APPENDIX B. GENERAL WETLAND CLASS AND ASSOCIATION DESCRIPTIONS

APPENDIX B. GENERAL WETLAND CLASS AND ASSOCIATION DESCRIPTIONS

Appendix B provides a summary of the typical characteristics of the wetland classes and associations sampled during the 2018 field season.

B.1. Bog

A bog is a nutrient-poor, *Sphagnum*-dominated peatland ecosystem in which the rooting zone is isolated from mineral-enriched groundwater, soils are acidic, and few minerotrophic plant species occur. Bogs generally occur on hummocks or raised domes and may contain a cover of slow-growing woody, ericaceous shrubs, or small stunted trees. A thick cover of *Sphagnum* (peat moss) is dominant, while other species that are tolerant of acidic, low-nutrient conditions also occur. Bogs often occur in closed basins (where precipitation is the primary water source), on the edges of larger peatlands, or as raised domes (normally within fens). Soils are generally deep peat deposits (although peat veneers can occur at immature, fen/bog stages) with poorly decomposed upper layers that remain saturated throughout the year. While some groundwater flow may occur, it is generally limited and confined to the lower organic tiers, resulting in little input of nutrients to plants growing on the bog surface (MacKenzie and Moran 2004).

B.1.1. Wb03 Black spruce - Lingonberry - Peat-moss bog

The Wb03 Black spruce - Lingonberry - Peat-moss bog is a Blue-listed ecosystem that occurs in various areas throughout northern BC (MacKenzie and Moran 2004). It occurs in depressions or stagnant portions of larger wetland complexes, where little groundwater movement occurs. The Wb03 is a “true” bog as it occurs in stable closed basins and represents the climax wetland type. These bogs have the typically treed bog appearance with small trees occurring on slight to strong mounds, and the areas between covered in deep sphagnum peat moss and a variety of ericaceous species. Vegetation can be thick, but diversity is limited to species that can tolerate the edaphic conditions.

B.1.2. Wb05 Black spruce - Water sedge - Peat-moss bog

The Wb05 Black spruce - Water sedge - Peat-moss bog is common throughout the sub-boreal and central interior of BC in closed basins and the edges of larger wetland complexes in areas of minor groundwater movement (MacKenzie and Moran 2004). As with the Wb03, these wetlands are characterized by an irregular cover of stunted black spruce and a deep layer of continuous peat moss over Mesisols (partially decomposed organic soils). The Wb05 is considered to be a transitionary wetland between sedge fens and “true” bogs, with vegetation intermediate between the two.

B.1.3. Wb06 Tamarack - Water sedge - Fen moss bog

The Wb06 Tamarack - Water sedge - Fen moss bog/fen is a Blue-listed ecosystem that is limited to northeastern BC (MacKenzie and Moran 2004). The Wb06 is considered to be a relatively “young” bog,

that is transitioning from fen to bog and does not strongly represent the conditions or vegetation communities that are typically associated with bogs.

B.2. Fen

Fens are nutrient-medium peatland ecosystems dominated by sedges, cottongrasses, and brown mosses, where mineral-bearing groundwater is within the rooting zone and minerotrophic plant species are common. Fens rely on steady groundwater inflow that provides relatively high nutrient contents and maintains the water table near the peat surface for most of the growing season. These conditions results in soils with richer nutrient regimes. Fens develop on a variety of landscape positions, including basins, lake and river margins, and seepage slopes. These sites are characterized by non-ericaceous shrubs, sedges, grasses, reeds, and brown mosses (MacKenzie and Moran 2004). Tall shrubs and trees are absent from these ecosystems.

B.2.1. Wf02 Scrub birch – Water sedge fen

The Wf02 Scrub birch – Water sedge is a common fen that is typically found throughout the interior of BC (MacKenzie and Moran 2004). The Wf02 association often occurs around the periphery of the wetter Wf01 or adjacent to the drier Wb05. This association may represent a sequence of long-term peatland succession. Many sites have a moss layer with rich and poor site indicators, suggesting that they are in transition from fen to bog conditions.

B.3. Swamp

Swamps are a nutrient-rich wetland ecosystem where significant groundwater inflow, periodic surface aeration, and/or elevated microsites allow for growth of large trees or tall shrubs under subhydric conditions (MacKenzie and Moran 2004). Swamps are dominated by conifer or broadleaf trees (often on mounded microsites), or tall shrubs. Herbaceous species are variable, and can range from thick to sparse covers, while bryophytes are generally limited to certain substrates. Tree-dominated swamps typically occur as transitional areas between water or other wetlands and upland terrestrial communities, while shrub-dominated swamps occur in a wide variety of conditions, including open-water fringes and various locations within fluvial systems. Swamps range from moderate to rich communities that have significant groundwater flow and water tables that remain near or above the surface throughout the growing season. Swamps typically occur on mineral soils of the Gleysolic order, often with a surface layer of well-decomposed organic material.

B.3.1. Ws04 Drummond's willow - Beaked sedge swamp

The Ws04 Drummond's willow - Beaked sedge swamp association is found throughout the central and sub-boreal interior of BC, typically along low-gradient streams and margins of larger complexes. It occurs in areas that receive deep spring flooding, which is often reflected in layers of fluvial material and sedge or peat organics in the soil (MacKenzie and Moran 2004).

B.3.2. Ws05 MacCalla's willow - Beaked sedge swamp

The Ws05 MacCalla's willow - Beaked sedge swamp association occurs sporadically throughout the central and sub-boreal interior of BC in basins, hollows, and stream margins with shallow early-season flooding. This association is considered to be transitional from swamp to fen and often contains deep peaty soils. The sites comprise a wide variety of willows, sedges, and grasses (MacKenzie and Moran 2004).

B.3.3. Ws07 Spruce - Common horsetail - Leafy moss swamp

The Spruce - Common horsetail - Leafy moss swamp association is common throughout much of the northern interior of BC, typically occurring on margins of wetland complexes in locations of rich groundwater movement (MacKenzie and Moran 2004). These swamps have high floral diversity, with the permanently high water table restricting tree growth to elevated mounds.

B.3.4. Ws14 Mountain alder – Bebb's willow – Glow moss swamp

The Ws14 Mountain alder – Bebb's willow – Glow moss swamp as described by DeLong et al. (2011) appears to be analogous to the Ws03 Bebb's willow – Bluejoint swamp as described in MacKenzie and Moran (2004). These shrubby swamps are uncommon in the region and typically occur on the edges of peatlands on fine-textured Gleysols (DeLong et al. 2011). Mountain alder and Bebb's willow are the dominant species, while white spruce, red-osier dogwood and other shrubs may occur. Bluejoint dominates the herbaceous layer on dryer sites, while horsetails are common in the wetter depressions.

B.4. Marsh

Marshes are permanently to seasonally flooded mineral wetland dominated by emergent grass-like vegetation (MacKenzie and Moran 2004). Marshes typically contain simplistic vegetation communities that are dominated by a small number of species, often in response to specific water regimes or other favourable conditions. Shrubs, trees, and mosses are generally absent or very sparse, while aquatic plants are often present. Marshes occur in dynamic hydrological systems where there are significant fluctuations in water levels through the year. They are generally nutrient-rich and more frequently present in warmer climates. Marshes occur in a variety of landscape positions, but most often at the margins of ponds or lakes and within river backwaters as a component of a larger wetland complex. Marshes are generally flooded in the spring, while drier months may see a persistent high water table, or substantial drying and substrate exposure.

B.4.1. Wm01 Beaked sedge - Water sedge marsh

The Wm01 Beaked sedge - Water sedge marsh is the most common marsh in the province, occurring in multiple landscape positions that experience early flooding and late-season drawdown (MacKenzie and Moran 2004). The Wm01 is flooded by low-energy water and has rich Gleysolic soils.

B.4.2. Wm02 Swamp horsetail – Beaked Sedge marsh

The Wm02 Swamp horsetail – Beaked Sedge marsh association is uncommon (Blue-listed) at low elevations throughout the interior of BC, typically in protected bays of lakes, along low-gradient streams, and hydrologically modified fens (MacKenzie and Moran 2004). Plant diversity is always low and limited to species that can survive in permanently flooded sites.

B.4.3. Wm03 Awned sedge fen-marsh

The Wm03 Awned sedge fen-marsh is an uncommon (Red-listed) association that is normally restricted to dry climates of the Central Interior (MacKenzie and Moran 2004). The Wm03 occurs in areas with prolonged saturation and shallow Mesisols or Humic Gleysols. It is typically a simplistic community, with awned sedge (*Carex atherodes*) being the dominant species.

B.4.4. Wm04 Common spike-rush marsh

The Wm04 Common spike-rush associations are common, but never extensive, throughout the interior of BC (MacKenzie and Moran 2004). They occur on the edges of permanent water, such as old side-channels and lake margins. The Wm04 is a floristically simple community that is dominated by common spike-rush (*Eleocharis palustris*), often with few other species occurring.

B.4.5. Wm05 Cattail marsh

The Wm05 Cattail marsh is common throughout much of the province at lower elevations (MacKenzie and Moran 2004). It typically occurs in wetter portions of wetland complexes and lake edges with permanent flooding and little wave action.

B.4.6. Wm06 Great bulrush marsh

The Wm06 Great bulrush marsh occurs throughout the province in areas with warm dry summers (MacKenzie and Moran 2004). The Wm06 is associated with deep permanent water and is normally located in the wettest portion of a marsh complex. The association is characterized by rich, somewhat sluggish turbid water that has gradual flow through the site.

B.5. Open Water

Shallow open-water wetlands are aquatic wetlands permanently flooded by still or slow-moving water and dominated by rooted submerged and floating-leaved aquatic plants (MacKenzie and Moran 2004). These aquatic wetlands are floristically simple communities that typically have less than 10% cover of emergent species. Shallow open-water wetlands occur as a component of still or slowly moving waterbodies, and are normally a small component of a larger wetland or aquatic complexes. They occur in water that is less than two metres deep (deeper water limits light penetration and the ability for most rooted emergent species to grow). There is no formal wetland associations or site series for shallow open water ecosystems.

B.6. Floodplain

Flood associations are non-wetland ecosystems that occur in riparian areas that are regularly flooded or have seasonally high water tables (MacKenzie and Moran 2004). Floodplain ecosystems are connected to, and highly dependent on, hydrological connections to creeks and rivers. Creeks and rivers provide regular flooding and groundwater, nutrients, and the exchange of biotic material (Ickes et al. 2005). The connection to the river system is considered to be essential for ecological health and viability of floodplain ecosystems, and contribute to floodplains being one of the most productive and biodiverse ecosystem types in a given landscape (Ickes et al. 2005; Junk et al. 1989). Physical alterations such as roads and dams disconnect floodplain ecosystems from rivers and creeks, resulting in ecological degradation (Ickes et al. 2005).

B.7. Fl03 Pacific willow – Red-osier dogwood – Horsetail low-bench floodplain

The Fl03 Pacific willow – Red-osier dogwood – Horsetail low-bench floodplain is a Red-listed association that is uncommon through the interior and coast of BC (MacKenzie and Moran 2004). It occurs along low-gradient systems where prolonged flooding is common and gradual.

B.7.1. Fl06 Sandbar willow low-bench floodplain

Fl06 Sandbar willow low-bench floodplains is rare in the province (Red-listed), but locally common along large river systems in the interior of BC (MacKenzie and Moran 2004). The Fl06 occurs at the edge of high-energy rivers where it is subject to prolonged flooding and scouring.

B.7.2. Fm02 Cottonwood - Spruce - Red-osier dogwood mid-bench floodplain

The Fm02 Cottonwood - Spruce - Red-osier dogwood mid-bench floodplain is the most common association along low-elevation rivers in the interior of BC (MacKenzie and Moran 2004). It occurs on relatively stable sandy and gravelly fluvial plains that flood for short periods (often during spring runoff), but are rarely subject to high-energy water flows. These sites rarely have water deficits, resulting in rich communities that can be diverse and include conifers such as hybrid white spruce (*Picea* X).

References

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MacKenzie, W.H., and Moran, J.R. 2004. Wetlands of British Columbia: A Guide to Identification. Victoria, BC: BC Ministry of Forests.

APPENDIX C. FIELD PLOT DATA

Appendix C. Wetland Field Data - Plots

Plot	Date	Surveyors	Easting	Northing	GPS Accuracy	Biogeoclimatic Subzone	Site Series	Soil Moisture Regime	Soil Nutrient Regime	Successional Stage	Structural Stage
BCH WL 001	13-Jul-18	DM RD	607343	6234983	5	BWBSmw	Fl00	2	B	DC	2a
BCH WL 002	13-Jul-18	DM RD	607543	6235155	5	BWBSmw	Fl00	2	B	PS	3a
BCH WL 003	14-Jul-18	JF RD TB	605608	6234762	4	BWBSmw	Wm03	8	C	DC	2b
BCH WL 004	14-Jul-18	JF RD TB	605407	6234705	4	BWBSmw	Wf00	8	C(D)		2a
BCH WL 005	14-Jul-18	JF RD TB DM	605399	6234759	2	BWBSmw	Ws07	8	D	YC	5c
BCH WL 006	15-Jul-18	RD JF	606517	6235813	3	BWBSmw	Wm03	8	D(C)		2b
BCH WL 007	15-Jul-18	RD JF	606583	6235828	3	BWBSmw	Ws05	8	D		3b
BCH WL 008	15-Jul-18	JF RD TB DM	606745	6235920	4	BWBSmw	Wb06	8	D	DC	3b
BCH WL 009	15-Jul-18	JF RD	606742	6235625	4	BWBSmw	Wm06	8	D		2b
BCH WL 010	17-Jul-18	DM TB RD	596675	6230602	5	BWBSmw	Fl00	2	B	DC	2b
BCH WL 011	17-Jul-18	RD DM TB	596599	6230680	3	BWBSmw	Fl06	2	B	DC	3b
BCH WL 012	17-Jul-18	TL RD DM	596694	6230710	5	BWBSmw	Wm00	6	D	DC	2b
BCH WL 013	17-Jul-18	RD DM TB	596653	6230868	4	BWBSmw	Fm02	3	C	YS	5sB
BCH WL 014	17-Jul-18	RD TB	608874	6237303	4	BWBSmw	Fl03	5+	C+	DC	3b
BCH WL 015	17-Jul-18	DM	608978	6237406	5	BWBSmw	Fl06	3-	B	YS	3a
BCH WL 016	18-Jul-18	RD TB EW	608752	6236312	3	BWBSmw	Fl00	3	B	YS	2b
BCH WL 017	17-Jul-18	RD TB EW	608687	6236428	3	BWBSmw	Fl06	5	C	YS	3a
BCH WL 018	18-Jul-18	RD TB EW	608458	6236409	5	BWBSmw	Wm04	7	D		2b
BCH WL 019	17-Jul-18	RD TB EW	608283	6236310	3	BWBSmw	Ws00	5	C+	YS	3b
BCH WL 020	19-Jul-18	RD TB EW	621101	6220355	3	BWBSmw	Wb06	7	B-	DC	3a
BCH WL 021	20-Jul-18	RD TB EW	626098	6223015	3	BWBSmw	Wf02	8	B+	DC	3a
BCH WL 022	20-Jul-18	RD TB EW	619486	6231846	4	BWBSmw	Wm02	8	C		2b
BCH WL 023	20-Jul-18	RD TB EW	619585	6231886	4	BWBSmw	FM00	5	C+	YS	3b
BCH WL 024	20-Jul-18	RD TB EW	619617	6231945	4	BWBSmw	Fl00	5	B	PS	2b
BCH WL 025	20-Jul-18	RD TB EW	613614	6235019	7	BWBSmw	OW	8	D	NA	2c
BCH WL 026	20-Jul-18	RD TB EW	614082	6235338	3	BWBSmw	Fm02	5	C	YC	5tB
BCH WL 027	20-Jul-18	RD TB EW	623665	6233390	4	BWBSmw	Ws00	6	D(C)		3a
BCH WL 028	21-Jul-18	RD TB EW	600077	6232848	2	BWBSmw	Fl00	5+	C(D)	YS	2a

Appendix C. Wetland Field Data - Plots

Plot	Age	Elevation (m)	Slope	Aspect	Mesoslope	Surface	Texture	Surficial Material	Surficial Expression	Geomorphological Process	Drainage Class	Flood Regime
BCH WL 001		418	0	999	LV	ST	g	F(A)	p		W	A
BCH WL 002	<5	420	0	999	LV	ST	g	F	p		W	OB
BCH WL 003		485	0	999	LV	ST	zc	L	p		V	
BCH WL 004		498	0	999	LV	ST	u	O	vp		V	
BCH WL 005		472	0	999	LV	ST	u	O	p		V	
BCH WL 006		456	0	999	LV	ST	u	O	vp		V	
BCH WL 007		458	0	999	LV	ST	u	0	x		V	
BCH WL 008		445	0	999	LV	ST	u	O	B		V	A
BCH WL 009		490	0	999	LV	ST	2c	L	p		V	AP
BCH WL 010		440	0	999	LV	ST	gs	F(A)	p	U W	W	A
BCH WL 011		435	0	999	LV	ST	sg	F(A)	p	V	W	
BCH WL 012		432	0	999	LV	ST	sz	F	p	U	I	
BCH WL 013		451	0	999	LV	ST	sg	F(A)	p		W	R
BCH WL 014		426	0	999	LV	ST	zs	F(A)	p	u	I	Fm
BCH WL 015	5	423	0	999	LVL	ST	s	F a	p		W	RT
BCH WL 016		423	0	999	LV	ST	s	FA	p	u	M	HT
BCH WL 017		422	0	999	LV	CC	zs	FA	p	u	I	OT
BCH WL 018		420	0	999	DP	CC	z	FA	d	u	P	RB
BCH WL 019		430	0	999	LV	ST	z	F	p		I	
BCH WL 020		603	0	999	LV	ST	u	O	bp		V	
BCH WL 021		655	1	999	DP	CC	u	O	d		V/pa	
BCH WL 022		422	0	999	DP	CC	sz	F	p	u	V	AT
BCH WL 023		420	0	999	LV	ST	zs	F	p		I	R
BCH WL 024		427	3	999	LV	ST	zs	FA	p	uw	W	
BCH WL 025		403	0	999	DP	CC	zc	F	p	u	vp	RB
BCH WL 026	>40	430	0	999	LV	ST	sz	F	p		I	Ot
BCH WL 027		416	0	999	LV	ST	zs	FA	p		I(P)	Ot
BCH WL 028		431	0	999	ST	LV	s	FA	p		W	AM

Appendix C. Wetland Field Data - Plots

Plot	Water Source	Hydrogeomorphic Units	Humus Form	Soil Classification	Root Zone Texture	Root Zone Coarse Fragments (%)	Root Depth (cm)	Seepage Depth (cm)	Restrictive Depth (cm)	Restrictive Type	Tree Cover (%)	Shrub Cover (%)	Herb Cover (%)	Moss Lichen Cover (%)
BCH WL 001	PG			O.R	F		20				0	0	20	1
BCH WL 002	PG			O.R	F		10				25	0.1	5	10
BCH WL 003	PG	P cb		O.G	FSI		20+	0			0	0	75	0.1
BCH WL 004	PG	P cb			Om		40				0	1	95	0.1
BCH WL 005	G			TY.M			20	20			55	30	90	70
BCH WL 006	G	P cb			FSI		40				0	0	98	0
BCH WL 007	G	P cb		O.G	FSL		60+				10	40	90	10
BCH WL 008	PG						10	0			50	75	70	95
BCH WL 009	G(P)	P cb		O.G			30+				0	0	80	0
BCH WL 010	PG			C.R	F		10				4	1	10	0
BCH WL 011	PG				F		10				0	35	25	1
BCH WL 012	PG			RH.GL	FSL		5				0	10	80+	0
BCH WL 013	P			E.DYB	CL		32				30	10	50	0
BCH WL 014	G	F ma		O.DYB	FLS		30				20	100	60	0
BCH WL 015	P			Cu.R	SL		5				0	65	25	0
BCH WL 016	G	F a		O.R	CLS		15				0	4	80	0
BCH WL 017	P	F		O.DYB	FL		25				0	34	100	0
BCH WL 018	F			O.G	FSI		20	30			0	7	90	5
BCH WL 019	PG	F a		O.DYB	FSI		20				0	70	100	0.1
BCH WL 020	P	P cb		TY.M	ME		20	20			0	40	12	25
BCH WL 021	G	P cb		TY.M	ME		30				0	30	80	10
BCH WL 022	F	F a		O.G	FSI		10				0	0	60	0
BCH WL 023	F	F		O.DYB	FL		20				0	60	80	0
BCH WL 024	F										0	0.1	35	0
BCH WL 025	F	P oh		O.G	FC		10?				0	0	90	0
BCH WL 026	F	Fa		O.DYB	FL		35				40	35	90	0
BCH WL 027	F	Fa		O.G	FL		30				0	30	90	0
BCH WL 028	F	Fa		O.R	S	20	20				0	0	90	0

Appendix C. Wetland Field Data - Plots

Plot	Date	Surveyors	Easting	Northing	GPS Accuracy	Biogeoclimatic Subzone	Site Series	Soil Moisture Regime	Soil Nutrient Regime	Successional Stage	Structural Stage
BCH WL 029	21-Jul-18	RD TB EW	599987	6232995	3	BWBSmw	Fm02	5+	D	YC	5tB
BCH WL 030	21-Jul-18	RD TB EW	594268	6229078	2	BWBSmw	Fm00	3	B	YC	3b
BCH WL 031	21-Jul-18	RD TB EW	598510	6231951	3	BWBSmw	Fl00	5	C	PS	2b
BCH WL 032	22-Jul-18	RD TB NB EW	588826	6232917	2	BWBSmw	Fl06	3+	B-	PS	3a
BCH WL 033	22-Jul-18	RD TB NB EW	590889	6234803	3	BWBSmw	Fm02	5	C	YC	5oB
BCH WL 034	22-Jul-18	RD TB NB EW	592609	6234277	4	BWBSmw	Fl00	3	A(B)	PS	3a/3b
BCH WL 035	22-Jul-18	RD TB NB EW	595024	6231153	4	BWBSmw	Fm02	3+	B(C)	YS	5oB
BCH WL 036	23-Jul-18	RD NB TB	606865	6235617	3	BWBSmw	Wm05	8	D+	DC	2b
BCH WL 037	23-Jul-18	RD NB TB	607210	6236318	3	BWBSmw	Ws00	8	C	DC	5oC
BCH WL 038	23-Jul-18	RD NB TB	607610	6236590	4	BWBSmw	Ws00	8	D	YS	3b
BCH WL 100	2-Aug-18	NB, TB, EW	587688	6174382	3	BWBSmw	Ws00 (Ws03)	6	C	DC	3b
BCH WL 101	3-Aug-18	NB, TB, EW	614529	6216710	3	BWBSmw	Wm01	7	D	DC	2b
BCH WL 102	3-Aug-18	NB, TB, EW	613938	6216424	3	BWBSmw	Wf02	8	B	DC	3a
BCH WL 103	4-Aug-18	NB, TB, EW	613720	6216335	3	BWBSmw	Wm01	8	D	DC	2b
BCH WL 104	4-Aug-18	NB, TB, EW	608527	6213458	2	BWBSmw	Wm01	7	D	DC	2b
BCH WL 105	4-Aug-18	NB, TB, EW	613919	6216502	3	BWBSmw	Wm02	8	B	DC	2a
BCH WL 106	5-Aug-18	NB, TB, EW	603519	6211169	3	BWBSmw	Ws14	7	D	DC	3a
BCH WL 107	5-Aug-18	NB, TB, EW	613661	6216259	3	BWBSmw	Ws04	7	D	DC	3a
BCH WL 108	6-Aug-18	NB, TB, EW	618253	6218858	5	BWBSmw	Ws14	7	D	DC	3b
BCH WL 109	6-Aug-18	NB, TB, EW	631895	6226444	3	BWBSmw	Wm05	7	D		3
BCH WL 110	7-Aug-18	NB, TB, EW	631912	6226426	3	BWBSmw	Wm03	8	D/E		2b
BCH WL 111	7-Aug-18	NB, TB, EW	631913	6226429	2	BWBSmw	Wm01	7	C		3
BCH WL 112	7-Aug-18	NB, TB, EW	631991	6226431	3	BWBSmw	Wm05	7	D		2b
BCH WL 113	8-Aug-18	DM TL EW	581035	6205281	5	BWBSmw	Wb06	7	B	DC	3b
BCH WL 114	8-Aug-18	DM TL EW	581147	6205302	5	BWBSmw	Wb05	8	B/C	DC	4b
BCH WL 115	9-Aug-18	DM TL EW	592669	6208183	5	BWBSmw	Wb06	8	B	DC	3b
BCH WL 116	9-Aug-18	DM TL EW	592801	6208191	5	BWBSmw	Ws06	7	D	DC	5c
BCH WL 117	10-Aug-18	DM TL EW	567244	6202704	5	BWBSmw	Ws07	7	D	DC	5tM

Appendix C. Wetland Field Data - Plots

Plot	Age	Elevation (m)	Slope	Aspect	Mesoslope	Surface	Texture	Surficial Material	Surficial Expression	Geomorphological Process	Drainage Class	Flood Regime
BCH WL 029	60-80	433	0	999	LV	ST	s	F	t		W	R
BCH WL 030		436	0	999	LV	ST	s	F	t		R	R
BCH WL 031		426	1	999	LV	ST	s	FA	p	u	R	AM
BCH WL 032		464	0	999	LV	ST	sc	FA	p	uw	W	AM
BCH WL 033	30-50	468	0	999	LV	ST	s	FA	p	u	W	AM
BCH WL 034		453	0	999	LV	ST	s	FA	p	u	W	AM
BCH WL 035	20-40	453	0	999	LV	ST	sg	FA	p	u	R	A
BCH WL 036		452	0	999	DP	CC	z	L	d		V	AP
BCH WL 037		460	0	999	LV	CC	u e	O L	b p		V	AP
BCH WL 038		455	0	999	LV	ST	zc	L	bp		V	
BCH WL 100		637	0	999	DP	CC	zc	L	b	u	P	
BCH WL 101		671	0	999	DP	CC	zc	L	b	u	P	
BCH WL 102		672	0	999	DP	CC	u	O	b	u	P	A
BCH WL 103		678	0	999	DP	CC	u	O	b		V	A
BCH WL 104		692	0	999	DP	CC	u	O L	v b	u	V	A
BCH WL 105		669	0	999	DP	CC	u	O	b		V	A
BCH WL 106		689	0	999	DP	CC		L	b	u	V	A
BCH WL 107		670	0	999	DP	CC	sz	L	b	u	P	A
BCH WL 108		658	0	999	DP	CC	zc	L	b	u	V	A
BCH WL 109		645	0	999	DP	CC	u	O	v		V	A
BCH WL 110		646	0	999	LV	ST		L	b		P	
BCH WL 111		644	0	999	DP	CC	u	O	x		V	A
BCH WL 112		642	0	999	DP	CC	u	O	x		V	A
BCH WL 113		768	0	999	LV	CV	u	O	v		V	A
BCH WL 114	150	768	0	999	LV	ST	u	O	b		V	A
BCH WL 115		683	0	999	LV	ST	u	O	b		V	A
BCH WL 116	100	679	0	999	LV	ST	sz	L	b		I	
BCH WL 117	60-80	743	0	999	DP	CC	u sz	O	v b		P	A

Appendix C. Wetland Field Data - Plots

Plot	Water Source	Hydrogeomorphic Units	Humus Form	Soil Classification	Root Zone Texture	Root Zone Coarse Fragments (%)	Root Depth (cm)	Seepage Depth (cm)	Restrictive Depth (cm)	Restrictive Type	Tree Cover (%)	Shrub Cover (%)	Herb Cover (%)	Moss Lichen Cover (%)
BCH WL 029	F	Fa		O.R	SL		30				55	80	5	0
BCH WL 030	F	Fa		O.R	S		20				42	0.1	40	15
BCH WL 031	F	Fa		O.R	S		10	0			0	0.1	90	5
BCH WL 032	F	Fa		O.R	S		20+				0	25	30	0.1
BCH WL 033	F	Fa		O.R	S		40				42	20	20	0.1
BCH WL 034	F	Fa		O.R	S		40				20	0.1	35	0.1
BCH WL 035	F	Fa		O.R	S		40				30	20	40	10
BCH WL 036	G	Pcb		O.HG	FL		10				0	0	60	0
BCH WL 037	G			ME.F			15				20	20	100	15
BCH WL 038	G	Pcb		O.G	V		15				49	40	90	16
BCH WL 100	G	P		O.G			9	4	9	P	0	40	15	0
BCH WL 101	G	P		O.G	FL		58	1	71	P	0	2	65	0
BCH WL 102	P			TY.M			60	0			0	20	80	0
BCH WL 103	G			O.G			10	3	25	W	0	0	35	0
BCH WL 104	G	P		O.G	ME		32	18	27	P	0	0	60	0
BCH WL 105	G	P	W	TY.M				2		W	0	5	40	0
BCH WL 106	G			O.G	FSI		30	5	70	P	0	20	15	0
BCH WL 107	PG	L		O.G			18	5	57	P	0	35	15	0
BCH WL 108	F G	P		O.G			34	22	36	P	0	60	50	0
BCH WL 109	F G			R.G	FSL		54	66		P	0	0	100	0
BCH WL 110											0	0.1	20	0
BCH WL 111	F G							25	30	P	0	25	25	0
BCH WL 112	F (+G?)			R.G	FSL					P	0	7	90	0
BCH WL 113	PG	p		TY.M			26	0			0	36	90	35
BCH WL 114	PG	P		TY.M			20	0	10	W	0	20	40	25
BCH WL 115	PG			TY.M					0	W	0	15	50	80
BCH WL 116	PG		RD	O.HG			17	<16	17	W	20	10	25	60
BCH WL 117	PG						60	36	60	W	7	45	35	25

Appendix C. Wetland Field Data - Plots

Plot	Date	Surveyors	Easting	Northing	GPS Accuracy	Biogeoclimatic Subzone	Site Series	Soil Moisture Regime	Soil Nutrient Regime	Successional Stage	Structural Stage
BCH WL 118	10-Aug-18	DM TL EW	567392	6202614	5	BWBSmw	Wb03	8	B	OC	3b

Appendix C. Wetland Field Data - Plots

Plot	Age	Elevation (m)	Slope	Aspect	Mesoslope	Surface	Texture	Surficial Material	Surficial Expression	Geomorphological Process	Drainage Class	Flood Regime
BCH WL 118	100+	737	0	999	LV	CV	e	O	b		V	A

Appendix C. Wetland Field Data - Plots

Plot	Water Source	Hydrogeomorphic Units	Humus Form	Soil Classification	Root Zone Texture	Root Zone Coarse Fragments (%)	Root Depth (cm)	Seepage Depth (cm)	Restrictive Depth (cm)	Restrictive Type	Tree Cover (%)	Shrub Cover (%)	Herb Cover (%)	Moss Lichen Cover (%)
BCH WL 118	P(G)			TY.F			15	23	15	W	0	60	10	80

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 001	*Populus balsamifera*	B2	0.1
	Salix prolixa	B2	0.1
	Allium schoenoprasum var. sibiricum	C	10
	Elymus repens	C	2
	Deschampsia cespitosa	C	10
	Agrostis stolonifera	C	2
	Agrostis gigantea	C	1
	Taraxacum officinale	C	1
	Arnica chamissonis	C	1
	Eurybia sibirica	C	1
	Symphyotrichum lanceolatum	C	1
	Carex kelloggii	C	0.1
	Solidago altissima	C	0.1
	Equisetum hyemale	C	0.1
	Achillea borealis	C	0.1
	Apocynum androsaemifolium	C	0.1
	Poa palustris	C	0.1
	Plantago major	C	0.1
	Trifolium hybridum	C	0.1
	Phalaris arundinacea	C	0.1
	Phleum pratense	C	0.1
	Moss	D	1
BCH WL 002	*Populus balsamifera*	B	25
	Picea glauca	B	0.1
	Amelanchier alnifolia	B	0.1
	Rosa acicularis	B	0.1
	Oxytropis campestris var. davisii	C	1
	Astragalus australis	C	1
	Artemisia campestris	C	1
	Melilotus alba	C	1
	Solidago altissima	C	0.1
	Oxytropis sericea	C	0.1
	Anemone multifida	C	1
	Symphyotrichum laeve	C	0.1
	Viola adunca	C	0.1
	Achillea borealis	C	0.1
	Hieracium canadense	C	0.1
	Dryas drummondii	C	0.1
	Medicago lupulina	C	0.1
	Symphyotrichum lanceolatum	C	0.1
	Eurybia sibirica	C	0.1
	Crepis tectorum	C	0.1
	Elymus repens	C	0.1
	Erigeron caespitosus	C	0.1
	Solidago simplex	C	0.1
	Medicago sativa	C	0.1
	Moss	D	10
BCH WL 003	*Carex aquatilis*	C	10
	Carex atherodes	C	70
	Rumex aquaticus	C	2
	Petasites sagittatus	C	2

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 003 (*cont'd*)	*Stachys palustris*	C	0.1
	Symphyotrichum boreale	C	1
	Scutellaria galericulata	C	1
	Cicuta maculata	C	0.1
	Mentha arvensis	C	1
	Epilobium palustre	C	0.1
	Juncus balticus	C	0.1
	Carex diandra	C	0.1
	Poa palustris	C	0.1
	Galium triflorum	C	0.1
	Calliergon sp.	D	0.1
BCH WL 004	*Larix laricina*	B	0.1
	Picea glauca	B	0.1
	Salix candida	B	1
	Salix maccalliana	B	0.1
	Salix bebbiana	B	0.1
	Betula pumila	B	0.1
	Betula glandulosa	B	0.1
	Schoenoplectus tabernaemontani	C	80
	Triglochin maritima	C	5
	Lobelia kalmii	C	0.1
	Eleocharis quinqueflora	C	2
	Viola nephrophylla	C	0.1
	Sonchus arvensis	C	0.1
	Carex viridula	C	1
	Parnassia parviflora	C	0.1
	Galium boreale	C	0.1
	Chara sp.	C	5
	Carex aquatilis	C	30
	Muhlenbergia richardsonis	C	0.1
	Muhlenbergia glomerata	C	1
	Moss	D	0.1
BCH WL 005	*Betula neoalaskana*	B	1
	Picea glauca	A	50
	Larix laricina	A	5
	Rosa acicularis	B	2
	Rhododendron groenlandicum	B	10
	Amelanchier alnifolia	B	1
	Alnus incana	B	7
	Cornus stolonifera	B	9
	Salix discolor	B	1
	Shepherdia canadensis	B	0.1
	Cornus canadensis	C	30
	Carex disperma	C	40
	Galium triflorum	C	1
	Mitella nuda	C	8
	Linnaea borealis	C	20
	Rubus pubescens	C	8
	Vaccinium vitis-idaea	C	5
	Carex leptalea	C	2
	Moneses uniflora	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 005 (*cont'd*)	*Viola renifolia*	C	0.1
	Aralia nudicaulis	C	0.1
	Platanthera obtusata	C	8
	Corallorhiza trifida	C	0.1
	Glyceria striata	C	1
	Maianthemum canadense	C	2
	Carex vaginata	C	0.1
	Galium boreale	C	0.1
	Geocaulon lividum	C	0.1
	Malaxis brachypoda	C	0.1
	Moss	D	70
BCH WL 006	*Carex atherodes*	C	98
	Lemna minor	C	50
	Lemna trisulca	C	50
	Typha latifolia	C	3
	Scolochloa festucacea	C	3
BCH WL 007	*Betula neoalaskana*	B	5
	Picea glauca	B	1
	Larix laricina	B	6
	Salix discolor	B	2
	Salix bebbiana	B	11
	Salix maccalliana	B	20
	Salix pseudomonticola	B	1
	Rosa acicularis	B	1
	Betula glandulosa	B	0.1
	Betula pumila	B	4
	Rhododendron groenlandicum	B	0.1
	Cornus stolonifera	B	2
	Salix serissima	B	1
	Carex aquatilis	C	8
	Carex utriculata	C	40
	Calamagrostis canadensis	C	40
	Carex praticola	C	0.1
	Petasites sagittatus	C	0.1
	Rubus pubescens	C	1
	Galium triflorum	C	0.1
	Equisetum palustre	C	0.1
	Rubus arcticus	C	0.1
	Mertensia paniculata	C	0.1
	Sium suave	C	0.1
	Maianthemum stellatum	C	0.1
	Pyrola asarifolia	C	0.1
	Moss	D	10
	Plagiomnium sp.	D	0.1
	Drepanocladus sp.	D	0.1
BCH WL 008	*Larix laricina*	B	35
	Picea glauca	B	30
	picea mariana	B	5
	Salix candida	B	1
	Rhododendron groenlandicum	B	70

