Appendix 2. Marl Fen baseline vegetation and wildlife report

SITE C CLEAN ENERGY PROJECT

WILDLIFE, VEGETATION AND MAPPING INVENTORY

FOR THE MARL FEN PROPERTY

FINAL

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December 2014

Document Number: 06-138

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i) Information available at the time of preparation;

ii) Data collected by Keystone Wildlife Research Ltd. and/or supplied by outside sources; and

iii) The assumptions, conditions, and qualifications set forth in this report.

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LIST OF ACRONYMS

BC .... British Columbia
BCCDC .... British Columbia Conservation Data Centre
BEC .... Biogeoclimatic Ecosystem Classification
COSEWIC .... Committee on the Status of Endangered Wildlife in Canada
GPS .... Global Positioning System
Project .... Site C Clean Energy Project
RISC .... Resource Inventory Standards Committee
SARA .... Species at Risk Act
SD .... Secure Digital

1.0 INTRODUCTION

Through its passive acquisition program BC Hydro purchased a 1574 acre property consisting of three (3) parcels (termed the ―Property" for this report) for the purposes of wetland and wildlife mitigation, on January 7th, 2014. The legal descriptions of the Property are:

- Pcl 395.6: PID: 013-335-553 Legal: Parcel A (T41614) of District Lot 1200 Peace River District;
- Pcl 395.7: PID: 014-789-736 Legal: District Lot 1211 Peace River District, Except the West 80 Feet; and,
- Pcl 395.8: PID: 024-828-203 Legal: Block A District Lot 1210 Peace River District[1].

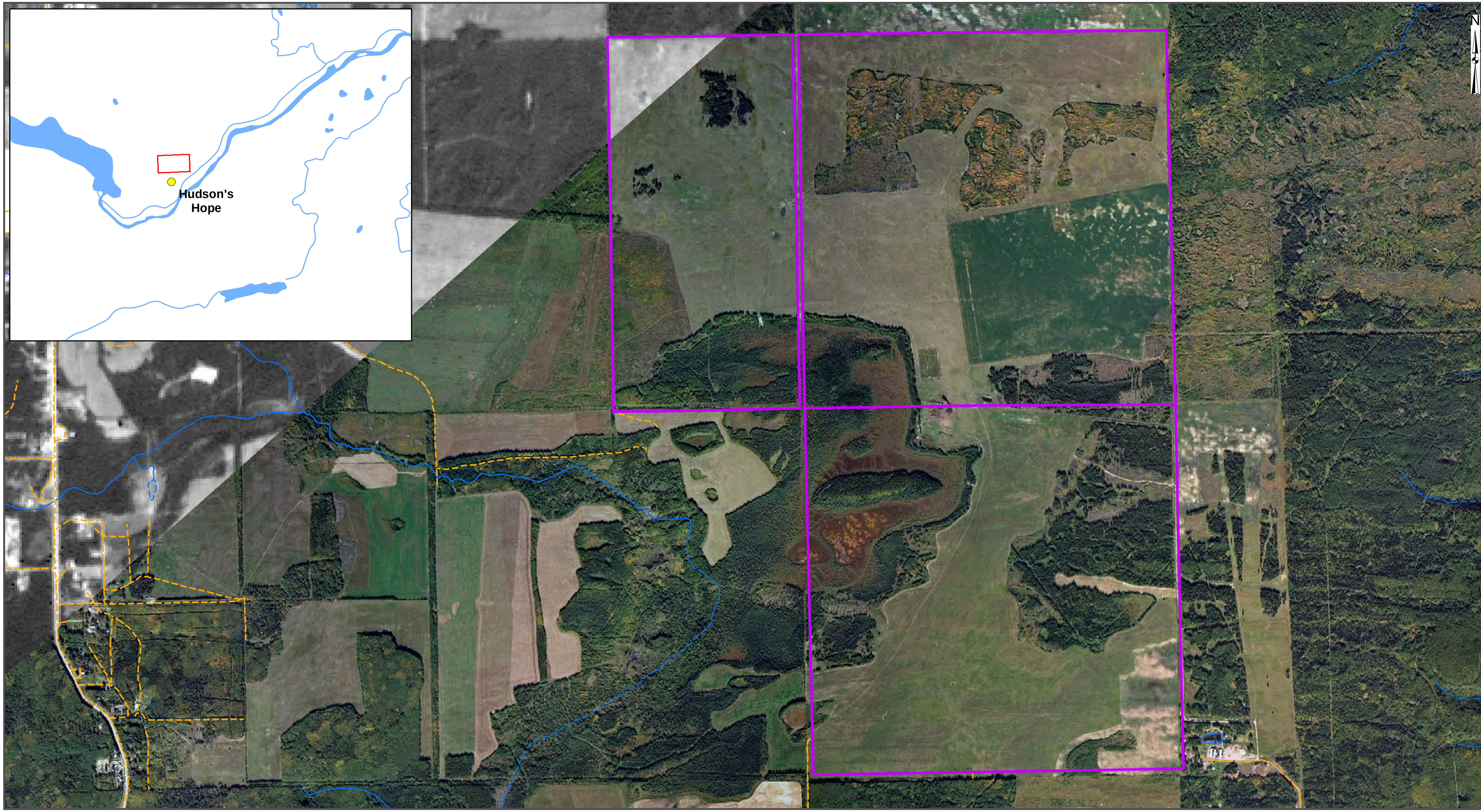
BC Hydro acquired the Property as it contains wetland habitat (**Map 1**) surrounded by cultivated field. As part of the pre-purchase work in 2012, baseline vegetation and wildlife surveys were conducted on the Property. These reconnaissance level surveys included surveys for the presence of rare plant species, dragonflies and damselflies, amphibians, breeding songbirds, Common Nighthawk, Short-eared Owl and Sharp-tailed Grouse (Keystone Wildlife Research Limited 2013). The presence of rare plants and wildlife species at risk was confirmed.

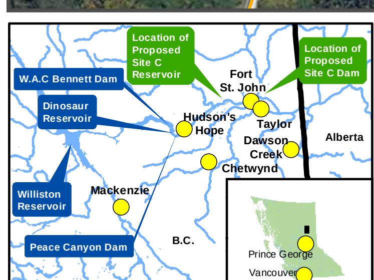
In support of development of a comprehensive Management Plan for the Property, additional mapping and inventory work was completed in 2014. This included detailed 1:5,000 scale Terrestrial Ecosystem Mapping (TEM) and additional surveys to provide further information on the presence and distribution of wildlife and rare plant species.

1.1 Study area

The Property is located approximately five kilometers northwest of Hudson's Hope (**Map 1**). The property contains 104 ha (256 acres) of wetland surrounded by 422 ha (1042 acres) of cultivated fields and 112 ha (276 acres) of forest. The Property is within the Peace Lowland Ecosection and the Boreal White and Black Spruce subzone variant (BWBSmw) (DeLong et al. 1990).

[1] This parcel was not surveyed in 2012 as it was added after field studies had commenced.





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

1:16,000

0 200 400 600 Meters

SITE C CLEAN ENERGY PROJECT

BC hydro

MAP 1: STUDY AREA

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-1	R 0

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

2.0 METHODS

A variety of field survey methods were utilized to complete vegetation and wildlife inventories on the Property. Surveys were completed in 2012 and 2014.

2.1 Terrestrial Ecosystem Mapping

Previous broad habitat mapping at a 1:20,000 scale had been completed for the general area of the Property in support of the Site C Project's Environmental Impact Statement. This mapping does not provide the fine resolution required for delineation of subtle differences in vegetation communities.

The TEM was produced at 1:5,000 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 (RIC) 1996), and *Standard for Terrestrial Ecosystem Mapping in British Columbia* (Resources Inventory Committee (RIC) 1998d) (**Appendix A**). Polygons were delineated based on vegetation, togographic and terrain features. The TEM for the Property was completed using the latest site series descriptions for the BWBSmw variant (DeLong et al. 2010). Outlined in **Appendix B** are the new TEM codes that correspond to old TEM codes used for previous mapping associated with the Site C Project.

Surveys targeted a level 1 sampling intensity (76-100% of polygons visited), following the methodology described in *A Field Guide to Ecosystem Identification for the Boreal White and Black Spruce Zone of British Columbia* (DeLong et al. 2010). Ground Inspection Forms and visual plots were completed (BC Ministry of Environment, Lands and Parks and BC Ministry of Forests 1998).

Field data were entered into a VENUS database. After initial quality assurance reviews, the bioterrain and ecosystem information in the map database and map linework were edited based on field data collected. Final map linework includes ecosection, variant, bioterrain and ecosystem unit.

2.2 Sensitive and At Risk Ecosystems

Sensitive ecological communities are those that may not be provincially listed but are ecologically fragile. Sensitive communities in the Peace Region have been defined as old-growth forests, tufa seeps, marl fens, grasslands, wetlands, and communities ranked

1 or 2 for the Goal 2 of the Conservation Framework (Hilton et al. 2013a). 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).

An ecological community can be defined as a natural plant community and its associated environmental site characteristics including soil, landform, nutrient, and moisture regimes. Ecological communities at risk (ECAR) are defined and ranked by the BC CDC and placed on the provincial Red- or Blue-list according to the degree of threat, trend in the area, number of protected and managed occurrences, intrinsic vulnerability, specificity of habitat requirement, as well as other considerations (BC Conservation Data Centre 2004). The BC CDC has identified thirteen ECAR that could potentially occur in BWBSmw in the Peace Forest Region (**Table 2.1**) (BC Conservation Data Centre 2014a). These include nine wetland communities, four forested communities and one floodplain community.

Table 2.1 ECAR associated with BWBSmw

Scientific Name	Common Name	Site Series Association	BC List
Picea mariana / Vaccinium vitis-idaea / Sphagnum spp.	black spruce / lingonberry / peat-mosses	Wb03	Blue
Larix laricina / Carex aquatilis / Tomentypnum nitens	tamarack / water sedge / golden fuzzy fen moss	Wb06	Blue
Picea mariana / Equisetum arvense / Sphagnum spp.	black spruce / common horsetail / peat-mosses	Wb09	Blue
Betula nana / Carex aquatilis	scrub birch / water sedge	Wf02	Blue
Larix laricina / Menyanthes trifoliata - Carex limosa	tamarack / buckbean - shore sedge	Wf18	Blue
Typha latifolia Marsh	common cattail Marsh	Wm05	Blue
Picea glauca - Picea mariana / Rhododendron groenlandicum / Aulacomnium palustre	white spruce - black spruce / Labrador-tea / glow moss	Ws15	Blue
Juncus arcticus - Puccinellia nuttalliana - Suaeda calceoliformis	arctic rush - Nuttall's alkaligrass - seablite	00*	Red
Muhlenbergia richardsonis - Juncus arcticus - Poa secunda ssp. *juncifolia*	mat muhly - arctic rush - Nevada bluegrass	00*	Red
Picea glauca / Gymnocarpium dryopteris - Aralia nudicaulis	white spruce / oak fern - wild sarsaparilla	110	Blue
Picea glauca / Ribes triste / Equisetum spp.	white spruce / red swamp currant / horsetails	111	Blue
Populus balsamifera - Picea glauca / Alnus incana - Cornus stolonifera	balsam poplar - white spruce / mountain alder -	112	Blue

Scientific Name	Common Name	Site Series Association	BC List
	red-osier dogwood		
Salix exigua Shrubland	narrow-leaf willow Shrubland	Fl06	Red

*Site unit not associated with Ministry of Forest site series classification.

ECAR are usually associated with one or more specific site series that have the potential to support the community in question (**Table 2.1**). Initially, ECAR were identified on the Property using the TEM mapping. During field truthing an ECAR was determined to be present if the characteristic vegetation and physiognomic structure was present at a site. The high sampling intensity allowed many rare and sensitive ecosystems to be identified on the ground. Field data was extrapolated to sites that were not visited, but were classified in the TEM as a site series associated with an ECAR. For these sites the range of natural variation associated with each ecosystem and how natural and anthropogenic disturbance might affect the function of the ecosystem was considered to determine if an ECAR was likely present. Both the BEC field guide and field observations were considered to make this determination (DeLong et al. 2010).

2.3 Rare Plant Inventory

Rare plant field surveys were conducted on the Property in 2012 and 2014. For the purposes of these investigations, ―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 2014); and
- species on the BC Conservation Data Centre's (BC CDC) provincial Red- or Blue-lists (BC Conservation Data Centre 2014a).

No formal provincial standards exist for conducting rare plant inventories in BC other than for the collection of voucher specimens (Resources Inventory Committee (RIC) 1999b). Guidelines for conducting rare plant inventories have been developed by a number of organizations in North America; the methods used for the rare plant work on the Property are based on a synthesis of several of these guidelines (Bizecki-Robson

1998; Whiteaker et al. 1998; Alberta Native Plant Council 2000; Alberta Native Plant Council 2012; California Native Plant Society 2001; Henderson 2009; Penny and Klinkenberg 2012) and are consistent with previous baseline data collection methods.

In 2012 and 2014 the rare plant investigations began with an office-based pre-field review designed to guide the methods, survey coverage, and timing for the work on the Property. The first step was to prepare a list of the rare plants either already known to occur in the Peace Region, or with a global range that is likely to include the Property. The following sources were consulted:

- BCCDC records of known rare plant occurrences in the vicinity of the Property (BC Conservation Data Centre 2014c; BC Conservation Data Centre 2014d);
- element occurrence data collected during the multi-year rare plant surveys that were conducted during the preparation of the Site C Project EIS;
- species distribution maps on the Electronic Atlas of the Flora of British Columbia website (Klinkenberg 2014);
- published floras (Hitchcock et al. 1955; Lawton 1971; Flora of North America Editorial Committee 1993; Goward 1994; Cody 1996; Douglas et al. 1998; Goward 1999); and
- online databases (BC Conservation Data Centre 2014a; NatureServe 2014).

These data were compiled to produce a list of the target rare plant species with potential for occurrence on the Property. It should be noted that the target list is used as a working guideline and is not intended to be an exhaustive list of all potential rare plants. For this reason, the surveyors considered all described plant taxa while conducting surveys. The completed field plans specified the target plant species and their likely habitats, the areas to be surveyed, and the timing window for those surveys.

The surveys were performed by two botanists from Eagle Cap Consulting Ltd. with extensive experience working with the rare plant and vegetation resources of the boreal region in general and the Site C Regional Assessment Area in particular.

The surveyors used the intuitive-controlled search protocol (Whiteaker et al. 1998) for all rare plant work conducted on the Property. The intuitive-controlled search pattern is designed to locate the majority of rare plant occurrences within a limited geographic area.

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.

The intuitive-controlled survey technique is habitat-directed and preferentially covers high-suitability ecosystems over the more common low-suitability habitats (MacDougall and Loo 2002). The survey method is also floristic in nature and all plant taxa encountered are recorded and identified to a level necessary to determine their rarity (Alberta Native Plant Council 2012). Furthermore, the intuitive-controlled search pattern is of variable-intensity, and when 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. 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.

During the field work, the surveyors monitored all areas traversed for changes in habitat and plant association as well as for previously unrecorded plant species (common and rare). Lists were kept of all plants and plant communities observed. Unknown species were collected for later identification in the lab. A global positioning system (GPS) unit was used to mark location points as appropriate in addition to notes and photographs taken to record plants of interest, landforms and unique features, habitat quality and disturbance, and areas requiring further survey.

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 2012a). The CDC defines a single rare plant occurrence as any population or populations found within 1 km of each other. An occurrence can contain several sub-occurrences or sub-populations (NatureServe Explorer 2004). Occurrence data were 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 (RIC) 1999b; Penny and Klinkenberg 2012), a voucher specimen was collected when doing so would not compromise the viability of the population. At each site, GPS units were used to record the boundary of each occurrence (and sub-occurrence where applicable).

2.4 Amphibians

Amphibian surveys in both 2012 and 2014 were based on protocols outlined in *Inventory Methods for Pond-breeding Amphibians and Painted Turtles* (Resources Inventory Committee 1998c). Systematic searches for egg masses were conducted to document use of wetland habitat for breeding (Resources Inventory Committee 1998c). The shoreline and shallow sections potentially suitable for amphibian breeding were searched during the day. Habitat attributes collected at each site included location (UTM NAD 83), size of water body, percent open water, percent solar exposure, duration of habitat, water condition (turbidity), air and water temperature and percentage of the habitat surveyed. Surveyors attempted to completely survey each area. Habitat types were associated with TEM polygons after field work was completed[2].

All egg masses, tadpoles and metamorphosed amphibians detected during surveys were recorded. Attributes recorded for observations included species, development stage, count, aggregate (egg mass) size, length (tadpoles and adults), distance from shore to observation, and average water depth.

General survey conditions were recorded at the start and end of all surveys, including cloud cover, ambient air temperature, precipitation and wind speed. Information was recorded on RISC standard data forms modified for this project.

[2] TEM polygons were not delineated when amphibian field work commenced so surveyed wetlands could only be associated with specific TEM polygons once the TEM was finalized.

2.5 Avian Surveys

2.5.1 Breeding Bird Surveys

Surveys in 2014 focused on habitats, particularly wetlands, not inventoried in 2012. Habitats expected to support use by rare birds were targeted.

Surveys followed the methodology in *Inventory Methods for Forest and Grassland Songbirds* (Resources Inventory Committee (RIC) 1999a).

Point counts were completed by a crew of two surveyors, beginning at sunrise and continuing for up to four hours. Point count stations were placed a minimum of 200 m apart so records at each station were independent of each other. Surveyors remained at each station for 5-minutes, during which time all bird species observed or heard were recorded.

Surveys targeting marsh birds started 30 minutes before sunrise at point count stations immediately adjacent to suitable marsh bird habitat.

All bird species seen or heard at point count stations during both breeding bird and marsh bird surveys were recorded; any observations made between stations were recorded as incidentals. Information was recorded on RISC standard data forms modified for this project. UTM coordinates (NAD 83), start and stop time and weather conditions (wind, cloud cover, precipitation, and temperature) were recorded for each point count station. For each detection, sex, age class, and call type were recorded whenever possible. Distance and direction to the initial detection location were estimated.

2.5.2 Sharp-tailed Grouse

The focus for 2014 survey efforts was to determine if a Sharp-tailed Grouse lek was present on the Property. Survey methods were based on *Inventory Methods for Upland Gamebirds* (Resources Inventory Committee (RIC) 1997).

Transects and associated survey stations were completed in early spring to maximize the opportunity for detecting and observing birds. Point count stations were located at 800 m intervals; surveyors also intuitively wandered the area surrounding the transect to search for lek sites. Surveys were initiated from 30 minutes before sunrise until 2 hours after sunrise. Two surveyors listened for sounds of displaying males for 3 minutes at each station. All Sharp-tailed Grouse observed were recorded and any congregation of Sharp-tailed Grouse observed was recorded as a lek.

Information was recorded on RISC data forms modified for this project. UTM coordinates (NAD 83), start and stop time and weather conditions (wind, cloud cover, precipitation, and temperature) were recorded for each station. If a grouse was observed, the species, sex and age class were recorded, whenever possible. The distance and direction to the initial detection location was estimated.

2.5.3 Common Nighthawk

Call-playback surveys for Common Nighthawks followed methods outlined in *Inventory Methods for Nighthawk and Poorwill* (Resources Inventory Committee (RIC) 1998b). Surveys were completed during the evening crepuscular period and transects were located in habitat suitable for Common Nighthawk. Stations were separated by 400 m.

At each station, a recording of a male nighthawk was broadcast to elicit a response from territorial males in the area. Five to six calls were broadcast in a series, followed by at least 30 seconds of silence, during which surveyors listened for a response. This sequence was repeated to achieve a total station survey time of five minutes. Surveys were not completed in inclement weather (wind >2, heavy rain, temp <7^{o}C).

Information was recorded on RISC data forms modified for this project. UTM coordinates (NAD 83), start and stop time and weather conditions (wind, cloud cover, precipitation, and temperature) were recorded for each station.

2.5.4 Short-eared Owl

Short-eared Owl surveys were conducted in accordance with the methods outlined in *Inventory Methods for Raptors* (Resources Inventory Committee 2001). Vehicle encounter transects were completed. Two observers drove at a low speed (not exceeding 40 km/hr) while scanning the surrounding suitable habitat for owls. Surveys were not completed in inclement weather conditions (wind speed >20km/hr, steady rain).

Information was recorded on RISC data forms modified for this project. UTM coordinates (NAD 83), start and stop time and weather conditions (wind, cloud cover, precipitation, and temperature) were recorded for each transect.

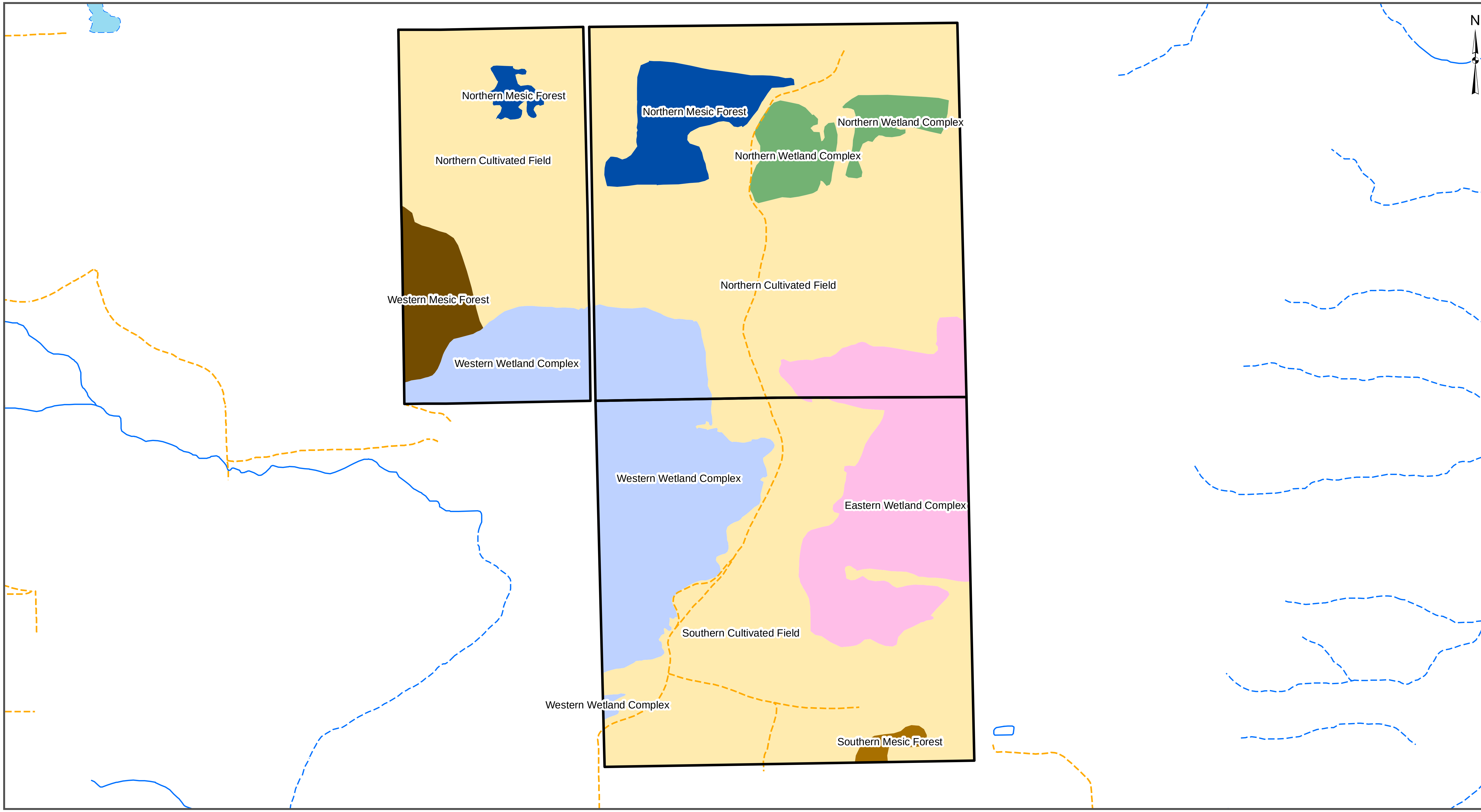
2.6 Bats

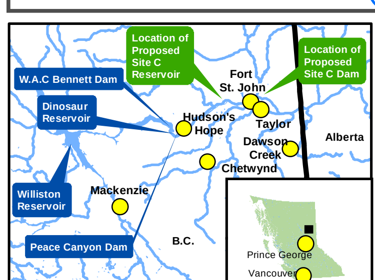
Survey work was completed in 2014 to determine bat species presence and general activity. Two SM-2 bat acoustic detectors (Wildlife Acoustics Ltd.) were installed near potentially suitable habitat. Inventory methods generally followed the *Inventory Methods for Bats* - taking into consideration advances in acoustic detection technology in the last 16 years (Resources Inventory Committee (RIC) 1998a). One detector was programmed to begin recording 30 minutes before sunset and stop recording 30 minutes after sunrise, allowing sampling to occur all night. The other detector was programmed to begin recording 30 minutes before sunset and stop recording 4 hours after sunset, the period of greatest bat activity. Limiting the sampling time to 4.5 hours increases the battery life of the detector, reducing the number of days potentially ―missed" between visits. Data were stored as .wac files on SD cards that were downloaded approximately every 10 to 14 days. The downloaded files were converted to zero-crossing files using Wildlife Acoustics' Kaleidoscope conversion software. The zero-crossing files were filtered and labelled by species group using Analook software, filters, and the professional judgement of an experienced bat biologist, and tabulated for analysis.

3.0 RESULTS

The data summaries presented below include results for the 2014 field program, as well as all relevant results from 2012.

The TEM polygons were grouped into 7 distinct areas with similar ecosystem attributes (**Map 2**). Three general habitat types were identified: wetlands, mesic forests, and cultivated fields. Rare plants and wildlife associated with each general habitat type and distinct area are summarized in the results. A summary of TEM polygons within each distinct area can be found in **Appendix D**.





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- Cultivated Field
- Eastern Wetland Complex
- Northern Mesic Forest
- Northern Wetland Complex
- Southern Mesic Forest
- Western Mesic Forest
- Western Wetland Complex

1:16,000

0 200 400 600 Meters

MAP 2: DISTINCT AREAS AND GENERAL HABITAT TYPES

DATE	NOVEMBER 14, 2014	DWG NO	1016-C14-B4574-15	R 0

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

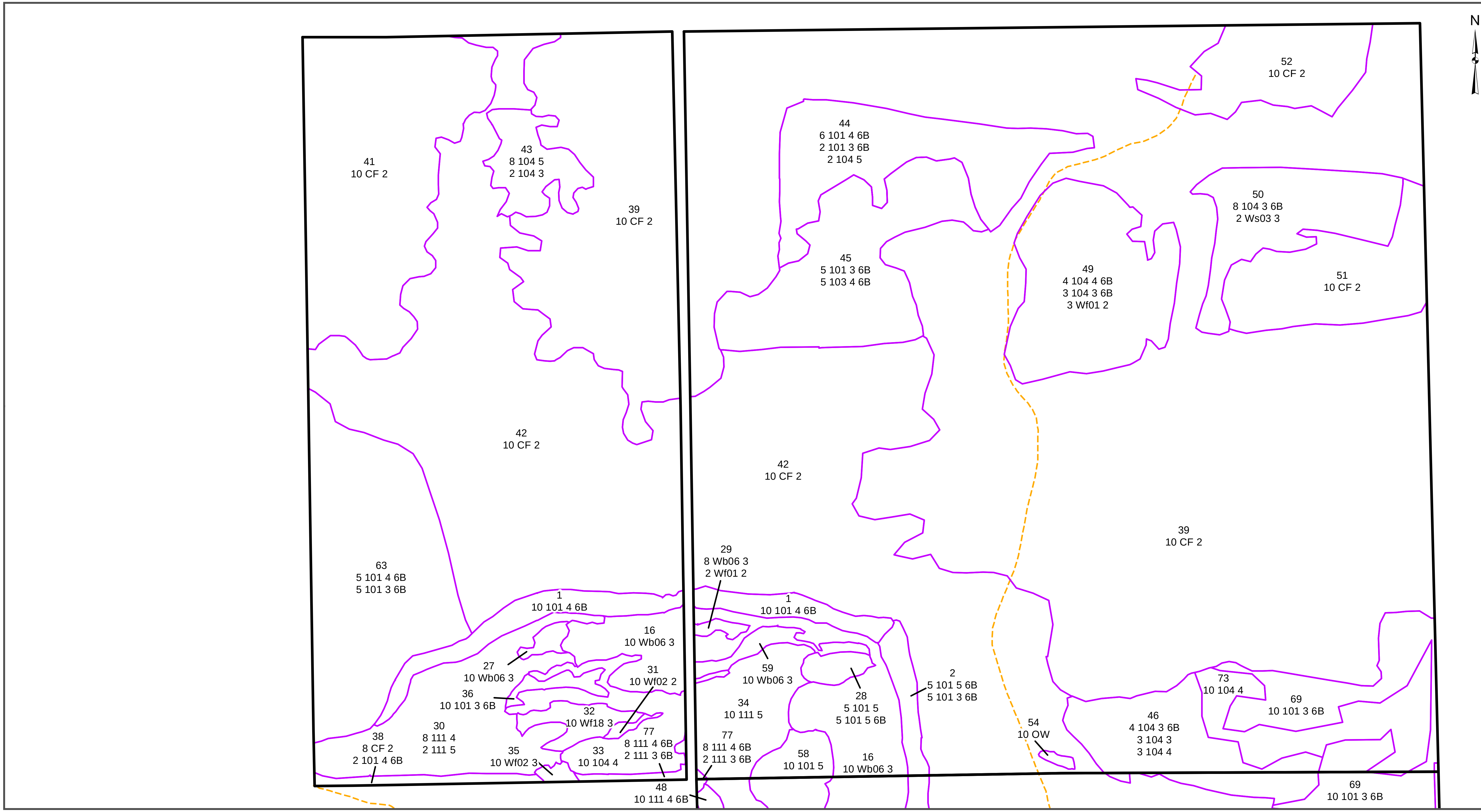
3.1 Terrestrial Ecosystem Mapping

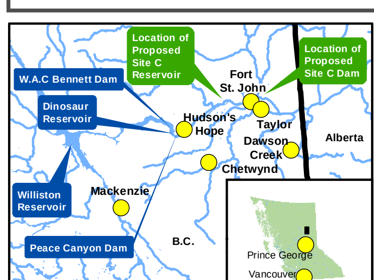
Seventy-five ecosystem polygons were delineated based on bioterrain and ecosystem attributes as per RIC standards (1998d) (**Map 3, Map 4**). Field truthing took place from August 24 to 27, 2014. A total of 9 Ground Inspection Forms and 64 visual plots were completed, resulting in 97% visitation of mapped polygons. This meets the target survey intensity of 76-100% for level 1 sampling (Resources Inventory Committee (RIC) 1998d), although no full plots were completed. The TEM for the Property was completed using the latest site series descriptions for the BWBSmw variant (DeLong et al. 2010). **Appendix B** correlates old and new TEM site series descriptions.

The Property is within the BWBSmw ecosystem. The majority (400 ha or 63%) of the Property is cultivated field (**Table 3.1**). A detailed summary of ecosystems on the Property by structural stage and site modifier is provided in **Appendix C**.

Table 3.1 Mapped Ecosystem Areas within the Property

Ecosystem Unit	Map Code	Seral Stage	Total Area (ha)	Comments
00	CF		399.5	
00	OW		0.5	
101			15.7	non-seral
101		6B	62.1	seral
103			2.2	non-seral
103		6B	9.3	seral
104			58.7	non-seral
104		6B	21.1	seral
111			14.3	non-seral
111		6B	1.0	seral
Wb06			25.9	
Wb09			5.9	
Wb09			2.7	
Wf01			8.0	
Wf02			0.9	
Wf10			6.5	
Wf18			3.8	
Wm01			0.2	
Wm05			<0.1	
Ws03			1.8	
TOTAL			**637.3**	





Map Notes:
1. Datum: NAD83
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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, 2014.

LEGEND

Property Boundary
Road/Track

Wildlife Data

TEM Polygon

1:8,000

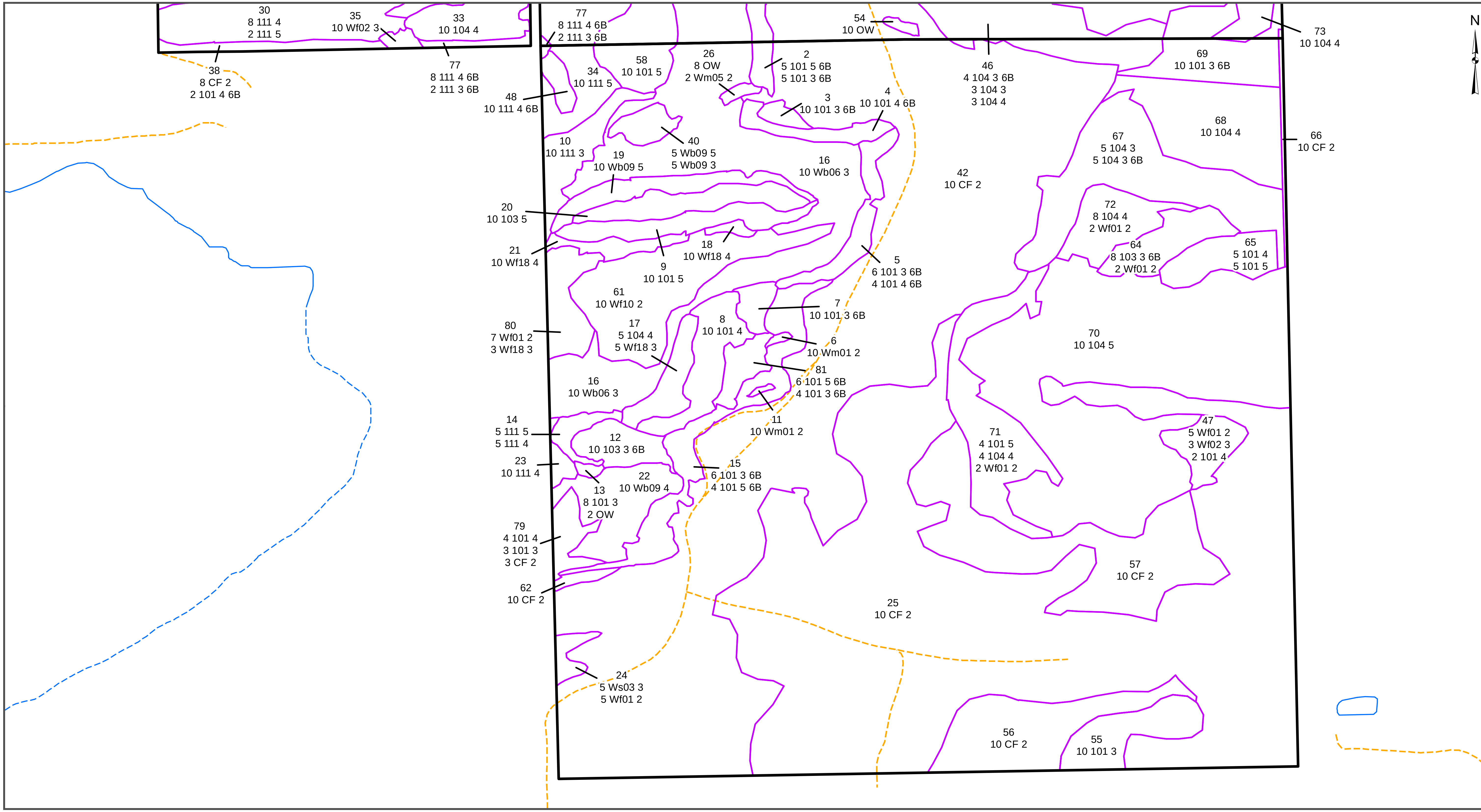
0 200 Meters

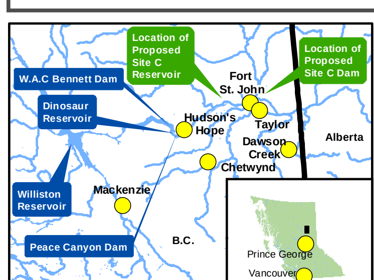
SITE C CLEAN ENERGY PROJECT

MAP 3: TERRESTRIAL ECOSYSTEM MAPPING OF THE NORTHERN PORTION OF THE PROPERTY (BIOTERRAIN LABELS HAVE NOT BEEN INCLUDED)

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-2	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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- TEM Polygon

1:8,000

0 200 Meters

BC hydro

SITE C CLEAN ENERGY PROJECT

Keystone

MAP 4: TERRESTRIAL ECOSYSTEM MAPPING OF THE SOUTHERN PORTION OF THE PROPERTY (BIOTERRAIN LABELS HAVE NOT BEEN INCLUDED)

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-3	R 0

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

3.2 Rare and Sensitive Ecosystems

Sensitive ecological communities that occur on the property include marl fens, grasslands and wetlands. No old growth forest, tufa seeps or communities ranked 1 or 2 for the Goal 2 of the Conservation Framework were documented on the Property.

Marl fens are a special class of calcareous fens that are not typically associated with any site series, with one exception being the Hudson's Bay clubrush/rusty hook moss (Wf10) which is often underlain by calcareous marl (MacKenzie and Moran 2004). Instead they are associated with a substrate of non-acidic peat and dependent on a constant supply of calcium rich and oxygen poor ground water (Minnesota Department of Natural Resources 2011). Areas of heavily concentrated Marl precipitate were documented in the western wetland complex. These calcareous fens exist within the larger fen complex and are present due to local conditions that allow the marl to accumulate.

In the BWBSmw, grasslands are infrequent, except on the Peace River breaks where they are locally common and associated with steep, warm aspect slopes (DeLong et al. 2010). Although the cultivated field is providing habitat to grassland dependant species it is not considered a sensitive ecosystem since it does not have the physical characteristics of the native grasslands in the region.

Three wetland complexes were documented on the Property. Wetlands are vulnerable to changes in hydrological regime, pollutants, siltation, compaction by livestock and vehicles, and the effects of exotic vegetation species. Seven of the nine wetland types occurring on the Property are also provincially listed. The other two site associations, Water sedge/ Beaked sedge (Wf01) and Beaked sedge / Water sedge (Wm01), are the most common and widespread in the province (MacKenzie and Moran 2004). The western wetland complex was the largest, most diverse wetland on the Property. There appeared to be minimal disturbance to this wetland complex, except along the periphery. The northern and eastern wetland complexes were more common wetland types and were in poor condition, due primarily to cattle grazing. Several smaller, unmapped wetlands were also present on the Property. These wetlands are not represented in the mapping, either because they were too small to be delineated or because they are so heavily disturbed that they were not evident during air photo interpretation.

Of the thirteen ECAR expected to occur in the BWBSmw, six occur on the Property (**Table 3.2)**. Two additional ECAR were found on the Property that are listed but are not expected to occur in the BWBSmw biogeoclimatic zone. This can occur if the ecological community occurs in areas that have not been sampled or if the CDC does not have data on the occurrence of this community in the Biogeoclimatic zone. These ecosystems were mapped in consultation with the regional ecologist.

Table 3.2 ECARs on the Property

Common Name	Site Series Assoc.	BC List	ha	# Field Plot	Location
Tamarack / water sedge/Fen Moss	Wb06	Blue	25.9	5	Western Wetland Complex
Black spruce / common horsetail / Sphagnum	Wb09	Blue	5.9	3	Western Wetland Complex
Scrub birch / water sedge	Wf02	Blue	0.9	3	Eastern and Western Wetland Complex
Hudson Bay clubrush-Rusty hook-moss	Wf10	Red*	6.5	1	Western Wetland Complex
Tamarack/ buckbean-shore sedge	Wf18	Blue	3.8	5	Western Wetland Complex
Common cattail marsh	Wm05	Blue	0.04	0	Western Wetland Complex
Bebb's Willow – Bluejoint	Ws03	Blue*	1.8	1	Northern Wetland Complex
White Spruce / red swamp currant / horsetails	111	Blue	15.3	7	Western Wetland Complex

*CDC does not list association in the BWBSmw

All ECAR were documented in wetland complexes, with most occurring in the western wetland complex. Twenty-eight field plots were completed, sampling all rare ecosystems except the Wm05 which was mapped in one small polygon in the western wetland complex. Field plots confirmed the occurrence of the rare ecosystem in 88% of the plots sampled.

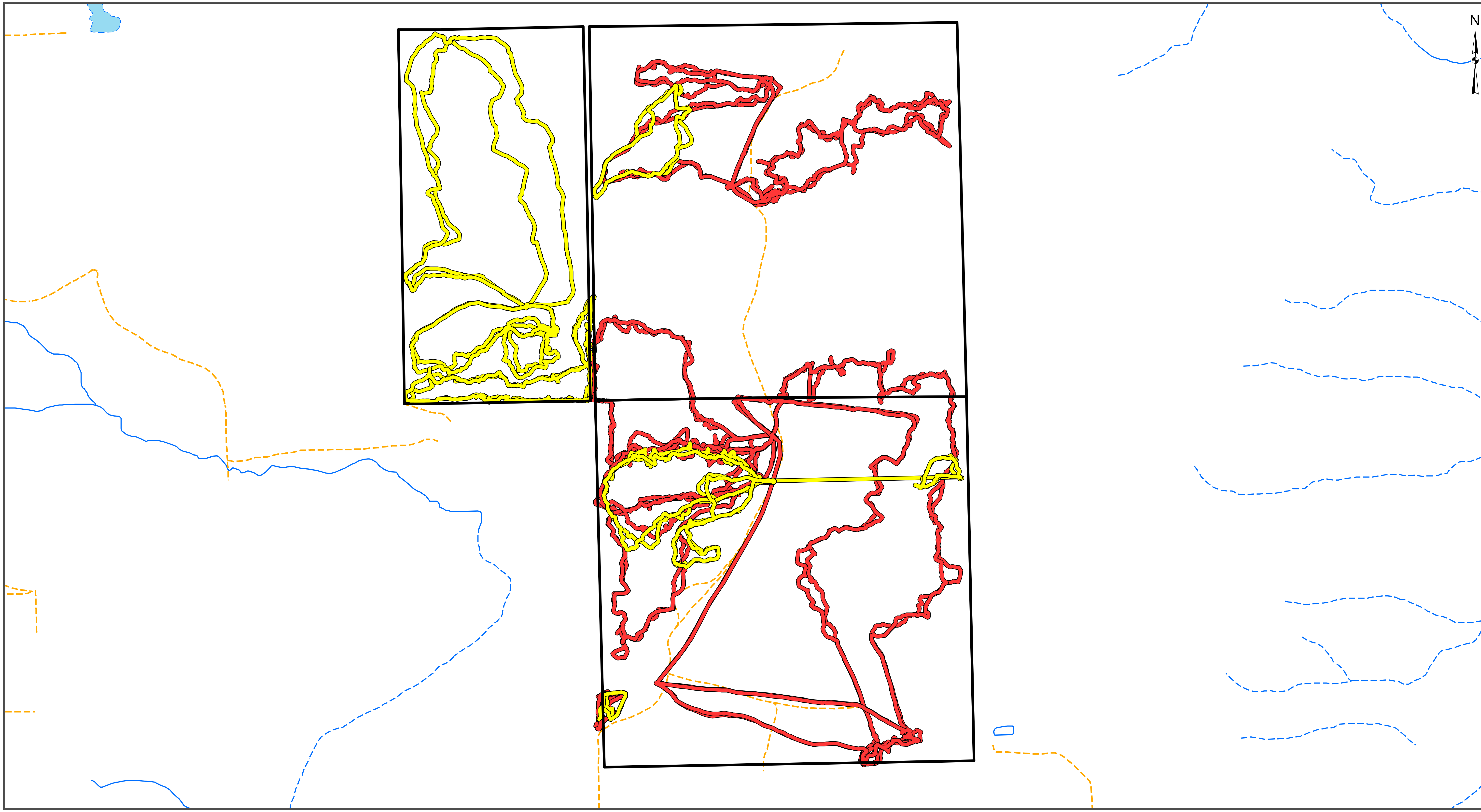
3.3 Rare Plant Inventory

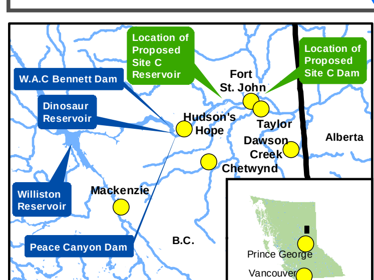
The field surveys were conducted during the following periods:

- July 17 through 20, 2012

- August 15, 2012
- July 26 through 28, 2014

A total of 28 intuitive-controlled survey transects were walked, covering a cumulative distance of 94.7 kilometres (**Map 5**).





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- Rare Plant Transect - 2012
- Rare Plant Transect - 2014

1:16,000

0 200 400 600 Meters

BC hydro

SITE C CLEAN ENERGY PROJECT

MAP 5: RARE PLANT TRANSECTS

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-4	R 0

3.3.1 Pre-field Review

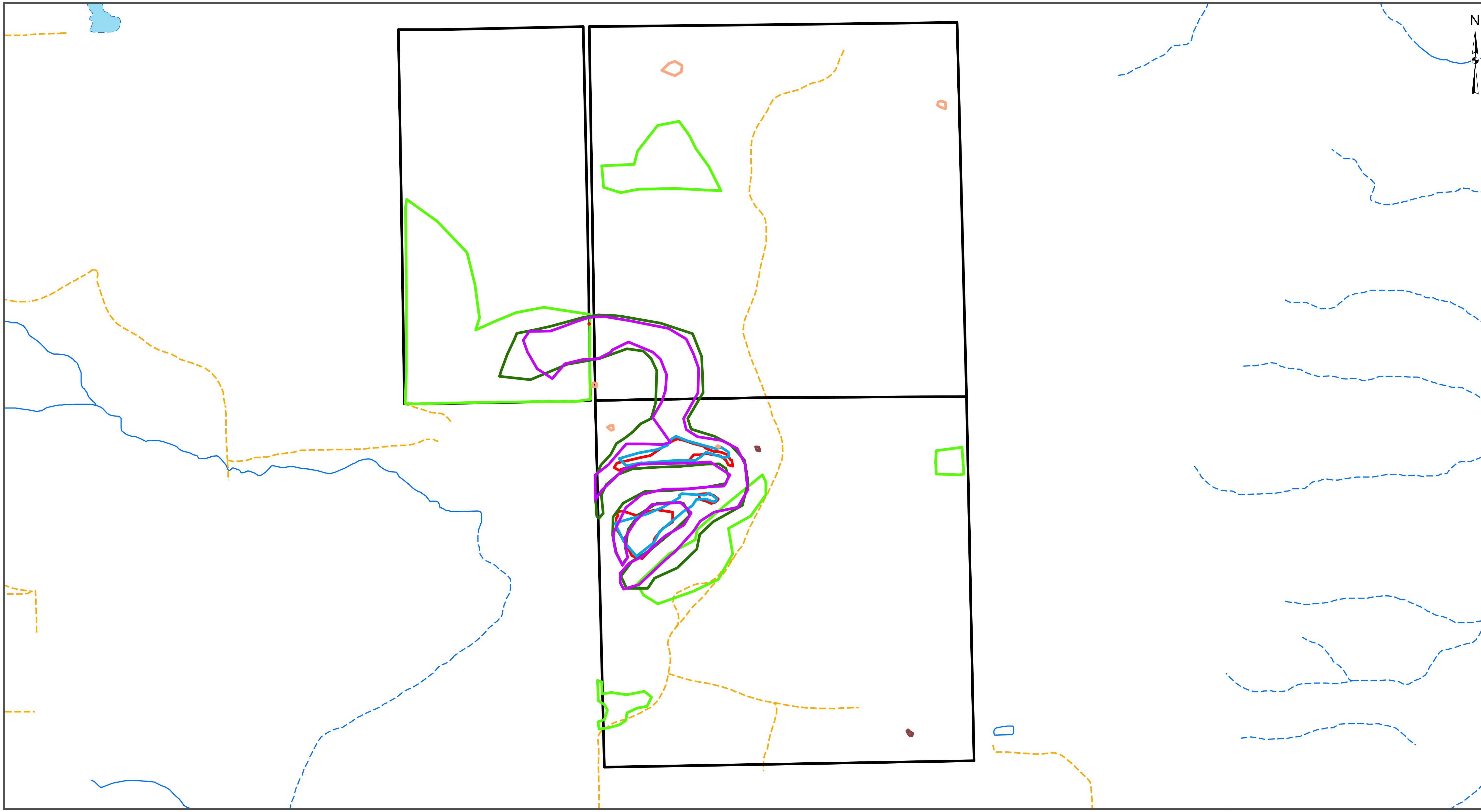
The pre-field review did not uncover any previously known rare plant occurrences on the Property. Analysis of vegetation maps and aerial imagery indicated the presence of habitats capable of supporting various rare plant species. In total 186 rare plant species thought to have potential for occurrence in the vicinity of the Property were identified (**Appendix E**).

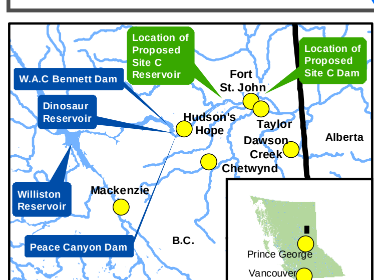
3.3.2 Field Surveys

The field surveys located eleven occurrences of seven different vascular rare plant species (**Table 3.3, Map 6**). Two are on the BCCDC's Red list, with the remaining five on the Blue list. None are SARA or COSEWIC listed. Species accounts for each of the seven rare plant taxa found on the Property are presented in **Appendix G**. A comprehensive list of all plant species observed during surveys is presented in **Appendix F**. Twenty-five voucher species were collected on the Property in 2012 and 2014.

Table 3.3 Rare Plant Occurrences on the Property

Taxon	Common Name	BC List	Occurrences	Location
Castilleja miniata var. fulva	Tawny Paintbrush	Red	1	Eastern Wetland Complex Western Wetland Complex Northern Mesic Forest Western Mesic Forest
Drosera linearis	Slender-leaf Sundew	Red	1	Western Wetland Complex
Galium labradoricum	Northern Bog Bedstraw	Blue	1	Western Wetland Complex
Juncus stygius ssp. americanus	Bog Rush	Blue	1	Western Wetland Complex
Pedicularis parviflora ssp. parviflora	Small-flowered Lousewort	Blue	1	Western Wetland Complex
Salix serissima	Autumn Willow	Blue	2	Western Wetland Complex Southern Mesic Forest
Symphyotrichum puniceum var. puniceum	Purple-stemmed Aster	Blue	4	Northern Wetland Complex Western Wetland Complex Northern Mesic Forest





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- Castilleja miniata var. fulva
- Drosera linearis
- Galium labradoricum
- Juncus stygius ssp. americanus
- Pedicularis parviflora ssp. parviflora
- Salix serissima
- Symphyotrichum puniceum var. puniceum

1:16,000

0 200 400 600 Meters

SITE C CLEAN ENERGY PROJECT

BC hydro

MAP 6: RARE PLANT SPECIES

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-14	R 0

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

3.4 Amphibians

In 2012, two wetlands were surveyed for western toads on April 28 and May 2 (**Map 7**). Survey effort was recorded as person-hours, with a total effort of 2 hours in April and 40 minutes in May (**Table 3.4**).

In 2014, surveys for western toads were completed in five distinct areas (**Map 7**). Surveys took place on May 14 and 16, June 3, and July 7. Survey effort was recorded as person hours, and ranged from 6 minutes to as many as 3 hours 8 minutes (**Table 3.4**). Total person-hour survey time in 2014 was 15 hours 56 minutes.

Weather conditions varied between survey dates, with air temperatures ranging from 11 to 25 ^{o}C and water temperatures ranging from 9.5 to 27.5 ^{o}C. There was no precipitation recorded during any of the surveys.

Table 3.4 Systematic Amphibian Wetland Surveys in 2012 and 2014

Distinct Location	Number of Surveys	Total Survey Time	Total Person-time
2012			
Western Wetland Complex	1	1:00	2:00
Western Wetland Complex	1	0:20	0:40
Total in 2012		**1:20**	**2:40**
2014			
Eastern Wetland Complex	7	1:41	3:22
Northern Cultivated Field	3	1:14	2:28
Northern Mesic Forest	2	0:18	0:36
Northern Wetland Complex	2	0:55	1:50
Western Wetland Complex	7	3:50	7:40
Total in 2014		**7:58**	**15:56**

In 2012, no western toads were detected during the systematic wetland surveys. Two boreal chorus frogs were heard calling and one wood frog was visually observed.

Two juvenile western toads were detected during the systematic wetland surveys in 2014. Both of the individuals were in the western wetland complex. Four boreal chorus frogs and 50 wood frogs were also recorded during surveys. Two juveniles and >2,500 tadpoles of an unidentified species were also observed (**Table 3.5**).

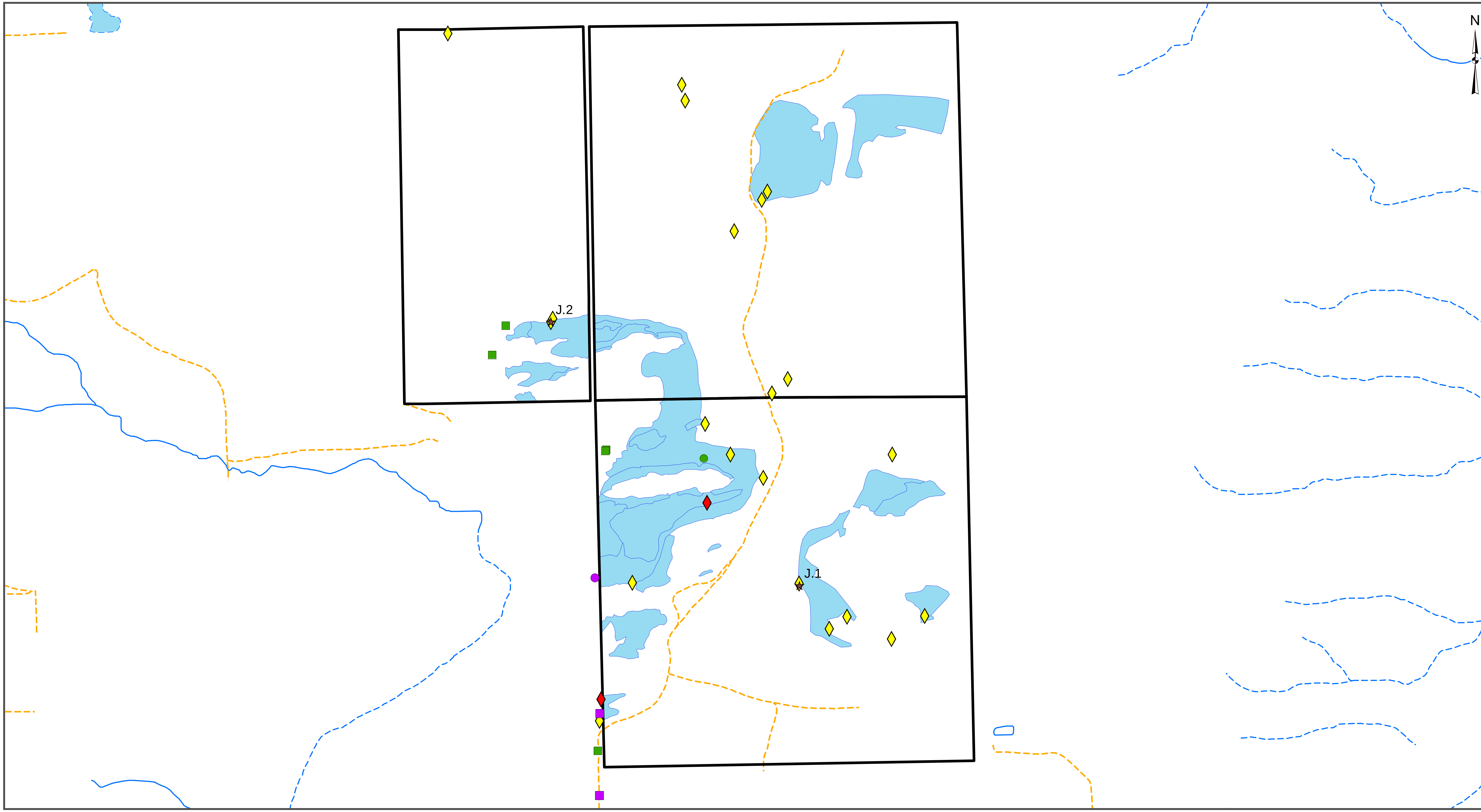
Table 3.5 Count of Amphibians Observed During Systematic Surveys in 2014

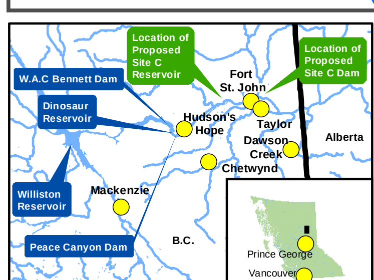
Species	Location	Tadpole	Juvenile	Adult	Total
Western Toad	Western Wetland Complex	0	2	0	2
Boreal Chorus Frog	Western Wetland Complex Northern Cultivated Field Southern Cultivated Field Northern Mesic Forest	0	1	3	4
Wood Frog	Northern Wetland Complex Eastern Wetland complex Western Wetland Complex Northern Cultivated Field Northern Mesic Forest	0	4	46	50
Unidentified Frog	Western Wetland Complex	>2500	0	2	>2500
Total		**>2500**	**7**	**7**	**>2500**

Incidental observations of western toad were made in both 2012 (n=5) and 2014 (n=6) (**Table 3.6, Appendix H**). All observations of western toad on the Property in 2012 and 2014 were within the western wetland complex. Two adults in 2012 and two adults in 2014 were observed within 250 m of the southern Property boundary.

Table 3.6 Count of Incidental Western Toad Observations in 2012 and 2014

Date	Western Toad Juvenile	Western Toad Adult	Total
12-Jun-12	2	0	2
19-Jun-12	0	2	2
07-Jul-12	0	1	1
07-Jul-14	0	2	2
25-Aug-14	0	2	2
26-Aug-14	0	2	2
Total	**2**	**9**	**11**





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake
- Wetland - EM
- Photos

Wildlife Data

- 2012 Survey Start Point
- 2014 Survey Start Point

2012 Incidental Observations
- Sub-Adult
- Adult

2014 Incidental Observations
- Adult

2014 Amphibian Survey Observations
- Sub-Adult

BC hydro

SITE C CLEAN ENERGY PROJECT

MAP 7: AMPHIBIAN WETLAND TRANSECTS AND WESTERN TOAD OBSERVATIONS

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-6	R 0

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

3.5 Avian Surveys

3.5.1 Breeding Bird Surveys

One transect with 18 stations was established in 2012 and sampled three times that year (May 24, 29 and June 12) (**Map 8**). A total count of 732 birds of 67 species was observed (**Appendix I**).

In 2014, surveys at 16 point counts were repeated (**Map 8**) for a total of 5 hours and 18 minutes of survey time. The surveys took place over four days (May 17, June 4 and 25, and July 10). A total of 46 species were observed (**Appendix I**) with a total count of 508 (including unknown species detections).

The survey on May 17 was initiated with temperatures of -2^{o}C, which is below the acceptable limits of >3^{o}C for central and northern interior of BC (Resources Inventory Committee (RIC) 1999a). The temperature at the end of the survey was 6^{o}C. The June 10th survey was added to address the colder start temperature from the first survey.

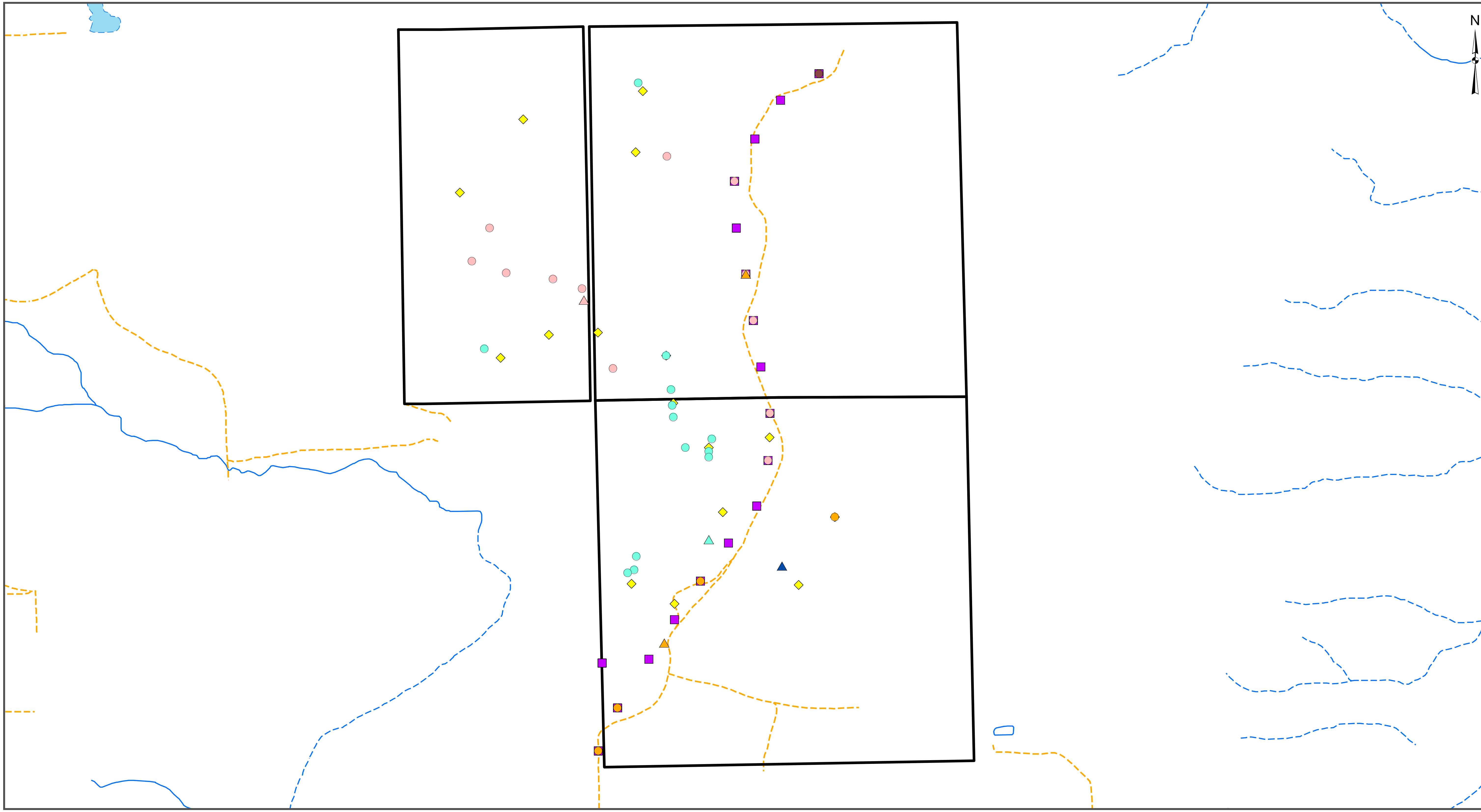
In total, 86 species have been detected on the Property (**Appendix I**). Fewer species were observed in 2014 (n=46) compared to 2012 (n=67). Four listed species were detected including the Blue-listed Rusty Blackbird, Le Conte's Sparrow, Great Blue Heron and Barn Swallow, and the Red-listed Upland Sandpiper (**Table 3.7** Listed Species Observed during Breeding Bird Surveys, Marsh Bird Surveys or Incidentally.). A Barn Swallow nest was found in one of the abandoned silos on the southern end of the Property. Although no Barn Swallows were seen on the nest, a Barn Swallow was seen leaving the silo just prior to the discovery of the nest.

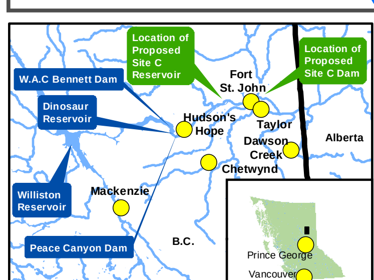
The majority of listed migratory birds were observed in the northern and southern cultivated fields and in the western wetland complex.

Table 3.7 Listed Species Observed during Breeding Bird Surveys, Marsh Bird Surveys or Incidentally.

Species	2012	2014	BC Status	COSEWIC Status	Location
Barn Swallow	11	2	Blue	Threatened	Southern Cultivated Field Eastern Wetland complex
Great Blue Heron	1*		Blue	No Status	Southern Cultivated Field
LeConte's Sparrow	1		Blue	No Status	Northern Cultivated Field
Rusty Blackbird		30	Blue	Special Concern	Western Wetland Complex Northern Mesic Forest
Upland Sandpiper	6	11	Red	No Status	Northern Cultivated Field Southern Cultivated Field Northern Mixed Forest Western Wetland Complex

*only detected incidentally





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.
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LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- BBS Station - 2012
- BBS Station - 2014
- Barn Swallow - Incidental
- Great Blue Heron - Incidental
- Rusty Blackbird - Incidental
- Upland Sandpiper - Incidental
- Barn Swallow - Breeding Bird Survey
- Le Conte's Sparrow - Breeding Bird Survey
- Rusty Blackbird - Breeding Bird Survey
- Upland Sandpiper - Breeding Bird Survey

1:16,000

0 200 400 600 Meters

SITE C CLEAN ENERGY PROJECT

MAP 8: BREEDING BIRD SURVEY STATIONS AND LISTED SPECIES OBSERVATIONS

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-7	R 0

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

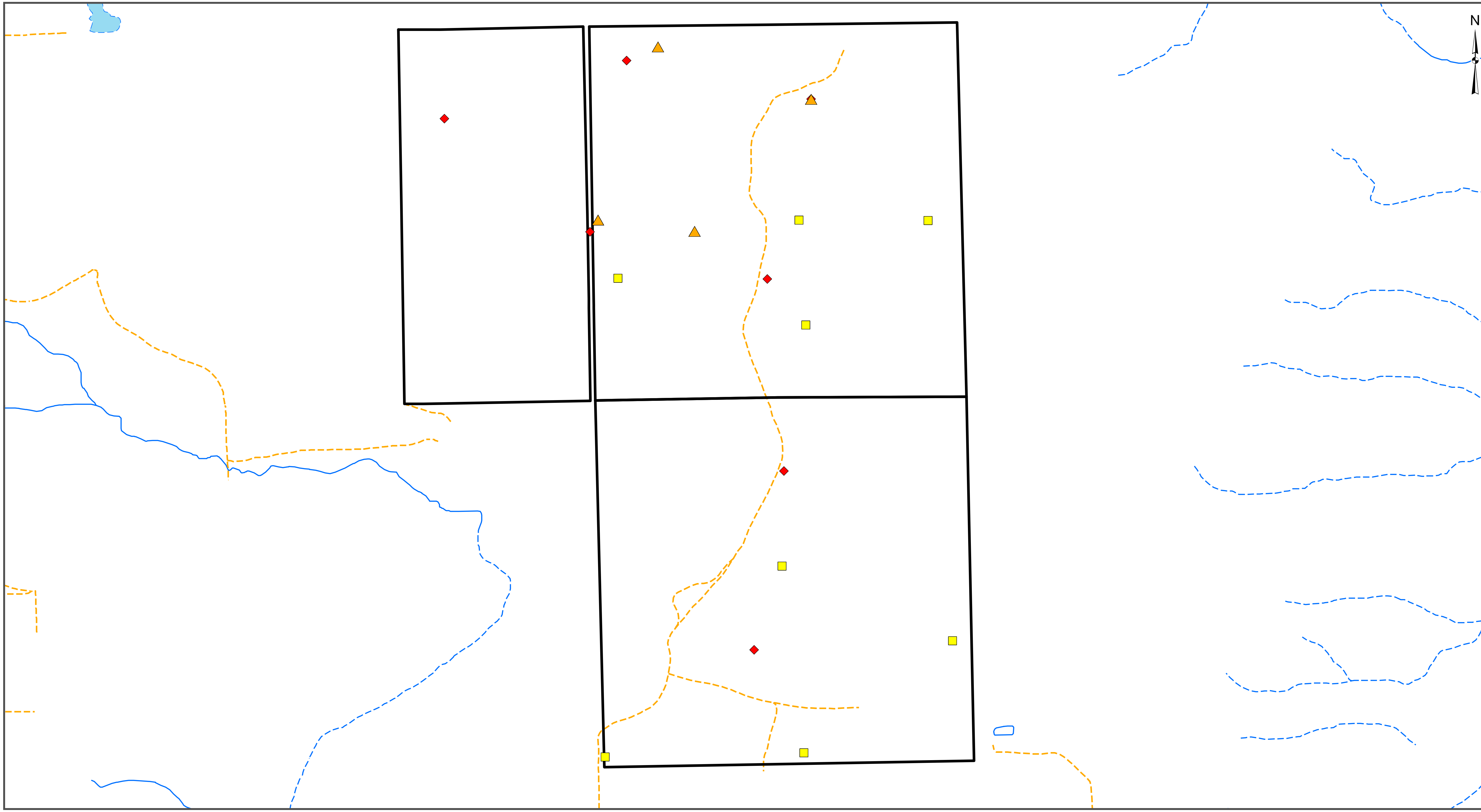
3.5.2 Sharp-tailed Grouse

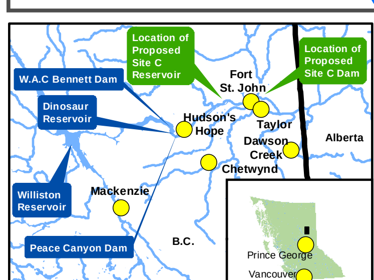
Two Sharp-tailed Grouse survey transects were completed between April 28 and May 4, 2012. No grouse were observed during surveys. Six Sharp-tailed Grouse were detected incidentally on the Property: two observations of single individuals, and one observation of four adult birds on May 4 (**Map 9**)(**Appendix H**). The observation of four adult birds suggested the presence of a lek. Surveyors in 2012 were unable to confirm if a lek was present and whether it was on the Property or an adjacent property.

A total of four survey visits to 7 survey stations were completed on April 8, 24, May 1 and 16, 2014. No grouse were recorded during targeted Sharp-tailed Grouse surveys in 2014.

Two incidental observations were made with 1 bird recorded on April 24 and another single detection of one bird on April 8 (**Map 9**)(**Appendix H**). All Sharp-tailed Grouse observations were located in the northern cultivated field.

No observations of a lek or congregations of Sharp-tailed Grouse were made in 2014. Discussions with the previous land owner confirmed the presence of a lek in the northeastern portion of the Property, north of the forested sites.





Map Notes:
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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.
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SITE C CLEAN ENERGY PROJECT

BC hydro

MAP 9: SHARP-TAILED GROUSE STATIONS AND OBSERVATIONS

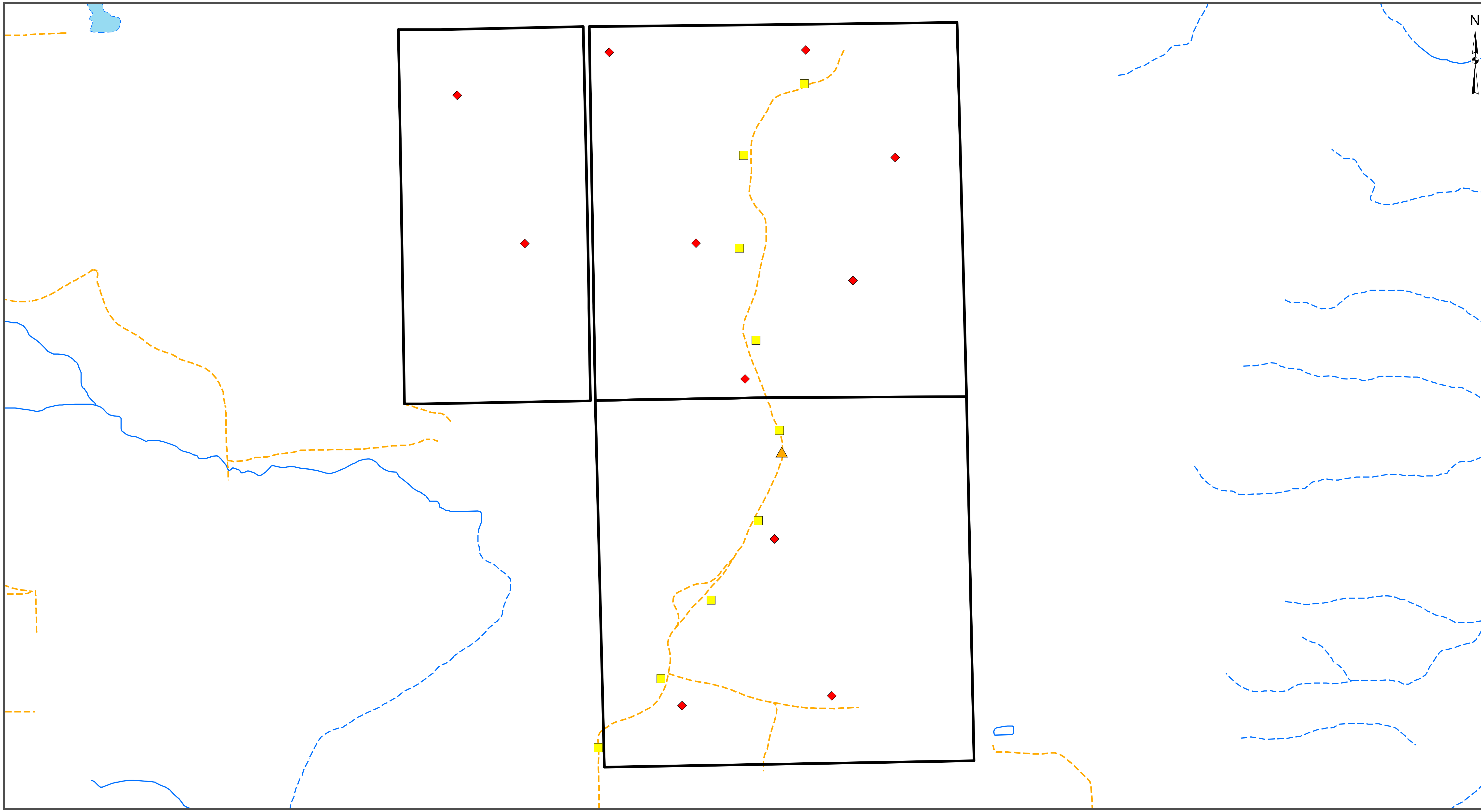
DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-8	R 0

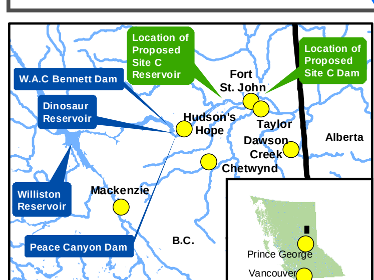
Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification

3.5.3 Common Nighthawk

In 2012, one transect comprised of nine call-playback stations was completed in the cultivated field (**Map 10**). Sampling occurred over 45 minutes on June 19, 2012. No Common Nighthawks were detected during targeted surveys. One Common Nighthawk was detected incidentally on the Property half an hour after the last call-playback listening period (**Appendix H**). This observation was in the southern cultivated field.

In 2014, seven stations were surveyed twice, on June 24 and July 6 (**Map 10**). An additional four stations were surveyed on July 6, as additional time allowed more stations to be added. Total survey time was 1 hour and 41 minutes. No observations or incidental detections of Common Nighthawk were recorded.





