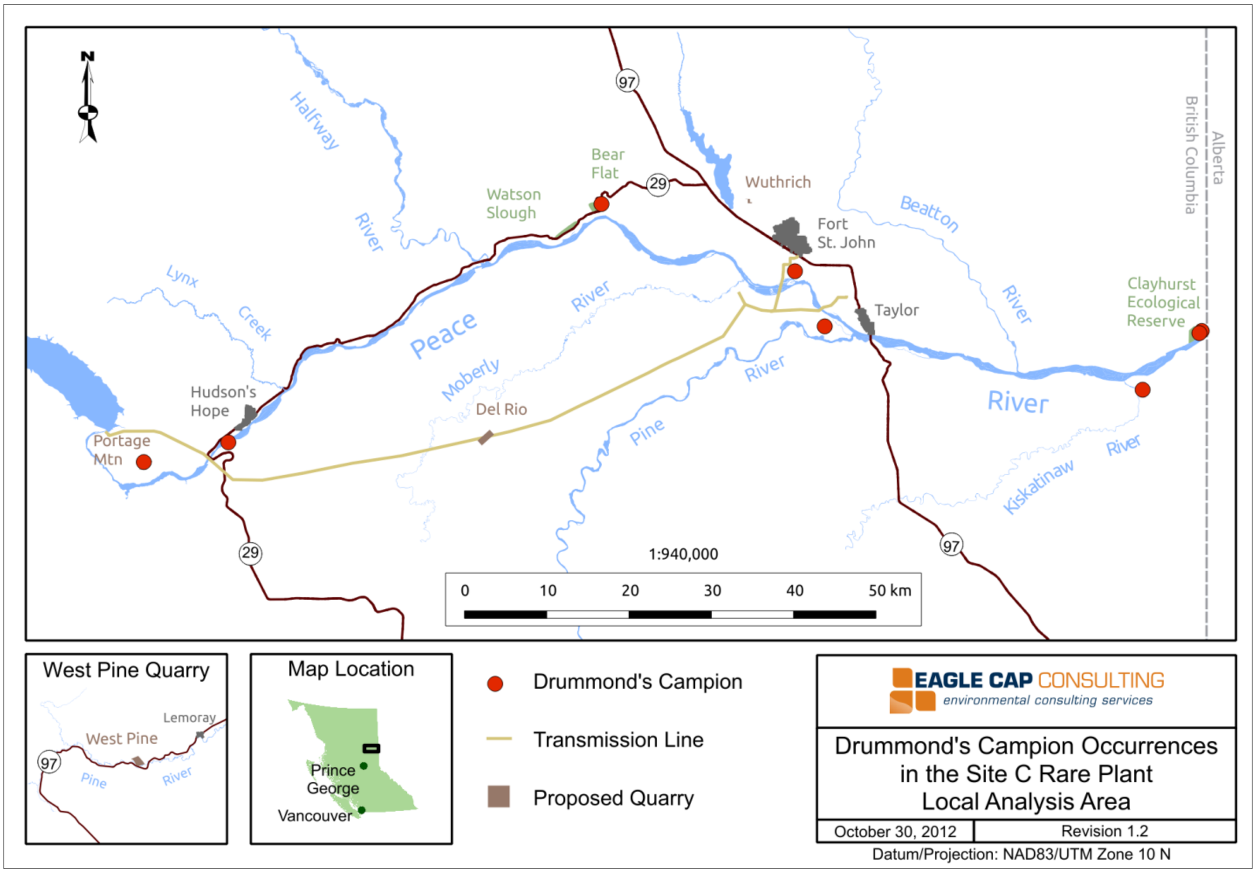
Valdespino, I.A. 1993. *Selaginella*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico. Volume 2: Pteridophytes and Gymnosperms*. Oxford University Press, New York, NY. Pp. 38–63.

G.36 ***Silene drummondii*** **var.** ***drummondii*** **(Drummond's campion)**

Drummond's campion is a taprooted perennial herb in the Caryophyllaceae (pink family). It is found in dry shrubland, meadows, and woodland openings, and on hillsides and prairies, from the steppe to alpine zones (Douglas et al. 1998; Morton 2005). In BC, Drummond's campion occurs in a number of locations east of the Coast-Cascade Mountains (BC Conservation Data Centre 2012; Klinkenberg 2012). Variety *drummondii* extends north into the Northwest Territories, east to Ontario, and south through much of the US Midwest and West, as far as Arizona and New Mexico (Morton 2005; NatureServe 2011). In addition, disjunct occurrences of the taxon are reported for Maryland (NatureServe 2011).

Drummond's campion is ranked S3 (Vulnerable) by the BCCDC, and is on the provincial Blue list (BC Conservation Data Centre 2012). NatureServe classifies the taxon as Secure globally (G5T5), and only three other subnational jurisdictions report the species as rare: Manitoba and Minnesota as S3 (Vulnerable), and Ontario as S1 (Critically Imperilled) (NatureServe 2011).

Eight occurrences of Drummond's campion are reported for the Local Assessment Area (**Map G.36.1**). Five of these records date from an earlier study in the vicinity (LGL Limited 2006). Site-specific rare plant surveys in 2011 and 2012 identified 3 additional occurrences: one on Portage Mountain and two in the Peace River corridor. The small site found in the Portage Mountain proposed materials source area consisted of 23 Drummond's campion plants (Abundance Class A), scattered along the base of a dry cliff in mixed upland forest (estimated total area 20 square metres). A second occurrence of the taxon was located on an island in the Peace River near the Peace Canyon Dam. The 50–250 individuals (Abundance Class B) were growing in an area of roughly 100 square metres, on a dry slope at the edge of mixed upland forest. The third and largest occurrence of Drummond's campion was located on a dry bench on the right bank of the Peace River, near the confluence with the Pine River. Although the area was crossed with various road tracks, the habitat was found to be dominated by native grasses. An estimated 1–50 plants (Abundance Class A) were sparsely distributed over approximately 1,000 square metres.