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 008 (*cont'd*)	*Betula glandulosa*	B	15
	Salix serissima	B	0.1
	Cornus stolonifera	B	0.1
	Betula pumila	B	5
	Alnus incana	B	1
	Salix athabascensis	B	2
	Carex aquatilis	C	20
	Carex praticola	C	2
	Platanthera aquilonis	C	0.1
	Salix myrtillifolia	C	20
	Cypripedium parviflorum	C	1
	Drosera rotundifolia	C	3
	Maianthemum trifolium	C	8
	Vaccinium vitis-idaea	C	15
	Triglochin maritima	C	1
	Vaccinium microcarpum	C	5
	Arctous ruber	C	1
	Triglochin palustris	C	0.1
	Carex gynocrates	C	0.1
	Geocaulon lividum	C	0.1
	Sphagnum	D	60
	Moss	D	35
BCH WL 009	*Schoenoplectus tabernaemontani*	C	80
	Carex aquatilis	C	15
	Typha latifolia	C	5
	Lemna trisulca	C	30
	Utricularia macrorhiza	C	30
	Galium triflorum	C	0.1
	Hippuris vulgaris	C	0.1
	Lemna minor	C	1
BCH WL 010	*Populus balsamifera*	B	0.1
	Salix maccalliana	B	0.1
	Rubus idaeus	B	0.1
	Phalaris arundinacea	C	1
	Solidago canadensis	C	1
	Deschampsia caespitosa	C	6
	Melilotus alba	C	0.1
	Achillea millefolium	C	0.1
	Hordeum jubatum	C	0.1
	Taraxacum officinale	C	0.1
	Elymus repens	C	3
	Allium schoenoprasum	C	3
	Matricaria maritima	C	0.1
	Aster hesperius	C	0.1
	Trifolium hybridum	C	0.1
	Hieracium umbellatum	C	0.1
	Equisetum hyemale	C	0.1
	Arnica chamissonis	C	0.1
	Rumex salicifolius	C	0.1
	Medicago lupulina	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 011	*Populus balsamifera*	B	20
	Salix interior	B	5
	Rosa acicularis	B	0.1
	Equisetum arvense	C	3
	Melilotus officinalis	C	10
	Melilotus alba	C	5
	Hieracium umbellatum	C	0.1
	Equisetum hyemale	C	3
	Phalaris arundinacea	C	1
	Taraxacum officinale	C	0.1
	Matricaria maritima	C	0.1
	Carex lenticularis	C	0.1
	Medicago lupulina	C	2
	Achillea millefolium	C	0.1
	Deschampsia sp.	C	1
	Apocynum androsaemifolium	C	0.1
	Dryas drummondii	C	1
BCH WL 012	*Salix interior*	B	0.1
	Salix maccalliana	B	7
	Scirpus microcarpus	C	30
	Beckmannia syzigachne	C	5
	Hordeum jubatum	C	0.1
	Carex lenticularis	C	5
	Typha latifolia	C	20
	Deschampsia sp.	C	0.1
	Calamagrostis neglecta	C	5
	Trifolium hybridum	C	0.1
	Carex aquatilis	C	10
	Carex utriculata	C	20
	Polygonum arenastrum	C	0.1
	Equisetum arvense	C	4
	Cirsium arvense	C	0.1
	Phalaris arundinacea	C	5
	Hieracium umbellatum	C	0.1
	Plantago major	C	0.1
	Chenopodium album	C	0.1
	Juncus balticus	C	0.1
BCH WL 013	*Populus balsamifera*	A	30
	Rosa acicularis	B	1
	Lonicera villosa	B	7
	Alnus incana ssp rugosa	B	1
	Taraxacum officinale	C	2
	Vicia americana	C	3
	Tragopogon dubius	C	0.1
	Equisetum hyemale	C	2
	Smilacina stellata	C	2
	Solidago canadensis	C	2
	Bromus inermis	C	30
	Medicago sativa	C	5
	Apocynum androsaemifolium	C	5
	Thalictrum venulosum	C	0.1
	Aster sp.	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 014	*Populus balsamifera*	A	5
	Rosa acicularis	B	5
	Alnus incana ssp rugosa	B	80
	Cornus stolonifera	B	0.1
	Lonicera villosa	B	0.1
	Salix lucida	B	10
	Amelanchier alnifolia	B	0.1
	Symphoricarpos albus	B	0.1
	Salix interior	B	2
	Smilacina stellata	C	2
	Melilotus officinalis	C	8
	Trifolium hybridum	C	0.1
	Equisetum arvense	C	10
	Melilotus alba	C	2
	Hieracium umbellatum	C	0.1
	Plantago major	C	0.1
	Bromus inermis	C	10
	Taraxacum officinale	C	1
	Solidago canadensis	C	0.1
	Thalictrum venulosum	C	0.1
	Rubus pubescens	C	0.1
	Scutellaria galericulata	C	0.1
	Rubus idaeus	C	0.1
BCH WL 015	*Populus balsamifera*	B	10
	Salix interior	B	40
	Salix maccalliana	B	10
	Rosa acicularis	B	0.1
	Lonicera villosa	B	0.1
	Cornus stolonifera	B	0.1
	Melilotus alba	C	10
	Melilotus officinalis	C	10
	Cirsium arvense	C	3
	Vicia americana	C	1
	Equisetum arvense	C	3
	Hordeum jubatum	C	0.1
	Goodyera oblongifolia	C	0.1
	Bromus inermis	C	1
BCH WL 016	*Populus balsamifera*	B	1
	Salix maccalliana	B	2
	Salix interior	B	1
	Alnus incana ssp rugosa	B	1
	Allium schoenoprasum	C	10
	Deschampsia caespitosa	C	20
	Calamagrostis stricta ssp. inexpansa	C	5
	Agrostis repens	C	5
	Bromus inermis	C	5
	Trifolium hybridum	C	5
	Medicago lupulina	C	15
	Solidago canadensis	C	5
	Matricaria maritima	C	0.1
	Arnica chamissonis	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 016 (*cont'd*)	*Calamagrostis canadensis*	C	3
	Aster hesperius	C	2
	Juncus nodosus	C	0.1
	Plantago major	C	0.1
	Carex lenticularis	C	1
	Achillea millefolium	C	1
	Rhinanthus borealis	C	0.1
	Aster sibiricus	C	2
	Phleum pratense	C	0.1
	Equisetum hyemale	C	0.1
BCH WL 017	*Salix interior*	B	30
	Salix maccalliana	B	2
	Alnus incana ssp rugosa	B	2
	Solidago canadensis	C	0.1
	Trifolium hybridum	C	10
	Sonchus arvensis	C	5
	Taraxacum officinale	C	0.1
	Agrostis repens	C	50
	Allium schoenoprasum	C	0.1
	Bromus inermis	C	5
	Phleum pratense	C	0.1
	Poa palustris	C	20
	Deschampsia caespitosa	C	0.1
	Cirsium arvense	C	2
BCH WL 018	*Salix interior*	B	2
	Salix maccalliana	B	5
	Scirpus microcarpus	C	20
	Equisetum hyemale	C	25
	Eleocharis palustris	C	25
	Eleocharis acicularis	C	15
	Sparganium angustifolium	C	10
	Medicago lupulina	C	0.1
	Trifolium hybridum	C	0.1
	Agrostis repens	C	0.1
	Poa palustris	C	0.1
	Juncus nodosus	C	0.1
	Hippuris vulgaris	C	0.1
	Ranunculus aquatilis	C	0.1
	Alisma plantago-aquatica	C	0.1
	Typha latifolia	C	0.1
	Cicuta maculata	C	0.1
	Equisetum arvense	C	0.1
	Phalaris arundinacea	C	0.1
	Plantago major	C	0.1
	polygonum arenastrum	C	0.1
	Chara sp.	C	0.1
	Equisetum pratense	C	5
	Sagittaria cuneata	C	0.1
	Carex retrorsa	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 019	*Alnus incana ssp rugosa*	B	70
	Cornus stolonifera	B	10
	Rubus pubescens	B	0.1
	salix sp	B	0.1
	Ribes oxyacanthoides	B	0.1
	Rosa acicularis	B	2
	Rubus idaeus	B	10
	Poa pratensis	C	20
	Cirsium arvense	C	0.1
	Bromus inermis	C	5
	Mentha arvensis	C	2
	Eurybia conspicua	C	2
	Taraxacum officinale	C	5
	Galium trifidum	C	0.1
	Thalictrum venulosum	C	0.1
	Potentilla norvegica	C	0.1
	Smilacina stellata	C	0.1
	Cicuta maculata	C	0.1
	Equisetum arvense	C	0.1
	Petasites sagittatus	C	0.1
	Geum macrophyllum	C	0.1
	Cinna latifolia	C	2
	Solidago canadensis	C	0.1
BCH WL 020	*Picea mariana*	B	2
	Ledum groenlandicum	B	20
	Salix maccalliana	B	2
	Rubus chamaemorus	B	5
	Betula pumila	B	2
	Vaccinium vitis-idaea	B	5
	Oxytropis microphylla	B	5
	Carex aquatilis	C	0.1
	Carex macloviana	C	0.1
	Equisetum arvense	C	0.1
	Calamagrostis canadensis	C	10
	Eriophorum vaginatum	C	2
	Sphagnum	D	25
BCH WL 021	*Larix laricina*	B	2
	Picea mariana	B	0.1
	Betula pumila	B	25
	Salix sp.	B	2
	Carex bebbii	C	0.1
	Carex aquatilis	C	50
	Comarum palustre	C	20
	Equisetum fluviatile	C	15
	Epilobium palustre	C	0.1
	Petasites sagittatus	C	0.1
	Calamagrostis canadensis	C	5
	Carex diandra	C	30
	Epilobium leptocarpum	C	0.1
	Stellaria longifolia	C	0.1
	Glyceria pulchella	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 021 (*cont'd*)	*Eriophorum vaginatum*	C	0.1
	Carex chordorrhiza	C	25
	Aulacomnium palustre	D	0.1
	Tomentypnum nitens	D	0.1
	Sphagnum sp.	D	0.1
BCH WL 022	*Equisetum fluviatile*	C	50
	Carex utriculata	C	10
	Lemna minor	C	0.1
	Schoenoplectus tabernaemontani	C	1
	Typha latifolia	C	0.1
	Scirpus microcarpus	C	0.1
BCH WL 023	*Alnus incana ssp rugosa*	B	50
	Salix maccalliana	B	5
	Cornus stolonifera	B	5
	Rubus pubescens	B	0.1
	Rubus idaeus	B	0.1
	Cirsium arvense	C	35
	Stachys sp.	C	0.1
	Equisetum arvense	C	5
	Carex retrorsa	C	3
	Calamagrostis canadensis	C	35
	Mentha arvensis	C	2
	Thalictrum venulosum	C	0.1
	Geum macrophyllum	C	0.1
	Galium trifidum	C	0.1
	Glyceria grandis	C	0.1
BCH WL 024	*Salix maccalliana*	B	0.1
	Salix exigua	B	0.1
	Phalaris arundinacea	C	0.1
	Arnica chamissonis	C	2
	Allium schoenoprasum	C	15
	Aster hesperius	C	2
	Deschampsia caespitosa	C	8
	Agrostis repens	C	5
	Veronica anagallis-aquatica	C	0.1
	Trifolium hybridum	C	0.1
	Cirsium arvense	C	0.1
	Achillea millefolium	C	0.1
	Polygonum arenastrum	C	0.1
BCH WL 025	*Sagittaria cuneata*	C	10
	Ranunculus aquatilis	C	40
	Sparganium angustifolium	C	30
	Scirpus microcarpus	C	2
	Carex utriculata	C	2
	Eleocharis palustris	C	1
	Equisetum fluviatile	C	5

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 026	*Populus balsamifera*	B	40
	Picea glauca	B	0.1
	Alnus incana ssp rugosa	B	30
	Cornus stolonifera	B	2
	Amelanchier alnifolia	B	0.1
	Sonchus arvensis	C	0.1
	Taraxacum officinale	C	20
	Trifolium hybridum	C	20
	Medicaga sativa	C	0.1
	Melilotus alba	C	2
	Calamagrostis canadensis	C	40
	Poa palustris	C	5
	Habenaria hyperborea	C	0.1
	Medicago lupulina	C	0.1
	Solidago canadensis	C	0.1
	Achillea millefolium	C	0.1
	Equisetum hyemale	C	0.1
	Bromus inermis	C	0.1
	Symphyotrichum puniceum	C	0.1
	Smilacina stellata	C	0.1
	Thalictrum venulosum	C	0.1
	Anaphalis margaritacea	C	0.1
	Oxytropis deflexa	C	0.1
	Melilotus officinalis	C	2
	Pyrola asarifolia	C	0.1
BCH WL 027	*Alnus incana ssp rugosa*	B	5
	Salix interior	B	0.1
	Salix maccalliana	B	10
	Cornus stolonifera	B	2
	Salix maccalliana	B	10
	Carex aquatilis	C	25
	Trifolium hybridum	C	50
	Calamagrostis stricta ssp. inexpansa	C	0.1
	Equisetum arvense	C	3
	Medicago lupulina	C	0.1
	Symphyotrichum puniceum	C	1
	Cirsium arvense	C	0.1
	Rhinanthus borealis	C	0.1
	Poa pratensis	C	5
	Potentilla anserina	C	20
	Deschampsia caespitosa	C	0.1
	Calamagrostis canadensis	C	10
	Sonchus arvensis	C	0.1
	Melilotus officinalis	C	0.1
	Juncus nodosus	C	0.1
	Scirpus microcarpus	C	0.1
	Cicuta maculata	C	0.1
	Phleum pratense	C	0.1
BCH WL 028	*Phalaris arundinacea*	C	50
	Trifolium hybridum	C	10
	Arnica chamissonis	C	7

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 028 (*cont'd*)	*Aster hesperius*	C	0.1
	Calamagrostis stricta ssp. inexpansa	C	15
	Sonchus arvensis	C	1
	Deschampsia caespitosa	C	0.1
	Plantago major	C	0.1
	Equisetum arvense	C	5
	Matricaria maritima	C	0.1
	Epilobium glaberrimum	C	0.1
	Medicago lupulina	C	0.1
	Cirsium arvense	C	0.1
	Rhinanthus borealis	C	0.1
	Phleum pratense	C	2
	Chenopodium album	C	0.1
	Solidago canadensis	C	0.1
	Polygonum arenastrum	C	0.1
	Rumex occidentalis	C	0.1
	Poa pratensis	C	0.1
	Carex aquatilis	C	0.1
BCH WL 029	*Populus balsamifera*	B	50
	Picea mariana	B	5
	Alnus incana ssp rugosa	B	20
	Cornus stolonifera	B	30
	Rubus idaeus	B	20
	Rosa acicularis	B	5
	Amelanchier alnifolia	B	0.1
	Symphoricarpos albus	B	0.1
	Shepherdia canadensis	B	1
	Smilacina stellata	C	1
	Equisetum hyemale	C	0.1
	Actaea rubra	C	0.1
	Pyrola asarifolia	C	0.1
	Maianthemum canadense	C	0.1
	Coeloglossum viride	C	0.1
	Trifolium hybridum	C	0.1
	Galium trifidum	C	0.1
	Taraxacum officinale	C	0.1
	Melica sp.	C	0.1
	Prosartes trachycarpa	C	0.1
	Aralia nudicaulis	C	0.1
	Bromus inermis	C	0.1
	Calamagrostis canadensis	C	0.1
	Osmorhiza sp.	C	0.1
BCH WL 030	*Populus balsamifera*	B	40
	Picea glauca	B	2
	Elaeagnus commutata	B	0.1
	Juniperus communis	B	0.1
	Dryas sp.	C	10
	Oxytropis splendens	C	20
	Achillea millefolium	C	0.1
	Hieracium umbellatum	C	0.1
	Chenopodium album	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 030 (*cont'd*)	*Taraxacum officinale*	C	0.1
	Aster hesperius	C	0.1
	Arctostaphylos uva-ursi	C	0.1
	Sonchus arvensis	C	0.1
	Deschampsia caespitosa	C	0.1
	Agrostis subrepens	C	0.1
	Medicago sativa	C	0.1
	Astragalus aboriginum	C	0.1
	Lotus corniculatus	C	0.1
BCH WL 031	*Alnus incana ssp rugosa*	B	0.1
	Salix interior	B	0.1
	Salix mackenzieana	B	0.1
	Allium schoenoprasum	C	0.1
	Arnica chamissonis	C	15
	Trifolium hybridum	C	0.1
	Scirpus microcarpus	C	0.1
	Rhinanthus borealis	C	0.1
	Deschampsia caespitosa	C	15
	Calamagrostis canadensis	C	2
	Equisetum arvense	C	0.1
	Carex lenticularis	C	0.1
	Carex bebbii	C	0.1
	Phleum pratense	C	1
	Phalaris arundinacea	C	0.1
	Carex aquatilis	C	0.1
	Hordeum jubatum	C	0.1
	Poa palustris	C	2
	Aster hesperius	C	0.1
	Calamagrostis neglecta	C	0.1
	Poa pratensis	C	0.1
	Cirsium arvense	C	0.1
	Agrostis repens	C	0.1
	Juncus nodosus	C	0.1
	Equisetum scirpoides	C	0.1
	Bromus inermis	C	0.1
	Solidago canadensis	C	0.1
	Achillea millefolium	C	0.1
BCH WL 032	*Populus balsamifera*	B	60
	Salix interior	B	12
	Salix maccalliana	B	2
	Rosa acicularis	B	0.1
	Potentilla norvegica	B	0.1
	Melilotus officinalis	B	15
	Hieracium umbellatum	C	0.1
	Artemisia sp.	C	0.1
	Agrostis repens	C	0.1
	Poa pratensis	C	1
	Melilotus alba	C	2
	Plantago major	C	0.1
	Cirsium arvense	C	0.1
	Trifolium hybridum	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 032 (*cont'd*)	*Achillea millefolium*	C	0.1
	Hordeum jubatum	C	0.1
	Calamagrostis stricta ssp. inexpansa	C	0.1
	Beckmannia syzigachne	C	0.1
	Solidago canadensis	C	0.1
	Achillea sibirica	C	0.1
	Bromus inermis	C	0.1
BCH WL 033	*Populus balsamifera*	B	40
	Picea mariana	B	2
	Alnus incana ssp rugosa	B	10
	Rosa acicularis	B	0.1
	Salix mackenzieana	B	0.1
	Cornus stolonifera	B	0.1
	Elaeagnus commutata	B	3
	Symphoricarpos albus	B	0.1
	Vicia americana	C	4
	Solidago canadensis	C	2
	Melilotus officinalis	C	2
	Eurybia conspicua	C	0.1
	Equisetum sylvaticum	C	0.1
	Taraxacum officinale	C	0.1
	Bromus inermis	C	4
	Achillea millefolium	C	0.1
	Agrostis repens	C	0.1
	Trifolium hybridum	C	0.1
	Fragaria virginiana	C	0.1
	Equisetum arvense	C	0.1
BCH WL 034	*Populus balsamifera*	B	20
	Elaeagnus commutata	B	0.1
	Equisetum hyemale	C	0.1
	Melilotus officinalis	C	25
	Artemisia sp.	C	2
	Hieracium umbellatum	C	0.1
	Fragaria virginiana	C	0.1
	Taraxacum officinale	C	0.1
	Poa pratensis	C	2
	Solidago canadensis	C	0.1
	Equisetum scirpoides	C	0.1
	Trifolium hybridum	C	0.1
	Juncus nodosus	C	0.1
	Sonchus arvensis	C	1
	Vicia americana	C	0.1
	Plantago major	C	0.1
BCH WL 035	*Acer negundo*	B	0.1
	Populus balsamifera	B	20
	Symphoricarpos albus	B	0.1
	Salix interior	B	0.1
	Vicia americana	C	1
	Melilotus officinalis	C	30
	Achillea millefolium	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 035 (*cont'd*)	*Taraxacum officinale*	C	0.1
	Equisetum hyemale	C	0.1
	Oxytropis splendens	C	0.1
	Aralia nudicaulis	C	0.1
	Habenaria viridis	C	0.1
	Lathyrus ochroleucus	C	0.1
	Plagiomnium sp.	D	10
BCH WL 036	*Typha latifolia*	C	40
	Lemna minor	C	5
	Lemna trisulca	C	5
	Potamogeton filiformis	C	5
	Ceratophyllum demersum	C	5
BCH WL 037	*Larix laricina*	B	10
	Picea mariana	B	10
	Betula pumila	B	5
	Alnus incana ssp rugosa	B	5
	Rubus pubescens	B	0.1
	Ledum groenlandicum	B	0.1
	Salix sp.	B	0.1
	Typha latifolia	C	30
	Equisetum fluviatile	C	50
	Urtica dioica	C	0.1
	Galium triflorum	C	0.1
	Smilacina stellata	C	3
	Galium trifidum	C	0.1
	Carex aquatilis	C	15
	Mitella nuda	C	0.1
BCH WL 038	*Picea glauca*	B	5
	Larix laricina	B	2
	Salix candida	B	30
	Rubus idaeus	B	0.1
	Rosa acicularis	B	0.1
	Alnus incana ssp rugosa	B	0.1
	Ribes lacustre	B	0.1
	Ribes hudsonianum	B	0.1
	Shepherdia canadensis	B	0.1
	Geum macrophyllum	C	0.1
	Petasites sagittatus	C	10
	Carex atherodes	C	15
	Stachys palustris	C	0.1
	Scutellaria galericulata	C	0.1
	Cirsium arvense	C	0.1
	Epilobium glaberrimum	C	0.1
	Equisetum fluviatile	C	30
	Typha latifolia	C	0.1
	Comarum palustre	C	0.1
	Epilobium watsonii	C	0.1
	Epilobium anagallidifolium	C	0.1
	Calamagrostis canadensis	C	0.1
	Bromus ciliatus	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 038	*Deschampsia caespitosa*	C	0.1
(*cont'd*)	*Habenaria hyperborea*	C	0.1
	Hordeum jubatum	C	0.1
BCH WL 100	*Alnus incana ssp. tenuifolia*	B	8
	Salix prolixa	B	35
	Equisetum arvense	C	3
	Carex aquatilis var. aquatilis	C	4
	Calamagrostis canadensis var. canadensis	C	3
	Carex aquatilis var. aquatilis	C	3
	Rosa acicularis	C	0.1
BCH WL 101	*Salix bebbiana*	B	2
	Carex utriculata	C	50
	Calamagrostis canadensis	C	10
	Geum macrophyllum	C	3
	Cirsium arvense	C	4
	Crepis tectorum	C	0.1
	Urtica dioica	C	2
	Rumex sp.	C	0.1
BCH WL 102	*Calamagrostis canadensis*	C	25
	Carex aquatilis	C	25
	Betula pumila	B	13
	Comarum palustre	C	2
	Salix pedicellaris	B	8
	Carex utriculata	C	30
BCH WL 103	*Equisetum fluviatile*	C	20
	Carex aquatilis	C	1
	Carex diandra	C	8
	Comarum palustre	C	5
BCH WL 104	*Carex atherodes*	C	60
BCH WL 105	*Salix bebbiana*	B	2
	Equisetum fluviatile	C	30
	Comarum palustre	C	10
	Galium labradoricum	C	1
	Betula pumila	B	3
BCH WL 106	*Salix prolixa*	B	20
	Calamagrostis canadensis var. canadensis	C	3
	Epilobium ciliatum	C	0.1
	Eurybia conspicua	C	2
	Galeopsis tetrahit	C	0.1
	Carex aquatilis var. aquatilis	C	3
	Agrostis scabra	C	0.1
	Salix sp.	C	8

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 107	*Salix prolixa*	B	35
	Equisetum arvense	C	4
	Trifolium hybridum	C	3
	Calamagrostis canadensis	C	5
	Populus tremuloides	C	3
	Rubus pubescens	C	1
BCH WL 108	*Populus balsamifera*	B	2
	Alnus incana ssp rugosa	B	5
	Picea glauca	B	3
	Salix bebbiana	B	20
	Salix prolixa	B	30
	Cornus stolonifera	B	1
	Calamagrostis canadensis	C	50
BCH WL 109	*Typha latifolia*	C	60
	Carex utriculata	C	2
BCH WL 110	*Carex atherodes*	C	30
	Carex utriculata	C	15
	Salix pedicellaris	B	2
BCH WL 111	*Carex atherodes*	C	15
	Carex utriculata	C	35
	Epilobium ciliatum ssp. glandulosum	C	0.1
	Sium suave	C	1
BCH WL 112	*Typha latifolia*	C	45
	Glyceria sp.	C	0.1
	Carex utriculata	C	5
	Sium Suave	C	1
BCH WL 113	*Larix laricina*	B	10
	Picea mariana	B	8
	Salix maccalliana	B	15
	Alnus incana	B	3
	Calamagrostis canadensis	C	60
	Petasites sagittatus	C	4
	Potentilla palustris	C	8
	Symphyotrichum ciliolatum	C	2
	Rhododendron groenlandicum	C	2
	Equisetum fluviatile	C	25
	Scutellaria galericulata	C	2
	Geum macrophyllum	C	1
	Carex utriculata	C	6
	Carex aquatilis	C	4
	Galium trifidum	C	<1
	Equisetum hyemale	C	<1
	Carex bebbii	C	<1
	Carex disperma	C	<1
	Rubus pubescens	C	<1
	moss	D	30
	Sphagnum spp.	D	5
	Tomentypnum nitens	D	<1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 114	*Picea mariana*	B	10
	Larix laricina	B	2
	Cornus stolonifera	B	1
	Ribes hudsonianum	B	3
	Salix maccalliana	B	1
	Lonicera involucrata	B	1
	Rhododendron groenlandicum	B	2
	Betula papyrifera	B	1
	Salix lasiandra var. lasiandra	B	
	Petasites sagittatus	C	1
	Calamagrostis canadensis	C	20
	Rubus pubescens	C	<1
	Equisetum hyemale	C	5
	Potentilla palustris	C	1
	Geum macrophyllum	C	<1
	Galium trifidum	C	<1
	Carex aquatilis	C	10
	Carex viridula	C	5
	Carex disperma	C	<1
	Tomentypnum nitens	D	10
	Sphagnum	D	15
BCH WL 115	*Larix laricina*	B	8
	Picea mariana	B	3
	Betula nana	B	5
	Rhododendron groenlandicum	B	1
	Equisetum fluviatile	C	10
	Carex disperma	C	5
	Calamagrostis canadensis	C	30
	Carex livida	C	2
	Potentilla palustris	C	<1
	Epilobium ciliatum	C	<1
	Petasites sagittatus	C	<1
	Oxycoccus microcarpus	C	<1
	Mitella nuda	C	<1
	Tomentypnum nitens	D	5
	Aulacomnium palustre	D	5
	Sphagnum sp.	D	60
BCH WL 116	*Larix laricina*	A	7
	Picea glauca x	A	5
	Picea glauca x	B	10
	Picea mariana	B	10
	Populus balsamifera	A	5
	Betula papyrifera	B	1
	Lonicera involucrata	B	5
	Ribes oxyacanthoides	B	<1
	Rhododendron groenlandicum	B	2
	Salix prolixa	B	1
	Rosa gymnocarpa	B	1
	Populus balsamifera	B	<1
	Rubus pubescens	C	1
	Equisetum arvense	C	6

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 116 (*cont'd*)	*Equisetum fluviatile*	C	1
	Petasites palmatus	C	<1
	Cornus canadensis	C	<1
	Mitella nuda	C	<1
	Carex disperma	C	10
	Carex livida	C	15
	Cornus canadensis	C	1
	Epilobium anagallidifolium	C	10
	Platanthera sp.	C	<1
	Pleurozium schreberi	D	40
	Aulacomnium palustre	D	2
	Dicranum sp.	D	10
	Plagiomnium medium	D	1
BCH WL 117	*Picea X*	A	5
	Picea X	B	10
	Picea mariana	B	8
	Betula papyrifera	B	14
	Populus balsamifera	A	2
	Populus balsamifera	B	10
	Salix lucida	B	1
	Alnus incana	B	15
	Salix maccalliana	B	1
	Ribes triste	B	5
	Rubus pubescens	C	1
	Equisetum arvense	C	10
	Petasites palmatus	C	1
	Carex disperma	C	10
	Carex livida	C	5
	Mitella nuda	C	1
	Galium trifidum	C	1
	Cornus canadensis	C	1
	Tiarella trifoliata	C	1
	Linnaea borealis	C	1
	Viburnum edule	B	1
	Rubus idaeus	C	1
	Rosa acicularis	C	1
	Viburnum edule	C	1
	Fragaria virginiana	C	1
	Asterella pumila	C	1
	Sphagnum sp.	D	10
	Plagiomnium medium	D	1
BCH WL 118	*Picea mariana*	B	13
	Larix laricina	B	3
	Rhododendron groenlandicum	B	22
	Rubus chamaemorus	B	10
	Salix pedicellaris	B	1
	Equisetum arvense	C	5
	Vaccinium vitis-idaea	C	0.1
	Linnaea borealis	C	0.1
	Vaccinium oxycoccos	C	0.1
	Vaccinium uliginosum	C	0.1

Appendix C. Wetland Field Data - Vegetation

Plot	Species	Layer	Percent Cover
BCH WL 118 (*cont'd*)	*Carex aquatilis*	C	0.1
	Carex pauciflora	C	0.1
	Sphagnum sp.	D	70
	Tomentypnum nitens	D	10
	Bruchiace spp.	D	1
	Thamnolia sp.	D	0.1

Appendix C. Wetland Field Data - Soil Horizons

Plot	Horizon	Upper Depth	Lower Depth	Von Post	pH	Texture	% CF Gravel	% CF Cobbles	% CF Stones	% CF Total	% CF Shape	Roots Abundance	Roots Size	Mineral Structure Class	Mineral Structure Kind	Comments
WL001	C	0	100			GS	50	30	10	85						No soil development
WL002	C	0	100			GS	40	40	10	90						No soil development
WL003	Of	0	12	3						0		P	V			
WL003	Om	12	19	5-6						0		P	V			
WL003	Oh	19	20	8+						0		P	V			
WL003	Bg	20	60			SiCL				0		F	F		MA	Strong mottles. Barely gleyed
WL004	Om1	0	16	3	7.8					0		A	F			
WL004	Om2	16	43	5						0		A	F			
WL004	Om3	43	70	5						0		P	F			
WL005	Om1	30	0	6	8.4					0		F	F			
WL005	Om2	30	150	5	8.4					0						
WL006	Om1	15	0	4						0		P	F			
WL006	Om2	65	15	6						0		F	F			
WL006	Bfg	65	100			SiCL				0						
WL007	Of	0	20	5						0		P	F			
WL007	Om1	20	37	6+						0		A	F			
WL007	Om2	37	79							0						
WL007	Bg	79	110			SiL				0						
WL008	Om	0	150	4	7.8					0		F	F			
WL009	Om	0	10	5	7.8					0						
WL009	C	10	50			SiL				0		A	F			
WL010	C	0				GS	50	30		80						No soil development
WL011	C	0	100			GS	70	10		80	SR	F	F			No soil development

Appendix C. Wetland Field Data - Soil Horizons

Plot	Horizon	Upper Depth	Lower Depth	Von Post	pH	Texture	% CF Gravel	% CF Cobbles	% CF Stones	% CF Total	% CF Shape	Roots Abundance	Roots Size	Mineral Structure Class	Mineral Structure Kind	Comments
WL012	Bg1	0	10							0				M	SBK	
WL012	Bg2	10	30							0					SGR	
WL012	Bg3	30	38							0				W	SBK	
WL012	Bg4	38	52							0					SGR	
WL012	C	52+								0						
WL013	Ahj	0	2			SL				0		P	F	F	GR	
WL013	Bml	2	35			LS				0		F	M	F	GR	
WL013	C	35	150			LS	70	10		80	RR					
WL014	Bm1	0	22			SL				0		F	F			
WL014	Bm2	22	58			L				0						
WL014	Bm3	0	90			LS				0						
WL015	C	0	100			S				0		F	F			
WL016	L	0.5	0													
WL016	C	0	30+			LS	20	25	25	70	RR	M	F			
WL017	L	0.5	0							0						
WL017	Bm1	0	37			SL				0	P	M				
WL017	Bm2	37	60			LS				0	F	L				
WL017	C	60+				S	75	25	25	75						
WL018	Bg	0	30			SiL				0						
WL018	Cg	30+				S				70+						
WL019	L	2	0.5													
WL019	F	0.5	0													
WL019	Bm	0	60			SiL				0		F	M			
WL020	Of	0	28	2	4.6					0		F	F			
WL020	Om	28	138	5						0						

Appendix C. Wetland Field Data - Soil Horizons

Plot	Horizon	Upper Depth	Lower Depth	Von Post	pH	Texture	% CF Gravel	% CF Cobbles	% CF Stones	% CF Total	% CF Shape	Roots Abundance	Roots Size	Mineral Structure Class	Mineral Structure Kind	Comments
WL021	Of	0	32	3						0		F	F			
WL021	Om	32	105	5						0						
WL022	Om	3	0	5+												
WL022	Bg1	0	5			SiL				0		F	F			
WL022	Bg2	5	30			Sil				0		A	F			
WL022	C	30+				LS				35						
WL023	Bm1	0	8			SiL				0		F	M			
WL023	Bm2	8	31			L	5	5		10		F	M			
WL023	C	34+				S	25	25	25	75						
WL024	C	0	100			SL	30	30	30	90		F	F			
WL025	Bg	0	40			SiCL				0		F	F			
WL026	L	1	0													
WL026	Bm1	0	14			L				0		P	M			
WL026	Bm2	14	60			SL	5	5		10	R	P	M			
WL026	C	60+				S	30	30		60	R					
WL027	Bg1	0	27			SiL				0		F	M			
WL027	Bg2	27	50			SL				0		F	F			
WL028	C	0	100			s	10	10		20	R	P	M			
WL029	L	4.5	4													
WL029	Fa	4	3													
WL029	Hr	3	0													
WL029	Ah	0	2			L				0		A	C			
WL029	C	2	100			S				0		A	C			
WL030	L	0.5	0													
WL030	C	0	?			S	30	30	20	80	R	F	C			

Appendix C. Wetland Field Data - Soil Horizons

Plot	Horizon	Upper Depth	Lower Depth	Von Post	pH	Texture	% CF Gravel	% CF Cobbles	% CF Stones	% CF Total	% CF Shape	Roots Abundance	Roots Size	Mineral Structure Class	Mineral Structure Kind	Comments
WL031	L	0.5	0													
WL031	Cg	0	?			LS	30	30		60	R	P	F			
WL032	C	0	?			S	30	30	20	80	R	F	C			
WL033	L	0.5	0													
WL033	C	0	60			S				0		P	C			
WL034	C	0	60			S	30	20		50	R	F	C			
WL035	L	0.5	0													
WL035	C					S	50	10		60	R	F	C			
WL036	Ahg	0	5			SiL				0		F	F			
WL036	Bg	5	80			L	5			5						
WL037	Of	70	0							0						
WL037	Om	100	71							0						
WL038	Bhg	0	8			SiCL				0		P	V		MA	
WL038	Bg	9	70			SiCL				0						
WL100	Bg	0	8			SiCL				0		F	V	S	MA	
WL100	Cg	8	95			SiCL				0		F	V	S	MA	
WL101	Ah	0	10			SiCL				0		A	V		MA	
WL101	Bhg	10	18			SiCL				0		P	V		MA	
WL101	Cg	19	71			SiCL				0		F	F		MA	
WL102	Of	0	6	4						0		A	F			
WL102	Om	6	60	5	7.0					0		A	F			
WL102	Oh	60	85	7						0		F	M			

Appendix C. Wetland Field Data - Soil Horizons

Plot	Horizon	Upper Depth	Lower Depth	Von Post	pH	Texture	% CF Gravel	% CF Cobbles	% CF Stones	% CF Total	% CF Shape	Roots Abundance	Roots Size	Mineral Structure Class	Mineral Structure Kind	Comments
WL103	Of	0	30	4						0		P	F			
WL103	Om	30	81	5						0		P	V			
WL103	Om	81	97	6						0		F	V			
WL104	Om	0	27	5						0		P	F			
WL104	Bg1	27	39			L				0				M	SP	
WL104	Bg2	39	50			SiCl				0				M	BK	
WL104	C	50	80			SiCl				0				S	MA	
WL105	Of	0	10	4						0		P	F			
WL105	Bg	10	30			SiCL				0		P	F	M	BK	
WL106	Om	0	10	5						0						
WL106	Abg	10	30			SCL				0		F	F	M	ABK	
WL106	Bg	30	70			SiCL				0		F	M	S	ABK	
WL107	Ag	3	13			SCL				0		P	F	M		
WL107	Bg1	13	25			SCL				0		F	M	S		
WL107	Bg2	25	57			SiCL				0		F	M	S		
WL108	Of	4	0									A	F			
WL108	Bg	5	15			SCL						P	F		MA	
WL108	Cg	16	76			SiCL								VF	ABK	
WL109	Of	2	0	3								F	A		MA	
WL109	Bmg	3	6			SCL						F	F		MA	
WL109	Bg	7	30			SCL								F	PL	
WL109	Bmb	31	40			SCL								F	PL	
WL109	Cg	41	60			SCL								C	ABK	
WL110	Soils not sampled									0						
WL111	Om	10	0	5								P	M		MA	
WL111	Oh	15	11									P	F		MA	

Appendix C. Wetland Field Data - Soil Horizons

Plot	Horizon	Upper Depth	Lower Depth	Von Post	pH	Texture	% CF Gravel	% CF Cobbles	% CF Stones	% CF Total	% CF Shape	Roots Abundance	Roots Size	Mineral Structure Class	Mineral Structure Kind	Comments
WL111	Bmg	16	28			SCL						P	M		MA	
WL111	Bg	29	42			SCL						F	M		MA	
WL111	Cg	43	63			SCL								F	ABK	
WL112	Of	8	0	3		SCL						F	F	F	MA	
WL112	Bg	9	30			SCL						F	F	F	MA	
WL113	Of	0	26	3						0		P	F			
WL113	Om	26	86	5						0						
WL113	Cg	86	120			FSL				0				M		
WL114	Of	0	13	3						0		P	F			
WL114	Om	13	120	6						0						
W115	Of	0	30	3	6.3					0						
W115	Om	30	130	5	6.3					0						
W116	L	10	9													
W116	F	9	3													
W116	H	3	0													
W116	Ah	0	6			SiL				0		F	F	M	SBK	
W116	Ahe	6	15			Sil				0		F	F	M	SBK	
W116	Bg	15	36			FSL				0				M	SBK	
W116	Cg	36	100			FSL				0					M	
W117	L	14	13													
W117	Fa	31	0													
W117	Of	0	25	3						0						
W117	Om	25	50	5						0						
W117	Oh	50	60	7						0						
W117	Ah	0	15			FSL				0				F	SBK	
W117	Cg	15	50			FSL				0					M	
W118	Of	0	100	3	6.3					0						

Appendix C. Wetland Field Data - Field Water Quality

Plot	pH	Temp (°C)	EC (µS)	DO (mg/L)	Turb (NTU)	TDS (ppm)
BCH WL 001						
BCH WL 002						
BCH WL 003	6.90	16.8	1108	3.11	2.63	809
BCH WL 004	7.80	18.0	1958	1.36	20.1	1.56 ppt
BCH WL 005	8.40					
BCH WL 006	7.80	19.5	978	6.5	32.3	682
BCH WL 007	7.72	15.0	746	3.1	2.43	505
BCH WL 008	7.87	15.9	503	4.18	3.93	372
BCH WL 009	7.84	21.0	1257	0.79	18.2	903
BCH WL 010						
BCH WL 011						
BCH WL 012						
BCH WL 013						
BCH WL 014						
BCH WL 015						
BCH WL 016						
BCH WL 017						
BCH WL 018						
BCH WL 019						
BCH WL 020	4.60					
BCH WL 021	5.35	19.2	144	1.9	32.1	105
BCH WL 022	7.07		334	4.75	3.82	243
BCH WL 023						
BCH WL 024						
BCH WL 025	7.71	17.8	268	5.24	4.2	191
BCH WL 026						
BCH WL 027						
BCH WL 028						
BCH WL 029						
BCH WL 030						
BCH WL 031						
BCH WL 032						
BCH WL 033						
BCH WL 034						
BCH WL 035						
BCH WL 036	8.02	16.3	1000	1.28	2.22	709
BCH WL 037	7.96	14.8	719	4.46	0.91	527
BCH WL 038	7.72	16.0	759	2.80	0.44	537
BCH WM 100	6.65	22.1	132	3.05	1.28	95.1
BCH WM 101						
BCH WM 102	7.00					
BCH WM 103	7.76	19.5	226	3.99	1.25	
BCH WM 104	7.46	16.7	166	1.05	2.00	
BCH WM 105	7.50	18.6				
BCH WM 106	7.01	16.7	576	1.05	17.10	
BCH WM 107	7.76	19.5	226	3.99	1.25	
BCH WM 108	7.36	23.5	408	0.16	0.96	
BCH WM 109	7.80	16.2	523	9.04	1.98	
BCH WM 110	7.80	16.2	523	9.04	1.98	
BCH WM 111	6.85	19.6	277	0.36	4.09	
BCH WM 112	7.01	19.0	272	3.40	2.72	
BCH WM 113						
BCH WM 114	6.97	18.4	94	1.02	0.58	
BCH WM 115						
BCH WM 116						
BCH WM 117						
BCH WM 118	6.30					

APPENDIX D. VEGETATION FLORISTIC QUALITY INDEX DATA

To supplement the vegetation sampling methods outlined in section 4.0 of the *BC Hydro Site C Wetland Monitoring Program Field Manual*, the field team used the Floristic Quality Index (FQI) protocols (Wilson et. al. 2013) to document vegetation. FQI provides a useful tool for assessing the biological condition of vegetation communities (including wetland communities in northern Canada), quantifying anthropogenic influences on vegetation communities, and tracking changes over time (Bourdaghs et al. 2006; Rooney and Rogers 2002; Washington 1984; Wilson et al. 2013). The FQI relies on a species' Coefficient of Conservation, a value assigned to local species by qualified botanists that signifies a species' habitat specificity and tolerance to disturbance. The FQI provides maximal value when comparing vegetation communities over time within the same wetland or when comparing among wetlands within the same type or class (e.g., comparing a reference wetland to a disturbed wetland of the same time in the same season).