Map Notes:
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5. Wildlife Data acquired from Keystone Wildlife Research Ltd, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- CONI Station - 2012
- CONI Station - 2014
- CONI Observation

1:16,000

0 200 400 600 Meters

SITE C CLEAN ENERGY PROJECT

BC hydro

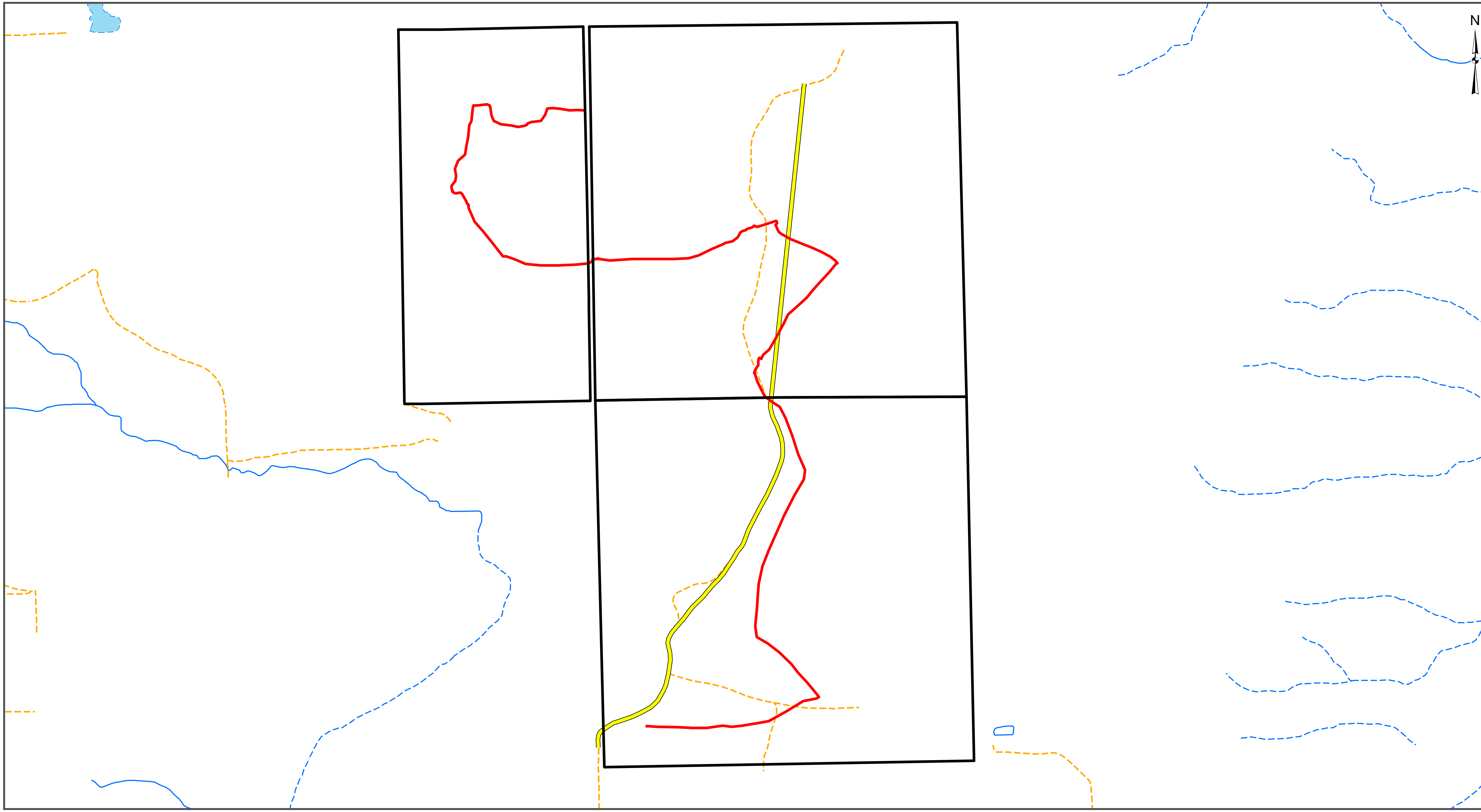
MAP 10: COMMON NIGHTHAWK STATIONS AND OBSERVATIONS

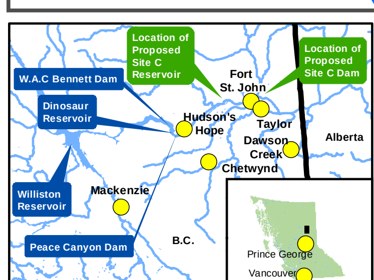
DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-9	R 0

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

3.5.4 Short-eared Owl

In 2012, one Short-eared Owl transect lasting 1 hour and 43 minutes was completed on June 19 (**Map 11**). In 2014, three encounter transects were completed on May 1, May 15 and July 7, for a total survey time of 2 hours and 35 minutes (**Map 11**). No Short-eared Owls were detected on the Property and no incidental observations were recorded.





Map Notes:
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2. Projection: UTM Zone 10N
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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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- SEOW Transect - 2014
- SEOW Transect - 2012

1:16,000

0 200 400 600 Meters

MAP 11: SHORT-EARED OWL ENCOUNTER TRANSECTS

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-10	R 0

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

3.6 Bats

Prior to 2014, no inventory surveys for bats had been completed on the Property. In the general area of the Peace River valley, eight species of bats have been documented (Simpson et al. 2013), including one Red-listed and one Blue-listed species.

Acoustic sampling was conducted from June 25 to September 24, 2014. Two detectors were placed on the edge of the western wetland complex (**Map 12**). A total of 22,586 files were downloaded from the two detectors. Total operating time for each detector was 383 hours and 636 hours. The difference in total time is an artifact of the programming.

Five species of bats were confirmed present on the Property. Two other bat species may have been present on the Property, but could not be identified conclusively based on acoustic data (**Table 3.8**).

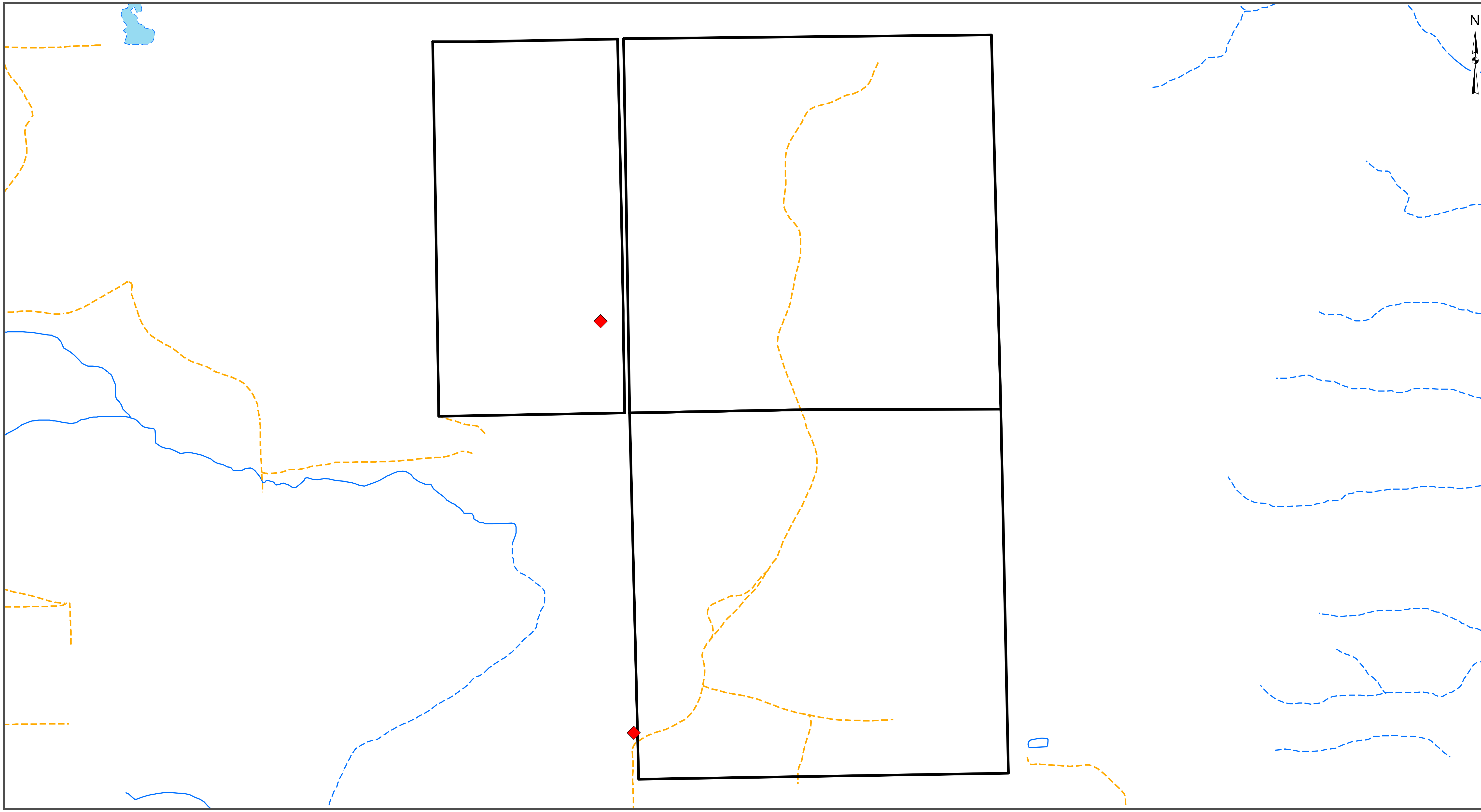
Table 3.8 Bat Species Recorded on Property

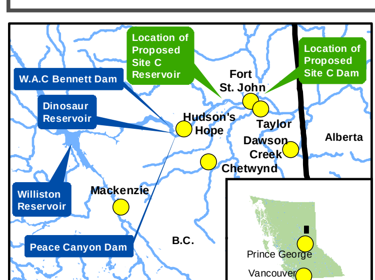
Scientific Name	Common Name	BC Status	COSEWIC Status	Identified on Property
Myotis evotis	Long-eared myotis	Yellow	No Status	Confirmed
Myotis lucifugus	Little brown myotis	Yellow	Endangered	Confirmed
Myotis septentrionalis	Northern myotis	Blue	Endangered	Confirmed
Myotis volans	Long-legged myotis	Yellow	No Status	Possible
Lasionycteris noctivagans	Silver-haired bat[a]	Yellow	No Status	Confirmed
Eptesicus fuscus	Big brown bat[a]	Yellow	No Status	Possible
Lasiurus cinereus	Hoary bat[a]	Yellow	No Status	Confirmed

[a] Species Considered Big Bats

A total of 123 hoary bat files were recorded at the southern detector (**Map 12**). Most files were recorded in a single night – July 4, 2014 between approximately 01:00-02:00 hr. This is unusual and has been identified as a potential migration event (D. Nagorsen, pers.comm.). This was the highest number of hoary bat files recorded at any of the detectors deployed for the Site C Project[3].

[3] Acoustic Sampling for the Site C Project was conducted in 2005,2006, 2008 and 2012





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- Bat Detector

1:16,000

0 200 400 600 Meters

BC hydro

SITE C CLEAN ENERGY PROJECT

MAP 12: BAT DETECTOR LOCATIONS

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-11	R 0

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

3.7 Other Wildlife

Dragonflies and damselflies

In 2012, surveys targeted two listed species of damselflies and one listed species of dragonfly. The prairie bluet (*Coenagrion angulatum*), the Hagen's bluet (*Enallagma hageni*), and the beaverpond baskettail (*Epitheca canis*) are provincially Blue-listed species with potential to occur on the Property.

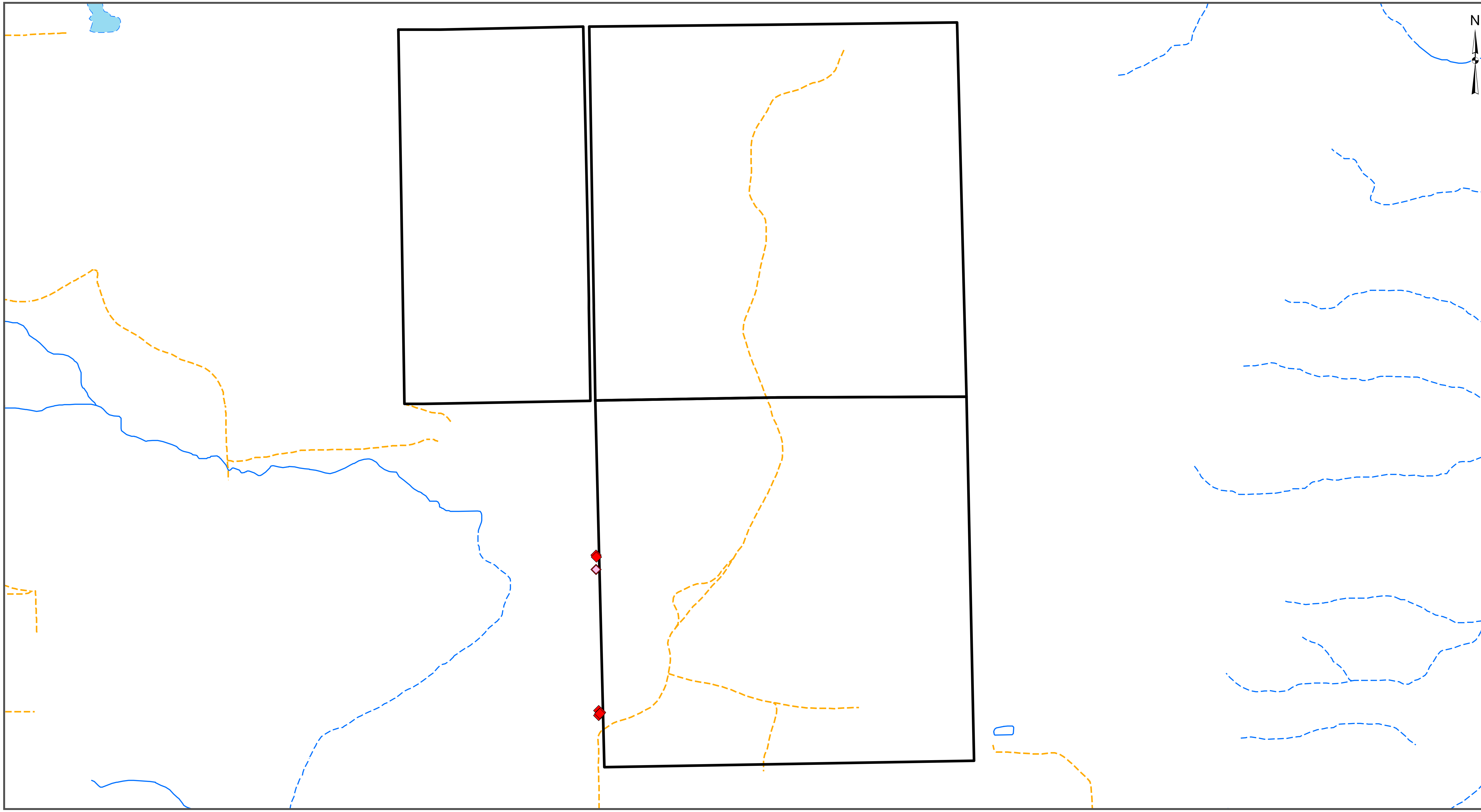
Surveys, conducted in the western wetland complex, included the collection and identification of aquatic life stages of dragonflies and damselflies. Wetlands were surveyed for exuviae that are typically left on emergent vegetation or woody vegetation and dip nets were used to sweep the bottom of the water. Adults were captured and identified opportunistically. Methods were consistent with the *Inventory Methods for Terrestrial Arthropods* (Resources Inventory Committee 1998). Sample identification was completed by entomological experts (Robert Cannings and Denis Knopp). Two survey stations were established and surveyed three times covering the western wetland complex (**Map 13**).

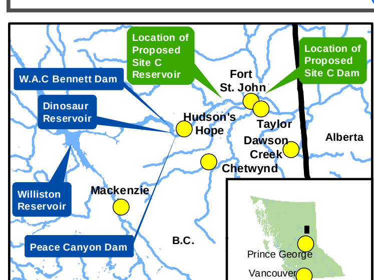
Surveys were completed on May 23, June 12 and July 7th. A total of 9 different species of dragonflies and 6 species of damselflies were documented on the Property (**Table 3.9**). None of the observed species are classified as species at risk.

A Blue-listed butterfly, the bronze copper (*Lycaena hyllus*), was observed incidentally during dragonfly and damselfly surveys in the western wetland complex.

Table 3.9 Count of Dragonfly and Damselfly Species Recorded in 2012

Common Name	Scientific Name	Number Observed
Dragonflies		
Sedge Darner	*Aeshna juncea*	1
Zigzag Darner	*Aeshna sitchensis*	14
Boreal Whiteface	*Leucorrhinia borealis*	2
Crimson-ringed Whiteface	*Leucorrhinia glacialis*	1
American Emerald	*Cordulia shurtleffi*	1
Four-spotted Skimmer	*Libellula quadrimaculata*	1
Whitehouse's Emerald	*Somatochlora whitehousei*	2
Black Meadowhawk	*Sympetrum danae*	20
White-faced Meadowhawk	*Sympetrum obtrusum*	6
Damselflies		
Taiga Bluet	*Coenagrion resolutum*	10
Northern Bluet	*Enallagma annexum*	34
Boreal Bluet	*Enallagma boreale*	1
Spotted Spreadwing	*Lestes congener*	3
Northern Spreadwing	*Lestes disjunctus*	37
Emerald Spreadwing	*Lestes dryas*	17
Total		**150**





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- Damselfly and Dragonfly Stations

Incidental Butterfly

- Bronze Copper Observation

1:16,000

0 200 400 600 Meters

SITE C CLEAN ENERGY PROJECT

BC hydro

MAP 13: DRAGONFLY SURVEY STATIONS

DATE	OCTOBER 22, 2014	DWG NO	1016-C14-B4574-12	R 0

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

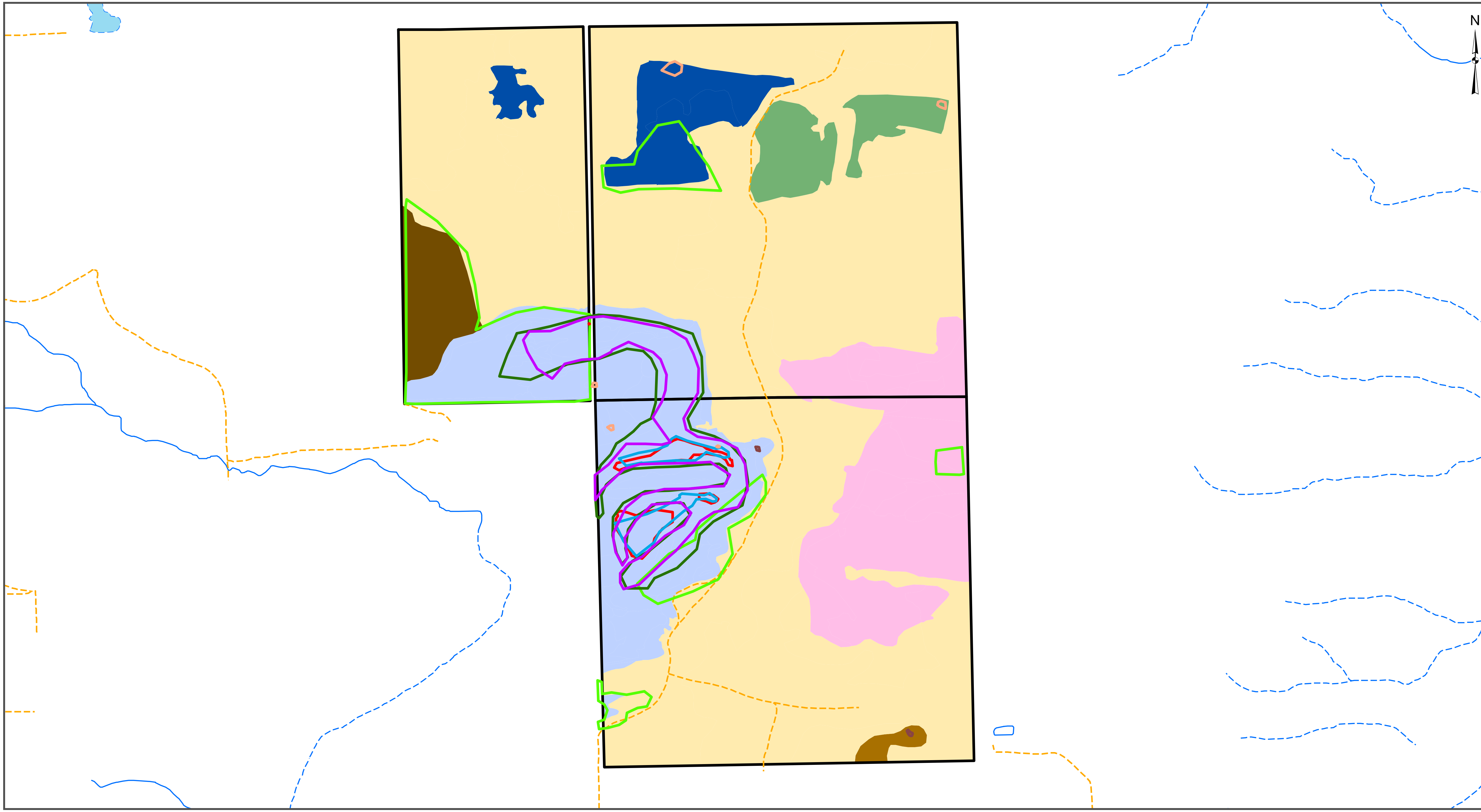
Mammals

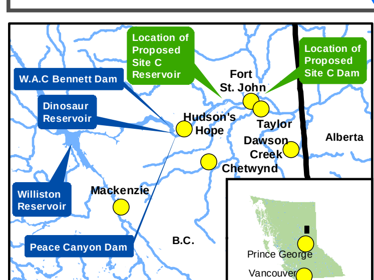
During the course of field studies on the Property in 2012 and 2014, a number of observations of wildlife or wildlife sign (scat, bones, etc.) were made. These include, moose, elk, deer, black bear and coyote (a den was recorded on the Property, see photo in **Appendix I**).

Other species observed incidentally in the general area adjacent to the Property include fisher (Blue-listed), mink, mule deer, and white-tailed deer.

4.0 DISCUSSION

The Property supports a number of rare plants and listed wildlife species. Seven distinct areas and three general habitat types were identified on the Property (**Map 14** and **Map 15**). A CDC list of Red- and Blue-species that could occur in each habitat type was generated and species occurrence was reviewed. Species occurrence and habitat features are summarized for each distinct area below.





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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- Cultivated Field
- Eastern Wetland Complex
- Northern Mesic Forest
- Northern Wetland Complex
- Southern Mesic Forest
- Western Mesic Forest
- Western Wetland Complex

- Castilleja miniata var. fulva
- Drosera linearis
- Galium labradoricum
- Juncus stygius ssp. americanus
- Pedicularis parviflora ssp. parviflora
- Salix serissima
- Symphyotrichum puniceum var. puniceum

1:16,000

0 200 400 600 Meters

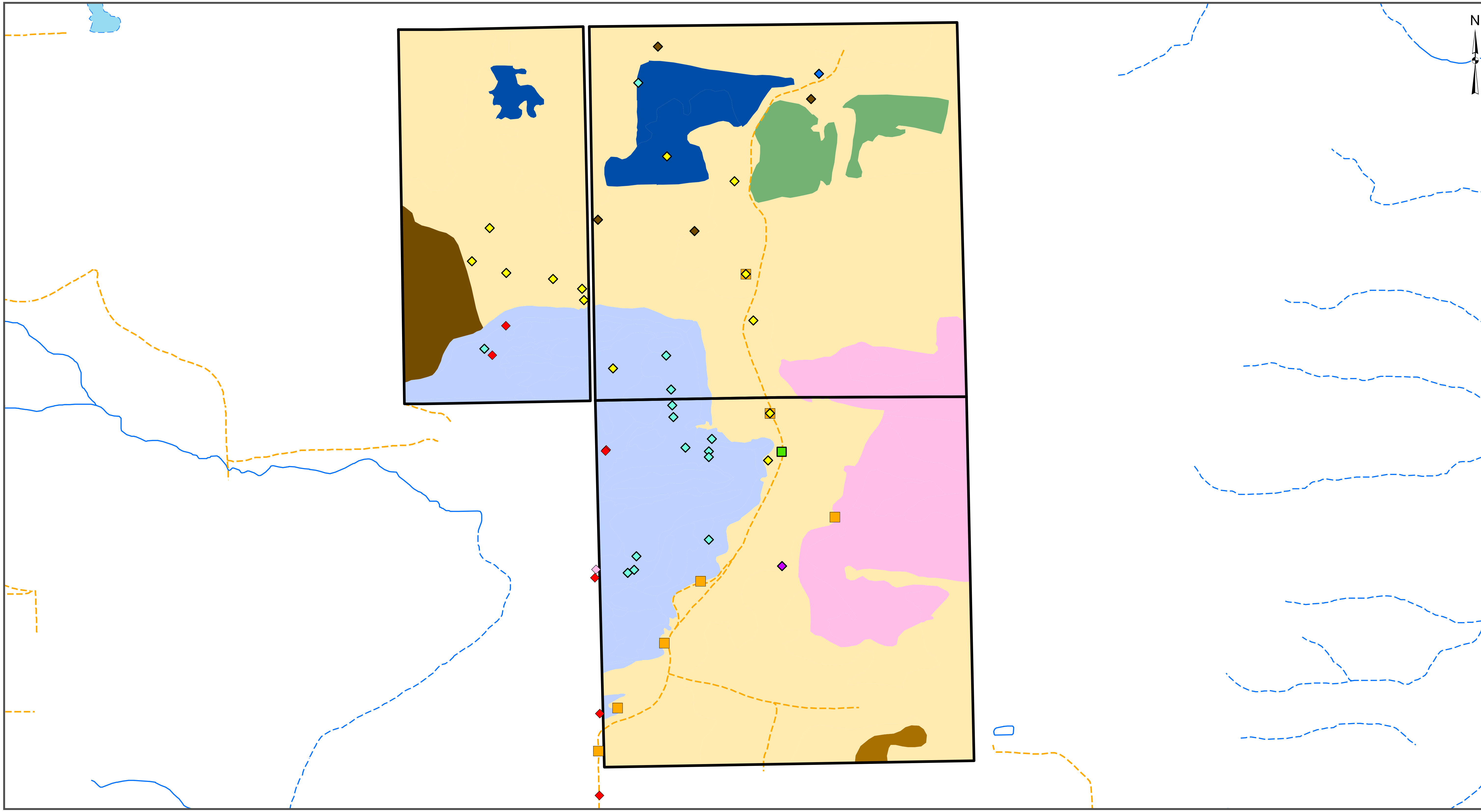
BC hydro

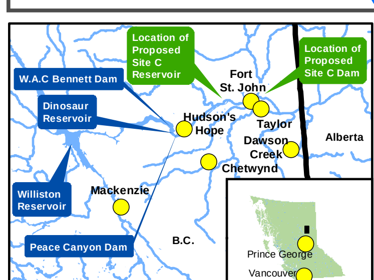
SITE C CLEAN ENERGY PROJECT

MAP 14: GENERAL HABITAT TYPES AND RARE PLANT SPECIES

DATE	NOVEMBER 17, 2014	DWG NO	1016-C14-B4574-17	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, 2014.

LEGEND

- Property Boundary
- Road/Track
- Indefinite River/Lake
- Definite River/Lake

Wildlife Data

- Barn Swallow
- Bronze Copper
- Common Nighthawk
- Great Blue Heron
- Le Conte's Sparrow
- Rusty Blackbird
- Sharp-tailed Grouse
- Upland Sandpiper
- Western Toad

- Cultivated Field
- Eastern Wetland Complex
- Northern Mesic Forest
- Northern Wetland Complex
- Southern Mesic Forest
- Western Mesic Forest
- Western Wetland Complex

1:16,000

0 200 400 600 Meters

SITE C CLEAN ENERGY PROJECT

BC hydro

MAP 15: GENERAL HABITAT TYPES AND LISTED SPECIES

DATE	NOVEMBER 14, 2014	DWG NO	1016-C14-B4574-15	R 0

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

4.1 Wetland Complexes

The Property contains 194.5 ha's of wetland in three complexes, the largest of which is the western wetland complex. Nine different wetland site series were identified on the Property, seven of which are Red- or Blue-listed:

- Common cattail marsh (Wm05)
- Scrub birch / water sedge (Wf02)
- Hudson Bay clubrush-Red hook-moss (Wf10)
- Tamarack/ buckbean-shore sedge (Wf18)
- Bebb's Willow – Bluejoint (Ws03)
- Tamarack / water sedge/Fen Moss (Wb06)
- Black spruce / common horsetail / Sphagnum (Wb09)

Several wetlands within the western wetland complex were also considered to be Marl Fens. These calcareous fens are uncommon in British Columbia, as most portions of the province are lacking in the calcareous substrates that allow these wetlands to form. Marl fens are of high conservation priority, not only for the rarity of their vegetation type, but because they so often harbour rare species (Minnesota Department of Natural Resources 2011).

Rare species that were observed in wetland complexes on the Property include:

- The Blue-listed western toad (*Anaxyrus boreas*) is the only listed amphibian known to occur in the area. They are found in a variety of aquatic and terrestrial habitats, breeding in shallow, littoral zones of lakes, temporary and permanent pools and wetlands, bogs, fens, and roadside ditches (BC Conservation Data Centre 2014e).
- The Blue-listed Rusty Blackbirds (*Euphagus carolinus*) breeding habitat consists of moist coniferous woodlands, bushy bogs and fens (COSEWIC 2006; BC Conservation Data Centre 2012h).
- The Blue-listed bronze copper (*Lycaena Hyllus*) is associated with sedge wetland and herbaceous riparian habitats (Hilton et al. 2013d).
- Five species of bats, including the blue-listed northern myotis (*Myotis septentrionalis*) were confirmed on the Property. Bats were detected in the western wetland complex but this is a function of the sampling method rather

than habitat preference, since detectors are placed near water where insects congregate and bats come to feed and drink.

Other wetland-associated wildlife species that were not found during surveys but could potentially occur in the area include (BC Conservation Data Centre 2014b):

- Two blue-listed dragonfly and damselfly species could occur on the Property: prairie bluet (*Coenagrion angulatum*) and Hagen's bluet (*Enallagma hageni*). Both species breed in ponds, fens, bogs and marshes (Cannings 2002). There are multiple location records, including from Site C baseline surveys, of prairie bluets within the Peace River area (Royal British Columbia Museum and the Spencer Entomological Museum 2004a; Hilton et al. 2013d). There is one record of Hagen's bluet from the Peace Region (Royal British Columbia Museum and the Spencer Entomological Museum 2004b).
- The American Bittern (*Botaurus lentiginosus*) is a blue-listed solitary species that generally occurs at low densities (The Nature Conservancy 1998). This small wading bird is a secretive species that rarely leaves heavy cover (BC Ministry of Water, Land and Air Protection 2004), inhabiting riparian areas, marshes, wet meadows, and wetlands. This species was found in the Peace Region (Cooper Beauchesne and Associates Ltd 2009) though none were recorded during Site C baseline surveys (Hilton et al. 2013c).
- The Blue-listed Olive-sided Flycatcher (*Contopus cooperi*) nests in a variety of habitats including open forest and woodland with a mixture of wetlands, meadows, ponds and streams (Wright 1997). Olive-sided Flycatchers have been observed in the Peace River area (Ryder 1975; Preston 2008; Lambie 2011; Hilton et al. 2013c), the closest observation during Site C baseline surveys was within 40 km of the Property (Hilton et al. 2013c).
- The Red-listed Nelson's Sparrow (*Ammodramus nelsoni*) nests in freshwater marshes and wet meadows with dense emergent vegetation (BC Conservation Data Centre 2012c). Nelson's Sparrow has a small and localized breeding distribution restricted to the Peace Lowlands and Kiskatinaw Plateau (Campbell et al. 2001; Phinney 1998). Nelson's Sparrow were observed within 40 km of the Property during Site C baseline surveys (Hilton et al. 2013c).
- The Blue-listed Short-billed Dowitcher (*Limnodromus griseus*) is a shorebird whose breeding habitat consists of mossy tundra or wet meadows (BC

Conservation Data Centre 2012j). In the Peace Region, the Short-billed Dowitcher is considered a seasonal resident and a probable breeder (BC Conservation Data Centre 2012k). Siddle (2010) reports several sightings of solitary birds throughout spring and into fall near Fort St. John. No Short-billed Dowitchers were observed during Site C baseline surveys (Hilton et al. 2013c).

- The Red-listed Yellow Rail (*Coturnicops noveboracensis*) is a wading bird most frequently found in wet sedge-dominated areas. The species is very secretive and rarely leaves the cover of dense wetland vegetation during the breeding season. Yellow Rails are rare in the province with most records from the Peace Region (Alvo and Robert 1999; BC Conservation Data Centre 2012g). Yellow Rails were observed within 40 km of the Property during Site C baseline surveys (Hilton et al. 2013c).

4.1.1 Western Wetland Complex

The large wetland complex located on the western side of the Property supports several listed species and listed ecosystems (**Map 14** and **Map 15**). This 102 ha wetland complex contains subxeric to hygric forests (103, 101, 104 and 111) and 9 different wetland types (**Appendix D**). Wetlands account for 44% of the area, while mesic (101) and moist (111) forests account for 26% and 20%, respectively.

One Red-listed ecosystem was documented in this wetland complex. The Hudson's Bay clubrush / rusty hook-moss (Wf10) was documented in one 6.5 ha area in the south central portion of the wetland complex. One plot was completed to confirm the occurrence of this ecosystem.

Seven Blue-listed ECAR were documented in this wetland complex. These include:

- White Spruce / red swamp currant / horsetails (111) – 20.6 ha and 4 plots confirming its occurrence.
- Tamarack / water sedge / fen Moss (Wb06) – 25.9 ha and 4 plots confirming its occurrence
- Black spruce / common horsetail / sphagnum (Wb09) – 5.9 ha and 3 plots confirming its occurrence
- Scrub birch / water sedge (Wf02) – 0.5 ha and 2 plots confirming its occurrence
- Tamarack / buckbean / shore sedge (Wf18) – 3.8 ha and 4 plots confirming its occurrence

- Common cattail marsh (Wm05) – 0.04 ha and no plots
- Ws03 – 0.3 ha and no plots

This wetland complex also contained several marl deposits. Three areas were identified where the marl precipitates were highly concentrated. These deposits were present in TEM polygons 80, 61 and 16, though the extent of the Marl is not represented by the polygon boundary. More specifically, two areas were located north and south of an area of high ground (polygons 20, 9 and 19) in the centre of the complex. The third area was in the northern section of polygon 16. Local conditions that allow the marl to accumulate to the degree observed in these areas is uncommon regionally and provincially.

This wetland complex contains the greatest diversity and abundance of rare plants found on the Property. Listed rare-plant species found in this fen complex include: tawny paintbrush, slender-leaf sundew, northern bog bedstraw, bog rush, small-flowered lousewort, autumn willow, and purple stemmed aster. The Red-listed tawny paintbrush was found in grasslands and open forests of the western wetland complex. The Red-listed slender-leaf sundew was found in the open portions of the marl fen. The Blue-listed northern bog bedstraw occurrence was observed with sedges and other herbs in the fen and the surrounding forest. The Blue-listed bog rush was found growing in a community of low trees and shrubs, sedges, and other herbs, in the ecotone between open and shrub portions of a marl fen. The Blue-listed small-flowered lousewort was found growing with sedges and other herbs in a series of patterned and non-patterned shrub fens. The Blue-listed autumn willow was found in a clearing within mixed bog forest at the edge of a shrub fen. The Blue-listed purple stemmed aster was found in transitional zones between mixed upland forest and fen wetlands. More details can be found in **Appendix G.**

Listed wildlife species observed in the western wetland complex include bronze copper, western toad, and Rusty Blackbird. Eighteen Rusty Blackbirds were observed during breeding bird surveys in 2014 and 11 were observed incidentally in the fall of 2014. Nine western toads were observed during pond surveys and incidentally in 2012 and 2014. In addition, several thousand tadpoles were observed during amphibian surveys, but could not be identified to the species level. One bronze copper was observed incidentally during dragonfly surveys.

The western wetland complex was also relatively undisturbed compared to the rest of the Property. Although cattle had grazed the periphery, the complex was likely too wet for cattle to venture into the interior. Livestock use of wetlands can change the vegetation structure and composition of a wetland as well as affect the habitat value for wildlife species (Jones et al. 2010). Given the number of rare plants, ecosystems and wildlife species documented in this wetland complex the structure and function should be maintained.

4.1.2 Eastern Wetland Complex

The eastern wetland complex contains submesic to hygric forests (103, 101 and 104) and two wetland types (**Appendix D**). This 73 ha wetland complex is predominantly nutrient poor forest (104, 75%) with a small wetland component (5%).

One blue-listed ECAR was documented in the wetland (Wf02). The occurrence of this ECAR was confirmed with one plot. This 0.5 ha wetland was located in the south-east portion of the wetland.

In the eastern wetland complex one Red-listed rare plant, tawny paintbrush (*Castilleja miniata ver. fulva*), was observed. Tawny paintbrush is not a wetland associated species. A sub-occurrence was observed in the forested area of the eastern wetland complex.

The eastern wetland complex provides breeding habitat for amphibians. Tadpoles were observed in the wetlands within this complex, though they could not be identified to the species. A single Barn Swallow was observed along the edge of this wetland/forest complex, but this observation was likely associated with the breeding habitat in the adjacent cultivated field. Barn Swallows are discussed in more detail under cultivated fields.

Disturbance was evident throughout this wetland complex with evidence of cattle grazing and tree clearing.

4.1.3 Northern Wetland Complex

The northern wetland complex contains mesic to hygric forests (104) and two wetland types (**Appendix D**). This 19 ha wetland complex is composed of 73% nutrient poor forest (104) and 26% wetland.

One blue-listed ECAR (Ws03) as documented in this wetland complex. The occurrence of this ECAR was confirmed with one plot. This 1.5 ha wetland was located in the eastern portion of this complex.

One occurrences of purple-stemmed aster was reported in the northern wetland complex. The purple-stemmed aster was growing in a shrubby graminoid-dominated marsh and meadow area. No listed wildlife species were found, though the area contains amphibian breeding habitat.

Disturbance was evident throughout this wetland complex with evidence of cattle grazing and tree clearing.

4.2 Cultivated fields

The majority (63%) of the Property is classified as cultivated field, and is actively grazed by cattle during the summer. The cultivated field was spilt into northern and southern areas. The Northern area is 263.7 ha and the southern is 134.2 ha. Cultivated fields provide important breeding and grazing habitat for a variety of wildlife species.

Rare species that were observed in cultivated fields on the Property include:

- Barn Swallows (*Hirundo rustica*) are a Blue-listed swallow that often nest in barns or other anthropogenic structures. Barn Swallows frequently use agricultural fields and wetlands to forage for insects (BC Conservation Data Centre 2012i).
- The Blue-listed Sharp-tailed Grouse (*Tympanuchus phasianellus*) require a mosaic of dense grass and shrubs with forb and insect foods during nesting and brood rearing (BC Conservation Data Centre 2012k). Active leks in the Peace Region have been found in a range of vegetated states, including fallow fields, grassy pastures, hayfields, cereal crop fields, and naturally vegetated clearings (Goddard 2010).
- Upland Sandpipers (*Bartramia longicauda*) are Red-listed and prefer large areas of short grass for feeding and courtship and adjacent taller grasses for nesting and brood cover (BC Conservation Data Centre 2014f). Upland Sandpipers have been observed in open fields, roadside edges and recently burned fields by Siddle (2005), who also reported that the main breeding area for Upland Sandpipers in the province is in the Peace Region.
- Common Nighthawk (*Chordeiles minor*) (SARA listed, Schedule 1 – Threatened) nesting habitat includes open areas, fields and grasslands as well as coniferous forests (BC Conservation Data Centre 2012f).
- The Blue-listed Le Conte's Sparrow (*Ammondramus leconteii*) will breed in wetlands, prairie, grassland, and idle pasture habitats, among others (BC

Conservation Data Centre 2012b). They are rare in the Peace River valley (Penner 1976), but historical records exist for the area (Thurber Consultants Ltd 1976).

Other species associated with cultivated fields that were not found during surveys but could potentially occur in the area include (BC Conservation Data Centre 2014b):

- Two Blue-listed butterflies may occur on the Property. Common ringlets (*Coenonympha tullia benjamini*) were observed during Site C baseline surveys in wet to dry forests; wetlands; roads; cultivated fields; steep, dry shrub/herb dominated slopes; and along the river (Hilton et al. 2013d). During Site C baseline surveys common woodnymphs (*Cercyonis pegala nephele)* were observed in moist to dry forests; wetlands; cultivated fields; steep, dry shrub/herb dominated slopes; and along the river (Hilton et al. 2013d). Common Ringlets have been found within 10 km of the Property. Common woodnymphs have been found within 50 km of the Property (Hilton et al. 2013d).
- The Blue-listed Short-eared Owl (*Asio flammeus*) is known to nest in broad expanses of open land with low vegetation (BC Conservation Data Centre 2012d). Short-eared Owls were observed within 5 km of the Property (Hilton et al. 2013b).
- American Bittern and Short-billed Dowitcher can also use cultivated fields. These species were described in more detail under wetlands.

4.2.1 Northern Cultivated Field

The Le Conte's Sparrow, the Upland Sandpiper and the Sharp-tailed Grouse were all observed in the northern cultivated field. No leks were observed during surveys, although discussions with the previous land owner confirmed the historical presence of a lek in the north-eastern portion of the Property, north of the forested sites. Both mule deer and elk have been observed grazing in the area, and signs of moose were also observed.

4.2.2 Southern Cultivated Field

No Le Conte's Sparrow or Sharp-tailed Grouse were detected in the southern cultivated field despite the presence of suitable habitat. Most Upland Sandpipers were also found in the northern cultivated field. Proximity to the highway or the location of neighbouring cultivated fields may be a factor influencing the occurrence of these species.

Barn Swallows were detected in the southern cultivated field. The presence of several abandoned buildings and silos provide potential breeding habitat, and the adjacent cultivated fields provide good Barn Swallow foraging habitat (BC Conservation Data Centre 2012i). A Barn Swallow nest was also found in an abandoned silo at the southern end of the Property. Barn Swallows were not observed on the nest, but an individual was seen leaving the silo immediately prior to the nest discovery.

A single Common Nighthawk was observed incidentally in the southern cultivated field. Nesting habitat for this species is present throughout the cultivated fields on the Property.

4.3 Mesic Forests

The mesic forest complexes make up 7% of the Property area. Mesic forests were split into three distinct areas, scattered across the Property. These are relatively small treed areas ranging from 2.6 to 23.4 ha.

Rare species that were observed in mesic forests on the Property include:

- The Blue-listed Northern Myotis (*Myotis septentrionalis*) is a forest-dependent species that forages and travels preferentially in forested habitats (Jung et al. 1999; Henderson and Broders 2008).

Other species associated with mesic forests that were not found during surveys but could potentially occur in the area include (BC Conservation Data Centre 2014b):

- Listed butterfly species that could occur in the forested areas of the Property include five Red-listed species: eastern pine elfin (*Callophrys niphon*), arctic skipper (*Carterocephalus palaemon mandan)*, assinboine skipper (*Hesperia assiniboia*,), Phillip's arctic (*Oeneis philipi*) and great spangled fritillary (*Speyeria cybele pseudocarpenteri)*; and four Blue-listed species: common woodnymph (*Cercyonis pegala nephele)*, common ringlet (*Coenonympha tullia benjamini)*, tawny crescent (*Phyciodes batesii)*, and Aphrodite fritillary (*Speyeria aphrodite Manitoba)* (BC Conservation Data Centre 2014a). Aphrodite fritillary, arctic skipper, great spangled fritillary and tawny crescent were all detected within 10 km of the Property during Site C baseline surveys (Hilton et al. 2013d).
- The Olive-sided Flycatcher breeds in diverse habitats including old-growth forest; young second-growth forest; burns; recent cutblocks where snags and stubs

remain (Campbell et al. 1997); and open forest and woodlands with a mixture of wetlands, meadows, ponds, and streams (Wright 1997). Additional details for Olive-sided Flycatcher are described under wetlands.

- Black-throated Green Warblers (*Setophaga virens*) are a Blue-listed species that breed in riparian stands of white spruce or mixed stands of mature white spruce - trembling aspen - balsam poplar (Campbell et al. 2001). Site C baseline surveys found Black-throated Green Warblers in coniferous and seral forests within 10 km of the Property (Hilton et al. 2013c).
- The Blue-listed Broad-winged Hawk (*Buteo platypterus*) has a limited distribution in BC and is rare in the Peace River area (Campbell et al. 1990). Evidence of breeding has been observed in the Peace Region (Phinney 2003; Hilton et al. 2013b), but the size of the regional breeding population is unknown. Broad-winged Hawks nest in broadleaf and mixed forests, preferring denser situations near wet areas and forest openings (BC Conservation Data Centre 2012e). A Broad-winged Hawk was observed within 15 km of the Property during Site C baseline surveys (Hilton et al. 2013b).
- The forested areas on the Property may also provide habitat for several mammals including the Blue-listed fisher. There is a patch of windthrow just inside the northern mesic forest that could be potential resting habitat for fisher. Tracked fisher were not found to use the Property but a fisher home range was within 5 km of the Property (Simpson et al. 2013). Due to the lack of old-growth forest, there are very few cavity trees that could support fisher reproduction, though the area could be used for resting or foraging.

4.3.1 Northern Mesic Forest

The northern mesic forest is approximately 25.5 ha in size and consists of sub mesic to hygric forests (103, 101 and 104). Mesic forests (101) is the predominant forest type (55%).

Two listed rare plant species were found in the northern mesic forest: tawny paintbrush (*Castilleja miniata* var, *fulva*) and purple stemmed aster (*Symphyotrichum puniceum* var, *puniciem*). The tawny paintbrush was found in an open forest area. The purple stemmed aster was growing in the transitional zones between a mixed upland forest and a fen wetland. There are several occurrences of these rare plant species throughout the Property.

A single observation of a Upland Sandpiper and of a Rusty Blackbird were recorded in the northern mesic forests. Upland Sandpipers do not use forest habitats for any life requisites, and this observation is unusual. Rusty Blackbirds use mixed forests occasionally, but are not thought to breed in these habitats (BC Conservation Data Centre 2012h). The presence of these species in the mesic forests is likely associated with the adjacent suitable habitat.

4.3.2 Southern Mesic Forest

The southern mesic forest consists of 2.6 ha of mesic forest (101).

One Blue-listed rare plant was observed in the southern mesic forest. Autumn willow (*Salix serissma*), was found growing with other willows in an area approximately 20 square metres in size, within a shrub- and sedge-dominated marsh (which was dry at the time of survey).

4.3.3 Western Mesic Forest

The western mesic forest consists of 16.8 ha of mesic forest (101).

One blue-listed ECAR (Ws03) as documented in this mesic forest during field work (one plot). The occurrence of this ecosystem was not mapped because it is too small and could not be differentiated on the air photo.

Tawny Paintbrush was the only listed species identified in the western mesic forest. It was found in the open forest and cut lines of the Property.

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APPENDIX A TEM MAP LEGEND

The Property is located in northeastern British Columbia approximately 3.5 km northwest of Hudson's Hope, on portions of 1:20,000 mapsheets 094A.001 and 094B.010. The 637 ha Property is within the Peace Forest District in the Northern Interior Forest Region.

The main ecosystems present on the Property are grazed pasture, wetlands of several different types, and mixed forest. Rare marl fen wetland types have been noted. Tree species present include white spruce (*Picea glauca*), lodgepole pine (*Pinus contorta*), black spruce (*Picea mariana*), trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), subalpine fir (*Abies lasiocarpa*) and tamarack (*Larix laricina*).

The ecosystem mapping methodology used is standard Terrestrial Ecosystem Mapping (TEM; Resources Inventory Committee 1998). There are three levels of ecosystem classification applicable to this map: the ecosection unit, biogeoclimatic unit (subzones) and ecosystem unit. Ecosections are large physiographic units influenced by particular macroclimate processes and are characterized by all the plant communities and wildlife populations present (Demarchi 2011). The biogeoclimatic ecosystem classification system (BEC) describes the variation in climate, vegetation and site conditions occurring within an ecosection, and divides the area into subzones and their variants. Ecosystem units are defined for each subzone and are indicated in the map label by a 2-letter code, with site modifiers if applicable, followed by the structural stage at the time the area was mapped. Ecosystems were mapped according to the latest provincial field guidebooks (MacKenzie and Moran 2004; DeLong 2011) and the provincial list of two-letter map codes for non-vegetated or anthropogenic ecosystems.

The Property lies within the Peace River Basin ecoregion and the Peace Lowlands (PEL) ecosection. One subzone is present, the moist, warm Boreal White and Black Spruce (BWBSmw).

MAP BOUNDARIES

Ecosection Boundary

Study Area Boundary

Ecosystem Map Unit

MAP LABEL FORMAT

Ecosection and Biogeoclimatic Unit Label

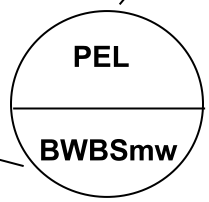
Ecosection Unit

PEL

Biogeoclimatic Unit

(Zone/Subzone/Variant)

BWBSmw



Ecosystem Unit Label

4 Ws03

40% Bebb's willow-Bluejoint

6 104

60% At-Labrador tea-Lingonberry

:6B seral association

6(101j5:6B)-4(Ws033b)

j5 – gentle slope,

structural stage 5,

young forest

3b- Structural stage 3b,

tall shrub

ECOSECTION

Peace Lowlands

The Property lies within the Peace Lowlands (PEL) ecosection. The Peace Lowlands ecosection is a blocky mountain area on the east side of the Rocky Mountains, with strong rainshadows (Demarchi 2011).

BIOGEOCLIMATIC SUBZONE

Moist, warm Boreal White and Black Spruce (BWBSmw)

The BWBSmw subzone is found on the rolling plains that extend from near the Alberta border, north to near the Beatton River (DeLong et al. 2010). Soils are generally fine-textured. Elevation ranges from 750 to 1050 m. Aspen forests are common due to past history of frequent fires. Balsam poplar occurs on moister sites. White spruce is present on moist to wetter sites where there has been limited fire history and human disturbance. Lodgepole pine occurs as a seral species on drier and poorer sites. Black spruce forests, often with a minor component of tamarack, are common on organic soils.

MAPPED ECOSYSTEMS

Site Series #	Seral Code	Ecosystem Name	Typical Conditions	Moisture Regime
BWBSmw				
101		Sw-Trailing raspberry-Step moss	gentle to moderate slopes	submesic-subhygric
103		SwPl-Soopolallie-Fuzzy-spiked wildrye	variable slope and slope position, often on glaciofluvial parent materials	submesic
104		Sb-Labrador tea-Step moss	Gentle slopes on medium to fine-textured soils	submesic-hygric
111		Sw-Currant-Horsetail	floodplains, gentle lower slopes or steeper cool aspects	subhygric-hygric
101	6B	At-Rose-Creamy peavine	Gentle to moderate slopes on level to upper slope positions	submesic-subhygric
103	6B	At-Rose-Fuzzy-spiked wildrye	Level to gentle slopes or on steep warm aspects	submesic
104	6B	At-Labrador tea-Lingonberry	Level to gentle slopes	submesic-subhygric
111	6B	At-Cow-parsnip-Meadowrue	level to gentle slopes; often along watercourses	mesic-subhygric
Wb06	-	Tamarack-Water sedge-Fen moss	Hummocky sites with deep peat	

Site Series #	Seral Code	Ecosystem Name	Typical Conditions	Moisture Regime
Wb09	-	Black spruce – Common horsetail-Sphagnum	Hummocky sites with shallow to deep peat veneer over mineral soils	
Wf01	-	Water sedge-Beaked sedge	Sedge fen subject to shallow flooding with late-season drawdown	
Wf02	-	Scrub birch-Water sedge	On thin to deep peat with fluctuating water table	
Wf10	-	Hudson Bay clubrush-Red hook-moss	Often underlain by marl, usually deep peat	
Wf18	-	Tamarack-Scrub birch-Buckbean	Patterned fen with mounded organic soils	
Wm01	-	Beaked sedge-Water sedge	Shallow marsh on mineral substrates with thin peat veneers	
Wm05	-	Cattail Marsh	Well-decomposed peat veneer over mineral soil	
Ws03	-	Bebb's willow-Bluejoint	Peat veneer over fine-textured Gleysols	

SITE MODIFIERS

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

p peaty material at the surface

r ridge

w warm aspect slope (135 to 285 deg.; slope 25-100%)

ANTHROPOGENIC, SPARSELY VEGETATED OR NON-VEGETATED SITES

CF Cultivated field (incl. pastures)

OW Shallow open water

STRUCTURAL STAGE

1 Non-vegetated/Sparse (< 20 yrs since major disturbance unless disclimax ecosystem)

1a Non – vegetated (less than 5% vegetation cover)

1b Sparse (bryophyte and lichen-dominated communities) (less than 10% cover of vascular plants)

2 Herb (< 20 yrs 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 <10 m tall, < 20 yrs old for forested sites)

3a Low Shrub (shrubs < 2 m tall)

3b Tall Shrub (shrubs 2-10 m tall)

4 Pole /Sapling (trees > 10 m tall & usually < 40 yrs old)

5 Young Forest (trees > 10 m tall & 40-80 yrs old)

6 Mature Forest (trees > 10 m tall; 80-140 yrs old)

7 Old Forest (trees > 10 m tall; >140 yrs old)

DATA SOURCES

Vegetation Map Sheets 094A.001 and 094B.010. Province of BC.

Map Base: 1:20,000 TRIM maps as above.

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APPENDIX B CONVERSION OF TEM UNITS

The TEM for the Property was completed to the new TEM standards. Outlined in the table below is the new TEM codes that correspond to old TEM codes used for mapping the Site C Project.

Site Series	Map Code	Old Ecosystem Name	New Site Series	New Ecosystem Name
02	LL	Pl - Lingonberry - Velvet-leaved blueberry	102	Pl - Kinnikinnick - Ligonberry
03	SW	Sw - Wildrye - Peavine	103	SwPl - Soopolallie - Wildrye
04	BL	Sb - Lingonberry - Coltsfoot	104	Sb - Labrador tea - Step moss
01	AM	SwAt - Step moss	101	Sw - Trailing Raspberry - Stepmoss
05	SO	Sw - Current - Oak fern	110	Sw - Oak fern - Sarsaparilla
06	SC	Sw - Current - Bluebells	101	Sw - Trailing Raspberry - Stepmoss
07	SH	Sw - Current - Horsetail	111	Sw - Current - Horsetail
08	BT	Sb - Labrador tea - Sphagnum	Wb03	Sb - Ligonberry - Peatmoss
09	Fm02	ActSw - Red-osier dogwood	112	AcbSw - Mountain alder - Dogwood
10	TS	Tamarack - Sedge – Fen	Wb06	Lt - Water sedge - Fen moss
$02	ak	$At - Soopolallie - Kinnikinnick	102$6B.1	At - Soopolallie - Kinnikinnick
$03	as	$At - Soopolallie - Wildrye	103$6B.1	At - Rose - Fuzzy-spiked wildrye
$04	al	$At - Labrador tea	104$6B.1	At - Labrador tea - Ligonberry
$01	ap	$At - Creamy peavine	101$6B.1	At - Rose - Creamy peavine
$05	ab	$At - Black Twinberry	101$6B.1	At - Rose - Creamy peavine
$06	ao	$At - Oak-fern	110$6B.1	At - Highbush cranberry - Oak fern
$07	ac	$Ac - Cow parsnip	111$6B.1	Acb - Dogwood - Highbush-cranberry
$07	ac	$Ac - Cow parsnip	111$6B.2	At - Cow-parsnip - Meadowrue

APPENDIX C TERRESTRIAL ECOSYSTEM MAPPING

Site Series Number	Letter Code	Ecosystem Name	Site Modifier	Structural Stage	Structural Stage Modifier	Seral Code	Ha
00	CF	Cultivated Field		2	b		399.5
00	OW	Shallow Open Water					0.5
101		Sw-Trailing raspberry-Step moss		3			0.3
101		Sw-Trailing raspberry-Step moss	j	3			2.7
101		Sw-Trailing raspberry-Step moss		4			0.3
101		Sw-Trailing raspberry-Step moss	j	4			4.0
101		Sw-Trailing raspberry-Step moss		5			1.0
101		Sw-Trailing raspberry-Step moss	j	5			4.9
101		Sw-Trailing raspberry-Step moss	r	5			0.4
101		Sw-Trailing raspberry-Step moss	j	5			2.1
101		At-Rose-Creamy peavine		3		6B	11.8
101		At-Rose-Creamy peavine	j	3		6B	19.8
101		At-Rose-Creamy peavine		4		6B	0.9
101		At-Rose-Creamy peavine	j	4		6B	12.5
101		At-Rose-Creamy peavine	j	4		6B	13.5
101		At-Rose-Creamy peavine		5		6B	2.1
101		At-Rose-Creamy peavine	j	5		6B	1.6
103		SwPl-Soopolallie-Fuzzy-spiked wildrye	r	5			2.2
103		At-Rose-Fuzzy-spiked wildrye	j	3		6B	1.7
103		At-Rose-Fuzzy-spiked wildrye	j	3		6B	1.5
103		At-Rose-Fuzzy-spiked wildrye	j	4		6B	6.0
104		Sb-Labrador tea-Step moss		3			2.8
104		Sb-Labrador tea-Step moss	j	3			3.8

Site Series Number	Letter Code	Ecosystem Name	Site Modifier	Structural Stage	Structural Stage Modifier	Seral Code	Ha
104		Sb-Labrador tea-Step moss		4			2.2
104		Sb-Labrador tea-Step moss	j	4			16.1
104		Sb-Labrador tea-Step moss		4			2.1
104		Sb-Labrador tea-Step moss	j	4			1.9
104		Sb-Labrador tea-Step moss	j	5			4.6
104		Sb-Labrador tea-Step moss	j	5			25.0
104		At-Labrador tea-Lingonberry		3		6B	7.5
104		At-Labrador tea-Lingonberry	j	3		6B	8.9
104		At-Labrador tea-Lingonberry	j	4		6B	4.8
111		Sw-Currant-Horsetail	j	3			2.0
111		Sw-Currant-Horsetail		4			0.3
111		Sw-Currant-Horsetail	j	4			3.9
111		Sw-Currant-Horsetail		5			0.9
111		Sw-Currant-Horsetail	j	5			7.2
111		At-Cow-parsnip-Meadowrue		3		6B	0.1
111		At-Cow-parsnip-Meadowrue	j	4		6B	0.9
Wb06		Tamarack-Water sedge-Fen moss	p	3			0.2
Wb06		Tamarack-Water sedge-Fen moss	p	3	b		25.7
Wb09		Black spruce – Common horsetail-Sphagnum		3			0.4
Wb09		Black spruce – Common horsetail-Sphagnum	p	4			3.2
Wb09		Black spruce – Common horsetail-Sphagnum	p	5			2.3
Wf01		Water sedge-Beaked sedge		2	b		4.4
Wf01		Water sedge-Beaked sedge		2			3.6
Wf02		Scrub birch-Water sedge		2	b		0.2

Site Series Number	Letter Code	Ecosystem Name	Site Modifier	Structural Stage	Structural Stage Modifier	Seral Code	Ha
Wf02		Scrub birch-Water sedge		3	a		0.7
Wf10		Hudson Bay clubrush-Red hook-moss		2	b		6.5
Wf18		Tamarack-Scrub birch-Buckbean		3			1.3
Wf18		Tamarack-Scrub birch-Buckbean		3	b		1.4
Wf18		Tamarack-Scrub birch-Buckbean		4			1.1
Wm01		Beaked sedge-Water sedge		2	b		0.2
Wm05		Cattail Marsh		2	b		0.0
Ws03		Bebb’s willow-Bluejoint		3	b		1.8
Total							**637.2**

APPENDIX D TEM SUMMARY OF DISTINCT AREAS

Distinct Area	Site Series Number	Letter Code	Site Modifier	Structural Stage	Structural Stage Modifier	Seral	Ha
Eastern Wetland Complex	00	CF		2	b		0.4
	101			4			0.3
	101		j	4			1.0
	101			5			1.0
	101		j	5			2.1
	101		j	3		6B	8.5
	103		j	3		6B	1.7
	104			3			2.2
	104		j	3			3.8
	104			4			4.3
	104		j	4			12.9
	104		j	5			25.0
	104			3		6B	3.8
	104		j	3		6B	2.9
	Wf01			2	b		2.7
	Wf02			3	a		0.5
Northern Cultivated Field	00	CF		2	b		263.5
	00	OW					0.2
Northern Mesic Forest	101			3		6B	2.0
	101		j	3		6B	6.0
	101		j	4		6B	6.1
	103		j	4		6B	6.0
	104			3			0.7
	104		j	5			2.0
	104		j	5			2.6
Northern Wetland Complex	104			3		6B	3.6
	104		j	3		6B	5.9
	104		j	4		6B	4.8
	Wf01			2			3.6
	Ws03			3	b		1.5
Southern Cultivated Field	00	CF		2	b		134.2
Southern Mesic Forest	101		j	3			2.6
Western Mesic Forest	101			3		6B	8.4
	101		j	4		6B	8.4
Western Wetland Complex	00	CF		2	b		1.4
	00	OW					0.2

Distinct Area	Site Series Number	Letter Code	Site Modifier	Structural Stage	Structural Stage Modifier	Seral	Ha
	101			3			0.3
	101		j	3			0.1
	101		j	4			3.0
	101		j	5			4.9
	101		r	5			0.4
	101			3		6B	1.4
	101		j	3		6B	5.2
	101			4		6B	0.9
	101		j	4		6B	6.2
	101			5		6B	2.1
	101		j	5		6B	1.6
	103		r	5			2.2
	103		j	3		6B	1.5
	104		j	4			5.1
	111		j	3			2.0
	111			4			0.3
	111		j	4			8.2
	111			5			1.9
	111		j	5			7.2
	111			3		6B	0.1
	111		j	4		6B	0.9
	Wb06		p	3			0.2
	Wb06		p	3	b		25.7
	Wb09			3			0.4
	Wb09		p	4			3.2
	Wb09		p	5			2.3
	Wf01			2	b		1.7
	Wf02			2	b		0.2
	Wf02			3	a		0.3
	Wf10			2	b		6.5
	Wf18			3			1.3
	Wf18			3	b		1.4
	Wf18			4			1.1
	Wm01			2	b		0.2
	Wm05			2	b		0.0
	Ws03			3	b		0.3
TOTAL							**637.2**

APPENDIX E POTENTIAL RARE PLANT OCCURRENCE ON PROPERTY

Group	Taxon	Common Name	BCList	COSEWIC	SARA
vascular	*Acorus americanus*	American Sweet-flag	Blue		
vascular	*Alopecurus magellanicus*	Alpine Meadow-foxtail	Red		
vascular	*Anemone canadensis*	Canada Anemone	Blue		
vascular	*Anemone virginiana var. cylindroidea*	Riverbank Anemone	Blue		
vascular	*Arctophila fulva*	Pendantgrass	Blue		
vascular	*Artemisia alaskana*	Alaskan Sagebrush	Blue		
vascular	*Artemisia herriotii*	Herriot's Sage	Red		
vascular	*Astragalus bourgovii*	Bourgeau's Milk-vetch	Blue		
vascular	*Astragalus umbellatus*	Tundra Milk-vetch	Blue		
vascular	*Astragalus vexilliflexus var. vexilliflexus*	Bent-flowered Milk-vetch	Blue		
vascular	*Atriplex gardneri var. gardneri*	Gardner's Sagebrush	Red		
vascular	*Avenula hookeri*	Spike-oat	Blue		
vascular	*Boechera sparsiflora*	Stretching Suncress	Red		
vascular	*Botrychium ascendens*	Upswept Moonwort	Red		
vascular	*Botrychium crenulatum*	Dainty Moonwort	Blue		
vascular	*Botrychium lineare*	Linear-leaf Moonwort	Red		
vascular	*Botrychium montanum*	Mountain Moonwort	Red		
vascular	*Botrychium paradoxum*	Two-spiked Moonwort	Red		
vascular	*Botrychium pedunculosum*	Stalked Moonwort	Blue		
vascular	*Botrychium simplex var. compositum*	Least Moonwort	Blue		
vascular	*Botrychium spathulatum*	Spoon-shaped Moonwort	Blue		
vascular	*Botrychium yaaxudakeit*	Yakutat Moonwort	Red		
vascular	*Braya glabella ssp. glabella*	Smooth Northern-Rockcress	Red		
vascular	*Calamagrostis montanensis*	Plains Reedgrass	Blue		
vascular	*Carex bicolor*	Two-coloured Sedge	Blue		
vascular	*Carex heleonastes*	Hudson Bay Sedge	Blue		
vascular	*Carex lapponica*	Lapland Sedge	Blue		
vascular	*Carex membranacea*	Fragile Sedge	Blue		
vascular	*Carex rostrata*	Swollen Beaked Sedge	Blue		
vascular	*Carex rupestris ssp. rupestris*	Curly Sedge	Blue		
vascular	*Carex sprengelii*	Sprengel's Sedge	Red		
vascular	*Carex sychnocephala*	Many-headed Sedge	Blue		
vascular	*Carex tenera*	Tender Sedge	Blue		
vascular	*Carex torreyi*	Torrey's Sedge	Blue		
vascular	*Carex vulpinoidea*	Fox Sedge	Blue		

Group	Taxon	Common Name	BCList	COSEWIC	SARA
vascular	*Carex xerantica*	Dry-land Sedge	Red		
vascular	*Castilleja miniata var. fulva*	Tawny Paintbrush	Red		
vascular	*Chamaerhodos erecta ssp. nuttallii*	American Chamaerhodos	Blue		
vascular	*Chenopodium hians*	Gaping Goosefoot	Red		
vascular	*Chrysosplenium iowense*	Iowa Golden-saxifrage	Red		
vascular	*Cirsium drummondii*	Drummond's Thistle	Red		
vascular	*Descurainia sophioides*	Northern Tansymustard	Red		
vascular	*Draba cinerea*	Gray-leaved Draba	Blue		
vascular	*Draba lactea*	Milky Draba	Blue		
vascular	*Drosera linearis*	Slender-leaf Sundew	Red		
vascular	*Dryopteris cristata*	Crested Wood Fern	Blue		
vascular	*Eleocharis elliptica*	Elliptic Spike-rush	Blue		
vascular	*Elymus lanceolatus ssp. psammophilus*	Sand-dune Wheatgrass	Blue		
vascular	*Epilobium halleanum*	Hall's Willowherb	Blue		
vascular	*Epilobium saximontanum*	Rocky Mountain Willowherb	Red		
vascular	*Galium labradoricum*	Northern Bog Bedstraw	Blue		
vascular	*Gentianella tenella ssp. tenella*	Slender Gentian	Red		
vascular	*Glyceria pulchella*	Slender Mannagrass	Blue		
vascular	*Gymnocarpium jessoense ssp. parvulum*	Nahanni Oak Fern	Blue		
vascular	*Helianthus nuttallii ssp. rydbergii*	Nuttall's Sunflower	Red		
vascular	*Hesperostipa spartea*	Porcupinegrass	Red		
vascular	*Impatiens aurella*	Orange Touch-me-not	Blue		
vascular	*Juncus albescens*	Whitish Rush	Blue		
vascular	*Juncus confusus*	Colorado Rush	Red		
vascular	*Lomatium foeniculaceum var. foeniculaceum*	Fennel-leaved Desert-parsley	Red		
vascular	*Lupinus kuschei*	Yukon Lupine	Blue		
vascular	*Luzula nivalis*	Arctic Wood-rush	Blue		
vascular	*Malaxis brachypoda*	White Adder's-mouth Orchid	Blue		
vascular	*Micranthes nelsoniana var. carlottae*	Dotted Saxifrage	Blue		
vascular	*Ophioglossum pusillum*	Northern Adder's-tongue	Blue		
vascular	*Oxytropis campestris var. davisii*	Davis' Locoweed	Blue		
vascular	*Oxytropis maydelliana*	Maydell's Locoweed	Blue		
vascular	*Packera ogotorukensis*	Ogotoruk Creek Butterweed	Red		
vascular	*Pedicularis parviflora ssp. parviflora*	Small-flowered Lousewort	Blue		
vascular	*Pedicularis verticillata*	Whorled Lousewort	Blue		

Group	Taxon	Common Name	BCList	COSEWIC	SARA
vascular	*Penstemon gormanii*	Gorman's Penstemon	Blue		
vascular	*Penstemon gracilis*	Slender Penstemon	Red		
vascular	*Physaria arctica*	Arctic Bladderpod	Blue		
vascular	*Physaria didymocarpa ssp. didymocarpa*	Common Twinpod	Blue		
vascular	*Pinguicula villosa*	Hairy Butterwort	Blue		
vascular	*Piptatherum canadense*	Canada Ryegrass	Red		
vascular	*Plantago eriopoda*	Alkali Plantain	Blue		
vascular	*Polemonium boreale*	Northern Jacob's-ladder	Blue		
vascular	*Polygala senega*	Seneca-snakeroot	Red		
vascular	*Polypodium sibiricum*	Siberian Polypody	Red		
vascular	*Potamogeton perfoliatus*	Perfoliate Pondweed	Blue		
vascular	*Potentilla nivea var. pentaphylla*	Five-leaved Cinquefoil	Blue		
vascular	*Prenanthes racemosa*	Purple Rattlesnake-root	Red		
vascular	*Pyrola elliptica*	Shinleaf Wintergreen	Blue		
vascular	*Ranunculus cardiophyllus*	Heart-leaved Buttercup	Red		
vascular	*Ranunculus pedatifidus ssp. affinis*	Birdfoot Buttercup	Blue		
vascular	*Ranunculus rhomboideus*	Prairie Buttercup	Red		
vascular	*Rorippa calycina*	Persistent-sepal Yellowcress	Red		
vascular	*Rosa arkansana var. arkansana*	Arkansas Rose	Blue		
vascular	*Rumex arcticus*	Arctic Dock	Blue		
vascular	*Salix petiolaris*	Meadow Willow	Blue		
vascular	*Salix raupii*	Raup's Willow	Red		
vascular	*Salix serissima*	Autumn Willow	Blue		
vascular	*Sarracenia purpurea ssp. purpurea*	Common Pitcher-plant	Blue		
vascular	*Saussurea angustifolia var. angustifolia*	Northern Sawwort	Red		
vascular	*Schizachyrium scoparium*	Little Bluestem	Red		
vascular	*Selaginella rupestris*	Rock Selaginella	Red		
vascular	*Senecio sheldonensis*	Mount Sheldon Butterweed	Blue		
vascular	*Silene drummondii var. drummondii*	Drummond's Campion	Blue		
vascular	*Silene ostenfeldii*	Taimyr Campion	Blue		
vascular	*Silene repens*	Pink Campion	Red		
vascular	*Sphaeralcea coccinea*	Scarlet Globe-mallow	Red		
vascular	*Sphenopholis intermedia*	Slender Wedgegrass	Blue		
vascular	*Sphenopholis obtusata*	Prairie Wedgegrass	Red		
vascular	*Stuckenia vaginata*	Sheathing Pondweed	Blue		
vascular	*Symphyotrichum puniceum var.*	Purple-stemmed Aster	Blue		

Group	Taxon	Common Name	BCList	COSEWIC	SARA
	puniceum				
vascular	*Tephroseris palustris*	Marsh Fleabane	Blue		
vascular	*Thalictrum dasycarpum*	Purple Meadowrue	Blue		
vascular	*Thermopsis rhombifolia*	Prairie Golden Bean	Red		
vascular	*Tofieldia coccinea*	Northern False Asphodel	Blue		
vascular	*Townsendia hookeri*	Hooker’s Townsendia	Red		
vascular	*Utricularia ochroleuca*	Ochroleucous Bladderwort	Blue		
moss	*Acaulon muticum var. rufescens*		Red		
moss	*Amblyodon dealbatus*		Blue		
moss	*Atrichum tenellum*		Blue		
moss	*Aulacomnium acuminatum*		Blue		
moss	*Barbula convoluta var. gallinula*		Red		
moss	*Bartramia halleriana*	Haller’s Apple Moss	Red	T (Nov 2011)	1-T (Jun 2003)
moss	*Brachythecium trachypodium*		Blue		
moss	*Bryum uliginosum*		Blue		
moss	*Didymodon rigidulus var. icmadophilus*		Blue		
moss	*Didymodon subandreaeoides*		Red		
moss	*Encalypta mutica*		Blue		
moss	*Encalypta spathulata*		Blue		
moss	*Grimmia teretinervis*		Red		
moss	*Haplodontium macrocarpum*	Porsild’s Bryum	Red	T (Nov 2003)	1-T (Feb 2011)
moss	*Hygrohypnum alpinum*		Blue		
moss	*Lescuraea saxicola*		Blue		
moss	*Meesia longiseta*		Blue		
moss	*Myurella sibirica*		Red		
moss	*Philonotis yezoana*		Blue		
moss	*Pohlia bulbifera*		Red		
moss	*Pohlia vexans*		Blue		
moss	*Pseudocalliergon turgescens*		Blue		
moss	*Schistidium boreale*		Blue		
moss	*Schistidium confertum*		Red		
moss	*Schistidium pulchrum*		Blue		
moss	*Schistidium robustum*		Blue		
moss	*Schistidium trichodon*		Blue		
moss	*Sphagnum contortum*		Blue		
moss	*Sphagnum wulfianum*		Blue		
moss	*Splachnum vasculosum*		Blue		
moss	*Stegonia latifolia var. latifolia*		Blue		
moss	*Stegonia latifolia var. pilifera*		Red		
moss	*Tayloria froelichiana*		Blue		

Group	Taxon	Common Name	BCList	COSEWIC	SARA
moss	*Tayloria splachnoides*		Red		
moss	*Tetraplodon urceolatus*		Red		
moss	*Timmia norvegica*		Blue		
moss	*Timmia sibirica*		Red		
moss	*Tomentypnum falcifolium*		Blue		
moss	*Tortella humilis*		Red		
moss	*Weissia brachycarpa*		Red		
lichen	*Anaptychia crinalis*	Electrified millepede	Red		
lichen	*Anaptychia ulotrichoides*	Amputated millepede	Blue		
lichen	*Cladonia grayi*	Gray's pixie-cup	Red		
lichen	*Cladonia parasitica*	Fence-rail pixie	Red		
lichen	*Collema bachmanianum*	Caesar's tarpaper	Red		
lichen	*Collema coniophilum*	Crumpled tarpaper	Red	T (Nov 2010)	
lichen	*Collema multipartitum*	Protracted tarpaper	Red		
lichen	*Fulgensia bracteata*	Goldnugget sulphur	Blue		
lichen	*Fulgensia bracteata*	Goldnugget sulphur	Blue		
lichen	*Fulgensia desertorum*	Desert sulphur	Red		
lichen	*Heterodermia speciosa*	Smiling centipede	Red		
lichen	*Lempholemma polyanthes*	Mourning phlegm	Blue		
lichen	*Leptogium intermedium*	Fourty-five vinyl	Blue		
lichen	*Leptogium plicatile*	Starfish vinyl	Blue		
lichen	*Leptogium pseudofurfuraceum*	Concentric vinyl	Blue		
lichen	*Leptogium schraderi*	Collapsing vinyl	Red		
lichen	*Leptogium tenuissimum*	Birdnest vinyl	Red		
lichen	*Peltigera degenii*	Lustrous pelt	Red		
lichen	*Peltigera evansiana*	Peppered pelt	Red		
lichen	*Phaeophyscia adiastola*	Granulating shadow	Red		
lichen	*Phaeophyscia hirsuta*	Smiling shadow	Red		
lichen	*Phaeophyscia hispidula*	Whiskered shadow	Red		
lichen	*Phaeophyscia kairamoi*	Five o'clock shadow	Blue		
lichen	*Phaeophyscia nigricans*	Least shadow	Red		
lichen	*Physcia dimidiata*	Exuberant rosette	Red		
lichen	*Physcia stellaris*	Immaculate rosette	Blue		
lichen	*Physcia tribacia*	Beaded rosette	Red		
lichen	*Physciella chloantha*	Downside shade	Blue		
lichen	*Punctelia perreticulata*	Galactic speckleback	Red		
lichen	*Ramalina sinensis*	Threadbare ribbon	Blue		
lichen	*Squamarina cartilaginea*	Pea-green dimple	Red		
lichen	*Squamarina lentigera*	Snow-white dimple	Red		
lichen	*Usnea cavernosa*	Pitted beard	Blue		
lichen	*Usnea glabrata*	Lustrous beard	Blue		

APPENDIX F COMPREHENSIVE SPECIES LIST

The following table presents a listing of all vascular plants and bryophytes identified on the Property during the two years of rare plant surveys.