Map G.36.1 Drummond's campion occurrences in the Local Assessment Area

G.36.1 Literature Cited

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NatureServe. 2011. *NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1*. Available at: http://www.natureserve.org/explorer. Accessed April 2011.

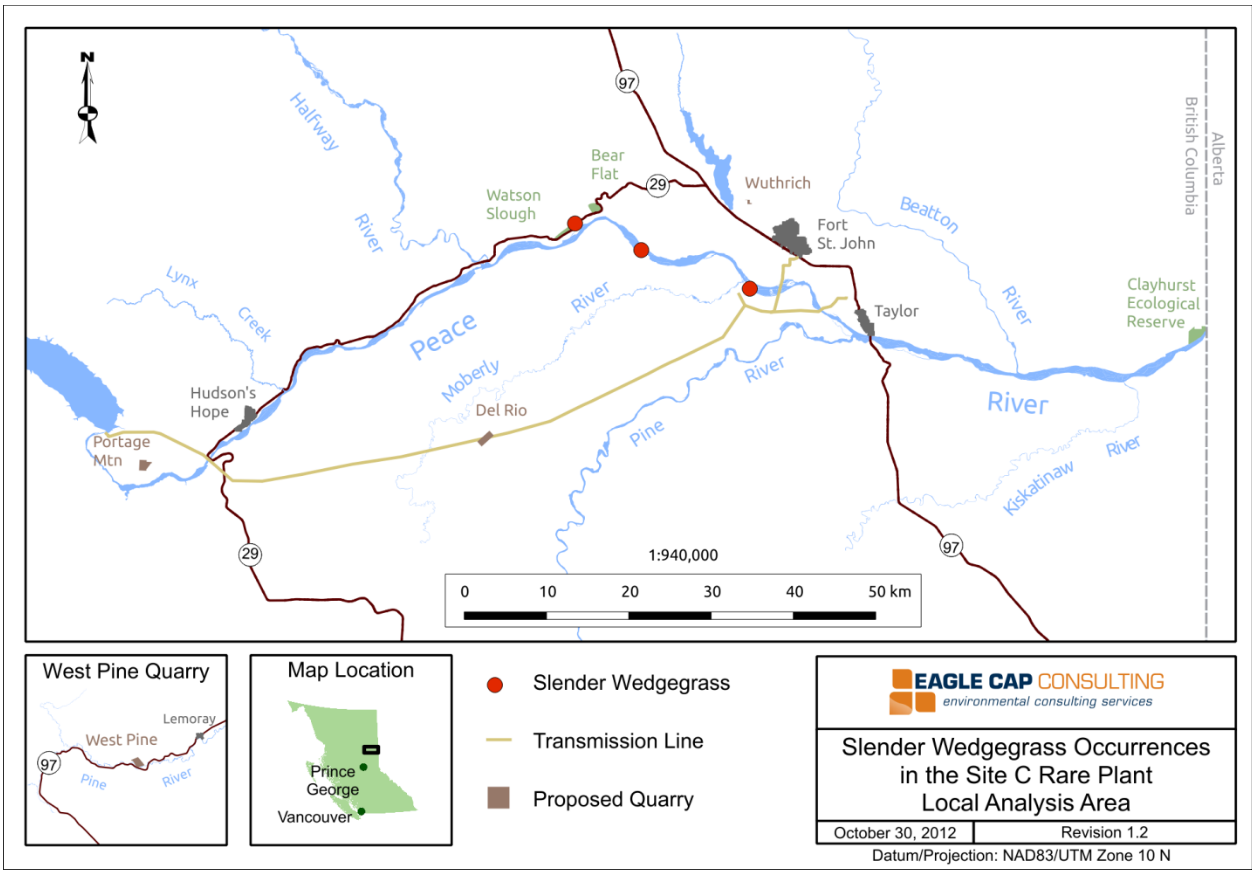
G.37 *Sphenopholis intermedia* (slender wedgegrass)

Slender wedgegrass (**Photograph G.37.1**), a perennial with long seed heads, is a member of the Poaceae (grass family). The species grows in moist meadows, along streambanks, and around lakes and ponds in the steppe and montane zones (Douglas et al. 2001; Daniel 2007). It is known from scattered locations in eastern BC, and occurs in all Canadian and US jurisdictions except Nunavut, Labrador, and California (Daniel 2007; NatureServe 2011; BC Conservation Data Centre 2012; Klinkenberg 2012).

Photograph G.37.1 Slender wedgegrass

Slender wedgegrass is ranked S3 (Vulnerable) in BC and is on the province's Blue list (BC Conservation Data Centre 2012). Globally the taxon is ranked as Secure (G5), but subnational ranking varies. Other jurisdictions where the species is considered rare include Alaska, Yukon, Montana, Newfoundland, and Prince Edward Island (S1 [Critically Imperilled]); Wyoming and North Carolina (S2 [Imperilled]); and Alberta, Illinois, Québec, and Nova Scotia (S3 [Vulnerable]) (NatureServe 2011).

Three total occurrences of slender wedgegrass are reported for the Local Assessment Area (**Map G.37.1**). Site-specific rare plant surveys in 2008 and 2011 discovered the grass in the Peace River corridor, between Watson Slough and the Pine River. Several hundred plants (Abundance Class C) were recorded from an area of approximately 200 square metres in an inundated section of Watson Slough. At this location, the slender wedgegrass was found growing partially submerged, with various wetland herbs and shrubs, in a dead stand of mixed forest. Farther downstream, the taxon was documented from open, wet sites along the right bank of the Peace: 1–50 plants (Abundance Class A) in an estimated area of 100 square metres on the river shoreline, and a single plant at a spring near a river side channel.