The following standards and field protocols were used for vegetation FQI sampling:

- The standard seven-letter code naming system was used for recording observed species. Naming conventions used for vegetation species were from the British Columbia Conservation Data Centre (CDC).
- FQI plots were established and surveyed once at each vegetation community within each monitoring wetland. Three pairs of quadrats (six quadrats in total) were deployed randomly throughout each vegetation community of each wetland. A power analysis done as part of the "*Floristic Quality Assessment for Marshes in Alberta's Northern Prairie and Boreal Regions*" showed that six quadrats were sufficient to detect differences in species richness between reference sites and monitored wetlands.
- The quadrat pair sample locations were subjectively selected in the field within the vegetation community being sampled and then the quadrats were tossed in a randomly selected cardinal direction to add randomness to the location.
- Quadrat pairs were positions directly beside each other.
- Each quadrat measured one square metre.
- Quadrat data were recorded on standard FQI field sheets with the standard naming convention for the wetland monitoring program.
- Within each of the quadrats, all herbaceous, shrub, and tree species and their percent cover were recorded. Percent cover estimations included overlapping vegetation; therefore, the total percent cover could be over 100%.
- Percent cover of live vegetation was estimated for each species present using the recording increment vegetation cover method shown in Table 2.6-1 and from the comparison charts for

estimation of foliage cover from the *Field Manual for Describing Terrestrial Ecosystems* (BC MOFR and BC MOE 2010).

- Photos of the quadrat were taken using the Solocator Application for iPhones to enable future monitoring.

Table D-1. Increments Used for Recording Vegetation Cover for the Wetland FQI Quadrats1

Cover Range	Recording Increment (%)	Examples (%)
A single plant	Exactly 0.1	0.1
Several plants	Exactly 0.5	0.5
1 – 10 %	To the nearest 1	1, 2, 3, 5, 8
10 – 30%	To the nearest 5	10, 15, 25
30 – 100%	To the nearest 10	30, 40, 50, 60, 70, 80, 90

[1] *Adapted from the Ecological Land Survey Site Description Manual (Alberta Sustainable Resource Development 2003).*

Bourdaghs, M., Johnston, C.A., and Regal, R.R. 2006. Properties and performance of the floristic quality index in Great Lakes coastal wetlands. *Wetlands* 26:718-725.

Rooney, T.P. and Rogers, D.A. 2002. The modified floristic quality index. *Natural Areas Journal* 22:340–344.

Washington, H. G. 1984. Diversity, biotic, and similarity indices: a review with special relevance to aquatic ecosystems. Water Resources 18:653–694.

Wilson, M. J., Forest, A.S., and Bayley, S.E. 2013. Floristic Quality Assessment for Marshes in Alberta's Northern Prairie and Boreal Regions. *Aquatic Ecosystems Health and Management*. 16:3. 288-299.

Appendix D. Vegetation FQI Data

Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL100.1	BC	Graminoid		Grass sp.						2.5	C
WL100.1	BC	Tree/Shrub		Willow sp.						1	B1
WL100.1	BC	Nonvascular		Moss sp.						3.5	D
WL100.1	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	< 1	B2
WL100.1	BC	Forb/Subshrub	*Pyrola* sp.							< 1	C
WL100.1	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	< 1	C
WL100.1	BC	Forb/Subshrub	*Lathyrus ochroleucus*	creamy peavine		Native	Yellow	S5	G5	< 1	C
WL100.1	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	0.5	C
WL100.1	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	28.5	B1
WL100.1	BC	Tree/Shrub	*Alnus incana* ssp. *tenuifolia*	mountain alder		Native	Yellow	S5	G5T5	39	B1
WL100.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	11	C
WL100.2	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	61.5	B1
WL100.2	BC	Tree/Shrub	*Alnus incana* ssp. *tenuifolia*	mountain alder		Native	Yellow	S5	G5T5	5	B1
WL100.2	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	3.5	C
WL100.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	2	C
WL100.2	BC	Nonvascular		Moss sp.						4.5	D
WL100.2	BC	Tree/Shrub	*Shepherdia canadensis*	soopolallie		Native	Yellow	S5	G5	< 1	B2
WL100.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	6	C
WL100.2	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	< 1	C
WL100.2	BC	Forb/Subshrub	*Rubus idaeus* ssp. *strigosus*	red raspberry		Native	Yellow	S5	G5T5	1	B2
WL100.2	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	< 1	B2
WL100.3	BC	Graminoid	*Poa palustris*	fowl bluegrass		Native	Yellow	S5	G5	9	C
WL100.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	40	C
WL100.3	BC	Graminoid	*Carex aquatilis var. aquatilis*	water sedge		Native	Yellow	S5	G5T5	5	C
WL100.3	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	1	B2
WL100.3	BC	Forb/Subshrub	*Maianthemum canadense*	wild lily-of-the-valley		Native	Yellow	S4S5	G5	0.5	C
WL100.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	< 1	C
WL100.3	BC	Forb/Subshrub	*Rubus idaeus* ssp. *strigosus*	red raspberry		Native	Yellow	S5	G5T5	1	B2
WL100.3	BC	Graminoid	*Carex aurea*	golden sedge		Native	Yellow	S5	G5	< 1	C
WL100.3	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	< 1	C
WL100.3	BC	Graminoid	*Glyceria grandis* var. *grandis*	reed mannagrass		Native	Yellow	S5	G5T5	0.5	C
WL100.3	BC	Tree/Shrub	*Salix maccalliana*	MacCalla's willow		Native	Yellow	S5	G5	10	B1
WL100.3	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	0.5	C
WL100.3	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	0.5	B2
WL100.3	BC	Nonvascular		Moss sp.						0.5	D
WL100.3	BC	Forb/Subshrub	*Petasites frigidus* var. *sagittatus*	arrow-leaved coltsfoot		Native	Yellow	S5	G5	0.5	C
WL100.3	BC	Forb/Subshrub	*Trifolium hybridum*	alsike clover		Exotic	Exotic	SNA	GNR	1	C
WL101.1	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	57.5	C
WL101.1	BC	Forb/Subshrub	*Cirsium arvense*	Canada thistle	Noxious	Exotic	Exotic	SNA	GNR	30	C
WL101.1	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	25	C

Appendix D. Vegetation FQI Data

Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL101.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	5	C
WL101.2	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	50	C
WL101.2	BC	Forb/Subshrub	*Petasites frigidus* var. *sagittatus*	arrow-leaved coltsfoot		Native	Yellow	S5	G5	12.5	C
WL101.2	BC	Forb/Subshrub	*Solidago canadensis*	Canada goldenrod		Exotic	Exotic	SNA	G5	8	C
WL101.2	BC	Forb/Subshrub	*Cirsium arvense*	Canada thistle	Noxious	Exotic	Exotic	SNA	GNR	1	C
WL101.2	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	1	C
WL101.2	BC	Forb/Subshrub	*Taraxacum officinale*	common dandelion		Exotic	Exotic	SNA	G5	6	C
WL101.2	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	1	C
WL101.2	BC	Graminoid	*Bromus ciliatus*	fringed brome		Native	Yellow	S5	G5	1.5	C
WL101.2	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	3.5	C
WL101.2	BC	Forb/Subshrub	*Aster* sp.							2.5	C
WL101.2	BC	Graminoid	*Poa pratensis* ssp. *pratensis*	Kentucky bluegrass		Exotic	Exotic	SNA	G5T5	2.5	C
WL101.3	BC	Forb/Subshrub	*Cirsium arvense*	Canada thistle	Noxious	Exotic	Exotic	SNA	GNR	27.5	C
WL101.3	BC	Graminoid	*Poa palustris*	fowl bluegrass		Native	Yellow	S5	G5	0.5	C
WL101.3	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	9	C
WL101.3		Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	65	C
WL101.3	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	10	C
WL101.3		Tree/Shrub	*Populus balsamifera*	balsam poplar		Native	Yellow	S5	G5	15	A2
WL101.3	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	< 1	C
WL102.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	50	C
WL102.1	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	3	C
WL102.1	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	2.5	C
WL102.1	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	1	C
WL102.1	BC	Tree/Shrub	*Populus balsamifera*	balsam poplar		Native	Yellow	S5	G5	1	A2
WL102.1	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	0.5	C
WL102.1	BC	Forb/Subshrub	*Rubus arcticus* ssp. *acaulis*	nagoonberry		Native	Yellow	S4	G5T5	2	B2
WL102.1	BC	Graminoid	*Glyceria grandis* var. *grandis*	reed mannagrass		Native	Yellow	S5	G5T5	0.5	C
WL102.1	BC	Tree/Shrub	*Betula papyrifera*	paper birch		Native	Yellow	S5	G5	7.5	A2
WL102.1	BC	Forb/Subshrub	*Stellaria longifolia*	long-leaved starwort		Native	Yellow	S4S5	G5	< 1	C
WL102.1	BC	Graminoid	*Poa palustris*	fowl bluegrass		Native	Yellow	S5	G5	0.5	C
WL102.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	27.5	C
WL102.2	BC	Tree/Shrub	*Betula pumila* var. *glandulifera*	low birch		Native	Yellow	S5	G5T5	27.5	B2
WL102.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	1.5	C
WL102.2	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	10	C
WL102.2	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	27.5	C
WL102.2	BC	Tree/Shrub	*Willow* sp.							12.5	B1
WL102.2	BC	Forb/Subshrub	*Rumex occidentalis*	western dock		Native	Yellow	S4S5	G5T5	1.5	C
WL102.2	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	5.5	C
WL102.3		Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	65	C
WL102.3	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	6.5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL102.3	BC	Forb/Subshrub	*Petasites frigidus var. palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	4	C
WL102.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	11	C
WL102.3	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	1.5	C
WL102.3	BC	Nonvascular		Moss sp.						1	C
WL102.3	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	0.5	B2
WL102.3	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	0.5	C
WL102.3	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	1	C
WL102.3	BC	Forb/Subshrub	*Pyrola asarifolia* ssp. *asarifolia*	pink wintergreen		Native	Yellow	S5	G5T5	1.5	B2
WL102.3	BC	Forb/Subshrub	*Maianthemum trifolium*	three-leaved false		Native	Yellow	S4	G5	1	C
WL102.3	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	< 1	C
WL103.1	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	14	C
WL103.1	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	1	C
WL103.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	40	C
WL103.1	BC	Forb/Subshrub	*Aralia nudicaulis*	wild sarsaparilla		Native	Yellow	S5	G5	1	C
WL103.1	BC	Forb/Subshrub	*Calla palustris*	wild calla		Native	Yellow	S5	G5	2	C
WL103.1	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	< 1	B2
WL103.1	BC	Tree/Shrub	*Betula occidentalis*	water birch		Native	Yellow	S5	G5	0.5	B2
WL103.1	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	3	C
WL103.1	BC	Forb/Subshrub	*Hieracium umbellatum* ssp. *umbellatum*	narrow-leaved		Native	Yellow	S5	G5	< 1	C
WL103.1	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	2	C
WL103.1	BC	Forb/Subshrub	*Potamogeton richardsonii*	Richardson's pondweed		Native	Yellow	S4S5	G5	0.5	C
WL103.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	30	C
WL103.2	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	0.5	C
WL103.2	BC	Nonvascular	*Moss* sp.							13.5	D
WL103.2	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	1	C
WL103.2	BC	Tree/Shrub	*Willow* sp.							12.5	B2
WL103.2	BC	Forb/Subshrub	*Calla palustris*	wild calla		Native	Yellow	S5	G5	2.5	C
WL103.2	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	5.5	B2
WL103.2	BC	Forb/Subshrub	*Pyrola asarifolia* ssp. *asarifolia*	pink wintergreen		Native	Yellow	S5	G5T5	1.5	B2
WL103.2	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	< 1	C
WL103.2	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	< 1	C
WL103.2	BC	Tree/Shrub	*Shepherdia canadensis*	soopolallie		Native	Yellow	S5	G5	1.5	B2
WL103.2	BC	Graminoid	*Poa pratensis* ssp. *pratensis*	Kentucky bluegrass		Exotic	Exotic	SNA	G5T5	< 1	C
WL103.2	BC	Forb/Subshrub	*Lemna minor*	common duckweed		Native	Yellow	S5	G5	< 1	C
WL103.2		Graminoid	*Eleocharis acicularis*	needle spike-rush		Native	Yellow	S5	G5	2.5	C
WL103.2	BC	Forb/Subshrub	*Potentilla gracilis* var. *gracilis*	graceful cinquefoil		Native	Red	S2	G5T5	< 1	C
WL103.2	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	< 1	B2
WL103.2	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	< 1	C
WL103.2	BC	Graminoid	*Glyceria pulchella*	slender mannagrass		Native	Yellow	S3S4	G5	< 1	C
WL103.3	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL103.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	11	C
WL103.3	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	34	B2
WL103.3	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	16.5	B2
WL103.3	BC	Forb/Subshrub	*Cornus stolonifera*	red-osier dogwood		Native	Yellow	S5	G5	4	B2
WL103.3	BC	Forb/Subshrub	*Solidago canadensis*	Canada goldenrod		Exotic	Exotic	SNA	G5	0.5	C
WL103.3	BC	Forb/Subshrub	*Thalictrum venulosum*	veiny meadowrue		Native	Yellow	S4S5	G5	2.5	C
WL103.3		Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	1	C
WL103.3	BC	Nonvascular	*Moss* sp.							5	D
WL103.3	BC	Tree/Shrub	*Salix exigua* var. *exigua*	narrow-leaf willow		Native	Yellow	S5	G5TNR	2	B2
WL103.3	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	1	C
WL103.3	BC	Forb/Subshrub	*Viburnum edule*	highbush-cranberry		Native	Yellow	S5	G5	0.5	B2
WL103.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	4	C
WL103.3	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	0.5	C
WL103.3	BC	Forb/Subshrub	*Symphyotrichum ciliolatum*	Lindley's aster		Native	Yellow	S5	G5	1.5	C
WL103.3	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	1	C
WL103.3	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	0.5	B2
WL103.3	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	< 1	C
WL103.3	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	0.5	C
WL103.3	BC	Forb/Subshrub	*Orthilia secunda*	one-sided wintergreen		Native	Yellow	S5	G5	0.5	C
WL104.1	BC	Forb/Subshrub	*Cirsium arvense*	Canada thistle	Noxious	Exotic	Exotic	SNA	GNR	16	C
WL104.1	BC	Forb/Subshrub	*Rubus idaeus* ssp. *strigosus*	red raspberry		Native	Yellow	S5	G5T5	60	B2
WL104.1	BC	Graminoid	*Carex athrostachya*	slender-beaked sedge		Native	Yellow	S5	G5	45	C
WL104.1	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	< 1	C
WL104.1	BC	Tree/Shrub	*Populus balsamifera*	balsam poplar		Native	Yellow	S5	G5	1	A2
WL104.1	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	0.5	C
WL104.1	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	1	B2
WL104.1	BC	Tree/Shrub	*Salix candida*	sage willow		Native	Yellow	S5	G5	1	B1
WL104.1	BC	Graminoid	*Bromus ciliatus*	fringed brome		Native	Yellow	S5	G5	< 1	C
WL104.1	BC	Forb/Subshrub	*Stellaria longifolia*	long-leaved starwort		Native	Yellow	S4S5	G5	< 1	C
WL104.1	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	< 1	C
WL104.2	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	60	C
WL104.2	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	2	C
WL104.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	10	C
WL104.2	BC	Forb/Subshrub	*Taraxacum officinale*	common dandelion		Exotic	Exotic	SNA	G5	1	C
WL104.2	BC	Forb/Subshrub	*Trifolium hybridum*	alsike clover		Exotic	Exotic	SNA	GNR	2	C
WL104.2	BC	Tree/Shrub	*Populus balsamifera*	balsam poplar		Native	Yellow	S5	G5	1.5	A2
WL104.2	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	< 1	C
WL104.2	BC	Forb/Subshrub	*Solidago canadensis*	Canada goldenrod		Exotic	Exotic	SNA	G5	1.5	C
WL104.2	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	2	B2
WL104.2	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	0.5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL104.2	BC	Forb/Subshrub	*Mentha arvensis*	field mint		Native	Yellow	S5	G5	0.5	C
WL104.2	BC	Nonvascular	*Moss* sp.							3.5	D
WL104.2	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	0.5	B2
WL104.2	BC	Forb/Subshrub	*Achillea millefolium*	yarrow		Exotic	Exotic	SNA	G5T5?	< 1	C
WL104.2	BC	Forb/Subshrub	*Geum macrophyllum* var. *macrophyllum*	large-leaved avens		Native	Yellow	S5	G5T5	0.5	C
WL104.2	BC	Forb/Subshrub	*Cirsium arvense*	Canada thistle	Noxious	Exotic	Exotic	SNA	GNR	0.5	C
WL104.3	BC	Graminoid	*Phalaris arundinacea* var. *arundinacea*	reed canarygrass		Exotic	Exotic	SNA	G5TNR	10	C
WL104.3	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	27.5	C
WL104.3	BC	Forb/Subshrub	*Rubus idaeus* ssp. *strigosus*	red raspberry		Native	Yellow	S5	G5T5	7	B2
WL104.3	BC	Forb/Subshrub	*Achillea millefolium*	yarrow		Exotic	Exotic	SNA	G5T5?	1.5	C
WL104.3	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	5.5	C
WL104.3	BC	Forb/Subshrub	*Cirsium arvense*	Canada thistle	Noxious	Exotic	Exotic	SNA	GNR	22.5	C
WL104.3	BC	Forb/Subshrub	*Stellaria longifolia*	long-leaved starwort		Native	Yellow	S4S5	G5	1	C
WL104.3	BC	Graminoid	Grass sp.							5	C
WL104.3	BC	Forb/Subshrub	*Petasites frigidus* var. *palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	22.5	C
WL104.3	BC	Forb/Subshrub	*Urtica dioica* ssp. *dioica*	stinging nettle		Exotic	Exotic	SNA	G5T5?	3	C
WL106.1	BC	Forb/Subshrub	*Geum macrophyllum* var. *macrophyllum*	large-leaved avens		Native	Yellow	S5	G5T5	6	C
WL106.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	20	C
WL106.1	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	14	B1
WL106.1	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	2	C
WL106.1	BC	Graminoid	*Carex brunnescens* ssp. *brunnescens*	brownish sedge		Native	Yellow	S4	G5T5	22.5	C
WL106.1	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	9	C
WL106.1	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	0.5	B2
WL106.1		Forb/Subshrub	*Anemone virginiana* var. *cylindroidea*	riverbank anemone		Native	Yellow	S4	G5T4T5	2	C
WL106.1	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	1	C
WL106.1	BC	Forb/Subshrub	*Eurybia conspicua*	showy aster		Native	Yellow	S5	G5	2.5	C
WL106.1	BC	Forb/Subshrub	*Veronica beccabunga* var. *americana*	American speedwell		Native	Yellow	S5	G5	1	C
WL106.1	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	< 1	C
WL106.1	BC	Nonvascular	*Moss* sp.							12.5	D
WL106.2	BC	Forb/Subshrub	*Stellaria longifolia*	long-leaved starwort		Native	Yellow	S4S5	G5	7	C
WL106.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	1	C
WL106.2	BC	Forb/Subshrub	*Eurybia conspicua*	showy aster		Native	Yellow	S5	G5	1.5	C
WL106.2	BC	Forb/Subshrub	*Galeopsis tetrahit*	hemp-nettle		Exotic	Exotic	SNA	GNR	0.5	C
WL106.2	BC	Forb/Subshrub	*Anemone virginiana* var. *cylindroidea*	riverbank anemone		Native	Yellow	S4	G5T4T5	< 1	C
WL106.2	BC	Graminoid	*Carex bebbii*	Bebb's sedge		Native	Yellow	S5	G5	0.5	C
WL106.2	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	10	C
WL106.2	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	10	C
WL106.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	78	C
WL106.2	BC	Forb/Subshrub	*Bidens cernua*	nodding beggarticks		Native	Yellow	S5	G5	17	C
WL106.3	BC	Forb/Subshrub	*Plantago major*	common plantain		Exotic	Exotic	SNA	G5	12.5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL106.3	BC	Graminoid	*Phleum pratense* ssp. *pratense*	common timothy		Exotic	Exotic	SNA	GNRTNR	1	C
WL106.3	BC	Graminoid	*Carex bebbii*	Bebb's sedge		Native	Yellow	S5	G5	8	C
WL106.3	BC	Forb/Subshrub	*Trifolium hybridum*	alsike clover		Exotic	Exotic	SNA	GNR	6	C
WL106.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	5.5	C
WL106.3	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	1.5	C
WL106.3	BC	Forb/Subshrub	*Anemone virginiana* var. *cylindroidea*	riverbank anemone		Native	Yellow	S4	G5T4T5	0.5	C
WL106.3	BC	Forb/Subshrub	*Ranunculus sceleratus* var. *multifidus*	celery-leaved buttercup		Native	Yellow	S5	G5T5	1	C
WL106.3	BC	Graminoid	*Juncus bufonius* var. *bufonius*	toad rush		Native	Yellow	S5	G5T5	20	C
WL106.3	BC	Forb/Subshrub	*Taraxacum officinale*	common dandelion		Exotic	Exotic	SNA	G5	5.5	C
WL106.3	BC	Graminoid	*Alopecurus aequalis* var. *aequalis*	little meadow-foxtail		Native	Yellow	S5	G5T5	3.5	C
WL106.3	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	5	C
WL106.3	BC	Tree/Shrub	*Salix maccalliana*	MacCalla's willow		Native	Yellow	S5	G5	4	B2
WL106.3	BC	Graminoid	*Beckmannia syzigachne*	American sloughgrass		Native	Yellow	S5	G5	1.5	C
WL106.3	BC	Graminoid	*Poa pratensis* ssp. *pratensis*	Kentucky bluegrass		Exotic	Exotic	SNA	G5T5	0.5	C
WL106.3	BC	Forb/Subshrub	*Sium suave*	hemlock water-parsnip		Native	Yellow	S5	G5	1.5	C
WL106.3	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	1.5	C
WL107.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	22.5	C
WL107.1	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	65	B2
WL107.1	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	3	B2
WL107.1	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	4.5	C
WL107.1	BC	Forb/Subshrub	*Viburnum edule*	highbush-cranberry		Native	Yellow	S5	G5	1	B2
WL107.1	BC	Nonvascular	*Moss* sp.							12.5	D
WL107.1	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	2	B2
WL107.1	BC	Forb/Subshrub	*Fragaria vesca* ssp. *americana*	wood strawberry		Native	Yellow	S5	G5T5	6.5	C
WL107.1	BC	Tree/Shrub	*Populus tremuloides*	trembling aspen		Native	Yellow	S5	G5	1.5	A2
WL107.1	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	0.5	C
WL107.1	BC	Forb/Subshrub	*Maianthemum canadense*	wild lily-of-the-valley		Native	Yellow	S4S5	G5	2.5	C
WL107.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	0.5	C
WL107.1	BC	Forb/Subshrub	*Petasites frigidus* var. *palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	2.5	C
WL107.1	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	1	C
WL107.1	BC	Forb/Subshrub	*Lonicera dioica* var. *glaucescens*	glaucous-leaved		Native	Yellow	S4	G5T5	1.5	B2
WL107.1	BC	Forb/Subshrub	*Viola canadensis* var. *rugulosa*	Canada violet		Native	Yellow	S5	G5T5	7.5	C
WL107.1	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	0.5	C
WL107.1	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	0.5	C
WL107.1	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	1.5	C
WL107.2	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	17.5	B1
WL107.2	BC	Tree/Shrub	*Willow* sp.							5	B2
WL107.2	BC	Tree/Shrub	*Willow* sp.							7.5	B2
WL107.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	6	C
WL107.2	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL107.2	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	12.5	C
WL107.2	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	11	B2
WL107.2	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	1	C
WL107.2	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	9	C
WL107.2	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	1	C
WL107.2	BC	Forb/Subshrub	*Petasites frigidus* var. *palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	6.5	C
WL107.2	BC	Forb/Subshrub	*Lathyrus ochroleucus*	creamy peavine		Native	Yellow	S5	G5	2.5	C
WL107.2	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	1	C
WL107.2	BC	Nonvascular	*Moss* sp.							5	D
WL107.2	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	16	C
WL107.2	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	6.5	C
WL107.2	BC	Tree/Shrub	*Populus balsamifera*	balsam poplar		Native	Yellow	S5	G5	8	A2
WL107.2	BC	Tree/Shrub	*Populus tremuloides*	trembling aspen		Native	Yellow	S5	G5	1	A2
WL107.2	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	1	C
WL107.2	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	0.5	C
WL107.2	BC	Forb/Subshrub	*Calla palustris*	wild calla		Native	Yellow	S5	G5	1.5	C
WL107.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	15	C
WL107.3	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	13.5	B2
WL107.3	BC	Forb/Subshrub	*Petasites frigidus* var. *palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	14.5	C
WL107.3	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	45	B1
WL107.3	BC	Forb/Subshrub	*Trifolium hybridum*	alsike clover		Exotic	Exotic	SNA	GNR	1.5	C
WL107.3	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	2	C
WL107.3	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	1	B2
WL107.3	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	0.5	C
WL107.3	BC	Graminoid	*Bromus inermis*	smooth brome		Exotic	Exotic	SNA	G5T5	0.5	C
WL107.3	BC	Forb/Subshrub	*Rubus idaeus* ssp. *strigosus*	red raspberry		Native	Yellow	S5	G5T5	4	B2
WL107.3	BC	Nonvascular	*Moss* sp.							1.5	D
WL107.3	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	< 1	C
WL107.3	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	1.5	C
WL107.3	BC	Forb/Subshrub	*Lathyrus ochroleucus*	creamy peavine		Native	Yellow	S5	G5	1	C
WL107.3	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *ciliatum*	purple-leaved		Native	Yellow	S5	G5T5	1.5	C
WL107.3	BC	Tree/Shrub	*Populus tremuloides*	trembling aspen		Native	Yellow	S5	G5	3.5	A2
WL108.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	37.5	C
WL108.1	BC	Tree/Shrub	*Populus tremuloides*	trembling aspen		Native	Yellow	S5	G5	17.5	A2
WL108.1	BC	Forb/Subshrub	*Cornus stolonifera*	red-osier dogwood		Native	Yellow	S5	G5	15	B2
WL108.1	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	2.5	C
WL108.1	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	4.5	B2
WL108.1	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	9	B1
WL108.1	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	2.5	C
WL108.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	2.5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL108.1	BC	Forb/Subshrub	*Hieracium umbellatum* ssp. *umbellatum*	narrow-leaved		Native	Yellow	S5	G5	2	C
WL108.1	BC	Nonvascular	*Moss* sp.							4.5	D
WL108.1	BC	Forb/Subshrub	*Pyrola asarifolia* ssp. *asarifolia*	pink wintergreen		Native	Yellow	S5	G5T5	3	C
WL108.1	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	1	C
WL108.1	BC	Forb/Subshrub	*Galium boreale*	northern bedstraw		Native	Yellow	S5	G5	< 1	C
WL108.1	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	0.5	C
WL108.1	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	0.5	C
WL108.1	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	3.5	C
WL108.1	BC	Forb/Subshrub	*Viburnum edule*	highbush-cranberry		Native	Yellow	S5	G5	2.5	B2
WL108.1	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	3	B2
WL108.1	BC	Forb/Subshrub	*Lathyrus ochroleucus*	creamy peavine		Native	Yellow	S5	G5	1	C
WL108.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	32.5	C
WL108.2	BC	Tree/Shrub	*Salix lasiandra* var. *lasiandra*	Pacific willow		Native	Yellow	S5	G5T5	55	C
WL108.2	BC	Nonvascular	*Moss* sp.							7.5	D
WL108.2	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	6	B2
WL108.2	BC	Tree/Shrub	*Ribes oxyacanthoides* ssp. *oxyacanthoides*	northern gooseberry		Native	Yellow	S5	G5T5	4	B2
WL108.2	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	0.5	C
WL108.2	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	1	C
WL108.2	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	1	B2
WL108.2	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	2	C
WL108.2	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	0.5	C
WL108.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	25	C
WL108.3	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	4	B1
WL108.3	BC	Tree/Shrub	*Salix lasiandra* var. *lasiandra*	Pacific willow		Native	Yellow	S5	G5T5	77.5	B1
WL108.3	BC	Forb/Subshrub	*Equisetum sylvaticum*	wood horsetail		Native	Yellow	S5	G5	1.5	C
WL108.3	BC	Forb/Subshrub	*Lemna minor*	common duckweed		Native	Yellow	S5	G5	1	C
WL108.3	BC	Forb/Subshrub	*Galium triflorum*	sweet-scented bedstraw		Native	Yellow	S5	G5	0.5	C
WL109.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	8	C
WL109.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	4	C
WL109.1	BC	Forb/Subshrub	*Mentha arvensis*	field mint		Native	Yellow	S5	G5	2.5	C
WL109.1	BC	Tree/Shrub	*Populus tremuloides*	trembling aspen		Native	Yellow	S5	G5	0.5	A2
WL109.1	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	1	C
WL109.1	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	70	C
WL109.2	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	55	C
WL109.2	BC	Forb/Subshrub	*Lemna minor*	common duckweed		Native	Yellow	S5	G5	25	C
WL109.2	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	27.5	C
WL109.2	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	1	C
WL109.3	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	35	C
WL109.3	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	20	C
WL109.3	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	12.5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL109.3	BC	Forb/Subshrub	*Lemna minor*	common duckweed		Native	Yellow	S5	G5	7.5	C
WL109.3	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	1.5	B1
WL109.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	0.5	C
WL110.1	BC	Graminoid	*Typha latifolia*	common cattail		Native	Yellow	S5	G5	25	C
WL110.1	BC	Graminoid	*Juncus bufonius* var. *bufonius*	toad rush		Native	Yellow	S5	G5T5	3	C
WL110.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	17.5	C
WL110.1	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	< 1	C
WL110.1	BC	Forb/Subshrub	*Potamogeton friesii*	flat-stalked pondweed		Native	Yellow	S4S5	G5	5	C
WL110.2	BC	Graminoid	*Typha latifolia*	common cattail		Native	Yellow	S5	G5	37.5	C
WL110.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	7.5	C
WL110.2	BC	Graminoid	*Phleum pratense* ssp. *pratense*	common timothy		Exotic	Exotic	SNA	GNRTNR	< 1	C
WL110.2	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	8	B1
WL110.2	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	60	C
WL110.2	BC	Graminoid	*Carex tenuiflora*	sparse-flowered sedge		Native	Yellow	S5?	G5	1	C
WL110.2	BC	Graminoid	*Carex bebbii*	Bebb's sedge		Native	Yellow	S5	G5	0.5	C
WL110.2	BC	Graminoid	*Poa palustris*	fowl bluegrass		Native	Yellow	S5	G5	6.5	C
WL110.2	BC	Graminoid	*Glyceria grandis* var. *grandis*	reed mannagrass		Native	Yellow	S5	G5T5	< 1	C
WL110.2	BC	Graminoid	*Arctagrostis latifolia* ssp. *arundinacea*	polargrass		Native	Yellow	S5	G5T5	2	C
WL110.2	BC	Tree/Shrub	*Populus balsamifera*	balsam poplar		Native	Yellow	S5	G5	8	A2
WL110.3	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	0.5	C
WL110.3	BC	Nonvascular	*Moss* sp.							12.5	D
WL110.3	BC	Forb/Subshrub	*Trifolium hybridum*	alsike clover		Exotic	Exotic	SNA	GNR	< 1	C
WL110.3	BC	Forb/Subshrub	*Symphyotrichum ciliolatum*	Lindley's aster		Native	Yellow	S5	G5	6	C
WL110.3	BC	Forb/Subshrub	*Plantago major*	common plantain		Exotic	Exotic	SNA	G5	1.5	C
WL110.3	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	< 1	C
WL110.3	BC	Graminoid	*Poa palustris*	fowl bluegrass		Native	Yellow	S5	G5	2.5	C
WL110.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	60	C
WL110.3	BC	Graminoid	*Typha latifolia*	common cattail		Native	Yellow	S5	G5	23.5	C
WL110.3	BC	Tree/Shrub	*Populus tremuloides*	trembling aspen		Native	Yellow	S5	G5	2	
WL110.3	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	10	B1
WL110.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	10.5	C
WL111.1	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	38	C
WL111.1	BC	Tree/Shrub	*Salix prolixa*	Mackenzie willow		Native	Yellow	S5	G5	4	B1
WL111.1	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	25	C
WL111.2	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	22.5	C
WL111.2	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	57.5	C
WL111.2	BC	Forb/Subshrub	*Lemna minor*	common duckweed		Native	Yellow	S5	G5	2	C
WL111.3	BC	Graminoid	*Carex atherodes*	awned sedge		Native	Yellow	S5	G5	40	C
WL111.3	BC	Forb/Subshrub	*Sium suave*	hemlock water-parsnip		Native	Yellow	S5	G5	2	C
WL111.3	BC	Forb/Subshrub	*Bidens cernua*	nodding beggarticks		Native	Yellow	S5	G5	16.5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL111.3	BC	Forb/Subshrub	*Lemna minor*	common duckweed		Native	Yellow	S5	G5	1	C
WL111.3	BC	Nonvascular	*Moss* sp.							3	D
WL111.3	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	3	C
WL111.3	BC	Forb/Subshrub	*Ranunculus sceleratus* var. *multifidus*	celery-leaved buttercup		Native	Yellow	S5	G5T5	0.5	C
WL112.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	4.5	C
WL112.1	BC	Graminoid	*Typha latifolia*	common cattail		Native	Yellow	S5	G5	28	C
WL112.1	BC	Forb/Subshrub	*Bidens cernua*	nodding beggarticks		Native	Yellow	S5	G5	8	C
WL112.1	BC	Forb/Subshrub	*Lemna minor*	common duckweed		Native	Yellow	S5	G5	< 1	C
WL112.1	BC	Nonvascular	*Moss* sp.							15	D
WL112.1	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	0.5	C
WL112.2	BC	Graminoid	*Typha latifolia*	common cattail		Native	Yellow	S5	G5	20	C
WL112.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	1	C
WL112.2	BC	Forb/Subshrub	*Alisma plantago-aquatica*	European water-		Exotic	Exotic	SNA	GNR	11	C
WL112.2	BC	Forb/Subshrub	*Myriophyllum spicatum*	Eurasian water-milfoil		Exotic	Exotic	SNA	GNR	37.5	C
WL112.2	BC	Forb/Subshrub	*Sium suave*	hemlock water-parsnip		Native	Yellow	S5	G5	3	C
WL112.3	BC	Graminoid	*Typha latifolia*	common cattail		Native	Yellow	S5	G5	30	C
WL112.3	BC	Forb/Subshrub	*Sium suave*	hemlock water-parsnip		Native	Yellow	S5	G5	5	C
WL112.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	12.5	C
WL112.3	BC	Nonvascular	*Moss* sp.							3.5	D
WL112.3	BC	Forb/Subshrub	*Myriophyllum spicatum*	Eurasian water-milfoil		Exotic	Exotic	SNA	GNR	55	C
WL112.3	BC	Forb/Subshrub	*Mentha arvensis*	field mint		Native	Yellow	S5	G5	1	C
WL112.3	BC	Forb/Subshrub	*Alisma plantago-aquatica*	European water-		Exotic	Exotic	SNA	GNR	3	C
WL112.3	BC	Forb/Subshrub	*Rumex occidentalis*	western dock		Native	Yellow	S4S5	G5T5	7	C
WL112.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	< 1	C
WL112.3	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	< 1	C
WL112.3	BC	Tree/Shrub	*Salix maccalliana*	MacCalla's willow		Native	Yellow	S5	G5	3.5	B1
WL113.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	3	C
WL113.1	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	10.5	C
WL113.1	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	24	C
WL113.1	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	50	C
WL113.1	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	7	C
WL113.1	BC	Nonvascular	*Moss* sp.							27.5	C
WL113.1	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	4	C
WL113.1	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	1.5	C
WL113.1	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	0.5	C
WL113.2	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	16.5	C
WL113.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	30	C
WL113.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	17.5	C
WL113.2	BC	Nonvascular	*Moss* sp.							22.5	D
WL113.2	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	5.5	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL113.2	BC	Forb/Subshrub	*Galium trifidum* ssp. *trifidum*	small bedstraw		Native	Yellow	S4?	G5T5	11	C
WL113.2	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	1	C
WL113.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	25	C
WL113.3	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	15.5	C
WL113.3	BC	Forb/Subshrub	*Alisma plantago-aquatica*	European water-		Exotic	Exotic	SNA	GNR	1.5	C
WL113.3	BC	Nonvascular	*Moss* sp.							77.5	D
WL113.3	BC	Graminoid	*Deschampsia cespitosa* ssp. *cespitosa*	tufted hairgrass		Native	Yellow	S5	G5T5	0.5	C
WL113.3	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	0.5	C
WL113.3	BC	Graminoid	*Carex utriculata*	beaked sedge		Native	Yellow	S5	G5	15	C
WL113.3	BC	Forb/Subshrub	*Scutellaria galericulata*	marsh skullcap		Native	Yellow	S5	G5	1.5	C
WL113.3	BC	Forb/Subshrub	*Equisetum hyemale* ssp. *affine*	scouring-rush		Native	Yellow	S5	G5T5	15	C
WL113.3	BC	Tree/Shrub	*Salix maccalliana*	MacCalla's willow		Native	Yellow	S5	G5	1.5	B1
WL113.3	BC	Graminoid	*Carex bebbii*	Bebb's sedge		Native	Yellow	S5	G5	14	C
WL113.3	BC	Graminoid	*Juncus nodosus*	tuberous rush		Native	Yellow	S4	G5	2.5	C
WL113.3	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	0.5	C
WL113.3	BC	Forb/Subshrub	*Trifolium hybridum*	alsike clover		Exotic	Exotic	SNA	GNR	1.5	C
WL113.3	BC	Graminoid	*Agrostis scabra*	hair bentgrass		Native	Yellow	S5	G5	0.5	C
WL114.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	7.5	C
WL114.1	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	17.5	C
WL114.1	BC	Nonvascular	*Moss sp.*							12.5	D
WL114.1	BC	Forb/Subshrub	*Petasites frigidus* var. *sagittatus*	arrow-leaved coltsfoot		Native	Yellow	S5	G5	16	C
WL114.1	BC	Forb/Subshrub	*Cornus stolonifera*	red-osier dogwood		Native	Yellow	S5	G5	11	B2
WL114.1	BC	Tree/Shrub	*Salix maccalliana*	MacCalla's willow		Native	Yellow	S5	G5	22.5	B1
WL114.1	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	3	C
WL114.1	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	2	B2
WL114.1	BC	Forb/Subshrub	*Epilobium ciliatum* ssp. *glandulosum*	purple-leaved		Native	Yellow	S3S4	G5T5	1.5	C
WL114.1	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	2.5	C
WL114.1	BC	Forb/Subshrub	*Viola canadensis* var. *rugulosa*	Canada violet		Native	Yellow	S5	G5T5	1.5	C
WL114.1	BC	Nonvascular	*Sphagnum* sp.							15	D
WL114.1	BC	Forb/Subshrub	*Maianthemum canadense*	wild lily-of-the-valley		Native	Yellow	S4S5	G5	0.5	C
WL114.1	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	1	C
WL114.2	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	7.5	C
WL114.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	7.5	C
WL114.2	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	22.5	B2
WL114.2	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	17.5	C
WL114.2	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	30	C
WL114.2	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	2	C
WL114.2	BC	Forb/Subshrub	*Viola canadensis* var. *rugulosa*	Canada violet		Native	Yellow	S5	G5T5	0.5	C
WL114.2	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	< 1	C
WL114.2	BC	Nonvascular	*Moss* sp.							4	D