Category	Taxon	Common Name
Vascular	*Achillea millefolium var. lanulosa*	Yarrow
Vascular	*Actaea rubra*	Baneberry
Vascular	*Agropyron cristatum ssp. pectinatum*	Crested Wheatgrass
Vascular	*Agrostis scabra*	Hair Bentgrass
Vascular	*Alisma triviale*	American Water-plantain
Vascular	*Alnus viridis ssp. crispa*	Green Alder
Vascular	*Alopecurus aequalis*	Little Meadow-foxtail
Vascular	*Amelanchier alnifolia*	Saskatoon Berry
Vascular	*Amerorchis rotundifolia*	Round-leaved Orchis
Vascular	*Andromeda polifolia var. polifolia*	Bog-rosemary
Vascular	*Anemone multifida var. multifida*	Cut-leaved Anemone
Vascular	*Antennaria microphylla*	White Pussytoes
Vascular	*Antennaria neglecta*	Field Pussytoes
Vascular	*Antennaria pulcherrima ssp. pulcherrima*	Showy Pussytoes
Vascular	*Antennaria racemosa*	Racemose Pussytoes
Vascular	*Antennaria rosea*	Rosy Pussytoes
Vascular	*Apocynum cannabinum*	Hemp
Vascular	*Aralia nudicaulis*	Wild Sarsaparilla
Vascular	*Arctostaphylos uva-ursi*	Kinnikinnick
Vascular	*Astragalus americanus*	American Milk-vetch
Vascular	*Betula papyrifera*	Paper Birch
Vascular	*Betula pumila var. glandulifera*	Low Birch
Vascular	*Bidens cernua*	Nodding Beggarticks
Vascular	*Botrypus virginianus*	Rattlesnake Fern
Vascular	*Bromus ciliatus*	Fringed Brome
Vascular	*Bromus inermis*	Smooth Brome
Vascular	*Bromus pumpellianus ssp. pumpellianus*	Pumpelly Brome
Vascular	*Calamagrostis canadensis var. canadensis*	Bluejoint Reedgrass
Vascular	*Calamagrostis canadensis var. langsdorfii*	Bluejoint Reedgrass
Vascular	*Calamagrostis stricta ssp. inexpansa*	Slimstem Reedgrass
Vascular	*Calamagrostis stricta ssp. stricta*	Slimstem Reedgrass
Vascular	*Calla palustris*	Wild Calla
Vascular	*Callitriche palustris*	Spring Water-starwort
Vascular	*Capsella bursa-pastoris*	Shepherd’s Purse
Vascular	*Carex aenea*	Bronze Sedge
Vascular	*Carex aquatilis var. aquatilis*	Water Sedge
Vascular	*Carex atherodes*	Awned Sedge
Vascular	*Carex atratiformis*	Black Sedge

Category	Taxon	Common Name
Vascular	*Carex aurea*	Golden Sedge
Vascular	*Carex bebbii*	Bebb's Sedge
Vascular	*Carex brevior*	Short-beaked Sedge
Vascular	*Carex brunnescens*	Brownish Sedge
Vascular	*Carex capillaris*	Hairlike Sedge
Vascular	*Carex chordorrhiza*	Cordroot Sedge
Vascular	*Carex concinna*	Low Northern Sedge
Vascular	*Carex crawfordii*	Crawford's Sedge
Vascular	*Carex cusickii*	Cusick's Sedge
Vascular	*Carex deweyana var. deweyana*	Dewey's Sedge
Vascular	*Carex diandra*	Lesser-panicled Sedge
Vascular	*Carex disperma*	Soft-leaved Sedge
Vascular	*Carex gynocrates*	Yellow Bog Sedge
Vascular	*Carex inops ssp. heliophila*	Long-stoloned Sedge
Vascular	*Carex interior*	Inland Sedge
Vascular	*Carex lasiocarpa ssp. americana*	Slender Sedge
Vascular	*Carex leptalea ssp. leptalea*	Bristle-stalked Sedge
Vascular	*Carex limosa*	Shore Sedge
Vascular	*Carex livida var. radicaulis*	Pale Sedge
Vascular	*Carex magellanica ssp. irrigua*	Poor Sedge
Vascular	*Carex microglochin*	Few-seeded Fen Sedge
Vascular	*Carex microptera*	Small-winged Sedge
Vascular	*Carex obtusata*	Blunt Sedge
Vascular	*Carex pachystachya*	Thick-headed Sedge
Vascular	*Carex pellita*	Woolly Sedge
Vascular	*Carex prairea*	Prairie Sedge
Vascular	*Carex praticola*	Meadow Sedge
Vascular	*Carex sartwellii var. sartwellii*	Sartwell's Sedge
Vascular	*Carex siccata*	Hay Sedge
Vascular	*Carex utriculata*	Beaked Sedge
Vascular	*Carex vaginata*	Sheathed Sedge
Vascular	*Carex vesicaria*	Lesser Bladder Sedge
Vascular	*Castilleja miniata var. fulva*	Tawny Paintbrush
Vascular	*Cerastium arvense*	Field Chickweed
Vascular	*Cerastium nutans*	Nodding Chickweed
Vascular	*Chenopodium album ssp. album*	Lamb's-quarters
Vascular	*Chenopodium album ssp. striatum*	Lamb's-quarters
Vascular	*Cicuta bulbifera*	Bulbous Water-hemlock
Vascular	*Cinna latifolia*	Nodding Wood-reed
Vascular	*Cirsium arvense*	Canada Thistle
Vascular	*Coeloglossum viride var. virescens*	Long-bracted Frog Orchid
Vascular	*Comarum palustre*	Marsh Cinquefoil
Vascular	*Corallorhiza maculata*	Spotted Coralroot

Category	Taxon	Common Name
Vascular	*Corallorhiza trifida*	Yellow Coralroot
Vascular	*Cornus canadensis*	Bunchberry
Vascular	*Cornus stolonifera*	Red-osier Dogwood
Vascular	*Dactylis glomerata*	Orchard grass
Vascular	*Descurainia sophia*	Flixweed
Vascular	*Drosera linearis*	Slender-leaf Sundew
Vascular	*Drosera rotundifolia var. rotundifolia*	Round-leaved Sundew
Vascular	*Dryopteris carthusiana*	Toothed Wood Fern
Vascular	*Eleocharis mamillata ssp. mamillata*	Nipple Spike-rush
Vascular	*Eleocharis palustris*	Common Spike-rush
Vascular	*Elymus trachycaulus ssp. trachycaulus*	Slender Wheatgrass
Vascular	*Epilobium angustifolium*	Fireweed
Vascular	*Epilobium ciliatum ssp. ciliatum*	Purple-leaved Willowherb
Vascular	*Epilobium hornemannii ssp. hornemannii*	Hornemann's Willowherb
Vascular	*Epilobium leptophyllum*	Narrow-leaved Willowherb
Vascular	*Epilobium palustre*	Swamp Willowherb
Vascular	*Equisetum arvense*	Common Horsetail
Vascular	*Equisetum fluviatile*	Swamp Horsetail
Vascular	*Equisetum palustre*	Marsh Horsetail
Vascular	*Equisetum pratense*	Meadow Horsetail
Vascular	*Equisetum scirpoides*	Dwarf Scouring-rush
Vascular	*Equisetum sylvaticum*	Wood Horsetail
Vascular	*Erigeron acris var. kamtschaticus*	Bitter Fleabane
Vascular	*Eriophorum angustifolium*	Narrow-leaved Cotton-grass
Vascular	*Eriophorum chamissonis var. chamissonis*	Chamisso's Cotton-grass
Vascular	*Eriophorum gracile*	Slender Cotton-grass
Vascular	*Eriophorum viridicarinatum*	Green-keeled Cotton-grass
Vascular	*Eurybia conspicua*	Showy Aster
Vascular	*Festuca rubra ssp. rubra*	Red Fescue
Vascular	*Festuca saximontana*	Rocky Mountain Fescue
Vascular	*Fragaria vesca var. bracteata*	Wood Strawberry
Vascular	*Fragaria virginiana*	Wild Strawberry
Vascular	*Fragaria virginiana var. platypetala*	Wild Strawberry
Vascular	*Galeopsis bifida*	Split-lip Hemp-nettle
Vascular	*Galium boreale*	Northern Bedstraw
Vascular	*Galium labradoricum*	Northern Bog Bedstraw
Vascular	*Galium trifidum ssp. subbiflorum*	Small Bedstraw
Vascular	*Galium trifidum ssp. trifidum*	Small Bedstraw
Vascular	*Galium triflorum*	Sweet-scented Bedstraw
Vascular	*Gentianella amarella ssp. acuta*	Northern Gentian
Vascular	*Geocaulon lividum*	False Toad-flax
Vascular	*Geum aleppicum*	Yellow Avens
Vascular	*Geum macrophyllum ssp. perincisum*	Large-leaved Avens

Category	Taxon	Common Name
Vascular	*Geum rivale*	Water Avens
Vascular	*Glyceria borealis*	Northern Mannagrass
Vascular	*Glyceria elata*	Tall Mannagrass
Vascular	*Glyceria grandis var. grandis*	Reed Mannagrass
Vascular	*Glyceria striata*	Fowl Mannagrass
Vascular	*Goodyera oblongifolia*	Rattlesnake-plantain
Vascular	*Gymnocarpium dryopteris*	Oak Fern
Vascular	*Hieracium umbellatum ssp. umbellatum*	Narrow-leaved Hawkweed
Vascular	*Hippuris vulgaris*	Common Mare's-tail
Vascular	*Hordeum jubatum ssp. jubatum*	Foxtail Barley
Vascular	*Hypopitys monotropa*	Pinesap
Vascular	*Juncus alpinoarticulatus ssp. americanus*	Northern Green Rush
Vascular	*Juncus articulatus ssp. articulatus*	Jointed Rush
Vascular	*Juncus balticus ssp. ater*	Baltic Rush
Vascular	*Juncus bufonius*	Toad Rush
Vascular	*Juncus dudleyi*	Dudley's Rush
Vascular	*Juncus stygius ssp. americanus*	Bog Rush
Vascular	*Juncus vaseyi*	Vasey's Rush
Vascular	*Lactuca serriola*	Prickly Lettuce
Vascular	*Larix laricina*	Tamarack
Vascular	*Lathyrus ochroleucus*	Creamy Peavine
Vascular	*Lemna minor*	Common Duckweed
Vascular	*Leymus innovatus*	Fuzzy-spiked Wildrye
Vascular	*Limosella aquatica*	Water Mudwort
Vascular	*Linnaea borealis*	Twinflower
Vascular	*Listera cordata*	Heart-leaved Twayblade
Vascular	*Lonicera dioica var. glaucescens*	Glaucous-leaved Honeysuckle
Vascular	*Lonicera involucrata*	Black Twinberry
Vascular	*Lycopodium dendroideum*	Ground-pine
Vascular	*Maianthemum canadense*	Wild Lily-of-the-valley
Vascular	*Maianthemum trifolium*	Three-leaved False Solomon's-seal
Vascular	*Matricaria discoidea*	Pineapple Weed
Vascular	*Medicago sativa ssp. sativa*	Alfalfa
Vascular	*Mentha arvensis*	Field Mint
Vascular	*Menyanthes trifoliata*	Buckbean
Vascular	*Mertensia paniculata var. paniculata*	Tall Bluebells
Vascular	*Mitella nuda*	Common Mitrewort
Vascular	*Moehringia lateriflora*	Blunt-leaved Sandwort
Vascular	*Moneses uniflora*	Single Delight
Vascular	*Monotropa uniflora*	Indian-pipe
Vascular	*Muhlenbergia glomerata*	Marsh Muhly
Vascular	*Orthilia secunda*	One-sided Wintergreen
Vascular	*Orthilia secunda var. secunda*	One-sided Wintergreen

Category	Taxon	Common Name
Vascular	*Osmorhiza depauperata*	Blunt-fruited Sweet-cicely
Vascular	*Packera paupercula*	Canadian Butterweed
Vascular	*Packera plattensis*	Plains Butterweed
Vascular	*Parnassia palustris*	Northern Grass-of-parnassus
Vascular	*Pedicularis parviflora ssp. parviflora*	Small-flowered Lousewort
Vascular	*Persicaria amphibia var. emersa*	Water Smartweed
Vascular	*Persicaria amphibia var. stipulacea*	Water Smartweed
Vascular	*Persicaria hydropiper*	Marshpepper Smartweed
Vascular	*Petasites frigidus var. palmatus*	Sweet Coltsfoot
Vascular	*Petasites frigidus var. sagittatus*	Arrow-leaved Coltsfoot
Vascular	*Phalaris arundinacea*	Reed Canarygrass
Vascular	*Phleum pratense*	Common Timothy
Vascular	*Picea glauca*	White Spruce
Vascular	*Picea mariana*	Black Spruce
Vascular	*Pinus contorta var. latifolia*	Lodgepole Pine
Vascular	*Piptatherum pungens*	Short-awned Ricegrass
Vascular	*Plantago major*	Common Plantain
Vascular	*Platanthera aquilonis*	Northern Green Rein Orchid
Vascular	*Platanthera huronensis*	Great Lakes Rein Orchid
Vascular	*Platanthera orbiculata*	Large Round-leaved Rein Orchid
Vascular	*Platanthera sp.*	Rein Orchid
Vascular	*Poa annua*	Annual Bluegrass
Vascular	*Poa compressa*	Canada Bluegrass
Vascular	*Poa palustris*	Fowl Bluegrass
Vascular	*Poa pratensis ssp. pratensis*	Kentucky Bluegrass
Vascular	*Polygonum achoreum*	Blake’s Knotweed
Vascular	*Polygonum aviculare*	Common Knotweed
Vascular	*Polygonum ramosissimum*	Yellow-flowered Knotweed
Vascular	*Populus balsamifera*	Balsam Poplar
Vascular	*Populus tremuloides*	Trembling Aspen
Vascular	*Potamogeton alpinus*	Northern Pondweed
Vascular	*Potamogeton foliosus*	Closed-leaved Pondweed
Vascular	*Potamogeton gramineus*	Grass-leaved Pondweed
Vascular	*Potamogeton pusillus ssp. tenuissimus*	Small Pondweed
Vascular	*Potentilla norvegica*	Norwegian Cinquefoil
Vascular	*Prosartes trachycarpa*	Rough-fruited Fairybells
Vascular	*Puccinellia distans*	Weeping Alkaligrass
Vascular	*Pyrola asarifolia*	Pink Wintergreen
Vascular	*Ranunculus aquatilis var. aquatilis*	White Water-buttercup
Vascular	*Ranunculus lapponicus*	Lapland Buttercup
Vascular	*Ranunculus macounii*	Macoun’s Buttercup
Vascular	*Ranunculus sceleratus var. multifidus*	Celery-leaved Buttercup
Vascular	*Rhinanthus minor*	Yellow Rattle

Category	Taxon	Common Name
Vascular	*Rhododendron groenlandicum*	Labrador-Tea
Vascular	*Ribes hudsonianum var. hudsonianum*	Northern Blackcurrant
Vascular	*Ribes lacustre*	Black Gooseberry
Vascular	*Ribes oxyacanthoides ssp. oxyacanthoides*	Northern Gooseberry
Vascular	*Rorippa palustris ssp. hispida*	Hispid Yellowcress
Vascular	*Rosa acicularis ssp. sayi*	Prickly Rose
Vascular	*Rubus arcticus ssp. acaulis*	Nagoonberry
Vascular	*Rubus idaeus ssp. strigosus*	Red Raspberry
Vascular	*Rubus pedatus*	Five-leaved Bramble
Vascular	*Rubus pubescens var. pubescens*	Dwarf Red Raspberry
Vascular	*Rumex occidentalis*	Western Dock
Vascular	*Sagittaria cuneata*	Arum-leaved Arrowhead
Vascular	*Salix arbusculoides*	Northern Bush Willow
Vascular	*Salix bebbiana*	Bebb’s Willow
Vascular	*Salix candida*	Sage Willow
Vascular	*Salix discolor*	Pussy Willow
Vascular	*Salix maccalliana*	Maccalla’s Willow
Vascular	*Salix myrtillifolia*	Bilberry Willow
Vascular	*Salix pedicellaris*	Bog Willow
Vascular	*Salix planifolia*	Plane-leaved Willow
Vascular	*Salix pseudomonticola*	Serviceberry Willow
Vascular	*Salix pseudomyrsinites*	Tall Blueberry Willow
Vascular	*Salix scouleriana*	Scouler’s Willow
Vascular	*Salix serissima*	Autumn Willow
Vascular	*Schizachne purpurascens*	False Melic
Vascular	*Scirpus microcarpus*	Small-flowered Bulrush
Vascular	*Scutellaria galericulata*	Marsh Skullcap
Vascular	*Shepherdia canadensis*	Soopolallie
Vascular	*Sium suave*	Hemlock Water-parsnip
Vascular	*Solidago lepida var. salebrosa*	Western Canada Goldenrod
Vascular	*Solidago simplex var. simplex*	Spikelike Goldenrod
Vascular	*Sparganium emersum*	Emersed Bur-reed
Vascular	*Spiraea betulifolia ssp. lucida*	Birch-leaved Spirea
Vascular	*Spiranthes romanzoffiana*	Hooded Ladies’ Tresses
Vascular	*Stellaria longipes var. longipes*	Long-stalked Starwort
Vascular	*Symphyotrichum boreale*	Rush Aster
Vascular	*Symphyotrichum ciliolatum*	Lindley’s Aster
Vascular	*Symphyotrichum puniceum var. puniceum*	Purple-stemmed Aster
Vascular	*Taraxacum officinale*	Common Dandelion
Vascular	*Thalictrum venulosum*	Veiny Meadowrue
Vascular	*Triantha glutinosa*	Sticky False Asphodel
Vascular	*Trichophorum cespitosum*	Tufted Clubrush
Vascular	*Trifolium hybridum*	Alsike Clover

Category	Taxon	Common Name
Vascular	*Trifolium pratense*	Red Clover
Vascular	*Trifolium repens*	White Clover
Vascular	*Triglochin maritima*	Seaside Arrow-grass
Vascular	*Triglochin palustris*	Marsh Arrow-grass
Vascular	*Trisetum spicatum*	Spike Trisetum
Vascular	*Turritis glabra*	Tower Mustard
Vascular	*Typha latifolia*	Common Cattail
Vascular	*Urtica dioica ssp. gracilis*	Stinging Nettle
Vascular	*Utricularia intermedia*	Flat-leaved Bladderwort
Vascular	*Utricularia macrorhiza*	Greater Bladderwort
Vascular	*Vaccinium caespitosum*	Dwarf Blueberry
Vascular	*Vaccinium myrtilloides*	Velvet-leaved Blueberry
Vascular	*Vaccinium oxycoccos*	Bog Cranberry
Vascular	*Vaccinium vitis-idaea ssp. minus*	Lingonberry
Vascular	*Veronica peregrina var. xalapensis*	Purslane Speedwell
Vascular	*Veronica scutellata*	Marsh Speedwell
Vascular	*Viburnum edule*	Highbush-cranberry
Vascular	*Vicia americana*	American Vetch
Bryophyte	*Amblystegium serpens*	
Bryophyte	*Aulacomnium palustre*	
Bryophyte	*Brachythecium sp.*	
Bryophyte	*Bryoerythrophyllum recurvirostre var. recurvirostre*	
Bryophyte	*Bryum caespiticium*	
Bryophyte	*Bryum pseudotriquetrum*	
Bryophyte	*Bryum sp.*	
Bryophyte	*Calliergon trifarium*	
Bryophyte	*Calypogeia sphagnicola*	
Bryophyte	*Campylium sp.*	
Bryophyte	*Campylium stellatum*	
Bryophyte	*Cephalozia lunulifolia*	
Bryophyte	*Ceratodon purpureus*	
Bryophyte	*Conardia compacta*	
Bryophyte	*Dicranum fuscescens var. fuscescens*	
Bryophyte	*Dicranum polysetum*	
Bryophyte	*Dicranum undulatum*	
Bryophyte	*Distichium capillaceum*	
Bryophyte	*Drepanocladus aduncus*	
Bryophyte	*Funaria hygrometrica*	
Bryophyte	*Helodium blandowii*	
Bryophyte	*Hylocomium splendens*	Step Moss
Bryophyte	*Hypnum revolutum var. revolutum*	
Bryophyte	*Hypnum sp.*	
Bryophyte	*Leptobryum pyriforme*	

Category	Taxon	Common Name
Bryophyte	*Marchantia polymorpha*	
Bryophyte	*Meesia triquetra*	
Bryophyte	*Mesoptychia badensis*	
Bryophyte	*Mylia anomala*	
Bryophyte	*Myurella julacea*	
Bryophyte	*Paludella squarrosa*	
Bryophyte	*Plagiomnium ellipticum*	
Bryophyte	*Pleurozium schreberi*	Red-stemmed Feathermoss
Bryophyte	*Pohlia nutans*	
Bryophyte	*Polytrichum commune var. commune*	
Bryophyte	*Polytrichum strictum*	
Bryophyte	*Preissia quadrata*	
Bryophyte	*Ptilidium pulcherrimum*	
Bryophyte	*Ptilium crista-castrensis*	Knight's Plume
Bryophyte	*Sanionia uncinata*	
Bryophyte	*Scorpidium revolvens*	
Bryophyte	*Scorpidium scorpioides*	
Bryophyte	*Sphagnum capillifolium*	
Bryophyte	*Sphagnum fuscum*	
Bryophyte	*Sphagnum warnstorfii*	
Bryophyte	*Tetraplodon angustatus*	
Bryophyte	*Tomentypnum nitens*	
Bryophyte	*Warnstorfia fluitans*	

APPENDIX G SPECIES ACCOUNTS FOR RARE PLANT TAXA ON PROPERTY

Castilleja miniata var. fulva **(tawny paintbrush)**

Tawny paintbrush is a perennial herb in the Orobanchaceae (Broom-rape family) which grows in grasslands, open forests, and roadsides in the Peace River region (Douglas et al. 1998; Egger 2008). Although the common variety of *Castilleja miniata* occurs throughout the Province, variety *fulva* is only known from the Hudson's Hope area extending south towards Chetwynd, and east towards Fort St. John.

Tawny paintbrush is currently ranked SH (Historical) in BC, and is on the Red list for the province (BCCDC 2014a). Globally tawny paintbrush is classed G1Q, meaning that there are unresolved questions regarding the taxonomy or distribution of the taxon. Because of the taxonomic uncertainty regarding the species, tawny paintbrush was not tracked at the time the rare plant surveys were being conducted for the Project Environmental Assessment. New work being conducted for the upcoming Flora of North America treatment of the Broom-rape family has suggested that variety *fulva* is a valid taxon (Egger 2008).

Tawny paintbrush was found in five large sub-occurrences in the open forests and cut lines of the Property. These sub-occurrences are extensive, containing thousands of individuals and covering several hectares.

Drosera linearis **(slender-leaf sundew)**

Slender-leaf sundew is a small, insectivorous perennial of the Droseraceae (sundew family) that inhabits calcareous wetlands and shorelines across much of northern North America (Gray and Fernald 1950; Moss and Packer 1983). The species is known from only two locations in BC, both along the axis of the Rocky Mountains, and is reported from fewer than 20 sites in Alberta (Williston and Bartemucci 2007; Klinkenberg 2014; BCCDC 2014b). Slender-leaf sundew also ranges north into the Northwest Territories and east to New Brunswick and Newfoundland, as well as south into five US states (Montana, Minnesota, Wisconsin, Michigan, and Maine) (Natureserve 2014).

In BC, slender-leaf sundew is ranked S1 (Critically Imperilled), and is on the Red list for the province (BCCDC 2014a). The species has a global status of G4 (Apparently Secure). Sub-national rankings for the taxon vary: S4 (Apparently Secure) in Ontario; S3

(Vulnerable) in Alberta, Québec and Minnesota; S2 (Imperilled) in Manitoba and Montana; and S1 (Critically Imperilled) in Saskatchewan, New Brunswick, Newfoundland, Wisconsin, and Maine. The Northwest Territories and Michigan do not provide a rank (Natureserve 2014).

A single occurrence of slender-leaf sundew is reported for the Property. Rare plant surveys in 2012 and 2014 located a large site comprising three subpopulations that contained an estimated total of 7,000 plants over approximately 6,000 square metres. The sundew plants were discovered growing with low shrubs, sedges, and other herbs, in the open portions of a marl fen near the western boundary of the Property. Five other rare plant taxa were also located within the same fen complex.

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. 1998). In BC the species is located primarily in the northeast section of the province, with one occurrence also reported from near Salmon Arm (Klinkenberg 2014; BCCDC 2014b). 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 2014).

Northern bog bedstraw is an S3 (Vulnerable) species in BC, and is on the provincial Blue list (BCCDC 2014a). 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 New Brunswick, Nova Scotia, Illinois, Massachusetts, and Maine; and S1 (Critically Imperilled) in Prince Edward Island, Iowa, Ohio, Pennsylvania, New Jersey, Connecticut, and Vermont (NatureServe 2014).

One occurrence of northern bog bedstraw is reported for the Property. The 2012 and 2014 rare plant surveys identified a large site along the western boundary, containing an estimated 10,000 plants covering approximately 50,000 square metres. The bedstraw plants were observed growing with sedges and other herbs in a shrub fen and in the surrounding forest. Five other rare plant taxa were also located within this fen complex.

Juncus stygius spp. americanus **(bog rush)**

Bog rush, a small, tufted perennial in the Juncaceae (rush family), grows in and around peat bogs and pools from the lowland to montane zones (Douglas, et al. 1998; Brooks and Clemants 2000). The taxon is found scattered in two general areas in central BC: in and near the Rocky Mountains; and also along the coast (Klinkenberg 2014; BCCDC 2014a). The species' global range extends east across Canada to Newfoundland, south into several US states, and north through Yukon and Alaska into parts of northern and central Eurasia (Brooks and Clemants 2000; NatureServe 2014; Kilgallen 2012).

Bog rush is ranked S2S3 (Imperilled and Vulnerable) in BC, and is on the Blue list for the province (BCCDC 2014a). Globally the species is classed G5 (Secure). Most North American sub-national jurisdictions indicate a rare status: SH (Possibly Extirpated) in New York; S1 (Critically Imperilled) in Saskatchewan, Manitoba, New Brunswick, Nova Scotia, New Hampshire, Wisconsin, and Michigan; S2 (Imperilled) in Yukon, Alberta, and Maine; and S3 (Vulnerable) in Québec, Newfoundland, and Minnesota. Bog rush is ranked S4 (Apparently Secure) in Ontario (Natureserve 2014).

One occurrence of bog rush is reported for the Property. Rare plant survey work in 2012 and 2014 recorded two subpopulations near the western boundary, containing an estimated total of 1,050 plants over approximately 600 square metres. The bog rush plants were found growing in a community of low trees and shrubs, sedges, and other herbs, in the ecotone between open and shrub portions of a marl fen. Five other rare plant taxa were also located within the same fen complex.

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. 1955; Douglas, et al. 1998). In BC, the taxon has been reported from numerous scattered locations across the central and northern parts of the province (Klinkenberg 2014; BCCDC 2014b). 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 2014).

Small-flowered lousewort is classified S3 (Vulnerable) in BC, and is on the Blue list for the province (BCCDC 2014a). 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 2014).

One occurrence of small-flowered lousewort is reported for the Property. Rare plant survey work in 2012 and 2014 located a large site along the western boundary, containing an estimated 250 – 1,000 plants over roughly 50,000 square metres. The lousewort plants were found growing with sedges and other herbs in a series of patterned and non-patterned shrub fens. Five other rare plant taxa were also located within this fen complex.

Salix serissima **(autumn willow)**

Autumn willow—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 (Douglas, et al. 1998; Argus 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 (Klinkenberg 2014; BCCDC 2014b).

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 2014).

Autumn willow is ranked S2S3 (Imperilled and Vulnerable) in BC, and is on the province’s Blue list (BCCDC 2014a). 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 2014).

Two occurrences of autumn willow are reported for the Property. The 2012 rare plant surveys identified one plant near the western boundary, in a clearing within mixed bog forest at the edge of a shrub fen. Five other rare plant taxa were also located in within this fen complex. An additional two autumn willow plants were discovered on the Property’s southern boundary. These were found growing with other willows in an area approximately 20 square metres in size, within a shrub- and sedge-dominated marsh (which was dry at the time of survey).

Symphyotrichum puniceum var. puniceum **(purple-stemmed aster)**

Purple-stemmed aster 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 (BCCDC 2007; Klinkenberg 2014). 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 2014).

Purple-stemmed aster is ranked S3 (Vulnerable) in BC and is on the province's Blue list (BCCDC 2014a). 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 2014).

A total of four occurrences of purple-stemmed aster are reported for the Property. Rare plant surveys in 2012 and 2014 recorded the taxon in scattered locations near the northern and western boundaries. All of the sites contained fewer than 50 individuals, and ranged in estimated size from 25 to 200 square metres. Two of the occurrences were located in or near a fen complex that also supported five other rare plant taxa; one of these sites comprised two subpopulations. The purple-stemmed aster plants were growing in a variety of habitats, including shrubby graminoid-dominated marsh and meadow areas, as well as transitional zones between mixed upland forest and fen wetlands.

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APPENDIX H INCIDENTAL OBSERVATIONS

Incidental observations recorded on the Property in 2014.

Detection Survey	Date	Species	UTM Zone	UTM Easting	UTM Northing	Count
CONI-CP	07/07/2014	Western Toad	10V	562925	6210878	1
STGR-Lek	08/08/2014	Sharp-tailed Grouse	10V	563832	6213993	1
STGR-Lek	24/08/2014	Sharp-tailed Grouse	10V	563173	6214219	1
A-ANBO	07/07/2014	Western Toad	10V	562517	6213017	1
TEM	25/08/2014	Western Toad	10V	562458	6212890	1
TEM	25/08/2014	Western Toad	10V	562949	6212481	1
TEM	26/08/2014	Western Toad	10V	562946	6212477	1
TEM	26/08/2014	Western Toad	10V	562913	6211185	1
CONI-CP	24/06/2014	Red-tailed Hawk	10V	562301	6214011	2
CONI-CP	24/06/2014	American Kestrel	10V	562960	6214201	2
A-ANBO	07/07/2014	Upland Sandpiper	10V	562854	6213127	4
BBS	10/07/2014	Sandhill Crane	10V	562930	6213110	2
TEM	24/08/2014	Northern Harrier	10V	562913	6211185	1
TEM	27/08/2014	Rusty Blackbird	10V	563392	6212095	12
Bat Detector Servicing	01/08/2014	Barn Swallow	10V	563200	6211650	1

APPENDIX I BREEDING BIRD OBSERVATIONS

Breeding Bird Survey Results and Incidental Reports From 2012 and 2014. NWC – Northern Wetland Complex; EWC – Eastern Wetland Complex; WWC – Western Wetland Complex; NCF – Northern Cultivated Field; SCF – Southern Cultivated Field; NMF – Northern Mesic Forest; SMF – Southern Mesic Forest; and WMF – Western Mesic Forest.

Common Name	2012 Count	2014 Count	Incidental 2012 2014	NWC	EWC	WWC	NCF	SCF	NMF	SMF	WMF
Alder Flycatcher	3	0						X			
American Crow	11	1						X			
American Kestrel	0	2	2				X				
American Pipit	30	0					X				
American Redstart	7	0				X	X	X			
American Robin	42	23		X	X	X	X	X	X		
American Three-toed	2	0						X			
Barn Swallow*	10	1	2		X		X	X			
Black-and-white Warbler	5	0					X	X			
Black-billed Magpie	4	1				X	X	X			
Black-capped Chickadee	3	10				X	X	X			
Brown-headed Cowbird	11	2		X		X	X	X			
Blue-headed Vireo	9	0		X		X	X	X			
Blackpoll Warbler	3	1				X	X	X			
Bank Swallow	8	0					X	X			
Blue Jay	1	0						X			
Boreal Chickadee	2	0						X			
Bufflehead	1	0						X			
Blue-winged Teal	8	0					X	X			
Canada Goose	24	7				X	X	X			
Clay-colored Sparrow	14	4		X		X	X	X			
Chipping Sparrow	27	44		X	X	X	X	X	X		
Common Nighthawk	0	0	1					X			
Common Raven	11	38		X	X	X	X	X	X		
Common Yellowthroat	3	11				X		X	X		
Dark-eyed Junco	9	25			X	X	X	X	X		
Downy Woodpecker	0	2				X	X				
Fox Sparrow	1	0						X			
Great Blue Heron*	0	0	1					X			

Common Name	2012 Count	2014 Count	Incidental 2012 2014	N W C	E W C	W W C	N C F	S C F	N M F	S M F	W M F
Golden-crowned Kinglet	0	9				X		X			
Gray Jay	5	4				X	X	X			
Greater Yellowlegs	0	4				X		X			
Hairy Woodpecker	0	2			X		X				
Hermit Thrush	32	2		X	X	X	X	X			
Killdeer	3	0					X	X			
Lapland Longspur	1	0					X				
Long-billed Dowitcher	1	0					X				
Le Conte's Sparrow*	1	0					X				
Least Flycatcher	8	3					X				
Least Sandpiper	0	0	2	X							
Lesser Yellowlegs	15	0				X	X	X			
Lincoln's Sparrow	15	1		X			X	X			
Mallard	9	0				X	X	X			
Mountain Chickadee	0	2				X					
Northern Flicker	4	4		X	X	X	X	X	X		
Northern Harrier	1	1	3			X	X	X			
Northern Pintail	3	0					X				
Northern Shoveler	4	0					X	X			
Northern Waterthrush	5	3				X		X			
Orange-crowned	14	0					X	X			
Pectoral Sandpiper	5	0					X				
Pine Siskin	45	0		X		X	X	X			
Pacific-slope Flycatcher	0	1				X					
Purple Finch	0	3				X	X				
Rose-beaked Grosbeak	2	0						X			
Red-breasted Nuthatch	2	0						X			
Ruby-crowned Kinglet	23	23			X	X	X	X			
Red-eyed Vireo	17	0		X			X	X			
Red-tailed Hawk	1	4	7			X	X	X			
Rusty Blackbird*	0	18	12			X			X		
Ruffed Grouse	0	3	3			X	X	X			
Red-winged Blackbird	10	7				X	X	X			
Sandhill Crane	5	4	2			X	X	X	X		

Common Name	2012 Count	2014 Count	Incidental 2012 2014	NWC	EWC	WWC	NCF	SCF	NMF	SMF	WMF
Savannah Sparrow	45	34		X		X	X	X			
Semipalmated Plover	0	0	1				X				
Sora	8	0				X	X	X			
Solitary Sandpiper	2	0					X	X			
Song Sparrow	0	1				X					
Sharp-tailed Grouse*	0	0	16				X				
Swainson's Thrush	16	63			X	X	X	X	X		X
Tennessee Warbler	44	17			X	X	X	X	X		X
Townsend's Solitaire	0	1							X		
Tree Swallow	2	6				X	X	X			
Upland Sandpiper**	6	7	4			X	X	X	X		
Unknown Owl	0	1					X				
Unknown Shorebird	3	0					X	X			
Unknown Passerine	0	2						X	X		
Unknown Sapsucker	0	1				X					
Unknown Sparrow	4	0						X			
Varied Thrush	1	0						X			
Vesper Sparrow	1	0						X			
Warbling Vireo	5	0					X	X			
White-crowned Sparrow	0	29				X	X	X	X		
Wilson's Snipe	42	51		X	X	X	X	X	X		X
Wilson's Warbler	4	4		X	X	X		X	X		X
White-throated Sparrow	14	0		X		X	X	X			
Yellow-bellied Flycatcher	1	0		X							
Yellow-bellied Sapsucker	11	0				X	X	X			
Yellow Warbler	11	4			X	X	X	X			
Yellow-rumped Warbler	32	17		X		X	X	X	X		
TOTAL	**732**	**508**	**55**								

*Provincially Blue-listed (Threatened), **Provincially Red-listed (Endangered)

APPENDIX J PHOTOGRAPHS

Photo J.1

Location: 10 V 563782 6211896

Description: Wetland within eastern wetland complex, from western toad surveys

Date: June 3, 2014

Photo J.2

Location: 10 V 562711 6213033

Description: Wetland within western wetland complex, from western toad surveys

Date: June 3, 2014

Photo J.3

Location: 10 V 564181 6212463

Description: Wetland within eastern wetland complex, from western toad surveys

Date: June 3, 2014

Photo J.4

Location: 10 V 562953 6210797

Description: Aerial view of Property, taken from ~200 m south of entrance, facing north

Date: May 2, 2014

Photo J.5

Location: 10 V 562992 6211102

Description: Aerial view of Property, taken from entrance, facing north, with small wetland in foreground

Date: May 2, 2014

Photo J.6

Location: 10 V 563998 6211557

Description: Eastern edge of Property, looking northwest

Date: May 2, 2014

Photo J.7

Location: 10 V 562933 6211881

Description: Typical black spruce horsetail ecosystem

Date: Aug. 27, 2014

Photo J.8

Location: 10 V 562921 6211692

Description: Coyote den

Date: Aug. 27, 2014

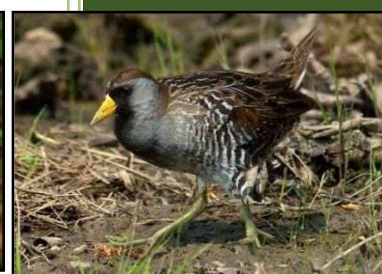
Appendix G. Wetland function assessment

Assessment of Wetland Function for the Site C Clean Energy Project

– prepared for BC Hydro –

November 2015






Prepared by:

L. Ross, P. Rose, J. Raizenne, L. Dupuis, and L. Armstrong

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Introduction

Condition 11 of the Federal Decision Statement requires BC Hydro to develop a plan that addresses, amongst other things, the potential effects of the Project on wetlands.

Condition 11.4 states that the plan shall include:

> 11.4.1 *baseline data on the biogeochemical, hydrological and ecological functioning of the wetlands and associated riparian habitat in the area affected by the Designated Project, including: ground and surface water quality and quantity; vegetation cover; biotic structure and diversity; migratory bird abundance, density, diversity and use; species at risk abundance, density, diversity and use; and current use of the wetlands for traditional purposes by Aboriginal people, including the plant and wildlife species that support that use;*
>
> *11.4.4 compensation measures to address the unavoidable loss of wetland areas and functions supporting migratory birds, species at risk, and the current use of lands and resources by Aboriginal people in support of the objective of full replacement of wetlands in terms of area and function;*

Condition 12 of Schedule B Table of Conditions issued by the province requires:

> *The EAC Holder must develop a Wetland Mitigation and Compensation Plan. The Wetland Mitigation and Compensation Plan must include an assessment of wetland function lost as a result of the Project that is important to migratory birds and species at risk (wildlife and plants). The Wetland Mitigation and Compensation Plan must be developed by a QEP with experience in wetland enhancement, maintenance and development.*

This report outlines a scientifically based system (Figure 1) that was used to characterize the ecological functioning of wetlands for migratory birds and species at risk (in accordance with federal condition 11 and Provincial condition 12 above), then describes baseline ecological functioning of wetlands in the areas that may be affected by the Project.

The process identifies function at the landscape level and uses existing GIS and baseline survey data from the Project, in conjunction with the scientific literature, to identify the relative importance of wetlands to migratory birds, rare plants, amphibians, bats, and species important to Aboriginal land use (see Table 10 and 'Record Keeping' section).

Assessment of Wetland Functions

Wetlands function assessments measure an array of wetland functions and typically assign them a quantitative value (e.g., numerical) or qualitative ranking (e.g., high, medium, low; United States Department of Agriculture 2008, Novitzki et al. 1997). These values and rankings can be used to determine the importance of individual functions in terms of maintaining a particular wetland or the degree to which a wetland function benefits the overall ecosystem. Wetland function is defined in Smith et al. (1995) as the normal or characteristic activities that take place in wetland ecosystems as a result of their physical, chemical, and biological attributes (e.g., short-term storage of surface water, cycling of nutrients, maintenance/support of plant and animal communities, etc.). In many cases it's impossible or impractical to measure wetland functions directly, so "indicators" are used as a representation (e.g., the number of waterfowl/acre is used as an indicator to measure how well a wetland is performing its waterfowl habitat function; Novitzki et al. 1997). Each situation is unique as not all wetlands are able to perform every function (e.g., a wetland's geographic location may determine the species it supports) and many factors determine how well these functions are performed (e.g., climatic conditions, quantity and quality of water entering the wetland, and disturbances or alterations within the wetland or the surrounding ecosystem; Novitzki et al. 1997).

By assessing the functional value of several individual wetlands of the same type and making comparisons between them, wetlands can be ranked based on their ecological significance with those areas that receive a high ranking avoided, if possible, during development. For projects where wetland loss is unavoidable, this information can be applied to the mitigation process and alternative wetlands can be enhanced, restored or constructed to offset the wetland functions lost. Wetland function assessments can also be utilized to determine the success (or failure) of programs and policies intended to protect or manage wetland resources (e.g., continuous assessment of the same wetlands in an agricultural area shows that the functional capacity of wetlands to provide habitat for aquatic animals improves as fertilizer restrictions are put in place) and to assist in identifying long-term trends in the condition of wetland resources (Novitzki et al. 1997).

The primary purpose of a wetland function assessment is to assist with wetland monitoring and assess project-level impacts to wetlands. Many wetland assessments are designed to estimate the loss or gain of wetland function as a result of a proposed project. Wetland processes can be assigned a score, which are then multiplied by the acreage of wetlands affected to develop the mitigation ratios (Kusler 2006). One challenge of using wetland assessments to calculate mitigation ratios is that they can require detailed knowledge and data of the resource being managed, which is not always practical to obtain due to budget constraints, the amount of field data required, the accuracy of the information collected, or the intent of the original field data collection process. This is not a constraint if sufficient published information is available to develop regional benchmarks (Clark & Bradford 2014).

The wetland function assessment for the Site C project exclusively considers the functional score of wetlands to specific wildlife and plant groups during important periods of their lifecycles. Standardized wetland assessments, such as Rapid Wetland Assessment Methods and HGM's, typically address wetland functions related to the chemical, physical, and biological processes of wetlands (Kusler 2006) and rarely utilize a scope as focused as this project (i.e., wetland functions associated with rare plants, migratory species and habitat). Because most wetland function assessments are completed at a much broader scale, so too is their high-level evaluation of wetland habitat functions (e.g., Does the existing wetland exhibit strong evidence of wildlife utilization, moderate evidence of wildlife utilization, minimal evidence of wildlife utilization, or no evidence of wildlife utilization?). Specific methodologies have been developed to evaluate animal species and biological communities in wetlands (e.g., Habitat Evaluation Procedures; U.S. Fish and Wildlife Service 1980, WETHINGS; Hicks 1996, Indices of Biological Integrity; EPA 2002), but these are used primarily to monitor changes in habitat quality over time (Kusler 2006).

Most wetland function assessments only make comparisons between wetlands of the same types or classes. The BC Hydro Site C project wetland function assessment calculated the total loss of each wetland habitat function by quantifying the degree of loss for each respective wetland type (i.e., SE, TS, etc.). This is weighted based on the habitat type's ability to perform a specific function and the wetland area scheduled to be lost as a result of construction. Function loss for each individual wetland type can then be combined to achieve an understanding of total function loss for each wetland function (i.e., functional loss of migratory bird breeding habitat in sedge wetland, tamarack sedge wetland, willow sedge wetland, etc. all combined to calculate total functional loss of migratory bird breeding habitat). This is unique to other wetland assessment methodologies, as most attempt to determine a wetland function value for an individual wetland type rather than evaluate the functional capacity of an entire wetland class throughout a landscape (Hanson et al. 2008). Some area-wide function assessments have been created, but these primarily focus on soils, topography and locations of wetlands and do not consider habitat functions or species of interest (Kusler 2006).

Wetland function assessments typically utilize a series of reference wetlands which are selected to represent “natural conditions” then functional values of these wetlands are determined (e.g., HGM). The functional values for reference wetlands are then used as the benchmark for comparison amongst all other wetlands evaluated during the assessment process (Smith et al. 1995). During the wetland function assessment utilized for the BC Hydro Site C project, the existing state of wetland functions during the pre-construction period, which are scheduled to be impacted as a result of construction activities, are used as the baseline reference and then equated to total function gained from mitigation efforts in an attempt to offset the two. This method is known as a habitat equivalency analysis (HEA), where “interim losses are quantified as lost habitat resources and services, and the scale of the restoration projects is that which provides equivalency between the lost and restored resources and services” (Penn & Tomasi 2002, Clarke & Bradford 2014). Service losses are represented as generic values (usually as a percentage of the undamaged habitat) that attempt to integrate the overall loss of service. This avoids the need for detailed ecosystem studies (Clark & Bradford 2014). The science of equivalence is still in its early stages and although the HEA concept was introduced in 1990, many of the primary papers discussing its utility were written in the mid 2000’s and the process is still subject to refinement (Clark & Bradford 2014).

In order to quantify project-related wetland function loss, the process considers three components:

1. Classification of *wetland types* within the Project area;
2. Selection of wetland *indicator species*, including migratory birds, rare plants, amphibians, bats, and species important to aboriginal land use
3. Identification of important *wetland habitat functions*.

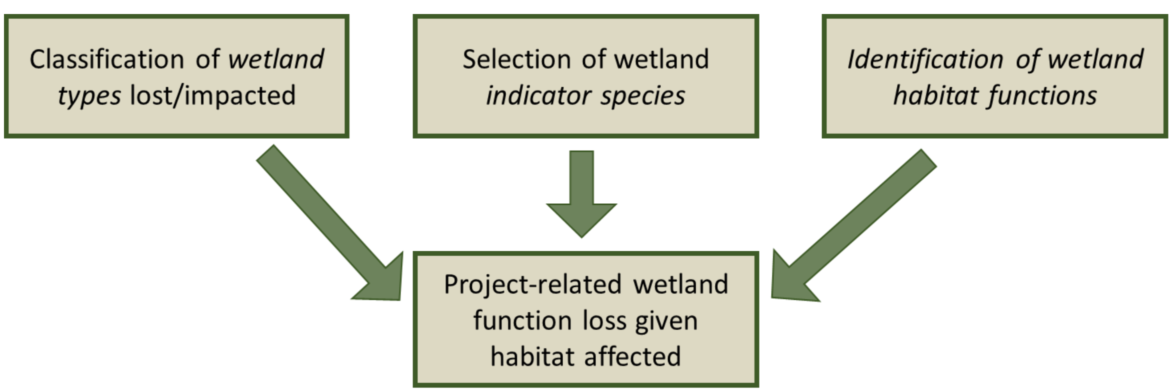

Figure 1. Wetland function assessment process for the Project.

Together, these three components are used to establish a Manly-Chesson Selectivity Index (Manly et al. 1972, Chesson 1978) for each wetland habitat function. This index is used to quantify the probability that an indicator species/assemblage will use a specific wetland type based on its habitat preferences and the proportion of that habitat type within the landscape. A modified Habitat Equivalency Analysis is then used to determine *Total Function Loss Given Habitat Affected* based on the selectivity index created for indicator species/assemblages and the area of wetland habitat that will be affected as a result of construction activities associated with the Site C project. An understanding of *Total Function Loss Given Habitat Affected* helps assess wetland habitat function that will be lost across all species groups identified (e.g., migratory birds, amphibians, bats, rare plants, species important to aboriginal land use) due to the Project and will inform planning and estimation of the mitigation measures required to offset functional loss. This equivalency analysis is classified as an "out of kind" offset as the impacts and offsets are of a different form than a like-for-like comparison and wetland function is utilized as the common metric (i.e., wetland habitat types are not replaced on a like-for-like basis although wetland habitat functions lost are equal to wetland habitat functions gained through mitigation efforts; Clark & Bradford 2014).

This document provides a summary of the process described above, and outlines the ranking process.

The literature review and data assessment are summarized in order to provide the structure for the habitat value ranking process. The ranking process is then outlined step by step for fauna then flora species, as well as practical examples and assumptions made as part of the process. Two excel spreadsheets for flora and fauna (NPS_bchydro_siteC_faunaspp_wetlandfunction_Nov2015.xlsx and NPS_bchydro_siteC_floraspp_wetlandfunction_Nov2015.xlsx) provide the baseline data used in the ranking and allocates that information to wetlands within the LAA. The LAA was defined in the EIS (Hilton et al. 2013) as:

> "The area within which the potential adverse effects of the Project are assessed. The LAA encompasses the Project activity zone, buffered by an additional 1,000 m. For the proposed reservoir, the erosion impact line has a 1,000 m buffer. The LAA also extends downstream from the dam to the Alberta border, and includes a 1,000 m buffer on both the south and north banks of the Peace River."

All calculations in the ranking process are provided in the spreadsheets, as well as described below.

For the purposes of this wetland function assessment, this process defines:

- *Wetland function* as the "…natural processes that are associated with wetlands, independent of considerations of the benefits of those processes to humans." (Hanson et al. 2008), with a specific focus on the wetland functions important to migratory birds, amphibians, bats, rare plants, and species important to Aboriginal land use.
- *Indicator species* as a species whose presence in a given area is used to indicate suitable conditions for a broader group of additional species.

Step 1. Classification of Wetland Types and Area.

Classification of wetland types in the LAA followed the structure of mapping and terrestrial ecosystem classification presented in the EIS (Hilton et al. 2013a). TEM developed for the Site C project was used to confirm the area and distribution of wetland types across the LAA (Figure 2). While the total wetland area within the transmission line right-of-way is included in the function assessment not all will be affected by the Project. The area of wetland lost/affected by the Project will be calculated based on the final transmission line design and the construction footprint. Some additional ecosystem types mapped have been classified as wetlands for this function assessment. Examples are:

- The Labrador tea – Sphagnum ecosystem type (BT) has been added as a wetland type due to its description as a bog.
- Tufa seep and marl fen habitats were included due to their uniqueness as habitats for rare plants. Tufa seep and marl fen habitat were recorded in the baseline as point occurrences; therefore, the ranking of their wetland function has not been included at this time. Their habitat will be included at a later date once their areas have been verified in the field.

The Provincial classification system was used to identify wetlands. Therefore, wetlands could not be assigned to one of the five major classes of the Canadian Wetland Classification System (National Wetlands Working Group 1997; i.e., swamp, bog, marsh, fen and shallow open water). Several of the wetland ecosystem types described in Hilton et al. (2013a) share characteristics of more than one of the five major classes (e.g., BT has characteristics of both a bog and a swamp).

Where possible, habitat associations and categories of use for the indicator species described above were described by mapped wetland types (Table 1). Baseline information on the biogeochemical, hydrological and ecological functioning of the wetland habitat types, where it informed indicator species use, was inferred based on general descriptions of the habitat types in the EIS (Hilton et al. 2013a), MacKenzie and Moran (2004), and Delong et al. (2011). For rare plants, in the review of secondary habitat associations, species were assessed following classification used in MacKenzie and Moran (2004), and then compiled to the level of classification used in the EIS.

During operations the monitoring of wetlands along and adjacent to the transmission line will be used to gather data on potential changes to area and function. Data collected will enable the quantification of further function loss during operations to be added to the wetland mitigation plan.

Table 1. Wetland ecosystem types in the Site C LAA[1].

Wetland Ecosystem	Total area in LAA (ha)	Total area to be affected by construction (ha)	Total area to be affected by operations (ha)
Labrador tea – Sphagnum (BT)	2051	93	58
Shallow open water (OW)	75	17	1
Sedge wetland (SE)	1169	142	55
Tamarack sedge (TS)	1406	68	47
Willow-horsetail-sedge riparian wetland (WH)	1009	392	1
Willow sedge wetland (WS)	363	50	16
Scrub birch-water sedge (Wf02)	10	0	0
Narrow-leaved cotton-grass shore sedge (Wf13)	9	<1	<1
Marl fen			
Tufa seep			

[1] Ecosystem coding is shown in brackets, where present), total area in the LAA, and area to be affected by construction and operations (modified from Hilton et al. 2013a). Labrador tea – Sphagnum (BT) habitat was included as part of this wetland function assessment. This was not considered wetland in the EIS. At this time, the exact area for marl fen and tufa seep are not available.

Step 2. Selection of Wetland Indicator Species.

In order to determine project-related wetland function loss, indicator species were selected from the list of species documented in the Project baseline studies. The selection of wetland indicator species for migratory birds, amphibians, bats, rare plants, and species important to aboriginal land use are described below. Information from peer-reviewed literature, provincial databases, and experts have been used to form an understanding of wetland habitat use by indicator species for the wetland function ranking. Baseline wildlife and vegetation survey data from the LAA was used to verify and confirm the literature review. Appendix A in this document lists the literature reviewed for each of the indicator species considered as part of this process.

Selection of Migratory Bird Indicator Species

A detailed review of the baseline conditions and the available literature was used to identify the important functions wetland habitats provide migratory bird species and how the Project will impact these functions. Due to the high number of migratory bird species observed in the LAA, bird species were combined into assemblages that share similar morphology and habitat use patterns. One to three indicator species were then selected to represent each assemblage. Thirteen assemblages of migratory bird species were identified and are described below. Information on species assemblages was taken from the National Geographic Field Guide to the Birds of North America (Dunn & Alderfer 2006) and the Cornell Lab of Ornithology: All About Birds website (Cornell University 2011).

Dabbling Ducks – Ducks of the genus *Anas* that feed on the water surface or by tipping, tail up, to reach aquatic plants. In most cases this assemblage nests in dry locations above the waterline at suitable wetland and upland sites.

Diving Ducks – Duck species that feed by diving below the water's surface and typically nest over water or close to the water's edge. This assemblage includes pochards (*Aythya*) and stiff-tailed ducks (*Oxyura*), as well as most sea ducks (*Melanitta, Clangula*, and *Histrionicus*) and mergansers (*Mergus*), with the exception of those that nest in tree cavities.

Cavity-nesting Ducks – Duck species that utilize tree cavities for nesting. With the exception of wood ducks (*Aix sponsa*), which are surface feeders, all are diving ducks from the genera *Bucephala, Mergus*, and *Lophodytes*.

Swans and Geese – Large, long-necked and primarily aquatic birds from the family Anatidae. This assemblage of waterfowl contains the genera *Cygnus, Anser, Chen,* and *Branta*.

Waterbirds – Aquatic diving birds from the families Gaviidae (loons) and Podicepedidae (grebes).

Gulls and Terns – Species from the family Laridae, which frequent coastal waters or inland lakes and wetlands and can be highly pelagic.

Forest-nesting Shorebirds – Species from the family Scolopacidae that spend most of their time along the water's edge and tend to nest in forested or shrubby areas.

Marsh-nesting Shorebirds – Species from the families Charadriidae and Scolopacidae that spend most of their time along the water's edge and tend to nest in open or marshy areas.

Rails – Marsh birds with short tails and short, rounded wings from the family Rallidae

Open Habitat Songbirds – Songbirds include the orders Passeriformes, Apodiformes, Columbiformes, and Coraciiformes. This assemblage consists of songbirds that occupy primarily open habitat types.

Deciduous Songbirds – Songbirds include the orders Passeriformes, Apodiformes, Columbiformes, and Coraciiformes. This assemblage consists of songbirds that occupy primarily deciduous tree- or shrub-dominated habitat types

Coniferous Songbirds – Songbirds include the orders Passeriformes, Apodiformes, Columbiformes, and Coraciiformes. This assemblage consists of songbirds that occupy primarily coniferous-dominated habitat types

Aerial Insectivores – Swallows and nighthawks from the families Hirundinidae and Caprimulgidae that feed on swarming insects during flight.

Indicator species representing the 13 assemblages were chosen from the species recorded during baseline inventories conducted within the LAA. The chosen species had a strong association with wetland habitats, used the Peace River region as a core part of their range, were important from a conservation standpoint, and do not have broad or generalized habitat preferences. Species with generalized habitat preferences were not selected because they would diminish the importance of wetland habitats in terms of assessing their functional value as many generalist species use a wide array of habitat types.

To narrow this list of representative species further, species identified by Environment Canada as conservation priorities for the Boreal Taiga Plains Region (BCR-6), which includes the Peace River area, were also selected (Environment Canada 2013a). Species listed as "priority species" in wetland habitats were preferred as indicator species.

Wetland habitat classes included bogs, fens, marshes, swamps, and shallow open water (largely non-vegetated surface, but <2m deep; Environment Canada 2013a). The final selection of species excluded species that were found in low numbers within the LAA (i.e., less than 100 observations for waterfowl during transect surveys, and less than 10 detections for other bird species, during breeding bird surveys), occurred in the region at the periphery of their range, had habitat preferences that mirrored other species on the list, or had more general habitat preferences in relation to other species that fell into the same category. Experts from within Ducks Unlimited Canada were also consulted during the selection process and included Stuart Slattery PhD (Research Scientist – boreal waterfowl ecology), Darryl Kroeker (Head of Conservation Programs, BC Peace), and Julienne Morissette PhD (Conservation scientist – National Boreal Program). In total, 23 species were selected to represent the 13 different assemblages (see Table 2 for the complete rationale behind the inclusion or exclusion of BCR-6 priority species for wetland habitats from the list). This initial list was further refined following discussion with colleagues from Environment Canada's Canadian Wildlife Service and British Columbia's MOE (March 6, 2015).

Few songbird species met the above criteria and often those that did were extremely rare on the landscape, therefore it was suggested that additional species be added to the Deciduous Songbirds and Coniferous Songbirds species assemblages to improve their representation (Julienne Morrisette, pers. comm., Ducks Unlimited Canada). Based on their distinct preferences for specific wetland habitat types and occurrence within the LAA, the two species added were Lincoln's Sparrow and Northern Waterthrush. Lincoln's Sparrows are representative of shrubby and coniferous wetland and riparian habitat types in the boreal region and Northern Waterthrush are representative of deciduous wetland and riparian habitat types. It was also recommended at the March 6th 2015 meeting that a swallow species be added to represent the aerial insectivore assemblage. There were no swallow species classified by Environment Canada as priority species in wetland habitats, but one swallow species observed in the Site C LAA, the bank swallow, is considered a priority species in "Waterbodies" habitat (i.e., lakes and ponds >2 m deep, rivers, streams and reservoirs). Therefore, bank swallows were selected to represent the aerial insectivore assemblage. With the addition of these three species the total number of indicator species representing migratory birds in the wetland function assessment is 26.

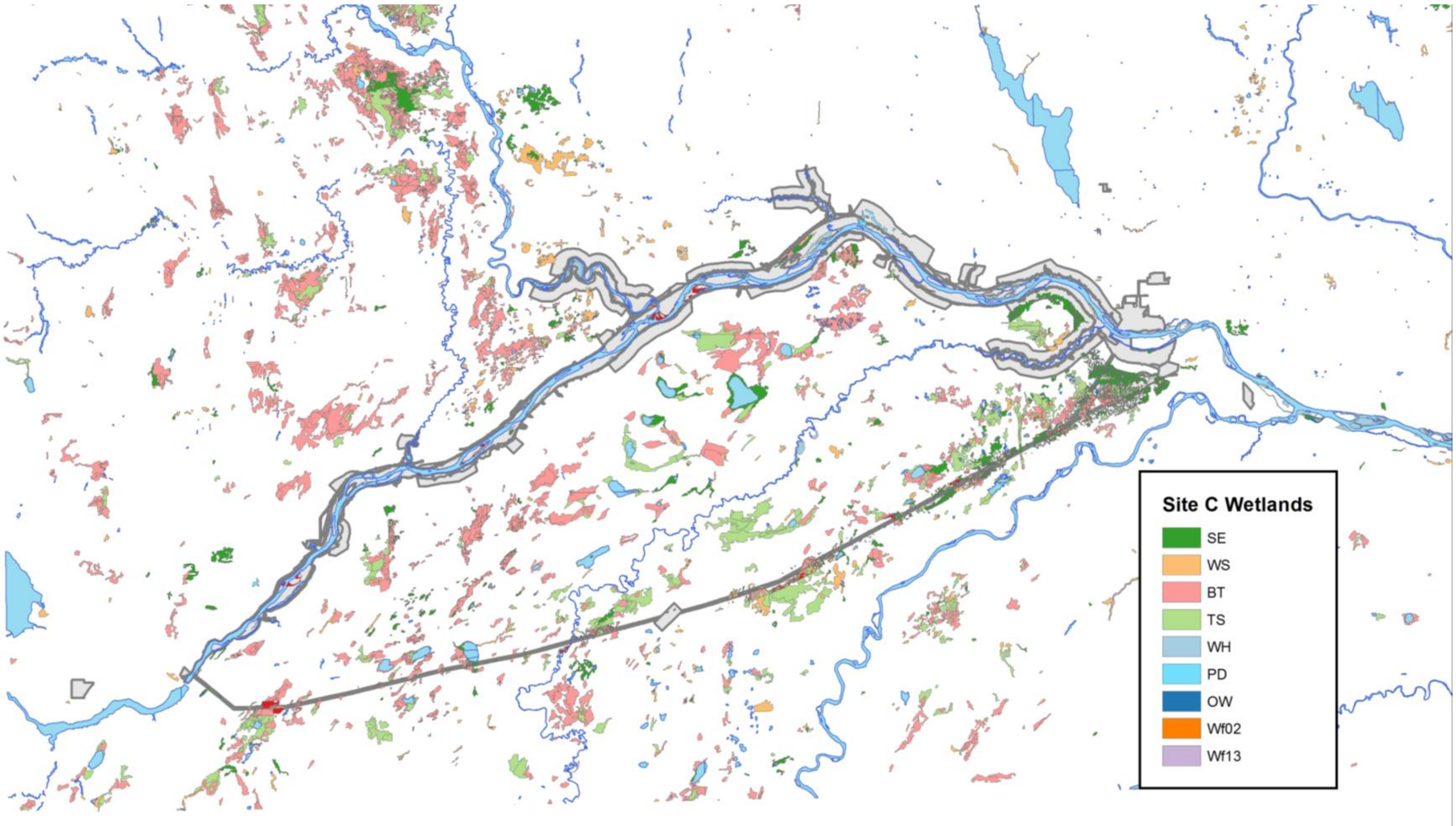

Figure 2. Detailed and TEM wetland mapping for the Site C project.

Table 2. Rationale for species inclusion[1]. Yellow highlight indicates species selected as an indicator. Blue highlight indicates those species whose listing has changed since March 2015.

Species Category	***Included***	***Rationale***[2]
Songbirds		
Alder Flycatcher	Y	Wetland species found in bog habitats; represents deciduous and early successional habitat types
Common Yellowthroat	Y	Found in deciduous-dominated wetland and riparian areas; important habitat features include a dense shrub understory
Connecticut Warbler	N	Red-listed wetland species found in bog habitats. In the western part of its range habitat preferences shift towards upland deciduous types
Le Conte's Sparrow	Y	Yellow-listed wetland species found in marsh and bog habitats; represents open habitat types. De-listed from blue to yellow June 2015
Nelson's Sparrow	Y	Red-listed wetland species found in marsh and fen habitats; represents open habitat types
Olive-sided Flycatcher	Y	Blue-listed wetland species associated with coniferous habitats with tall trees/snags and forest openings; represents coniferous habitat types
Rusty Blackbird	Y	Blue-listed wetland species; represents coniferous and early successional habitat types
Lincoln's Sparrow	Y	Not a priority species in wetland habitats within BCR-6, but indicative of shrubby and coniferous (Julienne Morissette, pers. comm., Ducks Unlimited Canada) wetlands and frequent throughout the landscape
Northern Waterthrush	Y	Not a priority species in wetland habitats within BCR-6, but indicative of deciduous wetland and riparian habitats (Julienne Morissette, pers. comm., Ducks Unlimited Canada) and frequent throughout the landscape
Aerial Insectivores		
Bank Swallow	Y	Priority species in waterbody habitats in BCR-6; strong association with rivers and perennial streams due to their nesting requirements
Common Nighthawk	Y	Federally listed as Threatened under the *Species at Risk Act*; nests in bogs and other open wetlands containing bare ground and forages over waterbodies and open habitats
Shorebirds		
Greater Yellowlegs	N	Similar habitat preferences as lesser yellowlegs & solitary sandpiper and found in low numbers within the study area
Killdeer	N	Considered a habitat generalist found in open or disturbed habitat types

Table 2. (continued)

Shorebirds continued	***Included***	***Rationale***[2]
Least Sandpiper	N	Found in low numbers within the study area and considered a transient species found only during migration
Lesser Yellowlegs	Y	Shorebird species found in marshes and all types of forested habitat near water; nesting occurs in forested habitat types
Solitary Sandpiper	Y	Shorebird species occupying bogs and found in coniferous and early successional habitat types near water; nesting occurs in forested habitat types
Upland Sandpiper	N	Red listed; found in low numbers within the study area and has similar habitat preferences to Wilson's snipe
Wilson's Snipe	Y	Shorebird species found in marshes and early successional habitats near water; nesting occurs in open habitat types
Rails		
Sora	Y	Found in marsh habitat associated with non-perennial ponds/small lakes
Yellow Rail	Y	Red-listed; found in bog, fen, and marsh habitat
Gulls and Terns		
Arctic Tern	N	Found in low numbers in the study area and considered a transient species
Black Tern	Y	Found in marshes and shallow water; emergent vegetation is an important habitat feature
Bonaparte's Gull	Y	Found in marshes and bogs; islands are an important habitat feature; preferred nesting sites are in coniferous trees near water
California Gull	N	Blue-listed; found in low numbers in the study area and considered a transient species
Caspian Tern	N	Blue-listed; found in low numbers in the study area and considered a transient species
Common Tern	N	Found in low numbers in the study area and considered a transient species
Common Loon	Y	Found in marsh habitat and lakes and wetlands with shallow water (<0.5 m); prefers large perennial lakes
Horned Grebe	Y	Designated as Special Concern by COSEWIC; found in shallow water and associated with emergent vegetation; prefers smaller waterbodies or secluded areas of lakes

Table 2. (continued)

Waterbirds	*Included*	*Rationale*[2]
Pacific Loon	N	Found in low numbers in the study area and considered a transient
Pied-billed Grebe	N	Very similar to horned grebe in terms of habitat use; found in marsh habitat; prefers smaller waterbodies or secluded areas of lakes
Red-necked Grebe	N	Similar to horned grebe and common loon in terms of habitat use; prefers large perennial lakes
Dabbling Ducks		
American Wigeon	Y	Common within the area, but is a species of conservation interest due to population declines in the boreal region (Stuart Slattery, pers. comm., Ducks Unlimited Canada)
Blue-winged Teal	N	Numbers lower than other dabbling duck species with similar habitat preferences within the area
Gadwall	N	Very low numbers found within the study area; similar habitat preferences to other dabbling ducks
Green-winged Teal	Y	Common species within the region and represents the typical habitat use of dabbling ducks, using a mixture of wetlands and adjacent uplands for breeding
Mallard	N	Very common species within the study area but has the most generalized nesting preferences of all dabbling ducks
Northern Pintail	N	A relatively common dabbling duck species in the area with breeding observations and migration requirements similar to other dabbling duck species
Northern Shoveler	N	Numbers within the study area were low in relation to other dabbling duck species and habitat preferences similar to American wigeon and green-winged teal
Diving Ducks		
Canvasback	N	Very low numbers within the study area, has similar habitat preferences to other diving duck species, and does not sufficiently represent the waterfowl community in the Peace River region (Darryl Kroeker, pers. comm., Ducks Unlimited Canada)
Lesser Scaup	Y	Common diving duck species within the area and nests on land and over water
Long-tailed Duck	N	Blue-listed; very low numbers within the study area and considered a transient species
Ring-necked duck	Y	Most common diving duck species within the area and nests over water, which is typical of diving duck species

Table 2. (continued)

Diving Ducks continued	***Included***	***Rationale***[2]
Surf Scoter	N	Blue-listed; very low numbers within the study area and does not sufficiently represent the waterfowl community in the Peace River region (Darryl Kroeker, pers. comm., Ducks Unlimited Canada)
White-winged Scoter	N	Very low numbers within the study area and does not sufficiently represent the waterfowl community in the Peace River region (Darryl Kroeker, pers. comm., Ducks Unlimited Canada)
Cavity-nesting Ducks		
Barrow's Goldeneye	N	Found in the study area in much lower numbers than other cavity nesting waterfowl, has similar habitat preferences, and does not sufficiently represent the waterfowl community in the Peace River region (Darryl Kroeker, Ducks Unlimited Canada pers. comm.)
Bufflehead	Y	Common cavity nesting species that uses wooded areas adjacent to wetlands for nesting
Common Goldeneye	Y	Common cavity nesting species that uses wooded areas adjacent to wetlands for nesting
Geese and Swans		
Cackling Goose	N	Yellow-listed; low numbers within the study area and considered a transient species. De-listed from blue to yellow June 2015
Trumpeter Swan	Y	Breeds within the study area and has narrower nesting habitat preferences than Canada goose

[1] All species listed in the table are listed as 'Priority species' for wetland habitat in the BCR-6 by Environment Canada (except for Lincoln's Sparrow and Northern Waterthrush) and were found in the BC Hydro Site C LAA.

[2] 'low numbers' within the LAA was defined as less than 100 observations for waterfowl during transect surveys, and less than 10 detections for other bird species, during breeding bird surveys

Selection of Amphibian Indicator Species

Amphibians are particularly vulnerable to wetland disturbance as they rely on available water to complete their breeding cycle. Five amphibian species were detected within the LAA during baseline surveys: boreal chorus frogs, Columbia spotted frogs, long-toed salamanders, western toads, and wood frogs. Due to the low detection rate of Columbia spotted frogs and long-toed salamanders they were considered to be rare in the LAA (as defined by Hilton et al. 2013c). Three amphibian species were selected to represent the amphibian assemblage. Each differs based on the type of wetlands they use for breeding and their use of upland habitats. Columbia spotted frogs are highly dependent on permanent water sources. Western toads require pools of water to breed, but otherwise inhabit drier upland sites. The habitat requirements of boreal chorus frogs exists between these two extremes using both wetland and upland habitat during the non-breeding period. The western toad is the only amphibian recorded in the LAA that is a provincially or federally listed species. It is provincially blue-listed (B.C. Ministry of Environment 2014) and on Schedule 1 of *SARA,* where it has a designation of species of concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2014).

Selection of Bat Indicator Species

Eight bat species were captured or detected acoustically during baseline surveys in the LAA: the little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), and eastern red bat (*Lasiurus borealis*). The eastern red bat has been changed from red to unknown in June 2015. The northern myotis is a Blue-listed species (B.C. Ministry of Environment 2014). The little brown myotis and northern myotis have received emergency listings as Endangered by COSEWIC as a result of an outbreak of a fungal disease in eastern Canada, known as white-nose syndrome (COSEWIC 2014). Both species have been added to Schedule 1 of *SARA*.

Because all eight bat species differ in terms of their foraging and roosting habitat preferences, all were selected to represent bats and the potential loss of important functions this group would experience as a result of wetland loss.

Selection of Flora Indicator Species

This wetland function assessment focused only on rare plant species documented in the LAA that have strong associations to wetland habitat types. An initial list of wetland-associated rare plants was compiled from baseline data (Hilton et al., 2013a), confirmed with the BC Hydro rare plant botanist, and used to conduct the preliminary ranking. Rare plant species were confirmed as wetland plants by their wetland indicator status for the Western Mountains, Valleys, and Coast (USDA, 2014; Lichvar, 2013). Wetland zonation for plants includes Obligate Wetland (OBL) species and Facultative Wetland (FACW) species (Table 4). OBL species are plants that always occur in wetlands. FACW plants typically occur in wetlands but can also be found in non-wetland habitats (USDA, 2014). Rare plant species were selected, based on the provincial list (i.e., Red: S1 and/or S2 and Blue: S2 and/or S3; Government of BC, N.D), which includes any indigenous species or subspecies considered to be threatened or vulnerable in BC. Since the release of the EIS, the CDC list of rare plants has been updated, and currently 9 of the original 18 wetland associated rare plants documented in the March document and in the LAA remain red or blue listed (Table 3). The other nine rare plants are now considered secure by the CDC in BC and are ranked as yellow listed (Table 3). An additional three rare plant species (*Epilobium saximontanum*, *Utricularia ochroleuca*, *Herzogiella turfacea*) are currently being included as indicators of wetland function for a total of 12 rare species, as noted in Tables 3 and 4;

Table 3. Rare plant species considered threatened or vulnerable by the BC CDC (2014). Those species highlighted in blue have been delisted since the March 2015 Functional Assessment Report. Those species highlighted in green have been added since March 2015.

Common Name	**Scientific Name**	**Provincial Rank (i.e., Red or Blue)(2008)**	**Status Change (2014)**	**Status Change (June 2015)**
Meadow arnica	*Arnica chamissonis* ssp. *incana*	Blue	Yellow	
Hudson Bay sedge	*Carax heleonastes*	Blue		
Many-headed sedge	*Carex sychnocephala*	Blue		Yellow
Tender sedge	*Carex tenera*	Blue		Yellow
Fox sedge	*Carex vulpinoidea*	Blue		Yellow
Iowa golden-saxifrage	*Chrysosplenium iowense*	Red		
European water-hemlock	*Cicuta virosa*	Blue	Yellow	
Hall's willowherb	*Epilobium halleanum*	Blue		
Northern bog bedstraw	*Gallium labradoricum*	Blue		Yellow
Slender mannagrass	*Glyceria pulchella*	Blue		
White Adder's-mouth Orchid	*Malaxis brachypoda*	Blue		
Marsh muhly	*Muhlenbergia glomerata*	Blue	Yellow	
Small-flowered lousewort	*Pedicularis parviflora* ssp. *parviflora*	Blue		Red
Meadow willow	*Salix petiolaris*	Blue		
Autumn willow	*Salix serissima*	Blue		Yellow
Slender wedgegrass	*Sphenopholis intermedia*	Blue		
Purple-stemmed aster	*Symphyotrichum puniceum*	Blue		
Dwarf clubrush	*Trichophorum pumilum*	Blue	Yellow	
Rocky mountain willowherb	*Epilobium saximontanum*	Red		
Ochroleucous bladderwort	*Utricularia ochroleuca*	Blue		
No common name given	*Herzogiella turfacea*	Red		

Table 4. Rare plant species wetland indicator status for the Western Mountains, Valleys, and Coast zone, unless otherwise noted (USDA, 2014; Anderson, 2006).

Common Name	**Scientific Name**	**Wetland Status**[A]
Hudson Bay sedge	*Carax heleonastes*	OBL (Alaska)
Iowa golden-saxifrage	*Chrysosplenium iowense*	OBL (Midwest)
Hall's willowherb	*Epilobium halleanum*	FACW
Slender mannagrass	*Glyceria pulchella*	OBL (Alaska)
White Adder's-mouth Orchid	*Malaxis brachypoda*	FACW(Alaska)[A]
Small-flowered lousewort	*Pedicularis parviflora ssp. parviflora*	FACW (Alaska)
Meadow willow	*Salix petiolaris*	OBL
Slender wedgegrass	*Sphenopholis intermedia*	FAC
Purple-stemmed aster	*Symphyotrichum puniceum*	OBL (Midwest)
Rocky mountain willowherb	*Epilobium saximontanum*	FACW
Ochroleucous bladderwort	*Utricularia ochroleuca*	OBL
No common name	*Herzogiella turfacea*	N/A

[A] Wetland indicator status taken from Anderson, 2006. OBL - Obligate Wetland, FACW - Facultative Wetland, FAC – Facultative wetland and non-wetland habitats. Grey shading denotes rare plant species that are being investigated for their inclusion as indicator species of wetland function.