Map G.37.1 Slender wedgegrass occurrences in the Local Assessment Area

G.37.1 Literature Cited

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Daniel, T.F. 2007. *Sphenopholis*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico. Volume 24: Magnoliophyta: Commelinidae (in part): Poaceae, part 1*. Oxford University Press, New York, NY. Pp. 620–624.

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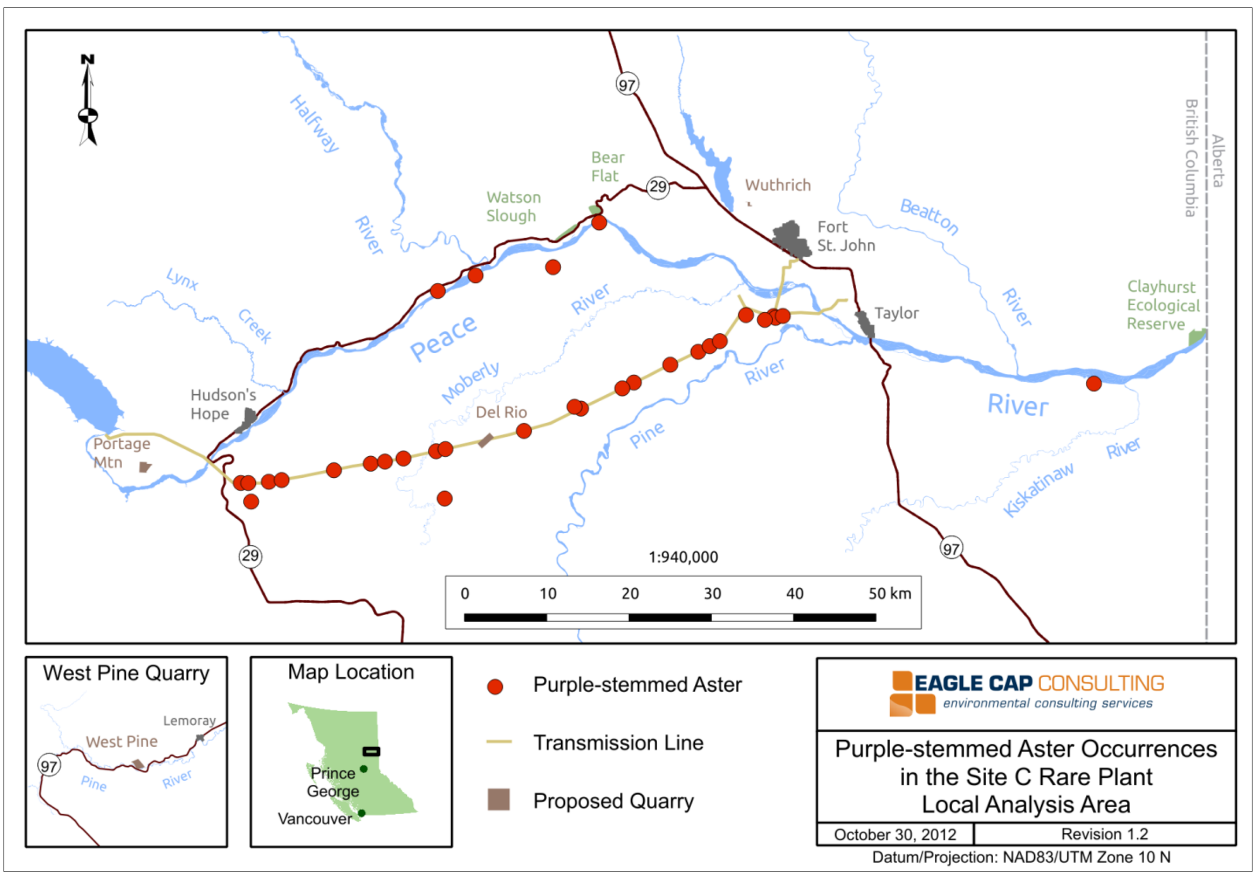
G.38 ***Symphyotrichum puniceum* var. *puniceum* (purple-stemmed aster)**

Purple-stemmed aster (**Photograph G.38.1**) is a branching perennial of the Asteraceae (sunflower family). It grows along streams and lake shores, in marshes and wet meadows, and at the edges of bogs (Douglas et al. 1998; Brouillet et al. 2006). In BC, the taxon is found in the Northeast, predominantly in the Peace River region (BC Conservation Data Centre 2007; BC Conservation Data Centre 2012; Klinkenberg 2012). Purple-stemmed aster ranges north into the Northwest Territories, east to the Atlantic coast, and south in the central and eastern US to Nebraska, Missouri, and Florida (NatureServe 2011).

Photograph G.38.1 Purple-stemmed aster

Purple-stemmed aster is ranked S2S3 (Imperilled and Vulnerable) in BC and is on the province's Blue list (BC Conservation Data Centre 2012). The taxon is considered Secure globally (G5T5) and, outside of BC, Kentucky is the only other jurisdiction to rank purple-stemmed aster as rare at the sub-national level (S3 [Vulnerable]) (NatureServe 2011).