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL114.2	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	1	C
WL114.2	BC	Forb/Subshrub	*Galium boreale*	northern bedstraw		Native	Yellow	S5	G5	0.5	C
WL114.2	BC	Forb/Subshrub	*Cornus stolonifera*	red-osier dogwood		Native	Yellow	S5	G5	0.5	B2
WL114.2	BC	Forb/Subshrub	*Dryopteris expansa*	spiny wood fern		Native	Yellow	S5	G5	7.5	C
WL114.3	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	1	C
WL114.3	BC	Tree/Shrub	*Salix maccalliana*	MacCalla's willow		Native	Yellow	S5	G5	20	B1
WL114.3	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	32.5	C
WL114.3	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	2.5	C
WL114.3	BC	Nonvascular	*Moss* sp.							27.5	D
WL114.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	2.5	C
WL114.3	BC	Forb/Subshrub	*Maianthemum canadense*	wild lily-of-the-valley		Native	Yellow	S4S5	G5	1	C
WL114.3	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	< 1	C
WL114.3	BC	Forb/Subshrub	*Petasites frigidus* var. *sagittatus*	arrow-leaved coltsfoot		Native	Yellow	S5	G5	1	C
WL114.3	BC	Tree/Shrub	*Picea mariana*	black spruce		Native	Yellow	S5	G5	30	A2
WL115.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	5	C
WL115.1	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	4	C
WL115.1	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	12	C
WL115.1	BC	Nonvascular	*Sphagnum* sp.							50	D
WL115.1	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	1	C
WL115.1	BC	Tree/Shrub	*Vaccinium oxycoccos*	bog cranberry		Native	Yellow	S4S5	G5	< 1	B2
WL115.1	BC	Tree/Shrub	*Larix laricina*	tamarack		Native	Yellow	S5?	G5	27.5	A2
WL115.1	BC	Nonvascular	*Moss* sp.							7.5	D
WL115.1	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	8.5	C
WL115.1	BC	Graminoid	*Carex livida*	pale sedge		Native	Yellow	S5	G5	13	C
WL115.1	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	< 1	C
WL115.2	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	17	C
WL115.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	1.5	C
WL115.2	BC	Nonvascular	*Sphagnum sp.*							18.5	D
WL115.2	BC	Nonvascular	*Moss* sp.							8	D
WL115.2	BC	Graminoid	*Carex livida*	pale sedge		Native	Yellow	S5	G5	33.5	C
WL115.2	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	15	C
WL115.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	2.5	C
WL115.2	BC	Tree/Shrub	*Larix laricina*	tamarack		Native	Yellow	S5?	G5	10	A2
WL115.2	BC	Tree/Shrub	*Betula pumila* var. *glandulifera*	low birch		Native	Yellow	S5	G5T5	9	B2
WL115.2	BC	Tree/Shrub	*Picea mariana*	black spruce		Native	Yellow	S5	G5	3	A2
WL115.3	BC	Nonvascular	*Sphagnum* sp.							39	D
WL115.3	BC	Tree/Shrub	*Larix laricina*	tamarack		Native	Yellow	S5?	G5	5	A2
WL115.3	BC	Forb/Subshrub	*Comarum palustre*	marsh cinquefoil		Native	Yellow	S5	G5	9	C
WL115.3	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	12.5	C
WL115.3	BC	Tree/Shrub	*Vaccinium oxycoccos*	bog cranberry		Native	Yellow	S4S5	G5	< 1	B2

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL115.3	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	6.5	C
WL115.3	BC	Nonvascular	*Moss* sp.							23	D
WL115.3	BC	Tree/Shrub	*Betula pumila* var. *glandulifera*	low birch		Native	Yellow	S5	G5T5	1	B2
WL115.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	1.5	C
WL115.3	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	3.5	C
WL115.3	BC	Tree/Shrub	*Picea mariana*	black spruce		Native	Yellow	S5	G5	25	A2
WL115.3	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	0.5	B2
WL116.1	BC	Tree/Shrub	*Salix lasiandra* var. *lasiandra*	Pacific willow		Native	Yellow	S5	G5T5	15	B1
WL116.1	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	5	C
WL116.1	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	13	C
WL116.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	5	C
WL116.1	BC	Forb/Subshrub	*Equisetum sylvaticum*	wood horsetail		Native	Yellow	S5	G5	2	C
WL116.1	BC	Forb/Subshrub	*Equisetum scirpoides*	dwarf scouring-rush		Native	Yellow	S5	G5	1	C
WL116.1	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	8	C
WL116.1	BC	Graminoid	*Carex livida*	pale sedge		Native	Yellow	S5	G5	4.5	C
WL116.1	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	1.5	B2
WL116.1	BC	Forb/Subshrub	*Achillea millefolium*	yarrow		Exotic	Exotic	SNA	G5T5?	1.5	C
WL116.1	BC	Forb/Subshrub	*Lathyrus ochroleucus*	creamy peavine		Native	Yellow	S5	G5	3.5	C
WL116.1	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	1.5	C
WL116.1	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	2.5	C
WL116.1	BC	Tree/Shrub	*Shepherdia canadensis*	soopolallie		Native	Yellow	S5	G5	1.5	B2
WL116.1	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	10	C
WL116.1	BC	Nonvascular	*Moss* sp.							3.5	D
WL116.1	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	2	C
WL116.1	BC	Forb/Subshrub	*Pyrola asarifolia* ssp. *asarifolia*	pink wintergreen		Native	Yellow	S5	G5T5	1.5	C
WL116.2	BC	Tree/Shrub	*Salix candida*	sage willow		Native	Yellow	S5	G5	8	B1
WL116.2	BC	Forb/Subshrub	*Chamerion angustifolium*	fireweed		Native	Yellow	S5	G5	1	C
WL116.2	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	7	C
WL116.2	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	15.5	C
WL116.2	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	17.5	C
WL116.2	BC	Forb/Subshrub	*Geum macrophyllum* var. *macrophyllum*	large-leaved avens		Native	Yellow	S5	G5T5	1	C
WL116.2	BC	Forb/Subshrub	*Vicia americana*	American vetch		Native	Yellow	S5	G5	1	C
WL116.2	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	1.5	C
WL116.2	BC	Forb/Subshrub	*Achillea millefolium*	yarrow		Exotic	Exotic	SNA	G5T5?	4	C
WL116.2	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	5	C
WL116.2	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	3.5	C
WL116.2	BC	Forb/Subshrub	*Galium trifidum* ssp. *trifidum*	small bedstraw		Native	Yellow	S4?	G5T5	1	C
WL116.2	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	9	C
WL116.2	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	4.5	C
WL116.2	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	1.5	B2

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL116.2	BC	Forb/Subshrub	*Petasites frigidus* var. *palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	3.5	C
WL116.2	BC	Tree/Shrub	*Salix lasiandra* var. *lasiandra*	Pacific willow		Native	Yellow	S5	G5T5	1	B1
WL116.2	BC	Forb/Subshrub	*Equisetum scirpoides*	dwarf scouring-rush		Native	Yellow	S5	G5	4.5	C
WL116.2	BC	Nonvascular	*Moss* sp.							25	D
WL116.2	BC	Forb/Subshrub	*Astragalus americanus*	American milk-vetch		Native	Yellow	S5	G5	2	C
WL116.2	BC	Forb/Subshrub	*Maianthemum trifolium*	three-leaved false		Native	Yellow	S4	G5	1	C
WL116.2	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	1	C
WL116.2	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	15	C
WL116.3	BC	Forb/Subshrub	*Geum macrophyllum* var. *macrophyllum*	large-leaved avens		Native	Yellow	S5	G5T5	7.5	C
WL116.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	11	C
WL116.3	BC	Forb/Subshrub	*Petasites frigidus* var. *sagittatus*	arrow-leaved coltsfoot		Native	Yellow	S5	G5	2.5	C
WL116.3	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	5	B2
WL116.3	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	1.5	C
WL116.3	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	6	C
WL116.3	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	30	C
WL116.3	BC	Graminoid	*Carex livida*	pale sedge		Native	Yellow	S5	G5	7.5	C
WL116.3	BC	Forb/Subshrub	*Achillea millefolium*	yarrow		Exotic	Exotic	SNA	G5T5?	2.5	C
WL116.3	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	12.5	C
WL116.3	BC	Nonvascular	*Moss* sp.							15.5	D
WL116.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	3.5	C
WL116.3	BC	Tree/Shrub	*Alnus incana* ssp. *tenuifolia*	mountain alder		Native	Yellow	S5	G5T5	25	A3
WL116.3	BC	Forb/Subshrub	*Galium trifidum* ssp. *trifidum*	small bedstraw		Native	Yellow	S4?	G5T5	1	C
WL116.3	BC	Forb/Subshrub	*Petasites frigidus* var. *palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	1.5	C
WL116.3	BC	Forb/Subshrub	*Maianthemum trifolium*	three-leaved false		Native	Yellow	S4	G5	1	C
WL116.3	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	1	C
WL116.3	BC	Tree/Shrub	*Ribes lacustre*	black gooseberry		Native	Yellow	S5	G5	2.5	B2
WL117.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	5.5	C
WL117.1	BC	Forb/Subshrub	*Galium boreale*	northern bedstraw		Native	Yellow	S5	G5	0.5	C
WL117.1	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	7	C
WL117.1	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	6	C
WL117.1	BC	Forb/Subshrub	*Viola canadensis* var. *rugulosa*	Canada violet		Native	Yellow	S5	G5T5	0.5	C
WL117.1	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	0.5	C
WL117.1	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	3	C
WL117.1	BC	Nonvascular	*Moss* sp.							1	D
WL117.1	BC	Forb/Subshrub	*Rubus idaeus* ssp. *strigosus*	red raspberry		Native	Yellow	S5	G5T5	< 1	B2
WL117.1	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	0.5	C
WL117.1	BC	Tree/Shrub	*Betula papyrifera*	paper birch		Native	Yellow	S5	G5	5	A2
WL117.1	BC	Tree/Shrub	*Picea glauca*	white spruce		Native	Yellow	S5	G5	55	A2
WL117.1	BC	Forb/Subshrub	*Geum macrophyllum* var. *macrophyllum*	large-leaved avens		Native	Yellow	S5	G5T5	17.5	C
WL117.1	BC	Forb/Subshrub	*Petasites frigidus* var. *sagittatus*	arrow-leaved coltsfoot		Native	Yellow	S5	G5	2	C

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Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL117.2	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	4.5	C
WL117.2	BC	Forb/Subshrub	*Cornus canadensis*	bunchberry		Native	Yellow	S5	G5	11	C
WL117.2	BC	Forb/Subshrub	*Petasites frigidus* var. *palmatus*	sweet coltsfoot		Native	Yellow	S5	G5T5	9	C
WL117.2	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	9	B2
WL117.2	BC	Tree/Shrub	*Rosa acicularis ssp. sayi*	prickly rose		Native	Yellow	S5	G5T5	5	B2
WL117.2	BC	Forb/Subshrub	*Fragaria virginiana* ssp. *glauca*	wild strawberry		Native	Yellow	S5	G5T5	7.5	C
WL117.2	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	1	C
WL117.2	BC	Forb/Subshrub	*Linnaea borealis* ssp. *borealis*	twinflower		Native	Yellow	S3S4	G5T5	4.5	C
WL117.2	BC	Forb/Subshrub	*Viburnum edule*	highbush-cranberry		Native	Yellow	S5	G5	7.5	B2
WL117.2	BC	Forb/Subshrub	*Heracleum maximum*	cow-parsnip		Native	Yellow	S5	G5	2	C
WL117.2	BC	Forb/Subshrub	*Mertensia paniculata* var. *paniculata*	tall bluebells		Native	Yellow	S4	G5T5	6.5	C
WL117.2	BC	Forb/Subshrub	*Ranunculus macounii*	Macoun's buttercup		Native	Yellow	S5	G5	< 1	C
WL117.2	BC	Tree/Shrub	*Picea glauca*	white spruce		Native	Yellow	S5	G5	10	A2
WL117.2	BC	Tree/Shrub	*Betula papyrifera*	paper birch		Native	Yellow	S5	G5	55	A2
WL117.2	BC	Nonvascular	*Moss* sp.							0.5	D
WL117.3	BC	Graminoid	*Calamagrostis canadensis* var. *canadensis*	bluejoint reedgrass		Native	Yellow	S5	G5T5	5	C
WL117.3	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	15	C
WL117.3	BC	Tree/Shrub	*Salix lasiandra* var. *lasiandra*	Pacific willow		Native	Yellow	S5	G5T5	50	B1
WL117.3	BC	Forb/Subshrub	*Maianthemum trifolium*	three-leaved false		Native	Yellow	S4	G5	4	C
WL117.3	BC	Forb/Subshrub	*Viola adunca* var. *adunca*	early blue violet		Native	Yellow	S5	G5T5	0.5	C
WL117.3	BC	Nonvascular	*Moss* sp.							27	D
WL117.3	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	9	C
WL117.3	BC	Forb/Subshrub	*Symphyotrichum puniceum* var. *puniceum*	purple-stemmed aster		Native	Yellow	S3S4	G5T5	2.5	C
WL117.3	BC	Tree/Shrub	*Alnus incana* ssp. *tenuifolia*	mountain alder		Native	Yellow	S5	G5T5	10	B1
WL117.3	BC	Tree/Shrub	*Picea mariana*	black spruce		Native	Yellow	S5	G5	5	A2
WL117.3	BC	Forb/Subshrub	*Rubus pubescens*	dwarf red raspberry		Native	Yellow	S5	G5	< 1	B2
WL117.3	BC	Forb/Subshrub	*Mitella nuda*	common mitrewort		Native	Yellow	S5	G5	< 1	C
WL117.3	BC	Forb/Subshrub	*Galium boreale*	northern bedstraw		Native	Yellow	S5	G5	< 1	C
WL118.1	BC	Forb/Subshrub	*Rubus chamaemorus*	cloudberry		Native	Yellow	S5	G5	10	C
WL118.1	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	22.5	C
WL118.1	BC	Nonvascular	*Sphagnum* sp.							75	D
WL118.1	BC	Tree/Shrub	*Picea mariana*	black spruce		Native	Yellow	S5	G5	1.5	A2
WL118.1	BC	Tree/Shrub	*Vaccinium vitis-idaea* ssp. *minus*	lingonberry		Native	Yellow	S5	G5T5	6	B2
WL118.1	BC	Tree/Shrub	*Vaccinium oxycoccos*	bog cranberry		Native	Yellow	S4S5	G5	3	B2
WL118.1	BC	Forb/Subshrub	*Drosera rotundifolia*	round-leaved sundew		Native	Yellow	S5	G5	1	C
WL118.1	BC	Forb/Subshrub	*Equisetum arvense*	common horsetail		Native	Yellow	S5	G5	2	C
WL118.1	BC	Nonvascular	*Moss* sp.							2.5	D
WL118.1	BC	Tree/Shrub	*Betula pumila* var. *glandulifera*	low birch		Native	Yellow	S5	G5T5	3	B2
WL118.1	BC	Tree/Shrub	*Salix pedicellaris*	bog willow		Native	Yellow	S5	G5	3.5	B2
WL118.2	BC	Forb/Subshrub	*Rubus chamaemorus*	cloudberry		Native	Yellow	S5	G5	22.5	C

Appendix D. Vegetation FQI Data

Wetland Field ID	Province	Layer	Scientific Name	Common Name	Weed Rank	Origin	CDC List	S Rank	G Rank	Cover - Percent	name_ strata
WL118.2	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	8	C
WL118.2	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	27.5	C
WL118.2	BC	Tree/Shrub	*Vaccinium vitis-idaea* ssp. *minus*	lingonberry		Native	Yellow	S5	G5T5	2.5	B2
WL118.2	BC	Tree/Shrub	*Vaccinium oxycoccos*	bog cranberry		Native	Yellow	S4S5	G5	1.5	B2
WL118.2	BC	Nonvascular	*Sphagnum* sp.							30	D
WL118.2	BC	Forb/Subshrub	*Drosera rotundifolia*	round-leaved sundew		Native	Yellow	S5	G5	1.5	C
WL118.2	BC	Nonvascular	*Moss* sp.							2.5	D
WL118.2	BC	Tree/Shrub	*Betula pumila* var. *glandulifera*	low birch		Native	Yellow	S5	G5T5	5	B2
WL118.2	BC	Tree/Shrub	*Picea mariana*	black spruce		Native	Yellow	S5	G5	< 1	A2
WL118.3	BC	Forb/Subshrub	*Platanthera huronensis*	Great Lakes rein orchid		Native	Yellow	S4	G5T5?	0.5	C
WL118.3	BC	Graminoid	*Carex aquatilis* var. *aquatilis*	water sedge		Native	Yellow	S5	G5T5	25	C
WL118.3	BC	Tree/Shrub	*Betula pumila* var. *glandulifera*	low birch		Native	Yellow	S5	G5T5	27.5	B2
WL118.3	BC	Nonvascular	*Moss* sp.							13.5	D
WL118.3	BC	Forb/Subshrub	*Rubus arcticus* ssp. *acaulis*	nagoonberry		Native	Yellow	S4	G5T5	3.5	C
WL118.3	BC	Graminoid	*Carex disperma*	soft-leaved sedge		Native	Yellow	S5	G5	7.5	C
WL118.3	BC	Nonvascular	*Sphagnum* sp.							10	D
WL118.3	BC	Forb/Subshrub	*Maianthemum trifolium*	three-leaved false		Native	Yellow	S4	G5	< 1	C
WL118.3	BC	Tree/Shrub	*Larix laricina*	tamarack		Native	Yellow	S5?	G5	2.5	A2
WL118.3	BC	Tree/Shrub	*Rhododendron groenlandicum*	Labrador-tea		Native	Yellow	S5	G5	4	C
WL118.3	BC	Graminoid	*Calamagrostis stricta* ssp. *inexpansa*	slimstem reedgrass		Native	Yellow	S5	G5T5	12.5	C
WL118.3	BC	Graminoid	*Poa pratensis* ssp. *pratensis*	Kentucky bluegrass		Exotic	Exotic	SNA	G5T5	2.5	C
WL118.3	BC	Forb/Subshrub	*Equisetum fluviatile*	swamp horsetail		Native	Yellow	S5	G5	2.5	C
WL118.3	BC	Tree/Shrub	*Rosa acicularis* ssp. *sayi*	prickly rose		Native	Yellow	S5	G5T5	3.5	B2
WL118.3	BC	Tree/Shrub	*Vaccinium oxycoccos*	bog cranberry		Native	Yellow	S4S5	G5	< 1	B2
WL118.3	BC	Forb/Subshrub	*Plantago* sp.							0.5	C

APPENDIX E. ANALYTICAL RESULTS – WATER QUALITY

Appendix E. Analytical Results - Water Quality

Location:	BCH-WL-003	BCH-WL-004	BCH-WL-005	BCH-WL-006	BCH-WL-007	BCH-WL-008	BCH-WL-009	BCHWL 012	BCHWL 018	BCH WL 21	BCH WL 022	BCH WL 025	BCH WL036	BCH WL037	BCH WL038	BCH WL 100	BCH WL 102	BCH WL 103	BCH WL 104	BCH WL 106	BCH WL 108	BCH WL 110D	BCH WL 110U	BCH WL 111	BCH WL 112	BCH WL 114	BCH WL 115
Sample Date:	5-Jul-2018	5-Jul-2018	5-Jul-2018	5-Jul-2018	5-Jul-2018	5-Jul-2018	5-Jul-2018	22-Jul-2018	21-Jul-2018	20-Jun-2018	20-Jul-2018	20-Jul-2018	23-Jul-2018	23-Jul-2018	23-Jul-2018	2-Aug-2018	3-Aug-2018	4-Aug-2018	4-Aug-2018	5-Aug-2018	6-Aug-2018	7-Aug-2018	7-Aug-2018	7-Aug-2018	7-Aug-2018	8-Aug-2018	9-Aug-2018
Laboratory Report Number:	8071673	8071673	8071673	8071673	8071673	8071673	8071673	L2133662	L2133662	L2133122	L2133487	L2133487	L2134167	L2134167	L2134167	L2141494	L2141494	L2141709	L2141709	L2141709	L2141903	L2142400	L2142400	L2142400	L2142400	L2144317	L2145036
Laboratory Sample ID:	8071673-01	8071673-02	8071673-03	8071673-04	8071673-05	8071673-06	8071673-07	L2133662-1	L2133662-2	L2133122-1	L2133487-1	L2133487-2	L2134167-1	L2134167-2	L2134167-3	L2141494-1	L2141494-2	L2141709-1	L2141709-2	L2141709-3	L2141903-1	L2142400-1	L2142400-2	L2142400-3	L2142400-4	L2144317-1	L2145036-1

Parameter	Unit	CSR - AW (Fresh)																										
Physical Parameters																												
Electrical Conductivity (EC)	µS/cm	-								-	-	162	317	265	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids (TDS)	µg/L	-	2,190,000	930,000	882,000	584,000	505,000	304,000	1,020,000	220,000	249,000	366,000	184,000	161,000	780,000	535,000	502,000	257,000	351,000	240,000	222,000	468,000	357,000	321,000	307,000	210,000	198,000	200,000	237,000
Total Suspended Solids (TSS)	µg/L	-	1,250,000	84,000	< 2,000	694,000	61,300	506,000	198,000	5,900	6,100	837,000	3,000	47,800	3,200	275,000	22,000	9,400	22,200	98,800	115,000	327,000	39,800	20,400	18,000	49,600	19,200	3,600	41,100
Hardness as $CaCO_3$	µg/L	-	1,760,000	555,000	526,000	433,000	412,000	297,000	567,000	181,000	167,000	112,000	160,000	137,000	375,000	346,000	356,000	67,200	326,000	159,000	90,400	302,000	240,000	321,000	286,000	140,000	142,000	57,600	80,200
Alkalinity (total as $CaCO_3$)	µg/L	-	921,000	527,000	494,000	576,000	455,000	318,000	555,000	130,000	185,000	66,400	176,000	146,000	540,000	499,000	497,000	54,600	301,000	150,000	82,000	206,000	221,000	253,000	249,000	129,000	131,000	30,300	53,300
Alkalinity (p)	µg/L	-	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicarbonate	µg/L	-	921,000	527,000	494,000	576,000	455,000	318,000	555,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbonate	µg/L	-	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydroxide	µg/L	-	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide	µg/L	-	-	-	-	-	-	-	-	< 50	< 50	< 50	< 50	< 50	< 250	< 250	< 250	< 50	< 50	< 50	< 50	858	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Chloride	µg/L	1,500,000	4,800	2,930	3,120	18,000	7,660	4,550	32,500	< 500	7,980	690	580	< 500	28,800	6,900	6,800	< 500	< 500	< 500	570	58,900	< 500	< 500	< 500	1,080	< 500	< 500	< 500
Fluoride	µg/L	3,000 [#2]	-	-	-	-	-	-	-	89	81	116	75	73	230	130	200	27	160	62	31	49	95	224	141	101	56	22	35
Orthophosphate (as P)	µg/L	-	-	-	-	-	-	-	-	7.7	9.5	4,610	-	-	181	36.8	148	705	20.5	56	316	546	244	7.7	1.9	94.6	4.5	355	2160
Phosphate (as P)	µg/L	-	517	< 5.0	16.4	17.1	81.5	< 5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	µg/L	2,180,000-4,290,000 [#1]	694,000	150,000	171,000	6,200	1,600	11,000	183,000	53,600	46,200	< 300	25,500	18,100	84,200	25,100	13,600	< 300	< 300	< 300	< 300	< 300	780	39,000	7,060	770	< 300	< 300	< 300
Nutrients																													
Ammonia as N	µg/L	1,310 [#2]	913	77	64	92	109	31	204	6.8	7.8	51.1	10	9.9	48.2	28.2	25.7	29.3	8.6	26.3	54.4	57.5	35.8	11.2	12.6	39	11.1	26.2	225
Nitrate (as N)	µg/L	400,000	< 10	15	< 10	12	< 10	< 10	< 100	< 5.0	8.3	< 5.0	< 5.0	< 5.0	< 25	73	80	63.8	< 5.0	339	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Nitrite (as N)	µg/L	200-2000 [#3]	< 10	< 10	< 10	< 10	< 10	< 10	407	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	<5.0	<5.0	< 1.0	< 1.0	7.5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nitrate and Nitrite (as N)	µg/L	400,000	< 10	15.3	< 10	12.1	< 10	< 10	407	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrogen (Total)	µg/L	-	71,300	3,190	1,730	1,070	2,690	7,320	6,020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Kjeldahl Nitrogen	µg/L	-	7,670	2,630	1,610	1,930	1,100	224	3,380	297	473	5,570	237	409	2,160	1,460	1,440	3,690	1,480	1,470	3,180	2,370	2,680	897	935	1,550	1,130	2,380	2,710
Total Kjeldahl Nitrogen (TKN)	µg/L	-	71,300	3,180	1,730	1,060	2,690	7,320	5,610	257	596	6,430	223	233	2,320	3,140	1,810	3,270	1,700	3,500	6,240	4,460	3,110	930	981	2,370	1,420	2,220	3,270
Phosphorus - Total	µg/L	-	5,830	45.6	17.1	1640	192	273	174	33.7	52.4	5,700	25.3	35.3	271	588	331	790	175	266	728	1,320	582	38.5	45.9	414	95.2	417	2,600
Phosphorus - Dissolved	µg/L	-	528	21.0	17.1	77.2	130	< 2.0	61.8	13.8	21.7	4,920	9.4	23.6	221	62.9	163	889	59.4	99.4	404	806	341	12.9	19.4	165	36.7	410	2,250
Carbon																													
Dissolved Organic Carbon	µg/L	-	113,000	71,900	65,000	46,300	43,600	21,900	84,000	16,300	8,270	109,000	2,120	2,400	45,100	38,900	39,800	76,000	33,100	35,100	53,700	45,600	50,300	14,700	18,300	23,200	20,900	22,000	67,500
Total Carbon	µg/L	-	-	-	-	-	-	-	-	-	-	197,000	39,200	35,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Inorganic Carbon	µg/L	-	274	114	114	130	113	77.8	160	31,400	35,700	23,200	36,500	32,500	102,000	93,600	93,200	15,300	72,700	34,600	19,200	47,000	50,700	61,800	64,600	36,000	33,600	8,910	12,500
Total Organic Carbon	µg/L	-	292	85.4	71.9	46.9	45.3	23.2	138	4,730	8,760	173,000	2,670	3,170	46,400	49,500	44,000	73,400	34,200	46,700	72,700	62,100	51,300	14,500	18,700	29,900	21,800	22,800	75,200
Total Metals																													
Aluminum	µg/L	-	13,200	31.4	17.7	11.1	25.0	92.8	97.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Antimony	µg/L	90	0.47	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	µg/L	50	7.05	0.72	< 0.50	< 0.50	< 0.50	< 0.50	0.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	µg/L	10,000	372	36.3	32.0	129	206	390	39.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beryllium	µg/L	1.5	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bismuth	µg/L	-	0.16	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	µg/L	12,000	461	205	188	34.6	37.8	34.4	94.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	µg/L	1.5-4.0 [#2]	2.23	0.012	0.011	< 0.010	0.010	0.029	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	µg/L	-	395,000	89,200	99,800	93,800	107,000	76,700	73,500	51,800	35,800	30,600	30,900	30,700	48,900	73,600	75,800	17,200	84,700	40,200	23,200	90,100	52,500	48,300	75,000	38,400	36,400	18,600	21,100
Chromium	µg/L	10 [#4]	24.2	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	µg/L	40	12.8	0.22	0.13	0.13	0.20	0.16	0.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	µg/L	30-90 [#2]	96.4	0.45	< 0.4	< 0.40	1.01	1.94	0.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	µg/L		26,500	198	23	97	455	287	273	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead	µg/L	50-160 [#2]	15.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lithium	µg/L	-	107	54.5	47.2	47.6	16.3	7.62	51.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium	µg/L	-	187,000	80,800	67,100	48,200	35,200	25,500	93,000	12,700	18,900	8,680	20,200	14,600	61,400	39,300	40,500	5,880	27,700	14,300	7,870	18,600	26,500	48,800	24,100	10,800	12,400	2,710	6,690
Manganese	µg/L	-	1,070	15.2	18.2	110	408	19.4	99.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	µg/L	10,000	4.97	4.77	5.69	< 0.10	0.21	1.18	0.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	µg/L	250-1,500 [#1]	44.3	0.47	0.53	0.67	0.57	0.62	1.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorus	µg/L	-	5,860	< 50	< 50	1,820	789	357	198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	µg/L	-	7,770	2,970	4,010	5,800	4,410	5,700	8,240	< 2,000	3,300	18,500	< 2,000	< 2,000	9,400	6,500	6,200	13,200	2,300	4,800	14,100	15,100	9,900	< 2,000	4,200	9,700	8,600	2,600	7,400
Selenium	µg/L	20	2.31	< 0.50	< 0.50	< 0.50	< 0.50	1.82	< 0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silicon	µg/L	-	41,200	15,200	10,800	4,300	6,500	5,700	1,500	1,520	480	3,520	1,020	1,570	1,730	4,770	5,220	5,860	6,390	4,390	7,240	8,090	8,750	170	1,190	6,870	1,270	1,760	5,760
Silver	µg/L	0.5 / 15 [#3]	0.297	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	µg/L	-	185,000	89,100	75,800	32,100	14,500	9,090	127,000	2,300	17,800	< 2,000	8,800	4,300	88,400	36,900	40,300	< 2,000	< 2,000	< 2,000	< 2,000	5,300	< 2,000	4,300	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000
Strontium	µg/L	-	2,800	818	830	508	491	370	639	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphur	µg/L	-	214,000	63,500	59,500	< 3,000	< 3,000	4,000	75,100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tellurium	µg/L	-	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	µg/L	3	0.101	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thorium	µg/L	-	0.61	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin	µg/L	-	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Titanium	µg/L	1,000	138	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tungsten	µg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium	µg/L	85	2.73	0.125	0.073	0.11	0.026	0.681	0.125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	µg/L	-	39.4	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	µg/L	75-2,400 [#1]	404	<4	6.5	5.5	6.6	8.9	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zirconium	µg/L	-	2.44	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NOTES:

#1 Standard varies with hardness. Values shown based hardness range of 58 mg/L to 1,760 mg/L.
#2 Standard varies with pH. Most conservative standard applied.
#3 Standard varies with chloride concentration. Values shown based on chloride range of < 0.50 mg/L to 58.9 mg/L
#4 Standard is for Chromium VI
- Not analyzed or no CSR standard exists.
< Concentration is less than the laboratory detection limit indicated.
CSR BC Contaminated Sites Regulation (BC Reg. 375/96, including amendments up to BC Reg. 116/2018 June 14, 2018) Schedule 3.2
AW (Fresh) Freshwater Aquatic Life Standards
Bold Bold and shaded indicates an exceedance of the CSR standard

Appendix 7. 2018 Preconstruction Rare Plant Surveys

EAGLE CAP CONSULTING
environmental consulting services

2018 Interim Report
Preconstruction Rare Plant Surveys
Site C Clean Energy Project

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December 12, 2018

Contents

1. 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 preconstruction 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 preconstruction rare plant surveys in previously unsurveyed areas of the proposed transmission line and access roads. By documenting additional occurrences of rare plants within the Project footprint, measures to mitigate effects to these occurrences—including seed recovery and translocation—can be identified.

Data collected during these surveys is 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 preconstruction surveys was completed in the summer and fall of 2015, and the work has been proceeding every year since. This interim report documents the methods and results of the surveys completed from 2015 through the end of the 2018 field season.

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 determine the location of rare plant occurrences within two mitigation parcels that will be used to compensate for project effects;
- to record detailed element occurrence data in the Project rare plant database on all rare plant populations found, and submit these data to the B.C. 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 resulting from the Project.

1.3. Study Area

Preconstruction rare plant surveys are being conducted in:

- the Highway 29 realignment corridors;
- the proposed transmission line corridor;

- the proposed new or upgraded transmission line access road corridors;
- the proposed new or upgraded access road corridors into the reservoir clearing zone—excluding the reservoir footprint;
- the proposed Project Access Road corridor 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 85th Avenue industrial site;
- the proposed conveyor corridor from the 85th Avenue industrial site to the dam site;
- the 204 hectare Rutledge mitigation parcel along Highway 29 at Dry Creek; and
- the 423 hectare Wilder Creek mitigation parcel located along the Peace River approximately six kilometres downstream from Bear Flat.

Pre-construction rare plant surveys were completed for some of these areas during the 2015 through 2017 field seasons. The 2018 work focussed on the Highway 29 realignment corridors, and proposed access roads into the eastern reservoir clearing areas.

2. METHODS

2.1. Prefield Review

Each year in the spring the investigation begins with a prefield review designed to collect and analyze existing data. This information is 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” are 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 2018); and
- species on the B.C. Ministry of Environment’s provincial Red or Blue lists (BCCDC 2018).

Since 2005, BC Hydro has been conducting 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 is based heavily on element occurrence data collected over the last 14 years. Currently, 36 different rare plant taxa are reported to occur in the Project area. Consequently, these 26 vascular

plants, 9 lichens, and 1 moss form the basis of the target species list for the work, comprising the rare species with the highest likelihood of occurrence.

In order to identify additional rare plant species that could potentially occur in the Project area, each year the dataset of all B.C. vascular plants, mosses, and lichens is downloaded from the Ministry of Environment's Species and Ecosystem Explorer (BCCDC 2018). Queries are run on the dataset to extract a list of the rare plant species that the Ministry of Environment associates with the Peace River Regional District and the Boreal Black and White Spruce Biogeoclimatic Zone. Each species on this list is further reviewed to determine its potential for occurrence within the areas targeted for survey.

In addition, the Conservation Data Centre's (CDC) occurrence dataset of all species and ecosystems at risk is downloaded from the B.C. Data Catalogue and added to the Project GIS (Ministry of Environment and Climate Change Strategy 2018). The dataset is queried to investigate historic and verified extant rare plant occurrences within the Project area.

All the above information is compiled to produce a list of target rare plant species potentially occurring within the Project area. This target list includes the 36 taxa currently reported to occur in the Project area, as well as numerous other possible Peace Region species uncovered during the prefield review of data and literature. 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, the botanists consider all described plant taxa while conducting surveys.

Aerial imagery, contour information, and project maps are reviewed to predict the habitat types present in the survey corridors. General plant communities are determined, and the locations of possible high-suitability rare plant habitat are noted.

In order to refine their search images for the target taxa, the surveyors study photographs, herbarium specimens, and species descriptions in various published references (Hitchcock et al. 1955; Flora of North America Editorial Committee 1993; Goward et al. 1994; McCune et al. 1995; Douglas et al. 1998; Goward 1999; Brodo et al. 2001; Cronquist et al. 2013; Brodo 2016) and online databases (Klinkenberg 2018; NatureServe 2018; CNALH 2018). In addition, they review similar data for species that might be confused with the target taxa. Tables of summary identification characteristics are prepared for field use. The goals are to maximize detectability of the target species and to reduce observer bias during the surveys.