Selection of Species Important to Aboriginal Land Use

To assist in assessing potential impacts to Aboriginal Groups, Traditional Land Use Studies (TLUS) were prepared for the Project during completion of the Environmental Impact Statement. Eight plant and one wildlife wetland associated species were identified in the EIS as being species of traditional use in the LAA. These species could be impacted by Project construction activities and were included in the function assessment.

Only plant species that had a strong association with wetland habitats were included (i.e., plant species that with either OBL or FACW wetland status in the Western Mountains, Valleys, and Coast Zone [USDA 2014, Anderson 2006] and these are provided in Table 5. Two plant species with a strong association to wetlands were included in this category (i.e., Labrador tea and highbush cranberry). Moose were also included because of their use of wetland habitat for important functions, such as feeding and birthing sites. Additional species may be added following further consultation with Aboriginal groups.

Table 5. List of species important to Aboriginal land use and their wetland indicator status for the Western Mountains, Valleys, and Coast zone (USDA 2014, Anderson 2006). Yellow shading indicate a species with a strong association to wetlands, which were included in the Site C wetland habitat function assessment.

Common Name	Scientific Name	Wetland Status[A]
Labrador Tea	*Ledum groenlandicum*	OBL
Lingonberry	*Vaccinium vitis-idaea*	N/A
Dwarf Red Raspberry	*Rubus arcticus*	FAC
Cloudberry	*Rubus chamaemorus*	N/A
Highbush Cranberry	*Viburnum opulus* var. *americanum*	FACW
Prickly Rose	*Rosa acicularis*	FACU
Stinging Nettle	*Urtica dioica*	FAC
Red Raspberry	*Rubus idaeus*	FACU

[A] Wetland indicator status taken from Anderson, 2006. OBL - Obligate Wetland, FACW - Facultative Wetland, FAC – Facultative wetland and non-wetland habitats.

Step 3. Identification of Important Wetland Habitat Functions.

A total of 11 wetland habitat functions were selected that are applicable to wildlife and rare plant habitat (Table 6). Wetland functions were selected based on the critical habitat requirements for each species assemblage and the indicators chosen to represent them. Functions provided by wetlands for migratory bird species were divided into four categories: Nesting, Feeding, Brood-rearing, and Migration. Wetland functions applicable to amphibians included: Feeding, Breeding, and Wintering. The following functions for bat species are also performed by wetlands: Feeding and Roosting. The wetland function associated with rare plants and Species Important to Aboriginal land use consisted of a wetland type's ability to support these species. A detailed review of the baseline conditions in the LAA and the available literature was conducted to identify which existing wetland habitats within the project area may facilitate each of these Wildlife Habitat Functions. These sources are summarized in Appendix A and B. Scientific literature was used as the primary source for assigning habitat use to indicator species and assemblages due to the shortage of raw data linked to specific wetland habitat types available from the region. Species inventories were conducted during baseline surveys for the EIS; however, these inventories were never intended to evaluate habitat use and therefore many of the datasets the sampling effort within wetland habitat types and the inability to confidently associate habitat type with observations makes them inadequate for this purpose (Appendix C). A detailed review of the baseline conditions in the LAA and the available literature was conducted to identify which existing wetland habitats within the project area may facilitate each of these Wildlife Habitat Functions.

Table 6. Wildlife and rare plant habitat functions provided by wetlands.

Function 1 – Migratory Bird Nesting Habitat
Function 2 – Migratory Bird Feeding Habitat
Function 3 – Migratory Bird Brood-Rearing Habitat
Function 4 – Migratory Bird Migration Habitat
Function 5 – Amphibian Breeding Habitat
Function 6 – Amphibian Feeding Habitat
Function 7 – Amphibian Wintering Habitat
Function 8 – Bat Feeding Habitat
Function 9 – Bat Roosting Habitat
Function 10 – Rare Plant Use
Function 11 – Species Important to Aboriginal Land Use

***Function 1:* Migratory Bird Nesting Habitat**

Definition: The ability of wetlands to provide critical nesting habitat for migratory bird species is defined as their capacity to support nesting populations of bird species that require resources provided by wetland habitats. This wetland function also takes into consideration the diversity of bird assemblages that rely on wetland habitat types for nesting (e.g., waterfowl, songbirds, etc.)

Rationale: For migratory bird species, nesting habitat is considered to be one of the most important habitat functions in terms of long term persistence of a species. Without adequate nesting habitat to successfully raise offspring to adulthood, populations would quickly decline. Bellrose (1977) found that waterfowl densities and propagation generally increased as the number of wetlands increased. Marsh wetland types in particular generally provide a higher habitat value for waterfowl species than other wetland types because of the nesting habitat they provide (Mackenzie & Moran 2004, Environment Canada 2013b). Wetlands also provide an important buffer or barrier to some land-based predators and reduce the risk of predation to nesting or young birds and many species have adapted to take advantage of this by nesting over water or on islands (Stewart 2014). Wetland obligate and wetland dependent species are particularly constrained to wetland habitat for nesting success. An estimated 38% of all waterfowl of Canada and the United States breed in the boreal forest of North America. In conjunction with adjacent and connected forest and riparian ecosystems, boreal wetlands provide nesting habitat for an estimated 26 million waterfowl comprising 35 species. Boreal wetlands also provide important shorebird habitat and up to 7 million shorebirds are estimated to breed within these wetlands (Cheskey et al. 2011). Because wetland birds are a diverse group of species, they also exhibit a high degree of variability in their nesting preferences, ranging from highly aquatic to terrestrial: (i) completely floating nests of buoyant vegetation (small grebes); (ii) in water but essentially resting on some substrate (some rails and ducks); (iii) above water and remote from shore (least bitterns, herons); (iv) near shore but at wet-to-damp sites (some rails, American bitterns, and ducks); (v) dry ground with varying degrees of short, herbaceous cover, at varying distances from, but associated with water (common yellowthroats, sedge wrens, some ducks); (vi) at bases of tall emergent vegetation, over land or water (sparrows, some New World blackbirds); (vii) mid-level in robust herbaceous vegetation or small trees that can support the weight of nest, eggs, and the incubating parent (New World blackbirds); (viii) at the top of sturdy vegetation such as trees or snags (ospreys, certain eagles, herons); (ix) tree holes created by woodpeckers (bufflehead), larger tree cavities or crevices (hooded mergansers, wood ducks); and (x) cliff faces or solid soil banks (kingfishers; Weller 1999).

Relevant Site C EIS Datasets:

- 2006, 2008, 2011, & 2012 Breeding Bird Counts
- 2010 & 2012 Common Nighthawk Call Playback Surveys
- 2008, 2011, & 2012 Marsh Bird Call Playback Surveys
- 2010 Swallow Nest Counts
- 2011 & 2012 Swallow Point Counts

Function 2: **Migratory Bird Feeding Habitat**

Definition: The ability for wetlands to support important feeding habitat for migratory birds is defined as the degree to which wetland habitat types provide suitable food sources and foraging habitat for wetland-dependent species. At a temporal scale, feeding habitat may overlap with other wetland functions associated with migratory birds (e.g., nesting habitat, migration habitat).

Rationale: Availability and timing of food resources utilized by wetland birds is critical so that energy can be directed towards functions, such as flight, migration, breeding, defense, etc. (Weller 1999). Wetlands are dynamic ecosystems and contain a unique assemblage of microhabitats and food resources that are products of the diversity of vegetation and animals they contain, which are themselves related to hydroperiods (i.e., duration of water in days, weeks, or months per year), timing of biological and environmental events (e.g., seasonal chronology), and water depths in different wetland types. Over time wetland birds have adapted to exploit every zone existing within wetland habitats (e.g., shoreline, above water, surface, water column, mudflat, basin substrate) and all of major foods they contain (e.g., seeds, plant material, invertebrates, fish, reptiles, amphibians, small mammals; Weller 1999, Stewart 2014). The standing water found in some wetland types (e.g., marshes) provides important breeding areas for invertebrates such as some caddisflies and midges, which are important food sources for many bird species (Environment Canada 2013b). Shorebirds diets are composed largely of invertebrates, such as insect larvae, worms, crustaceans, and mollusks, existing within the mud and soils of wetlands (Cheskey et al. 2011). Food resources within wetlands can be diverse and vary temporally and spatially. Birds are unique among vertebrates in their ability to use wetlands dispersed over hundreds or thousands of miles in their annual range (Weller 1999).

Relevant Site C EIS Datasets:

- None

Function 3: **Migratory Bird Brood-Rearing Habitat**

Definition: Migratory bird brood-rearing habitat is defined as the ability of a wetland to support family groups during the brood-rearing period, which occurs once eggs have hatched and the family group has left the nest site. Brood-rearing is a wetland function that is only applicable to bird species with precocious young that develop the ability to travel with the female and abandon the nest site soon after the eggs hatch (e.g., waterfowl). The functional capacity of a wetland to provide brood-rearing habitat considers both the proportional use of a wetland type by a species in relation to other habitat types, as well as diversity of bird assemblages that rely on wetland habitat types (e.g., waterfowl, shorebirds, etc.)

Rationale: Brood-rearing habitats must contain a mixture of suitable food resources for the growth and development of young birds, and adequate escape cover, while birds remain flightless. The food required by young birds often differs from that required by adults and therefore different habitats or microhabitats are required during this early stage, which separates it from *Function 2: Migratory Birds Feeding Habitat*. Young omnivores gradually shift from animal protein in early growth to more seeds and then foliage as they mature. Carnivores or piscivores show shifts more in size and species of prey (Weller 1999). Brood-rearing locations may be situated near nesting sites and occur in similar habitat, but females of some species, such as mallards, may move greater than two kilometers to reach suitable habitat and entirely different wetland complexes (Baldassarre 2014).

Relevant Site C EIS Datasets:

- None

Function 4: **Migratory Bird Migration Habitat**

Definition: The functional capacity of wetlands to provide suitable migration habitat for bird species is defined as its ability to supply the appropriate food and cover resources during both the spring and fall migration periods. Assessment of this function takes into consideration both the scale of migration in terms of individual species and the diversity of bird assemblages that rely on wetland habitat types during migration (e.g., waterfowl, songbirds, etc.)

Rationale: Wetland habitats offer important stopover areas for waterfowl and other wetland birds for resting and to replenish energy reserves (Environment Canada 2013b, Stewart 2014). Birds linked to wetlands and riparian areas tend to migrate along large perennial streams and use marshes, wetlands, lakes, reservoirs, and other water bodies for stopover sites. Large lakes and wetlands in close proximity can support large groups of migrating waterfowl and shorebirds and provide safety from predators (Pocewicz et al. 2013). During the fall a total of 3.5 to 5 billion birds migrate south through the boreal region. Of the 7 million shorebirds estimated to breed in boreal forest wetlands, millions more also depend on them as stopover locations during migration (Cheskey et al. 2011). Wetland use by migratory birds also varies for spring and fall migrations. At northern latitudes, birds that are adapted to water environments are restricted to pools of run-off and ice-free wetlands and waterbodies during spring migration (Stewart 2014).

Relevant Site C EIS Datasets:

- 2012 Migratory Bird Encounter Surveys

- ➢ 2006, 2008, 2013, & 2014 Waterfowl Encounter Surveys

Function 5: **Amphibian Breeding Habitat**

Definition: The ability of wetlands to provide amphibian breeding habitat is defined as whether or not a wetland type contains the appropriate habitat features to support egg laying, tadpole development, and metamorphosis for amphibian species inhabiting the Peace River Region. Wetland habitats are not only evaluated on their degree of use by individual amphibian species, but also a representation of species diversity by including multiple amphibian indicator species rather than only one.

Rationale: Most amphibians require some sort of aquatic component to their habitat for breeding sites, egg laying, and habitat for larval development (Environment Canada 2013b, Meyer et al. 2003), although the specific hydrological requirements for each species varies (EPA 2002). Wetland classes are highly variable in terms of their hydrological conditions and therefore different amphibian species will inhabit different wetland classes. The aquatic larval stage of amphibians may last several days to many months (EPA 2003), and therefore the habitats required by breeding amphibians range from vernal wetlands or temporary pools to permanent ponds (EPA 2002). Wetland habitats used by amphibians for breeding may include marshes, swamps, bogs, and fens (EPA 2003).

Relevant Site C EIS Datasets:

- ➢ 2006 & 2008 Amphibian Auditory Surveys
- ➢ 2006, 2008, & 2012 Amphibian Pond Surveys

Function 6: **Amphibian Feeding Habitat**

Definition: The ability of wetland habitats to provide suitable foraging sites and prey species for amphibians throughout their active period. Feeding habitat exists in both the breeding and non-breeding periods but tends to be less specialized once breeding is completed. This function is not only based on the level of use habitats receive from amphibian species, but also a representation of species diversity by including multiple amphibian indicator species rather than only one.

Rationale: Wetlands provide a primary food source for many amphibian species, which includes prey such as insects, spiders, snails, worms, and small fish (EPA 2003). The importance of wetland habitats to amphibians for feeding varies considerably amongst species. Highly aquatic species, such as Columbia spotted frogs, feed primarily in or at the edge of the water in wetlands or waterbodies, but will occasionally forage in nearby meadows or damp woods during rainy periods; whereas western toads are less reliant on wetland habitats, using fields, forests, meadows, and shrubby thickets when foraging (B.C. Ministry of Forests 2014). However, because of moisture requirements even the most terrestrial amphibian species must seek out wetland habitats during prolonged dry periods (EPA 2003).

Relevant Site C EIS Datasets:

- ➢ None

Function 7: **Amphibian Wintering Habitat**

Definition: The ability for wetland habitats to contain appropriate over-wintering sites for amphibian species. The functional capacity of wetlands to provide wintering habitat considers both a wetland's level of use by amphibian species and a representation of species diversity by including multiple amphibian indicator species rather than only one.

Rationale: Typical wintering habitat includes waterbodies that do not freeze entirely to the bottom or burrows in the ground that maintain moisture and do not fall below a specific temperature range, although some frogs can tolerate freezing conditions. The importance of wetland habitat types is difficult to quantify as wintering habitat varies considerably amongst amphibian species. In the northern extent of their range, Columbia spotted frogs overwinter in the muddy bottoms of wetlands and waterbodies and require highly-oxygenated water that does not freeze to the bottom (B.C. Ministry of Forests 2014). Other amphibian species (e.g., western toad, wood frog, boreal chorus frog) hibernate on land in small mammal burrows, root masses, or beneath logs and leaf litter (B.C. Ministry of Forests 2014, Alaska Fish and Game 2008). Conditions suitable for these other amphibian species may be present in wetland or terrestrial habitat types.

Relevant Site C EIS Datasets:

- None

Function 8: **Bat Feeding Habitat**

Definition: The capacity for wetland habitats to provide suitable foraging habitat for bat species. Suitable foraging habitat must contain concentrations of swarming insects and the appropriate vertical vegetation structure required by each individual species. The functional capacity of bat feeding habitat occurring in wetlands is defined by the level of bat foraging activity that occurs and the diversity of bat species that utilize them.

Rationale: Many bat species have frequently been observed feeding in wetlands and over water. Bat species at the northern extent of their range feed exclusively on insects and wetlands provide important breeding habitat for prey species, such as caddisflies and midges (Environment Canada 2013b, Maslonek 2009). Some bat species could also be considered wetland-dependent if the insect biomass produced by these wetlands in the late summer and early fall provides an essential portion of the pre-hibernation diet (Tiner 2005).

Relevant Site C EIS Datasets:

- 2005, 2006, 2008, 2009, & 2011 Bat Capture Surveys
- 2005, 2006, & 2008 Bat Detector Surveys

Function 9: **Bat Roosting Habitat**

Definition: The ability for wetlands to provide roosting habitat for bat species is defined as whether a habitat supports the necessary structural complexity required for bat roosting sites. The functional capacity of bat roosting habitat of wetlands is based on the level of use from bat species and the diversity of bat species that use a wetland type.

Rationale: Trees are important roost sites for many bat species (e.g., big brown bat, silver-haired bat, long-eared myotis, long-legged myotis), which will occupy woodpecker holes, natural tree cavities and cracks, and areas beneath loose bark (Vohnof & Barclay 1996, OMNR 2000). Very little research has been conducted on the roosting potential of forested wetlands, but because they contain trees and are situated near important feeding areas, these wetland types are expected to provide suitable roosting habitat.

Relevant Site C EIS Datasets:

- 2006, 2008, & 2009 Bat Telemetry Studies

***Function 10:* Rare Plant Use**

Definition: The likelihood that a wetland habitat demonstrates the appropriate conditions to support the presence of a rare plant species. This function takes into consideration both the primary and secondary habitat associations of rare plant species recorded within the LAA.

Rationale: Unlike migratory birds, which have multiple categories of use (e.g., breeding, feeding, etc.) within wetland habitats, rare plants are either present or absent. Rare plants are particularly vulnerable as many are habitat specialists, adapting to their unique wetland environments over long periods of time (Haeussler, 1998). These rare species are of importance because further loss of known occurrences may have impacts on their overall persistence. Wetland habitats also exhibit many unique conditions related to their hydrology and soils, which translates to numerous plant species that are specialists to these areas. Some wetland habitats such as fens support a wide variety of rare or unique plant species. Of 320 vascular plant species found within fens in Iowa, 44% were considered rare (Meyer et al. 2003). In the Manitoba boreal region, Locky and Bayley (2006) also found that a high diversity and rarity of plants occurred in some peatland types (e.g., wooded moderate-rich fens, black spruce swamps, and open moderate-rich fens), which would suggest they are important from a rare plant and conservation perspective.

For each of the 12 plant species associated with wetland habitats, scientific literature was compiled to collect information on their growth characteristics, distribution and habitat in other similar regions to the LAA (see Appendix A). This information was used to confirm two methods that were selected to explore LAA rare plants associated with wetland habitats, and rank their importance to wetland function: primary habitat associations and secondary habitat associations.

- **Primary habitat associations:** Primary habitat associations for rare plant species consist of direct observations from the baseline survey data of rare plants in wetland habitat types (Table 7). This included both raw data from baseline inventories conducted within the LAA, as well as descriptions in the EIS (Hilton et al., 2013a; Bjork et al. 2009). In total, 10 of the 12 species have been directly linked to a wetland habitat type located in the LAA. The remaining 2 of the 12 species were either not linked to wetland habitat types found in the LAA (i.e., Meadow Willow), or the habitat type was not noted at the time of survey and the species was not found again in future surveys (i.e., Slender Mannagrass).
- **Secondary habitat associations:** The primary habitat associations from the baseline data may not completely describe the extent of the rare species wetland habitat associations, therefore, secondary habitat associations were considered (e.g., a rare plant was located in the LAA only in a fen but may also use a marsh habitat) to fully evaluate the importance of wetland function for these species. This method considered the associated species found with rare plants during the baseline vegetation surveys in the LAA (Table 8), and evaluated the wetland habitat used by these associated species. For each associated species, their importance as an indicator of a

particular wetland habitat type was considered (e.g., uncommon to dominant, in terms of presence in a wetland type), according to the Wetlands of British Columbia: A Guide to Identification (MacKenzie and Moran, 2004). Caution was taken when interpreting the associated species that occurred with rare plants as an indication of a habitat type. Associated species were not considered if they were generalists, invasive, not indicated in baseline observations (i.e., genus only given), or not described in MacKenzie and Moran (2004). This information was then used in the ranking process. The likelihood of an associated species to occur in a particular wetland habitat (from 0-100%; MacKenzie and Moran, 2004) was weighted by the number of times the associated plant occurred with a rare plant in the field. This produced a secondary habitat association value, or an estimate of the likelihood that a rare plant will occur in a wetland type, based on its associated species (see Step a in the 'Flora ranking protocol' section for a step-by-step example of how secondary habitat values are calculated).

Relevant Site C EIS Datasets:

- 2005, 2006, 2008, 2011, & 2012 Rare Plant Surveys

Table 7. Primary rare plant occurrences in habitat types identified in the EIS.

Rare Plant Species Detected	Primary Habitat Associations[A]
Purple-stemmed aster, Ochroleucous bladderwort	SE
Hudson Bay sedge, Hall's willowherb, Purple-stemmed aster, Herzogiella turfacea	TS
Slender wedgegrass	WH
Purple-stemmed aster	WS
White Adder's-mouth orchid, Small-flowered lousewort	BT
Iowa golden-saxifrage	Tufa Seep

[A] Rare plant occurrences in habitat types taken from Hilton et al, 2013a; Bjork et al., 2009; Data from Rare Plant Surveys 2008, Data from Rare vascular plant 2005, 2006, 2008, 2011, 2012 (SE=Sedge wetland, TS=Tamarack-Sedge - Fen, WH=Willow – Horsetail – Sedge – Riparian wetland, WS = Willow – Sedge – wetland, BT = Black Spruce – Labrador tea – Sphagnum)

Table 8. Secondary rare plant occurrences in habitat types identified in the EIS.

Rare Plant Species	**Associated Species**[A]
Hudson Bay sedge	Tamarack, Labrador tea, Black spruce, Golden fuzzy fen moss
Iowa golden-saxifrage	No data
Hall's willowherb	Tamarack, Labrador tea, Black spruce, Prickly rose, Drummond's willow, Golden fuzzy fen moss
Slender mannagrass	No data
White Adder's-mouth Orchid	Glow moss, Black spruce, Balsam poplar, Bilberry willow, Golden fuzzy fen moss
Small-flowered lousewort	Crowberry, Tamarack, Labrador tea, Black spruce, Lingonberry
Meadow willow	Drummond's willow, Pacific willow
Slender wedgegrass	Bluejoint reedgrass, Water sedge, Awned sedge, Nightshade, Tufted hairgrass, Common horsetail, Broadleaf cattail, Stinging nettle
Purple-stemmed aster	Speckled alder, Lady fern, scrub birch, Tufted hairgrass, Watersedge, Awned sedge, Slender sedge, beaked sedge, Marsh cinquefoil, Red-osier dogwood, Blue wildrye, Swamp horsetail, Buckbean, Balsam poplar, Prickly rose, Drummond's willow, Bog willow, Hemlock water-parsnip, Stinging nettle,
Rocky Mountain Willowherb	No data
Ochroleucous bladderwort	Awned sedge, Beaked sedge, Swamp horsetail, Hemlock water parsnip, Bluejoint reedgrass
Herzogiella turfacea	Bilberry willow, Labrador tea, Soft leaved sedge, Yellow star-moss

[A] Rare plant associations with indicator species of a habitat type in the LAA taken from Hilton et al, 2013a; rare vascular plant 2005, 2006, 2008, 2011, 2012 ; MacKenzie & Moran, 2004). Associated species with rare plants were not considered if they were generalists, invasive, if the level of genus was indicated only for associated species during baseline surveys, or if the habitat type was not described in MacKenzie and Moran (2004) as an indicator of wetland habitat type.

***Function 11:* Species Important to Aboriginal land use**

Definition: The ability of wetland habitat types to support plant and wildlife species that have a high traditional value to Aboriginal people. These species are regarded for the importance as a source food and/or medicine.

Rationale: Wetland associated species identified as being used for traditional purposes by Aboriginal Groups in TLUS studies completed for the Project (See EIS Volume 2, Sections 13 and 14). Loss of wetland habitat could affect the distribution of the species on the landscape and alter continued use by Aboriginal Groups.

Relevant Site C EIS Datasets:

- 2010, 2011, & 2012 Ungulate Radio-collar Data
- EIS, Volume 2, Sections 13 and 14

Step 4. Determining Total Loss Given Habitat Affected.

An evaluation process has been developed by Native Plant Solutions that considers the three factors described above (i.e., indicator species, wetland habitat functions, and wetland type) to quantify functional loss expected to occur within wetland habitat given the impacts linked with construction activities associated with the Site C project. This evaluation process can also be used in the future to quantify additional function losses associated with indirect effects to wetlands along the transmission line documented during operations. Although the evaluation process is similar for each species group considered (i.e., migratory birds, amphibians, bats, plants, and species important to Aboriginal land use), there are slight differences between methods for fauna and flora. A step by step process for calculating Total Function Loss Given Habitat Affected is considered below, along with examples, for fauna and flora separately. For each example, a series of screenshots from the Excel files are presented (see Appendix D and Appendix E), in order to aid the reader in following along with the examples. It is recommended that the reader print the screenshots, for reference while reading the examples, to allow for ease of comprehension. Note that the 'habitat values' calculated, as a measure of wetland function, have no units, and are relative values for comparison purposes only.

Fauna ranking protocol for wetland habitat value: Migratory birds, Amphibians, Bats

Refer to Excel file 'NPS_bchydro_siteC_faunaspp_wetlandfunction_Nov2015.xlsx'' as a companion document to the step-by-step ranking protocol below. Screenshots from this spreadsheet are given in Appendix D, to aid the reader in following the examples provided. The Excel file also contains comments to demonstrate each step.

a) *Summarize the number of wetland habitat functions each wetland type provides to indicator species:* This step compiles the indicator species selected, their use of the wetland habitats (see 'Species Habitat Use' tab in Excel file) and the existing wetland habitat functions they provide (e.g., nesting, brood-rearing, feeding, etc.; see 'Functional Loss per Habitat' tab in Excel file) for each assemblage (e.g., dabbling ducks), which provides a summary of the wetland functions important to each species assemblage in each wetland type. By first organizing the applicable information, it can then be incorporated into the evaluation process.

   For example: (see screenshot 1 & 2 in Appendix D) Dabbling ducks (represented by American Wigeon and Green-winged Teal as indicator species) may use wetland types WS, WH, SE, Wf02 and Wf13 for nesting.

b) *Standardize the indicator values for each species assemblage:* Some species use multiple wetland habitat types for one category of use, where as other species are restricted to one habitat type. To consider the difference between species which are specialists, versus generalists, the use of each habitat by an indicator species (or assemblage) is referred to as its indicator value and is standardized to 1. This is considered for each wetland habitat function (refer to table 6 for full list of wetland habitat functions).

   For example (see 'Migratory Birds Nesting' tab in Excel file and screenshot 3 in Appendix D)**:** Dabbling ducks may use five different wetland habitat types for nesting; therefore, each wetland habitat gets an indicator value of 0.2 (1/5). On the other hand, swans and geese may only use one wetland habitat in the area for nesting; therefore, this wetland habitat gets an indicator value of 1 (1/1).

c) *Indicator values summarized for each wetland type, to calculate Total Wetland Type-Usage:* For each wetland habitat function, the indicator values for each species assemblage within a particular wetland type (e.g., SE, TS) are summed to calculate Total Wetland Type-Usage. This value summarizes habitat usage expected to occur within each wetland type assuming that all habitats are equally available within the landscape.

   For example (see 'Migratory Birds Nesting' tab in Excel file and screenshot 4 in Appendix D)**:** The Total Wetland Type-Usage for Migratory Bird Nesting Habitat in wetland type WS is 1.3, this is a sum of the indicator values for dabbling ducks, forest-nesting shorebirds, deciduous songbirds, coniferous songbirds and aerial insectivores.

d) *Standardize total wetland type-usage across all wetland habitat types:* This standardization is the final step for developing a Manly-Chesson Standardized Selectivity Index and is used to quantify habitat use over multiple habitat types. The Proportional Wetland Type-Usage represents the relative expected use of each wetland type if all types are equally available in the landscape. Wetland Type-Usage is standardized so that selectivity indices remain comparable amongst all wetland habitat functions examined.

   For example (see 'Migratory Birds Nesting' tab in Excel file and screenshot 5 in Appendix D): The Proportional Wetland Type-Usage for Migratory Bird Nesting Habitat in wetland type WS is 0.11. This is the Total Wetland Type-Usage for WS (1.3) divided by the sum of the Total Wetland Type-Usage values for each wetland type (12).

e) *Calculate baseline wetland area percentages for wetland types occurring within the LAA:* Baseline wetland areas are standardized to 1 by dividing the area of each wetland type by total wetland area. The same standardized baseline wetland areas are used during the evaluation of each wetland habitat function.

   For example (see 'Migratory Birds Nesting' tab in Excel file and screenshot 6 in Appendix D): 363ha of WS occur within the Site C LAA and this is divided by 6092ha of total wetland area to get a Percentage Baseline Area of 0.059586. This means that 6.0% of the baseline wetland habitat within the LAA is classified as WS.

f) *Multiply the Proportional Wetland Type-Usage by percentage baseline wetland area to determine Usage Given Habitat Availability:* Expected habitat usage is modified to reflect how much habitat is actually available upon the landscape. Some wetland types may provide valuable wetland functions for indicator species/assemblages but if its availability is limited this diminishes its potential usage. Conversely, some wetland types with low functional value to indicator species may be very common in the LAA and therefore usage would increase. This step takes into account that wetland habitats in the LAA are not equally available and is the product of Percentage Baseline Wetland Area and the Manly-Chesson Standardized Selectivity Index and scales habitat usage within each wetland type to actual habitat availability existing within the LAA.

For example (see 'Migratory Birds Nesting' tab in Excel file and screenshot 7 in Appendix D)**:** WS has a proportional wetland type-usage for migratory bird nesting habitat of 0.11, and a percentage baseline wetland area within the LAA of 0.059586. The two values are multiplied, which leads to a Usage Given Habitat Availability for WS of approximately 0.006455. Because WS is not a dominant wetland type on the landscape, its potential use as migratory bird nesting habitat decreases in comparison to other wetland types that would experience similar usage if all wetland types were equally available (e.g., WH).

g) *Standardize usage given baseline habitat availability:* This represents the expected relative usage of habitats given the baseline habitat availability and habitat selection indices. Usage given baseline habitat availability is standardized in order to keep values comparable amongst all wetland habitat functions examined.

For example (see 'Migratory Birds Nesting' tab in Excel file and screenshot 8 in Appendix D): The Usage Given Habitat Availability for WS (0.006455) is divided by the sum of Usage Given Habitat Availability values for all wetland types (0.139005), which results in a Standardized Usage Given Habitat Availability of 0.046439. This means that given the baseline proportion of wetlands existing within the LAA, 4.6% of migratory bird nesting habitat is predicted to occur in WS wetlands.

h) *Calculate Total Loss Given Habitat Affected:* Although some wetland types in the LAA may be common on the landscape, they may represent only a small proportion of what is estimated to be affected on the landscape. Conversely, other wetland types in the LAA may have limited coverage, but represent a larger proportion of what is estimated to be affected by the project. The importance of a wetland type for a specific habitat function is adjusted based on the wetland area that is expected to be affected by construction activities. This is the product of value of services (i.e., standardized usage given habitat availability) and area affected (i.e., Construction), which are the two primary components of a Habitat Equivalency Analysis. Total

Loss Given Habitat Affected is calculated separately based on wetland area affected by construction. Total Loss values are summed across each wetland type and this directly relates to Total Gain Given Habitat Restored (see step i). The overall goal is to achieve a balance between the two (i.e., Total Loss values = Total Gain values)

For example (see 'Migratory Birds Nesting' tab in Excel file and screenshot 9 in Appendix D)**:** WS has a Standardized Usage Given Habitat Availability of 0.046439 for migratory bird nesting habitat, and a total of 50ha of WS will be affected by construction activities. This leads to a Total Loss Given Habitat Affected of 2.32 for migratory bird nesting habitat in WS.

i) *Calculate Total Gain Given Habitat Restored:* Wetland function is applied to Total Gain Given Habitat Restored using the same principles for calculating Total Loss. Total Gain is calculated by multiplying amount and type of wetland habitat being restored by value of services. Total Gain values are summed across each wetland type and this directly relates to Total Loss Given Habitat Affected (see step h). The overall goal is to achieve a balance between the two (i.e., Total Loss values = Total Gain values)

Hypothetical example (see screenshot 10): If 100ha of WS wetlands are restored, this is multiplied by the Standardized Usage Given Habitat Availability to calculate a Total Gain Given Habitat Restored value of 4.64 for WS. If 100ha of WS, 100ha of SE and 100ha of BT are restored to compensate for habitat lost during construction you are nearly half way to meeting your mitigation goals for migratory bird nesting habitat (i.e., Total Gain Given Habitat Restored = 73.90, which is approximately half of Total Loss Given Habitat Affected = 152.79).

In the case of the above ranking process for fauna species, a number of assumptions are made to obtain an overall wetland habitat value:

- The ranking process assumes that habitats where indicator species are found are equally preferred. For example, for nesting dabbling ducks, the process assumes that they would equally use WS, WH, SE, Wf02 or Wf13.
- The ranking process assumes that species assemblages are equally valuable, in terms of mitigation for loss. For example, dabbling ducks are equally as valuable as cavity nesters.
- Relative usages of wetland habitats are consistent with the amount of habitat in the LAA, area affected, or area restored. For example, given equal habitat availability, migratory nesting birds would use SE at a rate three times the use of Wf02 (0.39 vs. 0.13) whether the area under consideration is 100 ha or 1000 ha.
- Habitat quality and fragmentation of individual patches does not significantly impact usage rates.

Flora ranking protocol for wetland habitat value: Rare Plant Species

Refer to Excel file 'NPS_bchydro_siteC_floraspp_wetlandfunction_Nov2015.xlsx' as a companion document to the step-by-step function assessment protocol below. Screenshots from this spreadsheet are given in Appendix E, to aid the reader in following the examples provided. The Excel file also contains comments to demonstrate each step.

a) *Summarize the wetland type associations with rare plants, by both primary and secondary habitat associations:* Rare plants are associated to wetland habitat types based on their presence or absence in a wetland type. Their associations to wetland types were considered based on recorded observations in the LAA (i.e., primary habitat associations), or based on associated species they were observed with in the field (i.e., secondary habitat associations). Habitat values are first ranked based on primary or secondary wetland habitat associations with particular wetland types. In the case of secondary habitat associations, wetland classification according to MacKenzie and Moran (2004) is then averaged where there may be more than one descriptor for a wetland type in the LAA (e.g., Fl01, Fl03 and Fl05 secondary habitat associations are averaged, to provide a value for WH).

   For example (for primary habitat associations; see 'Species associated habitats' tab and 'Primary habitat use' tab in Excel file and screenshot 11 in Appendix E**):** Hudson Bay Sedge was observed in TS, during baseline rare plant surveys in the LAA.

   For example (for secondary habitat associations; see 'Species associated habitats' tab and 'Secondary habitat use' tab in Excel file and screenshots 12-14 in Appendix E): Tender sedge was observed six times in the LAA. Seven plant species were observed with tender sedge and were selected as associated species to help better indicate what their wetland habitat preference is in the LAA. The percent occurrence of the associated species with the rare plant in the field was multiplied by the likelihood of the associated species to occur in a certain wetland type (according to MacKenzie and Moran, 2004).

   - For example (screenshot 12, Appendix E), Sandbar willow occurred with tender sedge in 1 out of 6 observations in the field (1/6 = 17%) and has a 30% chance of being associated with Fl03, a WH wetland habitat (MacKenzie and Moran, 2004). Therefore the likelihood that tender sedge would occur adjacent to sandbar willow in a WH wetland habitat is 0.17*0.30 = 0.05. These values are averaged across all associated species with tender sedge to provide a secondary habitat use value for Fl03 (e.g., for Tender sedge, two of the seven associated species were indicators of Fl03, and these values were averaged to provide a secondary habitat value for Fl03 of 0.03 [0.14 + 0.05/7=0.03]; see 'Species Associated Habitats' tab in Excel file).

   - Screenshot 13 & 14, Appendix E: Wetland classification according to MacKenzie and Moran (2004) is then averaged where there may be more than one descriptor for a wetland type in the LAA. For example, Fl01, Fl03 and Fl05 secondary habitat associations are averaged ([0.02+0.03+0.00]/3, to provide an indicator value for WH for Tender sedge = 0.02). Note that this calculation is hidden in the Excel file (see 'Species Associated Habitats' tab and 'Secondary habitat use' tab in Excel file).

b) *Standardize the indicator values for each rare species:* Some species use multiple wetland habitat types, whereas other species are restricted to one habitat type. To consider the difference between species that are specialists, versus generalists, the importance of each habitat to a rare plant species is referred to as an indicator value and is standardized to 1. The same process applies to the calculation of wetland function loss using both primary habitat and secondary habitat associations.

   For example (for primary habitat associations; see 'Primary habitat use' tab and 'Primary habitat rank' tab in Excel file and screenshots 15 & 16 in Appendix E)**:** based on primary habitat data collected in the LAA, purple-stemmed aster was found in WS, SE and TS (screenshot 15); therefore each habitat gets an indicator value of 0.33 (1/3; screenshot 16).

   For example (for secondary habitat associations; see 'Secondary habitat use' tab and 'Secondary habitat rank' tab in Excel file and screenshots 17 & 18 in Appendix E)**:** Based on secondary habitat data, purple-stemmed aster was associated with all wetland types (except open water, marl fen and tufa seep), with a total secondary indicator value of 0.3035 (screenshot 17). Therefore, to standardize to 1, TS as an example, gets a standardized indicator value of 0.0356/0.3035 = 0.1173 (see screenshots 17 & 18).

c) *Indicator values summarized for each wetland type, to calculate Total Relative Density:* The indicator values for each rare species occurring within a particular wetland type (e.g., SE, TS) are summed to calculate Total Relative Density (same as Total Wetland Type-Usage for fauna). This value summarizes rare plant density expected to occur within each wetland type assuming that all habitats are equally available within the landscape. The same process applies to the calculation of wetland function loss using both primary habitat and secondary habitat associations.

   For example (see 'Primary habitat rank' tab in Excel file and screenshot 19 in Appendix E)**:** the total relative density for TS is 4.83, which is the sum of indicator values for Hudson Bay Sedge, Hall's Willowherb, Northern Bog Bedstraw, Small-flowered Lousewort, Autumn Willow and Purple-stemmed Aster.

d) *Standardize Total Wetland Density across all wetland types:* This standardization is the final step for developing a Manly-Chesson Standardized Selectivity Index and is used to quantify rare species occurrence over multiple habitat types. Proportional Wetland Density represents the relative expected occurrence of rare plant species within each wetland type if all types are equally available in the landscape. Wetland density is standardized so that selectivity indices remain comparable amongst all wetland habitat functions examined. The same process applies to the calculation of wetland function loss using both primary habitat and secondary habitat associations.

For example (see 'Primary habitat rank' tab in Excel file and screenshot 20 in Appendix E)**:** The Standardized Wetland Density for rare plant primary habitat associations in wetland type TS is 0.4028. This is the Total Wetland Density for TS (4.833) divided by the sum of the Total Wetland Density values for each wetland type (12). This means that if habitats were equally available on the landscape, 40.3% of rare plant primary habitat associations are predicted to occur in TS wetlands (does not include upland habitats).

e) *Calculate baseline wetland area percentages for wetland types occurring within the LAA:* Baseline wetland areas are standardized to 1 by dividing the area of each wetland type by total wetland area. The same standardized baseline wetland areas are used during the evaluation of each wetland habitat function. The same process applies to calculating wetland function loss using both primary habitat and secondary habitat associations.

For example (see 'Primary habitat rank' tab in Excel file and screenshot 21 in Appendix E): 1406ha of TS occur within the Site C LAA and is divided by 6092ha of total wetland area to get a Percentage Baseline Wetland Area of 0.2307945. This means that 23.1% of the baseline wetland habitat within the LAA is classified as TS.

f) *Multiply the Standardized Relative Density by percentage baseline wetland area to determine Density Given Baseline Habitat Availability:* Expected habitat density is modified to reflect how much habitat is actually available upon the landscape. Some wetland types may provide valuable wetland functions for rare plants but if its availability is limited this diminishes its potential occurrence. Conversely, some wetland types with low functional value to rare plants may be very common in the LAA and therefore likelihood of occurrence would increase. This step takes into account that wetland habitats in the LAA are not equally available and is the product of Percentage Baseline Wetland Area and the Manly-Chesson Standardized Selectivity Index and scales rare species occurrence within each wetland type to actual habitat availability existing within the LAA. The same process applies to the calculation of wetland function loss using both primary habitat and secondary habitat associations.

For example (see 'Primary habitat rank' tab in Excel file and screenshot 22 in Appendix E)**:** TS has a standardized relative density for primary habitat of 0.40278, and a Percentage Baseline Wetland Area of 0.23079. This leads to a Density Given Baseline Availability of approximately 0.09296.

g) *Standardize density given baseline habitat availability:* This represents the expected density of rare plants given the baseline habitat availability and habitat selection indices. Density given baseline habitat availability is standardized in order to keep values comparable amongst all wetland habitat functions examined. The same process applies to the calculation of wetland function loss using both primary habitat and secondary habitat associations.

For example (see 'Primary habitat rank' tab in Excel file and screenshot 23 in Appendix E): The Density Given Habitat Availability for TS (0.092959) is divided by the sum of Density Given Habitat Availability values for all wetland types (0.2005), which results in a Standardized Density Given Habitat Availability of 0.4636. This means that given the baseline proportion of wetlands existing within the LAA, 46.4% of rare plant primary habitat associations are predicted to occur in TS wetlands.

h) *Average Primary and Secondary Standardized Densities Given Baseline Habitat Availability:* Although wetland habitat value for rare plants can be explored based on primary habitat associations (i.e., based on field observations) or secondary habitat associations (i.e., based on associated species, and as indicators of wetland types), Average Standardized Density Given Baseline Habitat Availability is calculated to summarize rare plant occurrence within the LAA, as both provide a representation of the same function – presence.

   For example (see 'Summary habitat rank' tab in Excel file and screenshots 24 in Appendix E)**:** For rare plants, the Primary Standardized Density Given Habitat Availability for TS is 0.4636 and the Secondary Standardized Given Habitat Availability is 0.2776. These two values are averaged to obtain the Average Standardized Density Given Habitat Availability, which is 0.3706 for TS ([0.4636 +.2776]/2 = 0.3706).

i) *Calculate Total Loss Given Habitat Affected:* Although some wetland types in the LAA may be common on the landscape, they may represent only a small proportion of what is estimated to be affected on the landscape. Conversely, other wetland types in the LAA may have limited coverage, but represent a larger proportion of what is estimated to be affected by the project. The importance of a wetland type for a specific habitat function is adjusted based on the wetland area that is expected to be affected by construction activities. This is the product of value of services (i.e., standardized density given habitat availability) and area affected (i.e., Construction), which are the two primary components of a Habitat Equivalency Analysis. Total Loss Given Habitat Affected is calculated separately based on wetland area affected by construction. Total Loss values are summed across each wetland type and this directly relates to Total Gain Given Habitat Restored (see step j). The overall goal is to achieve a balance between the two (i.e., Total Loss values = Total Gain values)

   For example (see 'Summary habitat rank' tab in Excel file and screenshot 25 in Appendix E)**:** TS has an Average Standardized Density Given Habitat Availability of 0.3706, and a total area of 68ha of area to be affected by construction. This leads to a Total Loss Given Habitat Affected – Construction value for TS of approximately 25.20 for rare plants.

j) *Calculate Total Gain Given Habitat Restored:* Wetland function is applied to Total Gain Given Habitat Restored using the same principles for calculating Total Loss. Total Gain is calculated by multiplying amount and type of wetland habitat being restored by value of services. Total Gain values are summed across each wetland type and this directly relates to Total Loss Given Habitat

Affected (see step i). The overall goal is to achieve a balance between the two (i.e., Total Loss values = Total Gain values)

Hypothetical example (see screenshot 26): If 100ha of TS wetlands are restored, this is multiplied by the Average Standardized Density Given Habitat Availability to calculate a Total Gain Given Habitat Restored value of 37.06 for TS. If 100ha of SE, 100ha of TS and 50ha of BT are restored to compensate for habitat lost during construction you are approximately half way to meeting your mitigation goals for rare plant habitat (i.e., Total Gain Given Habitat Restored = 65.81, which is approximately half of Total Loss Given Habitat Affected = 130.68).

In the case of the above ranking process for flora species, a number of assumptions are made to obtain an overall habitat value:

- For primary habitat ranking, the ranking process assumes that habitats with a rare plant species have an equal probability of having that plant present. For example, for purple-stemmed aster, the process assumes it equally prefers SE, TS and WS.
- The ranking process assumes that rare plant species are equally valuable in terms of what is to be mitigated for wetland loss. For example, Hudson Bay sedge is equally as valuable as Hall's willowherb.
- For primary habitat ranking, the ranking process assumes that equal sampling effort was conducted across all wetland habitat types, during baseline rare plant species surveys.

Summary

Overall, this process assessed 54 indicator species, and their categories of use (e.g., nesting, brood-rearing, feeding and migration) in wetland habitats in order to evaluate the functional importance of wetland habitat in the LAA for migratory birds, rare plants, amphibians, bats, and species important to Aboriginal land use (Figure 2). An estimated 763ha of wetland area will be lost or affected by construction. As the assessment process outlines above, functional importance for wetland habitat to be affected for these 54 species can be identified using a scientifically based process for estimating and evaluating wetland function.

Table 9 summarizes the results of the wetland function assessment process. Note total loss values for wetland function should only be compared within species indicator groups (i.e., migratory birds, amphibians, bats and rare plants), rather than across groups, as the habitat values for wetland function are relative. The greatest functional loss of migratory bird habitat functions was calculated to occur in sedge wetlands (SE) affected during construction. Willow-horsetail-sedge riparian wetlands (WH) affected during construction also contributed to functional loss for all migratory bird functions, except brood-rearing. Functional loss to migratory bird brood-rearing habitat will occur primarily in SE wetland types.

The greatest functional loss of amphibian breeding habitat as a result of construction activities was found to occur within SE wetlands. Construction activities also impacted WH, Labrador tea-sphagnum (BT), and tamarack-sedge (TS) wetlands. Amphibian feeding function loss in wetlands affected by construction activities was the most prevalent in WH, followed by BT, SE, and TS. Feeding function loss associated with construction activities will have the most impact on WH wetlands, followed by BT, and SE wetlands. Function loss associated with amphibian wintering habitat that will be impacted by construction activities will be the greatest in WH wetland types, as well as willow sedge wetlands (WS).

The functional loss of bat feeding habitat as a result of constructions activities will be the greatest in WH wetlands, followed by BT, TS, and SE wetlands. Bat roosting habitat will be affected the greatest by construction activities in WH wetlands, followed by BT, TS, and WS wetland types.

Wetland function loss caused by construction activities regarding their ability to support rare plant species was calculated to be the greatest in WH, followed by BT, TS, and SE.

Functional loss associated with species important to Aboriginal land use and as a result of construction activities will be the greatest in WH and BT wetland types.

The results from this process will be used to inform implementation of the wetland mitigation compensation program and can be used to guide field-level wetland and species monitoring programs**.**

Table 9. Summary of Total Loss Given Habitat Affected values for construction and representing wetland functions for migratory birds, amphibians, bats, rare plants and species important to Aboriginal land use.

	Wetland habitat type								
	OW	**WS**	**WH**	**SE**	**TS**	**Wf02**	**Wf13**	**BT**	**Total**
	Migratory Bird Nesting Habitat								
Construction	0	2.32	50.60	77.32	8.78	0	0.00124	13.77	152.79
	Migratory Bird Brood-rearing Habitat								
Construction	2.72	0	0	118.01	0	0	0.00427	0	120.73
	Migratory Bird Nesting Feeding Habitat								
Construction	1.05	2.40	52.29	84.01	4.47	0	0.00143	8.91	153.13
	Migratory Bird Migration Habitat								
Construction	1.76	3.43	74.76	51.53	7.46	0	0.00186	14.88	153.83
	Amphibian Breeding Habitat								
Construction	0.45	2.12	46.10	58.04	11.14	0	0.00105	22.23	140.08
	Amphibian Feeding Habitat								
Construction	0.00	3.02	65.74	27.59	15.89	0.00	0.00	31.70	143.93
	Amphibian Wintering Habitat								
Construction	0.88	12.54	273.34	0.00	0.00	0.00	0.00	0.00	286.77
	Bat Feeding Habitat								
Construction	0.13	2.42	52.70	16.59	19.11	0	0.0009	38.12	129.07
	Bat Roosting Habitat								
Construction	0	7.19	156.69	0	12.62	0	0	25.19	201.69
	Rare Plant Habitat								
Construction	0	1.21	55.78	16.06	25.20	0	0.00033	32.43	130.68
	Habitat for Species Important to Aboriginal Land Use								
Construction	0	2.86	62.38	9.82	14.14	0	0.00053	47.01	136.21

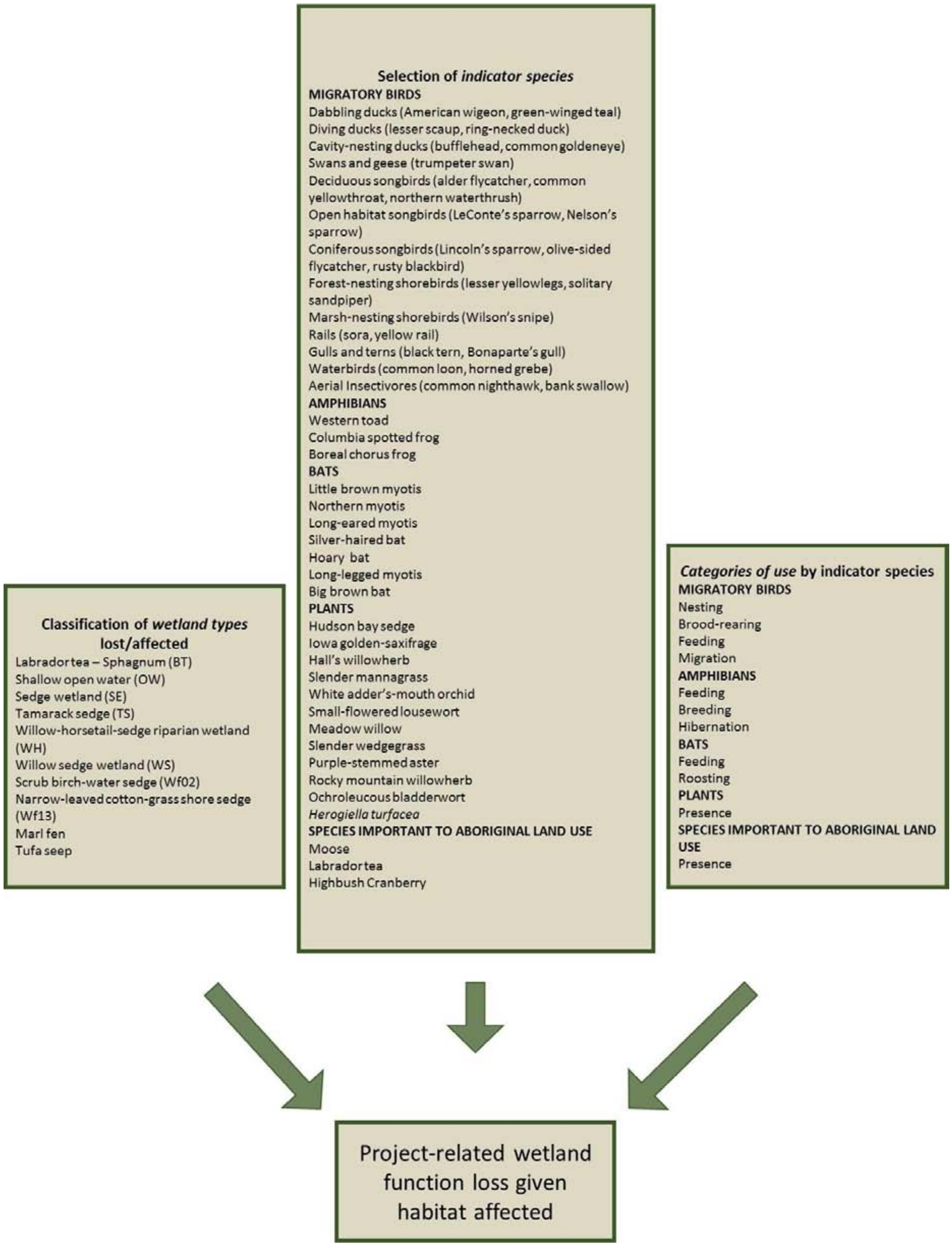

Figure 2. Components of the wetland function assessment process for the BC Hydro Site C Clean Energy Project.

Record keeping

Table 10. Record keeping detail, as per federal condition 18. For data sources utilized, see Appendix A and Hilton et al. 2013a, b, c.

Sampling Location	N/A
Date of Sampling	N/A
Time of sampling	N/A
Name of sampler(s)	N/A
Analyses Performed	Wetland function assessment: literature review and analysis
Date of analyses	October to December, 2014
Person(s) who collected sample(s)	N/A
Person(s) who conducted analysis	Native Plant Solutions/Ducks Unlimited Canada (Lisette Ross, Phil Rose, Jade Raizenne, Lynn Dupuis)

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Appendix A: BC Hydro Site C Baseline Data Investigated

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1.1 Ecosystem Mapping

1.1.2 Results

1.1.2.1 Habitats within the LAA

1.2 At-risk and Sensitive Ecological Communities

1.2.2 Results

1.2.2.3 Wetland Function

Appendix A Terrestrial Ecosystem Mapping Expanded Legend

Appendix G Rare Plant Species Accounts

G.6 *Carex heleonastes* (Hudson Bay sedge)

G.12 *Chrysosplenium iowense* (Iowa golden-saxifrage)

G.16 *Epilobium halleanum* (Hall's willowherb)

G.17 *Epilobium saximontanum* (Rocky Mountain willowherb)

G.19 *Glyceria pulchella* (slender mannagrass)

G.24 *Malaxis brachypoda* (white adder's-mouth orchid)

G.27 *Pedicularis parviflora* ssp. *parviflora* (small-flowered lousewort)

G.32 *Salix petiolaris* (meadow willow)

G. 37 *Sphenopholis intermedia* (slender wedgegrass)

G.38 *Symphotrichum puniceum* var. *puniceum* (purple-stemmed aster)

G.40 *Utricularia ochroleuca* (ochroleucous bladderwort)

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1.1 Amphibians

1.1.3 Field Survey Results

1.1.3.1 Pond Breeding Surveys

1.1.3.2 Auditory Surveys

A.1 Species – Habitat Model for Western Toad

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1.1 Songbirds

1.1.3 Field Survey Results

1.1.3.1 Breeding Bird Surveys

1.1.3.2 Seasonal Habitat Analysis: Breeding

1.1.3.3 Seasonal Habitat Analysis: Migration

1.2 Swallows

1.2.3 Field Survey Results

1.2.3.1 Point-count Surveys

1.3 Waterfowl

1.3.3 Field Survey Results

1.3.3.3 2013 Aerial Surveys

1.4 Marsh Birds

1.4.3 Field Survey Results

1.4.3.1 Habitat Suitability

1.6 Common Nighthawk

1.6.3 Field Survey Results

A.6 Species Model: Rusty Blackbird

A.7 Songbird species counts during point-counts

A.8 Songbird species counts during migration surveys: 2012

B.1 Waterfowl Detections

C.2 Species Model: Nelson's Sparrow

C.3 Species Model: Yellow Rail

E.1 Species Model: Common Nighthawk

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1.1 Bats

1.1.3 Results

1.1.3.1 Bat Capture

1.1.3.2 Radio-telemetry

1.1.3.3 Acoustic Sampling

1.4 Ungulates

1.4.3 Results

1.4.3.1 Radio-collaring

1.4.3.3 Birthing Site Investigations

1.4.3.8 Moose

A.1 Species – Habitat Model for Bats

C.1 Summary of Ungulates, Pregnancy Status, and Relocations

C.3 Resource Selection Function Models

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Appendix B: Sources used to identify individual species' habitat preferences

Migratory Birds

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Appendix C: Evaluation of existing datasets and their ability to inform the Wetland Function Assessment

Dataset	Years Available	Description	Applicable to Wetland Function Assessment	Rationale	Limitations[1]
Amphibian_AuditorySurveys_2006_2008	2006 2008	Record of breeding adults calling from point count locations	Yes	Provides data on the diversity, relative abundance, and frequency of breeding amphibian species and the habitats they were detected in (i.e. habitat can be determined by overlaying UTM coordinates with mapping data)	a
Amphibian_PondSurveys_2006_2008_2012	2006 2008 2012	Record of amphibian life stages (eggs, tadpoles, juveniles, adults) observed at wetlands surveyed	Partial	Provides data on the diversity, relative abundance, life stage, and frequency of amphibian species and the habitats they were detected in (i.e. habitats could be determined by overlaying transects with mapping data)	b
Amphibian_RoadSurveys_2006_2008	2006 2008	Record of migrating amphibians encountered along roadway transects	No	Provides data on amphibian (specifically western toad) movements throughout the study area following metamorphosis, but does not provide any applicable habitat use data	
Bat_Capture_2005_2006_2008_2009_2011	2005 2006 2008 2009 2011	Record of bats captured during mist net sampling	Yes	Provides data on the diversity, relative abundance, gender, age class, reproductive stage, and site series code at bat capture sites (site series should be verified with map data)	e
Bat_Telemetry_2006_2008_2009	2006 2008 2009	Record of roost sites used by bats fitted with radio transmitters	Yes	Provides data on the specific roosts used by individual bats and the site series codes they were occurred in (site series should be verified with map data)	e

Dataset	Years Available	Description	Applicable to Wetland Function Assessment	Rationale	Limitations[1]
Bat_DetectorSurvey_2005_2006_2008	2005 2006 2008	Record of bat activity and the species groups using an area (i.e., Myotis, Big Bat, Hoary Bat)	No	Provides a measure of bat activity within a habitat type and provides site series code (site series should be verified with map data), but no measure of abundance (1 bat travelling through an area 4 times is recorded the same as 4 bats travelling through once)	c
Breeding_Bird_Point_Count_2006_2008 & Breeding_Bird_Point_Count_2011_2012	2006 2008 2011 2012	Record of breeding bird species detected at point count locations	Yes	Provides data on the diversity, relative abundance, and frequency of breeding bird species and the habitats they were detected in (i.e. habitat can be determined by overlaying UTM coordinates with mapping data)	a
Migratory_Encounter_2012	2012	Record of birds present during the fall migration period	Partial	Provides data on the diversity, relative abundance, and frequency of bird species during migration and the habitats they were detected in (i.e. habitats could be determined by overlaying transects with mapping data)	b
Waterfowl_Encounter_2006_2008 & 'Keystone waterfowl 2013 2014 data combined"	2006 2008 2013 2014	Record of waterfowl species detected during spring and fall migration and the breeding season	No	Provides data on the diversity and relative abundance of waterfowl species during migration and transect segments they were detected in (i.e. habitats could be determined by overlaying transects with mapping data). 2006 & 2008 data stratified into: River, Backchannel, Wetland, and Lake	b, d

Dataset	Years Available	Description	Applicable to Wetland Function Assessment	Rationale	Limitations[1]
CONI_Call_Playback_2010_2012	2010 2012	Record of common nighthawks detected at call playback locations	Yes	Provides data on the relative abundance, and frequency of common nighthawks and the habitats they were detected in (i.e. habitat can be determined by overlaying UTM coordinates with mapping data)	a
MarshBirds_Call_Playback_2008_2011_2012	2008 2011 2012	Record of marsh bird species detected at call playback locations	Yes	Provides data on the relative abundance, and frequency of marsh bird species and the habitats they were detected in (i.e. habitat can be determined by overlaying UTM coordinates with mapping data)	a
Swallow_NestCounts_2010	2010	Record of swallow nests detected along the Peace River	No	Provides data on the location of swallow nesting sites, but nests of targeted species restricted to habitat features associated with manmade structures or cliffs and banks along riparian areas and are not found in wetland habitats	d
Swallow_PointCount_2011_2012	2011 2012	Record of swallow detections at point count locations along the Peace River	Partial	Provides data on the relative abundance, and frequency of swallow species and the habitats they were detected in (i.e. habitat can be determined by overlaying UTM coordinates with mapping data)	a, d

[1]Limitations

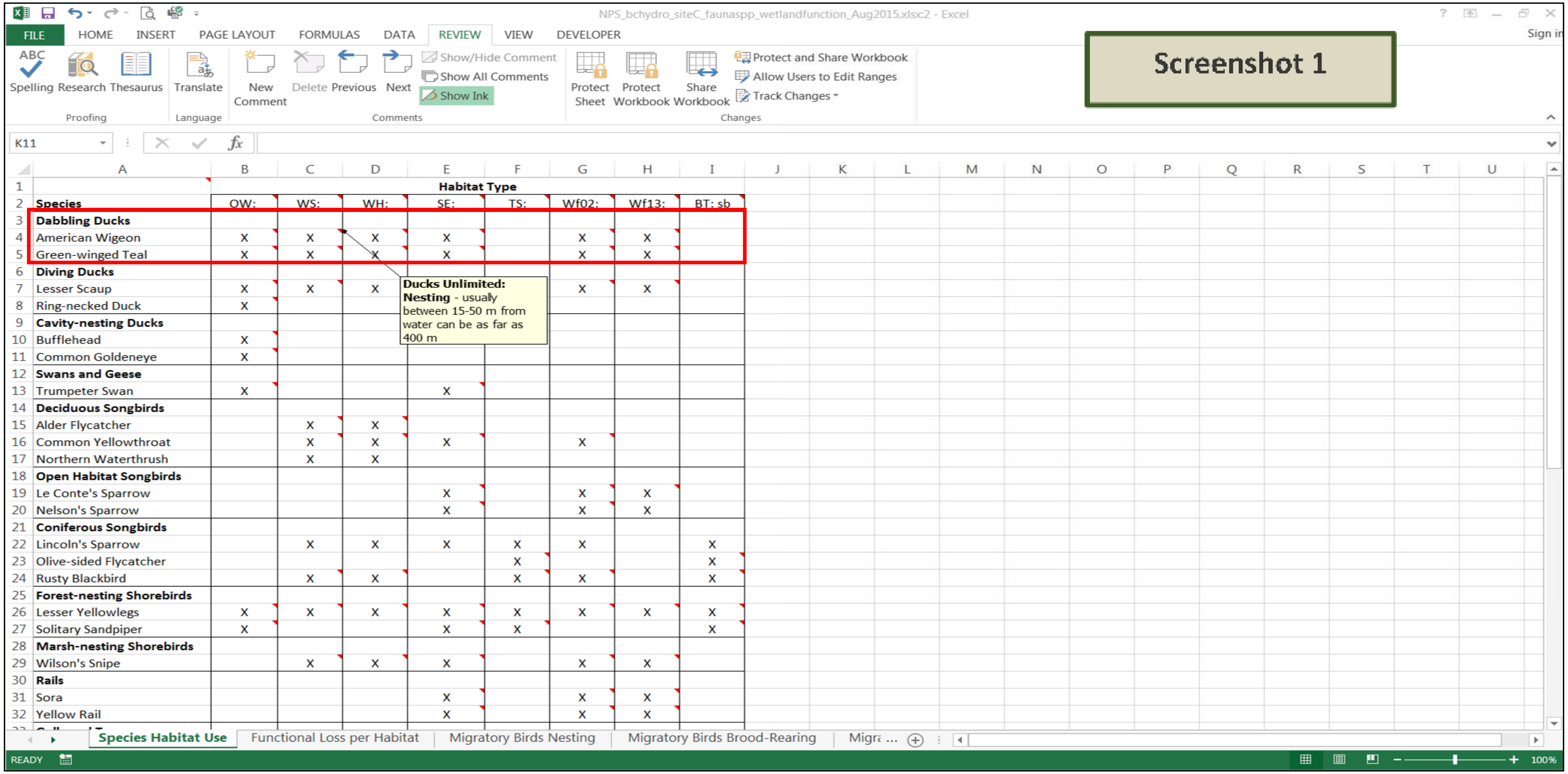
a - habitats correspond to the ecosystem at the center of the point count station and may not represent the habitat in which the species was present (e.g., a bird survey station occurs in SE habitat and a bird is detected 100 m to the west of the station, but 100 m to the west could be a different habitat type)

b – because most detections were made along transect surveys it makes it difficult to distinguish the actual habitat type the detection occurred in if transect routes passed through multiple habitat types

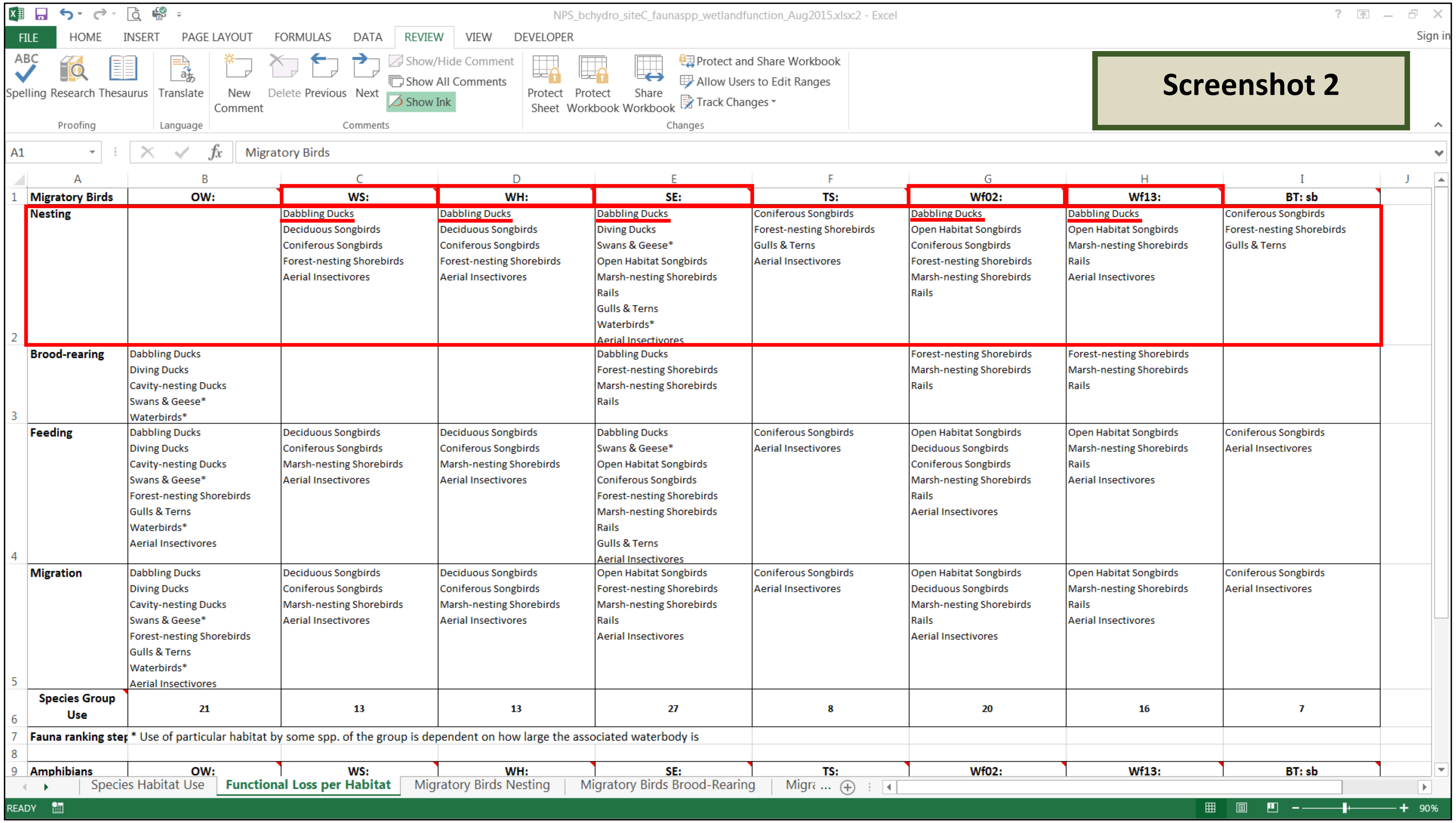
c - data can only be separated into species groups (i.e., Myotis, Big Bat, Hoary Bat) and not individual species

d - surveys were restricted to habitats adjacent to the river and do not sample off-system wetlands (this is not entirely true for waterfowl as some wetlands were also surveyed but a majority of the effort was focused on the Peace River)

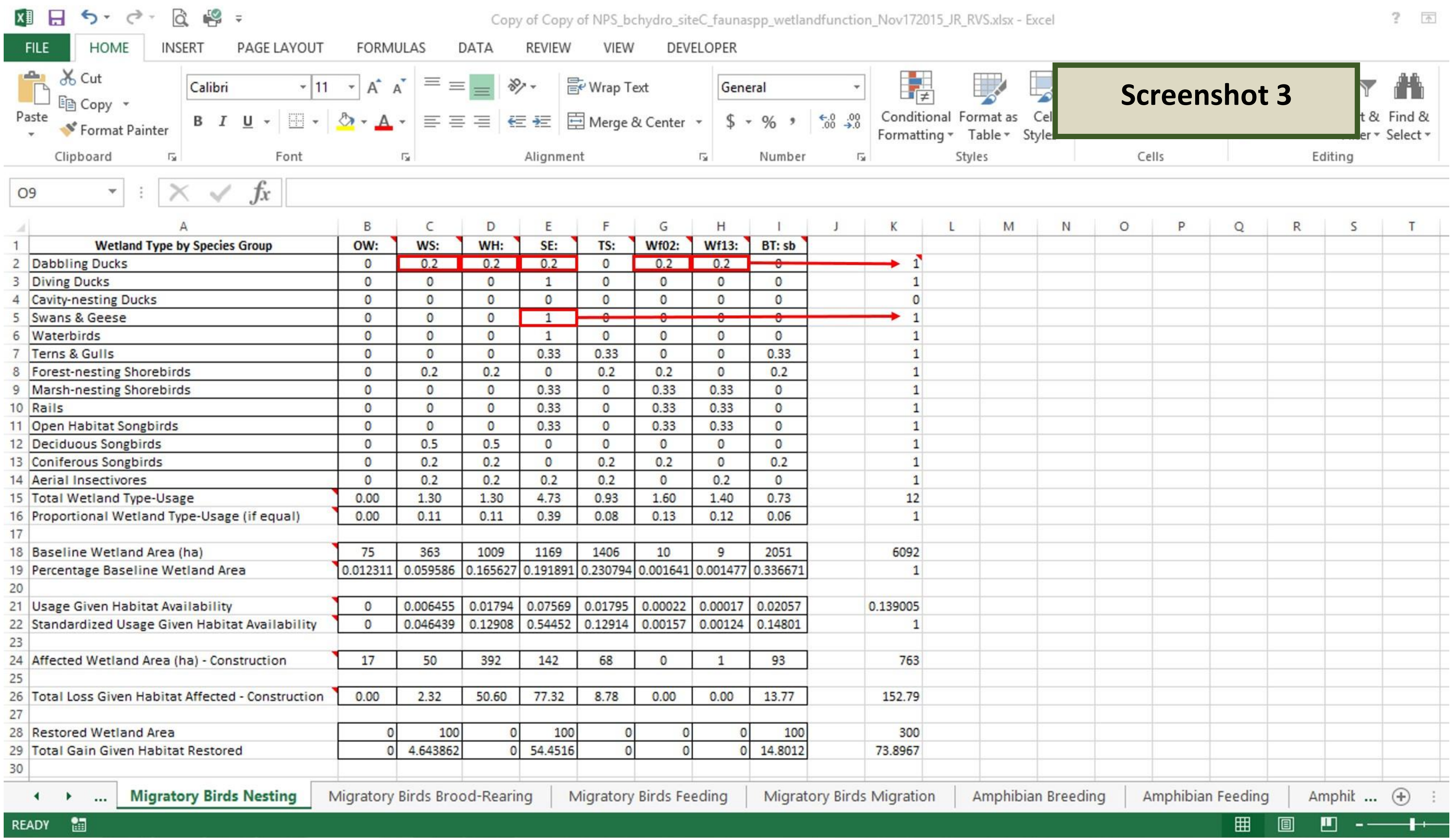
Appendix D: Screenshots for fauna ranking examples



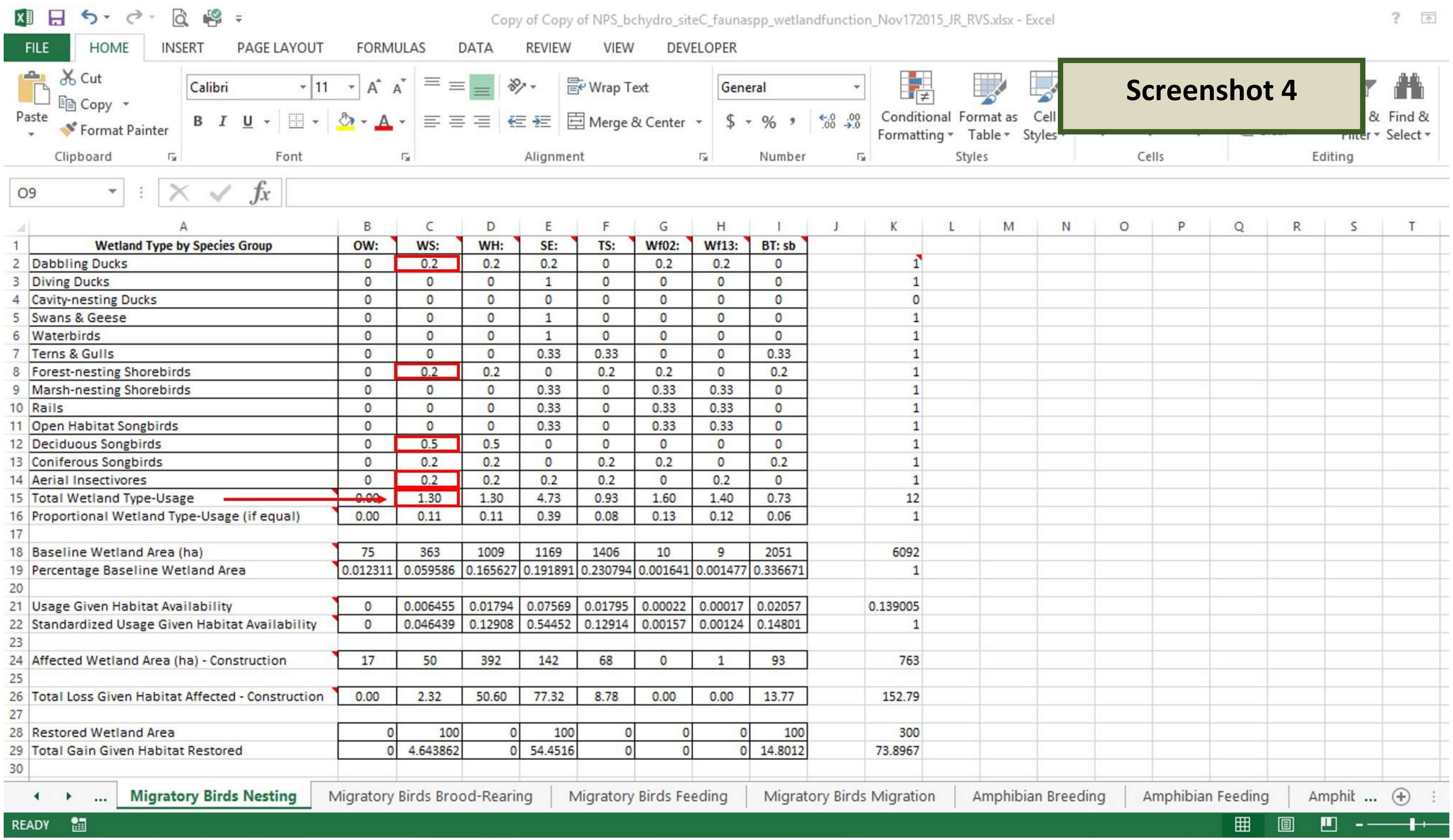
	Habitat Type							
Species	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb
Dabbling Ducks								
American Wigeon	X	X	X	X		X	X	
Green-winged Teal	X	X	X	X		X	X	
Diving Ducks								
Lesser Scaup	X	X	X			X	X	
Ring-necked Duck	X							
Cavity-nesting Ducks								
Bufflehead	X							
Common Goldeneye	X							
Swans and Geese								
Trumpeter Swan	X			X				
Deciduous Songbirds								
Alder Flycatcher		X	X					
Common Yellowthroat		X	X	X		X		
Northern Waterthrush		X	X					
Open Habitat Songbirds								
Le Conte's Sparrow				X		X	X	
Nelson's Sparrow				X		X	X	
Coniferous Songbirds								
Lincoln's Sparrow		X	X	X	X	X		X
Olive-sided Flycatcher					X			X
Rusty Blackbird		X	X		X	X		X
Forest-nesting Shorebirds								
Lesser Yellowlegs	X	X	X	X	X	X	X	X
Solitary Sandpiper	X			X	X			X
Marsh-nesting Shorebirds								
Wilson's Snipe		X	X	X		X	X	
Rails								
Sora				X		X	X	
Yellow Rail				X		X	X	