Thirty-one occurrences of purple-stemmed aster are reported for the Local Assessment Area (**Map G.38.1**). Site-specific rare plant surveys in 2008, 2011, and 2012 located the taxon primarily on the plateau south of the Peace River; in addition, several occurrences were also discovered in the Peace River corridor between Farrell Creek and the Kiskatinaw River. The purple-stemmed aster plants were found in a variety of wetland habitat: most frequently in sedge and grass marshes with scattered willow shrubs, but occasionally around ponds, or in forested bogs, mixed upland woods, or riparian communities. The taxon was often observed growing along quad tracks in or near the existing transmission line right-of-way. Smaller sites consisted of 1–50 plants (Abundance Class A) and ranged in actual or estimated size from 1 to 100 square metres. However, the majority of the occurrences contained hundreds of plants (Abundance Classes B and C) and covered some hundreds or thousands of square metres. The three most extensive occurrences were situated on the eastern section of the plateau above the Pine River (1,000–2,500 plants each [Abundance Class D], over approximate areas of 75,000–100,000 square metres).



Map G.38.1 Purple-stemmed aster occurrences in the Local Assessment Area

G.38.1 Literature Cited

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Brouillet, L., J.C. Semple, G.A. Allen, K.L. Chambers and S.D. Sundberg. 2006. *Symphotrichum*. In: Flora of North America Editorial Committee (ed.), *Flora of North America North of Mexico. Vol. 20. Volume 20, Magnoliophyta: Asteridae, part 7: Asteraceae, part 2.* Oxford University Press, New York, NY. Pp. 465–539.

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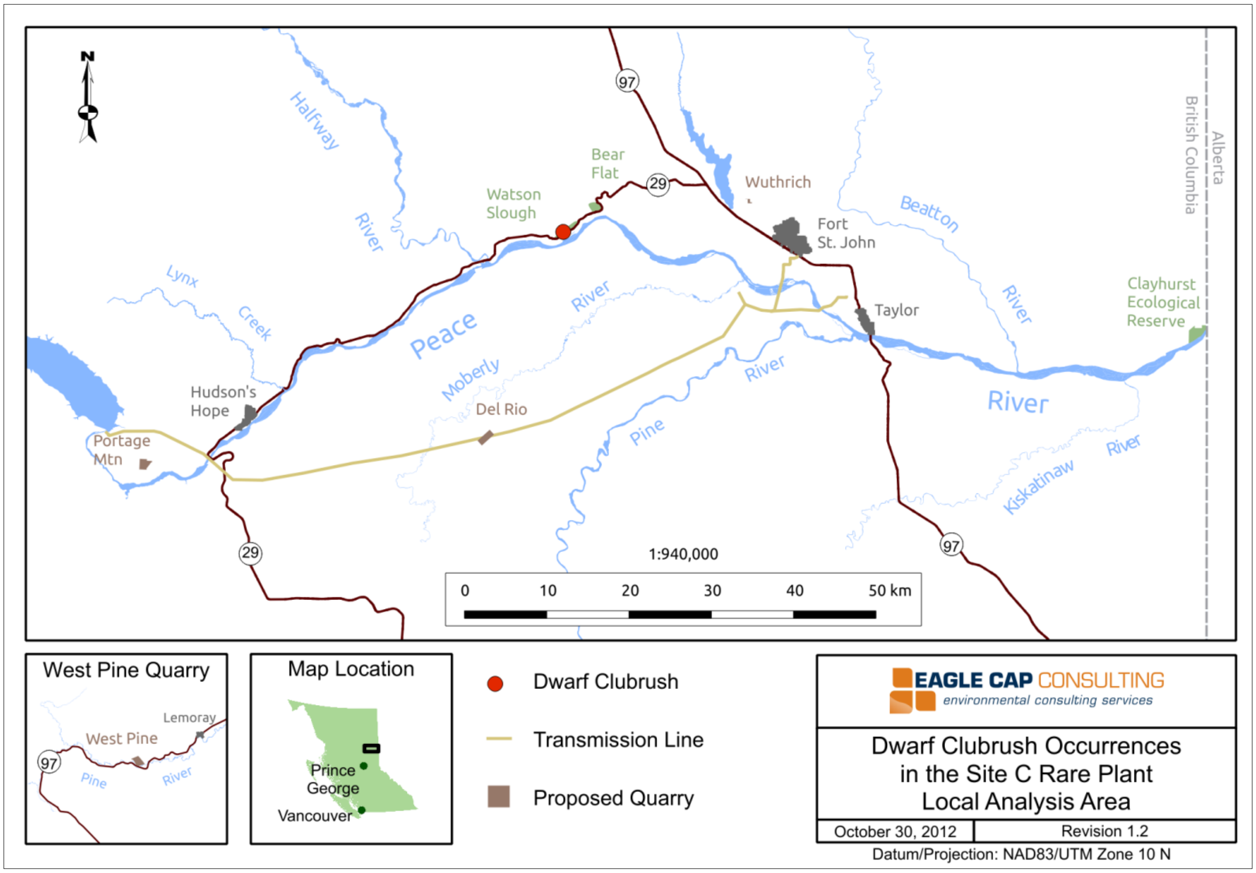
G.39 *Trichophorum pumilum* (dwarf clubrush)

Dwarf clubrush—a small perennial herb of the Cyperaceae (sedge family) —inhabits bogs, fens, coniferous swamps, wet meadows, and lake and stream shorelines (Crins 2003; Douglas et al. 2001). The species is distributed sporadically in BC, with population clusters in the southwest, southeast, and north-central parts of the province (BC Conservation Data Centre 2012; Klinkenberg 2012). Globally, the taxon is found scattered from Alaska, Yukon and the Northwest Territories south into the US Rocky Mountains as far as Colorado, with disjunct populations in Québec and California. The clubrush also extends circumboreally into Europe and central Asia (Crins 2003; NatureServe 2011).