The final field plan each year is designed to guide the methods, coverage, and timing of the rare plant surveys. Seasonal timing is based on the predicted phenologies of the target species.

2.2. Field Survey

The preconstruction surveys began in June of 2015 and have taken place every year since. Over the four field seasons, 151 surveyor-days have been spent surveying a total transect distance of 862.6 kilometres (Table 1 and Figure 1).

Table 1: Rare Plant Survey Effort

Year	Start Date	End Date	Surveyor-Days	Total Survey Km
2015	June 30	September 7	42	209.8
2016	June 20	August 23	41	191.8
2017	June 23	August 12	12	51.7
2018	June 13	August 29	56	409.3
Totals			**151**	**862.6**

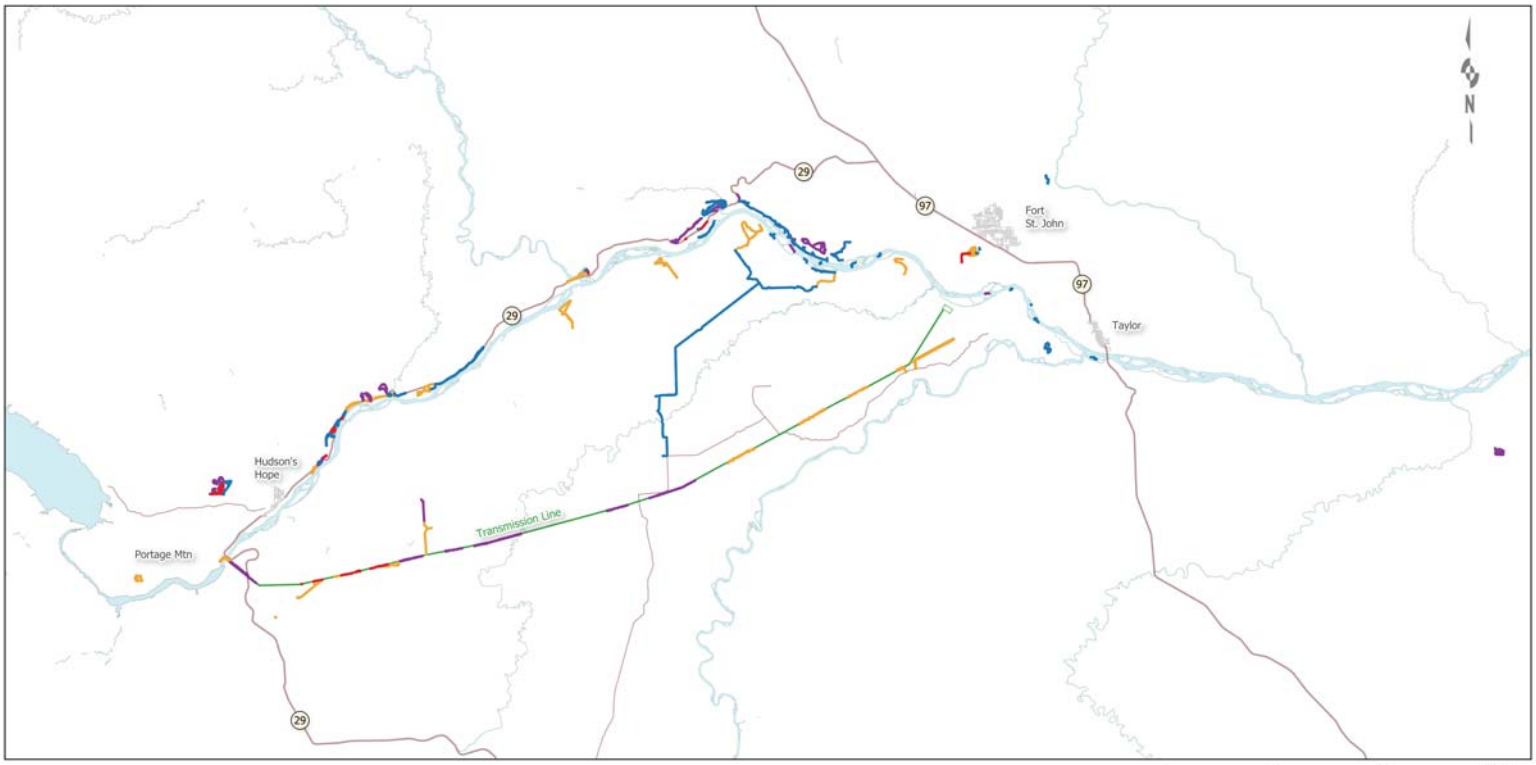
Table notes:

- *Surveyor-Days = days spent surveying x number of botanists*
- *Total Survey Km = total survey transect distance*

For all four years, the surveys were performed by two senior-level rare plant botanists—both of whom have been working with the rare flora of the Project area for the past eight years. The surveyors primarily use a habitat-directed meander search protocol to cover the areas surveyed. 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 & Klinkenberg 2012; Ministry of Environment and Climate Change Strategy Ecosystems Branch 2018). The surveyors, working together or separately, walk the length of the 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 Avenue or Portage Mountain sites, the surveyors conduct meander transects to cover the entire area.

When using the habitat-directed meander search protocol:

- 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 and 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 when surveying non-linear features); and
- surveyors attempt to traverse a representative cross-section of all low-suitability rare plant habitat within the unit.



Map Notes:

1. Based on surveys completed through September 2018.
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

Survey Routes
- 2015
- 2016
- 2017
- 2018

Map Scale 1:350000

0 10 20 30 km

SITE C CLEAN ENERGY PROJECT

BC hydro

EAGLE CAP CONSULTING environmental consulting services

Figure 1
Preconstruction Rare Plant Survey Routes

Date	November 15, 2018	DWG NO	2018-11-15-0001	Revision 0

The habitat-directed meander search preferentially covers high-suitability ecosystems over the more common low-suitability habitats (MacDougall & 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 habitat-directed 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 some areas.

For certain linear corridors that traverse habitat with a low potential for rare plant occurrence, the botanists drive slowly along the corridor in a Utility Terrain Vehicle (UTV) or truck, scanning both sides for rare plants and pockets of high-suitability rare plant habitat. This procedure is only conducted in corridors where the majority of habitat is low-probability, and at a speed of approximately five kilometres per hour. If high-potential rare plant habitat is encountered—such as wetlands or rock outcrops—the surveyors exit the vehicle and survey the habitat on foot. In 2015, 5.1% of the total 209.8 kilometres traversed was surveyed from UTV—the rest was walked. In 2016 only 0.9% of the total 191.8 kilometres survey distance was covered by UTV. In 2017, none of the transects were surveyed by UTV. In 2018, 14.6% of the total 409.3 kilometres was covered by UTV or truck.

In 2016, surveys were conducted within the Rutledge and Wilder Creek mitigation parcels. These surveys were designed to provide a general overview of the rare plant populations present within the parcels, in order to inform mitigation planning. As such, these areas were surveyed at a lower intensity level, covering a smaller percentage of the suitable habitats, than in the areas proposed for disturbance. Although the habitat-directed meander survey technique described above was used in the mitigation parcels, certain areas of suitable habitat were not covered.

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

When target rare plants are found during the fieldwork, element occurrence information is entered into custom-built digital forms or recorded on printed CDC rare plant survey forms (BCCDC 2012). Where paper forms are used, the information is later transcribed into digital format to facilitate analysis of the sites. Photographs are taken of both the individual plants and the surrounding habitat. Consistent with the B.C. Resource Information Standards Committee guidelines and the rare plant survey guidelines on the B.C. E-Flora website (RIC 1999; Penny & Klinkenberg 2012; Ministry of Environment and Climate Change Strategy Ecosystems Branch 2018), a voucher specimen is collected where permitted by the landowner, and when doing so would not compromise the viability of the population. At each vascular rare plant site, GPS units are used to record the boundary of the occurrence to facilitate mitigation planning.

Delimitation of "Element Occurrences"—referred to herein simply as "occurrences"—is based on *A Habitat-Based Strategy for Delimiting Plant Element Occurrences* (NatureServe 2004). The Element Occurrence (EO) is a fundamental unit of information in the CDC system, and is defined as "an area of land and/or water in which a species or natural community is, or was present." (NatureServe 2002). Based on the NatureServe guidance, rare plants are typically grouped into a single occurrence when they are located closer than one kilometre from another individual of the same species. In some cases, occurrences were composed of two or more discrete patches—also referred to as "sites" in this report—spread out over a large area. These patches are mapped separately to facilitate mitigation planning, but are recorded as a single occurrence when the patches are closer than one kilometre to each other.

2.3. Analysis

As field data are collected, they are imported into the Project rare plant database on a daily basis. This includes rare plant element occurrence information, survey transect routes, and field notes. Collected data are encrypted and secured with multi-factor authentication protocols. The information and field photos are backed up nightly to secure off-site servers.

Following the field season, the collected rare plant information is compiled and analyzed in the Project rare plant Geographic Information System (GIS). Voucher specimens are examined and sent to outside experts where additional verification is required. New rare plant locations are compared with CDC data to determine if the newly discovered sites can be combined as extensions of previously recorded occurrences.

Every year, once the data have been compiled, verified, and cleaned, a submission package is prepared for the CDC. This dataset contains all the new rare plant occurrences found during the previous field season, as well as any updates and extensions to previously reported occurrences. The data are provided in a spatial format compatible with CDC submission requirements. Voucher specimens are prepared based on Ministry of Environment (MOE) guidelines (Ministry of Environment and Climate Change Strategy Ecosystems Branch 2018) and submitted to the appropriate herbarium.

The updated rare plant dataset is imported into the BC Hydro Site C GIS and used to populate the rare plant environmental features layer. This spatial information is made available to Project engineers for use in mitigation planning.

The following quality assurance and quality control measures are applied to promote accurate data collection and analysis:

- All project rare plant data are stored in a custom-built spatial database (PostgreSQL 9.6 spatially enabled with PostGIS 2.4). The database server software is regularly updated to the latest stable versions and all security patches are applied soon after issue.
- The tables in the database have been normalized to reduce data redundancy and improve integrity.

- Primary key constraints are enforced for all relational tables to improve database integrity and allow complex queries to be run.
- Data fields are constrained at the database level to ensure type-consistency. Electronic input forms also constrain entered data to provide front-end validation and user guidance.
- Regular updates are pulled from the MOE's Ecosystem Explorer and are added to the database to ensure that analyses are performed using the latest CDC rare plant statuses and nomenclature.
- The data fields *UTM northing*, *UTM easting*, and *occurrence area* are calculated programmatically from the rare plant polygons, ensuring accuracy of the derived fields. Point data are also derived programmatically from the rare plant polygons to ensure locational consistency between the spatial fields.
- Multipolygons are used as the basic spatial descriptor for the rare plant occurrences recorded after 2008 to enable more precise avoidance mitigation than would be possible using single polygons or points.
- Custom-built electronic forms are used by the botanists to enter rare plant data in the field while at the occurrence. Paper versions of the forms are also used in cases where there are difficulties with the electronic entry devices. In these cases, the paper forms are transcribed onto the electronic forms as soon as possible to allow for data validation.
- Every record is reviewed for typographical and transcription errors at the end of the field season.
- Associated species lists are reviewed by a second botanist to ensure identification accuracy.
- Rare plant polygons are reviewed on aerial imagery and ecosystem layers in the GIS to check boundary accuracy by the botanist(s) who recorded the occurrence.
- Voucher specimens are collected where appropriate and verified in the lab and herbarium, or are sent to species experts for further verification when taxonomic questions still exist.

3. RESULTS

3.1. Prefield Review

The prefield review identified 147 rare plant taxa with potential for occurrence in the overall Project area (Appendix 1). The list is comprised of 66 vascular plant species, 51 bryophytes, and 30 lichens. As noted previously, this list was used for planning purposes and was not considered to be an exhaustive listing of all possible rare plant taxa in the project area. The surveyors considered all rare taxa during the surveys, whether they were on the target list or not.

It should also be noted that the CDC regularly reviews the statuses of the plant taxa in the province to determine if new information warrants a change in the rarity rankings. As the Site C rare plant work

proceeds, the numerous new occurrences that have been found during the surveys have allowed the CDC to reassess many of the Project Area plant taxa. In 2018 for instance, 19 Project Area plant taxa were removed from the Red or Blue lists, meaning that they no longer meet the definition of "rare plants" for the Project (see Section 2.1). This resulted in a 37% decrease in the number of rare plant sites within the Project Area, allowing Project botanists to focus mitigation efforts on the remaining rare taxa.

3.2. Field Survey

The 2015 field surveys found 34 new sites of 14 different rare plant species—11 vascular plants and 3 lichens. Some 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 previously reported occurrences. Of the 14 rare species, 5 were on the MOE's Red list, with the remaining 9 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 2018). Some of the rare taxa found in 2015 have since had their statuses revised and are no longer Red- or Blue-listed by the B.C. Ministry of Environment.

In 2016, 88 new sites of 13 different rare plant species were found—10 vascular plants and 3 lichens. As in 2015, some of the new sites were considered to be extensions of occurrences found in previous years. Of the 13 rare species found in 2016, 5 were on the B.C. Red list, while the remaining 8 were on the Blue list. None of the 2016 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 2018). As with the 2015 rare plant taxa, some of the 13 rare plant species found in 2016 are no longer Red- or Blue-listed by the B.C. Ministry of Environment.

In 2017, three new sites of two different lichen species were found. One of the sites was considered to be an extension of a previously reported occurrence, and two were new occurrences. Both taxa found in 2017 were on the B.C. Blue list, however one has since been removed. Neither is listed on Schedule 1 of the Species at Risk Act, or is considered to be Extinct, Extirpated, Endangered, Threatened, or Special Concern by COSEWIC (Government of Canada 2002; COSEWIC 2018).

For the 2018 field season, 46 rare plant sites were found. Several of these were extensions of previously known occurrences. Fourteen different rare plant taxa were found: 4 B.C. Red list, and 10 Blue list. None of the 14 are listed on Schedule 1 of the Species at Risk Act, or is considered to be Extinct, Extirpated, Endangered, Threatened, or Special Concern by COSEWIC (Government of Canada 2002; COSEWIC 2018).

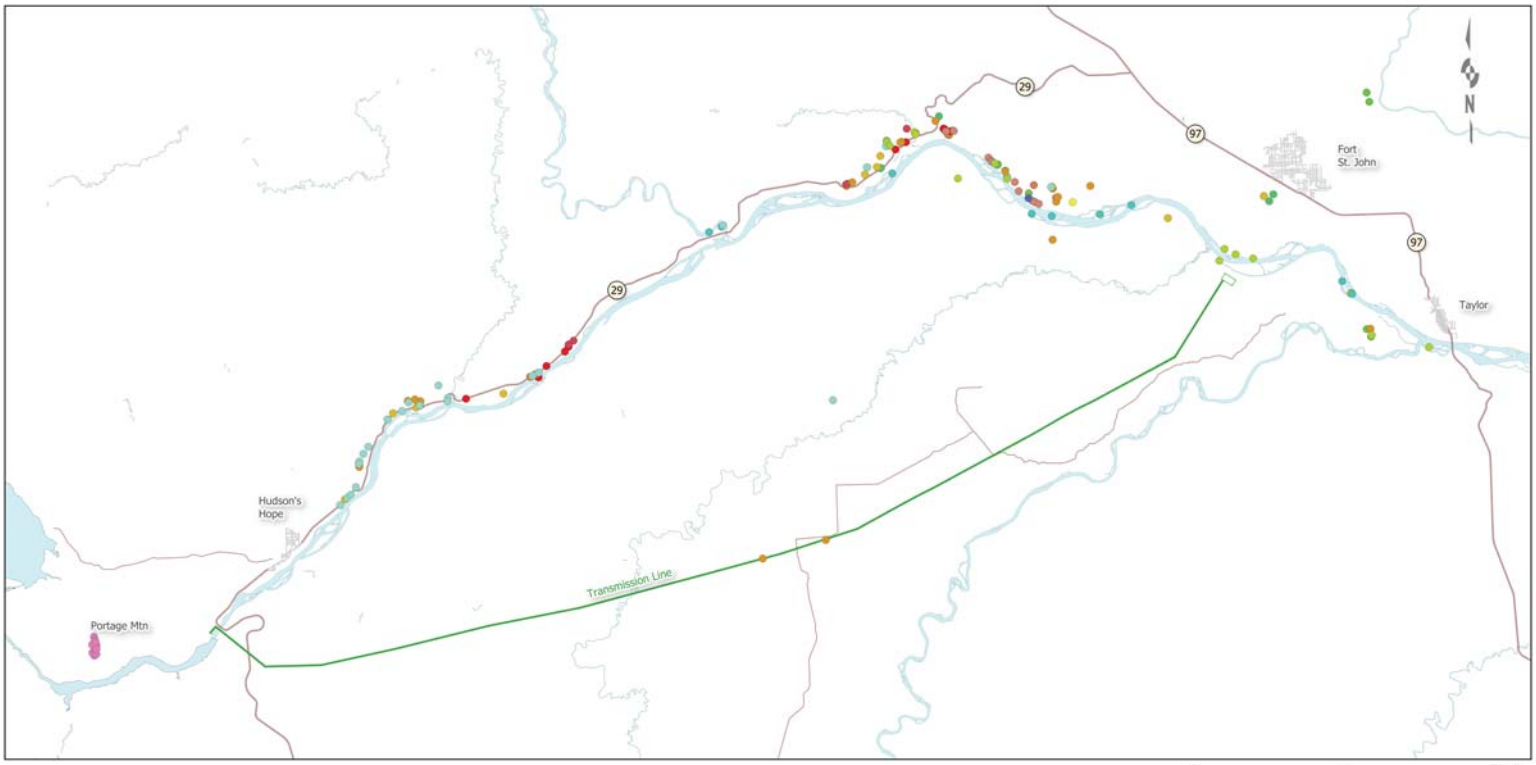
In total, 85 occurrences of 16 currently listed rare plant taxa were discovered or expanded during the preconstruction surveys (Table 2 and Figure 2). Over the course of the four survey years, the investigators recorded 624 vascular plant, bryophyte, and lichen taxa (Appendix 2).

Table 2: Rare plants found during the Site C Preconstruction surveys

Taxon	Common Name	BC List	Occurrences	Patches
Vascular Plants				
Artemisia herriotii	Herriot's sage	Blue	6	13
Atriplex gardneri var. gardneri	Gardner's sagebrush	Red	1	1
Carex backii	Back's sedge	Blue	2	4
Carex sprengelii	Sprengel's sedge	Blue	3	4
Carex torreyi	Torrey's sedge	Red	3	6
Carex xerantica	dry-land sedge	Blue	6	12
Cirsium drummondii	Drummond's thistle	Blue	4	13
Oxytropis campestris var. davisii	Davis' locoweed	Blue	7	9
Penstemon gracilis	slender penstemon	Blue	6	16
Piptatheropsis canadensis	Canada ricegrass	Red	1	1
Polypodium sibiricum	Siberian polypody	Blue	1	12
Ranunculus rhomboideus	prairie buttercup	Blue	4	5
Selaginella rupestris	rock selaginella	Red	3	4
Lichens				
Physcia biziana	frosted rosette	Blue	16	28
Physcia stellaris	immaculate rosette	Blue	8	11
Ramalina sinensis	threadbare ribbon	Blue	14	25
TOTAL			**85**	**164**

Table notes:

- *BC List (B.C. Ministry of Environment): Red = Endangered, Threatened, or Extirpated; Blue = Special Concern*
- *Occurrences: Includes newly discovered occurrences as well as occurrences expanded during the preconstruction surveys*



Map Location

Map Notes:

1. Based on surveys completed through September 2018.
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

- Artemisia herriotii
- Atriplex gardneri var. gardneri
- Carex backii
- Carex sprengelii
- Carex torreyi
- Carex xerantica
- Cirsium drummondii
- Oxytropis campestris var. davisii
- Penstemon gracilis
- Physcia biziana
- Physcia stellaris
- Piptatheropsis canadensis
- Polypodium sibiricum
- Ramalina sinensis
- Ranunculus rhomboideus
- Selaginella rupestris

Map Scale 1:250000

0 10 20 km

SITE C CLEAN ENERGY PROJECT

BC hydro

EAGLE CAP CONSULTING environmental consulting services

Figure 2
Rare Plant Sites Found
During Preconstruction Surveys

Date	December 8, 2018	DWG NO	2018-11-15-0002	Revision 1

Many of the rare plant taxa found during the preconstruction surveys had been documented previously in other occurrences during the baseline surveys performed for the Project environmental impact assessment. Species descriptions for the 16 currently rare taxa recorded during the 2015-2018 preconstruction surveys are presented in Appendix 3. Each section also contains an overview of the new sites documented in 2018, and to-date summary information on all reported occurrences for each of these taxa in the Regional Assessment Area (RAA).

In this report all of the rare plant taxa discussed in Table 2 and Appendix 3 are currently Red- or Blue-listed by the CDC. For clarity, rare species found in previous years that have subsequently been removed from the Red or Blue lists are not included. Although not currently of conservation concern, the occurrence data for these taxa have been retained in the Project rare plant database for future reference if needed.

Information on additional taxa and occurrences located prior to 2015 can be found in the following references:

- Site C Project Environmental Impact Statement, Volume 2, Appendix R, Part 1 (Hilton et al. 2013);
- Report: Site C Clean Energy Project: Pre-disturbance Rare Plant Assessment #1: Rolling Work Plan 10 (Eagle Cap Consulting Ltd 2014);
- Report: Site C Clean Energy Project: Wildlife, Vegetation and Mapping Inventory for the Marl Fen Property (Simpson et al. 2014); and
- B.C. Ecosystem Explorer website (BCCDC 2018).

4. Discussion

4.1. Coverage

Coverage of the areas proposed for construction disturbance—both the linear corridors and non-linear areas—was considered sufficient to locate the majority of identifiable target rare plant species. The field crew used a habitat-directed search protocol, employing a variable-intensity survey pattern that focussed time and effort on the habitats most likely to contain rare plant occurrences. Transects were spaced so that the majority of rare plant occurrences and high-suitability rare plant habitat would have been visible during the surveys. See Section 2.2 above for a complete description of the survey methods.

For the mitigation parcels—where the goal was to provide only a general overview of the rare plant populations present—the lower intensity meander surveys sampled most of the important habitats at both parcels. Although there are likely additional rare plant occurrences to be found at the mitigation parcels, the surveys provided a general picture of the rare plant resources present.

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 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 mainly 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.

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6. APPENDICES

6.1. Appendix 1: Rare plant taxa with potential for occurrence in the Site C Project area

Scientific Name	Common Name	BC List	COSEWIC	SARA
VASCULAR PLANTS				
Acorus americanus	American sweet-flag	Blue		
Alopecurus magellanicus	alpine meadow-foxtail	Red		
Arctophila fulva	pendantgrass	Blue		
Artemisia alaskana	Alaskan sagebrush	Red		
Artemisia herriotii	Herriot's sage	Blue		
Atriplex gardneri var. gardneri	Gardner's sagebrush	Red		
Boechera sparsiflora	stretching suncress	Red		
Botrychium ascendens	upswept moonwort	Blue		
Botrychium lineare	Linear-leaf moonwort	Blue		
Botrychium montanum	mountain moonwort	Blue		
Botrychium paradoxum	two-spiked moonwort	Blue		
Botrychium spathulatum	spoon-shaped moonwort	Blue		
Braya glabella ssp. glabella	smooth northern-rockcress	Blue		
Carex bicolor	two-coloured sedge	Blue		
Carex lapponica	Lapland sedge	Red		
Carex sprengelii	Sprengel's sedge	Blue		
Carex torreyi	Torrey's sedge	Red		
Carex xerantica	dry-land sedge	Blue		
Chrysosplenium iowense	Iowa golden-saxifrage	Blue		
Cirsium drummondii	Drummond's thistle	Blue		
Descurainia sophioides	northern tansymustard	Blue		
Drosera linearis	slender-leaf sundew	Blue		
Elymus albicans	Montana wildrye	Red		
Elymus lanceolatus ssp. psammophilus	sand-dune wheatgrass	Blue		
Epilobium hornemannii ssp. behringianum	Hornemann's willowherb	Blue		
Epilobium saximontanum	Rocky Mountain willowherb	Red		

Erigeron pacalis	Peace daisy	Red		
Helianthus nuttallii ssp. rydbergii	Nuttall's sunflower	Red		
Lomatium foeniculaceum var. foeniculaceum	fennel-leaved desert-parsley	Red		
Lomatogonium rotatum	marsh felwort	Blue		
Lupinus kuschei	Yukon lupine	Blue		
Luzula rufescens	rusty wood-rush	Blue		
Ophioglossum pusillum	northern adder's-tongue	Blue		
Oxytropis campestris var. davisii	Davis' locoweed	Blue		
Oxytropis maydelliana	Maydell's locoweed	Blue		
Packera ogotorukensis	Ogotoruk Creek butterweed	Red		
Pedicularis parviflora	small-flowered lousewort	Blue		
Penstemon gormanii	Gorman's penstemon	Blue		
Penstemon gracilis	slender penstemon	Blue		
Physaria arctica	arctic bladderpod	Blue		
Piptatheropsis canadensis	Canada ricegrass	Red		
Plantago eriopoda	alkali plantain	Blue		
Polemonium boreale	northern Jacob's-ladder	Blue		
Polygala senega	Seneca-snakeroot	Red		
Polygonum ramosissimum ssp. prolificum	proliferous knotweed	Red		
Polypodium sibiricum	Siberian polypody	Blue		
Potentilla arenosa ssp. arenosa	scree cinquefoil	Red		
Potentilla furcata	forked cinquefoil	Red		
Prenanthes racemosa	purple rattlesnake-root	Red		
Pyrola elliptica	shinleaf wintergreen	Blue		
Ranunculus cardiophyllus	heart-leaved buttercup	Red		
Ranunculus rhomboideus	prairie buttercup	Blue		
Rorippa sinuata	spreading yellowcress	Red		
Rosa arkansana	Arkansas rose	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		
Selaginella rupestris	rock selaginella	Red		
Silene ostenfeldii	Taimyr campion	Blue		
Silene repens	pink campion	Red		
Sphenopholis obtusata	prairie wedgegrass	Red		
Symphyotrichum falcatum var. commutatum	white prairie aster	Red		
Tephroseris palustris	marsh fleabane	Blue		
Thalictrum dasycarpum	purple meadowrue	Red		
Utricularia ochroleuca	ochroleucous bladderwort	Blue		
BRYOPHYTES				
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		
Seligeria tristichoides	[no common name]	Blue		
Sphagnum balticum	[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		
Fulgensia subbracteata	creeping sulphur	Red		
Heterodermia speciosa	smiling centipede	Red		
Leptogium pseudofurfuraceum	concentric vinyl	Blue		
Leptogium schraderi	collapsing vinyl	Red		
Peltigera evansiana	peppered pelt	Red		
Phaeophyscia adiastola	granulating shadow	Red		
Phaeophyscia hirsuta	smiling shadow	Red		
Phaeophyscia hispidula	whiskered shadow	Red		
Physcia biziana	frosted rosette	Blue		
Physcia dimidiata	exuberant rosette	Red		
Physcia stellaris	immaculate rosette	Blue		
Physcia tribacia	beaded rosette	Red		
Physciella chloantha	downside shade	Blue		
Ramalina sinensis	threadbare ribbon	Blue		
Squamarina cartilaginea	pea-green dimple	Red		
Squamarina lentigera	snow-white dimple	Red		
Thyrea confusa	candied gummybear	Blue		
Usnea glabrata	lustrous beard	Blue		
Usnea trichodea	deadman's beard	Red		
Xanthoparmelia camtschadalis	rockfrog	Red		

Table notes:

- *B.C. List (B.C. 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*

6.2. Appendix 2: Plant and lichen species recorded during the 2015–2017 surveys

Vascular Plants

Acer glabrum var. douglasii
Acer negundo
Achillea alpina
Achillea borealis
Achillea millefolium var. lanulosa
Achnatherum nelsonii ssp. dorei
Achnatherum richardsonii
Aconitum delphiniifolium
Actaea rubra
Agropyron cristatum ssp. pectinatum
Agrostis capillaris
Agrostis exarata
Agrostis gigantea
Agrostis scabra
Alisma triviale
Allium cernuum var. cernuum
Allium schoenoprasum var. sibiricum
Alnus incana ssp. tenuifolia
Alnus viridis ssp. crispa
Alnus viridis ssp. sinuata
Alopecurus aequalis
Amelanchier alnifolia
Amerorchis rotundifolia
Anaphalis margaritacea
Androsace septentrionalis
Anemone cylindrica
Anemone multifida var. multifida
Anemone patens ssp. multifida
Anemone virginiana var. cylindroidea
Angelica genuflexa
Antennaria howellii ssp. canadensis
Antennaria howellii ssp. petaloidea
Antennaria microphylla
Antennaria neglecta
Antennaria parvifolia
Antennaria pulcherrima ssp. pulcherrima
Antennaria racemosa
Antennaria rosea
Anthoxanthum hirtum
Apocynum androsaemifolium var. androsaemifolium
Aquilegia brevistyla
Aralia nudicaulis
Arctium sp.
Arctostaphylos uva-ursi
Arnica chamissonis
Arnica cordifolia
Artemisia biennis
Artemisia campestris ssp. pacifica
Artemisia dracunculus
Artemisia frigida
Artemisia herriotii
Asparagus officinalis
Astragalus alpinus var. alpinus
Astragalus americanus
Astragalus australis
Astragalus canadensis
Astragalus cicer
Astragalus eucosmus
Astragalus laxmannii var. robustior
Astragalus tenellus
Athyrium filix-femina ssp. cyclosorum
Atriplex gardneri var. gardneri
Avena sativa
Avenula hookeri
Axyris amaranthoides
Beckmannia syzigachne
Betula neoalaskana
Betula papyrifera
Betula pumila
Betula pumila var. glandulifera
Bidens cernua
Blitum capitatum ssp. capitatum
Boechera divaricarpa
Boechera grahamii
Boechera pendulocarpa
Boechera retrofracta
Boechera stricta
Botrypus virginianus
Brassica rapa var. rapa
Bromus ciliatus
Bromus inermis
Bromus pumpellianus ssp. pumpellianus
Calamagrostis canadensis
Calamagrostis canadensis var. langsdorfii

Calamagrostis montanensis
Calamagrostis purpurascens var. purpurascens
Calamagrostis stricta ssp. inexpansa
Calla palustris
Callitriche palustris
Campanula rotundifolia
Capsella bursa-pastoris
Caragana arborescens
Cardamine oligosperma var. oligosperma
Carex aquatilis
Carex aquatilis var. aquatilis
Carex arcta
Carex atherodes
Carex atratiformis
Carex aurea
Carex backii
Carex bebbii
Carex brunnescens
Carex brunnescens ssp. brunnescens
Carex canescens ssp. canescens
Carex capillaris
Carex chordorrhiza
Carex concinna
Carex crawfordii
Carex cusickii
Carex deweyana var. deweyana
Carex diandra
Carex disperma
Carex duriuscula
Carex eburnea
Carex foenea
Carex gynocrates
Carex inops ssp. heliophila
Carex interior
Carex lasiocarpa
Carex limosa
Carex livida var. radicaulis
Carex magellanica ssp. irrigua
Carex microptera
Carex obtusata
Carex peckii
Carex pellita
Carex praticola
Carex retrorsa
Carex richardsonii
Carex rossii
Carex sartwellii
Carex sartwellii var. sartwellii
Carex siccata
Carex sprengelii
Carex tenera
Carex tenuiflora
Carex torreyi
Carex utriculata
Carex vaginata
Carex xerantica
Castilleja miniata
Castilleja miniata var. fulva
Cerastium arvense
Cerastium fontanum
Cerastium nutans
Chamerion angustifolium
Chenopodiastrum simplex
Chenopodium album
Chenopodium album ssp. album
Chenopodium album ssp. striatum
Chenopodium desiccatum
Chenopodium pratericola
Chrysosplenium tetrandrum
Cicuta bulbifera
Cicuta douglasii
Cicuta virosa
Cinna latifolia
Circaea alpina ssp. alpina
Cirsium arvense
Cirsium drummondii
Cirsium foliosum
Cirsium vulgare
Clematis occidentalis ssp. grosseserrata
Coeloglossum viride var. virescens
Collomia linearis
Comandra umbellata var. umbellata
Comarum palustre
Conyza canadensis
Corallorhiza maculata
Corallorhiza striata var. striata

Corallorhiza trifida
Cornus canadensis
Cornus stolonifera
Corydalis aurea ssp. aurea
Corylus cornuta
Crepis tectorum
Cypripedium passerinum
Cystopteris fragilis
Dactylis glomerata
Danthonia intermedia ssp. intermedia
Danthonia spicata
Dasiphora fruticosa
Delphinium glaucum
Deschampsia cespitosa ssp. cespitosa
Descurainia sophia
Dracocephalum parviflorum
Drosera linearis
Drosera rotundifolia
Drosera rotundifolia var. rotundifolia
Dryas drummondii
Drymocallis convallaria
Dryopteris carthusiana
Dryopteris expansa
Elaeagnus commutata
Eleocharis mamillata ssp. mamillata
Eleocharis palustris
Elymus glaucus
Elymus glaucus ssp. glaucus
Elymus lanceolatus ssp. lanceolatus
Elymus repens
Elymus trachycaulus
Elymus trachycaulus ssp. subsecundus
Elymus trachycaulus ssp. trachycaulus
Epilobium angustifolium
Epilobium ciliatum
Epilobium ciliatum ssp. ciliatum
Epilobium ciliatum ssp. glandulosum
Epilobium halleanum
Epilobium hornemannii ssp. hornemannii
Epilobium palustre
Equisetum arvense
Equisetum fluviatile
Equisetum hyemale
Equisetum hyemale ssp. affine
Equisetum laevigatum
Equisetum palustre
Equisetum pratense
Equisetum scirpoides
Equisetum sylvaticum
Equisetum variegatum ssp. variegatum
Erigeron caespitosus
Erigeron glabellus var. pubescens
Erigeron philadelphicus
Erigeron philadelphicus var. philadelphicus
Eriophorum angustifolium
Eriophorum chamissonis
Eriophorum gracile
Eriophorum sp.
Eriophorum viridicarinatum
Erysimum cheiranthoides
Eurybia conspicua
Eurybia sibirica
Fallopia convolvulus
Festuca rubra ssp. rubra
Festuca saximontana
Festuca trachyphylla
Fragaria vesca var. bracteata
Fragaria virginiana
Fragaria virginiana var. platypetala
Galeopsis bifida
Galium boreale
Galium labradoricum
Galium trifidum
Galium trifidum ssp. trifidum
Galium triflorum
Gentianella amarella ssp. acuta
Geocaulon lividum
Geranium bicknellii
Geum aleppicum
Geum macrophyllum
Geum macrophyllum ssp. macrophyllum
Geum macrophyllum var. perincisum
Geum triflorum var. triflorum
Glyceria borealis
Glyceria grandis var. grandis
Glyceria striata

Gnaphalium uliginosum
Goodyera repens
Grindelia squarrosa var. quasiperennis
Gymnocarpium dryopteris
Halerpestes cymbalaria
Hedysarum alpinum
Hedysarum boreale
Heracleum maximum
Hesperostipa comata ssp. comata
Hesperostipa curtiseta
Heuchera richardsonii
Hieracium canadense
Hieracium umbellatum ssp. umbellatum
Hierochloë hirta ssp. arctica
Hippuris vulgaris
Hordeum jubatum ssp. jubatum
Hypopitys monotropa
Impatiens noli-tangere
Juncus alpinoarticulatus ssp. americanus
Juncus balticus ssp. ater
Juncus bufonius
Juncus dudleyi
Juncus nodosus
Juncus stygius ssp. americanus
Juncus vaseyi
Juniperus communis
Koeleria macrantha
Lactuca serriola
Lappula occidentalis var. occidentalis
Lappula squarrosa
Larix laricina
Lathyrus ochroleucus
Lemna minor
Lepidium densiflorum
Leucanthemum vulgare
Leymus cinereus
Leymus innovatus ssp. innovatus
Limosella aquatica
Linaria genistifolia ssp. dalmatica
Linaria vulgaris
Linnaea borealis
Linum lewisii ssp. lewisii
Listera borealis
Listera cordata
Lithospermum incisum
Lonicera dioica var. glaucescens
Lonicera involucrata
Lotus corniculatus
Lycopodium dendroideum
Maianthemum canadense
Maianthemum racemosum ssp. amplexicaule
Maianthemum stellatum
Maianthemum trifolium
Matricaria discoidea
Medicago lupulina
Medicago sativa
Medicago sativa ssp. falcata
Melica smithii
Melilotus albus
Melilotus officinalis
Mentha arvensis
Menyanthes trifoliata
Mertensia paniculata var. paniculata
Mitella nuda
Moehringia lateriflora
Monarda fistulosa var. menthaefolia
Moneses uniflora
Monotropa uniflora
Muhlenbergia glomerata
Mulgedium pulchellum
Myriophyllum sibiricum
Nassella viridula
Neslia paniculata
Oplopanax horridus
Opuntia fragilis
Orobanche fasciculata
Orthilia secunda
Orthilia secunda var. secunda
Orthocarpus luteus
Oryzopsis asperifolia
Osmorhiza berteroi
Osmorhiza sp.
Oxybasis glauca
Oxytropis campestris var. davisii
Oxytropis deflexa var. sericea
Oxytropis sericea var. speciosa

Oxytropis splendens
Packera paupercula
Packera plattensis
Packera streptanthifolia
Parnassia palustris
Pascopyrum smithii
Pedicularis groenlandica
Pedicularis parviflora
Penstemon gracilis
Penstemon procerus var. procerus
Persicaria amphibia
Persicaria amphibia var. emersa
Persicaria amphibia var. stipulacea
Persicaria hydropiper
Persicaria lapathifolia
Persicaria sp.
Petasites frigidus var. palmatus
Petasites frigidus var. sagittatus
Phalaris arundinacea var. arundinacea
Phleum pratense ssp. pratense
Picea glauca
Picea mariana
Pinus contorta var. latifolia
Piptatheropsis canadensis
Piptatheropsis pungens
Piptatherum pungens
Plantago major
Platanthera aquilonis
Platanthera huronensis
Platanthera obtusata ssp. obtusata
Platanthera orbiculata
Platanthera sp.
Poa alpina ssp. alpina
Poa compressa
Poa glauca
Poa glauca ssp. glauca
Poa nemoralis ssp. interior
Poa palustris
Poa pratensis
Poa pratensis ssp. pratensis
Poa secunda
Polygonum achoreum
Polygonum aviculare
Polygonum douglasii
Polygonum fowleri
Polygonum ramosissimum
Polypodium sibiricum
Populus balsamifera
Populus tremuloides
Potamogeton alpinus
Potamogeton gramineus
Potamogeton pusillus ssp. tenuissimus
Potentilla anserina
Potentilla gracilis var. fastigiata
Potentilla hippiana
Potentilla norvegica
Potentilla pensylvanica
Potentilla pensylvanica var. pensylvanica
Potentilla pulcherrima
Prosartes trachycarpa
Prunus pensylvanica
Prunus virginiana ssp. melanocarpa
Prunus virginiana var. demissa
Puccinellia distans
Puccinellia nuttalliana
Pyrola asarifolia
Pyrola chlorantha
Pyrola minor
Ranunculus acris
Ranunculus aquatilis var. aquatilis
Ranunculus aquatilis var. diffusus
Ranunculus cymbalaria
Ranunculus gmelinii
Ranunculus macounii
Ranunculus rhomboideus
Ranunculus sceleratus
Ranunculus sceleratus var. multifidus
Rhinanthus minor
Rhododendron groenlandicum
Ribes hudsonianum var. hudsonianum
Ribes lacustre
Ribes oxyacanthoides ssp. oxyacanthoides
Rorippa palustris
Rorippa palustris ssp. palustris
Rosa acicularis ssp. sayi
Rosa woodsii ssp. woodsii

Rubus arcticus ssp. acaulis
Rubus chamaemorus
Rubus idaeus ssp. strigosus
Rubus parviflorus var. parviflorus
Rubus pedatus
Rubus pubescens
Rumex britannica
Rumex crispus
Rumex fueginus
Rumex occidentalis
Rumex triangulivalvis
Salix arbusculoides
Salix bebbiana
Salix candida
Salix discolor
Salix drummondiana
Salix interior
Salix lasiandra var. lasiandra
Salix maccalliana
Salix myrtillifolia
Salix pedicellaris
Salix planifolia
Salix prolixa
Salix pseudomonticola
Salix pseudomyrsinites
Salix pyrifolia
Salix scouleriana
Salix serissima
Salsola tragus
Sanicula marilandica
Saxifraga tricuspidata
Schizachne purpurascens
Schoenoplectus tabernaemontani
Scirpus microcarpus
Scutellaria galericulata
Selaginella rupestris
Senecio vulgaris
Shepherdia canadensis
Silene drummondii var. drummondii
Silene latifolia
Sisymbrium altissimum
Sisyrinchium montanum var. montanum
Sium suave
Solidago altissima ssp. gilvocanescens
Solidago bellidifolia
Solidago lepida var. salebrosa
Solidago multiradiata
Solidago simplex var. simplex
Sonchus arvensis
Sonchus arvensis ssp. uliginosus
Sorbus scopulina var. scopulina
Sparganium emersum
Sparganium natans
Sparganium sp.
Sphenopholis intermedia
Spiraea betulifolia ssp. lucida
Spiraea lucida
Spiranthes romanzoffiana
Stachys palustris ssp. pilosa
Stellaria borealis
Stellaria borealis ssp. borealis
Stellaria longifolia
Stellaria longipes var. longipes
Stellaria media
Stuckenia pectinata
Symphoricarpos albus
Symphoricarpos occidentalis
Symphyotrichum boreale
Symphyotrichum ciliolatum
Symphyotrichum ericoides var. pansum
Symphyotrichum laeve var. geyeri
Symphyotrichum lanceolatum var. hesperium
Symphyotrichum puniceum var. puniceum
Tanacetum vulgare
Taraxacum officinale
Thalictrum venulosum
Thinopyrum intermedium
Thlaspi arvense
Tofieldia pusilla
Tragopogon dubius
Triantha glutinosa
Trifolium hybridum
Trifolium pratense
Trifolium repens
Triglochin maritima
Triglochin palustris

Tripleurospermum inodorum
Triticum aestivum
Turritis glabra
Typha latifolia
Urtica dioica ssp. gracilis
Utricularia intermedia
Vaccinium caespitosum
Vaccinium membranaceum
Vaccinium myrtilloides
Vaccinium oxycoccos
Vaccinium vitis-idaea ssp. minus
Valeriana dioica ssp. sylvatica
Verbascum thapsus
Veronica beccabunga ssp. americana
Veronica peregrina var. xalapensis
Veronica scutellata
Viburnum edule
Vicia americana
Viola adunca var. adunca
Viola canadensis var. rugulosa
Woodsia scopulina
Zizia aptera

Bryophytes

Aulacomnium palustre
Ceratodon purpureus
Funaria hygrometrica
Hylocomium splendens
Marchantia polymorpha
Pleurozium schreberi
Polytrichum commune
Preissia quadrata
Ptilium crista-castrensis
Sphagnum magellanicum
Sphagnum sp.