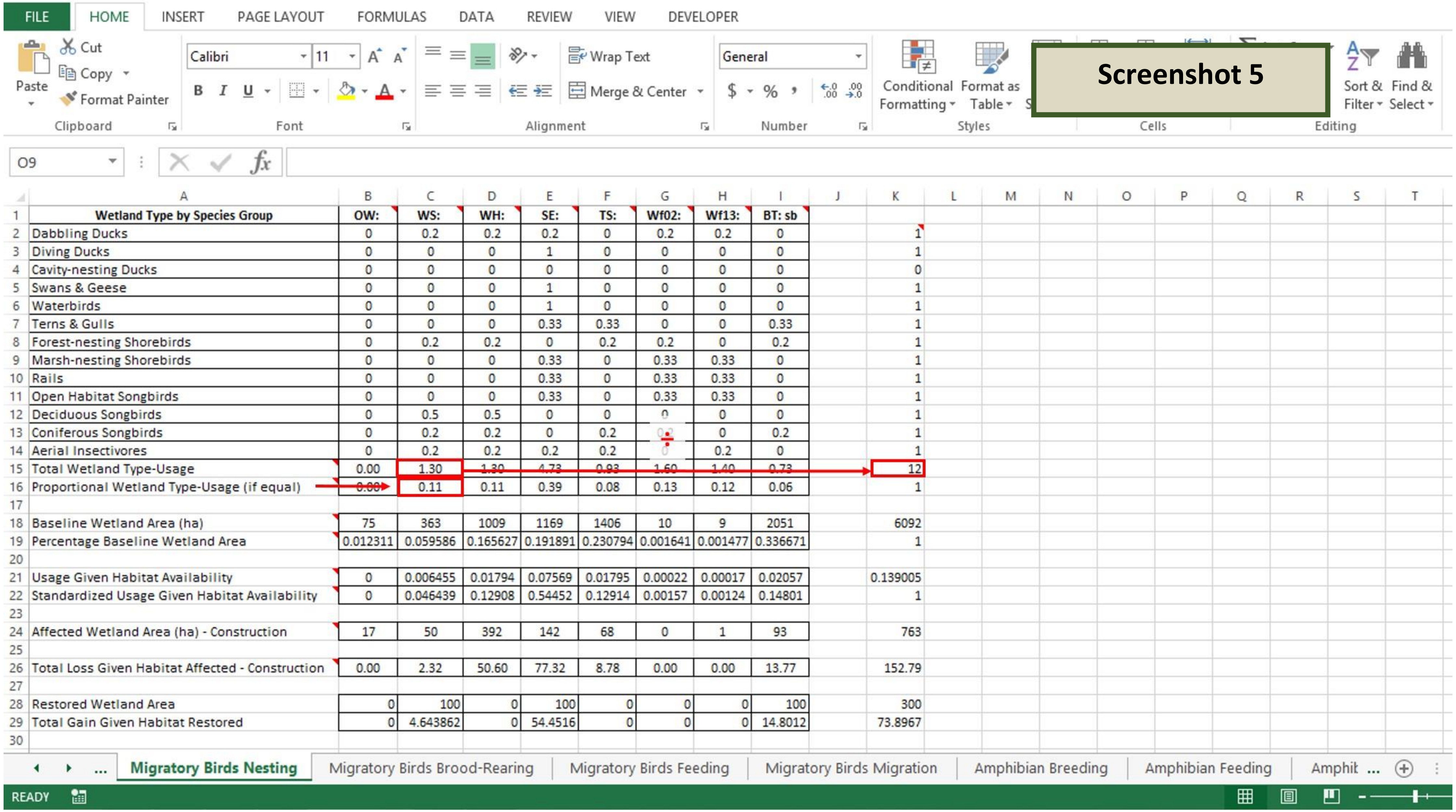
	A	B	C	D	E	F	G	H	I
1	**Migratory Birds**	**OW:**	**WS:**	**WH:**	**SE:**	**TS:**	**Wf02:**	**Wf13:**	**BT: sb**
2	**Nesting**		Dabbling Ducks Deciduous Songbirds Coniferous Songbirds Forest-nesting Shorebirds Aerial Insectivores	Dabbling Ducks Deciduous Songbirds Coniferous Songbirds Forest-nesting Shorebirds Aerial Insectivores	Dabbling Ducks Diving Ducks Swans & Geese* Open Habitat Songbirds Marsh-nesting Shorebirds Rails Gulls & Terns Waterbirds* Aerial Insectivores	Coniferous Songbirds Forest-nesting Shorebirds Gulls & Terns Aerial Insectivores	Dabbling Ducks Open Habitat Songbirds Coniferous Songbirds Forest-nesting Shorebirds Marsh-nesting Shorebirds Rails	Dabbling Ducks Open Habitat Songbirds Marsh-nesting Shorebirds Rails Aerial Insectivores	Coniferous Songbirds Forest-nesting Shorebirds Gulls & Terns
3	**Brood-rearing**	Dabbling Ducks Diving Ducks Cavity-nesting Ducks Swans & Geese* Waterbirds*			Dabbling Ducks Forest-nesting Shorebirds Marsh-nesting Shorebirds Rails		Forest-nesting Shorebirds Marsh-nesting Shorebirds Rails	Forest-nesting Shorebirds Marsh-nesting Shorebirds Rails	
4	**Feeding**	Dabbling Ducks Diving Ducks Cavity-nesting Ducks Swans & Geese* Forest-nesting Shorebirds Gulls & Terns Waterbirds* Aerial Insectivores	Deciduous Songbirds Coniferous Songbirds Marsh-nesting Shorebirds Aerial Insectivores	Deciduous Songbirds Coniferous Songbirds Marsh-nesting Shorebirds Aerial Insectivores	Dabbling Ducks Swans & Geese* Open Habitat Songbirds Coniferous Songbirds Forest-nesting Shorebirds Marsh-nesting Shorebirds Rails Gulls & Terns Aerial Insectivores	Coniferous Songbirds Aerial Insectivores	Open Habitat Songbirds Deciduous Songbirds Coniferous Songbirds Marsh-nesting Shorebirds Rails Aerial Insectivores	Open Habitat Songbirds Marsh-nesting Shorebirds Rails Aerial Insectivores	Coniferous Songbirds Aerial Insectivores
5	**Migration**	Dabbling Ducks Diving Ducks Cavity-nesting Ducks Swans & Geese* Forest-nesting Shorebirds Gulls & Terns Waterbirds* Aerial Insectivores	Deciduous Songbirds Coniferous Songbirds Marsh-nesting Shorebirds Aerial Insectivores	Deciduous Songbirds Coniferous Songbirds Marsh-nesting Shorebirds Aerial Insectivores	Open Habitat Songbirds Forest-nesting Shorebirds Marsh-nesting Shorebirds Rails Aerial Insectivores	Coniferous Songbirds Aerial Insectivores	Open Habitat Songbirds Deciduous Songbirds Marsh-nesting Shorebirds Rails Aerial Insectivores	Open Habitat Songbirds Marsh-nesting Shorebirds Rails Aerial Insectivores	Coniferous Songbirds Aerial Insectivores
6	**Species Group Use**	21	13	13	27	8	20	16	7
7	**Fauna ranking step**	* Use of particular habitat by some spp. of the group is dependent on how large the associated waterbody is							
8									
9	**Amphibians**	**OW:**	**WS:**	**WH:**	**SE:**	**TS:**	**Wf02:**	**Wf13:**	**BT: sb**



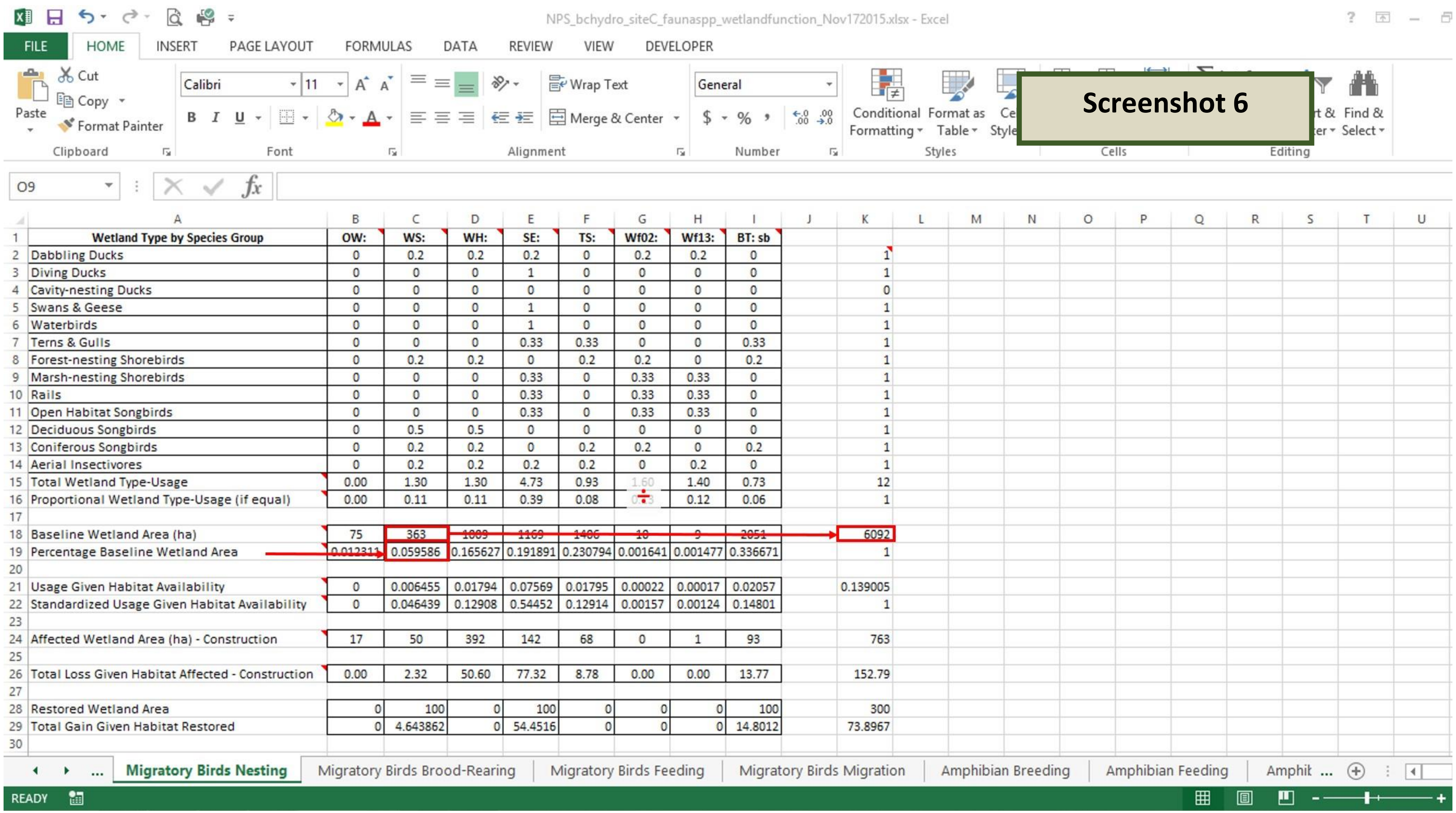
Row	Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb	J	K
2	Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
3	Diving Ducks	0	0	0	1	0	0	0	0		1
4	Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
5	Swans & Geese	0	0	0	1	0	0	0	0		1
6	Waterbirds	0	0	0	1	0	0	0	0		1
7	Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
8	Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
9	Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
10	Rails	0	0	0	0.33	0	0.33	0.33	0		1
11	Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
12	Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
13	Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
14	Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
15	Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
16	Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	0.13	0.12	0.06		1
17											
18	Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
19	Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	0.001641	0.001477	0.336671		1
20											
21	Usage Given Habitat Availability	0	0.006455	0.01794	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
22	Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
23											
24	Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
25											
26	Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77		152.79
27											
28	Restored Wetland Area	0	100	0	100	0	0	0	100		300
29	Total Gain Given Habitat Restored	0	4.643862	0	54.4516	0	0	0	14.8012		73.8967



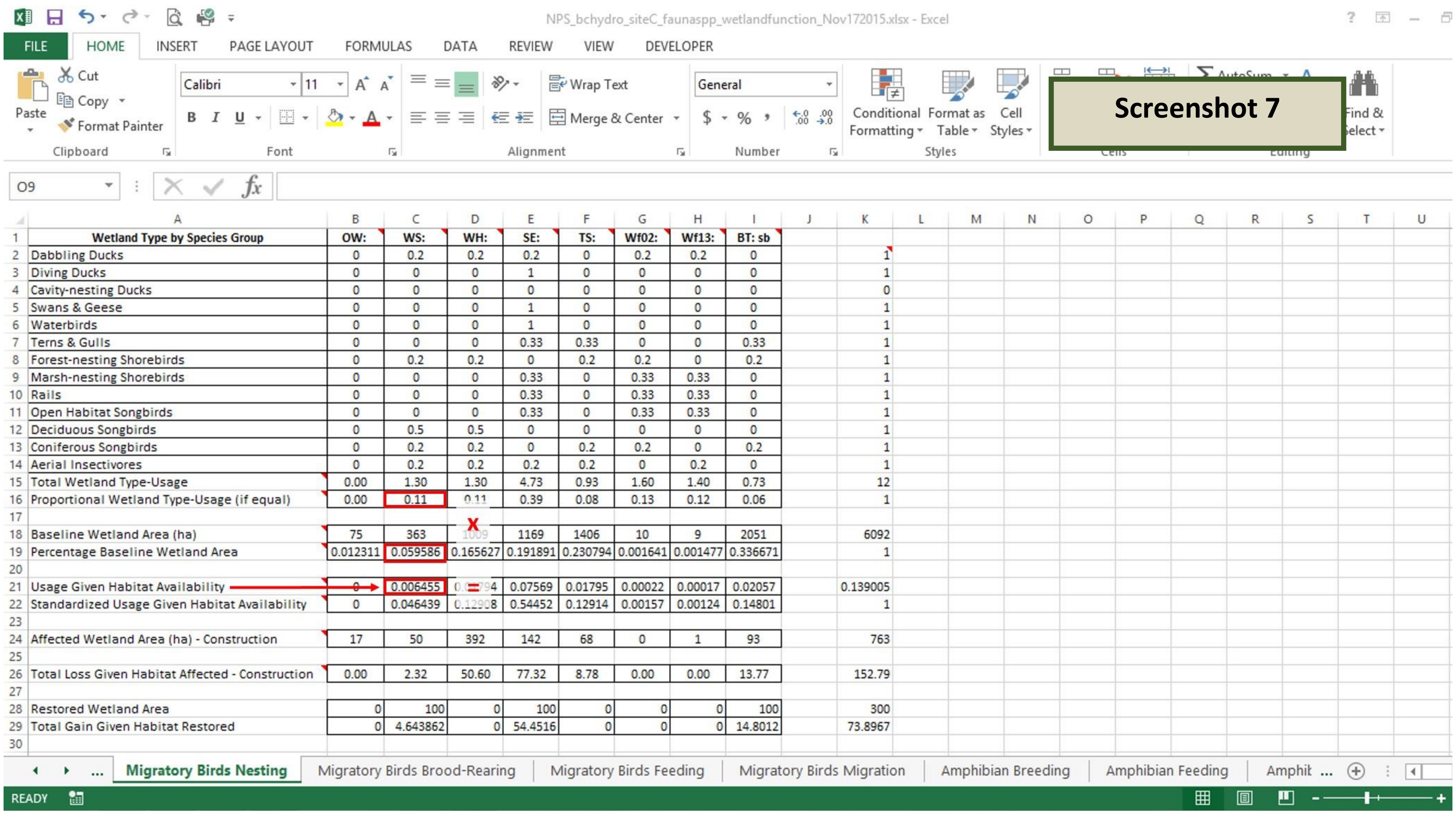
	A	B	C	D	E	F	G	H	I	J	K
1	Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		
2	Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
3	Diving Ducks	0	0	0	1	0	0	0	0		1
4	Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
5	Swans & Geese	0	0	0	1	0	0	0	0		1
6	Waterbirds	0	0	0	1	0	0	0	0		1
7	Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
8	Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
9	Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
10	Rails	0	0	0	0.33	0	0.33	0.33	0		1
11	Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
12	Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
13	Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
14	Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
15	Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
16	Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	0.13	0.12	0.06		1
17											
18	Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
19	Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	0.001641	0.001477	0.336671		1
20											
21	Usage Given Habitat Availability	0	0.006455	0.01794	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
22	Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
23											
24	Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
25											
26	Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77		152.79
27											
28	Restored Wetland Area	0	100	0	100	0	0	0	100		300
29	Total Gain Given Habitat Restored	0	4.643862	0	54.4516	0	0	0	14.8012		73.8967
30											



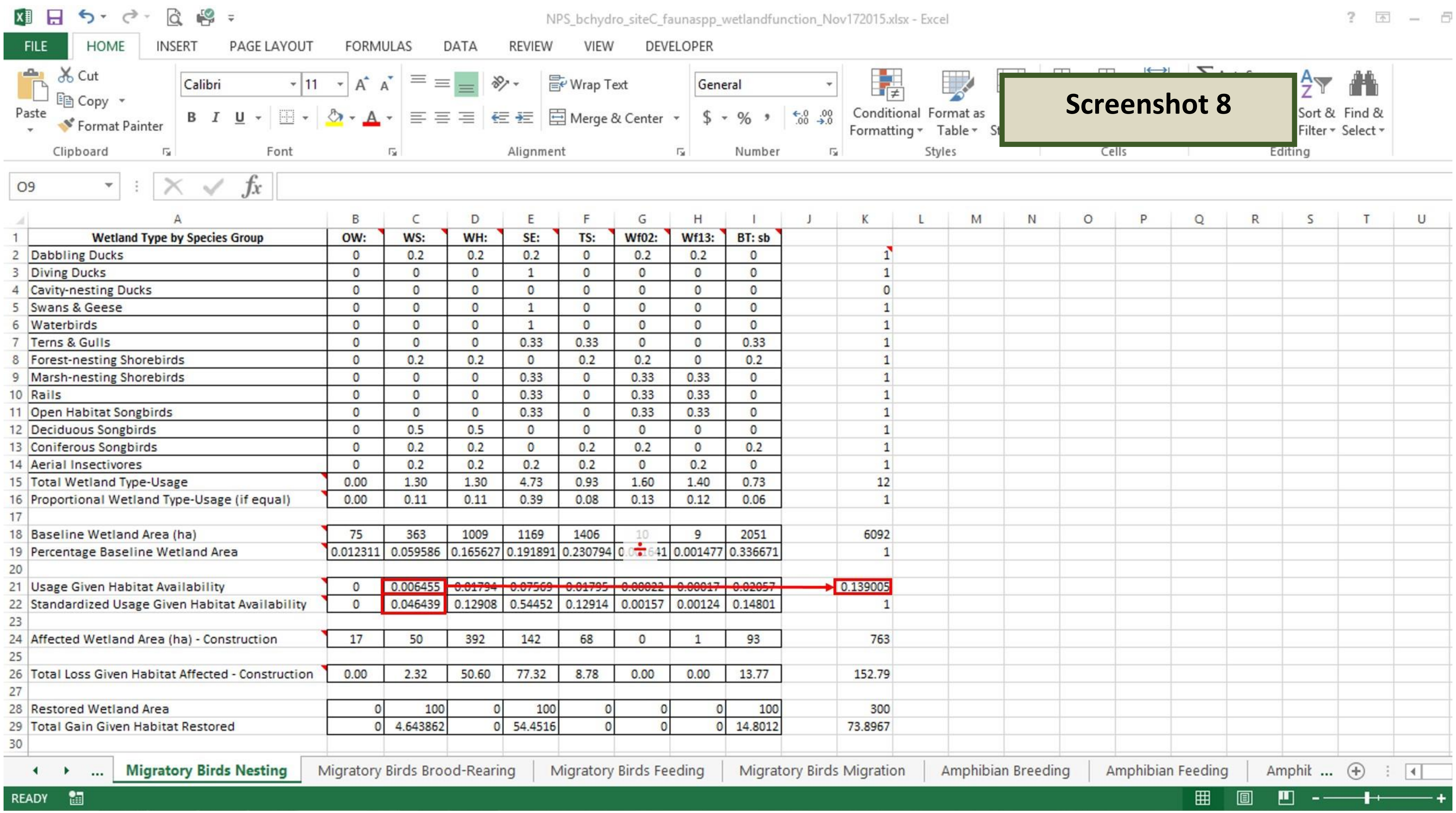
Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		K
Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
Diving Ducks	0	0	0	1	0	0	0	0		1
Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
Swans & Geese	0	0	0	1	0	0	0	0		1
Waterbirds	0	0	0	1	0	0	0	0		1
Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
Rails	0	0	0	0.33	0	0.33	0.33	0		1
Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	0.13	0.12	0.06		1
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	0.001641	0.001477	0.336671		1
Usage Given Habitat Availability	0	0.006455	0.01794	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77		152.79
Restored Wetland Area	0	100	0	100	0	0	0	100		300
Total Gain Given Habitat Restored	0	4.643862	0	54.4516	0	0	0	14.8012		73.8967



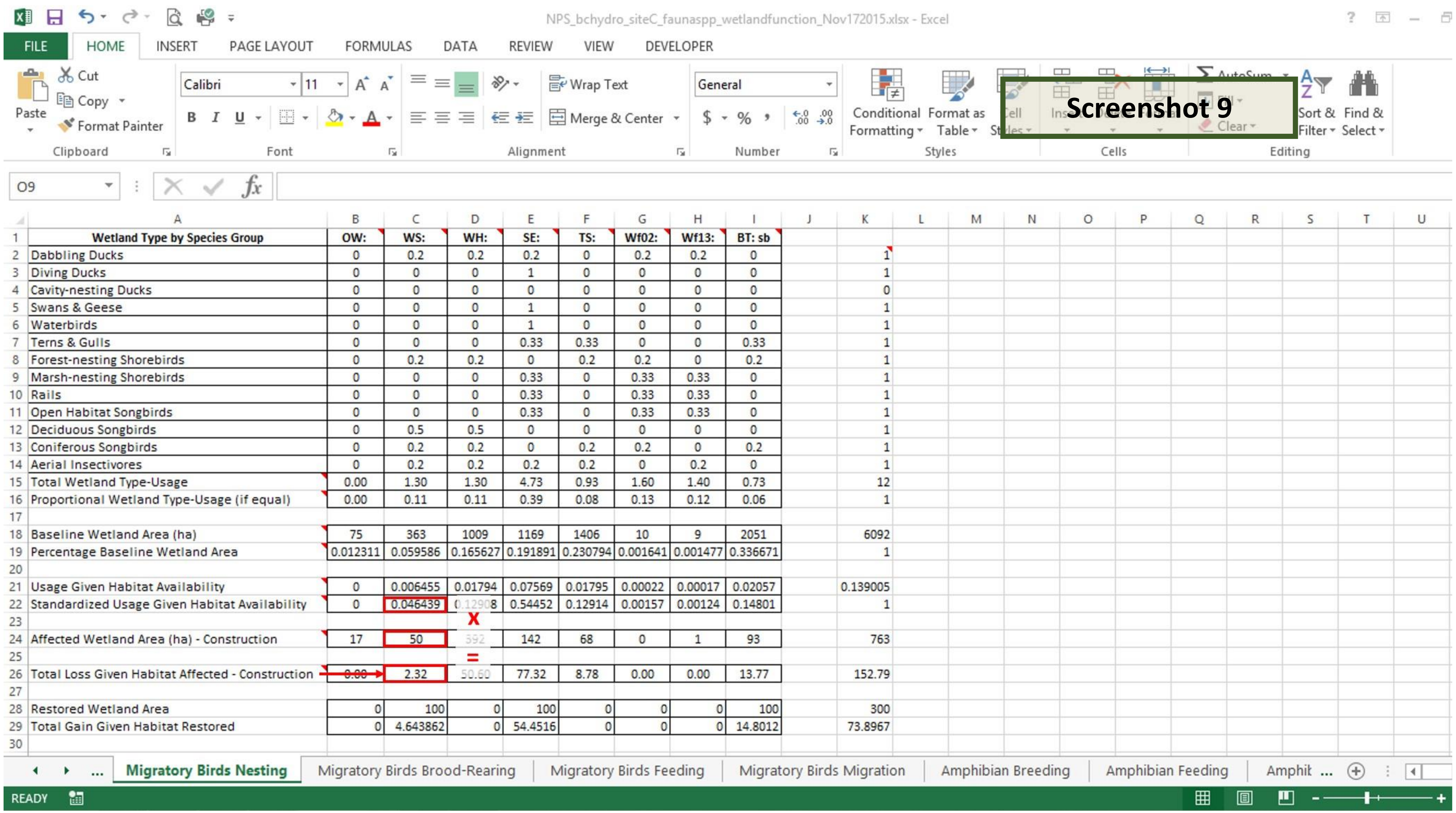
	A	B	C	D	E	F	G	H	I	J	K
1	Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		
2	Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
3	Diving Ducks	0	0	0	1	0	0	0	0		1
4	Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
5	Swans & Geese	0	0	0	1	0	0	0	0		1
6	Waterbirds	0	0	0	1	0	0	0	0		1
7	Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
8	Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
9	Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
10	Rails	0	0	0	0.33	0	0.33	0.33	0		1
11	Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
12	Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
13	Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
14	Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
15	Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
16	Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	[illegible]	0.12	0.06		1
17											
18	Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
19	Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	0.001641	0.001477	0.336671		1
20											
21	Usage Given Habitat Availability	0	0.006455	0.01794	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
22	Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
23											
24	Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
25											
26	Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77		152.79
27											
28	Restored Wetland Area	0	100	0	100	0	0	0	100		300
29	Total Gain Given Habitat Restored	0	4.643862	0	54.4516	0	0	0	14.8012		73.8967
30											



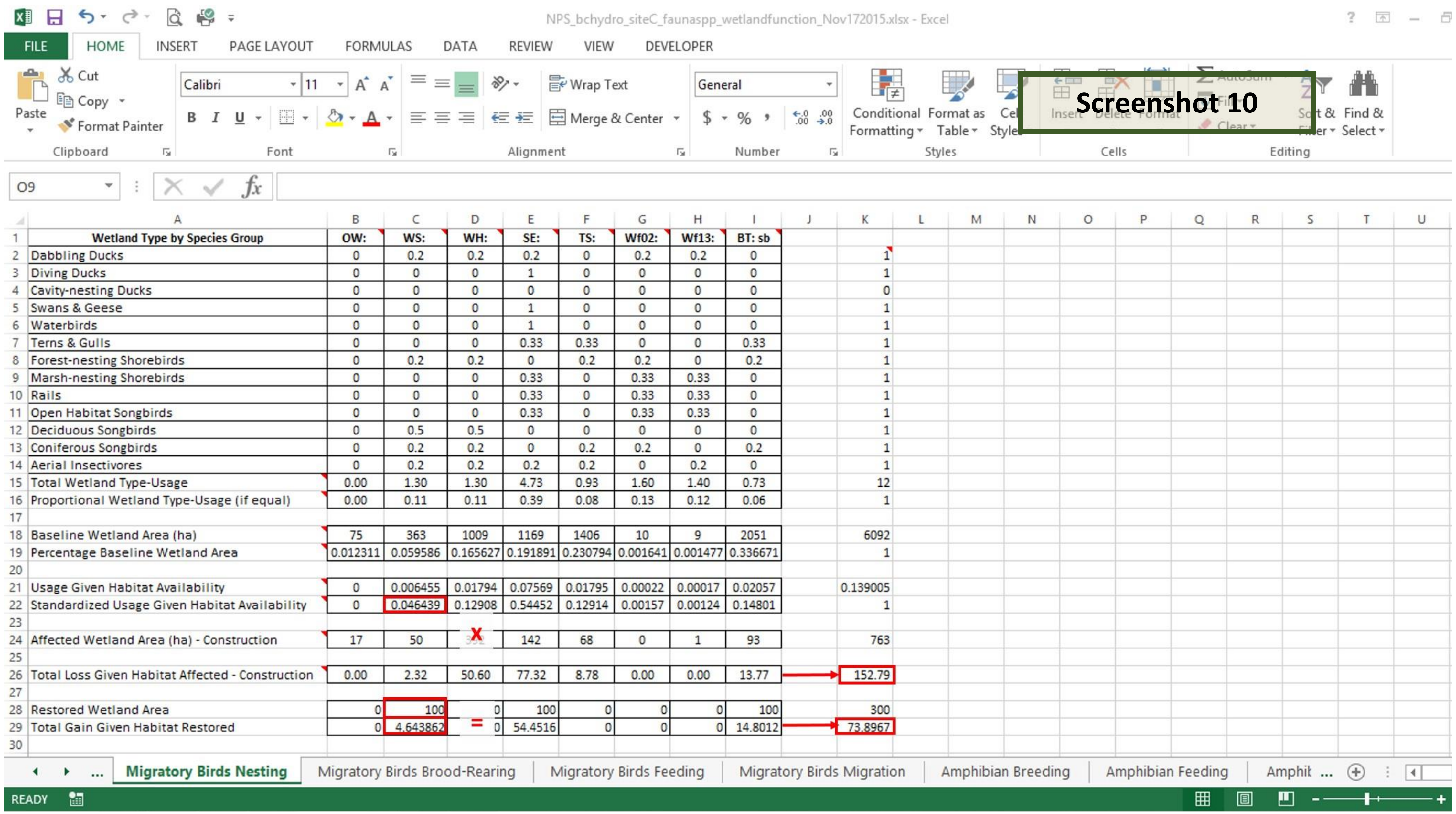
Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		
Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
Diving Ducks	0	0	0	1	0	0	0	0		1
Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
Swans & Geese	0	0	0	1	0	0	0	0		1
Waterbirds	0	0	0	1	0	0	0	0		1
Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
Rails	0	0	0	0.33	0	0.33	0.33	0		1
Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	0.13	0.12	0.06		1
			x							
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	0.001641	0.001477	0.336671		1
Usage Given Habitat Availability	0	0.006455	0.[illegible]794 =	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77		152.79
Restored Wetland Area	0	100	0	100	0	0	0	100		300
Total Gain Given Habitat Restored	0	4.643862	0	54.4516	0	0	0	14.8012		73.8967



	A	B	C	D	E	F	G	H	I	J	K
1	Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		
2	Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
3	Diving Ducks	0	0	0	1	0	0	0	0		1
4	Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
5	Swans & Geese	0	0	0	1	0	0	0	0		1
6	Waterbirds	0	0	0	1	0	0	0	0		1
7	Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
8	Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
9	Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
10	Rails	0	0	0	0.33	0	0.33	0.33	0		1
11	Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
12	Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
13	Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
14	Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
15	Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
16	Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	0.13	0.12	0.06		1
17											
18	Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
19	Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	[illegible]	0.001477	0.336671		1
20											
21	Usage Given Habitat Availability	0	0.006455	0.01794	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
22	Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
23											
24	Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
25											
26	Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77		152.79
27											
28	Restored Wetland Area	0	100	0	100	0	0	0	100		300
29	Total Gain Given Habitat Restored	0	4.643862	0	54.4516	0	0	0	14.8012		73.8967
30											

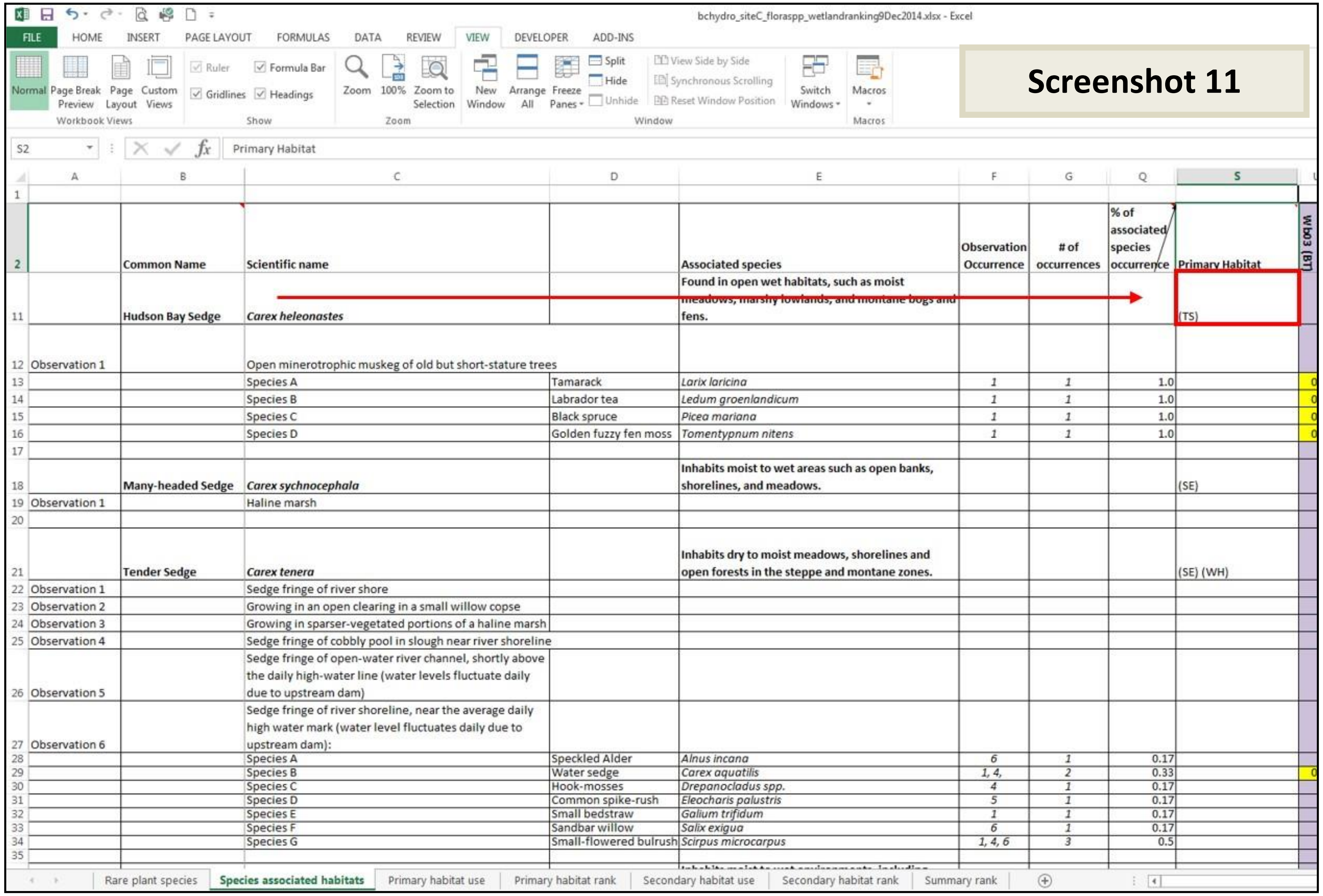


Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		K
Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
Diving Ducks	0	0	0	1	0	0	0	0		1
Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
Swans & Geese	0	0	0	1	0	0	0	0		1
Waterbirds	0	0	0	1	0	0	0	0		1
Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
Rails	0	0	0	0.33	0	0.33	0.33	0		1
Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	0.13	0.12	0.06		1
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	0.001641	0.001477	0.336671		1
Usage Given Habitat Availability	0	0.006455	0.01794	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
		X								
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
		=								
Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77		152.79
Restored Wetland Area	0	100	0	100	0	0	0	100		300
Total Gain Given Habitat Restored	0	4.643862	0	54.4516	0	0	0	14.8012		73.8967

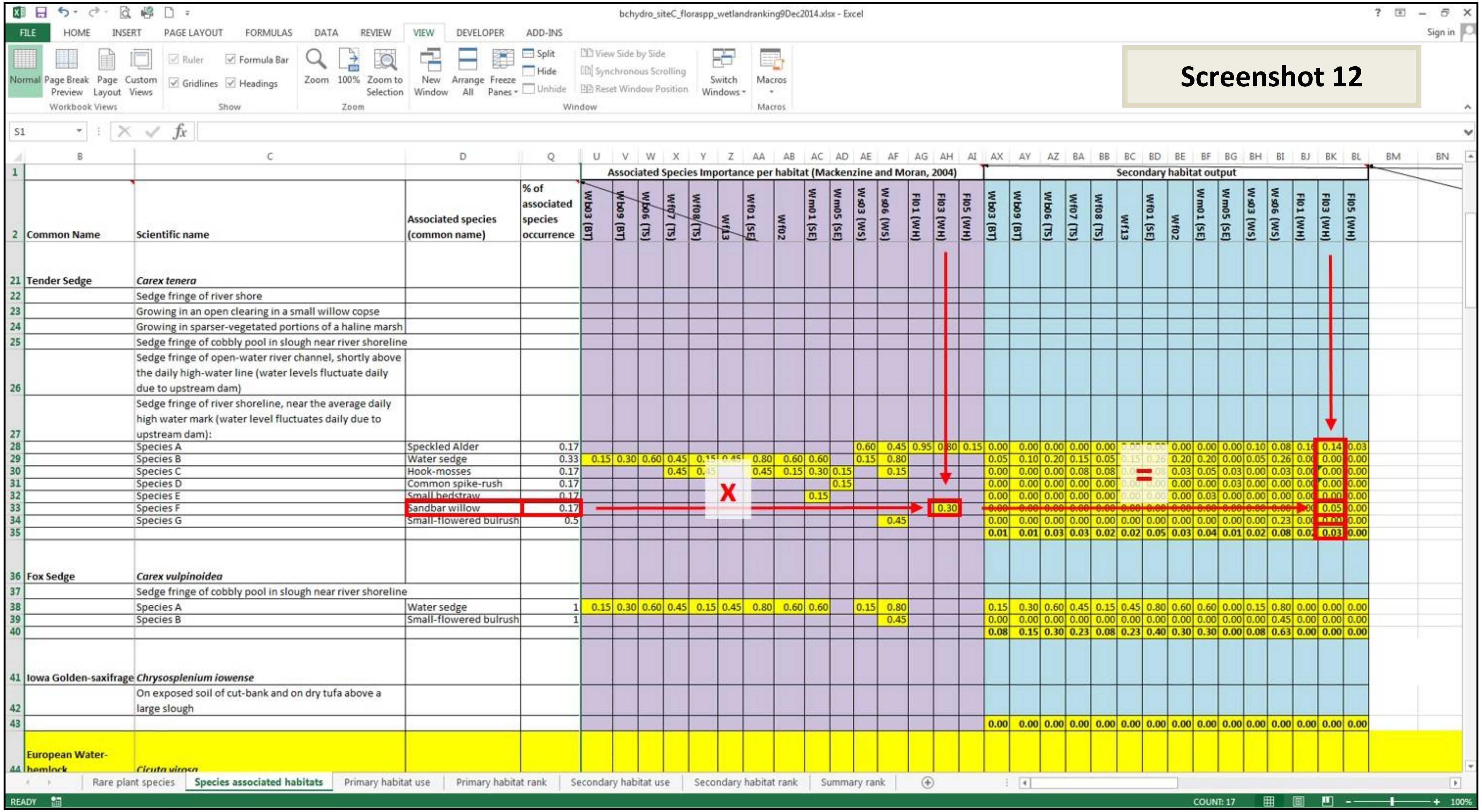


	A	B	C	D	E	F	G	H	I	J	K
1	Wetland Type by Species Group	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		
2	Dabbling Ducks	0	0.2	0.2	0.2	0	0.2	0.2	0		1
3	Diving Ducks	0	0	0	1	0	0	0	0		1
4	Cavity-nesting Ducks	0	0	0	0	0	0	0	0		0
5	Swans & Geese	0	0	0	1	0	0	0	0		1
6	Waterbirds	0	0	0	1	0	0	0	0		1
7	Terns & Gulls	0	0	0	0.33	0.33	0	0	0.33		1
8	Forest-nesting Shorebirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
9	Marsh-nesting Shorebirds	0	0	0	0.33	0	0.33	0.33	0		1
10	Rails	0	0	0	0.33	0	0.33	0.33	0		1
11	Open Habitat Songbirds	0	0	0	0.33	0	0.33	0.33	0		1
12	Deciduous Songbirds	0	0.5	0.5	0	0	0	0	0		1
13	Coniferous Songbirds	0	0.2	0.2	0	0.2	0.2	0	0.2		1
14	Aerial Insectivores	0	0.2	0.2	0.2	0.2	0	0.2	0		1
15	Total Wetland Type-Usage	0.00	1.30	1.30	4.73	0.93	1.60	1.40	0.73		12
16	Proportional Wetland Type-Usage (if equal)	0.00	0.11	0.11	0.39	0.08	0.13	0.12	0.06		1
17											
18	Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
19	Percentage Baseline Wetland Area	0.012311	0.059586	0.165627	0.191891	0.230794	0.001641	0.001477	0.336671		1
20											
21	Usage Given Habitat Availability	0	0.006455	0.01794	0.07569	0.01795	0.00022	0.00017	0.02057		0.139005
22	Standardized Usage Given Habitat Availability	0	0.046439	0.12908	0.54452	0.12914	0.00157	0.00124	0.14801		1
23											
24	Affected Wetland Area (ha) - Construction	17	50	X	142	68	0	1	93		763
25											
26	Total Loss Given Habitat Affected - Construction	0.00	2.32	50.60	77.32	8.78	0.00	0.00	13.77	→	152.79
27											
28	Restored Wetland Area	0	100	0	100	0	0	0	100		300
29	Total Gain Given Habitat Restored	0	4.643862	= 0	54.4516	0	0	0	14.8012	→	73.8967
30											

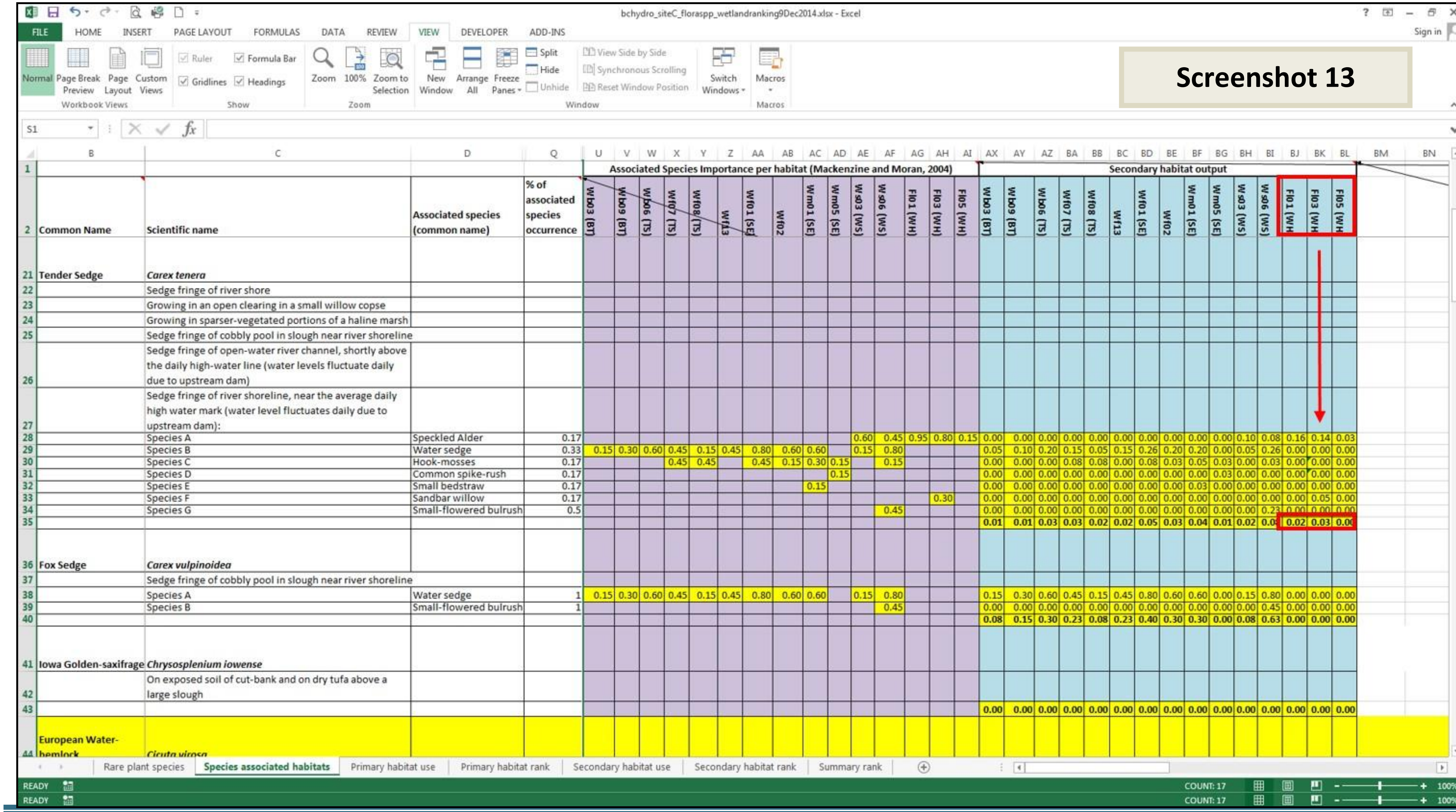
Appendix E: Screenshots for flora ranking examples



Row	A	B	C	D	E	F	G	Q	S
2		Common Name	Scientific name		Associated species	Observation Occurrence	# of occurrences	% of associated species occurrence	Primary Habitat
11		Hudson Bay Sedge	*Carex heleonastes*		Found in open wet habitats, such as moist meadows, marshy lowlands, and montane bogs and fens.				(TS)
12	Observation 1		Open minerotrophic muskeg of old but short-stature trees						
13			Species A	Tamarack	*Larix laricina*	1	1	1.0	
14			Species B	Labrador tea	*Ledum groenlandicum*	1	1	1.0	
15			Species C	Black spruce	*Picea mariana*	1	1	1.0	
16			Species D	Golden fuzzy fen moss	*Tomentypnum nitens*	1	1	1.0	
17									
18		Many-headed Sedge	*Carex sychnocephala*		Inhabits moist to wet areas such as open banks, shorelines, and meadows.				(SE)
19	Observation 1		Haline marsh						
20									
21		Tender Sedge	*Carex tenera*		Inhabits dry to moist meadows, shorelines and open forests in the steppe and montane zones.				(SE) (WH)
22	Observation 1		Sedge fringe of river shore						
23	Observation 2		Growing in an open clearing in a small willow copse						
24	Observation 3		Growing in sparser-vegetated portions of a haline marsh						
25	Observation 4		Sedge fringe of cobbly pool in slough near river shoreline						
26	Observation 5		Sedge fringe of open-water river channel, shortly above the daily high-water line (water levels fluctuate daily due to upstream dam)						
27	Observation 6		Sedge fringe of river shoreline, near the average daily high water mark (water level fluctuates daily due to upstream dam):						
28			Species A	Speckled Alder	*Alnus incana*	6	1	0.17	
29			Species B	Water sedge	*Carex aquatilis*	1, 4,	2	0.33	
30			Species C	Hook-mosses	*Drepanocladus spp.*	4	1	0.17	
31			Species D	Common spike-rush	*Eleocharis palustris*	5	1	0.17	
32			Species E	Small bedstraw	*Galium trifidum*	1	1	0.17	
33			Species F	Sandbar willow	*Salix exigua*	6	1	0.17	
34			Species G	Small-flowered bulrush	*Scirpus microcarpus*	1, 4, 6	3	0.5	
35									


Screenshot 12
bchydro_siteC_floraspp_wetlandranking9Dec2014.xlsx - Excel
Associated Species Importance per habitat (Mackenzine and Moran, 2004)
Secondary habitat output
Common Name
Scientific name
Associated species (common name)
% of associated species occurrence
Tender Sedge
Carex tenera
Sedge fringe of river shore
Growing in an open clearing in a small willow copse
Growing in sparser-vegetated portions of a haline marsh
Sedge fringe of cobbly pool in slough near river shoreline
Sedge fringe of open-water river channel, shortly above the daily high-water line (water levels fluctuate daily due to upstream dam)
Sedge fringe of river shoreline, near the average daily high water mark (water level fluctuates daily due to upstream dam):
Species A Speckled Alder
Species B Water sedge
Species C Hook-mosses
Species D Common spike-rush
Species E Small bedstraw
Species F Sandbar willow
Species G Small-flowered bulrush
X
=
Fox Sedge
Carex vulpinoidea
Sedge fringe of cobbly pool in slough near river shoreline
Species A Water sedge
Species B Small-flowered bulrush
Iowa Golden-saxifrage
Chrysosplenium iowense
On exposed soil of cut-bank and on dry tufa above a large slough
European Water-hemlock
Cicuta virosa
Rare plant species
Species associated habitats
Primary habitat use
Primary habitat rank
Secondary habitat use
Secondary habitat rank
Summary rank

Screenshot 13



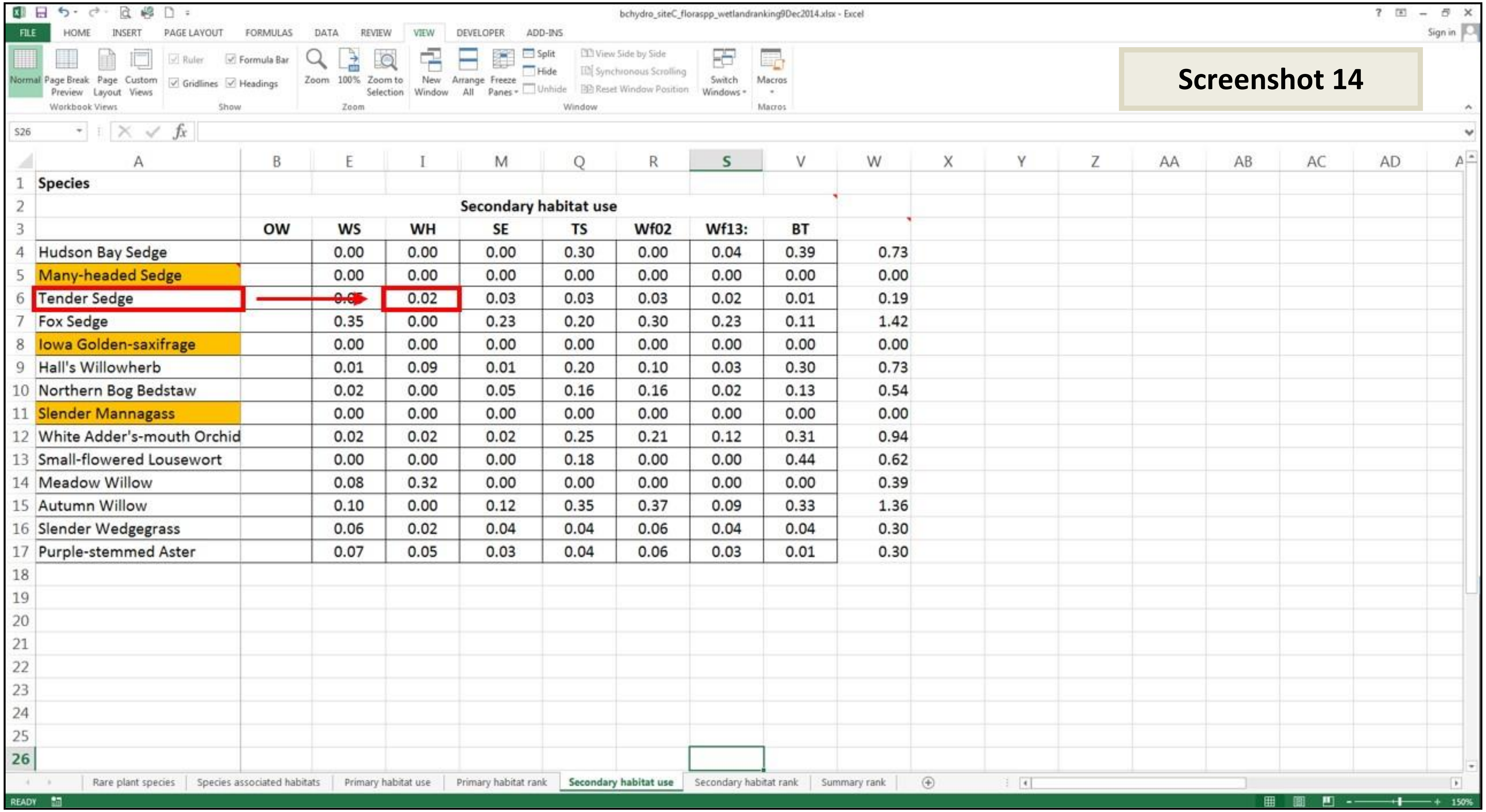
bchydro_siteC_floraspp_wetlandranking9Dec2014.xlsx - Excel

Row	B	C	D	Q	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1					Associated Species Importance per habitat (Mackenzine and Moran, 2004)														
2	Common Name	Scientific name	Associated species (common name)	% of associated species occurrence	Wb03 (BT)	Wb09 (BT)	Wb06 (TS)	Wf07 (TS)	Wf08 (TS)	Wf13	Wf01 (SE)	Wf02	Wm01 (SE)	Wm05 (SE)	Ws03 (WS)	Ws06 (WS)	Fl01 (WH)	Fl03 (WH)	Fl05 (WH)
21	Tender Sedge	*Carex tenera*																	
22		Sedge fringe of river shore																	
23		Growing in an open clearing in a small willow copse																	
24		Growing in sparser-vegetated portions of a haline marsh																	
25		Sedge fringe of cobbly pool in slough near river shoreline																	
26		Sedge fringe of open-water river channel, shortly above the daily high-water line (water levels fluctuate daily due to upstream dam)																	
27		Sedge fringe of river shoreline, near the average daily high water mark (water level fluctuates daily due to upstream dam):																	
28		Species A	Speckled Alder	0.17											0.60	0.45	0.95	0.80	0.15
29		Species B	Water sedge	0.33	0.15	0.30	0.60	0.45	0.15	0.45	0.80	0.60	0.60		0.15	0.80			
30		Species C	Hook-mosses	0.17				0.45	0.45		0.45	0.15	0.30	0.15		0.15			
31		Species D	Common spike-rush	0.17										0.15					
32		Species E	Small bedstraw	0.17									0.15						
33		Species F	Sandbar willow	0.17														0.30	
34		Species G	Small-flowered bulrush	0.5												0.45			
35																			
36	Fox Sedge	*Carex vulpinoidea*																	
37		Sedge fringe of cobbly pool in slough near river shoreline																	
38		Species A	Water sedge	1	0.15	0.30	0.60	0.45	0.15	0.45	0.80	0.60	0.60		0.15	0.80			
39		Species B	Small-flowered bulrush	1												0.45			
40																			
41	Iowa Golden-saxifrage	*Chrysosplenium iowense*																	
42		On exposed soil of cut-bank and on dry tufa above a large slough																	
43																			
44	European Water-hemlock	*Cicuta virosa*																	

Row	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL
1	Secondary habitat output														
2	Wb03 (BT)	Wb09 (BT)	Wb06 (TS)	Wf07 (TS)	Wf08 (TS)	Wf13	Wf01 (SE)	Wf02	Wm01 (SE)	Wm05 (SE)	Ws03 (WS)	Ws06 (WS)	Fl01 (WH	Fl03 (WH	Fl05 (WH
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.08	0.16	0.14	0.03
29	0.05	0.10	0.20	0.15	0.05	0.15	0.26	0.20	0.20	0.00	0.05	0.26	0.00	0.00	0.00
30	0.00	0.00	0.00	0.08	0.08	0.00	0.08	0.03	0.05	0.03	0.00	0.03	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00
35	**0.01**	**0.01**	**0.03**	**0.03**	**0.02**	**0.02**	**0.05**	**0.03**	**0.04**	**0.01**	**0.02**	**0.0**	**0.02**	**0.03**	**0.0**
38	0.15	0.30	0.60	0.45	0.15	0.45	0.80	0.60	0.60	0.00	0.15	0.80	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.00
40	**0.08**	**0.15**	**0.30**	**0.23**	**0.08**	**0.23**	**0.40**	**0.30**	**0.30**	**0.00**	**0.08**	**0.63**	**0.00**	**0.00**	**0.00**
43	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

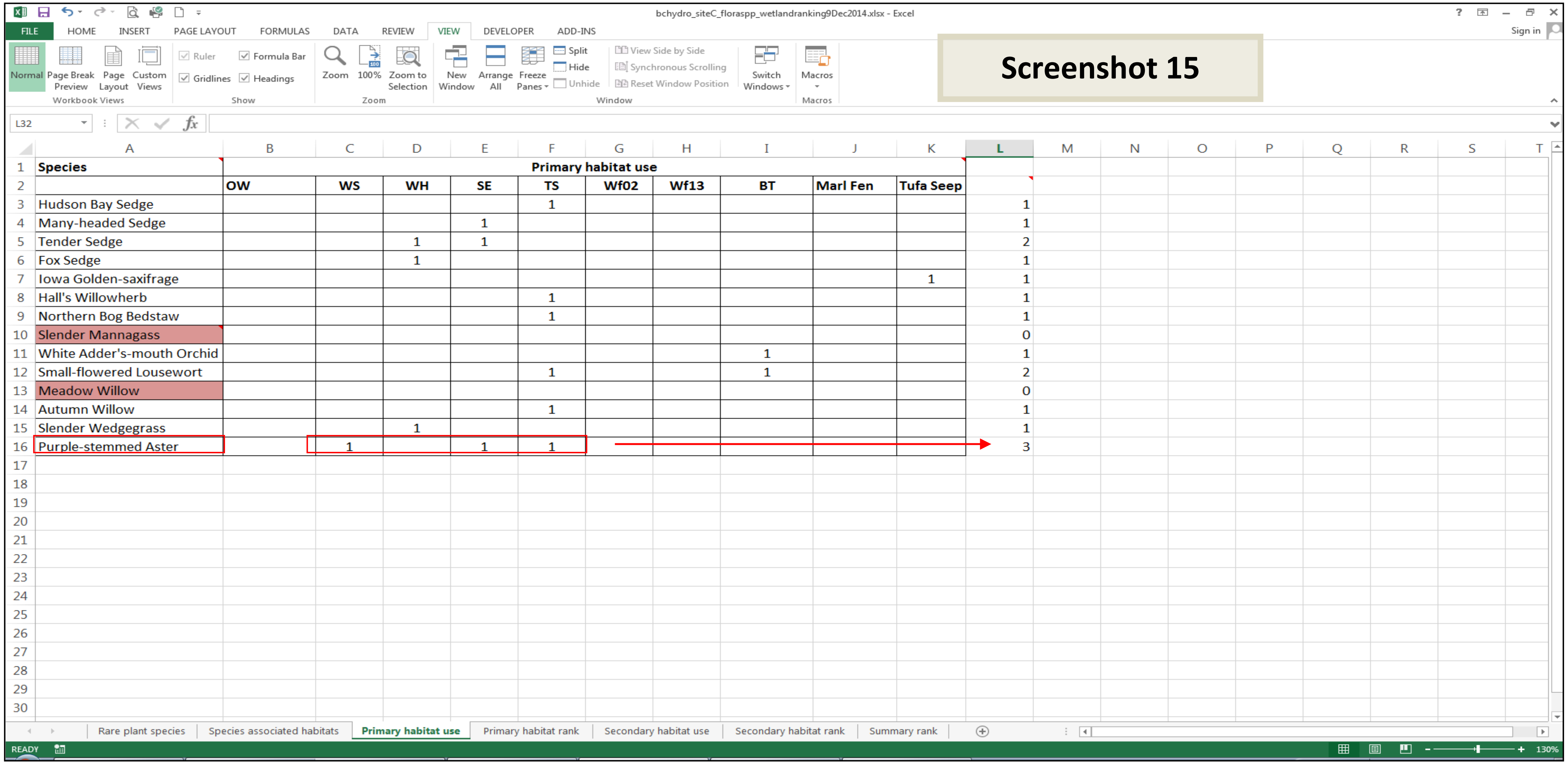
Rare plant species | Species associated habitats | Primary habitat use | Primary habitat rank | Secondary habitat use | Secondary habitat rank | Summary rank

Screenshot 14

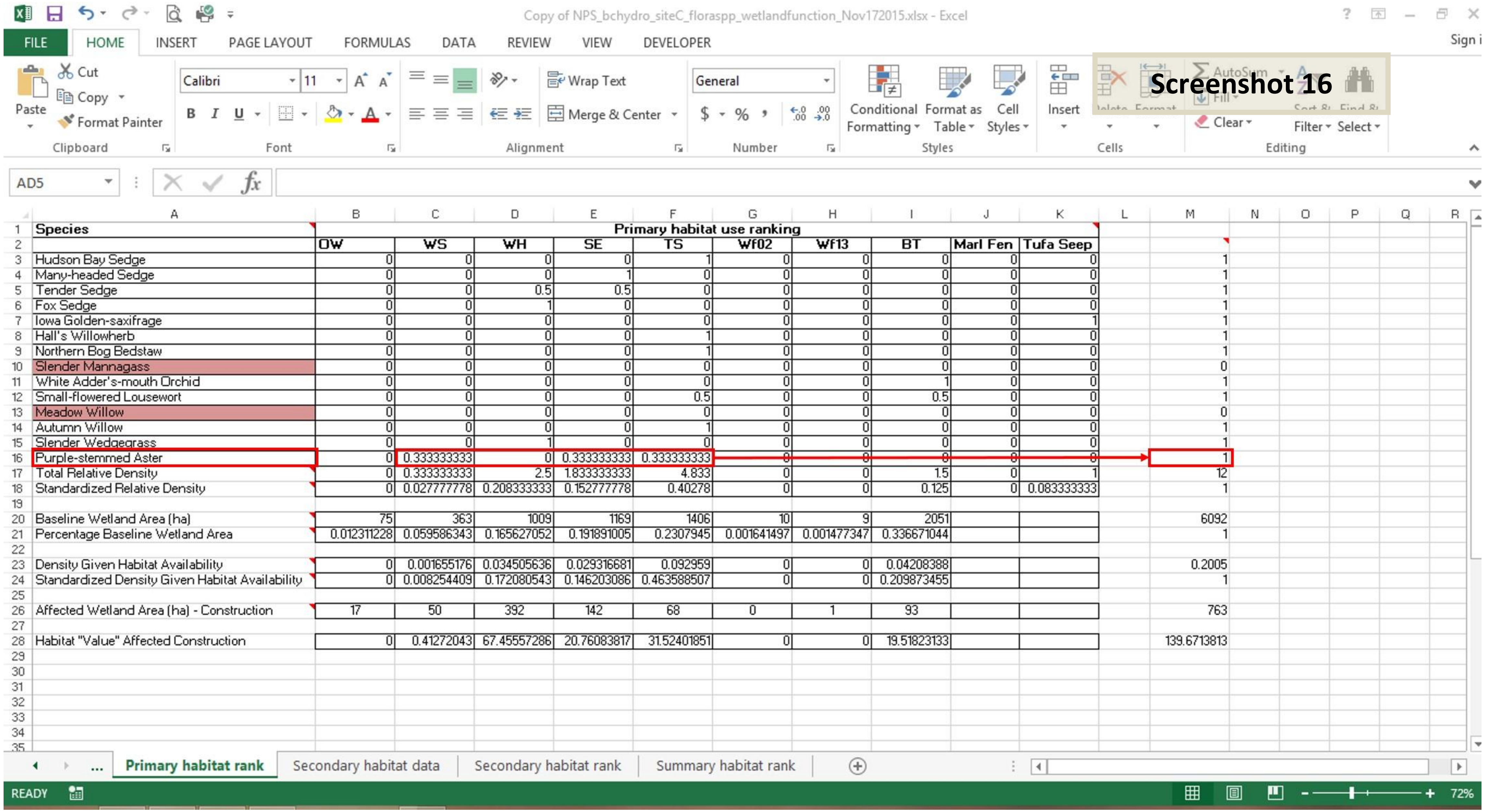


Species									
	Secondary habitat use								
	OW	WS	WH	SE	TS	Wf02	Wf13:	BT	
Hudson Bay Sedge		0.00	0.00	0.00	0.30	0.00	0.04	0.39	0.73
Many-headed Sedge		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tender Sedge		0.05	0.02	0.03	0.03	0.03	0.02	0.01	0.19
Fox Sedge		0.35	0.00	0.23	0.20	0.30	0.23	0.11	1.42
Iowa Golden-saxifrage		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hall's Willowherb		0.01	0.09	0.01	0.20	0.10	0.03	0.30	0.73
Northern Bog Bedstaw		0.02	0.00	0.05	0.16	0.16	0.02	0.13	0.54
Slender Mannagass		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Adder's-mouth Orchid		0.02	0.02	0.02	0.25	0.21	0.12	0.31	0.94
Small-flowered Lousewort		0.00	0.00	0.00	0.18	0.00	0.00	0.44	0.62
Meadow Willow		0.08	0.32	0.00	0.00	0.00	0.00	0.00	0.39
Autumn Willow		0.10	0.00	0.12	0.35	0.37	0.09	0.33	1.36
Slender Wedgegrass		0.06	0.02	0.04	0.04	0.06	0.04	0.04	0.30
Purple-stemmed Aster		0.07	0.05	0.03	0.04	0.06	0.03	0.01	0.30

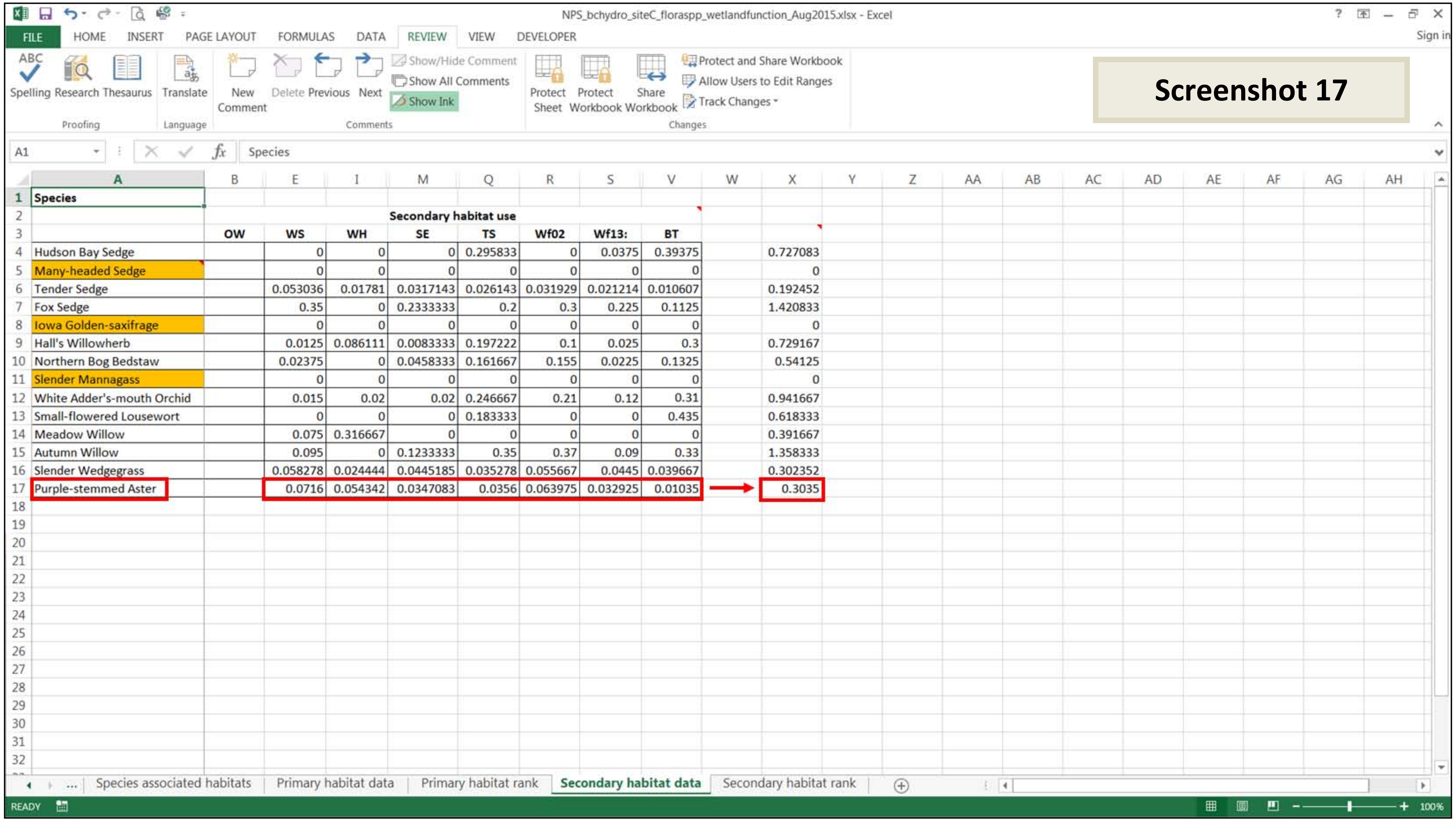
Screenshot 15



Species	Primary habitat use										
	OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep	
Hudson Bay Sedge					1						1
Many-headed Sedge				1							1
Tender Sedge			1	1							2
Fox Sedge			1								1
Iowa Golden-saxifrage										1	1
Hall's Willowherb					1						1
Northern Bog Bedstaw					1						1
Slender Mannagass											0
White Adder's-mouth Orchid								1			1
Small-flowered Lousewort					1			1			2
Meadow Willow											0
Autumn Willow					1						1
Slender Wedgegrass			1								1
Purple-stemmed Aster		1		1	1						3



	Species	OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep		
1	Species	Primary habitat use ranking											
2		OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep		
3	Hudson Bay Sedge	0	0	0	0	1	0	0	0	0	0		1
4	Many-headed Sedge	0	0	0	1	0	0	0	0	0	0		1
5	Tender Sedge	0	0	0.5	0.5	0	0	0	0	0	0		1
6	Fox Sedge	0	0	1	0	0	0	0	0	0	0		1
7	Iowa Golden-saxifrage	0	0	0	0	0	0	0	0	0	1		1
8	Hall's Willowherb	0	0	0	0	1	0	0	0	0	0		1
9	Northern Bog Bedstaw	0	0	0	0	1	0	0	0	0	0		1
10	Slender Mannagass	0	0	0	0	0	0	0	0	0	0		0
11	White Adder's-mouth Orchid	0	0	0	0	0	0	0	1	0	0		1
12	Small-flowered Lousewort	0	0	0	0	0.5	0	0	0.5	0	0		1
13	Meadow Willow	0	0	0	0	0	0	0	0	0	0		0
14	Autumn Willow	0	0	0	0	1	0	0	0	0	0		1
15	Slender Wedgegrass	0	0	1	0	0	0	0	0	0	0		1
16	Purple-stemmed Aster	0	0.333333333	0	0.333333333	0.333333333	0	0	0	0	0		1
17	Total Relative Density	0	0.333333333	2.5	1.833333333	4.833	0	0	1.5	0	1		12
18	Standardized Relative Density	0	0.027777778	0.208333333	0.152777778	0.40278	0	0	0.125	0	0.083333333		1
19													
20	Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051				6092
21	Percentage Baseline Wetland Area	0.012311228	0.059586343	0.165627052	0.191891005	0.2307945	0.001641497	0.001477347	0.336671044				1
22													
23	Density Given Habitat Availability	0	0.001655176	0.034505636	0.029316681	0.092959	0	0	0.04208388				0.2005
24	Standardized Density Given Habitat Availability	0	0.008254409	0.172080543	0.146203086	0.463588507	0	0	0.209873455				1
25													
26	Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93				763
27													
28	Habitat "Value" Affected Construction	0	0.41272043	67.45557286	20.76083817	31.52401851	0	0	19.51823133				139.6713813