Dwarf clubrush is classified as S2S3 in BC (Imperilled and Vulnerable) and is on the Blue list for the province (BC Conservation Data Centre 2012). Its global status is Secure (G5), however, all North American jurisdictions that provide a rank for the species report some degree of rarity: S1 (Critically Imperilled) in Alaska, Montana, Idaho, Wyoming, and California; S2 (Imperilled) in Québec and Colorado; and S3 (Vulnerable) in Alberta (NatureServe 2011).

A single occurrence of dwarf clubrush is reported for the Local Assessment Area (**Map G.39.1**). The 2008 site-specific rare plant field work located the species in the Peace River corridor at Watson Slough. An estimated 2,500–10,000 dwarf clubrush plants (Abundance Class E) were observed in a fen at the west end of the slough, covering an area of approximately 100,000 square metres.



Map G.39.1 Dwarf clubrush occurrences in the Local Assessment Area

G.39.1 Literature Cited

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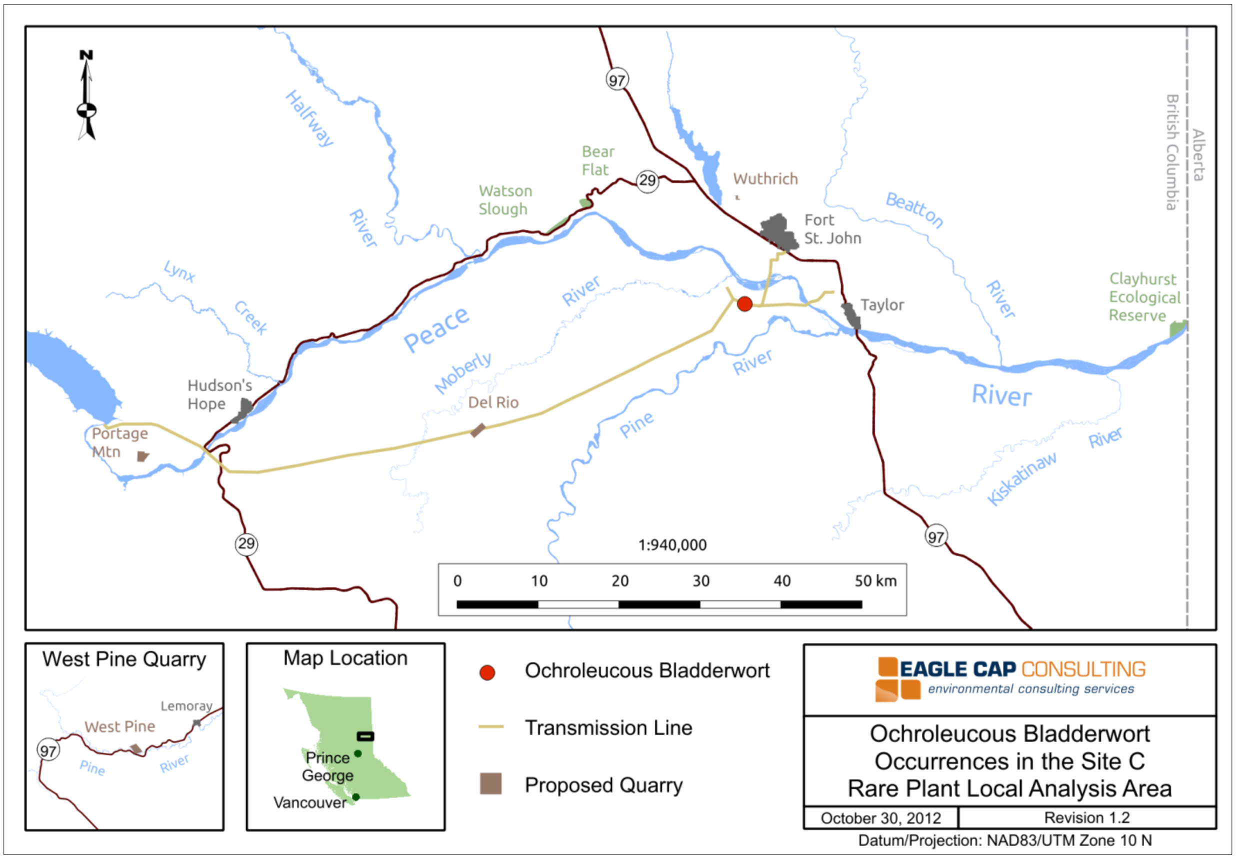
G.40 *Utricularia ochroleuca* (ochroleucous bladderwort)

Ochroleucous bladderwort, a delicate aquatic herb in the Lentibulariaceae (bladderwort family), is found floating or submerged in low nutrient lakes and ponds in the montane zone (Douglas et al. 1999). In BC the species has been collected at several widely-separated sites, including Vancouver Island, the north Okanagan, and near the Yukon border (BC Conservation Data Centre 2012; Klinkenberg 2012). The taxon is found throughout North America, from California to Alaska, across the Northwest Territories into Nunavut, and south through Manitoba, Ontario, and Québec, to Minnesota, Illinois, Michigan, and New York State. Disjunct occurrences are also reported from Nova Scotia and Colorado (NatureServe 2011).

Ochroleucous bladderwort is ranked S2S3 (Imperilled and Vulnerable) in BC and is on the province's Blue list (BC Conservation Data Centre 2007; BC Conservation Data Centre 2012). Globally, the species is considered Apparently Secure, although questions remain regarding its status (G4?). Of the North American jurisdictions that provide a rank for the taxon, all indicate some degree of rarity: SH (Possibly Extirpated) in Ontario; S1 (Critically Imperilled) in Alaska, Nova Scotia, New York, Colorado, California, and Oregon; and S3 (Vulnerable) in Québec (NatureServe 2011). It should be noted that there is disagreement among taxonomists regarding the definition and range of this species (BC Conservation Data Centre 2007).