Lichens

Bryoria capillaris
Bryoria fuscescens
Bryoria lanestris
Bryoria sp.
Caloplaca cerina
Caloplaca holocarpa
Cetraria ericetorum
Cladina rangiferina
Cladina sp.
Cladonia carneola
Cladonia pocillum
Cladonia sp.
Collema furfuraceum
Diploschistes muscorum
Enchylium tenax
Endocarpon pusillum
Evernia mesomorpha
Flavocetraria cucullata
Hypogymnia occidentalis
Hypogymnia physodes
Icmadophila ericetorum
Lathagrium undulatum var. granulosum
Lecanora impudens
Leptogium saturninum
Leptogium teretiusculum
Lobaria pulmonaria
Melanelixia subaurifera
Melanohalea exasperatula
Melanohalea septentrionalis
Melanohalea subolivacea
Nephroma resupinatum
Parmelia fraudans
Parmelia sulcata
Parmeliopsis ambigua
Parmeliopsis hyperopta
Peltigera aphthosa
Peltigera britannica
Peltigera didactyla
Peltigera elisabethae
Peltigera extenuata
Peltigera lepidophora
Peltigera leucophlebia
Peltigera malacea
Peltigera neckeri
Peltigera sp.
Phaeophyscia orbicularis
Phaeophyscia sciastra
Phaeophyscia sp.
Physcia adscendens
Physcia aipolia
Physcia alnophila

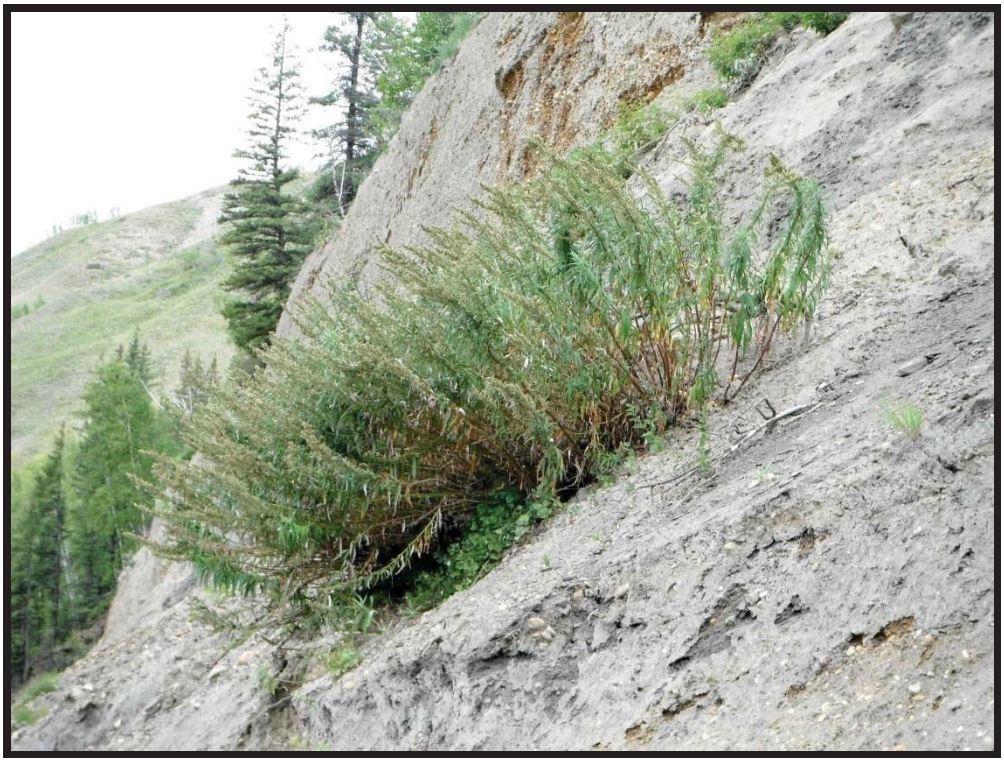
Physcia biziana
Physcia caesia
Physcia phaea
Physcia stellaris
Physcia tenella
Physconia muscigena
Physconia perisidiosa
Platismatia glauca
Ramalina dilacerata
Ramalina obtusata
Ramalina sinensis
Rinodina sp.
Stereocaulon tomentosum
Tuckermannopsis americana
Tuckermannopsis sp.
Umbilicaria americana
Usnea cavernosa
Usnea filipendula
Usnea lapponica
Usnea scabrata
Usnea sp.
Usnea substerilis
Vulpicida pinastri
Xanthomendoza fallax
Xanthoparmelia wyomingica
Xanthoria candelaria

6.3. Appendix 3: Species Accounts for Rare Plant Taxa Found During Preconstruction Surveys

6.3.1. Artemisia herriotii (Herriot's sage)

Herriot's sage (Figure 3) is an aromatic perennial herb in the Asteraceae (sunflower family) that grows on plains, dry ridges, and gravelly shores (Gray & Fernald 1950). In B.C., Herriot's sage is known only from the Peace River area (BCCDC 2018). The taxon ranges across northern Alberta, and south in the U.S. to Minnesota and South Dakota (Gray & Fernald 1950). Herriot's sage is ranked S3? (Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2018). An assessment of global rank for Herriot's sage has not yet been published.

Figure 3: *Artemisia herriotii* (Herriot's sage)



It should be noted that the taxonomy of Herriot's sage is uncertain, and little is known about the taxon's precise habitat requirements and global range. Herriot's sage is not recognized in Illustrated Flora of British Columbia (Douglas et al. 1998). The best published description of Herriot's sage dates from 1950 (Gray & Fernald 1950), and the species is also briefly mentioned in the Flora of Canada (Scoggan 1979). The name Herriot's sage is listed as a synonym of Aleutian mugwort (*Artemisia tilesii* ssp. *elatior*) in Flora of Alberta (Moss & Packer 1983) and in Rare Vascular Plants of Alberta (Kershaw et al. 2001). Herriot's sage is also listed as a synonym of western mugwort (*Artemisia ludoviciana* ssp. *ludoviciana*) in the Flora of North America (Shultz 2006), and on the NatureServe Explorer website (NatureServe 2018).

Four new sites of Herriot's sage were discovered in the study area in 2018. Two new occurrences were recorded along the south shoreline of the Peace River, the first just downstream of the confluence with the Pine River, and the second approximately 5.5 kilometres upstream from the Pine. Seven Herriot's

sage plants were found at the first site, in an area of roughly 5 square metres in dense riparian shrub; four Herriot's sage were found at the second site, in an area of approximately two square metres and growing in an open balsam poplar (*Populus balsamifera*) woodland on a cobble floodplain.

Two other new sites were determined to be extensions of previously reported nearby occurrences. At Cache Creek just north of Highway 29, two Herriot's sage plants were located on an active shrubby floodplain, approximately 87 metres and 160 metres upstream of an occurrence recorded in 2016. Additionally, on the north bank of the Peace River just downstream from the confluence of the Moberly River, a linear patch of Herriot's sage was observed growing on steep, loose soil above a road cut. At least seven large flowering plants were mapped along a 370 metre stretch of road. This patch is approximately 950 metres downstream from a large occurrence reported in 2011 (now largely extirpated due to dam construction).

For the entire Site C Regional Assessment Area (RAA), there are currently 46 reported occurrences of Herriot's sage (comprising 78 patches). An estimated 20,000 plants have been observed in an approximate total area of 24.9 hectares. Herriot's sage has been found in a variety of habitats, including steep loose-soiled open river banks and creek draws, moist openings on wooded slopes, and flat, open to forested floodplains and gravel bars of rivers and large creeks. Many of the occurrences on river banks and slopes are quite large and Herriot's sage is a dominant component of the local plant community. The occurrences found on floodplains and gravel bars tend to be small. Plants commonly found growing with Herriot's sage include: balsam poplar, alder (*Alnus* spp.), willow (*Salix* spp.) and prairie sagewort (*Artemisia frigida*), along with a wide assemblage of other native trees, shrubs, and forbs. Non-native forbs and occasionally noxious weeds are also frequently noted at Herriot's sage occurrences, likely because these sites often occur in areas of disturbance to the overall plant community (actively slumping soils, active cobble bars and floodplains, etc.).

6.3.2. Atriplex gardneri var. gardneri (Gardner's sagebrush)

Gardner's sagebrush (Figure 4), a small perennial sub-shrub with a woody base, is a member of the Chenopodiaceae (goosefoot family). Variety *gardneri* is found on fine-textured saline soils and dry grassy slopes in the Great Plains and Intermountain regions of central North America (Douglas et al. 1998; Welsh 2003). In B.C., Gardner's sagebrush is known only from the Peace River region (BCCDC 2018). Variety *gardneri* can be found as far east in Canada as southern Manitoba, and as far south as Utah and Colorado in the United States (Welsh 2003; NatureServe 2018).

Gardner's sagebrush has a rank of S2 (Imperilled) in B.C. and is on the province's Red list (BCCDC 2018). The taxon has a global classification of G5TNR (*Atriplex gardneri* as a species is ranked globally Secure, but variety *gardneri* has not yet been given a global rank). Five other sub-national jurisdictions provide a rank for Gardner's sagebrush: Saskatchewan, Manitoba, and Wyoming class the species as S5 (Secure), and Utah and Nebraska class the species as S1 (Critically Imperilled) (NatureServe 2018).

Figure 4: *Atriplex gardneri* var. *gardneri* (Gardner's sagebrush)

One occurrence of Gardner's sagebrush was discovered in the study area in 2018. This is the first new record of the taxon for B.C. since 1995, and only the fourth record for the province. The plants were found growing on a steep grassland slope and down into a road cut along a proposed access road north of the Peace River. An estimated 50 to 250 individuals were observed in an area of 618 square metres; most plants were in bloom, but only male flowers were noted. Native grasses and forbs comprised the dominant associated species in the grassland portion of the occurrence, however, on the road cut portion the Gardner's sagebrush was growing on bare soil and was the principal species present.

In total, there are currently four reported occurrences of Gardner's sagebrush in the RAA. In addition to the 2018 occurrence, there are three older records from 60 kilometres east near the Alberta border. No information on number of individuals or areal coverage is available for these three sites. All four of the Gardner's sagebrush occurrences are situated on open, dry, south-facing grassland slopes. The dominant associated species include native grasses such as wildrye (*Elymus* spp.), junegrass (*Koeleria macrantha*), and green needlegrass (*Nassella viridula*), and native forbs such as prairie sagewort and aster (*Symphyotrichum* spp.).

6.3.3. Carex backii (Back's sedge)

Back's sedge (Figure 5), a small tufted perennial in the Cyperaceae (sedge family), is found in a wide variety of dry to moist, open to forested habitats across northern North America (Douglas et al. 1998; Ball & Reznicek 2002; NatureServe 2018). Prior to the Site C rare plant survey work, the sedge had only

been reported from two locations in the western interior of B.C. (BCCDC 2018; Klinkenberg 2018). Back's sedge is distributed across Canada as far east as New Brunswick and is found in the U.S. as far south as Utah, Colorado, Iowa, and New York state (Ball & Reznicek 2002; NatureServe 2018).

Figure 5: *Carex backii* (Back's sedge)

In B.C. Back's sedge is ranked S2S3 (Imperilled and Vulnerable) and is on the Blue list for the province (BCCDC 2018). The species has a global status of G5 (Secure). Sub-national rankings for the sedge vary: S5 (Secure) in Saskatchewan; S4 (Apparently Secure) in Manitoba and Ontario; S3 (Vulnerable) in Alberta, Québec, North Dakota, Vermont and Maine; S2 (Imperilled) in Idaho, Montana, Wyoming, New York, and New Hampshire; S1 (Critically Imperilled) in New Brunswick, Utah, Iowa, Wisconsin, Massachusetts and Connecticut; SH (Possibly Extirpated) in New Jersey; and SX (Presumed Extirpated) in Pennsylvania (NatureServe 2018).

Two new occurrences of Back's sedge were located in the study area in 2018. At the first occurrence, two plants in bloom were discovered along small trails approximately 28 metres apart at Watson Slough. Both plants were growing in shade underneath dense prickly rose (*Rosa acicularis*), along with native and non-native herbs. The second occurrence of Back's sedge was found roughly two kilometres to the north, in full sun in an open swale next to a plowed field. A cluster of three plants were found in one patch, and a fourth plant was observed approximately 48 metres to the south; all plants were in fruit

and insect damage was noted in the inflorescences. The dominant associated species at this site was the non-native grass smooth brome (*Bromus inermis*).

For the entire Site C RAA, there are currently four reported occurrences of Back's sedge (comprising six patches). In addition to the two 2018 occurrences, there is one collection from a shrub-grassland hillside above the Halfway River and one collection from a shrubby, moist draw east of Bear Flat. No information on total number of individuals or areal coverage is available for these two sites. For all four reported occurrences, the habitats are quite variable, ranging from full sun on level ground to full shade on shrubby slopes. Associated species are also diverse and include native shrubs and native and weedy herbs.

6.3.4. Carex sprengelii (Sprengel's sedge)

Sprengel's sedge (Figure 6) 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. 1998; Ball & Reznicek 2002). Sprengel's sedge was only known from three locations in B.C. prior to the Site C rare plant survey work: two near Williams Lake, and one in the Peace River region (BCCDC 2018). 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 & Reznicek 2002; NatureServe 2018).

Figure 6: *Carex sprengelii* (Sprengel's sedge)

Sprengel's sedge has a rank of S3 (Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2018). Globally, the taxon is classed G5 (Secure). Across much of North America the taxon is classed as Secure (S5) or Apparently Secure (S4), but is considered rare on the western, southern, and eastern edges of its range: S3 (Vulnerable) in Québec, Pennsylvania, Illinois, Montana and Wyoming; S2 (Imperilled) in New Brunswick, Maine, Ohio, Missouri, and Colorado; S1 (Critically Imperilled) in Alaska, and SH (Possibly Extirpated) in Delaware (NatureServe 2018).

Two new sites of Sprengel's sedge were recorded in 2018 in the study area. One new occurrence was discovered on a slope north of the Peace River west of Wilder Creek, along a small animal trail through open shrubby woodland. Here, one plant in early fruit was found growing with young aspen (*Populus tremuloides*) trees, native shrubs such as prickly rose and prairie saskatoon (*Amelanchier alnifolia*), and a mix of native and non-native herbs. The second new site of Sprengel's sedge was determined to be an extension of an occurrence east of Bear Flat that was first reported in 2015. This new site also consisted of one blooming plant, growing in dense herbaceous vegetation in the shade of young aspen and native shrubs in a moist draw.

In total, there are currently four reported occurrences of Sprengel's sedge in the RAA. Three of these occurrences (comprising four patches) are situated between Bear Flat and Wilder Creek, on south-facing shrubby slopes above the Peace River. 50 or fewer plants have been observed growing in a total estimated area of 15 square metres. All of the sites are moist to mesic, and the Sprengel's sedge plants are generally found in relatively shaded microhabitats. Associated species are similar, including prickly rose, prairie saskatoon, and western snowberry (*Symphoricarpos occidentalis*) as well as a diverse assemblage of native and weedy herbs. The fourth occurrence of Sprengel's sedge is over 80 kilometres southwest, in moist balsam poplar (*Populus balsamifera*) woods north of the Moberly River. No clear information is available on current number of individuals or areal coverage (BCCDC 2018).

6.3.5. Carex torreyi (Torrey's sedge)

Torrey's sedge (Figure 7) is a soft-hairy perennial in the Cyperaceae (sedge family) found growing in montane meadows, shrublands, and moist woods (Douglas et al. 1998; Ball & Reznicek 2002). In B.C. the species is found only in the Peace River region (BCCDC 2018; Klinkenberg 2018). Globally, Torrey's sedge is distributed east across Canada to Ontario, and south in the U.S. as far as Colorado, South Dakota, Minnesota, and Wisconsin (NatureServe 2018).

Torrey's sedge is ranked S2 (Imperilled) in B.C. and is on the province's Red list (BCCDC 2018). The species is ranked G4 (Apparently Secure) globally. Sub-national ranks vary—Torrey's sedge is classed as S4 (Apparently Secure) in Alberta and Saskatchewan, S3 (Vulnerable) in Manitoba and Montana, S2 (Imperilled) in Ontario and Wyoming, and S1 (Critically Imperilled) in Colorado and Wisconsin (NatureServe 2018).

Figure 7: *Carex torreyi* (Torrey's sedge)

Two new sites of Torrey's sedge were discovered in the study area in 2018. One new occurrence, consisting of two fruiting plants, was found west of Wilder Creek on an open, shrubby, south-facing slope north of the Peace River. The Torrey's sedge plants were growing in full sun near a road track among dense weedy grasses such as smooth brome and Kentucky bluegrass (*Poa pratensis*). The second new site was determined to be an extension to an occurrence first reported in 2005 east of Bear Flat. A patch of five Torrey's sedge plants were observed in dense vegetation in a cleared area along a fence line.

In total, there are currently eight reported occurrences (comprising 13 patches) of Torrey's sedge in the RAA. An estimated 360 plants have been observed growing in a total area of approximately 390 square metres. Seven of the occurrences are situated near the Peace River; the eighth occurrence (not reconfirmed since the 1960 report) is located more than 45 kilometres south, near Dawson Creek. All of the occurrences were found on mesic south-facing slopes in open shrub grassland complexes. Associated species are similar at the sites and include native shrubs such as prickly rose, prairie saskatoon, and western snowberry; native and non-native graminoids such as smooth brome, bluegrass (*Poa* spp.), and sedge (*Carex* spp.); and a diverse mix of native and weedy forbs.

6.3.6. Carex xerantica (dry-land sedge)

Dry-land sedge (Figure 8), a perennial herb with silvery-gold heads of the Cyperaceae (sedge family), is found in xeric steppe and montane habitats such as dry grasslands and hillsides, open forests, and rock

outcrops (Douglas et al. 1998; Ball & Reznicek 2002). Dry-land sedge has been collected in the Peace River area in B.C., as well as scattered locations in the central interior and central Rocky Mountains (BCCDC 2018; Klinkenberg 2018). There is some disagreement on the taxon's global range. Douglas et al. (1998) note that dry-land sedge extends east from B.C. to Manitoba, and south to Minnesota and Nebraska; Ball & Reznicek (2002) show the species occurring as far east as Ontario and also in Wyoming; and Natureserve (2018) reports the sedge from as far north as Yukon and Alaska, and as far south as Arizona and New Mexico.

Figure 8: *Carex xerantica* (dry-land sedge)

Dry-land sedge is classed as S3? (Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2018). Although globally the taxon is considered Secure (G5), most jurisdictions that provide a rank for the species indicate some degree of rarity: S1 (Critically Imperilled) in Alaska, Yukon and Wyoming; S2 (Imperilled) in Manitoba, Ontario, Nebraska, and New Mexico; and S3 (Vulnerable) in Minnesota. Alberta and Saskatchewan rank the species S4 (Apparently Secure) (NatureServe 2018).

Two new occurrences of dry-land sedge were documented in the study area in 2018. Both were located west of Wilder Creek, on dry shrub-grassland slopes above the Peace River. The first occurrence extends in a narrow band near the crest of a dry ridge below a plowed field; another patch was located farther west along the same ridge, and a single plant was found 540 metres northwest in a grassland remnant between plowed fields. An estimated total of 250 to 1,000 fruiting dry-land sedge plants were observed in an area of 573 square metres. The second, much smaller occurrence, was discovered three kilometres to the west. Here, six fruiting dry-land sedge plants were found in three patches within an area of

approximately 60 square metres. This occurrence is on steep, dry grassland just above a road track. Associated species at both sites included native shrubs and native and weedy herbs.

In addition, an occurrence of dry-land sedge first reported in 2012 was resurveyed in 2018, and both the number of individuals and the areal coverage were substantially increased.

For the entire RAA, there are currently 13 reported occurrences of dry-land sedge (comprising 29 patches). An estimated 8,700 plants have been observed growing in an approximate total area of 12.6 ha. Twelve of the occurrences were found on dry, south-facing slopes, and one was found on a dry bench. The dry-land sedge sites are invariably located in xeric grassland habitat, generally in the vicinity of low shrub thickets. The dominant associated species include native shrubs such as prairie saskatoon, prickly rose, and snowberry (*Symphoricarpos* spp.), and native grasses such as needlegrasses (*Achnatherum* spp. and *Nassella viridula*), needle-and-thread grass (*Hesperostipa comata*), and short-awned porcupinegrass (*Hesperostipa curtiseta*). A diverse mix of native and non-native forbs are also present at dry-land sedge occurrences.

6.3.7. Cirsium drummondii (Drummond's thistle)

Drummond's thistle (Figure 9) is a stout biennial herb of the Asteraceae (sunflower family). The taxon grows in dry to moist soils of pastures, meadows, forest openings, prairies, and roadsides, in steppe and montane regions of north-central North America (Douglas et al. 1998; Keil 2006). In B.C., the only recent records of Drummond's thistle are from the Peace River region (BCCDC 2018). Drummond's thistle ranges north into Northwest Territories and east across the Canadian prairie provinces to Ontario; the thistle is also found in the U.S. states of South Dakota and Wyoming. Historically, Drummond's thistle has been collected in Colorado as well (Keil 2006; NatureServe 2018).

Drummond's thistle is ranked S3 (Vulnerable) in B.C. and is on the provincial Blue list (BCCDC 2018). The taxon is classed G5 (Secure) globally, although the thistle's sub-national rankings vary: S1 (Critically Imperilled) in Ontario, S2 (Imperilled) in Wyoming, S3 (Vulnerable) in Saskatchewan, S4 (Apparently Secure) in Manitoba and South Dakota, and S5 (Secure) in Alberta (Keil 2006; NatureServe 2018).

Ten new sites of Drummond's thistle were observed in the study area in 2018. One new occurrence was discovered along the south side of Highway 29 just east of Farrell Creek. Here, eight rosettes were growing in a weedy, disturbed road verge. The dominant associated species was the non-native grass smooth brome.

The remaining nine new sites of Drummond's thistle were determined to be extensions of previously-reported occurrences. A large occurrence, situated five kilometres east of Farrell Creek and first recorded in 2012, was greatly expanded: three patches were extended, and two new patches were added. An estimated 150 Drummond's thistle plants were observed in 2018 along an approximately 3.5 kilometre section of Highway 29. Associated species include native trees and shrubs, and native and non-native herbs. The invasive noxious weed Canada thistle (*Cirsium arvense*) was also present in one of the patches.

Figure 9: *Cirsium drummondii* (Drummond's thistle)

Another two new patches of Drummond's thistle were added to an occurrence from 2012 between Cache Creek and Watson Slough. One new plant was discovered in a road verge, and 5 new plants were observed in a shrubby swale between a woodland and a plowed field. Native shrubs and smooth brome dominated the roadside habitat; native shrubs and a diverse assemblage of native and weedy herbs were present in the swale. Canada thistle was also observed nearby at the edge of the plowed field. A further two new patches of Drummond's thistle found east of Bear Flat were combined with an occurrence recorded in 2005. Five rosettes were noted in dense grass in a cleared area along a fence line, and one plant was spotted on the open shore of a small lake. Smooth brome dominated the fence line habitat; the lake shore supported a very diverse plant community.

In total, there are currently 17 reported occurrences (comprising 35 patches) of Drummond's thistle in the RAA. An estimated 500 plants have been recorded in an approximate total area of 3.5 hectares. Twelve of these occurrences are recent records (since 2005) and are clustered in four locations, generally along the Peace River corridor from Farrell Creek to the Alberta border. The five remaining occurrences are older records (pre-1970) which have not been reconfirmed—one is from the Hudson Hope area and four are from the Dawson Creek area. The majority of the 17 occurrences of Drummond's thistle are small (1 to 50 individuals observed); only two large occurrences, along Highway 29, contain an estimated 50 to 250 individual plants. The Drummond's thistle occurrences are all situated in moist to mesic, generally sunny habitats with a dense cover of ground vegetation. The dominant associated

species are similar at all sites: native trees and shrubs, and a wide mix of herbs which are frequently not native species (likely due in part to the various types of disturbance present in locations which support Drummond's thistle).

Of note, the exact location of any one Drummond's thistle occurrence may gradually shift over time since the species is a biennial. This shifting has been observed at the occurrence at Watson Slough as well as the occurrence east of Bear Flat. For the same reason, the number of Drummond's thistle individuals present in any one year at an occurrence can also fluctuate compared to the relatively stable numbers of individuals found at occurrences of perennial taxa.

Threats to Drummond's thistle are numerous. Besides the overarching threat of clearing related to the construction of the Site C dam and reservoir, extensive insect damage has been observed in developing seed heads at two of the occurrences; in addition, as a species of thistle, the plant can suffer from the general misconception that it is an invasive weed which needs to be eradicated.

6.3.8. Oxytropis campestris var. davisii (Davis' locoweed)

Davis' locoweed (Figure 10) is a small perennial in the Fabaceae (pea family) that grows on stream gravels and in mesic to dry meadows and forest openings in the montane zone (Elisens & Packer 1980; Welsh 1991; Douglas et al. 1998). Variety *davisii* is found in northeast B.C. where it can be locally abundant, and is also reported from Alberta (Welsh 1991; BCCDC 2018; NatureServe 2018). Davis' locoweed is classed S3 (Vulnerable) by the BCCDC, and is on the provincial Blue list (BCCDC 2018). Globally, the variety is also ranked as Vulnerable (T3), due to its limited range. Alberta lists Davis' locoweed as S2? (Imperilled), and the Northwest Territories has not yet ranked the taxon (NatureServe 2018).

One very large new occurrence (comprising two patches) of Davis' locoweed was observed in the study area in 2018. An estimated 55,000 individuals were found in a total estimated area of 33.3 hectares on the south shore of the Peace River between Fort St. John and Taylor, BC. The Davis' locoweed was growing on an open gravel floodplain with young balsam poplar saplings and scattered native and weedy herbs.

In addition, six previously-reported occurrences were resurveyed in 2018. At two of these sites, both the estimated areal coverage and the estimated number of Davis' locoweed plants were substantially increased; at the remaining four sites, the areal coverage was only slightly increased and the estimated number remained the same.

For the entire RAA, there are currently 14 reported occurrences of Davis' locoweed (comprising 16 patches). An estimated 66,000 plants have been recorded in an approximate total area of 10.3 hectares. Many of the sites contain hundreds or thousands of individuals and cover relatively large areas of ground. All 14 occurrences have been mapped within 500 metres of the current river shoreline, on non-active cobble bars, floodplains or river benches which have begun to revegetate. Habitat at all the sites is similar, consisting of open, often bare cobble-silt substrates and young to medium-aged balsam poplar. Other associated species include a relatively sparse cover of native and weedy herbs such as

yellow mountain-avens (*Dryas drummondii*), sweet-clover (*Melilotus* spp.), quackgrass and slender wheatgrass (*Elymus* spp.).

Figure 10: *Oxytropis campestris* var. *davisii* (Davis' locoweed)

1.1.1 6.3.9. Penstemon gracilis (slender penstemon)

Slender penstemon (Figure 11) is a perennial herb of the Plantaginaceae (plantain family)—formerly of the Scrophulariaceae (figwort family)—that inhabits mesic to dry plains and grasslands (Hitchcock et al. 1959; Douglas et al. 1998; Freeman & Rabeler 2016). The species is commonly found throughout much of the Great Plains and Midwestern regions of Canada and the U.S., but in B.C. is restricted to the Peace River area (Hitchcock et al. 1959; BCCDC 2018; NatureServe 2018).

Slender penstemon is ranked S3? (Vulnerable) in B.C., and is on the province's Blue list (BCCDC 2018). The species' global status is G5 (Secure) (NatureServe 2018). Of the remaining 17 jurisdictions where it is known to occur, only four rank slender penstemon with any degree of rarity—Manitoba and Wyoming as S3 (Vulnerable), and Iowa and Michigan as S1 (Critically Imperilled) (NatureServe 2018).

Eight new sites of slender penstemon were discovered in the study area in 2018. A large occurrence was recorded east of Farrell Creek on a south-facing slope above Highway 29. 250 to 1,000 plants were found growing on steep, dry grassland in an estimated area of 1,413 square metres. Associated species included low native shrubs such as prairie saskatoon and kinnikinnick (*Arctostaphylos uva-ursi*), and a diverse mix of native herbs including junegrass, prairie crocus (*Anemone patens*) and wild bergamot (*Monarda fistulosa*). A second new occurrence (comprising four patches) was observed between Bear

Flat and Wilder Creek. Fewer than 50 slender penstemon plants were found scattered on a steep, dry shrub-grassland hillside above a road track. The total estimated areal coverage at this occurrence was 77 square metres, and associated species consisted of prairie saskatoon and native grasses and forbs.

The remaining three new sites of slender penstemon were determined to be extensions of an occurrence first reported in 2016. One small and two large patches were observed along a narrow south-facing ridge below a plowed field west of Wilder Creek. 1,000 to 2,500 plants were recorded in an estimated total area of 10,402 square metres of dry shrub-grassland habitat. Associated species were similar to the previous two sites, however non-native weeds such as Dalmatian toadflax (*Linaria genistifolia*) and yellow salsify (*Tragopogon dubius*) were also present.

In total, there are currently 25 reported occurrences of slender penstemon in the RAA (comprising 49 patches). An estimated 3,900 plants have been documented in an approximate total area of 4.1 hectares. All of the occurrences were found on dry, south-facing slopes and invariably located in xeric grassland habitat, generally in the vicinity of low shrub thickets. Dominant associated species include the native shrub prairie saskatoon, native graminoids such as junegrass and wildrye, and a diverse mix of native and non-native forbs.

Figure 11: *Penstemon gracilis* (slender penstemon)

6.3.10. Physcia biziana (frosted rosette)

Frosted rosette—a small grayish foliose lichen—is distinguished by the powdery coating that covers its upper surface (Figure 12). 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; Brodo et al. 2001). In B.C., frosted rosette is reported from numerous locations in the south-central section of the province (Goward et al. 1994; Brodo et al. 2001; CNALH 2018). Four sites have been reported in other parts of Canada—three collections in the Rocky Mountains of Alberta, and one occurrence on Lake Ontario. Frosted rosette is most common, however, from the central and western U.S. states south into central Mexico; in addition, one occurrence has been observed in Vermont in the eastern U.S. The taxon has been documented from scattered locations in Eurasia and Africa as well (CNALH 2018).

Figure 12: *Physcia biziana* (frosted rosette)

Frosted rosette has a rank of S3 (Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2018). The species is also considered rare in Alberta (S2 Imperilled) and in Ontario (S1S3 Critically Imperilled or Vulnerable). Frosted rosette has not been ranked by other Canadian or U.S. jurisdictions; globally the taxon is considered Secure (G5) (NatureServe 2018).

Five new sites (comprising nine patches) of frosted rosette were recorded in the study area in 2018. Three thalli were observed on aspen trees in shrubby woodland north of Highway 29 at a small occurrence east of Lynx Creek. A second occurrence was documented east of Farrell Creek, where nine thalli were found growing on aspen trunks in a stretch of mixed woodland along Highway 29. A third occurrence, in a remnant woodland between plowed fields east of Wilder Creek, comprised fewer than 50 frosted rosette thalli growing on aspen trees and native shrubs. The fourth new occurrence consisted of a single thallus found on aspen bark between a native grassland flat and a small patch of mixed mesic woods. The final new site of frosted rosette documented in 2018 was determined to be an extension of

an occurrence first reported in 2016. Four thalli were observed in two patches on aspen trees west of Wilder Creek.

In the entire RAA, there are currently 16 reported occurrences of frosted rosette (comprising 28 patches). An estimated 245 individual thalli have been documented, however site delineation has been cursory and the actual size of each occurrence is unknown. The taxon is always found growing on the bark of native trees and shrubs, generally in part shade on live aspen trunks but also on live or dead twigs of prairie saskatoon, willow, alder, and choke cherry (*Prunus virginiana*), occasionally in full sun. The surrounding habitat usually consists of mesic woodland, but frosted rosette has also been observed in open, dry shrubland as well as wetland thickets. Dominant associated species at the micosite level include various species of rosette (*Physcia* spp.) and a variety of other epiphytic lichens.

This frosted rosette occurrence group in the B.C. Peace area represents a 700 kilometre northward range extension in the province of B.C., and a 400 kilometre extension of the taxon's mapped global range (CNALH 2018).

6.3.11. Physcia stellaris (immaculate rosette)

Immaculate rosette (Figure 13) is a small foliose lichen that forms light grey circular clusters 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, both outward-looking rosette (*Physcia alnophila*) and hoary rosette (*Physcia aipolia*), and must be separated from these taxa by a chemical test (Goward et al. 1994; Brodo et al. 2001; Brodo 2016). In B.C., 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 2018). The taxon's global range encompasses much of North America, and also extends to Eurasia and Australia (CNALH 2018).

Immaculate rosette is ranked S3 (Vulnerable) in B.C., and is on the province's Blue list (BCCDC 2018). The taxon is classed S3S5 (Vulnerable or Secure) in Alberta, S3S4 (Vulnerable or Apparently Secure) in Saskatchewan, S4S5 (Apparently Secure or Secure) in New Brunswick, and S5 (Secure) in Ontario and Nova Scotia. Immaculate rosette is considered to be globally Secure (G5) (NatureServe 2018).

No new collections of immaculate rosette were made in the study area in 2018. In total, there are currently 16 reported occurrences in the RAA (comprising 19 patches). Because positive identification of immaculate rosette requires a chemical test, it is not possible to estimate number of individuals in the field. Immaculate rosette is generally found growing in part shade on bark or twigs of live or dead deciduous trees, including aspen, balsam poplar, willow, and paper birch (*Betula papyrifera*). The surrounding habitat usually consists of mesic woodland; dominant associated species at the microsite level include various species of rosette (*Physcia* spp.) and a variety of other epiphytic lichens.