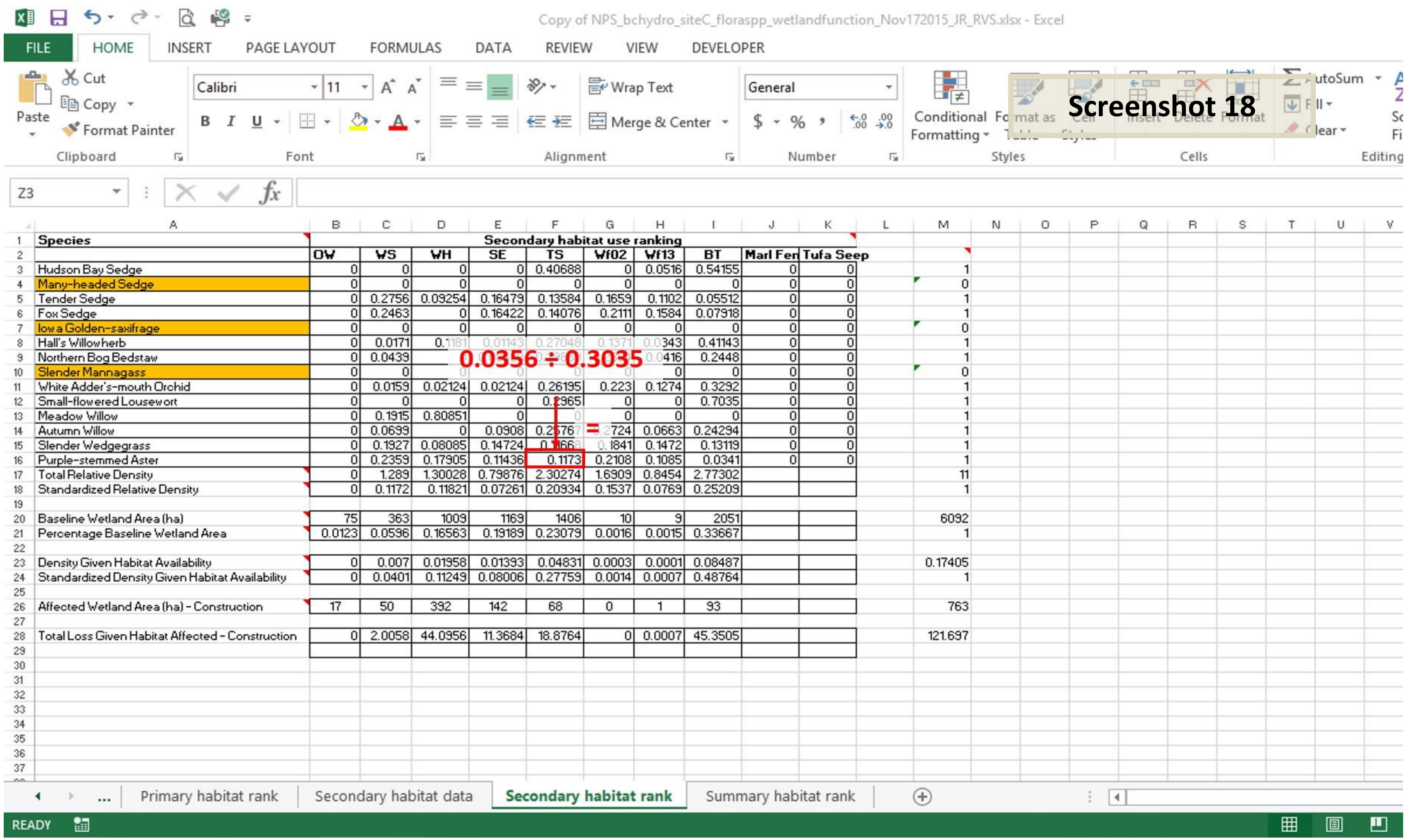


Screenshot 17

NPS_bchydro_siteC_floraspp_wetlandfunction_Aug2015.xlsx - Excel

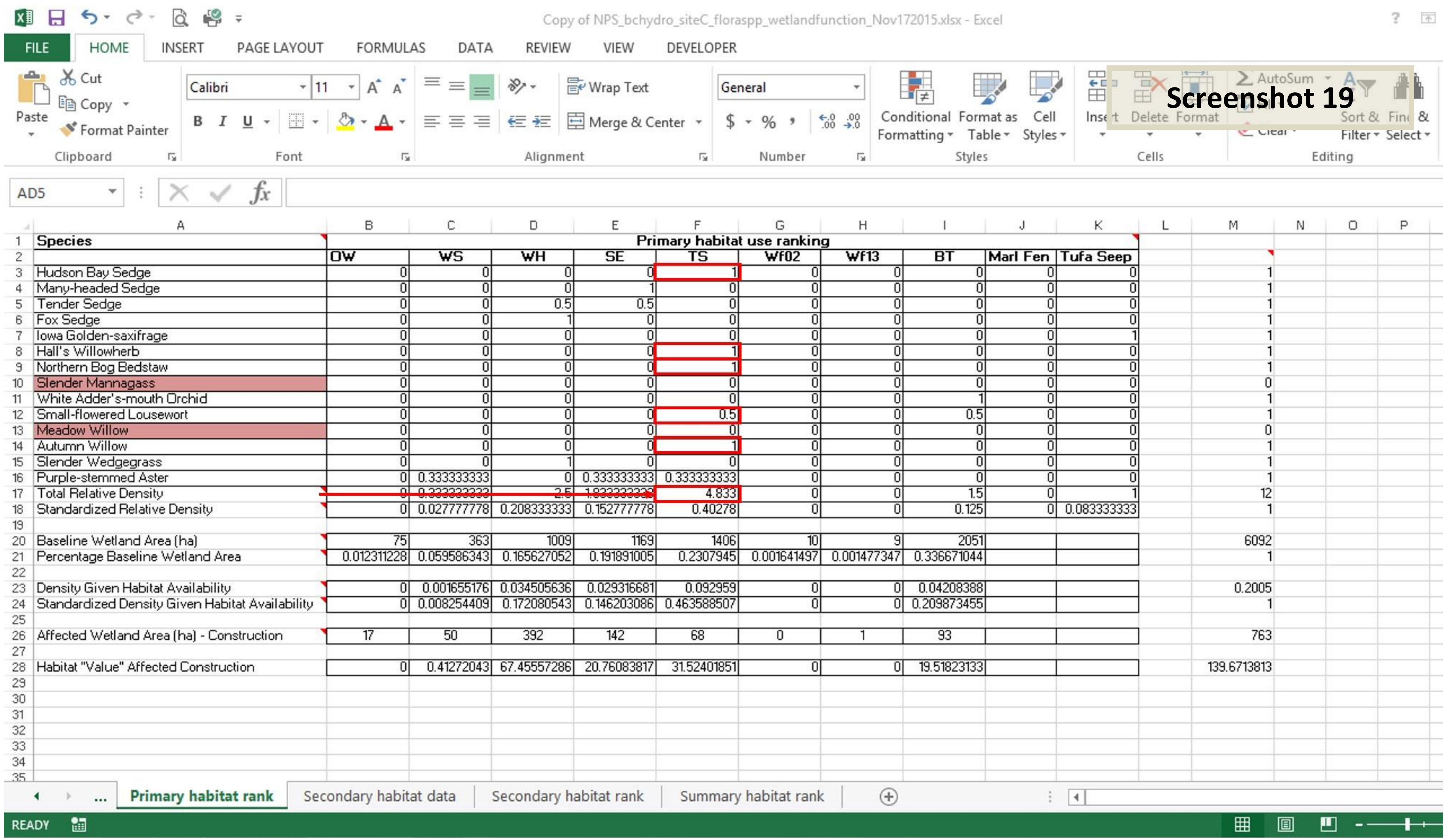
Species				Secondary habitat use					
	OW	WS	WH	SE	TS	Wf02	Wf13:	BT	
Hudson Bay Sedge		0	0	0	0.295833	0	0.0375	0.39375	0.727083
Many-headed Sedge		0	0	0	0	0	0	0	0
Tender Sedge		0.053036	0.01781	0.0317143	0.026143	0.031929	0.021214	0.010607	0.192452
Fox Sedge		0.35	0	0.2333333	0.2	0.3	0.225	0.1125	1.420833
Iowa Golden-saxifrage		0	0	0	0	0	0	0	0
Hall's Willowherb		0.0125	0.086111	0.0083333	0.197222	0.1	0.025	0.3	0.729167
Northern Bog Bedstaw		0.02375	0	0.0458333	0.161667	0.155	0.0225	0.1325	0.54125
Slender Mannagass		0	0	0	0	0	0	0	0
White Adder's-mouth Orchid		0.015	0.02	0.02	0.246667	0.21	0.12	0.31	0.941667
Small-flowered Lousewort		0	0	0	0.183333	0	0	0.435	0.618333
Meadow Willow		0.075	0.316667	0	0	0	0	0	0.391667
Autumn Willow		0.095	0	0.1233333	0.35	0.37	0.09	0.33	1.358333
Slender Wedgegrass		0.058278	0.024444	0.0445185	0.035278	0.055667	0.0445	0.039667	0.302352
Purple-stemmed Aster		0.0716	0.054342	0.0347083	0.0356	0.063975	0.032925	0.01035	0.3035

Species associated habitats | Primary habitat data | Primary habitat rank | Secondary habitat data | Secondary habitat rank



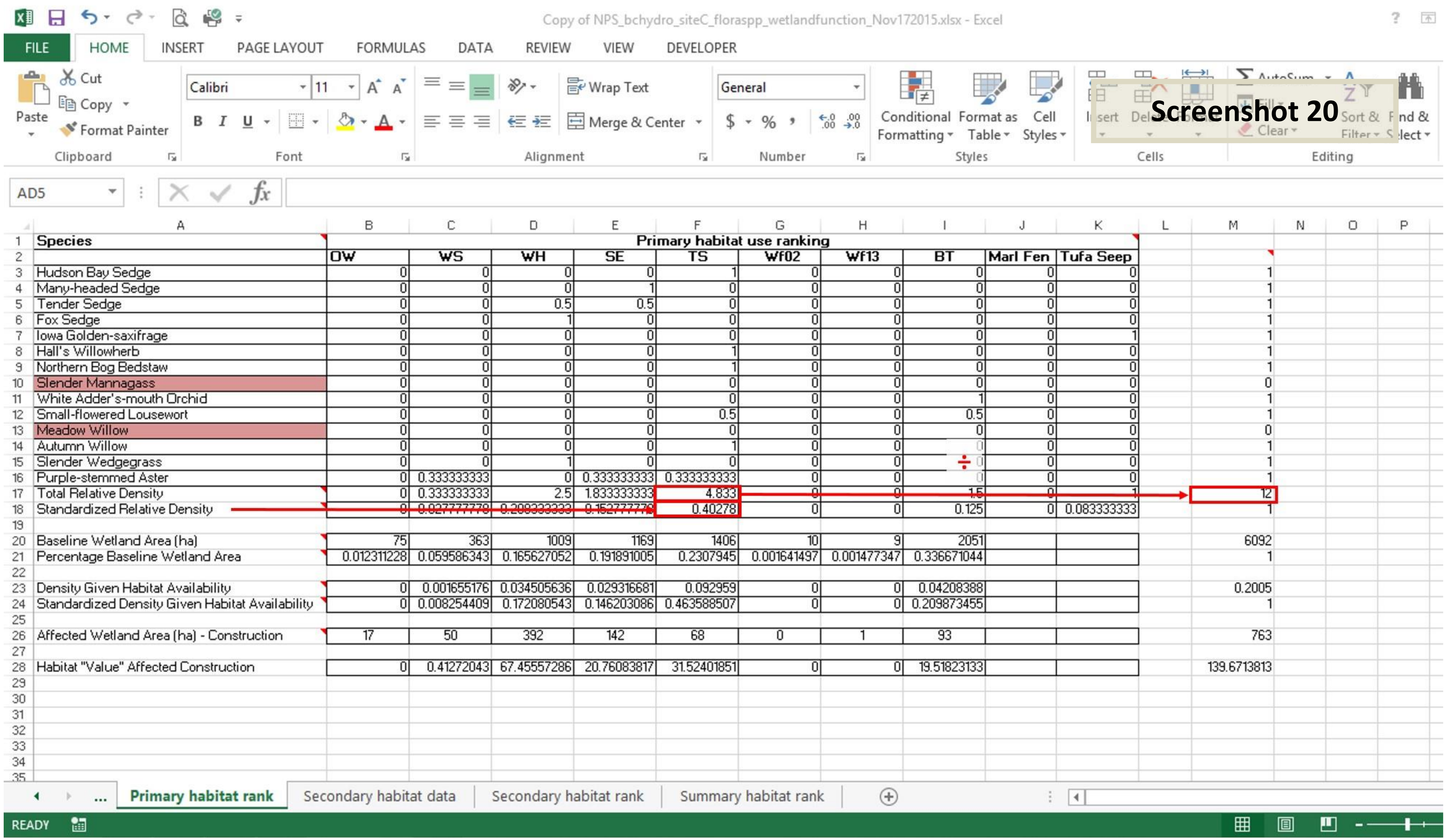
Species	Secondary habitat use ranking										
	OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep	
Hudson Bay Sedge	0	0	0	0	0.40688	0	0.0516	0.54155	0	0	1
Many-headed Sedge	0	0	0	0	0	0	0	0	0	0	0
Tender Sedge	0	0.2756	0.09254	0.16479	0.13584	0.1659	0.1102	0.05512	0	0	1
Fox Sedge	0	0.2463	0	0.16422	0.14076	0.2111	0.1584	0.07918	0	0	1
Iowa Golden-saxifrage	0	0	0	0	0	0	0	0	0	0	0
Hall's Willowherb	0	0.0171	0.1181	0.01143	0.27048	0.1371	0.0343	0.41143	0	0	1
Northern Bog Bedstaw	0	0.0439	[illegible]	[illegible]	[illegible]	[illegible]	0.0416	0.2448	0	0	1
Slender Mannagass	0	0	[illegible]	0	0	0	0	0	0	0	0
White Adder's-mouth Orchid	0	0.0159	0.02124	0.02124	0.26195	0.223	0.1274	0.3292	0	0	1
Small-flowered Lousewort	0	0	0	0	0.2965	0	0	0.7035	0	0	1
Meadow Willow	0	0.1915	0.80851	0	0	0	0	0	0	0	1
Autumn Willow	0	0.0699	0	0.0908	0.2576[illegible]	[illegible]724	0.0663	0.24294	0	0	1
Slender Wedgegrass	0	0.1927	0.08085	0.14724	[illegible]	0.1841	0.1472	0.13119	0	0	1
Purple-stemmed Aster	0	0.2359	0.17905	0.11436	0.1173	0.2108	0.1085	0.0341	0	0	1
Total Relative Density	0	1.289	1.30028	0.79876	2.30274	1.6909	0.8454	2.77302			11
Standardized Relative Density	0	0.1172	0.11821	0.07261	0.20934	0.1537	0.0769	0.25209			1
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051			6092
Percentage Baseline Wetland Area	0.0123	0.0596	0.16563	0.19189	0.23079	0.0016	0.0015	0.33667			1
Density Given Habitat Availability	0	0.007	0.01958	0.01393	0.04831	0.0003	0.0001	0.08487			0.17405
Standardized Density Given Habitat Availability	0	0.0401	0.11249	0.08006	0.27759	0.0014	0.0007	0.48764			1
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93			763
Total Loss Given Habitat Affected - Construction	0	2.0058	44.0956	11.3684	18.8764	0	0.0007	45.3505			121.697

Screenshot 19

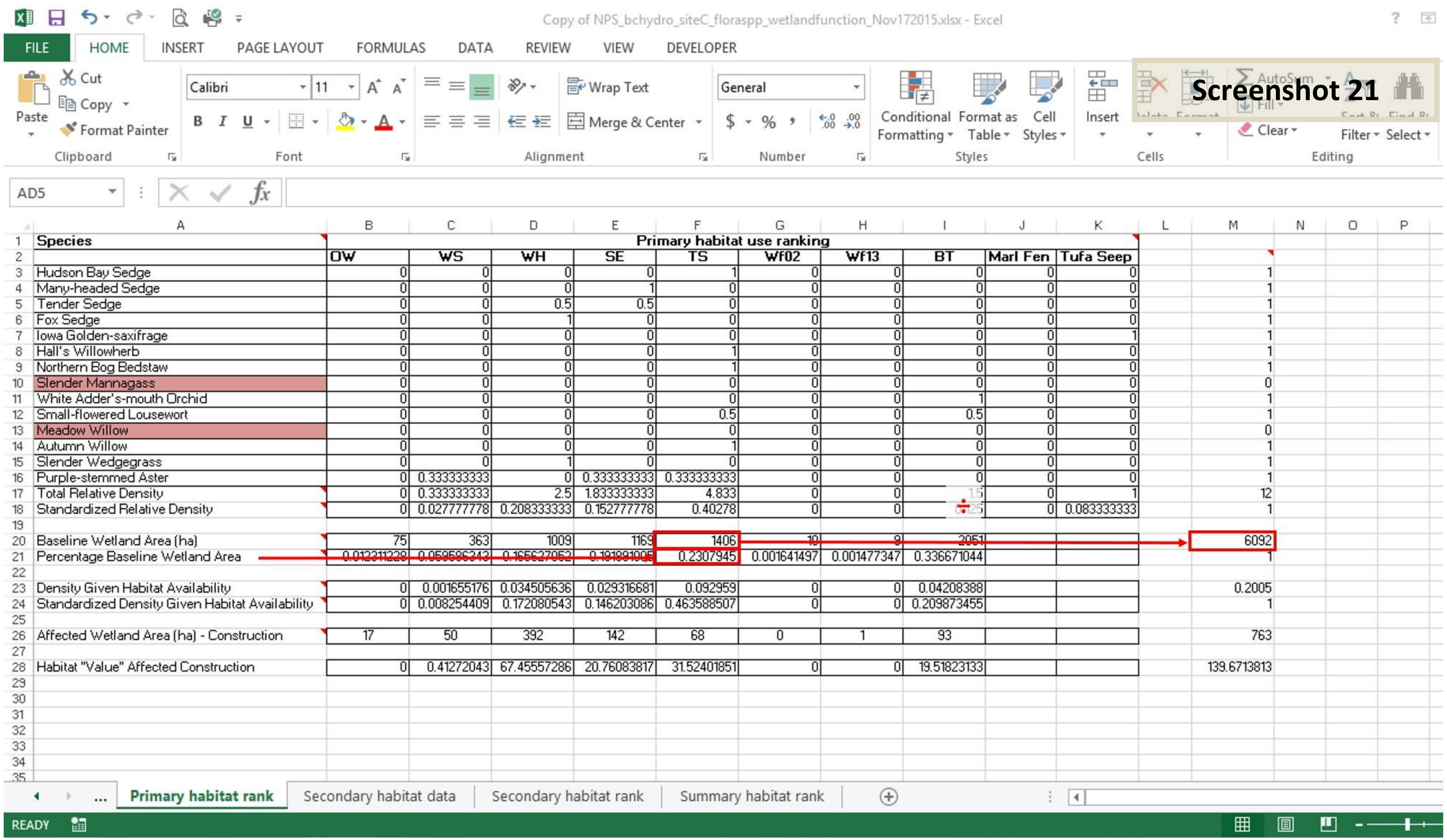

Copy of NPS_bchydro_siteC_floraspp_wetlandfunction_Nov172015.xlsx - Excel

Species	Primary habitat use ranking										
	OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep	
Hudson Bay Sedge	0	0	0	0	1	0	0	0	0	0	1
Many-headed Sedge	0	0	0	1	0	0	0	0	0	0	1
Tender Sedge	0	0	0.5	0.5	0	0	0	0	0	0	1
Fox Sedge	0	0	1	0	0	0	0	0	0	0	1
Iowa Golden-saxifrage	0	0	0	0	0	0	0	0	0	1	1
Hall's Willowherb	0	0	0	0	1	0	0	0	0	0	1
Northern Bog Bedstaw	0	0	0	0	1	0	0	0	0	0	1
Slender Mannagass	0	0	0	0	0	0	0	0	0	0	0
White Adder's-mouth Orchid	0	0	0	0	0	0	0	1	0	0	1
Small-flowered Lousewort	0	0	0	0	0.5	0	0	0.5	0	0	1
Meadow Willow	0	0	0	0	0	0	0	0	0	0	0
Autumn Willow	0	0	0	0	1	0	0	0	0	0	1
Slender Wedgegrass	0	0	1	0	0	0	0	0	0	0	1
Purple-stemmed Aster	0	0.333333333	0	0.333333333	0.333333333	0	0	0	0	0	1
Total Relative Density	~~0~~	~~0.333333333~~	~~2.5~~	~~1.833333333~~	4.833	0	0	1.5	0	1	12
Standardized Relative Density	0	0.027777778	0.208333333	0.152777778	0.40278	0	0	0.125	0	0.083333333	1
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051			6092
Percentage Baseline Wetland Area	0.012311228	0.059586343	0.165627052	0.191891005	0.2307945	0.001641497	0.001477347	0.336671044			1
Density Given Habitat Availability	0	0.001655176	0.034505636	0.029316681	0.092959	0	0	0.04208388			0.2005
Standardized Density Given Habitat Availability	0	0.008254409	0.172080543	0.146203086	0.463588507	0	0	0.209873455			1
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93			763
Habitat "Value" Affected Construction	0	0.41272043	67.45557286	20.76083817	31.52401851	0	0	19.51823133			139.6713813

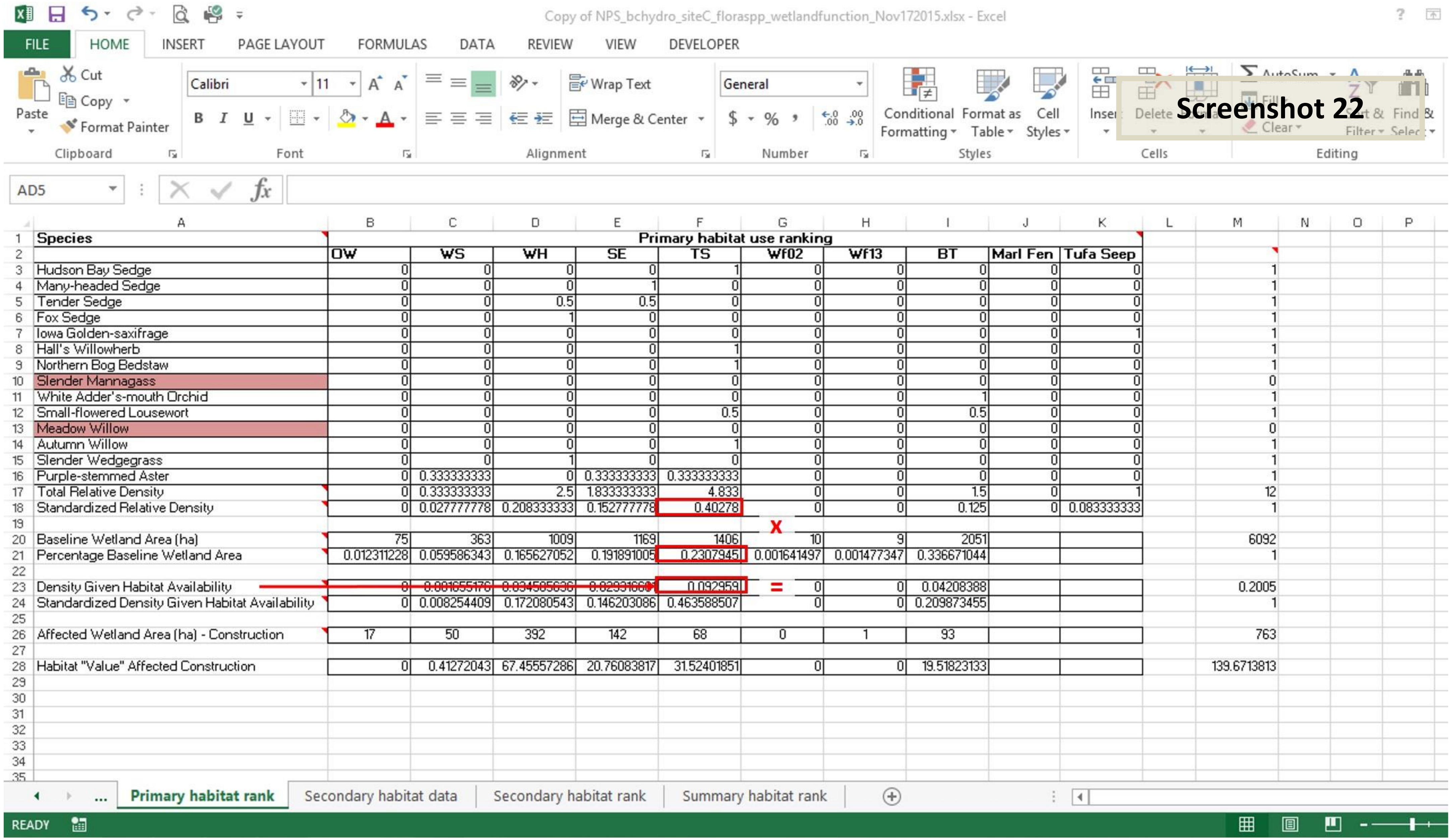
Primary habitat rank | Secondary habitat data | Secondary habitat rank | Summary habitat rank



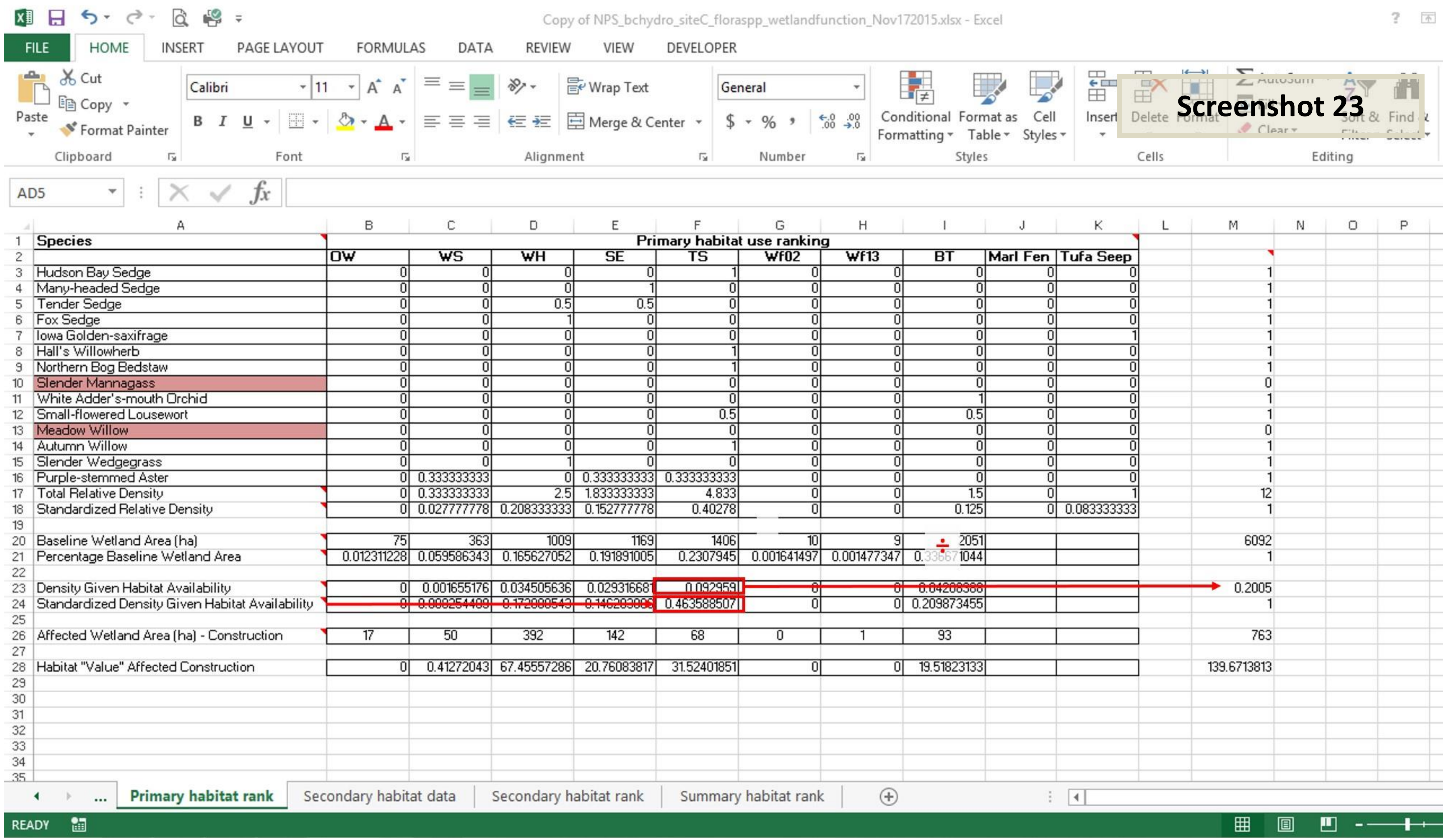
Species	Primary habitat use ranking										
	OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep	
Hudson Bay Sedge	0	0	0	0	1	0	0	0	0	0	1
Many-headed Sedge	0	0	0	1	0	0	0	0	0	0	1
Tender Sedge	0	0	0.5	0.5	0	0	0	0	0	0	1
Fox Sedge	0	0	1	0	0	0	0	0	0	0	1
Iowa Golden-saxifrage	0	0	0	0	0	0	0	0	0	1	1
Hall's Willowherb	0	0	0	0	1	0	0	0	0	0	1
Northern Bog Bedstaw	0	0	0	0	1	0	0	0	0	0	1
Slender Mannagass	0	0	0	0	0	0	0	0	0	0	0
White Adder's-mouth Orchid	0	0	0	0	0	0	0	1	0	0	1
Small-flowered Lousewort	0	0	0	0	0.5	0	0	0.5	0	0	1
Meadow Willow	0	0	0	0	0	0	0	0	0	0	0
Autumn Willow	0	0	0	0	1	0	0	0	0	0	1
Slender Wedgegrass	0	0	1	0	0	0	0	0	0	0	1
Purple-stemmed Aster	0	0.333333333	0	0.333333333	0.333333333	0	0	0	0	0	1
Total Relative Density	0	0.333333333	2.5	1.833333333	4.833	0	0	1.5	0	1	12
Standardized Relative Density	0	0.027777778	0.208333333	0.152777778	0.40278	0	0	0.125	0	0.083333333	1
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051			6092
Percentage Baseline Wetland Area	0.012311228	0.059586343	0.165627052	0.191891005	0.2307945	0.001641497	0.001477347	0.336671044			1
Density Given Habitat Availability	0	0.001655176	0.034505636	0.029316681	0.092959	0	0	0.04208388			0.2005
Standardized Density Given Habitat Availability	0	0.008254409	0.172080543	0.146203086	0.463588507	0	0	0.209873455			1
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93			763
Habitat "Value" Affected Construction	0	0.41272043	67.45557286	20.76083817	31.52401851	0	0	19.51823133			139.6713813



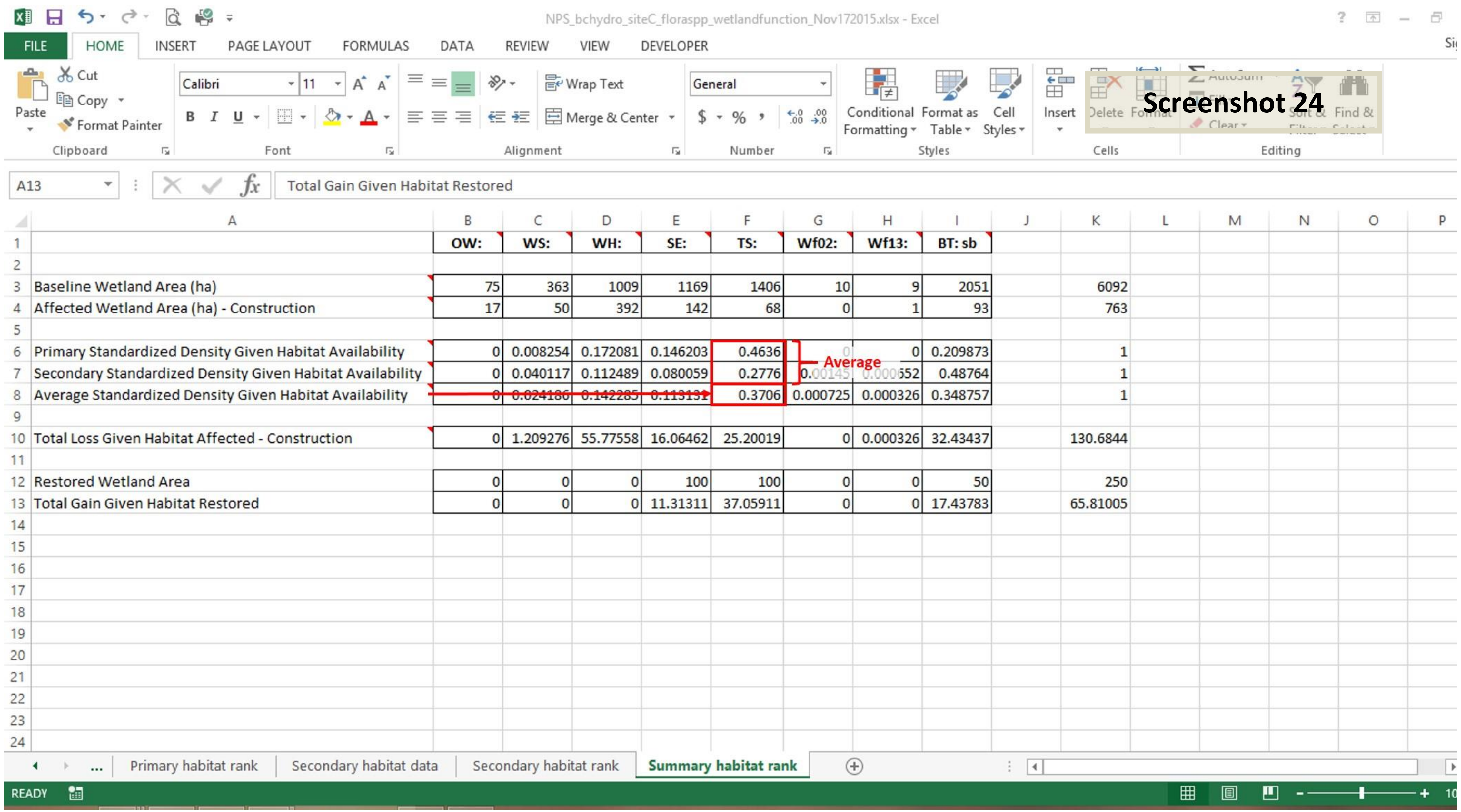
Species	OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep	M
	Primary habitat use ranking										
Hudson Bay Sedge	0	0	0	0	1	0	0	0	0	0	1
Many-headed Sedge	0	0	0	1	0	0	0	0	0	0	1
Tender Sedge	0	0	0.5	0.5	0	0	0	0	0	0	1
Fox Sedge	0	0	1	0	0	0	0	0	0	0	1
Iowa Golden-saxifrage	0	0	0	0	0	0	0	0	0	1	1
Hall's Willowherb	0	0	0	0	1	0	0	0	0	0	1
Northern Bog Bedstaw	0	0	0	0	1	0	0	0	0	0	1
Slender Mannagass	0	0	0	0	0	0	0	0	0	0	0
White Adder's-mouth Orchid	0	0	0	0	0	0	0	1	0	0	1
Small-flowered Lousewort	0	0	0	0	0.5	0	0	0.5	0	0	1
Meadow Willow	0	0	0	0	0	0	0	0	0	0	0
Autumn Willow	0	0	0	0	1	0	0	0	0	0	1
Slender Wedgegrass	0	0	1	0	0	0	0	0	0	0	1
Purple-stemmed Aster	0	0.333333333	0	0.333333333	0.333333333	0	0	0	0	0	1
Total Relative Density	0	0.333333333	2.5	1.833333333	4.833	0	0	1.5	0	1	12
Standardized Relative Density	0	0.027777778	0.208333333	0.152777778	0.40278	0	0	0.125	0	0.083333333	1
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051			6092
Percentage Baseline Wetland Area	0.012311228	0.059586343	0.165627052	0.191891005	0.2307945	0.001641497	0.001477347	0.336671044			1
Density Given Habitat Availability	0	0.001655176	0.034505636	0.029316681	0.092959	0	0	0.04208388			0.2005
Standardized Density Given Habitat Availability	0	0.008254409	0.172080543	0.146203086	0.463588507	0	0	0.209873455			1
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93			763
Habitat "Value" Affected Construction	0	0.41272043	67.45557286	20.76083817	31.52401851	0	0	19.51823133			139.6713813

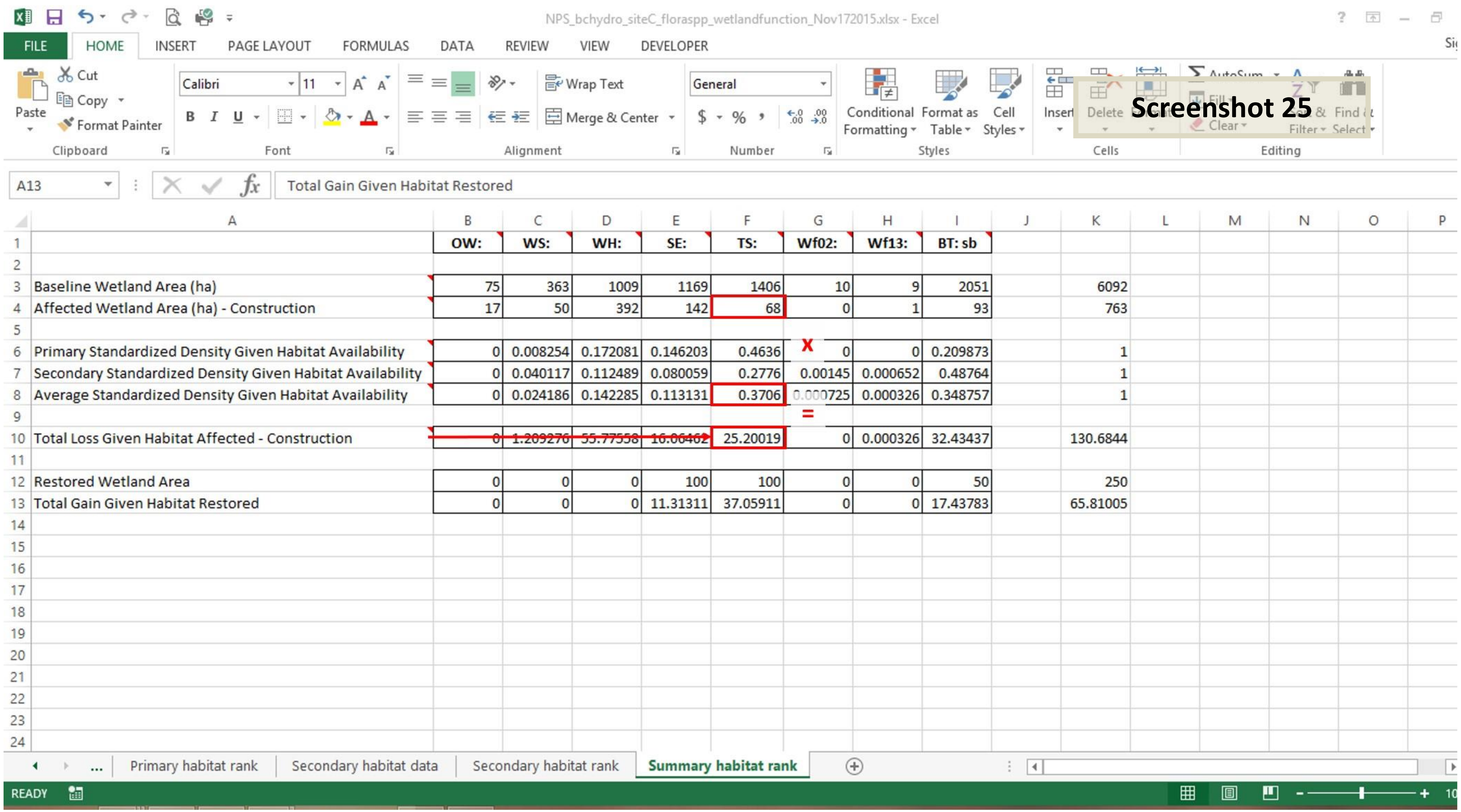


Species	OW	WS	WH	SE	TS	Wf02	Wf13	BT	Marl Fen	Tufa Seep	M
	Primary habitat use ranking										
Hudson Bay Sedge	0	0	0	0	1	0	0	0	0	0	1
Many-headed Sedge	0	0	0	1	0	0	0	0	0	0	1
Tender Sedge	0	0	0.5	0.5	0	0	0	0	0	0	1
Fox Sedge	0	0	1	0	0	0	0	0	0	0	1
Iowa Golden-saxifrage	0	0	0	0	0	0	0	0	0	1	1
Hall's Willowherb	0	0	0	0	1	0	0	0	0	0	1
Northern Bog Bedstaw	0	0	0	0	1	0	0	0	0	0	1
Slender Mannagass	0	0	0	0	0	0	0	0	0	0	0
White Adder's-mouth Orchid	0	0	0	0	0	0	0	1	0	0	1
Small-flowered Lousewort	0	0	0	0	0.5	0	0	0.5	0	0	1
Meadow Willow	0	0	0	0	0	0	0	0	0	0	0
Autumn Willow	0	0	0	0	1	0	0	0	0	0	1
Slender Wedgegrass	0	0	1	0	0	0	0	0	0	0	1
Purple-stemmed Aster	0	0.333333333	0	0.333333333	0.333333333	0	0	0	0	0	1
Total Relative Density	0	0.333333333	2.5	1.833333333	4.833	0	0	1.5	0	1	12
Standardized Relative Density	0	0.027777778	0.208333333	0.152777778	0.40278	0	0	0.125	0	0.083333333	1
					X						
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051			6092
Percentage Baseline Wetland Area	0.012311228	0.059586343	0.165627052	0.191891005	0.2307945	0.001641497	0.001477347	0.336671044			1
					=						
Density Given Habitat Availability	0	0.001655176	0.034505636	0.02931660	0.092959	0	0	0.04208388			0.2005
Standardized Density Given Habitat Availability	0	0.008254409	0.172080543	0.146203086	0.463588507	0	0	0.209873455			1
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93			763
Habitat "Value" Affected Construction	0	0.41272043	67.45557286	20.76083817	31.52401851	0	0	19.51823133			139.6713813



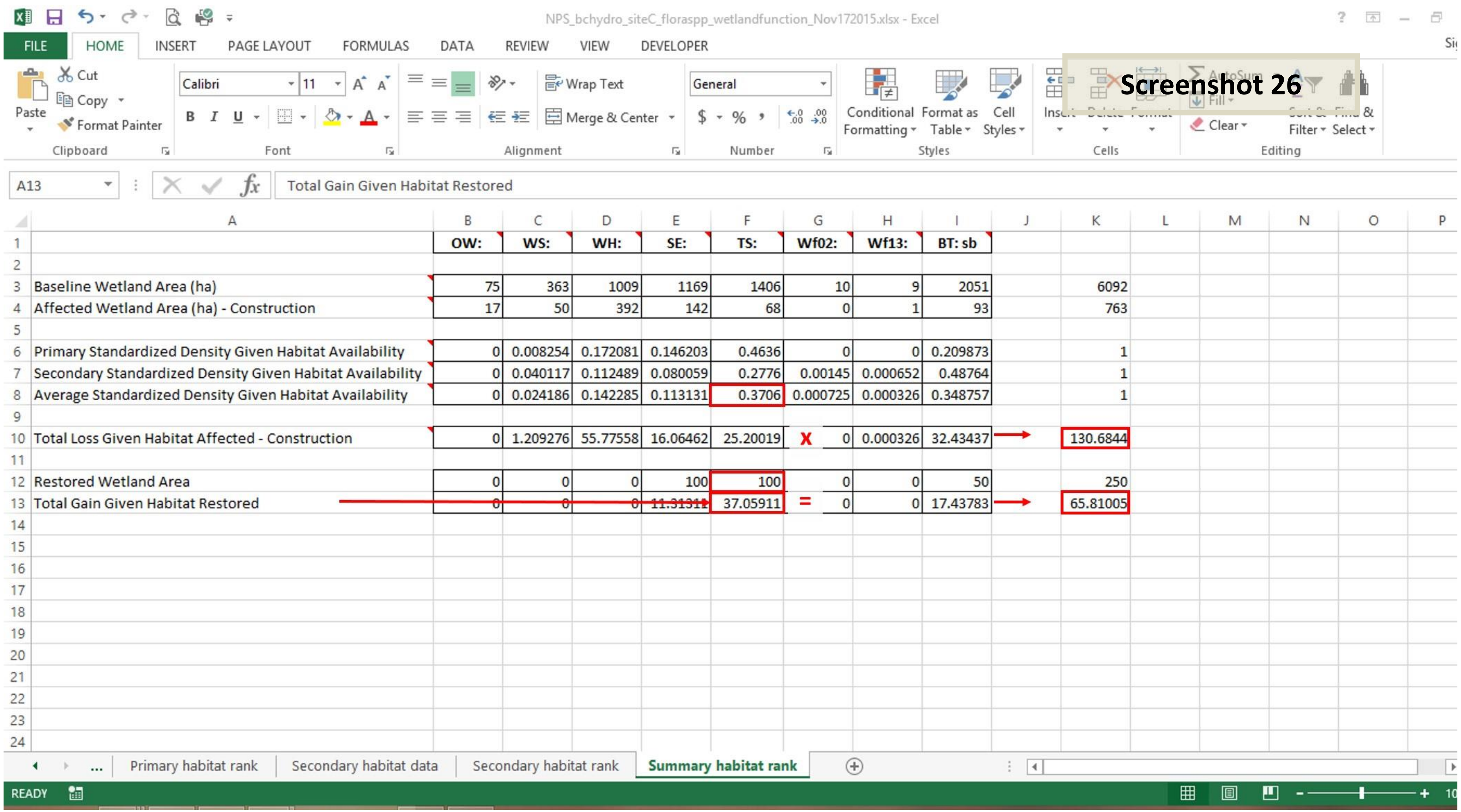
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Species**	**Primary habitat use ranking**											
2		**OW**	**WS**	**WH**	**SE**	**TS**	**Wf02**	**Wf13**	**BT**	**Marl Fen**	**Tufa Seep**		
3	Hudson Bay Sedge	0	0	0	0	1	0	0	0	0	0		1
4	Many-headed Sedge	0	0	0	1	0	0	0	0	0	0		1
5	Tender Sedge	0	0	0.5	0.5	0	0	0	0	0	0		1
6	Fox Sedge	0	0	1	0	0	0	0	0	0	0		1
7	Iowa Golden-saxifrage	0	0	0	0	0	0	0	0	0	1		1
8	Hall's Willowherb	0	0	0	0	1	0	0	0	0	0		1
9	Northern Bog Bedstaw	0	0	0	0	1	0	0	0	0	0		1
10	Slender Mannagass	0	0	0	0	0	0	0	0	0	0		0
11	White Adder's-mouth Orchid	0	0	0	0	0	0	0	1	0	0		1
12	Small-flowered Lousewort	0	0	0	0	0.5	0	0	0.5	0	0		1
13	Meadow Willow	0	0	0	0	0	0	0	0	0	0		0
14	Autumn Willow	0	0	0	0	1	0	0	0	0	0		1
15	Slender Wedgegrass	0	0	1	0	0	0	0	0	0	0		1
16	Purple-stemmed Aster	0	0.333333333	0	0.333333333	0.333333333	0	0	0	0	0		1
17	Total Relative Density	0	0.333333333	2.5	1.833333333	4.833	0	0	1.5	0	1		12
18	Standardized Relative Density	0	0.027777778	0.208333333	0.152777778	0.40278	0	0	0.125	0	0.083333333		1
19													
20	Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051				6092
21	Percentage Baseline Wetland Area	0.012311228	0.059586343	0.165627052	0.191891005	0.2307945	0.001641497	0.001477347	0.336671044				1
22													
23	Density Given Habitat Availability	0	0.001655176	0.034505636	0.029316681	0.092959	0	0	0.04208388				0.2005
24	Standardized Density Given Habitat Availability	0	0.008254409	0.172080543	0.146203006	0.463588507	0	0	0.209873455				1
25													
26	Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93				763
27													
28	Habitat "Value" Affected Construction	0	0.41272043	67.45557286	20.76083817	31.52401851	0	0	19.51823133				139.6713813


NPS_bchydro_siteC_floraspp_wetlandfunction_Nov172015.xlsx - Excel
Screenshot 24
A13
Total Gain Given Habitat Restored
OW: WS: WH: SE: TS: Wf02: Wf13: BT: sb
Baseline Wetland Area (ha) 75 363 1009 1169 1406 10 9 2051 6092
Affected Wetland Area (ha) - Construction 17 50 392 142 68 0 1 93 763
Primary Standardized Density Given Habitat Availability 0 0.008254 0.172081 0.146203 0.4636 0 0 0.209873 1
Secondary Standardized Density Given Habitat Availability 0 0.040117 0.112489 0.080059 0.2776 0.00145 0.000652 0.48764 1
Average Standardized Density Given Habitat Availability 0 0.024186 0.142285 0.113131 0.3706 0.000725 0.000326 0.348757 1
Average
Total Loss Given Habitat Affected - Construction 0 1.209276 55.77558 16.06462 25.20019 0 0.000326 32.43437 130.6844
Restored Wetland Area 0 0 0 100 100 0 0 50 250
Total Gain Given Habitat Restored 0 0 0 11.31311 37.05911 0 0 17.43783 65.81005
Primary habitat rank
Secondary habitat data
Secondary habitat rank
Summary habitat rank
READY



	B	C	D	E	F	G	H	I	J	K
	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb		
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051		6092
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93		763
Primary Standardized Density Given Habitat Availability	0	0.008254	0.172081	0.146203	0.4636	0	0	0.209873		1
Secondary Standardized Density Given Habitat Availability	0	0.040117	0.112489	0.080059	0.2776	0.00145	0.000652	0.48764		1
Average Standardized Density Given Habitat Availability	0	0.024186	0.142285	0.113131	0.3706	0.000725	0.000326	0.348757		1
Total Loss Given Habitat Affected - Construction	0	1.209276	55.77558	16.06462	25.20019	0	0.000326	32.43437		130.6844
Restored Wetland Area	0	0	0	100	100	0	0	50		250
Total Gain Given Habitat Restored	0	0	0	11.31311	37.05911	0	0	17.43783		65.81005

Screenshot 26



NPS_bchydro_siteC_floraspp_wetlandfunction_Nov172015.xlsx - Excel

A13 Total Gain Given Habitat Restored

	OW:	WS:	WH:	SE:	TS:	Wf02:	Wf13:	BT: sb	
Baseline Wetland Area (ha)	75	363	1009	1169	1406	10	9	2051	6092
Affected Wetland Area (ha) - Construction	17	50	392	142	68	0	1	93	763
Primary Standardized Density Given Habitat Availability	0	0.008254	0.172081	0.146203	0.4636	0	0	0.209873	1
Secondary Standardized Density Given Habitat Availability	0	0.040117	0.112489	0.080059	0.2776	0.00145	0.000652	0.48764	1
Average Standardized Density Given Habitat Availability	0	0.024186	0.142285	0.113131	0.3706	0.000725	0.000326	0.348757	1
Total Loss Given Habitat Affected - Construction	0	1.209276	55.77558	16.06462	25.20019	0	0.000326	32.43437	130.6844
Restored Wetland Area	0	0	0	100	100	0	0	50	250
Total Gain Given Habitat Restored	0	0	0	11.31311	37.05911	0	0	17.43783	65.81005

Primary habitat rank | Secondary habitat data | Secondary habitat rank | Summary habitat rank

Appendix H. Species model verification report

Site C Clean Energy Project

TEM Species Modeling Verification

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January 2016

DISCLAIMER

This report was prepared exclusively for BC Hydro by Bianchini Biological Services and Spicker GIS Services. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort expended and is based on:

i) Information available at the time of preparation;

ii) Data collected by Bianchini Biological Services and/or supplied by outside sources; and

iii) The assumptions, conditions, and qualifications set forth in this report.

This report is intended to be used by BC Hydro only, subject to the terms and conditions of its contract with Bianchini Biological Services. Any other use or reliance on this report by any third party is at that party's sole risk.

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LIST OF ACRONYMS

BBS……………………………………………………………………………………….BIANCHINI BIOLOGICAL SERVICES
BC.. BRITISH COLUMBIA
BCH………………………………………………………………………………………….BRITISH COLUMBIA HYDRO
BHM…………………………………………………………………………………………BROAD HABITAT MAPPING
EIS……………………………………………………………………………………ENVIROMENTAL IMPACT STATEMENT
GIS…………………………………………………………………………………GEOGRAPHIC INFORMATION SYSTEMS
GPS..GLOBAL POSITIONING SYSTEM
HA……HECTARES
JRP……JOINT REVIEW PANEL
KM……KILOMETRES
LAA……………………………………………………………………………………………………LOCAL ASSESSMENT AREA
PEM……………………………………………………………………………………..PREDICTIVE ECOSYSTEM MAPPING
PROJECT...SITE C CLEAN ENERGY PROJECT
RIC………………………………………………………………………………RESOURCES INVENTORY COMMITTEE
STGR………………………………………………………………………………………………SHARP-TAILED GROUSE
STGR-W……………………………………………………………………………SHARP-TAILED GROUSE - WINTER
TEM…………………………………………………………………………….…TERRESTRIAL ECOSYSTEM MAPPING
US...UNITED STATES
VRI………………………………………………………………………………VEGETATION RESOURCES INVENTORY

ACKNOWLEDGEMENTS

BBS gratefully acknowledges the contributions of the field and technical support crews, Damian Power, Rosemary Spicker and Anré McIntosh. BBS also thanks Keystone Wildlife Research for providing their 2005 to 2012 survey results.

Executive Summary

As part of BC Hydro's Site C Clean Energy Project, 1:20,000 Terrestrial Ecosystem Mapping (TEM) was conducted for the Project's Local Assessment Area (LAA) from 2005 to 2012. Wildlife species models were created in conjunction with the TEM in order to quantify the habitat quality within the LAA and to determine potential habitat loss for each species resulting from the Project. The maps and models were reviewed by the Joint Review Panel (JRP). The JRP identified variability in model accuracy for 17 bird, bat, toad and butterfly species. Accuracy was determined by the number of field observations of species of concern in habitats rated Moderate (M) or High (H). Wildlife observation that were observed in habitats mapped Nil (N) or Low (L) were considered inaccurate. Model accuracy varied between 1.2% to 87.8% for the species identified. As a result, the JRP comments were incorporated into the Environmental Certificate for the Project and are indicated in Provincial Condition 15 and Federal Conditions 16.1, 16.2, 16.3.1 and 16.3.6.

In order to address these conditions, Bianchini Biological Services (BBS) was requested by BC Hydro (BCH) to verify the modeled results for the species identified by the JRP. In addition, BBS was asked to review the existing data and conduct a field program to identify if there were any errors with the wildlife models or TEM that resulted in the reduced accuracy. BBS was also requested to see if the models could be revised to improve the modeling accuracy with a target of ≥80%.

Upon review of the species models and TEM it was determined that species with <80% model accuracy would be the focus of the model accuracy verification project. The original list was refined to 13 species and included Nelson's sparrow (*Ammodramus nelsoni*), Yellow Rail (*Coturnicops noveboracensis*), Le Conte's Sparrow (*Ammodramus leconteii*), Broad-winged Hawk (*Buteo platypterus*), Short-eared Owl (*Asio flammeus*), Sharp-tailed Grouse (*Tympanuchus phasianellus*), little brown Myotis (*Myotis lucifugus*), northern Myotis (*Myotis septentrionalis*), great spangled fritillary (*Speyeria cybele pseudocarpenteri*), common wood-nymph (*Cercyonis pegala nephele*), Arctic blue (*Plebejus glandon lacustris*), Aphrodite fritillary (*Speyeria aphrodite manitoba*) and western toad (*Anaxyrus boreas*).

A total of 211 TEM polygons with 937 records were identified with observations of wildlife in N or L rated habitats. A total of 101 polygons and 433 records were field checked in June 2015. The remainder of the polygons and records were verified using aerial photograph interpretation and review of the original wildlife data. 171 site specific records were adjusted based on field observations and aerial photograph interpretation. 75 records were revised adjusting model buffers through GIS.

The field data and desktop analysis produced improved accuracy results for all 13 species with six species models improving to over 80% accuracy and six improving to 50-80%. Western toad improved to 45.2%. In most situations the microhabitats used by these species were not mappable at 1:20,000. Other factors that affected habitat ratings included adjacency to High rated habitat (i.e. observation on a road adjacent to a wetland), ratings associated to dominant decile (Site Series) only and incorrect TEM label. An example of an incorrect TEM label included polygons labeled 'Lake' based on VRI data but field check or aerial photograph interpretation identified a polygon as a wetland.

1.0 Introduction

As part of BC Hydro's Site C Clean Energy Project, 1:20,000 TEM was conducted for the Project's Local Assessment Area (LAA) from 2005 to 2012. The LAA was defined as the Peace River main stem from the Peace Canyon dam to the Alberta border and the proposed transmission route located south of the Moberly River between Hudson's Hope and the proposed Site C dam site including a one kilometre (km) buffer extending around the study area. The total mapped project area includes portions of 33 1:20,000 TRIM map sheets encompassing 62,000 hectares (ha).

Wildlife habitat models were developed for key wildlife indicator species and species groups. The models were based on a combination of academic research and field observations. From these models, habitat ratings were developed for each habitat type identified and mapped during the TEM process. The data were used to generate themed habitat maps for each species identifying High, Moderate, Low and Nil rated habitats within the LAA. Model accuracy was tested by overlaying field observations onto the habitat maps for each species. The maps and models were reviewed by the JRP. The JRP identified variability in model accuracy for 17 bird, bat, toad and butterfly species. Upon review of the species models and TEM it was determined that species with <80% model accuracy would be the focus of the model accuracy verification project. The original list was refined to 13 species. Results varied for each species model in the EIS with the accuracy for 13 species falling below 80% and six species below 50% (**Table 1**).

BBS was requested by BCH to verify the modeled results for 13 of the surveyed species at risk by reviewing the existing data and conducting a field program to identify if there were any errors with the models or TEM that resulted in the reduced accuracy. BBS was also requested to see if the models could be revised to improve the modeling accuracy with a target of 80%.

Table 1. Summary of species model accuracy of individuals observed for the original 17 wildlife species identified by the JRP. Species in bold are the 13 species that are the focus of this report.

Species	# Obs. In Highly Suitable Habitat	# Obs. In Moderately Suitable Habitat	# Obs. In Low Suitable Habitat	# Obs. In Non-Suitable Habitat	# Obs. In Non-Rated Habitat	Total Field Obs.	Total Field Obs. In Non-Suitable (L&N) Habitat	Model Accuracy (Obs. H&M/Total Obs.)
Nelson's Sparrow	**11**	**6**	**1**	**4**	**0**	**22**	**5**	**77.3%**
Yellow Rail	**4**	**12**	**17**	**13**	**0**	**46**	**30**	**34.8%**
Le Conte's Sparrow	**73**	**3**	**13**	**13**	**0**	**102**	**26**	**74.5%**
Broad-winged Hawk	**18**	**1**	**23**	**4**	**1**	**47**	**27**	**40.4%**
Short-eared Owl	**0**	**14**	**0**	**9**	**0**	**23**	**9**	**60.9%**
Sharp-tailed Grouse (LI W)	**0**	**1**	**77**	**4**	**0**	**82**	**81**	**1.2%**
Sharp-tailed Grouse (LI G)	71	1	6	4	0	82	10	87.8%
Little Brown Myotis/Northern Myotis (RB)	**45**	**49**	**5**	**27**	**0**	**126**	**32**	**74.6%**
Little Brown Myotis/Northern Myotis (FD)	**1**	**79**	**23**	**23**	**0**	**126**	**46**	**63.5%**
Old World Swallowtail	4	33	1	3	2	43	4	86.0%
Great Spangled Fritillary		**14**	**29**	**8**	**0**	**51**	**37**	**27.5%**
Common Wood-Nymph	**16**	**28**	**61**	**20**	**0**	**125**	**81**	**35.2%**
Uhler's Arctic	71	160	15	34	7	287	49	80.5%
Tawny Crescent	60	147	21	25	3	256	46	80.9%
Artic Blue	**6**	**38**	**3**	**15**	**1**	**63**	**18**	**69.8%**
Aphrodite Fritillary	**2**	**26**	**8**	**9**	**1**	**46**	**17**	**60.9%**
Western Toad	**41090**	**3404**	**1**	**141374**	**0**	**185869**	**141375**	**23.9%**

L=Low N=Nil H=High M=Moderate LI-W=Living-Winter LI-G=Living-Growing Season RB=Security/Thermal FD=Feeding

2.0 Objectives

The objective of the project was to verify modeled results for surveyed species at risk as part of conditions set out in BC Hydro's Environmental Certificate for the Site C Clean Energy Project. Verification involved ground truthing of observations of species at risk and to verify suitability ratings assigned to habitats in species specific suitability models. Specific objectives of the field surveys and desktop analysis were to:

1) Review the existing TEM and wildlife habitat models and identify potential errors (if any).
2) Conduct field work to verify habitat model results presented in the EIS and additional materials provided during the Joint Review Panel process, for targeted species at risk;
3) Conduct field work targeted at verifying modeled results for: Nelson's sparrow (*Ammodramus nelsoni*), Yellow Rail (*Coturnicops noveboracensis)*, Le Conte's Sparrow (*Ammodramus leconteii*), Broad-winged Hawk (*Buteo platypterus*), Short-eared Owl (*Asio flammeus)*, Sharp-tailed grouse (*Tympanuchus phasianellus jamesi*), little brown Myotis (*Myotis lucifugus*), northern Myotis (*Myotis septentrionalis*), great spangled fritillary (*Speyeria cybele pseudocarpenteri*), common wood-nymph (*Cercyonis pegala nephele*), Arctic blue (*Plebejus glandon lacustris*), Aphrodite fritillary (*Speyeria aphrodite manitoba*) and western toad (*Anaxyrus boreas*).
4) Collect data at each site to verify if the mapping and models were accurate. Data also included information on adjacent habitats and model adjustments were suggested if warranted.
5) Conduct desktop analysis for observations that were not accessible during the field program and suggest model adjustments if warranted.
6) Incorporate field and desktop analysis data into the wildlife models and TEM using GIS to refine model accuracy.

2.2 Survey Limitations

Access to private/leased properties was not obtainable at some sites. Road conditions in some areas also limited access. 211 polygons were identified for ground truthing. Due to these constraints, 48% (101) of the polygons were ground truthed. The remaining 110 polygons were assessed via photo interpretation and inferring results from similar polygons that had been ground truthed.

3.0 Study Area

The study area is located in northeastern British Columbia and is defined as the Peace River main stem from the Peace Canyon dam to the Alberta border and the proposed transmission route located south of the Moberly River between Hudson's Hope and the proposed Site C dam site. A one kilometre (km) buffer extents around the study area and is referred to the LAA (**Figure 1**).

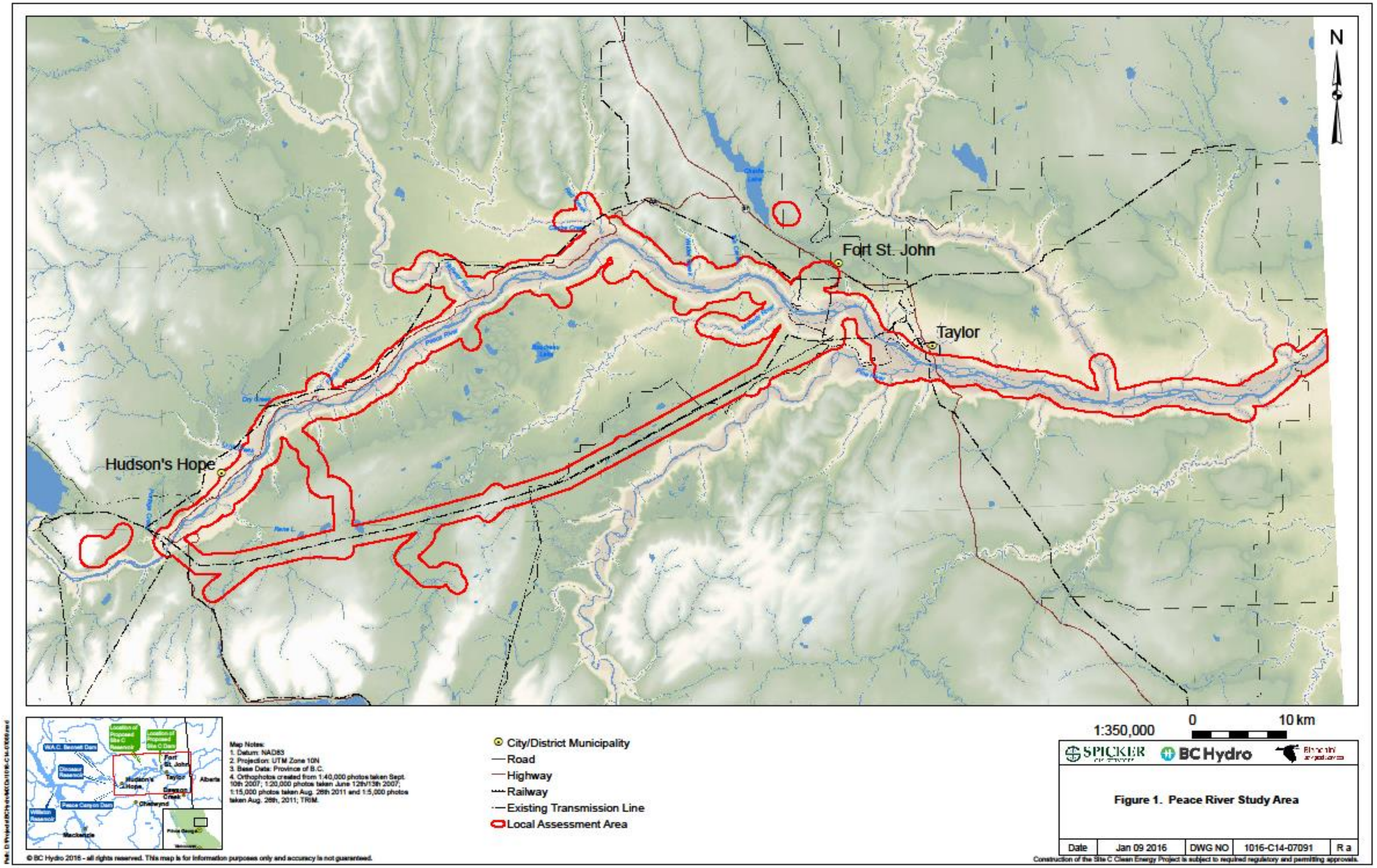

Figure 1. The Peace River Study Area.

4.0 Methods

4.1 Original Mapping and Models

The ecosystem mapping methodology used was standard 1:20,000 TEM; Resources Inventory Committee (RIC) (1998) which were based on existing Terrain Resource Information Management (TRIM) mapping. Ecosystems were mapped according to standard provincial guidebooks (DeLong 2004; DeLong et al. 1990; BC Ministry of Forests 2002; MacKenzie and Moran 2004) and the provincial list of two-letter map codes (MoE 2006). Each TEM polygon was mapped with up to three Site Series (one per decile) adding up to 100%.

Where TRIM data was not available then existing Broad Habitat Mapping (BHM) was incorporated to complete mapping for the Project. The BHM methods loosely followed the Standards for Predictive Ecosystem Mapping (PEM). The intent was to use the mapping for the Environmental Assessment of the potential Site C project for BC Hydro to provide a regional context for indicator species. Vegetation Resources Inventory (VRI) data was used as the base for the BHM to maintain spatial accuracy (linework and attributes were not modified). The BHM data available was at 1:50,000 scale and was originally mapped in the 1980's. The BHM data was updated for the Project, prior to combining with the TEM. Since BHM is of a coarser scale compared to TEM, some smaller scale features are not mapped.

4.2 Sampling Design and Effort

Prior to initiating the field program, all pre-existing model outputs using baseline data were reviewed and analyzed. Species models with <80% accuracy were selected for model verification. For each species the locations of each field observation were overlaid onto output maps to determine the number and proportion of species observations in suitable (High and Moderate) and non-suitable (Low and Nil) habitat, as identified by existing models. All records with Low or Nil ratings were selected to determine if the occurrence matches the season and/or use modeled (e.g. breeding season observation vs. non-breeding season observation). Only observations matching season or use modeled were considered for field verification. Where records occurred in Low or Nil rated polygons, aerial photo interpretation was used to determine if suitable habitat was present in the map polygon. The results of this analysis were used to generate a list of sites for field verification.

4.3 Field Visits

All records, species models and accompanying output maps were uploaded into an Apple iPad™ connected to a Garmin GLO™ GPS receiver running Motion X GPS HD™ mapping software. Target polygons were visited during the field program to verify species suitability models. Depending on access, polygons containing non-suitable and suitable habitat were visited to determine if the species observation was located in suitable habitat within the polygon.

Data collected at each site included:

- Map No.
- Observation No.
- Species
- TEM Label
- Polygon Habitat Attributes
- Adjacent Polygon Habitat Attributes
- Original Rating
- Proposed Model Adjustments

In addition to the above data, photographs of each site were also obtained. During the field assessment all data collected was compared to the output maps and databases. Any ratings adjustments (if required) were noted. In addition, suggested GIS queries were also noted to aid in the model adjustments.

4.4 Data Entry and Desktop Analysis

All data collected were entered into a database and provided for GIS analysis. During the GIS analysis the source polygon information (TEM or VRI) were identified. The VRI polygons were checked by adding an updated version of VRI (DataBC 2015) to see if any changes were made in the study area. Random polygons were checked throughout the study area and no changes were found. The database of field observations was then used to update polygon ratings where applicable. All polygon updates in the geodatabase were documented. Once changes were made to the TEM, it was joined to the species point locations based on the spatial location (point falling inside the TEM polygon). Some further adjustments were made to the point location ratings (as opposed to changes to the entire TEM polygon) to take into account adjacency issues. Once the adjustments were completed the models were rerun to recalculate the model accuracy.

Further ratings adjustments to point locations included:

- Selected all non-paved roads from digital road atlas file and buffered the selection set by 50 m and dissolved all buffered areas.
- Buffered all small TRIM streams by 4 m on each side to create stream widths of 8 m (assumed average stream width).
- Buffered all water bodies (rivers, streams, lakes, wetlands) by 50 m.
- Checked point locations of species to see if they were within buffers created. Changes were made to species ratings for:
    - Any western toad records falling within water buffer – rating changed to H.
    - Any bat feeding (FD) records falling within water buffer – ratings changed 3 (M).
    - Any great spangled fritillary records within road buffer and water buffer – ratings increased by one (i.e. L to M).
- For Sharp-tailed Grouse (winter) the adjustment process was as follows:
    - Step 1 - Selected grouse locations and buffered by 150m.
    - Step 2 - Selected all TEM polys containing grouse.
    - Step 3 - Created a selection set of all TEM polygons that shared a boundary with polygons selected in Step 2.
    - Step 4 – From Step 3 selection set, selected all polygons that would be 'H' for Sharp-tailed Grouse (winter).
    - Step 5 – Selected Step 1 buffers that intersected Step 4 polygons.
    - Step 6 – Changed ratings to 'H' for Sharp-tailed Grouse (winter) points identified in Step 5.
    - Step 7 – Repeated steps 4-6, Selected all 'M' rated polygons in step 4 and changed points to 'M' in step 6 that were identified in step 5.

5.0 Results

5.1 Model Accuracy

The field data and desktop analysis produced improved accuracy results for all 13 species with seven species models improving to over 80% accuracy and five improving $\geq$50%. Western toad improved to 45.2% (**Table 2**). In most situations the microhabitats used by these species were not mappable at 1:20,000. Other factors that affected habitat ratings included adjacency to High rated habitat, ratings associated to dominant Site Series only and incorrect TEM label. An example of an incorrect TEM label included polygons labeled 'Lake' based on VRI data but field check or aerial interpretation identified polygon as a 'wetland'. A detailed table showing the results of the field assessment, desktop analysis and GIS modeling can be found in **Appendix 1**. Maps showing the locations of the sites visited versus sites analyzed through desktop analysis can be found in **Appendix 2**.

Table 2. Original and revised model accuracy of the 13 wildlife species assessed.

Species	Original Model Accuracy	Revised Model Accuracy
Nelson's Sparrow	77.30%	90.9%
Yellow Rail	34.80%	89.1%
Le Conte's Sparrow	74.50%	84.3%
Broad-Winged Hawk	40.40%	65.2%
Short-Eared Owl	60.90%	91.3%
Sharp-Tailed Grouse (LI W)	1.20%	50.0%
Sharp-Tailed Grouse (LI G)	87.80%	100.0%
Little Brown Myotis/Northern Myotis (RB)	74.60%	74.6%
Little Brown Myotis/Northern Myotis (FD)	63.50%	83.3%
Great Spangled Fritillary	27.50%	72.5%
Common Wood-Nymph	35.20%	77.6%
Artic Blue	69.80%	93.5%
Aphrodite Fritillary	60.90%	71.1%
Western Toad	23.90%	45.2%

5.2 Model Adjustments

5.2.1 General Model Adjustments

A total of 1037 records were evaluated during the assessment. Of these, 433 records in 211 polygons were visited in the field and 604 records were reviewed via desktop aerial photograph interpretation. Based on the field results and desktop analysis a total of 171 records were adjusted based on field observations, 75 records were revised by incorporating buffers that encompassed adjacent Moderate or High rated polygons within specified distances and 24 records were adjusted using desktop analysis.

5.2.2 Adjustments Based on Buffers

The *pseudocarpenteri* subspecies of the great spangled fritillary is typically associated with edges and forest opening with moist grassy sites where they feed on their larval food plant, presumably wild violets (*Viola* spp.) (Guppy and Shepard 2001). Little brown and northern myotis typically feed over open water and wetlands (Fenton and Bogdanowicz 2002). Male toads often stay within 300 m of breeding sites (Loeffler, 2001). The original models for the Project rated lakes, rivers, creeks and wetlands Moderate or High for bats, great spangled fritillary and western toad.

Based on the habitat preferences of these species, Low and Nil rated polygons within 50 m of lakes, rivers, creeks and wetlands were upgraded to either Moderate or High depending on adjacent habitat quality.

Sharp-tailed Grouse winter in riparian areas, aspen complexes, deciduous hardwood shrub draws, and deciduous and open coniferous woods at the onset of snowfall (Leupin 2003 and Natural Resources Conservation Service 2007). Cultivated fields may be used when snow is shallow (Ritcey 1995). Snow roosting by Sharp-tailed Grouse is a common strategy to conserve energy in winter (Evans and Moen 1975). Snow roosting areas are typically found near deciduous/riparian and shrub cover (Ritcey 1995).

Based on the winter habitat preferences for this species, most Low and Nil rated cultivated fields within 150 m preferred wintering habitat were upgraded to either Moderate or High depending on site specific attributes.

The following describes the findings of the habitat model revisions for each of the 13 species reviewed.

5.3 Species Specific Model Adjustments

5.3.1 Nelson's Sparrow

Of the 22 records for Nelson's Sparrow, there were a total of five records in Low or Nil rated polygons. The original model accuracy was 77.3%. Three records in two polygons were field checked with the remainder verified through aerial photograph interpretation. Two records were located in a mislabeled polygon originally based on VRI data. The polygon was changed from 'lake' to 'wetland' which increased the rating. The other observation was within a polygon mapped based on VRI and the suitable habitat (beaver pond/wetland) was not mappable at 1:20,000. The model adjustments resulted in an improved accuracy to 90.9%.

5.3.2 Yellow Rail

There were a total of 30 records of Yellow Rail in Low or Nil rated polygons. The original model accuracy was 34.8%. Twenty-seven records in nine polygons were field checked with the remainder verified through aerial photograph interpretation. Twenty-three records were adjusted in the field. Four records were rated appropriately as they were observations along roads adjacent to suitable habitat that were unmappable at 1:20,000. All others were adjusted for various reasons including adjacency to polygons with high rated Site Series, rating assigned to incorrect decile and polygon mislabeled 'lake' instead of 'wetland' due to error in VRI data which was then corrected. The model adjustments resulted in an improved accuracy to 89.1%.

5.3.3 Le Conte's Sparrow

There were a total of 24 records of Le Conte's Sparrow in Low or Nil rated polygons. The original model accuracy was 74.5%. Fourteen records in six polygons were field checked with the remainder verified through aerial photograph interpretation. Eight records were adjusted in the field. Six records were rated appropriately with one observation along a road adjacent to suitable habitat that was unmappable 1:20,000. All others were adjusted for various reasons including adjacency to polygons with High rated Site Series and a polygon mislabeled 'lake' instead of ‘wetland’ due to error in VRI data. The model adjustments resulted in an improved accuracy to 84.3%.

5.3.4 Broad-Winged Hawk

There were a total of 19 records of Broad-winged Hawk in Low or Nil rated polygons. The original model accuracy was 40.4%. Six records in five polygons were field checked with the remainder (n=11) verified through aerial photograph interpretation. Five of the six polygons were adjusted in the field. Four records were adjacent to known nest sites. Fourteen records were rated appropriately. Five records were within 150 m of known nest sites in suitable habitat. The model adjustments resulted in an improved accuracy to 65.2%.

5.3.5 Short-Eared Owl

There were a total of 8 records of Short-eared Owl in Low or Nil rated polygons. The original model accuracy was 60.9%. Six records in four polygons were field checked with the remainder (n=2) verified through aerial photograph interpretation. Six records were adjusted in the field. All records were along roads adjacent to suitable habitat and were upgraded by one rating level. The model adjustments resulted in an improved accuracy to 90.3%.

5.3.6 Sharp-Tailed Grouse (LI W)

There were a total of 27 records of Sharp-tailed Grouse in Low or Nil rated polygons. The original model accuracy was 1.2% for the winter season. Eleven records in nine polygons were field checked with the remainder (n=16) verified through aerial photograph interpretation. Six records were adjusted in the field. Cultivated Fields (CF) were originally rated Nil for Winter season. Many of the sites visited were fields with small forested stands within or adjacent that would provide suitable winter security cover and therefore would result in Sharp-tailed Grouse use of some CF habitats in the winter. Many of the forested stands were too small to map at 1:20,000. Nil rated polygons within 150 m of mapped suitable Winter habitat were upgraded to Moderate (except in areas where CF area was extremely large compared to available security habitat). The model adjustments resulted in an improved Winter Season accuracy to 50%.

5.3.7 Little Brown Myotis/Northern Myotis (FD)

Of the 89 myotis Feeding (FD) records, 46 records were in Low or Nil rated polygons. The original model accuracy was 63.5% for FD and 74.6% for Security/Thermal (RB). Six records were field checked which included six Low or Nil records in two polygons with the remainder of the Low or Nil records (n=40) verified through aerial photograph interpretation. Five records were adjusted in the field. Many of the sites visited were fields with small forested stands within or adjacent to wetlands or riparian areas and therefore would result in bat observations. Many of the riparian areas were too small to map at 1:20,000. Nil or Low rated polygons within 50 m of mapped wetlands or riparian habitats were upgraded to Moderate or High. The model adjustments resulted in an improved FD accuracy to 83.3% and there was no change in the RB accuracy.