One occurrence of ochroleucous bladderwort is reported from the Local Assessment Area (**Map G.40.1**). Site-specific rare plant surveys in 2011 located the species on the plateau south of the Peace River. Two small plants were discovered floating in a pond within a sedge-dominated wetland, near an existing transmission line right-of-way.



Map G.40.1 Ochroleucous bladderwort occurrences in the local assessment area

G.40.1 Literature Cited

BC Conservation Data Centre. 2007. *Conservation Status Report:* Utricularia ochroleuca. BC Ministry of Environment. Available at: http://a100.gov.bc.ca/pub/eswp/esr.do?id=14644.

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APPENDIX H CONCEPTUAL MITIGATION PLAN FOR BC HYDRO LANDS WEST OF WILDER CREEK

H.1 Introduction

BC Hydro owned lands west of Wilder Creek have been identified as a location where mitigation to offset loss of vegetation and ecological resources and wildlife habitat might be implemented[11] (**Map 1**). The lands are located along the north bank of the Peace River and comprise a mix of level river terraces currently used for forage and oilseed crops, which back onto steep warm (south) aspect valley wall slopes. The steep sloped portions of the subject lands are not cultivated but are used for cattle grazing. These slopes also provide winter habitat for moose, elk and mule deer, breeding habitat for a range of butterfly and bird species (e.g. Sharp-tailed Grouse, Northern Harrier, Short-eared Owl) and have the potential to provide reptile habitat.

Once the reservoir is filled, portions of the cultivated fields will be flooded creating a shallow water area with water depths less than 3m. This shallow water area, surrounding field and south facing sloped habitats are the focal point of the mitigation measures outlined in this plan.

[11] Parcels 48, 50, 52, 53, 54, 55, 56 and 57

H.2 Plan Objectives

The Wilder Creek Mitigation plan has the following objectives:

- Establish riparian wetland habitat in the portion of field inundated by the reservoir. A berm will be used to isolate the wetland from the reservoir and manage water levels (**Map 2**);
- Create additional pothole wetlands in the south-eastern corner of parcel 48 adjacent to the edge of the reservoir (**Map 2**);
- Establish a 15m band of riparian vegetation along the reservoir shore between the confluence of Wilder Creek with the reservoir and the edge of parcel 57 to the west;
- Provide littoral habitat for fish along the edge of the reservoir;
- Establish old field/ grassland habitat in portions areas that are currently in hay/pasture production;
- Retain and improve existing grain and oilseed fields;
- Manage agricultural lands in a manner that retains the suitability and availability of the steep slopes for ungulate use in late fall, winter and early spring.

H.2.1 Wetland Habitats

Wetland habitat will be created within those areas that will be inundated with reservoir creation. Approximately 128,500 square meters of habitat will be created. Water levels within the inundated portions will be controlled with a berm. The berm will be constructed to isolate a portion of the inundated area from the main body of the reservoir to create approximately 12ha of wetland habitat. An additional 11ha of shallow water riparian habitat 0-3m in depth will be created along the edge of the reservoir. Four clustered pothole wetlands, will be created in the south-eastern corner of the compensation area west of Wilder Creek (**Map 2**). Vegetation will be established, through plantings of native shrubs and trees, around the edge of the large wetland.

Wetland habitat creation will focus on characteristics to support:

- Amphibian (western toad) and dragonfly breeding;
- Nesting and foraging habitat for birds (swallows, raptors, songbirds, waterfowl);
- Roosting and foraging habitat for bats.

Detailed design of the wetland, shallow water riparian habitat and pothole wetlands – including maximum depth, side slope and internal contouring - will be finalized in 2013 based on consultation with the Canadian Wildlife Service and Ducks Unlimited. A detailed planting plan will also be developed in 2013 based on consultation with Ducks Unlimited, the Canadian Wildlife Service and Ministry of Environment. Fencing will be installed to exclude cattle from riparian and wetland areas.

H.2.2 Establishment of a 15m riparian vegetation zone along the edge of the reservoir