Figure 13: *Physcia stellaris* (immaculate rosette)

6.3.12. Piptatheropsis canadensis (Canada ricegrass)

Canada ricegrass (Figure 14) is a delicate perennial bunchgrass of the Poaceae (grass family). The species grows in grasslands and open woods on dry to moist, sparsely-vegetated soils which are usually sandy or rocky. Canada ricegrass ranges from Alberta east across Canada to Newfoundland, and south into the U.S. northeast and Great Lakes regions (Lapin 2004; Barkworth 2007). Prior to 2018, no verified extant occurrences of Canada ricegrass were known from B.C. (BCCDC 2018). Of note: the genus *Piptatheropsis* was only recently described (Romaschenko et al. 2011), therefore Canada ricegrass is still referred to by the name *Piptatherum canadense* in some important literature (Lapin 2004; Barkworth 2007; NatureServe 2018).

Canada ricegrass is ranked SH (Possibly Extirpated) in B.C., and is on the province's Red list (BCCDC 2018). The taxon's global classification is G4G5 (Apparently Secure or Secure) (NatureServe 2018). However, although Canada ricegrass is widely distributed across North America, the species has few reported occurrences and most of these are small (frequently less than 100 individuals at a site) (Lapin 2004). Accordingly, Canada ricegrass is generally classed as rare sub-nationally: SH (Possibly Extirpated) in Prince Edward Island; S1 (Critically Imperilled) in Manitoba, Wisconsin, West Virginia, and New Hampshire; S2 (Imperilled) in Alberta, Saskatchewan, New Brunswick, Nova Scotia, Newfoundland, Minnesota, Michigan, New York, and Maine; and S4 (Apparently Secure) in Ontario and Québec (NatureServe 2018).

Figure 14: *Piptatheropsis canadensis* (Canada ricegrass)

One occurrence of Canada ricegrass was found in the study area in 2018, between a road track and a plowed field west of Wilder Creek. This occurrence is also the only current record of the taxon in the RAA, and the only verified record in B.C. Eight plants were recorded scattered over an estimated area of 41 square metres in a small segment of remnant shrub-grassland. Dominant associated species included the native shrubs prairie saskatoon and soopolallie (*Shepherdia canadensis*), and native and non-native grasses such as spreading needlegrass (*Achnatherum richardsonii*), false melic (*Schizachne purpurascens*), and Kentucky bluegrass.

6.3.13. Polypodium sibiricum (Siberian polypody)

Siberian polypody (Figure 15) is a leathery-leaved evergreen fern in the Polypodiaceae (polypody family). The taxon grows in montane regions on dry to mesic rock outcrops (Haufler et al. 1993; Douglas et al. 1998). In B.C., prior to the Site C work in 2011, Siberian polypody was only known from two unconfirmed reports to the north and west of Fort St. John: one near the upper Beatton River and one near Williston Reservoir (BCCDC 2018). The fern's global range extends across large portions of the boreal regions of Canada, Alaska, and Asia. The species has also been found in southern Greenland (Haufler et al. 1993).

In B.C., Siberian polypody is classed S3 (Vulnerable) and is on the Blue list for the province (BCCDC 2018). Although Siberian polypody is tentatively considered Secure globally (G5?), most of the North American jurisdictions that report a status for the taxon rank it as rare: SH (Possibly Extirpated) in Québec; S1

(Critically Imperilled) in Ontario; S2 (Imperilled) in Yukon and Alaska; and S3 (Vulnerable) in Alberta. Northwest Territories and Saskatchewan rank the fern as S4 (Apparently Secure) (NatureServe 2018).

Figure 15: *Polypodium sibiricum* (Siberian polypody)

No new patches of Siberian polypody were found in the study area in 2018. In total, there are currently four reported occurrences of Siberian polypody in the RAA (comprising 15 patches). An estimated 1,900 individuals have been documented in an approximate total area of 11,695 square metres. All of the occurrences are situated on forested cliffs and outcrops where the Siberian polypody plants are found growing in cracks in bedrock, usually in shaded locations. Associated species at the microsite level include fragile fern (*Cystopteris fragilis*) and Rocky Mountain woodsia (*Woodsia scopulina*), and the overstory is dominated by aspen, paper birch, and white spruce (*Picea glauca*). In 2018 it was observed that a portion of the large occurrence discovered on Portage Mountain in 2012 (Hilton et al. 2013) appears to have been extirpated by aggregate extraction work for the Project.

6.3.14. Ramalina sinensis (threadbare ribbon)

Threadbare ribbon (Figure 16) 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. In B.C., threadbare ribbon has been collected in a few locations in the northeast part of the province (Goward 1999; Brodo et al. 2001). Globally, the species is reported from across much of North America as well as a few sites in Eurasia and one in Australia (CNALH 2018).

Figure 16: *Ramalina sinensis* (threadbare ribbon)

Threadbare ribbon has a rank of S2S3 (Imperilled and Vulnerable) in B.C., and is on the provincial Blue list (BCCDC 2018). The taxon's global rank is G4G5 (Apparently Secure or Secure) (NatureServe 2018). A few other jurisdictions also class the species as rare: S3 (Vulnerable) in Alberta and Northwest Territories, S1S3 (Critically Imperilled and Vulnerable) in Yukon Territory, and S2 (Imperilled) in Colorado (NatureServe 2018).

Seven new sites of threadbare ribbon were discovered in the study area in 2018. Near the mouth of Farrell Creek, an occurrence comprising four thalli in two patches was observed in shrubby upland woods. At a second occurrence approximately 8.5 kilometres east of Farrell Creek, two thalli were recorded 450 metres apart in woodland along the south side of Highway 29. West of Cache Creek, a third occurrence of eight thalli was documented in a 50 square metre area at the edge of a deciduous woodland by an alfalfa field. The fourth occurrence, located in a shrubby wooded draw west of Wilder Creek, consisted of a single thallus found just above a road track. Similarly, a fifth occurrence approximately 13 kilometres south of the Peace River also consisted of a single thallus in woods along an access road.

The two remaining new sites of threadbare ribbon found in 2018 were determined to be extensions of previously-reported occurrences. At Lynx Creek just north of Highway 29, two thalli were observed in mixed woodland; this patch was found to merge with a large, multi-patch occurrence first documented

in 2015. Finally, in woods east of Lynx Creek, two thalli approximately 160 metres apart were joined with an occurrence reported in 2017.

There are currently 14 reported occurrences of threadbare ribbon in the RAA (comprising 25 patches). An estimated 98 thalli have been documented, however site delineation has been cursory and the actual size of each occurrence is unknown. While most of the occurrences consist of only one to several individuals, there are three large, multi-patch occurrences clustered in woodlands along Highway 29 from the Lynx Creek area east to Dry Creek. Threadbare ribbon is always found growing on the bark of trees and shrubs, particularly aspen and balsam poplar but also white spruce, Scouler's willow, prairie saskatoon, and choke cherry. The surrounding habitat generally consists of mesic woodland and the microsite is usually partially shaded. Dominant associated species at the micosite level include punctured ribbon (*Ramalina dilacerata*), various species of rosette (*Physcia* spp.), and a variety of other epiphytic lichens.

6.3.15. Ranunculus rhomboideus (prairie buttercup)

Prairie buttercup (Figure 17) is a soft-hairy perennial of the Ranunculaceae (buttercup family). The species grows in grasslands, prairies, open woods and thickets across north-central North America (Whittemore & Parfitt 1997; Douglas et al. 1998). In B.C., prairie buttercup is only known from the Peace River region (BCCDC 2018). The taxon's current range extends north to Northwest Territories and southeast through the Canadian prairie provinces and the northern U.S. Great Plains into southern Ontario (Whittemore & Parfitt 1997; NatureServe 2018).

Prairie buttercup has a ranking of S2S3 (Imperilled and Vulnerable) in B.C., and is on the provence's Blue list (BCCDC 2018). Globally, the taxon is ranked G5 (Secure). Only sporadic sub-national ranks are provided for prairie buttercup: Alberta, Saskatchewan, Manitoba, and Ontario class the species as S4 (Apparently Secure); Iowa as S3 (Vulnerable); Illinois and Michigan as S2 (Imperilled); Nebraska as S1 (Critically Imperilled); and Québec as SX (Presumed Extirpated) (NatureServe 2018).

Four occurrences (comprising five patches) of prairie buttercup were documented in the study area in 2018. The largest occurrence was found in full sun in an open swale next to a plowed field west of Cache Creek. Here, 50 to 250 plants were observed in an estimated area of 207 square metres; most plants were in early fruit and prairie buttercup was a co-dominant of the plant community at the site. Associated species included prickly rose and a variety of native and non-native forbs and graminoids. This occurrence also included a second small patch of three prairie buttercup plants, in a shrubby opening between a mixed woodland and a plowed field 350 metres to the southeast.

West of Wilder Creek, two small occurrences of prairie buttercup were discovered on dry shrub-grassland slopes. One comprised three vegetative plants and the other two fruiting plants; habitat and associated species were similar at both sites—the dominant associates consisted of prairie saskatoon, prickly rose, and Kentucky bluegrass. The fourth occurrence, one vegetative plant, was located on a dry grassland flat west of the confluence of the Peace and Pine Rivers. Associated species included kinnikinnick, needlegrass and a diverse assemblage of native forbs.

Figure 17: Ranunculus rhomboideus (prairie buttercup)

In the entire RAA, there are currently nine reported occurrences of prairie buttercup (comprising ten patches). Six of the occurrences—discovered during the Site C rare plant survey work—contain an estimated 190 plants in an approximate total area of 343 square metres. The remaining three occurrences are historical records not recently verified and with no information available on number of individuals or area. The habitat for prairie buttercup is somewhat variable: soils can range from moist to dry, shrub cover can be dense to sparse, and occurrence microsite can be flat to gently sloped. Dominant associated species include a wide variety of native forbs such as northern bedstraw (*Galium boreale*) and American vetch (*Vicia americana*) as well as native and weedy grasses. Native shrub species are also present, the most commonly reported being rose (*Rosa* spp.).

6.3.16. Selaginella rupestris (rock selaginella)

Rock selaginella (Figure 18) is a small, mat-forming evergreen perennial in the Selaginellaceae (spike-moss family). The taxon is found in a variety of open, dry, rocky or gravelly habitats in eastern and central North America (Valdespino 1993; Douglas et al. 1998). In B.C., rock selaginella is known only from the Peace River region (BCCDC 2018; Klinkenberg 2018). The taxon ranges east across Canada to Nova Scotia and southeast in the U.S. to southern Georgia (Valdespino 1993; NatureServe 2018).

Figure 18: *Selaginella rupestris* (rock selaginella)

Rock selaginella is ranked S1 (Critically Imperilled) in B.C., and is on the Red list for the province (BCCDC 2018). The taxon is classed as G5 (Secure) globally, but sub-national rankings vary. Of the jurisdictions providing a rank, rock selaginella is listed as S5 (Secure) in Ontario, Arkansas, Georgia, and Virginia; as S4 (Apparently Secure) in Saskatchewan, Manitoba, Québec, and New York; as S3 (Vulnerable) in Alberta, Illinois, North Carolina, West Virginia, Vermont, and Massachusetts; as S2 (Imperilled) in Iowa, Indiana, Alabama, and New Jersey; as S1 (Critically Imperilled) in New Brunswick, Nova Scotia, Wyoming, and North Dakota; as SH (Possibly Extirpated) in Ohio; and SX (Presumed Extirpated) in Delaware (NatureServe 2018).

Two large occurrences (comprising three patches) of rock selaginella were documented in the study area in 2018. East of Farrell Creek, 250 to 1,000 plants were observed in an estimated area of 1,156 square metres. The main patch was found on a steep, dry shrub-grassland hillside north of Highway 29, and a small patch was found in similar habitat 400 metres to the north just below the highway. A second occurrence was discovered on a narrow, dry ridge just west of Cache Creek. Here, another 250 to 1,000 plants were mapped in an estimated area of 1,285 square metres. The rock selaginella plants were growing in a band just below the crest of the ridge. Associated species at both sites included a diverse assemblage of native shrubs and herbs.

In total, there are currently five reported occurrences of rock selaginella in the RAA (comprising six patches). An estimated 1,400 individuals have been recorded in an approximate area of 2,613 square metres. All of the occurrences are in open shrub-grassland habitat on south-facing dry hillsides.

Associated species include native shrubs such as kinnikinnick and prairie saskatoon; native graminoids including junegrass, short-awned porcupinegrass, and various dryland sedge species; and native forbs such as prairie sagewort, northern wormwood (*Artemisia campestris*), and bastard toad-flax (*Comandra umbellata*).

Appendix 8. Downstream Western Toad and Gartersnake Monitoring Program – 2018

Site C Vegetation and Wildlife, Downstream Western Toad and Gartersnake Monitoring Program – 2018

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March 18, 2019

EXECUTIVE SUMMARY

Habitat assessments and sampling for presence for western toad (*Anaxyrus boreas*), common gartersnake (*Thamnophis sirtalis*), and terrestrial gartersnake (*Thamnophis elegans*) downstream of the Site C Clean Energy Project were conducted in 2018. Based on a Before-After-Impact-Control (BACI) design, the data collected from these surveys will allow an analysis of the change in suitable habitat and changes in distribution and relative abundance of western toad and gartersnake related to changes in the water regime downstream of the Project.

A total of nine sites in the impact study area and 13 in the control study area were found to be suitable habitat for monitoring western toad abundance and distribution. The relative abundance of adult western toads in the impact study area was 0.56 toads per survey, and in the control was 0.08 toads per survey. The relative abundance of tadpoles in the impact study area was 14 tadpoles per survey, and in the control was 237 tadpoles per survey. These results were based on only one site visit during the associated life stage. The target number of sites in the impact and control study areas was less than expected based on pre-survey planning and available terrestrial ecosystem mapping. The same areas used for monitoring western toad abundance will be used to assess habitat suitability changes due to project-related water regime changes. These sites were further characterized for water quality. Preparations for future gartersnake surveys were completed, with the placement of 257 Artificial Cover Objects (ACO); 136 ACO within 10 sites in the impact study area, and 121 ACOs within 11 sites in the control study area.

Recommendations for the western toad and gartersnake monitoring program in 2019 include the addition of standardized water depth as an additional variable in the assessment of water regime change, specifically for western toad. Study design limitations due to the unavailability of suitable habitat in the impact study area will be addressed in 2019. Because only nine sites for western toads and 11 for gartersnakes were found with suitable habitat within the impact study area, expectations of the statistical power available will need to be adjusted, as the reduced sample size reduces the power to detect significant changes. Regardless, multiple years and multiple visits per year will increase statistical power to detect change over time, and at a minimum a trend of abundance or occurrence can still be observed. In 2019 we will refine the study design to balance the numbers of control and impact sites for optimal statistical power by reducing the number of impact sites and to focus on sample replication. Monitoring surveys for western toads will focus on one (toad) lifestage in early spring, rather than multiple life stages through the seasons. Monitoring surveys for gartersnakes will proceed in 2019 as per the workplan.

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APPENDICES

1.0 INTRODUCTION

This document describes the results of the 2018 Gartersnake and Western Toad Monitoring Program. This monitoring program is being used to verify conclusions of the Environmental Impact Statement related to potential displacement of amphibians and reptiles in areas where surface water hydrology will be most affected by the Site C Clean Energy Project (the Project). This program also fulfills the requirements and conditions set forth in the Site C Clean Energy Project's Environmental Assessment Certificate (Condition 21) and the Federal Decision Statement (Conditions 16.1, 16.2, 16.3.6, 18.1).

1.1 Background

In 2006 and 2012, amphibians and reptiles were surveyed in the local assessment area (LAA; BC Hydro 2013). All five amphibian species known to occur in the area were observed: boreal chorus frog (*Pseudacris maculata*), Columbia spotted frog (*Rana luteiventris*), long-toed salamander (*Ambystoma macrodactylum*), wood frog (*Lithobates sylvatucus*), and western toad (*Anaxyrus boreas*). Two reptile species of gartersnake are also known to occur in the area: the common red-sided gartersnake (*Thamnophis sirtalis parietalis*) and terrestrial gartersnake (*T. elegans*). Two of these species were chosen as key amphibian and reptile indicator species to measure the potential impact of the project. The indicator species are the western toad, common red-sided gartersnakes and terrestrial gartersnake. The western toad is federally listed as Special Concern under COSEWIC, SARA Schedule 1 – Special Concern, but is considered not at risk in BC (BC CDC 2018). The gartersnakes are considered to be not at risk federally, and in BC (BC CDC 2018).

The Peace River water regime downstream of the Site C dam will change very little during construction because the flows from the upstream Peace Canyon Dam will remain mostly unaltered (EIS section 11.4.3.2.3). River volume (flow) will drive the water regime in areas downstream of the Site C dam and is expected to generally remain unchanged from baseline conditions during the construction period. The headpond will dampen flow rates, resulting in smaller and smoother changes in the Peace River downstream of the Site C dam, but because river volume will not change, the headpond is not considered to affect the water regime downstream of the Site C dam. At the start of the diversion period (i.e., Winter 2020) river flows from the Peace Canyon Dam will be temporarily reduced to 283 m^3/s for one week to construct the closure berm. After that, for five weeks flows will be increased as the coffer dam height is raised. After these six weeks, normal river flows will resume. This short-term alteration to river volume will occur at a time when gartersnakes and western toads are hibernating in upland sites, and therefore is expected to have no influence on the target species downstream of the Site C dam.

1.2 Monitoring Objectives

The objective of the western toad and gartersnake monitoring program is to determine the downstream effects of the Project on these species' distribution and abundance within suitable habitat, and the change in extent of suitable habitat. Site C dam operations are predicted to affect the downstream hydrology (i.e., changes in water levels and flow rates which are predicted to displace these species; BC Hydro 2013).

Information in this report and subsequent annual reports will address conclusions of the Environmental Impact Statement related to the potential displacement of amphibians and reptiles in the area where surface water regimes will be most affected – downstream of the Project to the Pine River. Downstream of the confluence of the Peace and Pine rivers, the inputs of tributary watercourses (including the Pine River) are expected to ameliorate any project-related changes. Flows in the Peace River below the Pine River confluence are about 20-30% greater than the flows above the confluence (Government of Canada hydrometric data).

2.0 MONITORING METHODS

The program is based on a BACI (before-after-control-impact) study design where monitoring is to be conducted in the control and treatment (i.e., impact) areas during the pre-operations (2018 until 2020) and operations periods (2025 to 2034). Sample sites in suitable habitat within the impact study area (i.e., from the Project downstream to the Pine River) and the control study area (i.e., from the Pine River downstream to the Beatton River) were established for monitoring of western toads and gartersnakes as per the workplan (BC Hydro 2018).

In accordance with best management practices (BC MWLAP 2004), all surveys incorporated standard hygiene protocols (BC MoE 2008) to minimize the potential for spreading amphibian and other aquatic diseases as well as non-native plants and animals.

2.1 Study Area

The study area is wetlands adjacent to the Peace River from the Site C dam to the Beatton River. The wetlands between the Site C dam and the Pine River confluence represent the impacted (affected) study area. Wetlands adjacent to the Peace River downstream of the Pine River to the Beatton River are the control (unaffected) study area.

2.2 Habitat Suitability Assessment

Using Terrestrial Ecosystem Maps (TEM) of the study area provided by BC Hydro and iMap imagery, suitable wetlands were mapped within the bounds of the study area. The area of each habitat type was calculated prior to the field habitat assessment (**Table 2.1**). Each wetland area was visited to verify the classification, and to assess the habitat suitability and its extent. Sites were selected based on habitat suitability for each species.

Table 2.1 Wetland habitat based on TEM data in the downstream impact and control study area

Habitat Type (TEM Map Code)	Impact Area (ha): Dam Site to Pine River	Control Area (ha): Pine River to Beatton River
Sedge (SE)	1.2	0.0
Shallow open water (PD, OW)	7.9	19.3
Non-forested floodplain wetlands (WH)	60.8	248.3
Vegetated floodplain (SH, FM02)	466.0	923.8
Willow sedge (WS)	7.2	0.7
Total	**543.1**	**1,192.0**

Habitat for western toad and gartersnake focused on breeding and foraging habitat, respectively. During the breeding season, western toads congregate in shallow ponds. After breeding is complete, they disperse widely to foraging and over-wintering habitats. Suitable habitat for breeding western toad was considered to be small ponds in 1) shallow open water, 2) willow sedge, and 3) sedge habitats. Gartersnake habitat selection was related to the location of its dominant prey species of amphibians and earthworms, and to a lesser degree, freshwater fish and leeches (Matsuda et al. 2006). Their suitable foraging habitat was considered to be 1) vegetated floodplain, 2) willow sedge, 3) sedge, 4) shallow open water, and 5) non-forested floodplain wetland. Foraging occurs near gartersnake hibernation sites, the locations of which can vary annually.

2.3 Habitat Change

Suitable western toad habitat was monitored during the surveys for changes due to changes in water regimes. Western toads prefer small shallow ponds for breeding, which are easily influenced by the amount of water entering the site. Minor changes in the water regime can cause a pond to become dry before breeding ends. As such, during each site visit for western toad monitoring, field crews collected wetland characteristic information (i.e., habitat type, percent emergent vegetation, percent submerged vegetation, substrate material), and, using an Oakton PCSTestr 35, water quality (i.e., water temperature, air temperature, pH, and conductivity) to understand within season changes that might be affecting presence and or abundance. Turbidity estimates were recorded using a LaMotte 2020we turbidity meter or a Secchi disk method.

2.4 Western Toad Abundance

Systematic visual searches are traditionally used to assess relative abundance of western toads and other amphibians within breeding habitat (RISC 1998a) but can fail to detect toads when they are present, especially at low densities. Concurrent eDNA surveys were conducted at wetlands where systematic visual searches failed to find presence - to provide a more accurate record of presence/not detected in areas of possible low density / low observability.

2.4.1 Relative Abundance

Survey methods followed the protocol for systematic visual searches described in Inventory Methods for Pond-Breeding Amphibians and Painted Turtle (RISC 1998a), and were conducted by qualified biologists with experience in amphibian surveys. Adjacent transects, approximately 10 m apart, in each of three different depths were conducted in suitable habitat for western toad. The three habitats were waist deep water, ankle to knee deep water, and terrestrial shore line habitats. Transects were 100 m in length and were linear unless the wetland was less than 100 m long, in which case transects were curvilinear following the riparian edge (**Figure 2.1**). The three 100 m long transects per sampling site are a standardized sampling unit. All amphibian species, development stage (i.e., egg mass, juvenile, adult), species abundance, as well as habitat characteristics and water quality (see **Section 2.1.1**) were recorded at each site. Sites were revisited up to three times in the mid-May to mid-June breeding season.

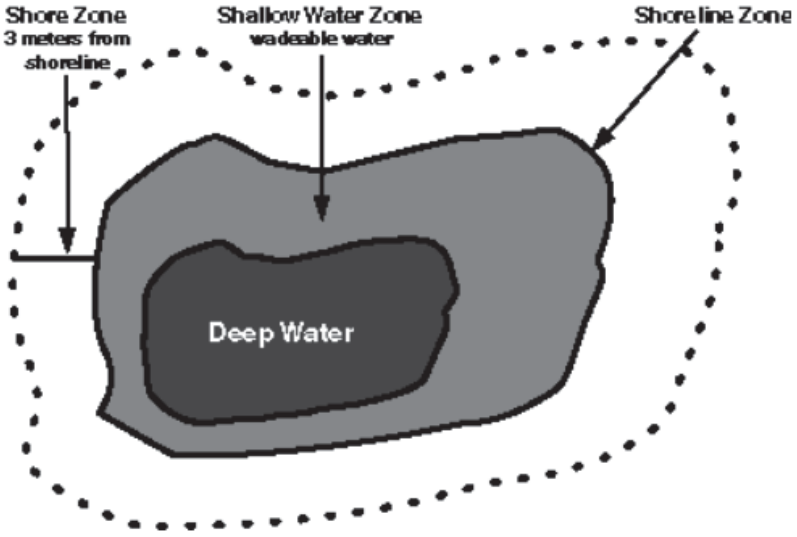

Figure 2.1 Water depth for western toad standardized transects. Adapted from RISC1998a

2.4.2 Presence / Not detected

If water was present at sampling sites but after repeated visits there were no western toads observed using systematic visual searches, environmental DNA (eDNA) sampling was employed. This method determines presence based on genetic testing of water in which skin and waste material from the target species is shed. The procedure for eDNA protocols in freshwater aquatic ecosystems (Hobbs et al. 2015, MoE 2017) involve the collection of water samples from the selected wetlands (sample sites) and subsequent lab analysis of the samples to detect the presence of the target species' DNA. A northeastern BC-specific western toad primer was created, and used to determine presence in water samples collected in the study area. Environmental DNA sampling and analysis was not conducted at wetlands where visual surveys had previously confirmed the presence of western toads. Relative abundance data are not available for wetlands where eDNA sampling was the only method for confirming presence.

2.5 Gartersnake Abundance

Surveys for gartersnakes will be conducted using Artificial Cover Objects (ACO), following methods by Halliday and Blouin-Demers (2015) and Joppa et al. (2009). Gartersnakes spend most of their time hidden under logs, rocks, and dead vegetation. ACO were deployed at sampling sites between April 30 and June 7, 2018. Such deployment allows sufficient time for gartersnakes to find and become accustomed to them/use them prior to 2019 surveys (Grant et al. 1992, Joppa et al. 2009, Eekhout 2010). At sites deemed suitable for gartersnake foraging, ACO were placed in a meandering transect adjacent to foraging habitat. The number of ACO placed at a site was determined by the size of the suitable habitat. ACO were placed using the following guidelines: three adjacent to wetlands <0.1 ha, six at wetlands between 0.1 and 1.0 ha, and a minimum of ten and a maximum of twenty at wetlands >1.0 ha.

Monitoring starting in 2019 will consist of lifting the ACO and counting and classifying any gartersnakes present by size and species. Surveys will be conducted during two periods: one in late-May (corresponding with western toad surveys), and mid-August, to provide a sample of early and late season habitat use.

3.0 DATA MANAGEMENT AND ANALYSIS

Western toad and gartersnake records from all surveys were collected via electronic (iPad) forms and compiled in a database. Data were reviewed to check for anomalous records (i.e., quality control), and questionable species identification or count data were queried with field staff.

The total number of western toads in each development (age) class detected by each survey method is reported for each survey period. Totals are described in terms of relative abundance, which represents the number of western toads detected across temporal and spatial scales as an indicator of relative differences in abundance. In contrast, true abundance would require an estimate of the individuals not detected during surveys to provide a total count of all toads that were present. Presence/not detected data are also presented as a further indicator of habitat use, where relative abundance data could not be collected (i.e., eDNA sampling). To control for variation in abundance due to the size of a suitable habitat, data are summarized in terms of abundance per survey unit as per RISC standards (RISC 1998b).

Analysis will, in future years, follow a single site BACI design to assess the project related changes while accounting for background variation. The BACI effect is the differential change or changes in the means that occur between the before and after periods (Swartz 2015). A general linear model will be used to determine if the number of western toad and gartersnake detections in the treatment area differ significantly between the construction and operations periods relative to the same periods at the control site with random effects included for Site, Year, and other relevant environmental variables, such as temperature and precipitation as measured at BC Hydro meteorological station 11 (Taylor or 7B (North Camp) to evaluate the influence of weather conditions may be affecting observations:

$$Abundance = Treatment\ (control|impact) + Period(before|after) + Treatment * Period + Site + Year + env\ variables$$

The interaction term "*Treatment * Period*" is the BACI effect, the non-parallel response where magnitude of change between treatment areas and time is estimated. Using an analysis of variance (ANOVA), the model will determine the level of significance (p-value) of the interaction of Treatment and Period. The BACI contrast estimates the magnitude of differences using least square means. This will indicate the magnitude and direction of the differences. Additionally, variation can be estimated within sites (sub samples), between sites within a treatment, between treatments, and between periods.

Until multiple years of data are available, and while awaiting the collection of before and after treatment data simple statistical analyses will be presented.

4.0 RESULTS

The workplan for this program suggested sampling at 30 sites in the impact area and 30 sites in the control area; however, field assessments found that access to and availability of suitable and discrete wetland habitat (**Table 2.1**) limited the application of the study design. The number of sites with suitable habitat for western toads and gartersnakes within the impact and control areas was nine and 13 sites, respectively, for western toad surveys, and ten and 11 sites, respectively, for gartnersnake surveys. All wetlands suitable for sampling were greater than 0.1 ha in size. Solutions to address the study area limitations are discussed in Section 5.0.

Table 4.1 Number of sampling sites and associated size and habitat type from western toad habitat assessments

Habitat Type	Number of Surveying Sites							
	Treatment / Impact Area				Control Area			
	<0.1 ha	0.1-1.0 ha	>1.0 ha	Total ha	<0.1 ha	0.1-1.0 ha	>1.0 ha	Total ha
Shallow open water	-	3	4	8.4	-	4	7	16.2
Willow Sedge	-	-	1	6.4	-	1	-	0.2
Sedge	-	1	-	0.2	-	-	1	2.4
Total	**-**	**4**	**5**	**15.0**	**-**	**5**	**8**	**18.8**

Table 4.2 Number of sampling sites and associated size and habitat type from gartersnake habitat assessments

Habitat Type	Number of Surveying Sites							
	Treatment / Impact Area				Control Area			
	<0.1 ha	0.1-1.0 ha	>1.0 ha	Total ha	<0.1 ha	0.1-1.0 ha	>1.0 ha	Total ha
Shallow open water	-	2	3	8.0	-	3	2	8.6
Non-forested floodplain	-	1	4	8.0	-	2	2	5.4
Willow Sedge	-	-	1	6.4	-	1	-	0.2
Vegetated floodplain	-	-	-	-	-	-	-	-
Sedge	-	-	-	-	-	-	-	-
Total	**-**	**3**	**8**	**23.2**	**-**	**6**	**4**	**14.2**

4.1 Habitat Assessment

On April 30, May 1, 2, 3, 4, and 5, 2018, wetlands identified from available TEM mapping were visited and their values verified and categorized according to vegetation (as per MacKenzie and Moran 2004) and water regimes (as per Stewart and Kanatrud 1971). Nine sites in the impact portion of the study area and 13 sites in the control portion of the study area were found to have suitable habitat for western toad breeding and gartersnake foraging and will be used for future assessment of project-related habitat changes. These sites have wetland features such as shallow open water and ponds that can be monitored for changes. These sites are also being used to monitor western toad abundance (**Section 4.2**).

Differences in water quality parameters between control and impact sites were recorded during the 2018 surveys (**Table 4.3**). The average water temperature for the impact sites was higher (20.33±3.35°C SD) than the control sites (19.60±3.15°C SD). The average air temperature during surveys in the impact area was also warmer (22.5±2.39°C SD) compared to the control area where the average air temperature was 19.70±2.51°C (**Table 4.3**). The average pH in the impact area was 8.68±0.89 SD, which was higher than the more-neutral control, at which average pH was 7.85±0.28 SD (**Table 4.3**). The average conductivity (dissolved ions / salinity) in the impact area (300.4±140 s/cm SD) was lower than in the control sites (399.8±157 s/cm SD; **Table 4.3**). Using a turbidity meter, the average turbidity at sites in the impact area (1.96±1.29 NTU SD) was lower than in the control area sites (2.30±0.79 NTU SD; (**Table 4.4**). For sites where turbidity was measured using the Secchi disc method the results were similar, the average depth at which a hand was not visible was 22.50±6.61 cm SD at sites in the impact area, and 15.05±8.20 cm SD at sites in the control area (**Table 4.4**). Despite the observed differences in parameters between sites in impact and control area, there was no statistically significant difference in parameters.

There were differences observed in the site habitat characteristics between survey sessions (i.e., visits). Seven sites changed to a habitat type characterized by less water, such as open water changing to a sedge habitat (see **Appendix A**).

Table 4.3 Average water temperature, air temperature, pH, and conductivity

Study Area	Sample Size	Average Water Temp (°C)	SD	Average Air Temp (°C)	SD	Average pH	SD	Average Conductivity (s/cm)	SD
Impact	n = 9	20.33	3.35	22.50	2.39	8.68	0.89	300.4	140
Control	n = 13	19.60	3.15	19.70	2.51	7.85	0.28	399.8	157

SD = standard deviation

Table 4.4 Average turbidity estimates

Study Area	Sample Size	Average Turbidity (NTU)	SD	Sample Size	Average Turbidity (cm)	SD
Impact	n = 5	1.96	1.29	n = 3	22.50	6.61
Control	n = 4	2.30	0.79	n = 10	15.05	8.20

SD = standard deviation

4.2 Western Toad

There were small differences in area between the TEM mapping classifications of habitat used to plan the program and habitat encountered in the field. Based on TEM mapping data in the treatment/impact area, there was 7.9 ha of open water, 7.2 ha of willow-sedge, and 1.2 ha of sedge (**Table 2.1**). In the field, 8.4 ha of open water, 6.4 ha willow-sedge, and 0.2 ha sedge habitat were recorded during the habitat assessment (**Table 4.1**). In the control area, TEM mapping suggested there was 19.3 ha of open water, 0.7 ha of willow-sedge, and 0.0 ha of sedge (**Table 2.1**). In the field, 16.2 ha of open water, 0.2 ha willow-sedge, and 2.4 ha of sedge habitat were identified in the control area during the assessment (**Table 4.1**). However, there were fewer discrete wetland habitats available for assessment in both the control and impact study areas than expected; nine in the impact portion of the study area and 13 in the control portion of the study area (**Table 2.1**).

4.2.1 Relative Abundance

On May 14 and 15, and June 6 and 7, 2018, field crews conducted relative abundance surveys using standardized transects at nine sites in the impact study area and seven of the 13 available sites in the control study area. Increased accuracy in abundance estimates was achieved through repeated site surveys. A second transect, or site survey, was conducted at two impact sites and three control sites. Due to limited availability of discrete wetlands with suitable habitat in the impact study area, the nine sites represent all available and accessible suitable habitat.

During the first survey session on May 14 and 15, only adult toads were observed on visual encounter transects, while during the second survey session on June 6 and 7, only tadpoles were observed (**Appendix C; Table 4.3**).

Based on the counts of western toads relative to the standardized sampling unit, the relative abundance of adult western toads was 0.56 toads per survey in the impact study area (nine sites) and 0.08 toads per survey in the control study area (seven sites) (**Figure 4.1**). The average relative abundance of tadpoles was 14 per survey in the impact study area, and 237 per survey in the control study area.

Figure 4.1 Western toad survey locations and presence / not detected

4.2.2 Presence / Not detected

On June 21, 2018, field crews conducted presence/not detect surveys at 14 sites. This included newly visited sites and returning to previously surveyed sites to confirm no western toad detection. This was further confirmed using eDNA sampling at two sites at which western toads were not observed. These data will be used in future analyses in combination with the relative abundance data collected.

In the impact study area, western toads were observed in five of nine (56%) sites, and in the control study area, western toads were observed in ten of 13 (77%) sites (**Table 4.5; Figure 4.1**).

Table 4.5 Relative abundance and presence / not detected for western toad in the impact and control study area

Survey method	Life Stage/ Sampling Unit	Study Area	
		Impact (n = 9)	Control (n = 7)
Relative Abundance (range)	Adults	0.56 (0 - 3)	0.08 (0 - 1)
	Tadpoles	14 (0 - 126)	237 (0 - 3000)
		Impact (n = 9)	**Control (n = 13)**
Presence / Not Detect	Adult/Tadpole/eDNA	56%	77%

4.3 Gartersnake

On April 30, and May 1, TEM wetland polygons adjacent to potentially suitable gartersnake foraging habitat were visited by field crews to assess their classifications and suitability as foraging habitat. Ten sites with suitable habitat were identified in the impact portion of the study area and 11 sites with suitable habitat were identified in the control portion of the study area. The ten sites identified in the impact study area represent the total available sites and are therefore a census of the impact area.

There were some large differences between the TEM mapping of suitable habitat for gartersnakes and suitable habitat that was encountered in the field and used for ACO placement. Based on TEM data, in the impact area, 7.9 ha of open water, 60.8 ha of non-forested floodplains, and 7.2 ha of willow-sedge was expected. In the field, 8.0 ha of open water, 8.0 non-forested floodplain, and 6.4 ha willow-sedge were recorded during the habitat assessment in the impact area (**Table 4.2**). In the control area, TEM mapping suggested there was 19.3 ha of open water, 248.3 ha non-forested floodplain, and 0.7 ha of willow-sedge. In the field, 8.6 ha of open water, 5.7 non-forested floodplain, and 0.2 ha willow-sedge habitat were encountered in the control area during the habitat assessment (**Table 4.2**). There was much less non-forested floodplain than expected in both the control and the impact study areas. Sedge and forested floodplain habitats were not accessible or available in the field. Despite the area of each habitat type within the impact and control areas, the number of discrete wetlands, access, and within-habitat suitability for gartersnakes was more limiting than expected based on TEM data.

On April 30, May 1, 2, 3, 4, and June 7, field crews placed a total of 257 ACO adjacent to suitable foraging habitat for gartersnakes. The majority of ACO were placed adjacent to shallow open water (34%), as well as in non-forested floodplains (17%), and backchannels (13%). Each ACO was placed in vegetated floodplains, with forest or shrubs as the dominant surrounding vegetation. There are 11 sites with a total of 121 ACO placed in the impact study area, and ten sites with 136 ACO placed in the control study area (**Table 4.6; Figure 4.2**).

There were no data collected on gartersnake abundance because ACO were deployed in spring 2018 and gartersnakes were not expected to use the ACO until a nine-month to one year period of acclimatization has occurred (Grant et al. 1992, Joppa et al. 2009, Eekhout 2010). Statistical comparisons and modeling planned for subsequent years of data collection are discussed in **Section 3.0**.

Table 4.6 Site, habitat, and number of ACO for gartersnake monitoring

Site Names	Number ACOs	
	Control	Impact
Non-forested floodplain (WH)	**46**	**32**
VF2	-	10
WH2	-	10
WH5	-	12
Taylor snake	10	-
WH3	11	-
WH4	11	-
WH6	14	-
Shallow open water (PD, OW)	**84**	**78**
OW1	-	11
OW10	-	13
OW11	-	10
OW2	-	20
OW3	-	12
OW4	-	12
OW5	10	-
OW6	11	-
OW7	20	-
OW8	12	-
OW9	13	-
PRP	18	-
Willow sedge (WS)	**6**	**11**
WS1	-	11
WS2	6	-
Total	**136**	**121**

Figure 4.2 Gartnersnake survey locations

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Habitat Assessments

Habitat and water regime data were collected at sites where western toad abundance surveys were conducted. In the study areas most sites are in shallow open water (7 impact, 11 control; **Table 4.1**) with the remainder of sites located in willow sedge and sedge habitat (one site each in the impact and control). The diversity of sizes in the wetland habitats available for sampling, and the number of discrete wetlands was more limited than was expected based on the field visitation.