5.3.8 Great Spangled Fritillary

There were a total of 18 observations of great spangled fritillary in Low or Nil rated polygons. The original model accuracy was 27.5%. Seven records in 5 polygons were field checked with the remainder (n=11) verified through aerial photograph interpretation. Five records were adjusted in the field. Most records were along roads adjacent to suitable habitat (i.e. within 50 m of wet habitats) and were upgraded by one rating level. The model adjustments resulted in an improved accuracy to 72.5%.

5.3.9 Common Wood-Nymph

There were a total of 39 records of common wood-nymph in Low or Nil rated polygons. The original model accuracy was 35.2%. Twenty-six records in 14 polygons were field checked with the remainder (n=13) verified through aerial photograph interpretation. Twenty-three records were adjusted in the field. Where records were along roads or other sites adjacent to suitable habitat, they were upgraded by one rating level. In addition, the rating assigned to one polygon was associated with the incorrect decile. The model adjustments resulted in an improved accuracy to 77.6%.

5.3.10 Arctic Blue

There were a total of 12 records of Arctic blue in Low or Nil rated polygons. The original model accuracy was 69.8%. Nine records in four polygons were field checked with the remainder (n=3) verified through aerial photograph interpretation. Eight records were adjusted in the field. Where records were adjacent to suitable habitat they were upgraded by one rating level. In addition, the rating assigned to one polygon was associated with the incorrect decile and in another the TEM label (based on VRI data) was erroneous which was then corrected. The model adjustments resulted in an improved accuracy to 93.5%.

5.3.11 Aphrodite Fritillary

There were a total of 10 records of Aphrodite fritillary in Low or Nil rated polygons. The original model accuracy was 60.9%. Five records in three polygons were field checked with the remainder (n=5) verified through aerial photograph interpretation. Where records were adjacent to suitable habitat they were upgraded by one rating level. In addition, the rating assigned to one polygon was associated with the incorrect decile and in another the TEM label (based on VRI data) was erroneous which was then corrected. The model adjustments resulted in an improved accuracy to 71.1%

5.3.12 Western Toad

There were a total of 442 records representing 141375 individuals in Low or Nil rated polygons. These high observation numbers are due counts of tadpoles observed in breeding ponds. The original model accuracy was 23.9%. Two hundred and twenty-one records were field checked with the remainder (n=221) verified through aerial photograph interpretation. 75 of the records were adjusted in the field. Where records were adjacent to suitable habitat they were upgraded by one rating level. Nil or Low rated polygons within 50 m of mapped wetlands or riparian habitats were upgraded to Moderate or High. Most observations were in habitats that were not mappable at 1:20,000 or were poorer habitats along movement corridors between Moderate or High rated polygons. Of the 442 records 124 improved with the model adjustments. The model adjustments resulted in an improved accuracy to 45.2%.

6.0 Discussion

Most records that were observed in Nil or Low rated polygons were either recorded in habitats that were not mappable at 1:20,000 or were adjacent to polygons with Moderate or High rated habitats. When adjacency was considered, the accuracy of the species models improved in most cases. Other reasons resulting in observations of species in Nil or Low rated habitat included:

- Habitat ratings being assigned to the primary TEM label decile even though suitable habitat was identified in the secondary or tertiary deciles.
- TEM label based on coarser (1:50,000) VRI data resulting in incorrect polygon label (i.e. 'wetland' observed in field identified as a 'lake' in VRI data).
- Animals observed crossing less suitable polygons to access Moderate or High rated polygons.

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Appendices

Appendix 1 – Field and Desktop Analysis Table

Appendix 1. Results of the field and desktop analysis for each of the species of concern observed in Nil and Low rated.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Nelson's Sparrow (*Ammodramus nelsoni*)						
143	D	N	H	Polygon mislabeled. NOT a lake as indicated by VRI. Site is a wetland just like adjacent area. Should be H.	Change to H	Changed to H
144	F	N	N	Observation adjacent to wetland at edge of beaver pond.	Once look at labels for other polygons in C46 may adjust if in proximity to M/H habitats.	No change made
145	F	N	H	Polygon is not LA is Sedge wetland.	Change polygon label to TS2.	Changed to H
146	F	N	M		Change rating to M BL is a forested wetland with pockets of suitable YERA habitat.	Changed to M
148	D	L	L	Adjacency issue. Suitable habitat within 18 m in next polygon.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Yellow Rail (*Coturnicops noveboracensis*)						
8	D	N	H	Polygon mislabeled. NOT a lake. It's a wetland just like adjacent area. Should be H	Change to H	Changed to H
15	F	L	L	L rating assigned as accurate. No idea why this individual was seen here.	None	No change made
34	F	N	L		Change BL to Low	Added poly to model; added YERA to model as L.
35, 36, 39, 40, 41, 44	F	L	H	All these obs in TS which is rated H for YERA.	Search all ratings for YERA and TS habitat-should be H for YERA not L.	Changed to H
36	D	L	H	All these obs in TS which is rated H.	Change to H	Changed to H
37, 45	F	L	H	Polygon label is TS, which is rated H for YERA.	Search all ratings for YERA and TS habitat-should be H for YERA not L.	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Yellow Rail (*Coturnicops noveboracensis*)						
38, 42, 43	F	L	H	Not sure why these are rated Low, they are in TS habitat, may be an artifact of where the UTM put the observation.	Search all ratings for YERA and TS habitat-should be H for YERA not L.	Changed to H
45	D	L	H	Not sure why these are rated Low, they are in TS habitat, may be an artifact of where the UTM put the observation.	Search all ratings for YERA and TS habitat-should be H for YERA not L.	Changed to H
46	D	L	H	Road bisecting TS (H) polygon & mislabeled polygon. Labeled LK but is a wetland-likely TS. Change to H.	Change to H	Changed to H
48, 49, 50, 56	F	N	H	Polygon is not LA is Sedge wetland.	Change polygon label to TS2.	Changed this to H; changed from 23533 to correct # of 23329.
52	D	N	H	Polygon is not LA is Sedge wetland. VRI data incorrect.	Change to H	Changed to H
53	D	N	H	Polygon is not LA is Sedge wetland. VRI data incorrect.	Change to H	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Yellow Rail (*Coturnicops noveboracensis*)						
54	D	N	H	Polygon is not LA is Sedge wetland. VRI data incorrect.	Change to H	Changed to H
60	D	N	H	Polygon is not LA is Sedge wetland. VRI data incorrect.	Change to H	Changed to H
61	F	N	L		Change rating to M BL is a forested wetland with pockets of suitable YERA habitat.	Changed to M
63	F	N	M	Not sure why these are rated Low, they are in TS habitat, may be an artifact of where the UTM put the observation.	Change rating to M BL is a forested wetland with pockets of suitable YERA habitat.	Changed to M
78	F	L	L	L rating assigned is accurate.	None	No change made
80	F	L	H	Obs in polygon in BL interspersed with SE. Polygons rating is that of the dominant unit (BL) not the most valuable to YERA.	Take the TEM unit with the highest rating for the species and assign that to the polygon rather than use the rating associated with the dominant unit.	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Yellow Rail (*Coturnicops noveboracensis*)						
92	F	L	L	Obs is adjacent to SE habitat. Rating assigned is accurate.	None	No change made
94	D	L	H	Adjacency issue. Suitable habitat within 18 m in next polygon.	Change to H	Changed to H
96	F	N	N	Obs at edge of road. Rating assigned is accurate.	None	No change made
Le Conte's Sparrow (*Ammodramus leconteii*)						
6	D	L	H	Poly labeled CF but actually wetland/ROW. Site should be upgraded to H.	Change to H	Changed to H
9	D	N	H	Polygon mislabeled. NOT a lake. It's a wetland just like adjacent area. Should be H.	Change to H	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Le Conte's Sparrow (*Ammodramus leconteii*)						
12	F	N	N	Adjacent to SC6/CF. Along west side of road at observation is a small bit of Salix/sedge/horsetail-not mappable at 1:20k.	None	No change made
13	F	N	N	Observation is at road edge. East side field is long grass (low value). West side has scattered low shrubs in the field and is good habitat. This is not mappable at 1:20K.	None	No change made
47, 51, 52, 53, 54, 58, 59, 60	F	N	H	Polygon is not LA is Sedge wetland.	Change polygon label to TS2.	Changed to H
55, 57	F	N	H	Polygon is not LA is Sedge wetland.	Change polygon label to TS2.	Changed this to H; changed from 23533 to correct # of 23329.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Le Conte's Sparrow (*Ammodramus leconteii*)						
62	F	N	L	Rated High for LCSP. Not sure why this is N check data.	Change to L	Changed poly # from 23533 to 23461 (actual point location); changed TEM label from TS3 to 10BL5:al (actual point location); **changed this to L.**
64, 65, 66, 67	F	L	L	This is old field habitat adjacent are several small wetlands in adjacent forest.	Old field habitat near wetlands should be rated M not Low. Look at orthophotos to pull out areas of old field.	Poly based on VRI data. Scale too course to map wetlands. Closest wetland 70m.
70	D	N	N	Label incorrect. Not a forested wetland. Looks like a shrub wetland which would have LCSP. Default to unmappable microhabitat at this scale.	None	No change made
93	D	L	H	Database error? Poly is WH which is rated H.	Correct rating	Rating corrected

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Le Conte's Sparrow (*Ammodramus leconteii*)						
116	D	L	L	Microhabitat issue. Observed at forest edge. Numerous small wet openings throughout polygon.	None	No change made
117, 118	D	L	L	Adjacency issue. Suitable habitat within 37 m in next polygon.	None	No change made
132	D	L	L	Adjacency issue. Observed from Road. Suitable habitat within 15 m in next polygon.	None	No change made
133	F	N	M	Observation is in a sedge dominated depression in the CF. Too small to pull out at 1:20k. Wetland layer shows this as a marsh.	Overlay wetland layer on the TEM, any field with a wetland within increase the rating to M for LESP.	Added poly to final model. Added LCSP as M.
141, 142	D	N	N	Adjacency issue. Observed along RN within 10m of H rated habitat.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Broad-Winged Hawk (*Buteo platypterus*)						
4	D	L	L	Forest edge along cutline. Likely foraging over area. Unmappable at this scale.	None	No change made
14	D	L	L	Forest edge along cutline. Likely foraging over area. Unmappable at this scale.	None	No change made
20	D	L	L	Forest edge along cutline. Likely foraging over area. Unmappable at this scale.	None	No change made
22	F	N	N	N rating assigned is accurate.	None.	No change made
23	D	L	L	Forest edge along river back channel. Likely foraging over area. Unmappable at this scale.	None	No change made
24, 25, 26, 27, 28, 29	D	L	L	Site within 150m of H rated habitat. Adjacency issue.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Broad-Winged Hawk (*Buteo platypterus*)						
69	D	L	L	Forest edge along road. Likely foraging over area. Unmappable at this scale.	None	No change made
125	F	L	M	Adjacency to nest site and wetland with toads for potential prey.	1. Use TRIM to ID At stands on slopes, rate M. 2. need to rate polygons with or adjacent to known nest sites at least M. 3. At stands adjacent to toad habitat should be rated M. 4. look at baseline nest data to see if other adjustments indicated.	Consider in polygons on slopes changing rating for SH from L to M (SHac is rated M).

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Broad-Winged Hawk (*Buteo platypterus*)						
126	F	L	M	This obs is near a confirmed nest site.	1. Use TRIM to ID At stands on slopes, rate M. 2. need to rate polygons with or adjacent to known nest sites at least M. 3. At stands adjacent to toad habitat should be rated M. 4. look at baseline nest data to see if other adjustments indicated.	Changed to M
127	F	L	M		1. Use TRIM to ID At stands on slopes, rate M. 2. need to rate polygons with or adjacent to known nest sites at least M. 3. At stands adjacent to toad habitat should be rated M. 4. look at baseline nest data to see if other adjustments indicated.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Broad-Winged Hawk (*Buteo platypterus*)						
128, 129	F	L	L	This obs is near a confirmed nest site.	1. Use TRIM to ID At stands on slopes, rate M. 2. need to rate polygons with or adjacent to known nest sites at least M. 3. At stands adjacent to toad habitat should be rated M. 4. look at baseline nest data to see if other adjustments indicated.	Changed to M
130	D	L	L	Forest edge along road. Likely foraging over area. Unmappable at this scale.	None	No change made
140	D	N	N	Adjacency issue. Soaring over river.	None	No change made
2	D	N	L	Observation on RZ adjacent to CF.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Short-Eared Owl (*Asio flammeus*)						
5	D	N	L	Poly should include RZ. Polygon bisected by 2km of road with 1km adjacent to CF. Location should be upgraded to L.	Change to L	Changed to L
71	F	N	M	Observation site has long grass fields on each side. ROW is also long grass.	RZ habitats in rural areas (outside FSJ, Taylor) if adjacent to CF increase rating to M.	Added poly to model; added M to SEOW.
134, 135, 136, 137, 138	F	N	M	Old field should be H.	Look at orthophotos, areas of old field should be rated H for SEOW.	TEM already listed as M. left as M.
806	F	M	M	M rating assigned is accurate. Long grass fields on both sides of road.	None	Edited id from 186 to 806 to match GIS.
808, 809, 810	F	M	M	M rating assigned is accurate.	None	No change made
812,813, 814	F	M	M	M rating assigned is accurate.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Sharp-Tailed Grouse (*Tympanuchus phasianellus*)						
182	F	H	H	H rating assigned is accurate. West side is grass field; north side is non-grass crop.	None	No change made
183	F	H	H	H rating assigned is accurate. Long grass fields on both sides of road.	None	No change made
184	F	L	H	Observation site west side CF2 east side AM5ap.	RZ habitats in rural areas should be rated the same as the adjacent polygon. If M habitat adjacent then rate M, if H then H.	Added poly to model; added STGR-G and W as H.
185	F	H	H	Rating assigned is accurate.	None	No change made
186	F	H	H	H rating assigned is accurate. Long grass fields on both sides of road.	None	No change made
196, 197	F	H	H	H rating assigned is accurate.	None	Added poly to final model. Added H to STGR G.
200	F	H	H	H rating assigned is accurate.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Sharp-Tailed Grouse (*Tympanuchus phasianellus*) - Winter						
175, 176	D	L	H	Mislabeled polygon. NOT a 10AM6. Recently clearcut. Should have been H.	Change to H	Changed to H
177	D	N	H	Adjacency issue. Observed along RN within 10 m of H rated habitat.	Change to H	Change to H
178	F	L	L	Observation is within 100m of At stand.	For mapped area outside TEM any forest/shrub units > str stg 3 should be rated M for STGR-W- due to the date between the mapping (1990's and now).	Due to size of polygon didn't change TEM rating.
180	D	L	H	Adjacency issue. Observed along forest edge within 25m of H rated summer habitat.	Change to H	Changed to H
182	F	L	L	L rating assigned is accurate- no At or shrub cover within 150m of this observation.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Sharp-Tailed Grouse (*Tympanuchus phasianellus*) - Winter						
184	F	L	L	Have nearby At forest-cover and food also have dense At-Salix along edge of the road and the field-cover and food.	Any CF that has At forest within 150m increase to M for STGR in winter.	Due to size of polygon didn't change TEM rating.
185	F	L	L	L rating assigned is accurate-no At or shrub cover within 150m of this observation.	None	No change made
186	F	L	L	The forested patch adjacent to the observation is rated High for winter.	Any CF that has At forest within 150m increase to M for STGR in winter.	Due to size of polygon didn't change TEM rating.
198	F	L	H	Observation in CF with shrubs-young forest within 150m. Rating should be H for winter.	Change rating here to H for STGR-W.	199 and 199 in same polygon therefore rating for both changed to H.
199	F	L	H	Observation in CF have At strip within 150m along road. Likely not mappable at 1:20k.	Change rating here to M for STGR-W.	199 and 199 in same polygon therefore rating for both changed to H.
200	F	L	L	Observation adjacent to shrub thicket along road corner and small At thicket up road.	Any CF that has shrubby habitat within 150m increase to M for STGR in winter.	Due to size of polygon didn't change TEM rating.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Bats - Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*Myotis septentrionalis*)						
7	D	L	M	Polygon 30% CB. Poly should 2 RB. Adjacent to wetland polygon. Should be 3 FD.		
16	F	FD=L	FD=M	Within 50 m of water.	Increase to M when within 50m of water	Changed FD to 3 based on location of poly to water.
72	F	N	N	This is a bat capture site and near a bat telemetry site (old tree in middle of younger At stand-likely not mappable at 1:20k). Polygon has scattered old decadent deciduous trees: not mappable at 1:20K.	None	No change made
73	F	6	5	Scattered large-str stg 6-Sw and At within the polygon. These trees are not mappable at 1:20K. Observation is also near the outhouse that supported a maternity colony during baseline surveys.	Increase to 5	Ratings increased to 5.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Bats - Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*Myotis septentrionalis*)						
85	F	FD=6	3	Capture site, along creek adjacent to FM02.	Polygons that have creeks or are adjacent to habitat rated M or H should be rated M for bats to account for adjacency	Changed FD to 3.
147	F	FD=4	3	Bridge at Red Creek. Polygon is 8CF2 ad 2AM6-bats using the AM6 (Spruce) forests along Red Creek. Assigned rating correlates to the dominant unit not the unit with the highest value.	Take the TEM unit with the highest rating for the species and assign that to the polygon rather than use the rating associated with the dominant unit.	Added poly to final model as a 4 for RB and 3 for FD.
749	F	M	FD=3	Site is adjacent to Lynx Creek and the Peace some larger trees present. Rating confirmed as suitable and accurate.	Increase rating to M when polygon is adjacent to any habitat rated H or M for bats.	Original TEM was FD=3/RB=2. Left as is.
693-733, 738, 739, 734-737, 740	F	3	3	Both the M and H ratings assigned are accurate.	None	734-739 ratings are FD=3/RB=6. 699-702 are FD=2//RB=1. left as is.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Bats - Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*Myotis septentrionalis*)						
747, 748	F	M	M	M rating assigned is accurate.	None	No change made
795-805	F	3	3	3 rating assigned is accurate. This corresponds to a bat netting site at creek.	None	No change made
82, 83, 84	F	FD=4	3	Capture site, along creek adjacent to Fm02.	Polygons that have creeks or are adjacent to habitat rated M or H should be rated M for bats to account for adjacency.	Changed FD to 3.
Great Spangled Fritillary (*Speyeria cybele pseudocarpenteri*)						
3	D	L	L	Isolated micro habitat. Not mappable.	None	No change made
11	F	N	L	Obs on edge of ROW, likely coming to road to get nutrients. There is swamp habitat within 50m.	RS within 100m(?) of WL habitat rate L to account for use for nutrients.	Swapped species around for Site #'s 10 and 12; changed to L.
18	D	N	N	Wet forest opening - Unmappable at this scale. Within 40 m of suitable poly.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Great Spangled Fritillary (*Speyeria cybele pseudocarpenteri*)						
19	F	L	L	This site is a dynamic floodplain that will change in suitability between years.	Where GB is adjacent to other suitable (M/H) habitat increase GB to M. Model indicates that this species was observed on GB.	No changes made. All surrounding polys L or N.
21	F	N	M	Obs is at edge of the road at the base of a south facing slope. AMap3 (M habitat) is across the road.	1. Rate RZ M to capture use of vegetation within the ROW by this species-obs summary in sp. model indicates individuals were obs on roads. 2. Any L/N habitat that is adjacent to M/H habitat should have rating increased.	Changed to M
31	D	L	L	Microhabitat issue. Unmappable at this scale. Suitable wet habitats likely occur along river.	None	No change made
32	F	L	M	Observation is associated with creek mouth at the Peace River.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Great Spangled Fritillary (*Speyeria cybele pseudocarpenteri*)						
33	D	N	L	Microhabitat. Roadside ditch likely provides habitat.	None	No change made
74	D	L	L	Correct. No Change.	None	No change made
77	F	L	M	Observation is along the gravel road adjacent to wetland and open At forest. Rating should not be based on RZ but the surrounding habitat.	For RZ areas assign rating that corresponds to the adjacent habitat.	Changed id from 76 to 77 to match GIS.
89	D	L	H	Database error? Poly is Fm02 which is rated H.	Change to H	Changed to H
91	D	L	L	Adjacency issue. Suitable habitat within 15 m in next polygon.	None	No change made
111	F	L	M	Slope contains some shrub pockets, may be moist areas.	Same as discussed earlier.	Edited from id of 11 to 111 to match GIS; changed to M.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Great Spangled Fritillary (*Speyeria cybele pseudocarpenteri*)						
112, 113, 114	F	L	M	All these observations are adjacent to AMap4 which is rated M. WW sites would provide this spp with a source of nutrients near areas where their native food plant (violet) grows.	Any WW polygon adjacent to M/H habitat should be rated M to account for adjacency and associated use.	Changed to M.
1037	F	M	M	M rating assigned is accurate.	None	No change made
Common Wood-nymph (*Cercyonis pegala nephele*)						
68	F	L	L	Obs within edge habitat dominated by grasses, not mappable at 1:20K.	None	No change made
75	F	L	H	This polygon is old field.	Old field habitat-not actively cultivated-should be rated H. Look at orthophotos and see if can pull out these uncultivated fields.	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Common Wood-nymph (*Cercyonis pegala nephele*)						
76	F	L	M		Rate the polygon for the highest rated unit not the dominant unit.	Changed to M.
79	D	N	N	Microhabitat issue. Grassy meadows occur in polygon which would provide suitable habitat.	None	No change made
81	D	L	L	Microhabitat issue. Observation along road w/ grassy meadows occur which would provide suitable habitat.	None	No change made
86	D	L	L	Microhabitat issue. Grassy meadows occur in polygon which would provide suitable habitat.	None	No change made
87, 88	D	L	L	Adjacency issue. Suitable habitat within 40 m.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Common Wood-nymph (*Cercyonis pegala nephele*)						
95	D	L	L	Microhabitat issue. Observed along road. Grassy sites occur in polygon which would provide suitable habitat.	None	No change made
98, 99, 100, 101, 102, 103, 104	F	N	M	Observations are due to adjacency to M habitat.	Areas adjacent to CF that are sloped (sloped areas between terraces) based on TRIM mapping should be rated M	Changed to M
105	F	N	M	Observations are due to adjacency to steep short structural stage 2 slope between fields.	Areas adjacent to CF that are sloped (sloped areas between terraces) based on TRIM mapping should be rated M.	Changed to M
106, 107, 108	F	L	M	Polygon should be rated M.	Assign rating associated with the highest value habitat in the polygon not the dominant habitat.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Common Wood-nymph (*Cercyonis pegala nephele*)						
109, 110	F	L	M	L rating assigned is accurate. Observation is adjacent to polygon 81696 8CB1-2ASg3 which is rated M. Observation is in an opening equivalent to adjacent polygon which is likely not mappable at 1:20.	Change to M	Changed to M
115	F	L	M	Cleared area dominated by grass at base of steep south facing slope (WW).	1. Adjust for adjacent to ww. 2. Increase CF to M from L.	Changed to M
119, 120	F	L	M	Observation on the boundary between M and L habitat.	Any polygon adjacent to M/H rated polygon increase rating to M to account for adjacency.	Changed to M; changed TEM label from 8WW2-2CB1 (adjacent label) to actual one.
121	F	L	M	Observation associated with gravel bar of river and are adjacent to suitable habitat.	If polygon is rated L and is adjacent to M/H then increase rating to M to account for adjacency.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Common Wood-nymph (*Cercyonis pegala nephele*)						
123	F	N	L	Observation at regional park, lots of openings in riparian forest.	Rate all FM02 L not just str. Stg. 2 and 3.	Changed to L.
124	D	L	L	Microhabitat issue. Numerous small wet openings throughout polygon.	None	No change made
139	D	N	N	Observed along shore of river. Microhabitat unmappable at this scale.	None	No change made
149, 150, 151	D	L	H	WH in 3rd decile which is rated H.	None	No change made
154	F	L	H	Obs adjacent to M value habitat.	When RZ/CF occurs adjacent to SE increase rating to account for adjacency to High value habitat.	Changed to H
155, 156, 157, 158, 161	F	L	H	Obs at boundary of SE which is High. Edge of SE is low shrub with rose-this is a mesic opening/cleared area.	When RZ/CF occurs adjacent to SE increase rating to account for adjacency to High value habitat.	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Common Wood-nymph (*Cercyonis pegala nephele*)						
159	F	L	H	Obs adjacent to M value habitat.	When RZ/CF occurs adjacent to SE increase rating to account for adjacency to High value habitat.	Changed to H
845, 846, 847, 848, 849, 850, 851, 852	F	H	H	H rating assigned is accurate.	None	No change made
896	F	M	M	M rating assigned is accurate.	None	Edited from id of 11 to 896 to match GIS.
Arctic Blue (*Plebejus glandon lacustris*)						
163	D	L	L	Mapped 10AS3 but ss 2 visible in ortho which is H. Microhabitat unmappable at this scale.	None	No change made
164	F	L	L	L rating assigned is accurate.	None	No change made
165, 166, 167, 168, 169, 170, 171, 172	F	N	M	Observations are due to adjacency to M habitat.	Areas adjacent to CF that are sloped (sloped areas between terraces) based on TRIM mapping should be rated M.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Arctic Blue (*Plebejus glandon lacustris*)						
173	D	N	H	Mislabeled polygon. NOT a CB. Actually a grassy slope. Should have been H.	None	No change made
174	D	L	L	Adjacency issue. Suitable habitat within 15 m in next polygon.	None	No change made
906	D	M	M	Correct.	None	No change made
932	F	M	M	Could not access. Road ends at Private Property. Need quad to follow trail down to observation.	None	No change made
1013, 1014	F	H	H	H rating assigned is accurate.	None	No change made
1021	F	M	M	M rating assigned is accurate.	None	Edited from 11 to 1021 to match GIS.
1035	F	M	H	Model rates SE as H, not M. Obs is in SE. Check to see if highest rating applied to polygon or rating for dominant unit.	Change to H	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Aphrodite Fritillary (*Speyeria aphrodite manitoba*)						
1	F	N	N	Forest opening – moist microsite unmappable at 1:20K. Within 80m of clearcut & cutline.	None	No change made
10	F	N	L	Obs on edge of ROW, likely coming to road to get nutrients. There is swamp habitat within 50m.	RS within 100m(?) of WL habitat rate L to account for use for nutrients.	Swapped species around for Site #'s 10 and 11; Changed to L.
17	D	N	N	Wet forest opening - Unmappable at this scale. Within 40 m of suitable poly.	None	No change made
30	D	L	L	Microhabitat issue. Unmappable at this scale. Mapped AM ss5 but ss 2 & 3 likely occurs which are M rated.	None	No change made
90	D	L	L	Adjacency issue. Suitable habitat within 15 m in next polygon.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Aphrodite Fritillary (*Speyeria aphrodite manitoba*)						
97	D	L	L	Microhabitat issue. Observed at forest edge. Numerous small wet openings throughout polygon.	None	No change made
122	F	L	M	Observation associated with gravel bar of river and are adjacent to suitable habitat.	If polygon is rated L and is adjacent to M/H then increase rating to M to account for adjacency.	Changed to M
153	F	N	N	Obs adjacent to SE habitat. N rating assigned is accurate.	None	No change made
160	D	N	N	Obs adjacent to SE habitat. N rating assigned is accurate	None	No change made
162	F	N	N	Obs adjacent to SE habitat. N rating assigned is accurate.	None	No change made
830, 831	F	M	M	Rating assigned is accurate.	None	Changed id from 76 to 830 & 831 to match GIS.
1036	F	M	M	M rating assigned is accurate.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
202	D	N	N	Microhabitat issue. Observed along cutline. Wet depressions likely occur within. Unmappable at this scale.	None	No change made
203-204	D	N	N	Microhabitat issue. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
205-226, 229	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
227-228	F	N	N	These sightings are due to adjacency to suitable habitat- movement of toads from wetlands to terrestrial forested habitats.	None	Same site #'s as above. No changes made.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
227, 228	F	N	N	All rated N for toad. All observations associated with either wetland, areas adjacent to wetlands.	Overlay wetland layer on the TEM, any field with a wetland within increase the rating to M for toad.	No water in poly. No changes made.
230	D	N	M	Observed along RZ. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
231	D	N	H	Database error. Mapped 10Fm02 which is H.	Fix database	Database fixed, rating changed to H
232-263	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
264, 270, 272-278	D	N	M	Observed along RZ. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
265-269, 271, 279, 281-285	D	N	M	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	Increase to M	Changed to M
280	F	N	H	This site should be rated H.	Change to H	Added poly to final model. ANBO rated as H.
286	D	N	M	Observed along RZ. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
287-290, 292-293, 295	D	N	M	Observed along river foreshore.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
291, 294, 308-309, 312-318	D	N	N	Microhabitat issue. Observed within forest. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
296-304, 306-307, 310-311, 325-327, 332, 336-339, 341	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
305	D	N	M	Adjacency issue. Within 10m of wetland.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
319, 323-324, 329-330, 333-334	D	N	N	Microhabitat issue. Observed along BCH ROW Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
320-322, 328	D	N	M	Observed along BCH ROW Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
331, 344	D	N	M	Observed within forest. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
335, 340, 347	D	N	N	Microhabitat issue. Observed within forest. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
342, 346	D	N	M	Observed along river foreshore. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
343	F	N	M	Site not visited but database says N but label SH6 should be M as per the model.	Check ratings table.	TEM already rated as M.
345	F	N	M	Site not visited but database says N. Polygon label is SHac6	SHac units should be rated M because they are wet.	Changed to M.
348	D	N	N	Microhabitat issue. Observed at edge of 30x40m pond within polygon. Unmappable at this scale.	None	No change made
349, 353, 354, 355	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
350-352	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
356	F	N	N	Adjacent to wet sites along the road. Not mappable at 1:20k.	No changes - very large TEM poly.	No change made
357, 358	F	N	N	Adjacent to wet sites along the road. Not mappable at 1:20k.	No changes - very large TEM poly.	No change made
359	F	N	N	Rating assigned is accurate for breeding but does not account for movement from adjacent breeding habitat.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	No change made
360	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
361-367	D	N	M		Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
368, 370	F	N	M	Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	Water bodies (rivers, streams, lakes, wetlands) within 50 m. Increased to M.	Changed to M
369	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
371	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	Added poly to TEM; toad as N.
372	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	Added poly to TEM; toad as N.
373	D	N	N	Adjacency issue. Within 80m of wetland.	None	No change made
374	F	N	M	Adjacent to wetland.	Adjust as per above re polygons adjacent to wetlands.	Changed to M.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
375, 376, 377,378, 379, 380, 381	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made
382, 383, 384	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
385, 386, 391, 392	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
387-390, 393-398	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
399, 400, 401, 402, 403, 408, 409, 410, 411, 412, 413, 414, 415	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
404, 405, 406, 407,416, 417, 420,	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
419, 421	F	N	M	No lake here. Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	Within 50 m of stream based on TRIM. Increase rating to M	Increased to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
418	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
422	F	N	M	Observation at edge of wetland. Should not be rated N.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	Changed to M
423, 426	F	N	M	Near TRIM lake.	Polygons with toad observations containing creeks (using TEM, PEM or TRIM) should be rated M for toad.	Added poly to TEM; added TEM as M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
424, 425, 427	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
439, 440, 441	F	N	M	In polygon with creek.	Polygons with toad observations containing creeks (using TEM, PEM or TRIM) should be rated M for toad.	Added poly to model; added Toad as M.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
442, 443, 444	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
445, 446, 447, 448, 449,	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
450, 452, 453	F	N	M	Rating assigned is accurate for breeding but does not account for movement from adjacent breeding habitat.	Polygons with toad observations containing creeks (using TEM, PEM or TRIM) should be rated M for toad.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
451	F	N	M	Observation at creek. Should not be rated N.	Polygons with toad observations containing creeks (using TEM, PEM or TRIM) should be rated M for toad.	Changed to M
454	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
455, 456, 457	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
458, 459, 460, 464	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made
461, 462, 463, 466, 467, 468, 469, 470, 471, 472	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made
465, 474	D	N	N	Microhabitat issue. Observed along RZ 20x20m pond visible in ortho. Unmappable at this scale.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
473, 475, 476, 477	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
478, 479, 480, 481, 482, 483	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made
484, 485, 485, 487, 488, 489	F	N	N	Adjacent to wet sites along the road. Not mappable at 1:20k.	No changes - very large TEM poly.	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
486	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
490, 491, 492, 494, 495, 496, 497, 498, 499, 505, 508, 509, 510	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made
493, 506, 507	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
500	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made
501	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
502, 503, 504	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	Polygons with toad observations containing creeks (using TEM, PEM or TRIM) should be rated M for toad.	No changes - very large TEM poly.
511, 512	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
513, 514, 515, 516, 517, 518	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made
519, 520, 521	F	N	N	Adjacent to wet sites along the road. Not mappable at 1:20k	No changes - very large TEM poly.	No change made
522, 523, 524, 525, 526, 527, 528	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	No changes - very large TEM poly.	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
529, 530	F	N	N	Rating assigned is accurate for breeding but does not account for movement from adjacent breeding habitat.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M. to account for movement from adjacent breeding habitat.	No change made
531	D	N	N	Microhabitat issue. Observed along cutline. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
532	F	N	M	Observation is between 2 wetlands.	Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad	Changed to M
533, 534, 535, 536	F	N	M	Rating assigned is accurate for breeding but does not account for movement from adjacent breeding habitat.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	Polygon added to TEM. Added M rating.

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
537, 538, 539	F	N	M	Rating assigned is accurate for breeding but does not account for movement from adjacent breeding habitat.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	Polygon added to TEM. Added M rating.
540	F	N	M	Observation is between 2 wetlands.	Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad.	Changed to M
541	D	N	N	Microhabitat issue. Observed along cutline. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
542-545, 547	D	N	M	Adjacency issue. Within 50m of wetlands.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
548	F	N	L	Obs associated with willow thicket at the edge of the Peace River in the lee of Clayhurst Bridge-area stays cool. Site is within 100m of confluence with Alces River. Likely instance of toad moving across the landscape. Habitat long Alces River is FM02=M for toad.	1. Look at literature to determine movement distance of toads. 2. Any polygon rated L or N increase by 1 if they are within that distance of M/H units (L to M, N to L).	Changed to L
549	F	N	L	Observation in wet draw/wetland-likely not mappable at 1:20K. Polygon surrounded by mapped wetlands.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	Changed to L
550-553	D	N	M	Adjacency issue. Within 50m of wetlands.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
554, 555	F	L	L		All polygons along the Peace River with creeks should be rated M for toads to account for movement.	>50 m from water on TRIM. No change.
556	F	N	M	Obs adjacent to back channel of the Peace River.	All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed from L to M in TEM.
557, 558	F	N	L	Road here is a single lane dirt road with water filled ruts. At obs site CF north moist At forest south. Obs is of toads moving from nearby breeding habitat (6 Mile Creek) to upland forest.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to L

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
559	F	N	L		RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to L
560	F	N	L		RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to L
561	F	N	M	Obs associated with creek and at edge of Peace River.	All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
562, 566, 567, 568, 569	F	N	M	Obs are adjacent to breeding habitats.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
563, 574, 576, 577	F	N	M	wetland along north side of road at 574, likely not mappable at 1:20K. Dense alder along part of S side of road.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
564	F	N	M	Obs. At CACA pond at S side of road likely not mappable at 1:20k.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
565	F	N	M	Obs. At CACA pond at S side of road likely not mappable at 1:20k.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
570, 571, 572	F	N	M	Obs associated with creek.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
573, 575, 579	D	N	M	Adjacency issue. Within 50m of wetlands.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
578	F	N	M	Obs. At CACA pond at S side of road likely not mappable at 1:20k.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
580	F	N	M	Small wetland N side of road, likely likely not mappable at 1:20K.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
581, 584, 587	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
582-583, 585-586, 591, 592, 596	D	N	M	Observed along RZ. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M
588, 589, 590	F	N	M		RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
593	F	N	M	Adjacent to wet ditch along rail road which leads from wetland. Adjacency again.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	Changed to M
594, 595	F	N	M	Observation at wetland. Should not be rated N.	Polygons with toad observations containing creeks (using TEM, PEM or TRIM) should be rated M for toad.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
597-602, 604, 605	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
603	D	N	M	Observed along RZ. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M
606, 607	F	N	M	Observations are adjacent to wetlands and road ditches and indicate movements to terrestrial habitats from breeding habitats.	RN in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad Polygons containing creeks (using TEM, PEM or TRIM) should be rated M for toad.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
608	D	L	L	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
609	F	N	M	All rated N for toad. All observations associated with either wetland, areas adjacent to wetlands.	Overlay wetland layer on the TEM, any field with a wetland within increase the rating to M for toad.	Observation within large wetland not indicated in VRI data but shows up as marsh on TRIM.
610-612	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
613, 614, 615, 616, 617, 618	F	N	N	Ratings assigned area accurate. Observations along roads scattered with small, non-mappable wet microsites (tire ruts, ditch lines, small wet depressions with cattails) within the ROW.	None	No change made

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
619	F	N	M	Observation associated with water filled ditch along rail line, likely not mappable at 1:20k	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	Changed to M
620	D	N	M	Adjacency issue. Within 50m of wetlands assoc. with Monias LK.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M
621-626	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
627, 633	D	N	M	Observed along RZ. Small wet openings visible in ortho.	Water bodies (rivers, streams, lakes, wetlands) within 50 m increased to M.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
623-632, 634	D	N	N	Microhabitat issue. Observed along RZ. Small wet openings visible in ortho. Unmappable at this scale.	None	No change made
635	F	N	H	Observation is within 10m of wetland.	Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad.	Changed to H
636	F	N	H	Observation at edge of wetland. Should not be rated N.	Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad	Changed to H
637	F	N	H	Observation at edge of wetland. Should not be rated N.	Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad	Changed to H
638	F	N	H	Observation at edge of wetland. Should not be rated N.	Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad	Changed to H
639	F	N	H	Observation is within 10m of wetland.	Polygons containing wetlands (using TEM, PEM or TRIM) should be rated H for toad.	Changed to H

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
640	F	N	M	N rating assigned is accurate. No wetlands mapped nearby and no wet areas observed but toads moving through.	Polygons without mapped wetlands but adjacent to wetlands and with toad observations should be rated M to account for movement from adjacent breeding habitat.	Changed to M
641	F	N	M	Wetland along north side of road at 574, likely likely not mappable at 1:20K. Dense alder along part of S side of road.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M
642	F	N	M	Both sides of rate At forest.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed to M

Site #	Field Check (F) or Desktop (D)	TEM rating	Revised TEM Rating	Comments	Proposed Model Adjustments (All rating increases are by 1 unless otherwise stated)	GIS Comments
Western Toad (*Anaxyrus boreas*)						
643	F	N	N	Both sides of rate At forest.	RZ in rural areas within documented toad moving distance from creeks, wetlands should be adjusted. All polygons along the Peace River with creeks should be rated M for toads to account for movement.	>50 m from water on TRIM. No change.
645, 646	D	H	H	Lake edge within 20m of wetland.	None	No change made
916, 917	F	M	M	M rating assigned is accurate.	None	No change made
918, 919, 920	F	H	H	H rating assigned is accurate.	None	No change made
967, 968	F	N	M	Obs adjacent to back channel of the Peace River.	All polygons along the Peace River with creeks should be rated M for toads to account for movement.	Changed from L to M in TEM.
1033	F	M	M	M rating assigned is accurate.	None	No change made

Appendix 2 – Maps

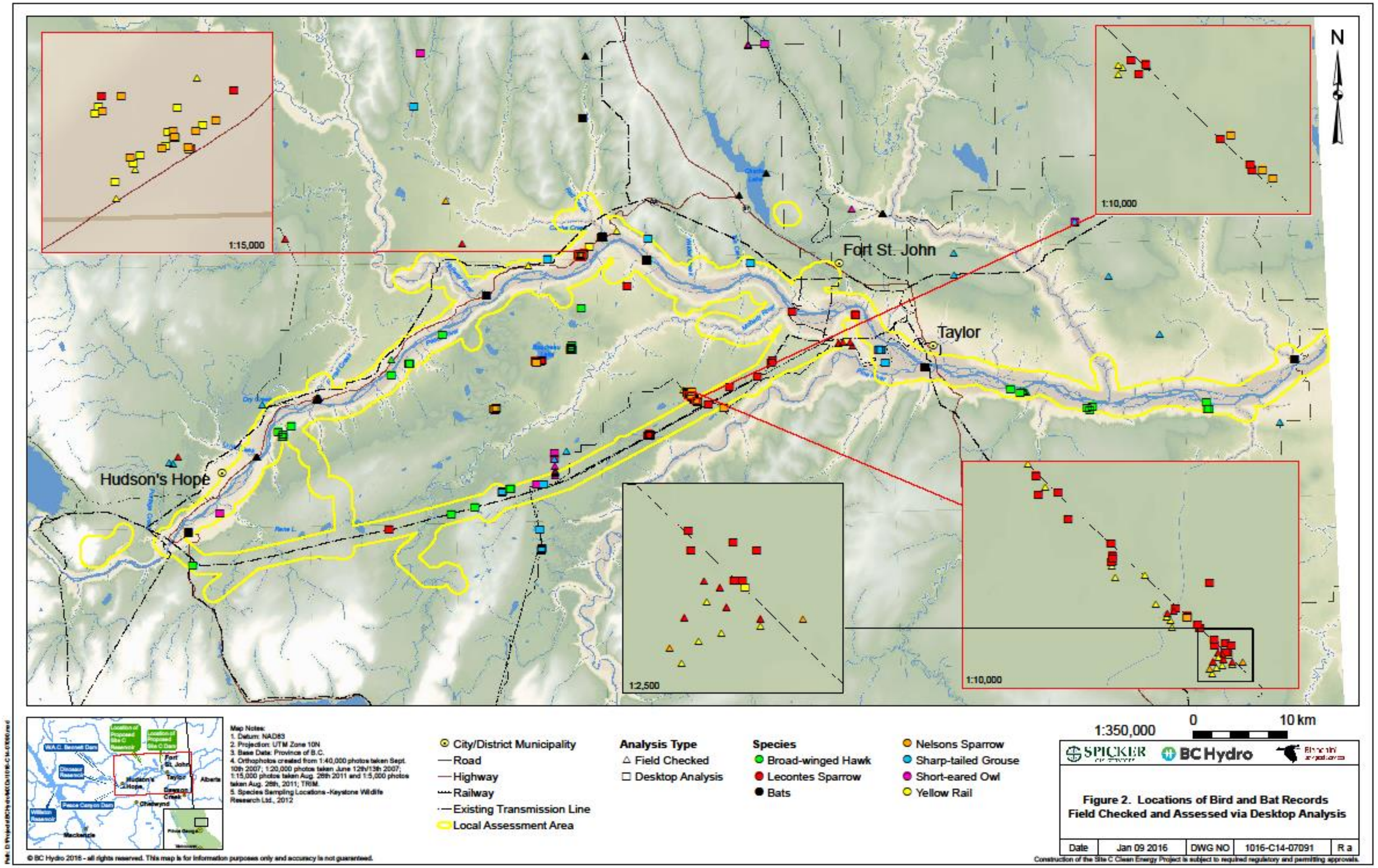

Figure 2. Locations of bird and bat records field checked and assessed via desktop analysis.

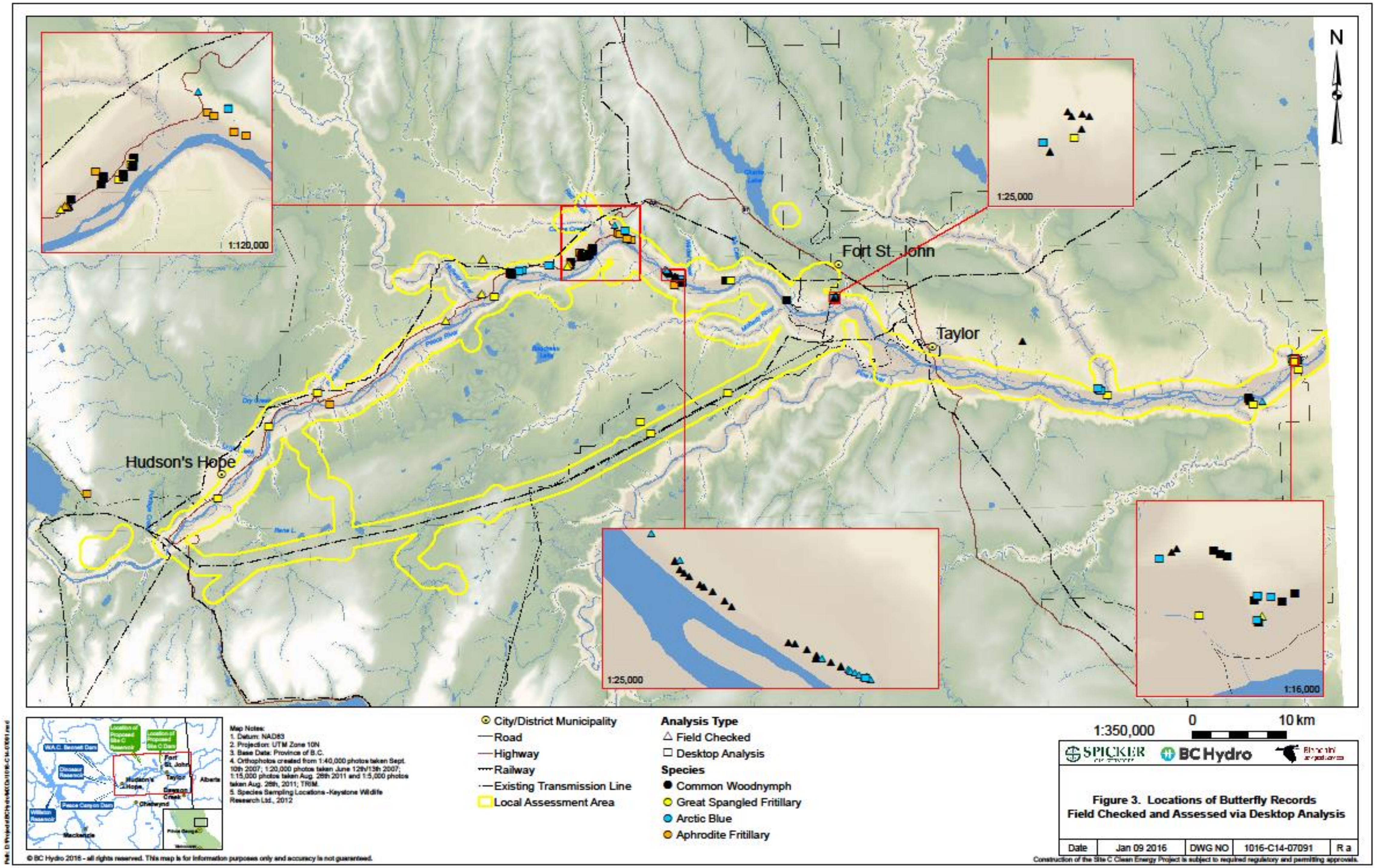

Figure 3. Locations of butterfly records field checked and assessed via desktop analysis.

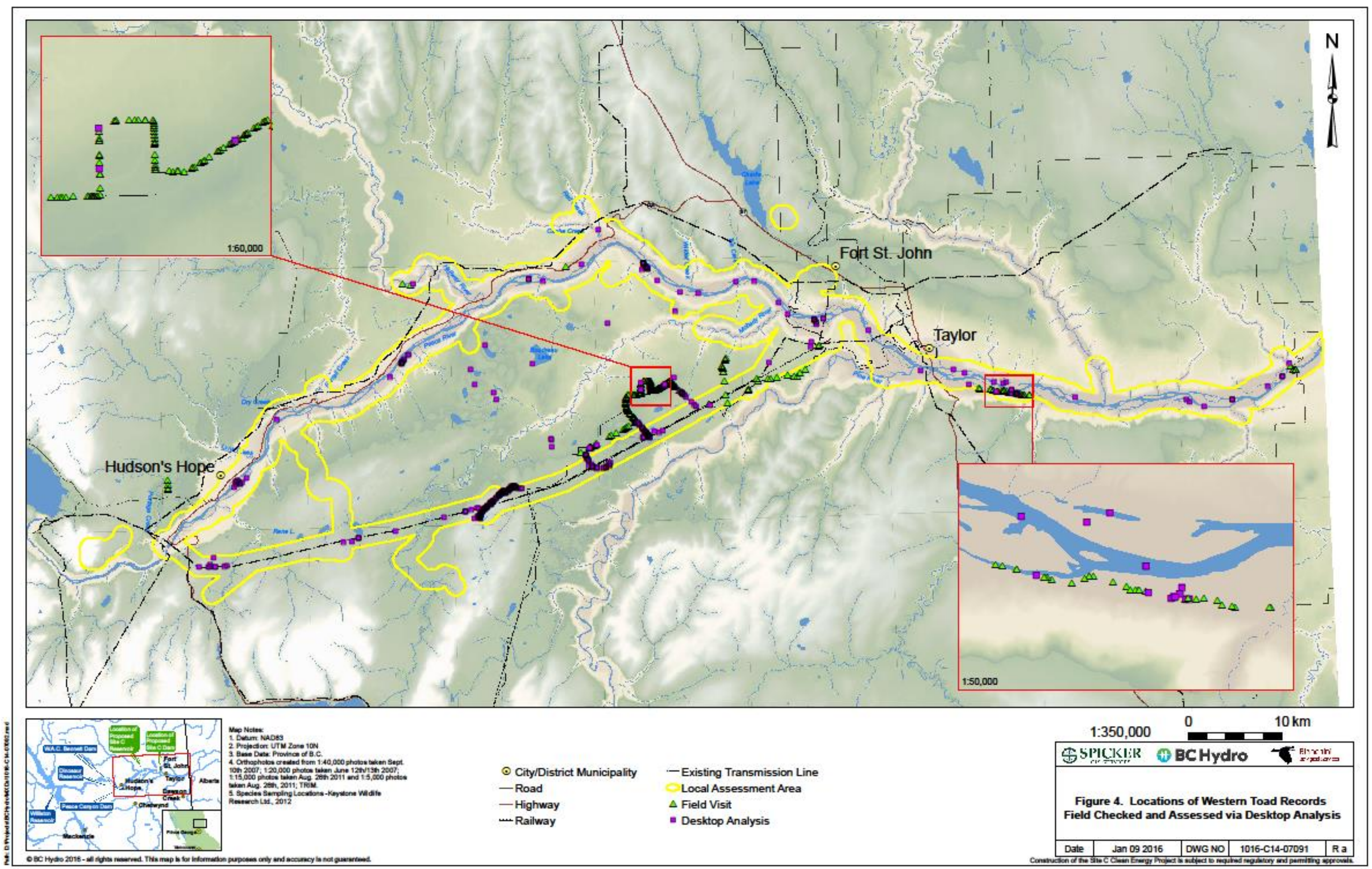

Figure 4. Locations of western toad records field checked and assessed via desktop analysis.

Appendix I. 2015 rare plant pre-construction survey report

INTERIM REPORT

RARE PLANT PRE-CONSTRUCTION SURVEYS

SITE C CLEAN ENERGY PROJECT

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1.0 INTRODUCTION

1.1 Background

The Environmental Assessment Certificate (EAC #E14-02) for the Site C Clean Energy Project (the Project) sets out the conditions that BC Hydro must comply with during construction and operation of the Project (BC Environmental Assessment Office 2014). Condition 9 states in part:

- *The EAC Holder must, with the use of a QEP, complete an inventory in areas not already surveyed and use rare plant location information as inputs to final design of access roads and transmission lines. These pre-construction surveys must target rare plants as defined in Section 13.2.2 of the EIS —including vascular plants, mosses, and lichens.*
- *The EAC Holder must create and maintain a spatial database of known rare plant occurrences in the vicinity of Project components that must be searched to avoid effects to rare plants during construction activities. The database must be updated as new information becomes available and any findings of new rare plant species occurrences must be submitted to Environment Canada and MOE using provincial data collection standards.*

In addition, the federal decision statement issued under the Canadian Environmental Assessment Act sets out conditions relating to rare plants (Canadian Environmental Assessment Agency 2014). Condition 16 states in part:

- *16.1 The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored.*
- *16.2. The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.*
- *16.3. The plan shall include:*
    - *16.3.3. measures to mitigate environmental effects on species at risk and at-risk and sensitive ecological communities and rare plants;*
    - *16.3.4. conservation measures to ensure the viability of rare plants, such as seed recovery and plant relocation;*
    - *16.3.6. an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive ecological communities and rare plants; and*

  - *16.3.7. an approach for tracking updates to the status of listed species identified by the Government of British Columbia, Committee on the Status of Endangered Wildlife in Canada, and the Species at Risk Act, and implementation of additional measures, in accordance with species recovery plans, to mitigate effects of the Designated Project on the affected species should the status of a listed species change during the life of the Designated Project.*

To partially fulfill EAC condition 9 and Federal conditions 16.1, 16.2, 16.3.3, 16.3.4, 16.3.6 and 16.3.7, BC Hydro is conducting pre-construction rare plant surveys in previously unsurveyed areas of the proposed transmission line and roads. By documenting additional occurrences of rare plants within the Project footprint, measures to mitigate these occurrences—including seed recovery and translocation—can be identified.

Data collected during these surveys will be added to the Project's environmental features map. This map is used during detailed design and construction to identify opportunities for avoidance, areas where extra care is needed and areas where losses will occur. The first season of pre-construction surveys was completed in the summer and fall of 2015, and this interim report documents the methods and results of this work.

1.2 Scope

The goals of the study are:

- to determine the location of rare plant occurrences in previously unsurveyed areas that are proposed for ground or vegetation disturbance during construction and operation of the Project;
- to record detailed element occurrence data in the Project rare plant database on all rare plant populations found, and submit these data to the BC Ministry of Environment and—for taxa of federal concern—to Environment Canada; and
- to develop occurrence-specific mitigation measures to eliminate or reduce adverse effects to rare plant populations as a result of the Project.

1.3 Areas Targeted for Pre-construction Surveys

Pre-construction rare plant surveys are being conducted in:

- the proposed Project Access Road running from Jackfish Road to the Dam Site;
- the additional aggregate extraction area at the Portage Mountain site;
- the proposed access road extension at the Portage Mountain site;
- the Highway 29 realignment corridors;
- the proposed new or upgraded transmission line access roads;

- the proposed new or upgraded access roads into the reservoir clearing zone;
- the 85th Avenue industrial site; and
- the proposed conveyor corridor from the 85th Avenue industrial site to the dam site.

2.0 METHODS

2.1 Prefield Review

The investigation began with a prefield review designed to collect and analyze existing data. This information was used to create a field study plan and to identify data gaps in order to direct further research.

For the purpose of the investigation "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 2015b); and
- species on the BC Ministry of Environment's provincial Red or Blue lists (BCCDC 2015).

Since 2005 BC Hydro has been performing rare plant surveys in the Project area—defined as the area within which Terrestrial Ecosystem Mapping was completed to support the Site C Environmental Impact Statement (Hilton, et al. 2013). As such, much is known about the rare flora of the area, and the prefield review was based heavily on element occurrence data collected over the last 10 years in the Project area. Currently, 47 different rare plant taxa are known to occur in the Project area. Consequently, these 36 vascular plants, 10 lichens, and 1 moss formed the basis of the target species list for the 2015 work, comprising the rare species with the highest likelihood of occurrence.

The dataset of all BC vascular plants, mosses, and lichens was downloaded from the Ministry of Environment's Species and Ecosystem Explorer (BCCDC 2015) and added to the Project rare plant database. This dataset served as the reference for BC plant statuses, as well as providing the scientific and common plant names used in this report. Queries were run on the dataset to extract a list of the rare plant species considered to potentially occur in the Peace River Regional District and the Boreal Black and White Spruce Biogeoclimatic Zone. Each species on this list was further reviewed to determine its potential for occurrence within the areas targeted for survey.

Aerial imagery, contour information, and Project maps were reviewed to predict the habitat types present in the areas targeted for survey. General plant communities were determined, and the locations of possible high-suitability rare plant habitat were noted.

All of the above data were compiled to produce a list of target rare plant species with potential for occurrence within the areas targeted for survey. 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 refine their search images for the target taxa, the surveyors studied photographs, herbarium specimens, and species descriptions in various published references (Hitchcock, et al. 1955; Cronquist, et al. 1977; Flora of North America Editorial Committee 1993; Goward, et al. 1994; McCune and Goward 1995; Douglas, et al. 1998; Goward 1999a; Brodo, et al. 2001; CNALH 2015a) and online databases (Klinkenberg 2015; NatureServe 2015). In addition, they reviewed similar data for species that might be confused with the target taxa. 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. The final field plan was designed to guide the methods, coverage, and timing of the rare plant surveys. Seasonal timing was based on the predicted phenologies of the target species.

2.2 Field Survey

Field surveys were performed between June 30 and September 7, 2015. The surveys were performed by two senior-level rare plant botanists—both of whom have been working with the flora of the Project area for the past five years. A total of 42 botanist-survey-days were spent on the ground in 2015, covering a total survey distance of 209.8 km (Figure 1).

The surveyors used a targeted-meander search protocol to cover most of the areas targeted. This survey technique is based on floristic, intuitive-controlled meander search types outlined in various rare plant survey guidelines (Whiteaker, et al. 1998; ANPC 2000; ANPC 2012; Penny and Klinkenberg 2012). The surveyors, working in pairs or separately, walked the length of the targeted linear corridors, zig-zagging back and forth from one edge of the proposed disturbance area to the other. For non-linear survey areas such as the Industrial 85th or Portage Mountain sites, the surveyors conducted meander transects to cover the entire area.

When using the targeted-meander search pattern:

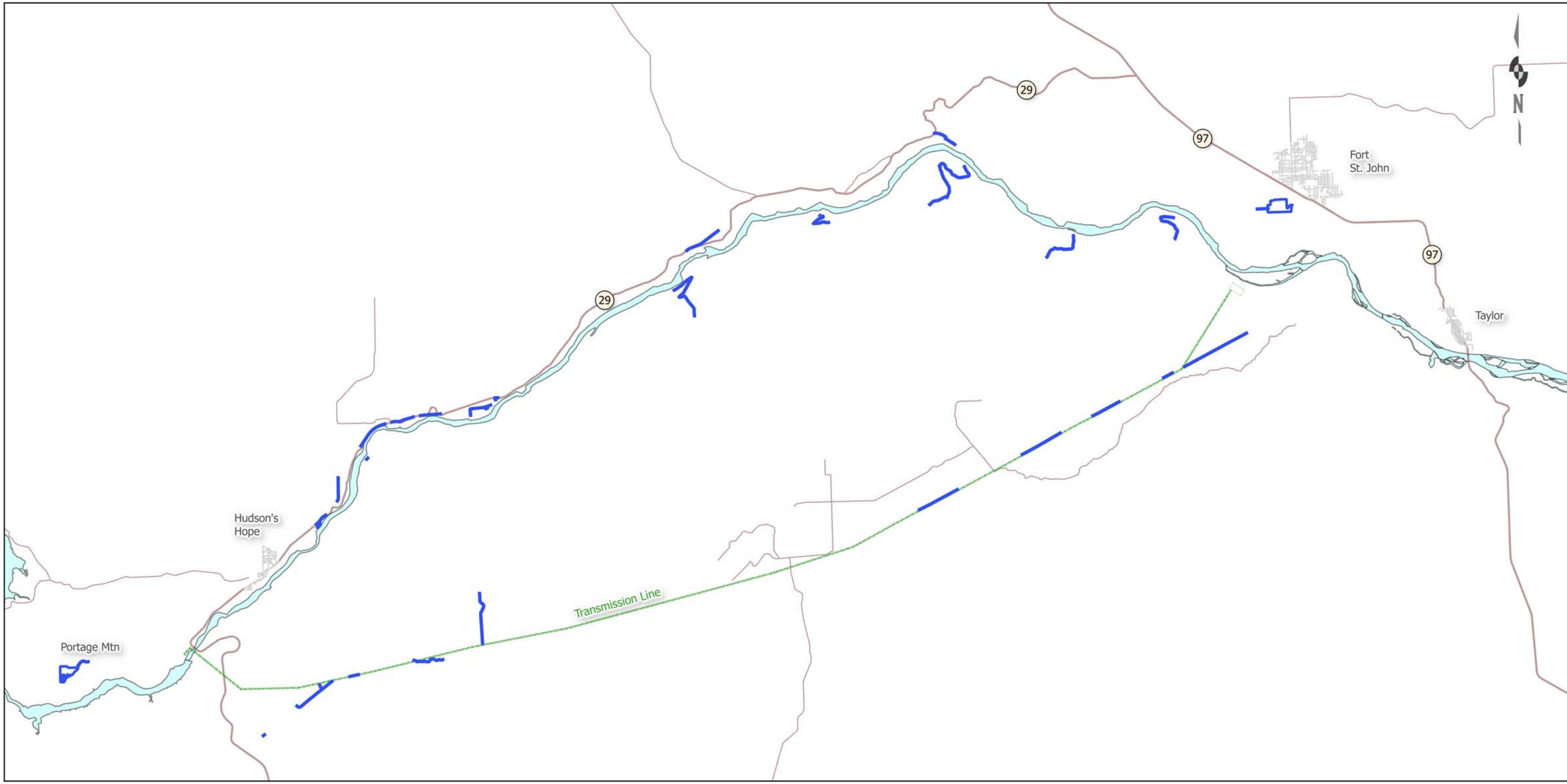
- surveyors walk variable-width transects that are spaced relatively close together (typically so that the edge of the transect just surveyed is still visible to the surveyor or their partner—this distance varies based on the habitat surveyed and the detectability of the target species);
- surveyors 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 non-linear feature); and
- surveyors attempt to traverse a representative cross-section of all low-suitability rare plant habitat within the unit.

The targeted-meander survey technique is habitat-directed; that is, it preferentially covers high-suitability ecosystems over the more common low-suitability habitats (MacDougall and Loo 2002). The survey method is also floristic in nature: meaning that all plant taxa encountered are recorded and identified to a level necessary to determine their rarity (ANPC 2012). Furthermore, the targeted-meander search pattern is 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.

For certain linear corridors that traversed habitat with a low potential for rare plant occurrence, the botanists drove slowly along in a Utility Terrain Vehicle (UTV or side-by-side) scanning both sides for rare plants. This was only done for corridors where the majority of habitat was low-probability, and at a speed of approximately 5 km/hour. If high-potential rare plant habitat was encountered—such as wetlands or rock outcrops—the surveyors got out of the UTV and surveyed the habitat on foot. In 2015, 5.1% of the total 209.8 km traversed was surveyed from UTV—the rest was walked.

During the field work, the surveyors constantly monitored all areas traversed for changes in habitat and plant association, as well as for previously unrecorded plant species (common and rare). Lists were kept of all plants and plant communities observed; unknown species were collected for later identification in the lab; global positioning system (GPS) units were used to mark location points as appropriate; and notes and photographs were taken to record plants of interest, landforms and unique features, habitat quality and disturbance, and areas requiring further survey.

When target rare plants were found during the field work, element occurrence data were recorded on a BCCDC rare plant survey form (BCCDC 2012). 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 (RIC 1999; Penny and Klinkenberg 2012), a voucher specimen was collected when doing so would not compromise the viability of the population. At each vascular rare plant site, GPS units were used to record the boundary of each occurrence (and suboccurrence where applicable) to facilitate mitigation planning.



Map Notes:

1. Based on surveys completed through September 2015.
2. Map Datum: NAD83
3. Map Projection: UTM Zone 10 N
4. Water Features Base Data from BC FreshwaterAtlas.
5. Road Base Data from the BC Digital Roads Atlas project.
6. Project-specific spatial data supplied by BC Hydro.

Legend

Roads

- Highway
- Secondary Roads
- Urban
- Areas Surveyed in 2015
- Peace River

Map Scale 1:250000

0 10 20 km

SITE C CLEAN ENERGY PROJECT

BC hydro

EAGLE CAP CONSULTING environmental consulting services

Figure 1:
Areas Surveyed for Rare Plants in 2015

Date	October 26, 2015	DWG NO	2015-10-01-0001	Revision 0

3.0 RESULTS

3.1 Prefield Review

The prefield review identified 200 rare taxa thought to have potential for occurrence within the areas to be surveyed (Table 1). Of these, 116 are vascular plants, 34 are mosses, and 50 are lichens. All of the species are on the BC Ministry of Environment's Blue or Red Lists (121 Blue and 79 Red); 3 are considered to be of possible conservation concern by COSEWIC (all three Threatened); and 2 are listed in Schedule 1 of the Species at Risk Act (both Threatened).

Table 1: Rare plant taxa with potential for occurrence within the areas to be surveyed

Taxon	Common Name	BC List	COSEWIC	SARA
VASCULAR PLANTS				
Acorus americanus	American sweet-flag	Red	-	-
Alopecurus magellanicus	alpine meadow-foxtail	Red	-	-
Anemone canadensis	Canada anemone	Blue	-	-
Antennaria neglecta	field pussytoes	Blue	-	-
Arctophila fulva	pendantgrass	Blue	-	-
Artemisia alaskana	Alaskan sagebrush	Blue	-	-
Artemisia herriotii	Herriot's sage	Red	-	-
Astragalus umbellatus	tundra milk-vetch	Blue	-	-
Astragalus vexilliflexus var. vexilliflexus	bent-flowered milk-vetch	Blue	-	-
Atriplex gardneri var. gardneri	Gardner's sagebrush	Red	-	-
Avenula hookeri	spike-oat	Blue	-	-
Boechera sparsiflora	stretching suncress	Red	-	-
Botrychium ascendens	upswept moonwort	Blue	-	-
Botrychium crenulatum	dainty moonwort	Blue	-	-
Botrychium lineare	Linear-leaf moonwort	Blue	-	-
Botrychium montanum	mountain moonwort	Red	-	-
Botrychium paradoxum	two-spiked moonwort	Red	-	-
Botrychium simplex var. compositum	least moonwort	Blue	-	-
Botrychium spathulatum	spoon-shaped moonwort	Blue	-	-
Braya glabella ssp. glabella	smooth northern-rockcress	Red	-	-
Calamagrostis montanensis	plains reedgrass	Blue	-	-
Carex bicolor	two-coloured sedge	Blue	-	-
Carex fuliginosa ssp. misandra	short-leaved sedge	Blue	-	-
Carex heleonastes	Hudson Bay sedge	Blue	-	-
Carex lapponica	Lapland sedge	Red	-	-
Carex lenticularis	lakeshore sedge	Blue	-	-
Carex membranacea	fragile sedge	Blue	-	-
Carex rupestris ssp. rupestris	curly sedge	Blue	-	-
Carex sprengelii	Sprengel's sedge	Red	-	-
Carex torreyi	Torrey's sedge	Blue	-	-

Taxon	Common Name	BC List	COSEWIC	SARA
Carex xerantica	dry-land sedge	Blue	-	-
Castilleja miniata var. fulva	tawny paintbrush	Red	-	-
Chamaerhodos erecta ssp. nuttallii	American chamaerhodos	Blue	-	-
Chenopodium hians	gaping goosefoot	Red	-	-
Chrysosplenium iowense	Iowa golden-saxifrage	Red	-	-
Cirsium drummondii	Drummond's thistle	Blue	-	-
Descurainia sophioides	northern tansymustard	Blue	-	-
Draba cinerea	gray-leaved draba	Blue	-	-
Draba fladnizensis	Austrian draba	Blue	-	-
Draba lactea	milky draba	Blue	-	-
Draba porsildii	Porsild's draba	Blue	-	-
Drosera linearis	slender-leaf sundew	Red	-	-
Dryopteris cristata	crested wood fern	Blue	-	-
Eleocharis elliptica	elliptic spike-rush	Blue	-	-
Elymus lanceolatus ssp. psammophilus	sand-dune wheatgrass	Blue	-	-
Epilobium halleanum	Hall's willowherb	Blue	-	-
Epilobium hornemannii ssp. behringianum	Hornemann's willowherb	Blue	-	-
Epilobium saximontanum	Rocky Mountain willowherb	Red	-	-
Erigeron pacalis	Peace daisy	Red	-	-
Erigeron trifidus	three-lobed daisy	Blue	-	-
Erigeron uniflorus var. eriocephalus	northern daisy	Blue	-	-
Gentianella tenella ssp. tenella	slender gentian	Red	-	-
Geum triflorum var. triflorum	old man's whiskers	Red	-	-
Glyceria pulchella	slender mannagrass	Blue	-	-
Helianthus nuttallii ssp. rydbergii	Nuttall's sunflower	Red	-	-
Hesperostipa spartea	porcupinegrass	Blue	-	-
Impatiens aurella	orange touch-me-not	Blue	-	-
Juncus albescens	whitish rush	Blue	-	-
Juncus confusus	Colorado rush	Blue	-	-
Juncus stygius ssp. americanus	bog rush	Blue	-	-
Lomatium foeniculaceum var. foeniculaceum	fennel-leaved desert-parsley	Red	-	-
Lomatogonium rotatum	marsh felwort	Blue	-	-
Lupinus kuschei	Yukon lupine	Blue	-	-
Luzula confusa	northern wood-rush	Blue	-	-
Malaxis brachypoda	white adder's-mouth orchid	Blue	-	-
Micranthes nelsoniana var. carlottae	dotted saxifrage	Blue	-	-
Ophioglossum pusillum	northern adder's-tongue	Blue	-	-
Oxytropis campestris var. davisii	Davis' locoweed	Blue	-	-
Oxytropis maydelliana	Maydell's locoweed	Blue	-	-
Oxytropis nigrescens var. uniflora	one-flower oxytrope	Blue	-	-
Packera ogotorukensis	Ogotoruk Creek butterweed	Red	-	-

Taxon	Common Name	BC List	COSEWIC	SARA
Papaver alboroseum	pale poppy	Blue	-	-
Pedicularis parviflora ssp. parviflora	small-flowered lousewort	Red	-	-
Pedicularis verticillata	whorled lousewort	Blue	-	-
Penstemon gormanii	Gorman's penstemon	Blue	-	-
Penstemon gracilis	slender penstemon	Red	-	-
Physaria arctica	arctic bladderpod	Blue	-	-
Physaria didymocarpa ssp. didymocarpa	common twinpod	Blue	-	-
Pinguicula villosa	hairy butterwort	Blue	-	-
Piptatherum canadense	Canada ryegrass	Red	-	-
Plantago eriopoda	alkali plantain	Blue	-	-
Polemonium boreale	northern Jacob's-ladder	Blue	-	-
Polygala senega	Seneca-snakeroot	Red	-	-
Polypodium sibiricum	Siberian polypody	Red	-	-
Potamogeton perfoliatus	perfoliate pondweed	Blue	-	-
Potentilla nivea var. pentaphylla	five-leaved cinquefoil	Blue	-	-
Potentilla pulcherrima	pretty cinquefoil	Red	-	-
Prenanthes racemosa	purple rattlesnake-root	Red	-	-
Pyrola elliptica	shinleaf wintergreen	Blue	-	-
Ranunculus cardiophyllus	heart-leaved buttercup	Red	-	-
Ranunculus pedatifidus ssp. affinis	birdfoot buttercup	Blue	-	-
Ranunculus rhomboideus	prairie buttercup	Red	-	-
Rorippa calycina	persistent-sepal yellowcress	Red	-	-
Rosa arkansana var. arkansana	Arkansas rose	Blue	-	-
Rumex arcticus	arctic dock	Blue	-	-
Salix petiolaris	meadow willow	Blue	-	-
Salix raupii	Raup's willow	Red	-	-
Sarracenia purpurea ssp. purpurea	common pitcher-plant	Red	-	-
Saussurea angustifolia var. angustifolia	northern sawwort	Red	-	-
Schizachyrium scoparium	little bluestem	Red	-	-
Selaginella rupestris	rock selaginella	Red	-	-
Senecio sheldonensis	Mount Sheldon butterweed	Blue	-	-
Silene drummondii var. drummondii	Drummond's campion	Blue	-	-
Silene ostenfeldii	Taimyr campion	Blue	-	-
Silene repens	pink campion	Red	-	-
Sphaeralcea coccinea	scarlet globe-mallow	Red	-	-
Sphenopholis intermedia	slender wedgegrass	Blue	-	-
Sphenopholis obtusata	prairie wedgegrass	Red	-	-
Stuckenia vaginata	sheathing pondweed	Blue	-	-
Symphyotrichum puniceum var. puniceum	purple-stemmed aster	Blue	-	-
Tephroseris palustris	marsh fleabane	Blue	-	-
Thalictrum dasycarpum	purple meadowrue	Red	-	-

Taxon	Common Name	BC List	COSEWIC	SARA
Thermopsis rhombifolia	prairie golden bean	Red	-	-
Tofieldia coccinea	northern false asphodel	Blue	-	-
Townsendia hookeri	Hooker's townsendia	Red	-	-
Utricularia ochroleuca	ochroleucous bladderwort	Blue	-	-
MOSSES				
Acaulon muticum var. rufescens	[no common name]	Red	-	-
Amblyodon dealbatus	[no common name]	Blue	-	-
Atrichum tenellum	[no common name]	Red	-	-
Aulacomnium acuminatum	[no common name]	Blue	-	-
Barbula convoluta var. gallinula	[no common name]	Red	-	-
Bartramia halleriana	Haller's apple moss	Red	T	1-T
Brachythecium trachypodium	[no common name]	Blue	-	-
Bryobrittonia longipes	[no common name]	Blue	-	-
Bryum uliginosum	[no common name]	Blue	-	-
Cynodontium glaucescens	[no common name]	Blue	-	-
Dicranum majus var. orthophyllum	[no common name]	Red	-	-
Didymodon rigidulus var. icmadophilus	[no common name]	Blue	-	-
Didymodon subandreaeoides	[no common name]	Red	-	-
Encalypta brevicollis	[no common name]	Blue	-	-
Encalypta intermedia	[no common name]	Blue	-	-
Encalypta longicolla	[no common name]	Blue	-	-
Encalypta mutica	[no common name]	Blue	-	-
Encalypta spathulata	[no common name]	Blue	-	-
Grimmia teretinervis	[no common name]	Red	-	-
Haplodontium macrocarpum	Porsild's bryum	Red	T	1-T
Hygrohypnum alpestre	[no common name]	Blue	-	-
Hygrohypnum alpinum	[no common name]	Blue	-	-
Lescuraea saxicola	[no common name]	Blue	-	-
Meesia longiseta	[no common name]	Blue	-	-
Myurella sibirica	[no common name]	Red	-	-
Orthothecium strictum	[no common name]	Blue	-	-
Orthotrichum speciosum var. elegans	[no common name]	Blue	-	-
Philonotis yezoana	[no common name]	Blue	-	-
Plagiobryum demissum	[no common name]	Red	-	-
Pohlia bulbifera	[no common name]	Blue	-	-
Pseudocalliergon turgescens	[no common name]	Blue	-	-
Schistidium boreale	[no common name]	Blue	-	-
Schistidium confertum	[no common name]	Red	-	-
Schistidium pulchrum	[no common name]	Blue	-	-
Schistidium robustum	[no common name]	Blue	-	-
Schistidium trichodon	[no common name]	Blue	-	-
Seligeria subimmersa	[no common name]	Red	-	-

Taxon	Common Name	BC List	COSEWIC	SARA
Seligeria tristichoides	[no common name]	Blue	-	-
Sphagnum contortum	[no common name]	Blue	-	-
Sphagnum wulfianum	[no common name]	Blue	-	-
Splachnum vasculosum	[no common name]	Blue	-	-
Tayloria froelichiana	[no common name]	Blue	-	-
Tayloria splachnoides	[no common name]	Red	-	-
Tetraplodon urceolatus	[no common name]	Red	-	-
Timmia norvegica	[no common name]	Blue	-	-
Timmia sibirica	[no common name]	Red	-	-
Tortella humilis	[no common name]	Red	-	-
Trichostomum crispulum	[no common name]	Blue	-	-
Warnstorfia pseudostraminea	[no common name]	Blue	-	-
Weissia brachycarpa	[no common name]	Blue	-	-
LICHENS				
Anaptychia crinalis	electrified millepede	Red	-	-
Anaptychia ulotrichoides	amputated millepede	Blue	-	-
Cladonia grayi	gray's pixie-cup	Red	-	-
Cladonia parasitica	fence-rail pixie	Red	-	-
Collema bachmanianum	Caesar's tarpaper	Red	-	-
Collema coniophilum	crumpled tarpaper	Red	T	-
Collema multipartitum	protracted tarpaper	Red	-	-
Fulgensia bracteata	goldnugget sulphur	Blue	-	-
Fulgensia bracteata	goldnugget sulphur	Blue	-	-
Fulgensia desertorum	desert sulphur	Red	-	-
Heterodermia speciosa	smiling centipede	Red	-	-
Lempholemma polyanthes	mourning phlegm	Blue	-	-
Leptogium intermedium	fourty-five vinyl	Blue	-	-
Leptogium plicatile	starfish vinyl	Blue	-	-
Leptogium pseudofurfuraceum	concentric vinyl	Blue	-	-
Leptogium schraderi	collapsing vinyl	Red	-	-
Leptogium tenuissimum	birdnest vinyl	Red	-	-
Peltigera degenii	lustrous pelt	Red	-	-
Peltigera evansiana	peppered pelt	Red	-	-
Phaeophyscia adiastola	granulating shadow	Red	-	-
Phaeophyscia hirsuta	smiling shadow	Red	-	-
Phaeophyscia hispidula	whiskered shadow	Red	-	-
Phaeophyscia kairamoi	five o'clock shadow	Blue	-	-
Phaeophyscia nigricans	least shadow	Red	-	-
Physcia dimidiata	exuberant rosette	Red	-	-
Physcia stellaris	immaculate rosette	Blue	-	-
Physcia tribacia	beaded rosette	Red	-	-
Physciella chloantha	downside shade	Blue	-	-

Taxon	Common Name	BC List	COSEWIC	SARA
Punctelia perreticulata	galactic speckleback	Red	-	-
Ramalina sinensis	threadbare ribbon	Blue	-	-
Squamarina cartilaginea	pea-green dimple	Red	-	-
Squamarina lentigera	snow-white dimple	Red	-	-
Usnea cavernosa	pitted beard	Blue	-	-
Usnea glabrata	lustrous beard	Blue	-	-

Table notes:

- *BC List (BC Ministry of Environment): Red = Endangered, Threatened, or Extirpated; Blue = Special Concern*
- *COSEWIC (Committee on the Status of Endangered Wildlife in Canada): E = Endangered; T = Threatened; SC = Special Concern; DD = Data Deficient*
- *SARA (Species at Risk Act): 1-E = Schedule 1 Endangered; 1-T = Schedule 1 Threatened; 1-SC = Schedule 1 Special Concern*

3.2 Field Survey

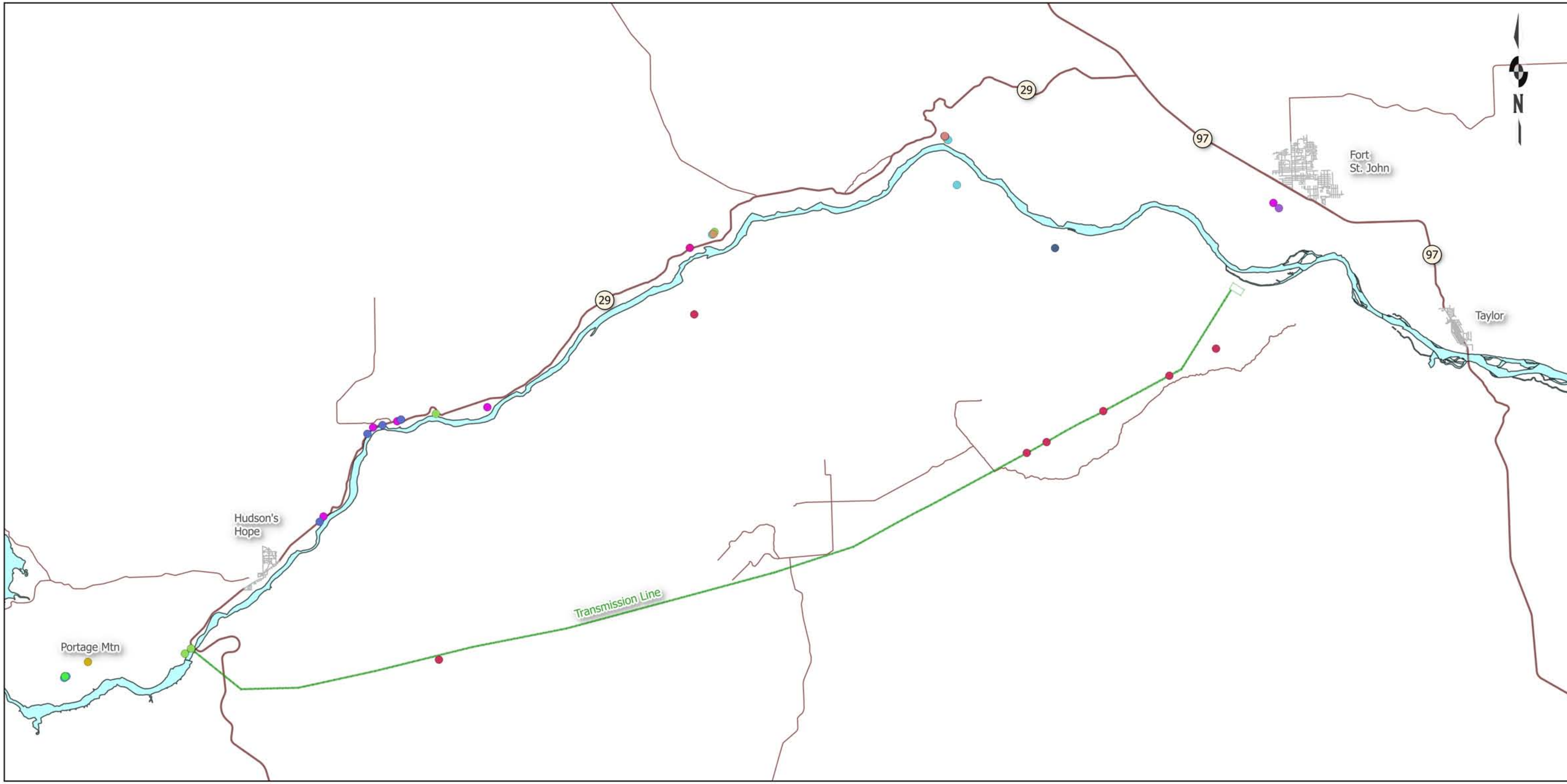
The 2015 field surveys found 39 new sites of 16 different rare plant species—13 vascular plants and 3 lichens (Table 2 and Figure 2). Many of these new sites were within one kilometre of other occurrences of the same species found in previous years, and so were considered to be extensions of these larger occurrences. Of the 16 rare species, 6 are on the BC Ministry of Environment's 'Red' list, with the remaining 10 being on the 'Blue' list. None of the taxa are listed on Schedule 1 of the Species at Risk Act, or are considered to be Extinct, Extirpated, Endangered, Threatened, or Special Concern by COSEWIC (Government of Canada 2002; COSEWIC 2015b).