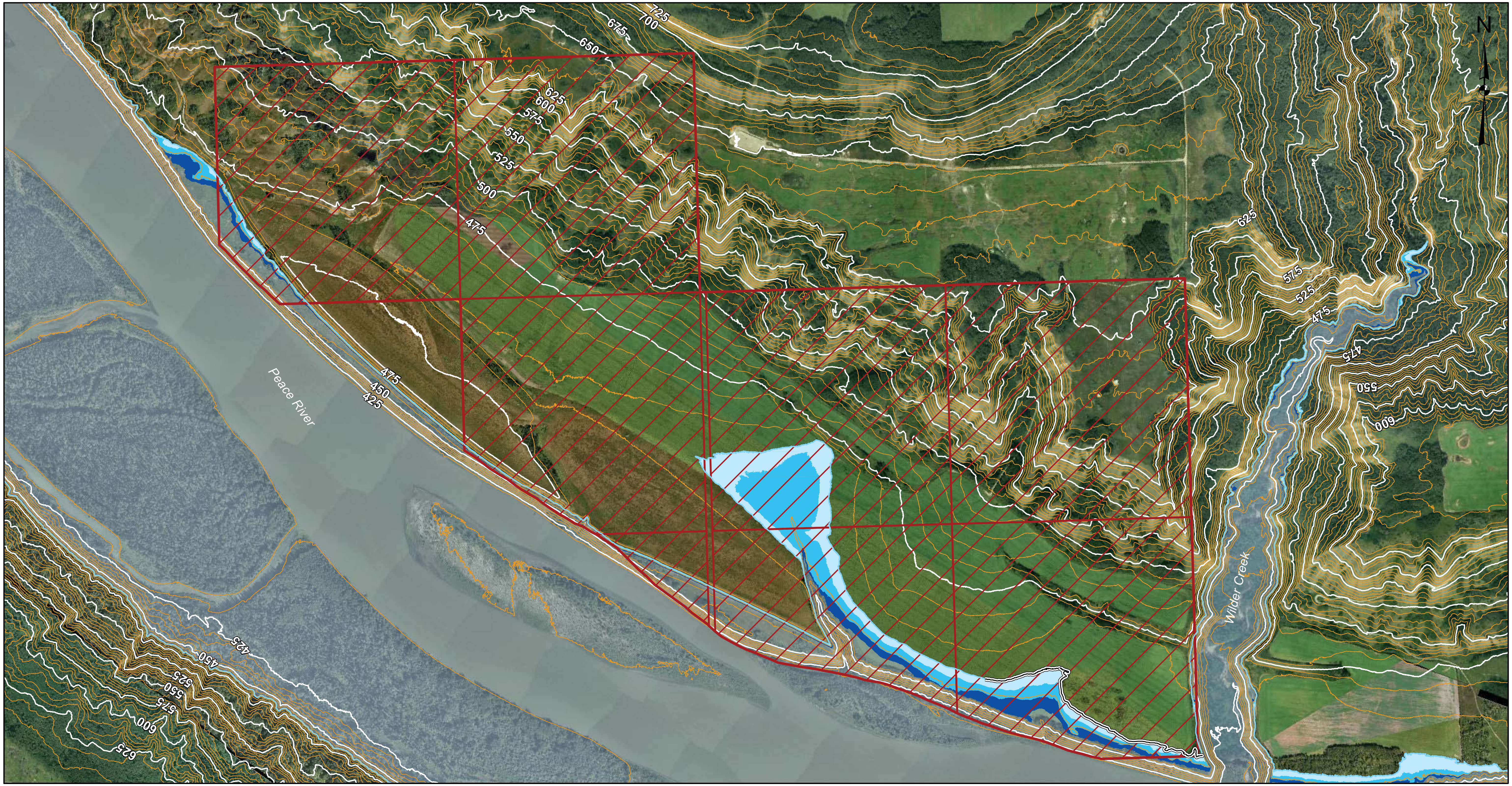
A 15 meter riparian vegetation zone will be established along the edge of the reservoir though planting of native shrubs and trees. The objective of establishing this zone is to replace deciduous and coniferous riparian vegetation lost due to reservoir creation. In the long term, the vegetation in this zone is expected to provide protection against erosion and provide nesting habitat for songbirds and cavity nesting birds and roosting habitat for bats. Consideration will also be given to creation of nest trees for Bald Eagles.

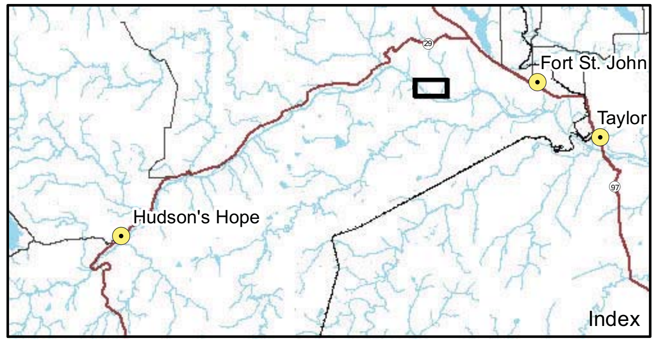
Installation of nest boxes for cavity nesting waterfowl and bat roost boxes will also be completed within this area. A maintenance plan will be developed to maintain the availability and effectiveness of the boxes.

H.2.3 Management of Agricultural lands and adjacent upslope areas

The majority of parcels 48, 50, 53, 55 and 56 are currently being used to produce forage, grain and oilseed crops. Portions of parcels 50, 54, 56 and 57 adjacent to the Peace River exhibit excessive stoniness and are used only for forage crops and pasture. Two management regimes will be implemented in the currently cultivated areas: the first will maintain intensive crop production on fields in parcels 48, 52, 53, 55, 56, and 57 after reservoir creation. The second will manage the stony portions of the fields along the river within parcels 50, 54, 56 and 57 as long-term forage and pasture. The stony areas of parcels 50, 54, 56 and 57 will be managed to provide old field-grassland habitat with a targeted vegetation height of 0.3 to 2.1 meters to provide breeding habitat for Short-eared Owl, Northern Harrier, Sharp-tailed Grouse and Common Nighthawk. A fence will be installed along the northern border of this area to manage livestock use. The fencing will not prohibit use by moose, elk or mule deer and will allow control of cattle and horse grazing wherein limited livestock use may be allowed in fall but would likely be prohibited in the spring and summer.

Sloped portions of parcels 48, 52, 53, 55, and 57 will be managed to retain their wildlife value.





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Orthophotos created from 1:40,000 photos taken Sept 10th, 2007; 1:15,000 photos taken Aug 26th, 2011 and 1:5,000 photos taken Aug 26th, 2011.
5. Property boundary locations are best available but should be considered approximate. Property information is a combination of surveyed data representing BC Hydro's current ownership records and ICIS data. Property data is current as of Sept 24th, 2012.
6. Proposed reservoir area (461.8 m maximum normal elevation), contours, and depths from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.

Legend

- BC Hydro Owned Land
- *Reservoir Depth*
  - 0-1 m
  - 1-2 m
  - 2-3 m
- Proposed Reservoir
- Intermediate Contour (1 m)
- Index Contour (25 m)

1:12,500

0 500 m

BC hydro

SITE C CLEAN ENERGY PROJECT

Map 1 - Wilder Creek Mitigation: BC Hydro lands

Date	Jan. 4, 2013	DWG NO	1016-C14-B6309-1	R 0

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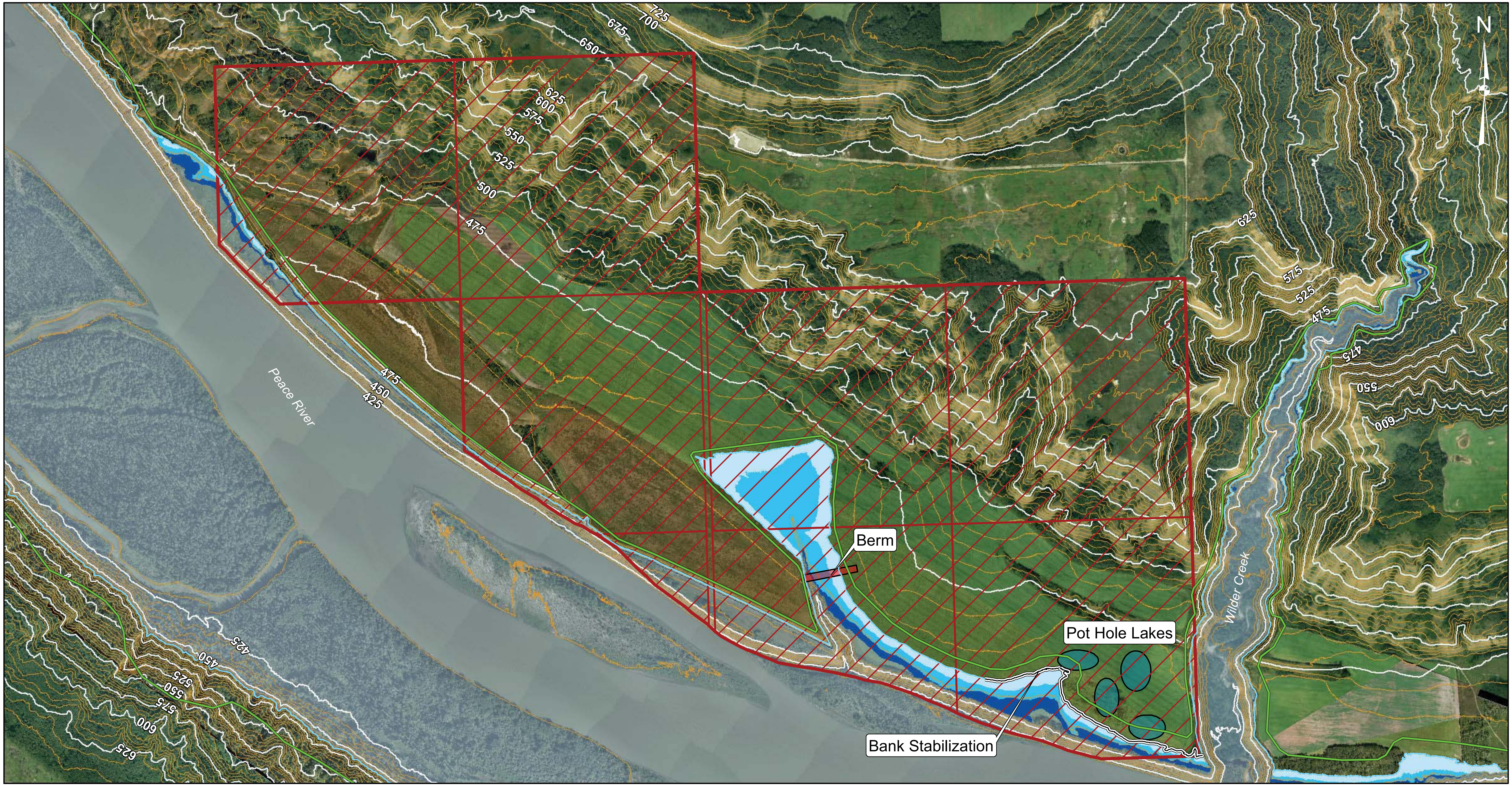

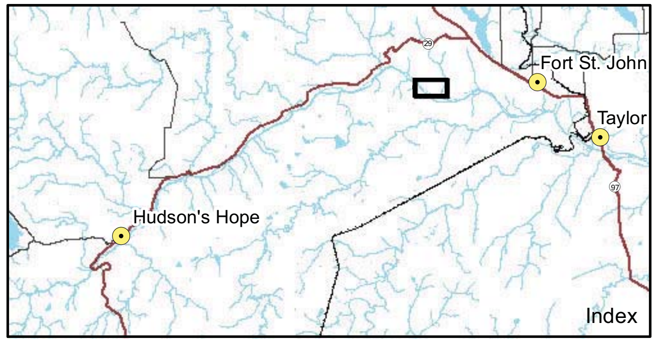

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Legend

BC Hydro Owned Land

Reservoir Depth
- 0-1 m
- 1-2 m
- 2-3 m

Proposed Reservoir
Preliminary Erosion Impact Line
Intermediate Contour (1 m)
Index Contour (25 m)

Wilder Creek Wetland Development
- Berm
- Pot Hole Lake
- Bank Stabilization

1:12,500

0 500 m

BChydro

SITE C CLEAN ENERGY PROJECT

Map 2 - Wilder Creek Mitigation: conceptual plan

Date	Jan. 4, 2013	DWG NO	1016-C14-B6309-2	R 0

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This report was prepared and reviewed by the undersigned:

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January 2013