Table 2: Rare plants found during the 2015 Site C preconstruction surveys

Taxon	Common Name	Sites	BC List
VASCULAR PLANTS			
Artemisia herriotii	Herriot's sage	3	Red
Calamagrostis montanensis	plains reedgrass	2	Blue
Carex sprengelii	Sprengel's sedge	1	Red
Carex torreyi	Torrey's sedge	1	Blue
Carex xerantica	dry-land sedge	1	Blue
Castilleja miniata var. *fulva*	tawny paintbrush	1	Red
Geum triflorum var. triflorum	old man's whiskers	2	Red
Oxytropis campestris var. *davisii*	Davis' locoweed	1	Blue
Penstemon gracilis	slender penstemon	1	Red
Polypodium sibiricum	Siberian polypody	3	Red
Silene drummondii var. *drummondii*	Drummond's campion	1	Blue
Sphenopholis intermedia	slender wedgegrass	4	Blue
Symphyotrichum puniceum var. *puniceum*	purple-stemmed aster	7	Blue
LICHENS			
Physcia biziana	frosted rosette	1	Blue
Physcia stellaris	immaculate rosette	6	Blue
Ramalina sinensis	threadbare ribbon	4	Blue

Table notes:

- *Sites = Number of sub-occurrences found in 2015*
- *BC List (BC Ministry of Environment): Red = Endangered, Threatened, or Extirpated; Blue = Special Concern*



Map Notes:

1. Based on surveys completed through September 2015.
2. Map Datum: NAD83
3. Map Projection: UTM Zone 10 N
4. Water Features Base Data from BC FreshwaterAtlas.
5. Road Base Data from the BC Digital Roads Atlas project.
6. Project-specific spatial data supplied by BC Hydro.

Rare Plant Sites

- *Artemisia herriotii*
- *Calamagrostis montanensis*
- *Carex sprengelii*
- *Carex torreyi*
- *Carex xerantica*
- *Castilleja miniata var. fulva*
- *Geum triflorum var. triflorum*
- *Oxytropis campestris var. davisii*
- *Penstemon gracilis*
- *Physcia stellaris*
- *Polypodium sibiricum*
- *Ramalina sinensis*
- *Silene drummondii var. drummondii*
- *Sphenopholis intermedia*
- *Symphyotrichum puniceum var. puniceum*
- *Physcia biziana*

Map Scale 1:250000

0 10 20 km

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Figure 2:
Rare Plant Sites Found in 2015

Date	November 9, 2015	DWG NO	2015-10-01-0002	Revision 1

Most of the rare taxa found in 2015 had been documented previously in other occurrences during the baseline surveys performed for the Project environmental impact assessment. The 2015 Sprengel's sedge and frosted rosette finds, however, represent new species documented in the Project area. In addition, although tawny paintbrush and old man's whiskers had been documented in the Project area during the baseline studies, they were not officially listed by the BC Conservation Data Centre at the time, and so were not treated in the impact assessment.

Species descriptions for 10 of the 16 rare plants recorded in 2015 can be found in the Project's Environmental Impact Statement (Hilton, et al. 2013). The six not included in that document—Sprengel's sedge, tawny paintbrush, old man's whiskers, frosted rosette, immaculate rosette, and threadbare ribbon—are described below.

3.2.1 Carex sprengelii (Sprengel's sedge)

Sprengel's sedge (Figure 3) is a perennial herb belonging to the Cyperaceae (sedge family); plants have tall stems with fibrous bases, and bear drooping seed heads. The species forms loose clumps in a variety of dry to wet habitats, including openings, slopes, and alluvial woodlands, often on calcareous substrates (Douglas, et al. 2001; Ball and Reznicek 2002). In BC, Sprengel's sedge is reported from two locations near William's Lake, and one location in the Peace River region (BCCDC 2015; Klinkenberg 2015). The taxon ranges across North America as far east as New Brunswick, and as far south as Colorado, Missouri, and New Jersey. It is also reported from Alaska (Ball and Reznicek 2002; NatureServe 2015).

Figure 3: *Carex sprengelii* (Sprengel's sedge)

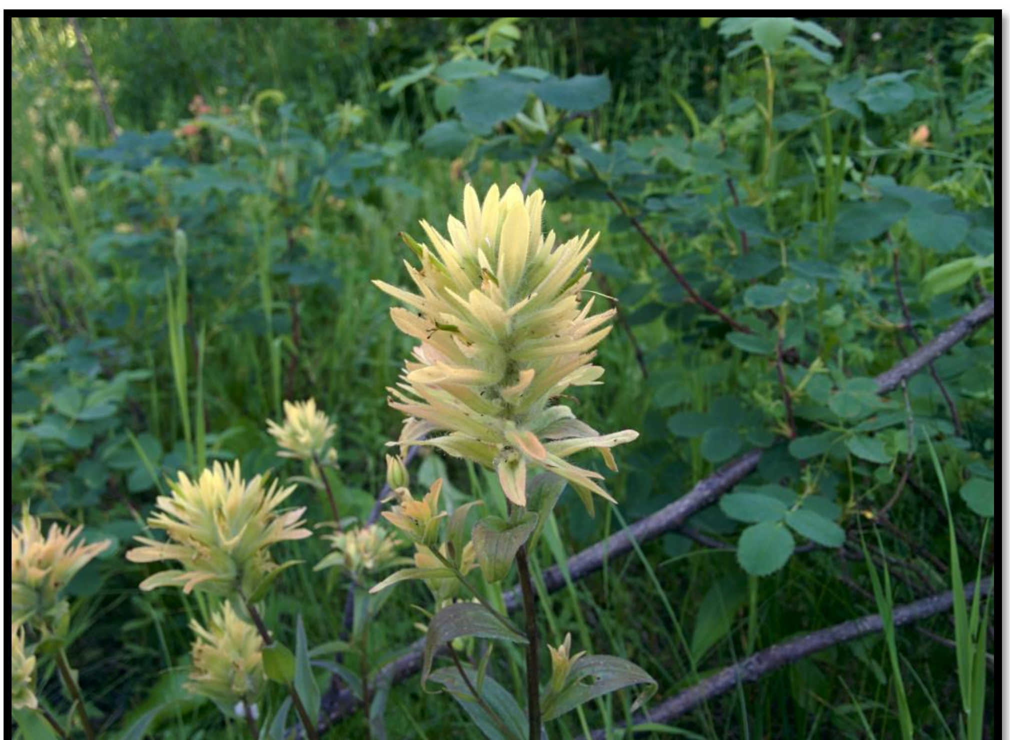
Sprengel's sedge has a rank of S2 (Imperiled) in BC, and is on the provincial Red list (BCCDC 2015). Across much of North America the taxon is classed as Secure (G5) or Apparently Secure (G4), but is considered rare on the western, southern, and eastern edges of its range: S3 (Vulnerable) in Quebec, Pennsylvania, Illinois, Montana and Wyoming; S2 (Imperiled) in New Brunswick, Maine, Ohio, and Colorado; S1 (Critically Imperiled) in Missouri and Alaska, and SH (Possibly Extirpated) in Delaware (NatureServe 2015).

One occurrence of Sprengel's sedge was located in the areas surveyed (Figure 2). Site-specific rare plant surveys in 2015 recorded the species east of Bear Flat above the north shore of the Peace River, in recently burned grassland-open woodland habitat. Several plants were observed in an area of less than one square metre, along a trail in an old road track near a calcareous seep. The area showed signs of moderate to heavy disturbance, and weedy plant species were abundant.

3.2.2 Castilleja miniata var. *fulva (tawny paintbrush)*

Tawny paintbrush (Figure 4) is a perennial herb in the Orobanchaceae (Broom-rape family) which grows in grasslands, open forests, and roadsides in northern BC (Douglas, et al. 1998; Egger 2008; Klinkenberg 2015). The taxon is currently ranked SH (Historical) in BC, and is on the Red list for the province (BCCDC 2015). Globally tawny paintbrush is classed G1Q, meaning that there are unresolved questions regarding the taxonomy or distribution of the taxon. Because of the taxonomic uncertainty regarding the species, tawny paintbrush was not tracked at the time the rare plant surveys were being conducted for the Project Environmental Assessment. However, new work being conducted for the upcoming Flora of North America treatment of the Broom-rape family has suggested that variety *fulva* is a valid taxon (Egger 2008).

Figure 4: *Castilleja miniata* var. *fulva* (tawny paintbrush)



Although only one occurrence of tawny paintbrush is listed in Table 2 hundreds of individuals were found throughout the western half of the areas surveyed. Point locations were recorded each time this species was encountered, but due to the large number of occurrences, detailed element occurrence data were not recorded for each site. In all, 382 point locations were recorded spread out over an area hundreds of square kilometres in size. Tawny paintbrush specimens were collected and sent to the botanist who described the variety, in order to confirm the identification. Given the large number of plants in the Peace Region, as well as newly found occurrences in northwestern BC, it is expected that tawny paintbrush will be de-listed with the next BCCDC status update in the spring of 2016.

3.2.3 Geum triflorum var. triflorum (old man's whiskers)

Old man's whiskers (Figure 5) is a low, soft-hairy perennial herb of the Rosaceae (rose family) that is found growing on dry to mesic slopes and bluffs, and in grasslands, meadows, prairies, and open woodlands (Douglas, et al. 1999; Rohrer 2014). Variety *triflorum* is differentiated from variety *ciliatum* by small differences in the leaves and style, and by geographic range (Rohrer 2014). In BC, variety *triflorum* is restricted to the Peace River region, where it has been reported from six locations, mostly on the dry grassland breaks above the Peace River (BCCDC 2015; Klinkenberg 2015). Old man's whiskers variety *triflorum* is distributed across North America as far east as New York state, and as far south as Arizona, New Mexico, and Illinois (Rohrer 2014; NatureServe 2015).

Figure 5: *Geum triflorum* var. *triflorum* (old man's whiskers)

Old man's whiskers variety *triflorum* is ranked S1/S3 (Critically Imperiled/Vulnerable) in BC, and is on the province's Red list (BCCDC 2015). The taxon is classed as S2 (Imperiled) in New York state, but otherwise is considered globally Secure (G5) or Apparently Secure (G4) (NatureServe 2015).

Two occurrences of old man's whiskers variety *triflorum* were documented in the areas surveyed (Figure 2) during the rare plant survey work in 2015. The first occurrence was located on a bench west of the Halfway River north of Highway 29, where 50–250 plants were found growing in an approximately 100 square metre area of native low-shrub and dry meadow habitat. The second occurrence was discovered on a xeric, disturbed grassland slope above the Peace River east of Bear Flat; here, fewer than 50 plants were located in an area of approximately 10 square metres.

3.2.4 Physcia biziana (frosted rosette)

Frosted rosette, a small grayish foliose lichen, is distinguished by the dense powdery coating that covers its entire upper surface (Figure 6). In addition, a chemical test aids in separating the taxon from morphologically similar species. Frosted rosette is found on bark or rock in open, dry habitats (Goward, et al. 1994; McCune and Goward 1995; Brodo, et al. 2001; CNALH 2015d). In the province of BC, frosted rosette is reported from locations in the south-central interior, as well as one site in the extreme southeast (Goward, et al. 1994; Brodo, et al. 2001). Globally, the species has been collected throughout much of the central and western US and northern and central Mexico, and has been documented from scattered locations in Eurasia and Africa. One occurrence has been observed in Vermont in the eastern US, and two sites have been reported in other parts of Canada: one occurrence on Lake Ontario, and one occurrence in the Rocky Mountains north of Jasper, Alberta (CNALH 2015d).

Figure 6: *Physcia biziana* (frosted rosette)

Frosted rosette has a rank of S3 (Vulnerable) in BC, and is on the provincial Blue list (BCCDC 2015). The species is also considered rare in Alberta, with a rank of S1/S2 (Critically Imperiled/Imperiled). Frosted rosette has not been ranked by other Canadian or US jurisdictions; globally the taxon is considered Secure (G5) (NatureServe 2014).

One occurrence of frosted rosette was observed in the areas surveyed (Figure 2). Site-specific rare plant surveys in 2015 collected the species on a slope above the south shore of the Peace River. The lichen was growing on the bark of a live aspen tree (*Populus tremuloides*) in open, disturbed mixed woodland. This occurrence represents a 400 km northward extension of the taxon's mapped global range, and a 700 km northward range extension in the province of BC (CNALH 2015d).

3.2.5 Physcia stellaris (immaculate rosette)

Immaculate rosette (Figure 7) is a small foliose lichen that forms light grey rosettes bearing darker, round fruiting bodies. The taxon grows on tree bark, particularly of deciduous trees, in open woodlands. Immaculate rosette is morphologically very similar to and sympatric with *Physcia aipolia* (syn. *P. alnophila*, outward-looking rosette), and must be separated by a chemical test (Goward, et al. 1994; McCune and Goward 1995; Brodo, et al. 2001; CNALH 2015b). In BC, immaculate rosette is reported from a few scattered locations in the northwest, northeast, and south-central parts of the province (Goward, et al. 1994; Brodo, et al. 2001; CNALH 2015b). The taxon's global range encompasses much of North America, and also extends to Eurasia, Australia, and South America (Brodo, et al. 2001; CNALH 2015b).

Figure 7: *Physcia stellaris* (immaculate rosette)

Immaculate rosette is ranked S3 (Vulnerable) in BC, and is on the province's Blue list (BCCDC 2015). The taxon is considered to be globally Secure (G5) (NatureServe 2015).

Four occurrences of immaculate rosette were located in the areas surveyed (Figure 2) during site-specific rare plant survey work in 2015. Three of the occurrences were discovered near Highway 29 in the Farrell Creek area, and a fourth was recorded just southwest of the town of Fort St. John. The immaculate rosette individuals were all found on the bark of deciduous trees in disturbed mixed woodlands.

3.2.6 Ramalina sinensis (threadbare ribbon)

Threadbare ribbon (Figure 8) is a small, pale green fruticose lichen. The thallus grows outward from a single point of attachment into a branching fan shape, which is tipped by cup-like fruiting bodies. The taxon is found on the bark of trees and shrubs in open habitats (Goward 1999b; Brodo, et al. 2001; CNALH 2015c). In BC, threadbare ribbon is known from only a few locations in the northeast part of the province (Goward 1999b; Brodo, et al. 2001). Globally, the species is reported across much of North America, as well as a few sites in Eurasia and one in Australia (Brodo, et al. 2001; CNALH 2015c).

Figure 8: *Ramalina sinensis* (threadbare ribbon)

Threadbare ribbon has a rank of S2/S3 (Imperiled/Vulnerable) in BC, and is on the provincial Blue list (BCCDC 2015). A few other Canadian jurisdictions also class the species as rare: S3S4 (Vulnerable/Apparently Secure) in Alberta; S3 (Vulnerable) in Northwest Territories; and S1S3 (Critically Imperiled/Vulnerable) in Yukon Territory (NatureServe 2015). The taxon's global rank is G4G5 (Apparently

Secure/Secure) (NatureServe 2015). The species is currently a 'low priority' candidate for COSEWIC assessment (COSEWIC 2015a).

Three occurrences of threadbare ribbon were discovered in the areas surveyed (Figure 2). The rare plant surveys in 2015 collected the species on a slope above Dry Creek, as well as in two locations just west of the junction of Farrell Creek Road and Highway 29. The habitat in all three sites consisted of disturbed, shrubby woodlands, where the threadbare ribbon individuals were found growing on twigs and bark of deciduous trees.

4.0 DISCUSSION

4.1 Coverage

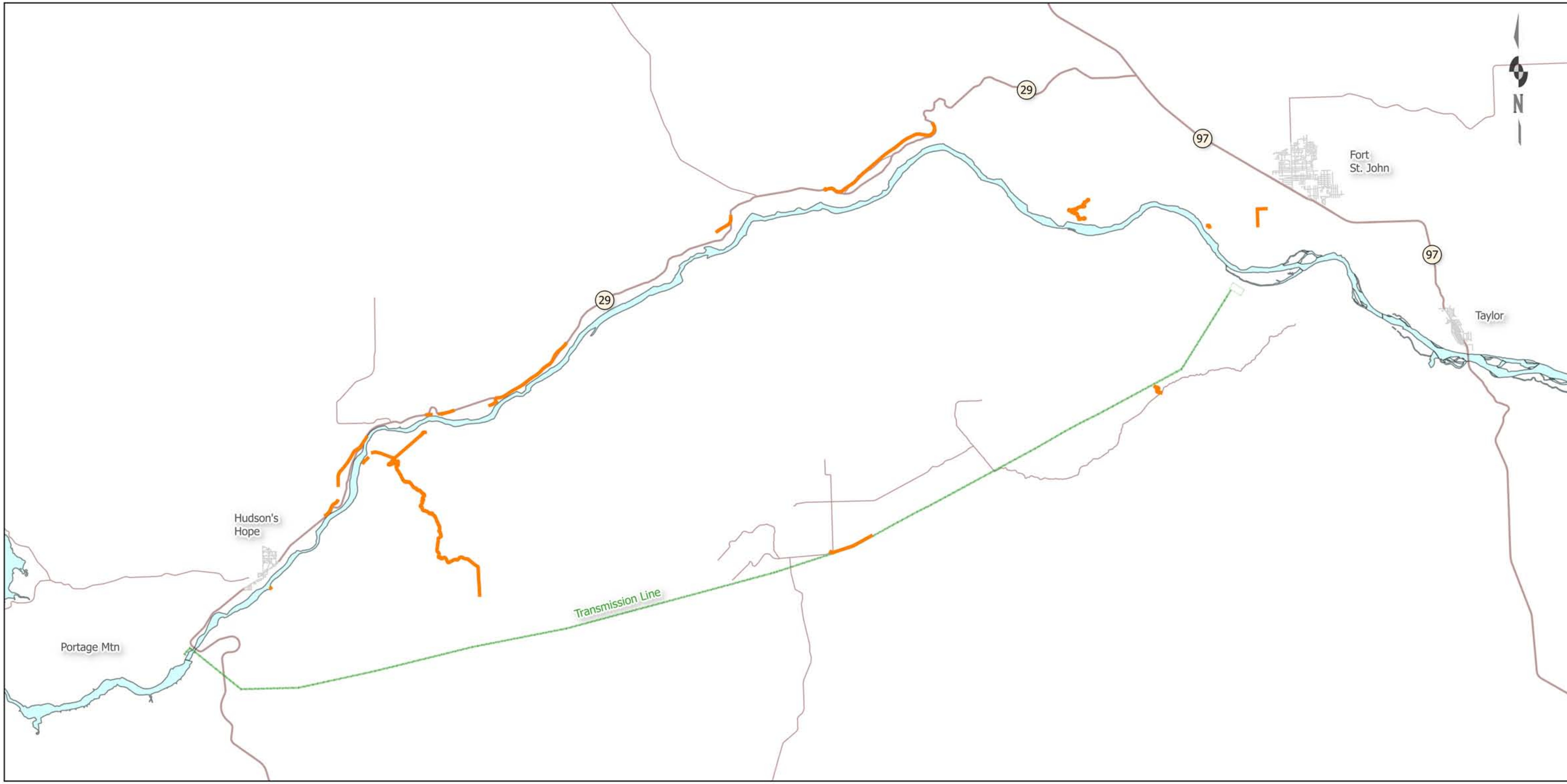
Coverage of the linear corridors and non-linear areas was sufficient to locate the majority of identifiable target rare plant species. The surveyors used a variable intensity survey pattern that focussed time and effort on the habitats most likely to contain rare plant occurrences.

4.2 Timing

Based on the observed phenology of the plants in the areas surveyed and data gathered during previous years' survey work, the timing of the surveys was sufficient to identify all of the target rare plants. The June and early July work focussed on sites north of the Peace River, where floodplain and grassland habitats make up the majority of the high-potential rare plant habitats present. Target species in these habitats often bloom early in the season, and then wither by later in the summer. The late summer and early fall surveys primarily focussed on areas south of the Peace River, where wetlands are the primary high-potential rare plant habitats. Many of these wetland-associated target rare plants bloom later in the season, and persist longer into the fall than those found in the upland areas.

4.3 Remaining Work

Private land access limitations and industrial fire restrictions during 2015 prevented field crews from surveying approximately 49 km of targeted corridor. This includes 22 km of Highway 29 realignment areas, 17 km of Medicine Woman Road, and various other facilities corridors. These areas are scheduled for survey in the summer of 2016 (Figure 9).



Map Notes:

1. Based on surveys completed through September 2015.
2. Map Datum: NAD83
3. Map Projection: UTM Zone 10 N
4. Water Features Base Data from BC FreshwaterAtlas.
5. Road Base Data from the BC Digital Roads Atlas project.
6. Project-specific spatial data supplied by BC Hydro.

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Figure 9:
Areas to Survey for Rare Plants in 2016

Date	January 5, 2016	DWG NO	2015-10-01-0003	Revision 1

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Appendix J. Rare ecosystem survey report

SITE C – At-Risk Ecological Communities

Final

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DISCLAIMER

This report was prepared exclusively for BC Hydro by Keystone Wildlife Research Ltd. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort expended and is based on:

i) Information available at the time of preparation;

ii) Data collected by Keystone Wildlife Research Ltd. and/or supplied by outside sources; and

iii) The assumptions, conditions, and qualifications set forth in this report.

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List of Acronyms

BC .... British Columbia

BEC .... Biogeoclimatic Ecosystem Classification

BWBSmw .... Boreal White and Black Spruce moist warm variant

CDC .... Conservation Data Centre

AREC .... At-Risk Ecological Community

mw .... moist, warm

Project .... Site C Clean Energy Project

PAZ .... Construction Project Activity Zone

PEL .... Peace Lowlands ecosection

SBSwk2 .... Sub-Boreal Spruce wet cool variant

ST .... Structural Stage

TEM .... Terrestrial Ecosystem Mapping

wk .... wet, cool

1.0 INTRODUCTION

The Site C Clean Energy Project (the "Project") is a third dam and hydroelectric generating station on the Peace River in northeastern British Columbia. Plant communities associated with the river valley may be distinct to the region and the effects of the Project on at-risk and sensitive ecological communities were determined to be significant in the Environmental Impact Assessment (Hilton et al. 2013). Condition 9 of Schedule B of the Table of Conditions, issued by the Province requires BC Hydro to:

> "*expand its modelling, including completing field work, to improve identification of rare and sensitive plant communities and aid in delineation of habitats that may require extra care, 90 days prior to any Project activities that may affect these rare or sensitive plant communities"*

In 2014, field work was conducted in areas where Project activities will occur during the first year of construction. This work confirmed the occurrence of at-risk ecological communities and identified changes to the mapping that improved the identification of at-risk ecological communities. The Project's environmental features map was updated to identify the location of confirmed and potential at-risk ecological communities.

Additional field work in 2015 was required to ensure at-risk ecological communities are identified in Project areas 90 days prior to initiation of Project activities. The objectives of this study were to:

1. review plot data to determine if at-risk ecological communities can be confirmed with data previously collected; and
2. sample polygons containing potentially at-risk ecological communities, where no data is available, to help delineate sites that would require extra care.

Results of 2014 surveys provided sufficient detail to identify at-risk ecological communities associated with forested sites in the BWBSmw and SBSwk2. Since non-forested wetlands units will be field truthed in 2016, this study focused on forested wetlands (bogs) and riparian units (floodplains) in the BWBSmw, as well as sites in the BWBSwk1 not sampled in 2014.

1.1 Background

An ecological community can be defined as a natural plant community and its associated environmental site characteristics, including: climate (macro or meso), landform, geomorphological and geological history, soil nutrient regimes, and soil moisture regimes. At-risk ecological communities (AREC) are defined and ranked by the BC Conservation Data Centre (CDC) and placed on the provincial red- or blue-list based on a number of considerations. At-risk ecological communities are mapped based on vegetation structure, disturbance, soil, and terrain characteristics.

The BC Ministry of Forests biogeoclimatic ecosystem classification (BEC) system integrates climate, soil, and vegetation into a single classification, focussing on late successional plant associations. A site series is a “habitat” capable of producing a particular ecological community. The CDC cross references site series with the potential to develop certain at-risk ecological communities because site series are widely recognized by resource managers. Forested sites in mature and late seral stages are often associated with at-risk ecological communities with good to excellent ecological integrity (BC Conservation Data Centre 2015). Early successional sites can be important recruitment sites for future occurrences of at-risk ecological communities. As such, it is important to identify sites with the potential to develop an at-risk ecological community, as well as existing occurrences.

Plant species are used to support the site series classification because specific plants are associated with sites that have the same environmental properties and have the potential to develop similar climax vegetation (Resource Information Standards Committee 2006). These plant associations are assigned a unique name that includes one to four of the plant species’ characteristic of that stable climax ecosystem. Thus, the species on the site combined with the ecological conditions can be used to help identify the at-risk ecological community. Occasionally, one of the species in the plant association name is not present due to a local variation or disturbance factor (BC Conservation Data Centre 2015). The expected range of variation, as described in Delong et al. (2011) for each defined plant association, must be considered to classify variable sites.

Three red-listed and fourteen blue-listed communities are defined for the BWBSmw, BWBSwk1 and SBSwk2 subzone variants, in the Peace River region (BC Conservation Data Centre 2015).

Work in 2015 focused on forested wetlands and riparian units in the BWBSmw and forested units in the BWBSwk1 (**Table 1-1**).

Table 1-1. Red- or Blue-listed ecological communities targeted during 2015 field surveys.

Scientific Name	English Name	BC List	BWBS mw*	BWBS wk1*	Mapped Ecosystem Unit
Picea mariana / *Vaccinium vitis-idaea* / *Sphagnum* spp.	black spruce / lingonberry / peat-mosses	Blue	Wb03		08/BT
Larix laricina / Carex aquatilis / Tomentypnum nitens	tamarack / water sedge / golden fuzzy fen moss	Blue	Wb06	(Wb06)	10/TS
Picea mariana / Equisetum arvense / Sphagnum spp.	black spruce / common horsetail / peat-mosses	Blue	(Wb09)	(Wb09)	May occur in 08/BT
Larix laricina / Betula nana / Menyanthes trifoliata	tamarack / buckbean - shore sedge	Blue	(Wf18)		May occur in 10/TS
Picea glauca - Picea mariana / Rhododendron groenlandicum / Aulacomnium palustre	white spruce - black spruce / Labrador-tea / glow moss	Blue	(Ws15)	(Ws15)	May occur in 08/BT
Picea glauca - *Abies lasiocarpa* / *Vaccinium membranaceum* / *Pleurozium schreberi*	white spruce - subalpine fir / black huckleberry / red-stemmed feathermoss	Blue		101	01/SM, 05/SC
Picea glauca - Pinus contorta / Shepherdia canadensis / Eurybia conspicua	white spruce - lodgepole pine / soopolallie / showy aster	Blue		103	04/SW
Salix exigua Shrubland	narrow-leaf willow Shrubland	Red	Fl06		00/WH

*(Unit) in brackets were not mapped in the subzone variant in the TEM.

2.0 METHODS

Site series that potentially support at-risk ecological communities were defined using the field guide for the Boreal White and Black Spruce (BWBS) zone (DeLong et al. 2011). Information on at-risk ecological communities was gathered from the BC CDC (BC Conservation Data Centre 2015) and NatureServe (2014).

2.1 Project Area

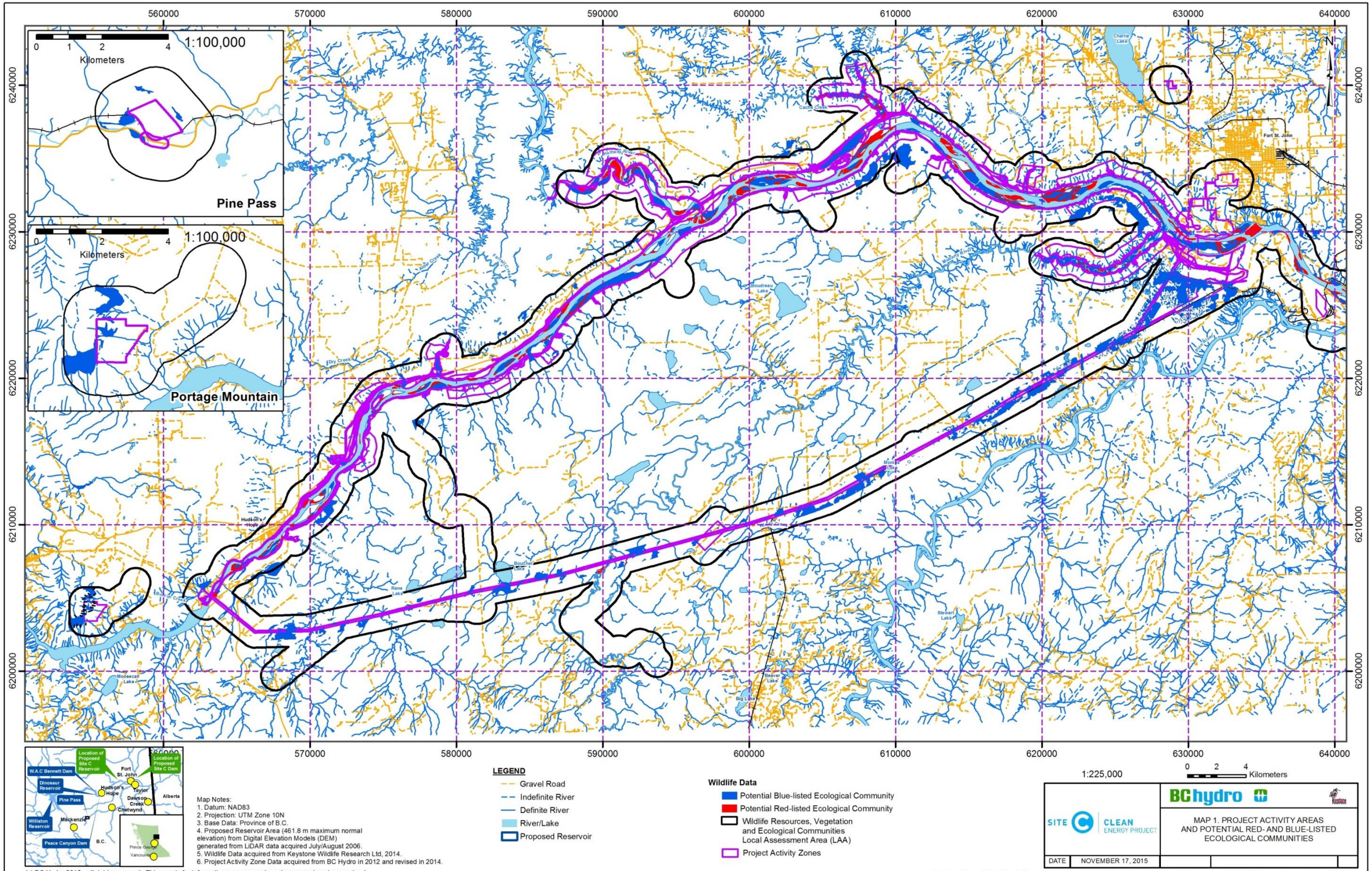
The Project area is defined as the area where Project activities will alter or remove terrestrial habitats. The Project area falls within the Peace River Basin ecoregion and Peace Lowland (PEL) ecosection. The Peace River Basin is a wide plain that lies between rolling uplands to the north and south, and is bisected by the Peace River and its tributaries. The PEL is a blocky plateau area on the east side of the Rocky Mountains and experiences strong rainshadows (Demarchi 1996).

At-risk ecological communities were identified during the environmental assessment (**Map 1**). Project Activity Zones (PAZs), including the transmission line, the erosion impact line, access roads, the highway realignment and the dam site, may be disturbed during construction and require extra care. At-risk ecological communities associated with the reservoir would not require extra care as these ecosystems would be removed from the landscape.

Field work focused on polygons containing:

- forested bogs (mapped ecosystem units TS and BT) in the BWBSmw wholly or partially within the erosion impact line, transmission line, access roads and highway realignment PAZs;
- forests (mapped ecosystem units SM or SW) in the BWBSwk1 wholly or partially within the off-site construction source material PAZ; and
- floodplain (mapped ecosystem units WH or Fm02) sites in the BWBSmw within the dam site PAZ.

Field data from previous TEM truthing were reviewed to determine if any of the target polygons had been sampled during baseline surveys.



Map 1. Project Activity Zones and Potential Red- and Blue-listed Ecological Communities

2.2 Field Truthing

Polygons that potentially support at-risk ecological communities within the PAZ were identified and targeted for sampling. Data from previous baseline surveys were reviewed to determine if information was available to assess the occurrence of an at-risk ecological community for these target polygons. A field plan was developed for the remaining target polygons.

Field surveys were performed by biologists familiar with BWBS flora identification. Field crews followed methods in the manual *Describing Ecosystem in the Field* and completed Site Visit Forms FS1333 (BC Ministry of Forests and Range and BC Ministry of Environment Lands and Parks 2010) at each sample site. A Conservation Evaluation Form was also completed when an at-risk ecological community was confirmed (Resource Information Standards Committee 2006). This form provides additional information required to assess the viability of the ecological community.

Site and stand variables were recorded, as were vascular plant species present and their respective percent cover. Other site variables such as soil conditions, aspect, elevation, and crown cover were also recorded. Visual plots were completed in sites determined to contain a site series not correlated with an at-risk ecological community, while a full ground inspection was completed in site series correlated with an at-risk ecological community. Multiple plots were completed in complexed polygons that contained more than one at-risk ecological community.

Data was entered into the provincial standard VENUS database. Data was confirmed with quality assurance procedures and all plots were reviewed by a senior biologist to confirm that they represented a current occurrence of an at-risk ecological community.

2.3 Assessment of At-Risk Ecological Communities

The Ministry of Environment (2006) describes a site series as a “habitat” capable of producing a particular plant association. A plant association is a formally recognized unit containing specific combinations of plant species, based on a number of stands of late successional vegetation that have similar species and structure. Plant associations are equivalent to CDC at-risk ecological communities that occur at sites with a characteristic vegetation and physiognomic structure.

In the field, each site sampled was assessed to determine if the plant association represented a current occurrence of a CDC at-risk ecological community. For each plant species expected to be present, the natural range of variation as determined from the field guides (DeLong et al. 2011), was considered. Site conditions and ecological processes influencing the ecological community, were also considered. A current occurrence was determined to be present if the ecological community generally matched the CDC description, within the natural range of variation.

For each at-risk ecological community the plot data from all current occurrences was compiled and examined to develop a local description. This information can be used for future assessments. The number of current occurrences within each sites series was also reported.

2.4 Map Assessment

To determine how mapped site series in the Project area correlate to CDC at-risk ecological communities, the number of field plots in each mapped ecosystem unit was determined and compared to the number of current occurrences in those plots. Information from these plots was compiled to determine if map features could be used to refine the selection of at-risk ecological communities.

Based on the results of this work adjustments were made to the identification of at-risk ecological communities in the Project area. The new selection was compared to the results reported in the Environmental Impact Assessment (Hilton et al. 2013).

3.0 RESULTS

3.1 Field Truthing

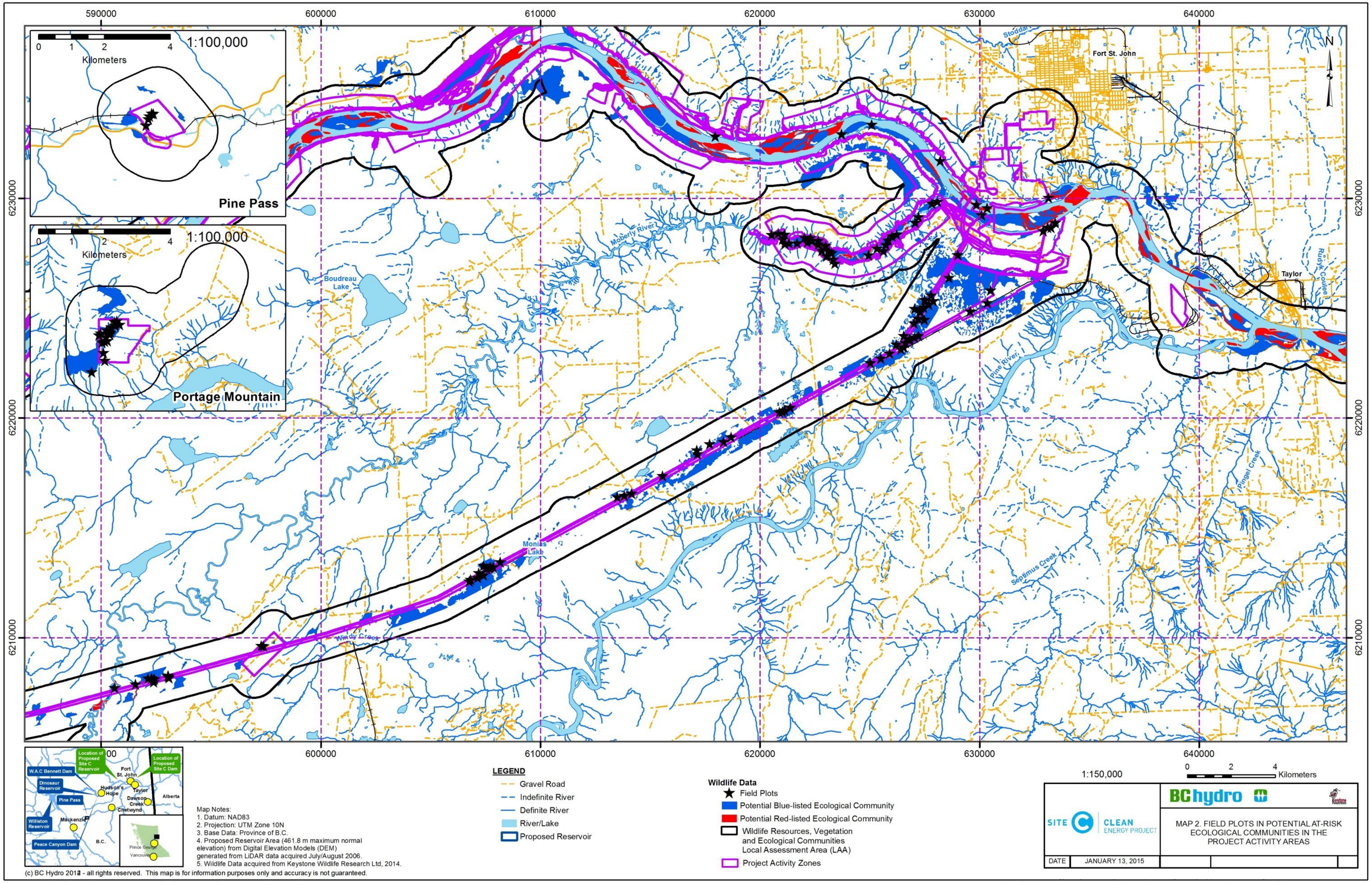
In 2015, field sampling was completed between August 14 and September 1, 2015. A total of 80 plots were completed; 68 in the BWBSmw and 12 in the BWBSwk1. Ground plots were completed for all potential CDC at-risk ecological communities. Visual plots were conducted at mapped sites that were reclassified in the field as a site series not associated with an at-risk ecological community.

Data from 156 plots was compiled to characterize at-risk ecological communities in the Project area. These include 14 plots from 2006, 62 plots from 2014, and 80 plots from 2015 (**Table 3-1**; **Map 2**). Because multiple plots were completed in complexed polygons the number of sites (polygons) sampled does not equal the number of plots completed. These data were used to determine the occurrence of at-risk ecological communities in the Project area and to assess the mapping of at-risk ecological communities.

Field data was used to describe the likelihood that a site series associated with an at-risk ecological community represents a current occurrence of the at-risk plant association. How both the mapped ecosystem unit and the field sites series co-relate to at-risk ecological communities was considered independently. This is required because mapped ecosystem units can differ from site series confirmed during field sampling due to map scale and accuracy.

Table 3-1. Summary of plot data completed to assess at-risk ecological communities in the Project area.

Zone	Subzone	TEM Ecosystem Unit	Field Site Series	Number of Plots Completed
BWBS	mw1	AM	101	8
		AM:ap	101$	8
		SW	103	2
		SW:as	103$	2
		BL	104	8
		BL:al	104$	1
		SO	110	4
		SH	111	8
		SH:ac	111$	4
		Fm02	112	14
		WH	Fl01	2
		WH	Fl03	2
		WH	Fl06	2
		GB	GB	1
		WW	Gg	2
		BT	Wb03	12
		BT	Wb05	6
		TS	Wb06	8
		BT	Wb09	10
		SE	Wf01	1
		TS	Wf18	8
		SE	Wm15	6
		WS	Ws14	4
		BT	Ws15	11
		Total		**134**
	wk1	SM	101	5
		SM:hc	101$	1
		n/a	102	1
		SW	103	6
		SW:ss	103$	3
		n/a	110	1
		Total		**17**
SBS	wk2	FR	01	3
		n/a	03	2
		Total		**5**



Map 2. Field Plots in Potential At-Risk Ecological Communities in the Project area

3.2 Assessment of At-Risk Ecological Communities

Surveys confirmed the occurrence of an at-risk ecological community in 61% of sampled sites, where the site series associated with the at-risk community was confirmed (**Table 3-2**). Each ecological community is considered separately below.

Table 3-2. Summary of sampled units and current occurrence of an at-risk ecological community.

Subzone	Sampled Site Series	Number of Plots Classified as Site Series	Number of Field Plots with a Confirmed Occurrence of an At-Risk Ecological Community
BWBSmw	110	4	0
	111	12	11
	112	14	8
	Fl	6	2
	Wb03	12	7
	Wb06	8	7
	Wb09	10	7
	Wf18	8	7
	Ws15	11	5
BWBSwk1	101	6	3
	103	9	4
SBSwk2	02	0	0
Total		**100**	**61**

Picea mariana / Vaccinium vitis-idaea / Sphagnum spp.

This CDC at-risk ecological community corresponds to the Wb03 – Black spruce – Lingonberry – Peat-moss bog site series in the BWBSmw described in Delong et al. (2011). This climax bog forest is uncommon and is characterized by stunted black spruce, forming an open to sparse canopy, over an open herb layer and continuous *Sphagnum* blanket (MacKenzie and Moran 2004). Black spruce and peat moss (*Sphagnum* spp.) are dominant (>70% of plots) and prominent (>10% cover) species, while lingonberry is dominant (>70% of plots) and occasionally prominent (±10% cover) (DeLong et al. 2011). Labrador tea and cloudberry are also abundant in the understorey (DeLong et al. 2011). Sites are hummocky, but because of luxuriant *Sphagnum* growth, hollows are generally no wetter than hummocks and support few minerotrophic indicators (MacKenzie and Moran 2004).

Within the PAZ, twelve plots have been completed at sites classified as Wb03 in the BWBSmw. All sites were dominated by stunted black spruce (*Picea mariana*) and Labrador tea (*Rhododendron groenlandicum*), with an almost continuous cover of peat moss (*Sphagnum* spp.). Cloudberry (*Rubus chamaemorus*) was dominant (92% of plots) and occasionally prominent (3-25% cover), while lingonberry (*Vaccinium vitis-idaea*) and bog cranberry (*Oxycoccus oxycoccus*) were typically present.

Seven sites represent a current occurrence of the CDC at-risk ecological community. These sites were characterized by a homogenous herb layer dominated by cloudberry, lingonberry and bog cranberry. The prominent shrub layer consisted of black spruce and labrador tea. Wb03 units that did not represent the at-risk ecological community had a more diverse plant community dominated by non-indicator species including, but not limited to, bluejoint reedgrass (*Calamagrostis canadensis*), horsetail species (*Equisetum* spp.), and false Solomon's-seal (*Maianthemum trifolium*).

Based on this information the *Picea mariana* / *Vaccinium vitis-idaea* / *Sphagnum* spp. community is present in the Project area and occurred in 58% of Wb03 units sampled. The Project's environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

Larix laricina / Carex aquatilis / Tomentypnum nitens

This CDC at-risk ecological community corresponds to the Wb06 – Tamarack – Water sedge – Fen moss site series in the BWBSmw and BWBSwk1 described in Delong et al. (2011) and in the SBSwk2 described in Delong (2004). This common bog / fen unit occurs adjacent to domed bogs along peatland streams, water tracks, or groundwater inflow seeps (MacKenzie and Moran 2004). A pattern of hummocks and hollows, high water tables and sluggish groundwater contribute to the characteristic vegetation type (BC Conservation Data Centre 2014). Tamarack and fen moss range from abundant (>70% of sites) and prominent (10-25% cover) while water sedge varies between common (50-70% of sites) and prominent (10-25% cover) (DeLong et al. 2011).

The CDC (2014) describes this association as a "bog/poor fen ecosystem with an open canopy of *Larix laricina*, and a moderate to dense shrub layer predominantly of *Betula nana*, *Rhododendron groenlandicum* and sometimes *Picea mariana*. The dense herbaceous layer is dominated by *Carex aquatilis* and *C. sitchensis*, other sedge species, *Comarum palustre*, and a variety of low woody species such as *Oxycoccus oxycoccus*, *Rubus chamaemorus*, *Gaultheria hispidula*, *Andromeda polifolia*, and *Empetrum nigrum*. The high cover of bryophytes includes *Sphagnums*, *Tomentypnum nitens* and *Aulacomnium palustre*."

Within the PAZ, eight plots have been completed at sites classified as Wb06 in the BWBSmw. All sites were dominated by tamarack (*Larix laricina*) or a combination of tamarack and black spruce (*Picea mariana*). Scrub birch (*Betula nana*) was present at all sites, while Labrador tea (*Rhododendron groenlandicum*) was often absent and/or sporadic. Sedge species (*Carex* spp.) dominated the herb layer, with a bryophyte layer consisting of fen moss (*Tomentypnum nitens*) and peat moss (*Sphagnum* spp.).

Seven of the eight sites represent a current occurrence of the CDC at-risk ecological community. Tree cover was typically absent and bryophyte cover was moderately low (<30% cover) at most of these sites. Vegetation was characterized by a well-developed understorey dominated by tamarack, scrub birch and sedges, with sporadic cover of fen moss. One plot did not represent the at-risk ecological community due to the sparse herb layer.

Based on this information the *Larix laricina / Carex aquatilis / Tomentypnum nitens* community is present in the Project area and occurred in 88% of Wb06 units sampled. The Project's environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

Picea mariana / Equisetum arvense / Sphagnum spp.

This CDC at-risk ecological community corresponds to the Wb09 – Black spruce – Common horsetail – Peat-moss site series in the BWBSmw and BWBSwk1 described in Delong et al. (2011). This unit is uncommon and occurs in small palustrine basins and at the periphery of larger peatlands (MacKenzie and Moran 2004). It occurs on sites with a hummock/hollow pattern, where hummocks remain above the water table and support bog-dependant species, while standing water persists in hollows throughout much of the growing season (BC Conservation Data Centre 2014). Black spruce and horsetail species are abundant (>70% of sites) and prominent (10-25% cover), while peat-moss ranges between common (60-70% of sites) and dominant (>25% cover) (DeLong et al. 2011).

The CDC (2014) describes this association as a "bog forest that is transitional to swamp forests. The bog-affiliated species occur commonly and abundantly on hummocks while swampaffiliated species occur in low lying areas around these hummocks. The canopy consists of sparse to dense *Picea mariana*. The understorey is dominated by *Rhododendron groenlandicum*, with *Betula nana* and *Salix* spp. occurring commonly. *P. mariana* may be regenerating in the understorey. Herbaceous species are dominated by *Equisetum* spp., *Carex* spp., and various less commonly occurring species such as *Cornus canadensis*, and the low woody *Vaccinium vitis-idaea*, *Oxycoccus oxycoccus* and *Empetrum nigrum*. The bryophyte layer is continuous on hummocky areas and is dominated by *Sphagnum* species on poor sites."

Within the PAZ, ten plots have been completed at sites classified as Wb09 in the BWBSmw. These sites were characterized by a black spruce (*Picea mariana*) canopy, with an understorey dominated (>10% cover) by Labrador tea (*Rhododendron groenlandicum*) and horsetails (*Equisetum* spp). The well-developed moss layer contained peat moss (*Sphagnum* spp.) and feathermoss (*Pleurozium schreberi*). A notable divergence from the site guide was the presence of tamarack at 70% of the sites classified as Wb09. Although tamarack is not expected to occur (Delong et al. 2011), these sites were classified as Wb09 based on the dominance of horsetails and the absence of sedges.

Seven of the ten sites represent a current occurrence of the CDC at-risk ecological community based on the presence of indicator species. Black spruce and horsetails dominated (>30% cover) of these sites, while peat moss was present but not abundant (<30% cover). Labrador tea was present and prominent (10-20% cover) at all sites. Wb09 sites that did not represent the at-risk ecological community lacked or had sporadic cover of Labrador tea, horsetails and/or peat moss. These sites appear to be transitional to other wetlands or terrestrial communities and typically contained non-characteristic vegetation.

Based on this information the *Picea mariana / Equisetum arvense / Sphagnum* spp. community is present in the Project area and occurred in occurred in 70% of Wb09 units sampled. The Project's environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

Larix laricina / Betula nana / Menyanthes trifoliata

This CDC at-risk ecological community corresponds to the Wf18 - Tamarack – Scrub birch – Buckbean site series in the BWBSmw described in Delong et al (2011). This uncommon unit occurs at low elevations in patterned fens with strongly mounded organic soils (MacKenzie and Moran 2004). Sites are poorly drained, with a high or raised water table that has some subsurface flow (BC Conservation Data Centre 2014). Scrub birch and buckbean are both dominant (>75% of sites) and prominent (>25% cover) on almost all sites, while tamarack is dominant (>75% of sites) and occasionally prominent (3-10% cover) on most sites (DeLong et al. 2011).

The CDC (2014) describes this association as a “sparse to open (27% cover) tree canopy dominated by *Larix laricina*, sometimes with a minor component of *Picea mariana*. The shrub and herb layers are high in cover, variable in composition, and diverse. They tend to be dominated by *Betula nana*, *Carex* spp., and *Menyanthes trifoliata*.”

Within the PAZ, eight plots have been completed at sites classified as Wf18 in the BWBSmw. These sites were characterized by a well-developed understorey dominated by tamarack (*Larix Laricina*), scrub birch (*Betula nana*) and willows (*Salix* spp.). The almost continuous herb layer was dominated by buckbean (*Menyanthes trifoliata*) and sedges (C*arex* spp.). A notable divergence from the site guide was the prominence (>10% cover) of sedges at 88% of the sites classified as Wf18.

Seven of the eight sites represent a current occurrence of the CDC at-risk ecological community based on the presence of indicator species. These sites were characterized by a diverse shrub and herb layer containing >10% cover of tamarack, shrub birch, willows, buckbean, sedges, horsetails (*Equisetum* spp.) and toad flax (*Comarum palustre*). A low cover (<10 %) of black spruce was present in 50% of plots. Tamarack was sporadic or absent at two sites, within the right of way (RoW), but its presence at adjacent sites suggest it would occur if not in an altered RoW. One site was dominated by willows and sedges, with no tamarack, and therefore did not contain a current occurrence of the AREC.

Based on this information the *Larix laricina / Betula nana / Menyanthes trifoliata* community is present in the Project area and occurred in 88% of Wf18 units sampled. The Project’s environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

Picea glauca - Picea mariana / Rhododendron groenlandicum / Aulacomnium palustre

This CDC at-risk ecological community corresponds to the Ws15 – White spruce – Black spruce – Labrador tea – Glow moss site series in the BWBSmw and BWBSwk1 described in Delong et al. (2011). This poor productivity bog forest is limited to very specific site conditions and generally occurs around the edges of peatlands (BC Conservation Data Centre 2014). White spruce, Labrador tea and glow moss are abundant (>75% of sites) and prominent to occasionally prominent (3-25% cover) species (DeLong et al. 2011). Black spruce is common (>50% of sites) and prominent (10-25% cover) in the well-developed understorey.

Delong et al. (2011) describes this unit as an open, poor-productivity forest characteristically dominated by *Picea glauca*, but with *Picea mariana* frequently prominent. The understorey is often a well-developed mix of bog species (*Vaccinium vitis-idaea*, *Arctostaphylos alpine*, *Empetrum nigrum*, and *Mitella nuda*) on raised hummocks and wet upland species (*Equisetum* spp. and *Petasites frigidus*) in hollows. *Ledum groenlandicum*, *Betula nana*, and *Salix myrtillifolia* are common shrubs. The moss layer is very well developed, with *Aulacomnium palustre*, *Hylocomium splendens*, and *Tomentypnum nitens* the most common species.

Within the PAZ, eleven plots have been completed at sites classified as Ws15 in the BWBSmw. These sites were characterized by an open canopy of white spruce (*Picea glauca*), black spruce and/or tamarack. Typically the understorey contained >10% cover of willow (*Salix* spp.) and horsetail (*Equisetum* spp.) species. The bryophyte layer was variable but typically contained step moss (*Hylocomium splendens*).

Five of the eleven sites represent a current occurrence of the CDC at-risk ecological community based on the presence of indicator species. Generally these sites were characterized by an open to sparse canopy dominated by black spruce (*Picea mariana*), with white spruce present and tamarack (*Larix laricina*) frequently prominent. Labrador tea (*Rhododendron groenlandicum)* and willow (*Salix* spp.) species were present in the shrub layer and the diverse herb layer typically contained sweet coltsfoot (*Petasites frigidus*), trailing raspberry (*Rubus pubescens*), sedges (*Carex* spp.) and horsetails. The bryophyte layer was moderately developed (25-45% cover), with glow moss (*Aulacomnium palustre*) present at 50% of sites. Ws15 sites that did not represent the at-risk ecological community lacked Labrador tea and did not have a diverse herb layer.

Based on this information the *Picea glauca - Picea mariana / Rhododendron groenlandicum / Aulacomnium palustre* community is present in the Project area and occurred in 45% of Ws15 units sampled. The Project's environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

Picea glauca - Abies lasiocarpa / Vaccinium membranaceum / Pleurozium schreberi

This CDC at-risk ecological community corresponds to the 101 – White spruce – Subalpine fir – Black huckleberry – Feathermoss site series in the BWBSwk1 described in Delong et al. (2011). This forested unit is common and widespread at mid to upper slope positions. Black huckleberry and feathermoss are abundant (>75% of sites), and white spruce is common (>50% of sites) and prominent (10-25% cover) (DeLong et al. 2011). Feathermoss dominates (>25% cover) the moss layer and black huckleberry is occasionally prominent (3-10% cover) in the shrub layer.

NatureServe (2014) describes the vegetation as an open canopy including *Picea glauca* (or *Picea engelmannii* X *glauca*), often with *Abies lasiocarpa* and/or *Pinus contorta*. The shrub layer consistently includes a high cover of *Vaccinium membranaceum* sometimes with *Ledum groenlandicum* or *Alnus viridis*. The herb layer is diverse including consistently high cover of *Cornus canadensis*, *Linnaea borealis*, and sometimes *Vaccinium vitis-idaea*. *Lycopodium annotinum*, *Orthilia secunda*, and *Arnica cordifolia* occur with low cover. The bryophyte layer includes high cover of *Hylocomium splendens*, *Pleurozium schreberi*, and *Ptilium crista-castrensis* along with lesser amounts of *Peltigera* species and numerous other moss and lichen species. Occasionally *Hylocomium splendens* may be absent.

Within the PAZ, six plots have been completed at sites classified as 101 in the BWBSwk1. These sites were characterized by an open canopy of white spruce (*Picea glauca*) with subalpine fir (*Abies lasiocarpa*) and/or lodgepole pine (*Pinus contorta*). The dense shrub layer was dominated by alder (*Alnus viridis*), with variable cover of high-bush cranberry (*Viburnum edule*) and birch-leaved spirea (*Spiraea betulifolia*). The herb layer was diverse but variable in terms of cover and composition and the moss layer was poorly developed if present.

Three of the six sites represent a current occurrence of the CDC at-risk ecological community based on the presence of all indicator species, although one site lacked subalpine fir. These sites were characterized by a mixed open (<35 % canopy closure) canopy of white spruce, pine and/or subalpine fir. Alder and huckleberry (*Vaccinium membranaceum*) dominated (>10% cover) the shrub layer, while heart-leaved arnica (*Arnica cordifolia*), bunchberry (*Cornus canadensis*), and pink wintergreen (*Pyrola asarifolia*) were present in the herb layer. The bryophyte layer was variable, with feathermoss (*Pleurozium schreberi*) present at 67% of sites. Three sites lacked huckleberry and did not represent the at-risk ecological community.

Based on this information the *Picea glauca - Abies lasiocarpa / Vaccinium membranaceum / Pleurozium schreberi* community is present in the Project area and occurred in 50% of 101 units sampled. The Project's environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

Picea glauca - Pinus contorta / Shepherdia canadensis / Eurybia conspicua

This CDC at-risk ecological community corresponds to the 103 – White spruce – Lodgepole Pine – Soopolallie – Showy Aster site series in the BWBSwk1 described in Delong et al. (2011). These uncommon forests are restricted to warm aspects and occur on mid to upper slopes with an open tree canopy and a well-developed to dense understorey (DeLong et al. 2011). Pine, soopolallie and showy aster are all abundant (>75% of sites), and dominant (>25% cover) to occasionally prominent (3-10% cover). White spruce occurs infrequently (DeLong et al. 2011).

Within the PAZ, nine plots have been completed at sites classified as 103 in the BWBSwk1. These sites were characterized by a mixed canopy of lodgepole pine (*Pinus contorta*) and white spruce (*Picea glauca*) with an understorey dominated by soopolallie (S*hepherdia canadensis*), birch-leaved spirea (*Spiraea betulifolia*), prickly rose (*Rosa acicularis*) and showy aster (*Eurybia conspicua*).

Four of the nine sites represent a current occurrence of the CDC at-risk ecological community based on the presence of indicator species. These sites were characterized by warm aspect, mid to upper slopes with a moderate (5-10%) cover of pine, white spruce and soopolallie. Showy aster dominated (>20% cover) a homogenous herb layer, while the bryophyte layer was sparse and dominated by feathermoss (*Pleurozium schreberi*). Five sites lacked soopolallie and did not represent the at-risk ecological community.

Based on this information the *Picea glauca - Pinus contorta / Shepherdia canadensis / Eurybia conspicua* community is present in the Project area and occurred in 44% of 103 units sampled. The Project's environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

Salix exigua Shrubland

This CDC at-risk ecological community corresponds to Fl06 - Sandbar willow site series in the BWBSmw described in Delong et al. (2011). This floodplain is locally common along low-gradient reaches of very large rivers, where it occurs on sandy lateral bars that receive prolonged spring flooding by powerful currents (MacKenzie and Moran 2004). Narrow-leaf willow (*Salix exigua*) is a dominant species occurring on all sites and is the most abundant species on most sites (>25% cover) (DeLong et al. 2011).

The CDC (2014) describes this association as “dominated by *Salix exigua*, a colonial species that is resistant to strong currents. In areas that have gradually accumulated sufficient deposits to allow the establishment of *Populus balsamifera* or *Alnus incana*, these species occur in the shrub layer. Because of the somewhat harsh conditions, germination of other species is difficult and plant diversity is low with *Equisetum hyemale* as the common understorey species, and mosses rarely present.”

Within the PAZ, six plots were completed at sites classified as low bench floodplain units in the BWBSmw. These sites were characterized by a well-developed shrub layer dominated by alder (*Alnus incana*) and willow (*Salix* spp.) species. A dense and diverse herb layer dominated by reed canary grass (*Phalaris arundinacea*) and alsike clover (*trifolium hybridum*) was present at all sites, while bryophytes were absent.

Two of the six sites represent a current occurrence of the CDC at-risk ecological community based on the presence of indicator species. These sites were characterized by a shrub layer dominated (>20% cover) by narrow-leaf willow (*Salix exigua*), with balsam poplar (*Populus balsamifera*; >10% cover) and alder (*Alnus incana;* >15% cover). The herb layer was dominated by reed canary grass and alsike clover, with horsetails (*Equisetum* spp.) present but not abundant. These sites had a higher diversity herb layer then described by the CDC. The shrub layer of sites that did not represent AREC were dominated by alder, while *Salix exigua* was sparse or absent.

Based on this information the *Salix exigua* Shrubland community is present in in the Project area and occurred in 33% of low-bench floodplain units sampled. The Project’s environmental features map has been updated to reflect current occurrences of this at-risk ecological community.

3.3 Map Assessment

Field classifications for all 156 plots were compared to the mapped ecosystem unit to determine map accuracy and occurrence of at-risk ecological communities.

Forested Bogs

Five at-risk ecological communities in the BWBSmw are correlated with the BT and TS mapped ecosystem units. Eighty-four plots were completed in the BWBSmw in polygons mapped as BT or TS. Of these, 53 were accurately mapped (field site series was associated with the BT or TS mapped ecosystem unit) and 33 had a confirmed occurrence of an at-risk ecological community. Sites mapped as BT or TS were also classified as Ws14, Wm15, or 104 in the field (SE or BL mapped ecosystem unit). Generally, field plots classified as Wb03, Wb05, Wb09, Ws14 and Ws15 were mapped as BT, while field plots classified as Wb06, Wf18 and Wm15 were mapped as TS. This confirms the associations noted in Table 1-1. Overall, ARECs were confirmed in 39% of sampled sites mapped as TS or BT in the BWBSmw.

Forested Units in the BWBSwk1

One at-risk ecological community in the BWBSwk1 is correlated with the 01/SM mapped ecosystem unit. Two plots were completed in polygons mapped as 01/SM. Both of these were accurately mapped (field site series matched the mapped ecosystem unit) and represented a current occurrence of the Picea glauca – Abies lasiocarpa / Vaccinium mambranaceum / Pleurozium schreberi AREC.

One at-risk ecological community in the BWBSwk1 is correlated with the 03/SW mapped ecosystem unit. Fourteen plots were completed in polygons mapped as 03/SW. Nine of these were accurately mapped (field site series matched the mapped ecosystem unit) and four represented a current occurrence of the Picea glauca - Pinus contorta / Shepherdia canadensis / Eurybia conspicua AREC. All confirmed occurrences were associated with warm aspect slopes (n=4), while cool aspect sites contained a different plant association not representative the AREC (n=5).

Overall, ARECs were confirmed in 38% of sampled sites mapped as 03/SW or 01/SM in the BWBSwk1.

Floodplain Sites

The *Salix exigua* Shrubland was confirmed at two sites. These sites were classified as the AREC based on the dominance of *Salix exigua*, although an uncharacteristically diverse understorey was also present. Polygons containing these units were mapped as WH and Fm02 structural stage 3 (active floodplain and gravel bar modifiers) in the TEM.

Sixteen plots completed during baseline surveys in polygons mapped as WH (n=7) and Fm02 structural stage 3 (active floodplain and gravel bar modifiers; n=9) were examined to determine the occurrence of this AREC. No additional occurrences were identified since S*alix exigua* was either sparse or absent. Overall, ARECs were confirmed in 13% of sampled sites mapped as WH or Fm02 (structural stage 3). This indicates that the *Salix exigua* Shrubland occurs in the Project area, but is extremely rare. Prolonged spring flooding by powerful currents creates conditions suitable for *Salix exigua*. Since upstream dams regulate the flow on the Peace River, prolonged flooding events are less common, allowing other plant species to colonize these sites.

Field surveys confirmed the *Salix exigua* Shrubland is associated with the WH and Fm02 structural stage 3 (active floodplain and gravel bar modifiers) mapped ecosystem units. Over 100 polygons are mapped as these units in the reservoir PAZ, and the AREC is expected to occur in a small proportion of these sites. This AREC might be more prominent downstream of the Pine and Moberly Rivers, where water from these rivers results in more significant flood events during the spring freshet.

3.4 Project interaction

The area summary of mapped ecosystems units associated with at-risk ecological communities occurring in the Project area has been refined based on field work (**Table 3-3**).

The total area for some forested areas has increased based on the inclusion of both seral and non-seral site series (BWBSmw:07/SH; BWBSwk1:04/SW) or decreased due to the exclusion of young stands (BWBSmw:09/Fm02 and 07/SH). Other forested sites have been removed from the selection because local conditions do not support the at-risk plant association (BWBSmw:05/SO; SBSwk2:02/LH). The total area for forested bogs has decreased based on field confirmation (BWBSmw:08/BT and 10/TS). New mapped ecosystem units associated with AREC were identified for the *Salix exigua* shrubland and the *Picea glauca* - *Abies lasiocarpa* / *Vaccinium membranaceum* / *Pleurozium schreberi* ecological communities which identified new areas for both these AREC in the local assessment area.

Both potential and confirmed current occurrences of all at-risk ecological communities will be represented on the Project's environmental features map as polygons. This will ensure extra care is taken when work is conducted in or adjacent to areas where at-risk ecological communities are occur.

Table 3-3. Ecosystem units in the Project Area associated with at-risk ecological communities (adapted from Hilton et al. 2013).

Scientific Name	English Name	BC List	BEC Unit	Associated Mapped Ecosystem Unit	Area (ha) of Mapped Ecosystem Unit	Area (ha) of Mapped At-risk Ecological Community (confirmed and potential)
Juncus arcticus - Puccinellia nuttalliana - Suaeda calceoliformis	arctic rush - Nuttall's alkaligrass - seablite	Red	BWBSmw	00/SE	1168	1168
Muhlenbergia richardsonis - Juncus arcticus - Poa secunda ssp. *juncifolia*	mat muhly - arctic rush - Nevada bluegrass	Red				
Typha latifolia Marsh	common cattail Marsh	Blue				
Betula nana / Carex aquatilis	scrub birch / water sedge	Blue	BWBSmw	00/WS	363	363
Eriophorum angustifolium - Carex limosa	narrow-leaved cotton-grass - shore sedge	Blue	SBSwk2	Wf13	8.5	8.5
Picea mariana / Vaccinium vitis-idaea / Sphagnum spp.	black spruce / lingonberry / peat-mosses	Blue	BWBSmw	08/BT	2051	1881
Picea mariana / Equisetum arvense / Sphagnum spp.	black spruce / common horsetail / peat-mosses	Blue				
Picea glauca - Picea mariana / Rhododendron groenlandicum / Aulacomnium palustre	white spruce - black spruce / Labrador-tea / glow moss	Blue				
Larix laricina / Carex aquatilis / Tomentypnum nitens	tamarack / water sedge / golden fuzzy fen moss	Blue	BWBSmw	10/TS	1405	1336
Larix laricina / Menyanthes trifoliata - Carex limosa	tamarack / buckbean - shore sedge	Blue				

Picea glauca - Abies lasiocarpa / Vaccinium membranaceum / Pleurozium schreberi	white spruce - subalpine fir / black huckleberry / red-stemmed feathermoss	Blue	BWBSwk1	01/SM, 05/SC	0	35
Picea glauca - Pinus contorta / Shepherdia canadensis / Eurybia conspicua	white spruce - lodgepole pine / soopolallie / showy aster	Blue	BWBSwk1	04/SW	52	158
Pinus contorta / Vaccinium membranaceum / Cladina spp.	lodgepole pine / black huckleberry / reindeer lichens	Blue	SBSwk2	02/LH	70	0
Picea glauca / Gymnocarpium dryopteris - Aralia nudicaulis	white spruce / oak fern - wild sarsaparilla	Blue	BWBSmw	05/SO	1215	0
Picea glauca / Ribes triste / Equisetum spp.	white spruce / red swamp currant / horsetails	Blue	BWBSmw	07/SH (ST 5-7)	1699	2630
Populus balsamifera - Picea glauca / Alnus incana - Cornus stolonifera	balsam poplar - white spruce / mountain alder - red-osier dogwood	Blue	BWBSmw	09/Fm02 (ST 5-7)	2664	1364
Salix exigua Shrubland	narrow-leaf willow Shrubland	Red	Fl06	09/Fm02 & WH (ST 3)	0	1634

4.0 CONCLUSION

Completion of this work, in addition to work that will be completed in 2016 to characterize wetland function, fulfills BC Hydro's commitment to complete field work to improve the identification of rare plant communities (Environmental Assessment Office 2014, no. 9). Adjustments to the mapping have improved the ability to predict the occurrence of at-risk ecological communities and additional field work was completed to determine the presence of the at-risk ecological communities in the Project area. Polygons that contain or are likely to contain an at-risk ecological community are delineated and represented on the Project's environmental features map allowing extra care to be taken when work occurs in or adjacent to at risk ecological communities. Work to identify at-risk ecological communities was conducted 90 days prior to Project activities at each site.

5.0 LITERATURE CITED

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Appendix A. Record Keeping

The following detail is provided in accordance with Federal Condition 18.

Sampling location	Detail
Date of sampling	August 14 and September 1, 2015
Time of sampling	8:00 to 18:00
Name of sampler(s)	Todd Kohler, Shane White, Kyle Routledge, Denise Cardinal
Analysis performed	Review plot data and draft report
Date of analysis	September and October, 2015
Person(s) who collected sample(s)	Todd Kohler
Person(s) who conducted analysis	Lauren Simpson