During the span of the survey season, wetland habitat types at a few sites were observed to change (e.g., from open water habitat to a sedge habitat). This resulted in some sites that were suitable habitat for either of the target species in early May becoming dry and unsuitable by late June. This change would have been due to some combination of the seasonally driven water cycle of the Peace River and precipitation. As such, to further quantify changes to the water regime, in 2019, estimates of water depth will be obtained from a standardized location within each wetland using a stationary water depth gauge or digital water depth meter. This will allow a quantification of water change at each site to compliment the vegetation data associated with each wetland type.

Turbidity measurements used two techniques: a turbidity meter and a modified Secchi disc method. Turbidity is an important water quality parameter for amphibians because higher turbidity affects an amphibian's ability to find food (Henley et al. 2000). The turbidity meter was found to be more effective approach for measuring turbidity, and therefore for future surveys a turbidity meter, will be employed at each site, and use of the Secchi disc method will be discontinued.

5.2 Western Toad Abundance

The assessment of habitat suitability resulted in identification of only nine sites with possible western toad breeding in the impact study area. The limited number of discrete wetlands located in this part of the Peace River floodplain will result in loss of statistical power for estimating average abundance or occurrence as compared to the expectations in the work plan. Collecting data throughout the spring and summer periods resulted in multiple life stages being observed, with widely varying estimates in population number.

To mitigate these outcomes as much as possible, we recommend focusing sampling effort in 2019 during the early spring and balancing the number of impact and control sites that are monitored. We will focus all survey effort on the period of peak congregations of adult western toads at breeding ponds and collecting data on all life stages present during the survey, such as egg masses. The period of adult congregation at breeding ponds reflects post-winter survival and tends to last longer than the peak abundances of other life cycles. Attempting to time surveys to coincide with peak egg masses, which take 2 – 12 days to hatch, or with peak tadpoles and metamorphs, which are highly variable in number and even more challenging to time, results in highly variable survey results. Therefore, we recommend that the approach in 2019 be refined by shifting from dispersed sampling effort across the spring to focus sampling effort in early spring when adults are likely to be congregating in breeding ponds. In 2018 there were sites with confirmed presence of western toad (confirmed by eDNA results) where toad or tadpole presence was not observed. Focussed effort in one period is considered more likely to provide reliable metrics of relative abundance. However, as with 2018, for sites where no presence was observed earlier in the first two surveys, eDNA samples will be collected during the final survey for presence / not detected data. These refinements to the study design will obtain a more accurate trend of abundance at sites with western toad presence.

Relative abundance and presence for western toads was based on nine sites in the impact portion of the study area and 13 in the control portion of the study area. Surveys in the control portion of the study area in 2019 will be reduced to nine in 2019 to balance the number of sites in the control and impact portions of the study area.

5.3 Gartersnake Abundance

In 2018, over 250 ACO were distributed to estimate gartersnake abundance in 2019 surveys. The 2019 surveys will be conducted in spring after the ACO have been in the environment long enough for gartersnakes to be accustomed to using them. Surveys will be conducted after the atmospheric temperature has increased and snake activity is assured. Three repeat visits to the ACO in each of two periods (late May and mid-August) will be conducted in an approximately one-week period (one to two-day return period). Timing of the gartersnake surveys will be between May and mid-August to avoid declining temperatures later in the year.

5.4 Summary

The monitoring program for western toad and gartersnakes is limited by the number of suitable habitat sites found in the impact area. Instead of being a stratified sample of the area, the survey represents a census of available habitat, as all suitable habitat sites were visited. Additionally, three of the impact sites, one of which a western toad was observed at, have been filled in to protect the area from stranded fish. The limited number of sites reduces the statistical power for detecting a significant difference in the relative abundance or occurrence of western toads and gartersnakes between sites and over time. Regardless, multiple years and multiple visits per year will increase statistical power, and at a minimum data can be examined for trends in relative abundance or occurrence.

6.0 CLOSING

This Report has been prepared by Hemmera, based on fieldwork conducted by Hemmera, for sole benefit and use by BC Hydro. In performing this work, Hemmera has relied in good faith on information provided by others and has assumed that the information provided by those individuals is both complete and accurate. This work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the Report was produced. The conclusions and recommendations contained in this Report are based upon the applicable guidelines, regulations, and legislation existing at the time the Report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

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APPENDIX A
Habitat Characteristics

APPENDIX B
Wetland Class Definitions

WETLAND CLASS DEFINITIONS

Temporary Wetlands are periodically covered by standing or slow moving water. They typically have open water for only a few weeks after snowmelt or several days after heavy storm events. Water seepage is fairly rapid, but surface water usually lingers for a few weeks after spring snowmelt and for several days after heavy rainstorms at other times of the year. Water is retained long enough to establish wetland or aquatic processes. They are dominated by wet meadow vegetation such as fine-stemmed grasses, sedges and associated forbs

Seasonal Ponds and Lakes are characterized by shallow marsh vegetation, which generally occurs in the deepest zone (usually dry by midsummer). These wetlands are typically dominated by emergent wetland grasses, sedges and rushes.

Semi-permanent Ponds and Lakes are characterized by marsh vegetation, which dominates the central zone of the wetland, as well as coarse emergent plants or submerged aquatics, including cattails, bulrushes and pondweeds. These wetlands frequently maintain surface water throughout the growing season, i.e., from May to September.

Permanent Ponds and Lakes have permanent open water in central zone that is generally devoid of vegetation. Submerged plants may be present in the deepest zone, while emergent plants are found along the edges. These wetlands maintain surface water year round. Plants commonly present in these wetlands include cattails, red swampfire and spiral ditchgrass.

APPENDIX C

Wetland Survey Effort by Survey Station

Details of western toad (AMBO) relative abundance and presence/ not detect surveys

		Survey 1 (0514 - 0515)	Survey 2 (0606 - 0607)	Survey 3 (0621)
	Site	**AMBO (Adult)**	**AMBO (Tadpole)**	**Presence/ Not detect**
IMPACT	OW1	1	-	-
	OW10	3	-	-
	OW11	0	0	N
	OW2a	-	0	N
	OW2b	-	0	N**
	OW3	3*	-	-
	OW4	1	0	-
	OW4a	-	126	-
	WS1	-	-	N
CONTROL	OW12	-	-	P
	OW13a	-	-	N
	OW13b	-	-	N
	OW14	-	-	P
	OW15	-	-	P
	OW5	-	-	P
	OW6	1	-	-
	OW7	0	1	-
	OW7a	-	80	-
	OW7b	-	0	P***
	OW8	0	-	N**
	OW9	0	3000	-
	WS2	-	0	P

* Incidental observation. Only included in presence / not detect

** eDNA sampled – negative

***eDNA sampled – positive control

APPENDIX D
Site and Habitat Area

SITE AND HABITAT AREA

Site Name	Study Area	Habitat Type	Site Area (ha)	Species
OW1	impact	Shallow-open Water	3.13	snake and toad
OW10	impact	Shallow-open Water	0.39	snake and toad
OW11	impact	Shallow-open Water	0.39	snake and toad
OW2	impact	Shallow-open Water	1.33	snake
OW2a	impact	Shallow-open Water	0.31	toad
OW2b	impact	Sedge	0.21	toad
OW3	impact	Shallow-open Water	1.23	snake and toad
OW4	impact	Shallow-open Water	1.51	snake and toad
OW4a	impact	Shallow-open Water	1.44	toad
VF2	impact	Non-forested Floodplain	4.79	snake
WH2	impact	Non-forested Floodplain	1.77	snake
WH5	impact	Non-forested Floodplain	1.46	snake
WS1	impact	Willow-Sedge	6.41	snake and toad
OW12	control	Shallow-open Water	1.55	toad
OW13a	control	Shallow-open Water	1.60	toad
OW13b	control	Shallow-open Water	2.21	toad
OW14	control	Shallow-open Water	1.24	toad
OW15	control	Shallow-open Water	2.15	toad
OW5	control	Shallow-open Water	0.75	snake and toad
OW6	control	Shallow-open Water	0.53	snake and toad
OW7	control	Shallow-open Water	2.98	snake and toad
OW7a	control	Shallow-open Water	0.54	toad
OW7b	control	Sedge	2.44	toad
OW8	control	Shallow-open Water	0.86	snake and toad
OW9	control	Shallow-open Water	1.47	snake and toad
PRP	control	Shallow-open Water	1.97	snake
WH3	control	Non-forested Floodplain	3.21	snake
WH4	control	Non-forested Floodplain	0.53	snake
WH6	control	Non-forested Floodplain	1.37	snake
TS	control	Non-forested Floodplain	0.29	snake
WS2	control	Willow-Sedge	0.18	snake and toad

Appendix 9. Experimental Rare Plant Translocation Program 2018 Annual Report

Experimental Rare Plant Translocation Program
2018 Annual Report

Date: January 28, 2019

PRESENTED TO:

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ACRONYMNS & ABBREVIATIONS

Term	Definition
ERPT	Experimental Rare Plant Translocation
ESCONET	European Native Seed Conservation Network
QAQC	Quality Assurance and Quality Control
Spp.	The abbreviation "spp." (plural) indicates "several species".
Sp.	The abbreviation "sp." Refers to a single species.

1. PROGRAM OVERVIEW

The Experimental Rare Plant Translocation (ERPT) program builds upon existing experience and knowledge to incorporate the lessons learned through previous studies and analyses (e.g., Guerrant 1996; Austin 2004; Guerrant and Kaye 2007; Maslovat 2009; Albrecht et. al 2011; Clements 2013; Guerrant 2013; Rynear 2013; NRC Research Press 2013; Guerrant 2014). In 2018, the program focused on implementing the first three phases of the ERPT program: propagule collection (phase 1); ex-situ propagation (phase 2); and translocation (phase 3), as outlined in the ERPT program document (EcoLogic 2018).

1.1.1 Objectives

The primary objective of the ERPT program is to establish new or augment extant populations of target rare plant species using established and, where necessary, experimental techniques.

The secondary objectives of the ERPT program are as follows:

- Support the conservation of the target species by promoting self-sustaining populations;
- Maintain local genetic diveristy of target species;
- Re-establish individuals of target species in high-risk areas (e.g., inundation zone) into secure, analogous habitat in low-risk areas; and
- Produce a secondary supply of viable plant stock in the event that supplementing translocated populations is required.

2. METHODS

2.1 PHASE 1. PROPAGULE COLLECTION

The 2018 propagule collection focused on acquiring propagules from species occurrences, according to a prioritization based on the 2018/2019 clearing schedule, the presence/absence of propagules held at the native plant nurseries from previous collections, and the conservation status of the species. Propagule collection was conducted in accordance with the decision framework established for the ERPT program using guidance outlined by the Royal Botanic Gardens (Millennium Seed Bank Partnership 2014), the Ministry of Environment (Maslovat 2009), and the European Native Seed Conservation Network (ESCONET 2009; Appendix D of the ERPT program document).

The field team sampled from as many plants as possible if there was only the one opportunity to collect, and from approximately 10% of the occurrence if there was more than one opportunity to collect. The field team aimed to capture a range of genetic variability by sampling a minimum of 25 plants per species occurrence, while taking into consideration the potential negative effects of the collection on the occurrence. In instances with larger populations (i.e., more than 25 plants), the rare plant occurrences were divided into distinct sampling quadrants. Seed collectors placed a pin flag at each sampled plant to avoid double sampling from the same plant or location by another seed collector. Seed collectors targeted a minimum of 500 seeds at sites with 100 or more plants to increase the genetic diversity of the sample and the opportunities to propagate the plants at both Twin Sisters Plant Nursery (Twin Sisters) and NATS native plant nurseries (NATS). Seeds are being stored at NATS and Twin Sisters for more in-depth analysis and care.

2.2 PHASE 2. EX-SITU PROPAGATION

Ex-situ propagation involved seed cleaning, drying, storage, stratification, and propagation for each individual target species. Curation Protocols and Recommendations (ESCONET 2009) and professional experience were used to inform the methods for this aspect of the program.

Depending on the species and seed type, seeds were either cleaned and/or dried following collection to maximize viability. Cleaning included the removal of waste material from the seed itself and the use of sieves, hand separation, and water baths and drying, as appropriate. Stratification was conducted as needed, whereby seeds were treated with cold or moist heat to simulate natural germination conditions. Through the pre-treatment and stratification process, seeds were treated to simulate the relevant natural conditions for breaking seed dormancy and initiating germination. Seeds that do not require stratification are being stored until spring.

Propagation methods were developed in the context of the ecological conditions observed at the source populations and included several measures and considerations (Vallee et al. 2004; Maslovat 2009):

- examination of the ecological and, if available, translocation literature to determine experimental trials, including optimum founder plant size, reproductive status relevant to propagation for each rare plant species, and out- planting requirements;
- review of common garden experiments as a potential source of horticultural information for a specific target species;
- exploration and implementation of a range of techniques (e.g., varying soil media) to determine the most effective propagation options for each target species; and
- determination of the feasibility of holding some source propagules in an ex-situ collection as backup material for future propagation.

All utilized ex-situ propagation methods have been documented including the following:

- provenance (i.e., origin of material collected);
- type of material collected (e.g., seed);
- location and date of collection; and
- growing conditions such as potting media, temperature of propagation area, watering and treatment of seeds.

2.3 PHASE 3. TRANSLOCATION IMPLEMENTATION

Translocation implementation included 1) recipient site selection; 2) transport and plant preparation through hardening; and 3) transplantation at recipient sites within the Peace Region.

2.3.1 Recipient Site Selection

Recipient site selection was informed by the extensive existing information collected for Site C along with expert knowledge of the individual species habitat preferences. Sites selected contain habitat analagous to the source occurrences in areas that are unlikely to be developed by industry in the foreseeable future. In some cases, sites also contained one or more target rare plant occurrences. All sites selected are located within the Peace Region in the areas surrounding Site C.

2.3.2 Transport and Hardening Plants

NATS Nursery shipped 347 plants in a refrigerator transport vehicle on 5 September 2018 from Langley, BC to Dunvegan Nursery in Fort. St. John, BC. The plants arrived on 7 September 2018 and were cared for and given time to harden over an 11- to 15-day period in the greenhouses until transplant (Plate 2.3-1; Table 2.3-1).

An additional 412 plants were transported from Twin Sisters' nursery in West Moberly to Dunvegan Gardens nursery on 17 September 2018 for holding until transplant at recipient sites (Plate 2.3-2). Dunvegan Gardens was selected for its proximity to the project translocation recipient sites, and was

used as a local laydown for regular daily withdrawal of only the number and species of plants required for the ERPT component scheduled to be implemented in that current day. Seedlings not scheduled to be outplanted remained in moderated environmental conditions with a regular watering schedule while in the Dunvegan Gardens greenhouse.

Table 2.3-1 summarizes the rare plant species shipped for transport along with nursery of origin and number and size of plants.

Table 2.3-1. Rare Plant Species Shipped for Transplant in 2018

Scientific Name	English Name	Nursery of Origin	Number and Size
Cirsium drummondii	Drummond's thistle	NATS	70 (1 gallon pots) 5 (plugs)
		Twin Sisters	100 (plugs)
Carex xerantica	dry-land sedge	NATS	100 (plugs)
		Twin Sisters	100 (plugs)
Carex sprengelii	Sprengel's sedge	Twin Sisters	12 (plugs)
Oxytropis campestris var. *davisii*	Davis' locoweed	NATS	100 (plugs)
		Twin Sisters	200 (plugs)
Polypodium sibiricum	Siberian polypody	NATS	72 (plugs)
Total			**759**

Plate 2.3-1. Rare plants stacked on the pallet at NATS Nursery in preparation for transport to Dunvegan Gardens Nursery in Fort St. John.

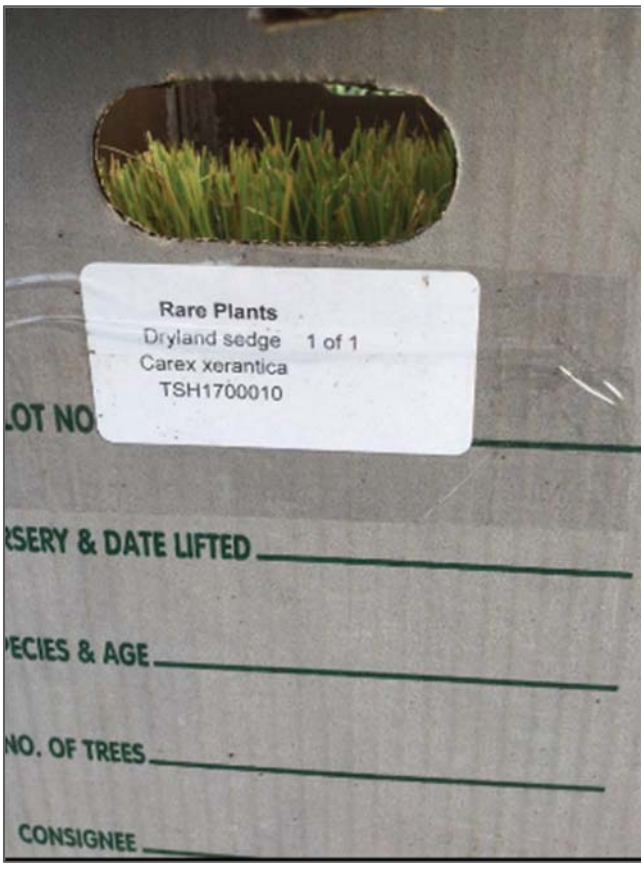


Plate 2.3-2. Rare plants placed within cardboard transport boxes at Twin Sisters Native Plant Nursery.

2.3.3 Plant Transplant at Recipient Sites

The specific timing windows for planting were determined based on the plant phenology, the development stage of the propagated plants, the local weather, temperature, and soil moisture conditions. The initial out-planting occurred between 17 and 23 September 2018. Some plant stock was withheld from planting as insurance should inclement conditions negatively affect the initial out-planting stock. Implementation of the translocation planting included the following:

- placement of plants into optimal microhabitats at the recipient sites, and in a spatial pattern suitable to the rare plant's biology as observed at the source populations or otherwise known;
- installation of durable, long-lasting tags or markers to label individual plants and plant groupings. Colour-code systems will be employed to differentiate various experimental treatments (e.g., plants grown in various soil media during ex-situ propagation efforts), as needed to retain as much information as possible on the pathway of a given plant (e.g., from seed collection to planting) to facilitate post-hoc assessments of success;

- collection of ambient temperature and weather conditions as well as soil temperature within each transplant site;
- marked boundaries for plants, plant groupings, and translocation site boundaries using GPS points and imported into the Project GIS system;
- care and maintenance at the time of planting, such as watering, trimming, and creation of microhabitat as necessary; and
- documentation of each translocation effort (including time spent on each phase), which includes the methods used to prepare and transport the material from the nursery to the recipient site, day of pre-translocation site preparation, environmental conditions (e.g., weather, ambient and soil temperature), method of re-introduction (e.g., mechanical means using a shovel), care and maintenance activities, planting density, and spatial pattern.

2.4 Quality Control and Assurance – Data Capture Methods

To ensure comparability of results across sites and species, numerous field personnel were required to perform field activities, make observations, and record data using standard and consistent methods. Quality assurance and quality control (QAQC) measures of data capture were implemented so that key elements of the methods remained consistent and were replicated across all field trials, and pertinent environmental variables or alterations in methodology were recorded. A data capture form with key instructions, data entry fields, and dropdown menus of select variables was designed for either hard copy or electronic use in the field. When used in paper format, a hard copy of the dropdown menu lists was provided, with each menu list numerically referenced to its data field.

Each individual data capture form was tracked using a unique informative identifying code built of the components "SPP -NURSERY- YYMMDD - n # # #", where "*SPP*" is the species 7- or 8-letter/numbered code, "*NURSERY"* identifies the origin of the individuals, and "*YYMMDD"* records the year, month, and date of the transplant. Where individual plant tracking was required, "*n*" indicated the nth individual that could be tied to a metal tag number.

The data capture form (Appendix A) collected data within the following informational groups:

- plant-specific and site-specific;
- seedling notes;
- outplanting /environmental conditions;
- site preparation activities;
- planting design;
- ground-delineations;
- additional disturbances;
- post-outplanting treatments;
- transplant team members; and
- general comments.

3. RESULTS

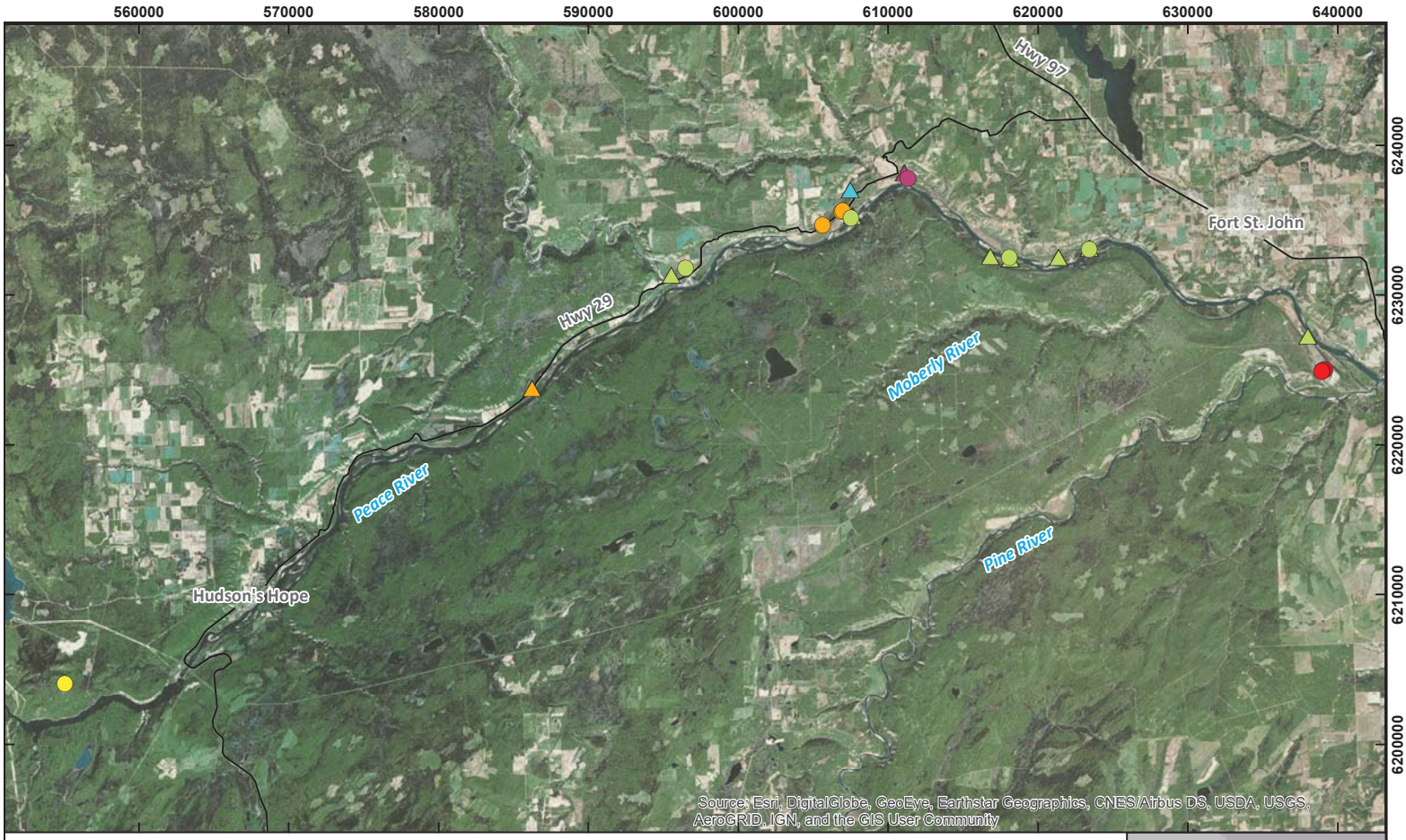
3.1 PHASE 1. PROPAGULE COLLECTION

The 2018 collection efforts focused on 10 of the 12 target plant species: *Carex sprengelii* (Sprengel's sedge); *Carex torreyi* (Torrey's sedge); *Carex xerantica* (dry-land sedge); *Chrysosplenium iowense* (Iowa golden-saxifrage); *Cirsium drummondii* (Drummond's thistle); *Erigeron pacalis* (Peace daisy); *Oxytropis campestris* var. *davisii* (Davis' locoweed); *Penstemon gracilis* (slender penstemon); *Ranunculus rhomboideus* (prairie buttercup); and *Schizachyrium scoparium* (prairie buttercup). Appendix B provides a summary of the 2018 collection efforts by species and by year.

The remaining two target plant species (i.e., *Polypodium sibiricum* [Siberian polypody] and *Artemisia herriotii* [Herriot's sage]) were considered lower priority for collection in 2018 because of prior collection success and clearing timing near occurrences. Future propagule collection efforts for *P. sibiricum* are not planned at this time because there are nearly 700 seedlings housed at NATS Nursery from which additional spores have been collected. Propagule collection efforts for *A. herriotii* will occur within the Middle Reservoir in 2019.

A considerable portion of the 2018 collection effort focused on acquiring seeds from *O. campestris* var. *davisii* and characterization of source occurrences along the Peace River prior to clearing. The field team collected from six of the eight documented occurrences that will be lost due to Site C and from one previously undocumented occurrence along the Peace River that will not be affected by Site C (Figure 3.1-1). The field team endeavoured to collect sufficient seed stock and genetic diversity to achieve the replacement target for this species.

The field team were successful in collecting seeds from three additional species: *Carex sprengelii* from Bear Flats; *R. rhomboideus* from north of the Hwy 29 realignment corridor in the Cache Creek area; and *C. drummondii* from along the south side of Hwy 29 east of Farrell Creek. Three species (*C. iowense*, *E. pacalis, and S. scoparium*) remain undetected after additional surveys at their documented locations in 2018. Efforts to collect propagules from the remaining species (*C. torreyi* at Industrial 85th Avenue and *P. gracilis* along the northwest side of Don Phillips Way) were unsuccessful as the seeds were not mature at the time of the visit.



Site C Project

Experimental Rare Plant Translocation
Propagule Collection Locations
Figure 3.1-1

Date: 1/2/2019

Map Number: BCH-030
Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Datum: North American 1983

ECOLOGIC environmental consulting

Legend

2017 2018

- *Carex sprengellii*
- *Carex xerantica*
- *Cirsium drummondii*
- *Polypodium sibricum*
- *Oxytropis campestris var. davisii*
- *Ranunculus rhomboideus*

0 3 6 9
1:350,000 km

N

3.1.1.1 Whole Plant Collection for Comparison to Wild Reference Transplants

In order to compare ex-situ propagated plant success against the success of wild population reference transplants, 35 wild transplants were carefully extracted from a wild sub-population sample site. Individuals were selected for above-ground growth appearance and sizes that were most similar to the ex-situ propagated individuals. Litter and loose mineral material were removed from beneath the rosette leaves to expose the extent of the entire plant. A slim weed puller was inserted into the ground at least 5 cm away from the plant centre or beside a cobble that was located next to the plant, and leveraged so as to disrupt the loose soil structure of the sand and gravel substrate, and free the central tap root and delicate lateral roots of the plant. Each plant was photographed beside a ruler in situ prior to extraction for comparisons of future above ground lateral growth (Plate 3.1-1).

Plate 3.1-1. Wild plant profile photograph and documentation of whole plant length growth at time of sampling.

Plants were measured for lateral dimensions (rosette diameter, aerial view) and longitudinal dimensions (total plant height from the top of the leaf growth to the tip of the root growth, profile view). The extent of any damage that may have occurred during extraction was also recorded. Once measurements were taken, the entire root system of individual plants was carefully placed in a pre-drilled hole in a storage container filled with soils.

3.2 PHASE 2. EX-SITU PROPAGATION

Ex-situ propagation resulting from the 2017 seed collection yielded 3,323 rare plants, including 971 *C. drummondii* (Plate 3.2-1 and Plate 3.2-2), 450 *Carex xerantica* (Plate 3.2-3 and Plate 3.2-4), 12 *C. sprengelii* (Plate 3.2-5), 1075 *O. campestris* var. *davisii* (Plate 3.2-6), and 815 *P. sibiricum* (Plate 3.2-7). A subset of these plants has been retained at the nurseries for the following reasons: 1) as insurance against random or stochastic events; 2) to increase the propagated gene pool and supplement recipient populations if and where needed; and 3) to provide sufficient time to identify additional suitable recipient sites. Table 3.2-1 summarizes the propagation results by species, nursery, and quantity.

Table 3.2-1. Ex- situ Propagation Results from the 2017 Seed Collection Efforts

Scientific Name	Common Name	Nursery of Origin	Quantity and Size
Cirsium drummondii	Drummond's thistle	NATS	671 (1 gallon pots)
		Twin Sisters	300 (plugs)
Carex xerantica	dry-land sedge	NATS	250 (plugs)
		Twin Sisters	200 (plugs)
Oxytropis campestris var. *davisii*	Davis' locoweed	NATS	775 (plugs)
		Twin Sisters	300 (plugs)
Carex sprengelii	Sprengel's sedge	Twin Sisters	12 (plugs)
Polypodium sibiricum	Siberian polypody	NATS	815 (plugs)
Total			**3,323**

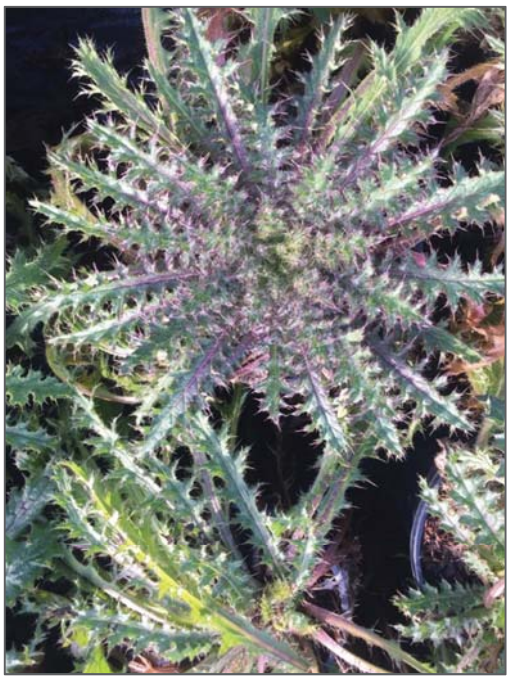


Plate 3.2-1. *Cirsium drummondii* plugs from NATS prior to planting in September 2018.

Plate 3.2-2. *Cirsium drummondii* plugs from NATS prior to planting in September 2018.

Plate 3.2-3. *Carex xerantica* seedlings from NATS prior to planting in September, 2018.

Plate 3.2-4. *Carex xerantica* seedlings from Twin Sisters prior to planting in September, 2018.

Plate 3.2-5. Carex sprengelii plugs from Twin Sisters prior to planting in September, 2018.

Plate 3.2-6. *Oxytropis campestris* var. *davisii* inflorescence resulting from the propagation efforts completed by NATS.

Plate 3.2-7. *Polypodium sibiricum* seedlings prior to planting in September, 2018.

3.3 PHASE 3. TRANSLOCATION IMPLEMENTATION

Translocation implementation involved establishment of new populations through planting at recipient sites that have greater long-term security than the locations of the source material. The recipient sites are within the known distribution range for the target plant and have similar habitat to the location of the source material.

The 2018 translocation included the following:

- Four recipient site locations: Bear Flats, the Peace River (west of Taylor, BC), along Hwy 29 (approximately 12 km east of Hudson's Hope), and Bull Mountain; and
- Five target plant species: *C. drummondii, C. xerantica*, *C. sprengelii, O. campestris* var. *davisii,* and *P. sibiricum* (Figure 3.3-1).

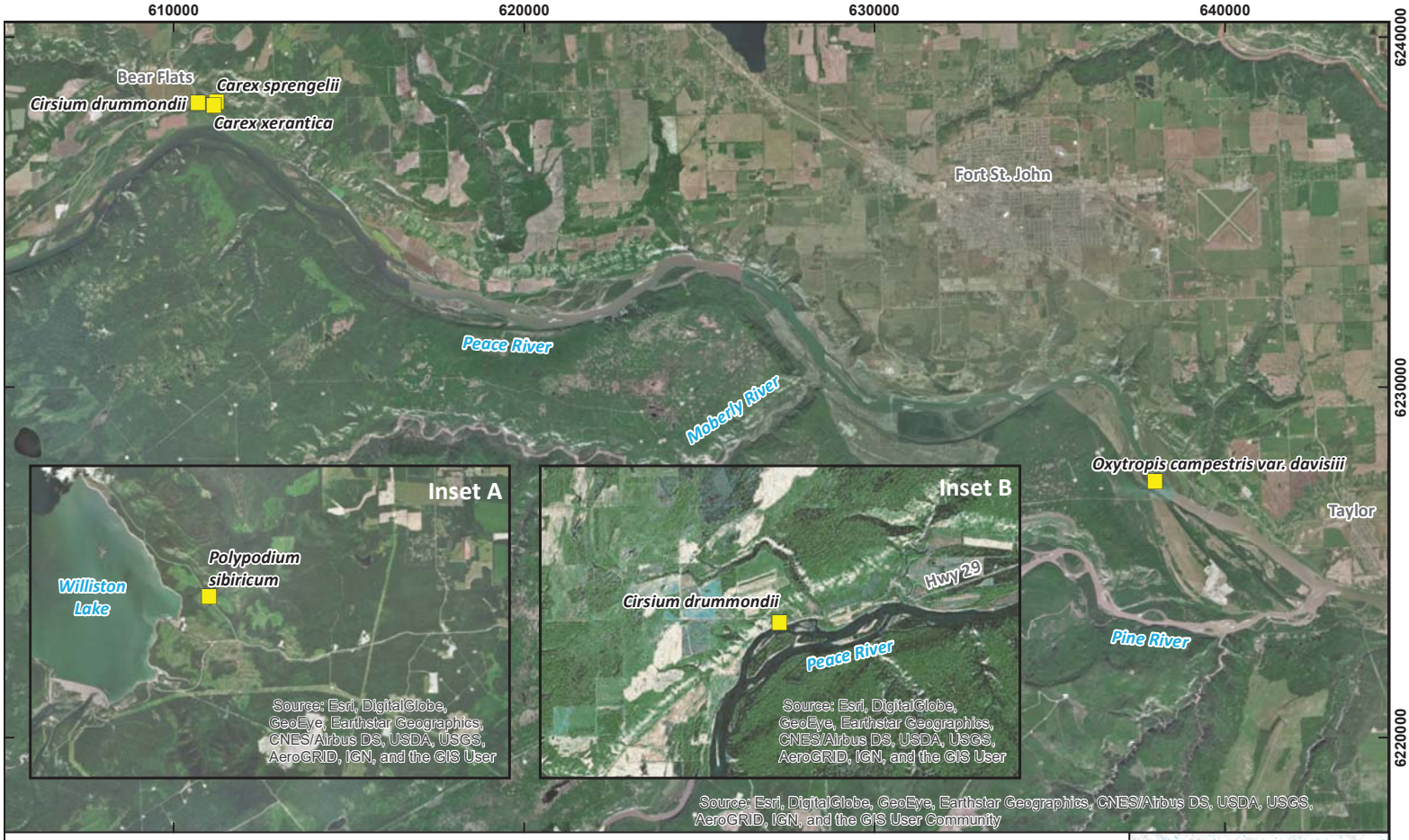
Experimental trials were established at each of the recipient sites to test if the rare plant species could withstand transplant and if there is any notable difference in terms of survival or growth of individuals within each site.

The translocation implementation involved a field team of professionals and local assistants comprising six horticulturists, three botanists, two ecologists, one soil scientist, two technicians, and one boat operator. The field aspect of the translocation occurred between September 17 and 23, 2018 and included over 224 hours of labour.

3.3.1 Cirsium drummondii

Two trials for *C. drummondii* were established at Bear Flats in two different locations, identified as sites *CIRSDRU-2018-A-50P* and *CIRSDRU-2018-B-1G* (Plate 3.3-1). Three transects with three sub-plots each were established at field site CIRSDRU-2018-A-50P-Bear Flats. Each subplot contains five individuals located within a 2.5-m radius of a centre marker (Figure 3.3-2). Individual *C. drummondii* plants were placed within a small hole (5 cm width x 10 cm depth) excavated for the plug. Soil removed from the excavations was mixed with similar soil extracted from a cutbank upslope of the plot to fill the gap between the transplants and walls of the natural ground. Each seedling was given 1,000 ml of water to ensure saturation of the surrounding soil matrix, indicated by an even presence of water visible at the surface. After transplanting, fine gravel was placed on the exposed soil surface to help reduce moisture loss from the soil and prevent soil erosion.

Three sub-plots were established for trial CIRSDRU-2018-B-1G-Bear Flats each of which had five *C. drummondii* plants installed (Figure 3.3-3). Plants were randomly arranged within a 2.5-m radius of a centre-plot flag. Individual *C. drummondii* were placed within a 25 cm wide x 40 cm deep hole that had been excavated for the pot size.



Site C Project

Experimental Rare Plant Translocation
2018 Recipient Site Locations
Figure 3.3-1

Date: 1/2/2019
Map Number: BCH-029
Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator
Datum: North American 1983

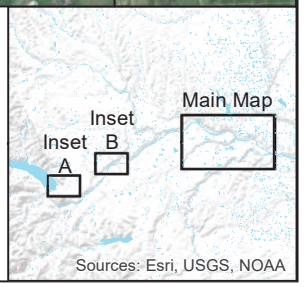
ECOLOGIC environmental consulting

Legend

- 2018 Recipient Sites

0 2 4 6
1:150,000 km

N



Individual plants were systematically tagged with numbered round aluminum tags fixed to the ground using 6-inch ground staples (Plate 3.3-2). An ERPT QA/QC data capture form was completed for each site.

Plate 3.3-1. *C. drummondii* translocation recipient site and flagged planting grid.

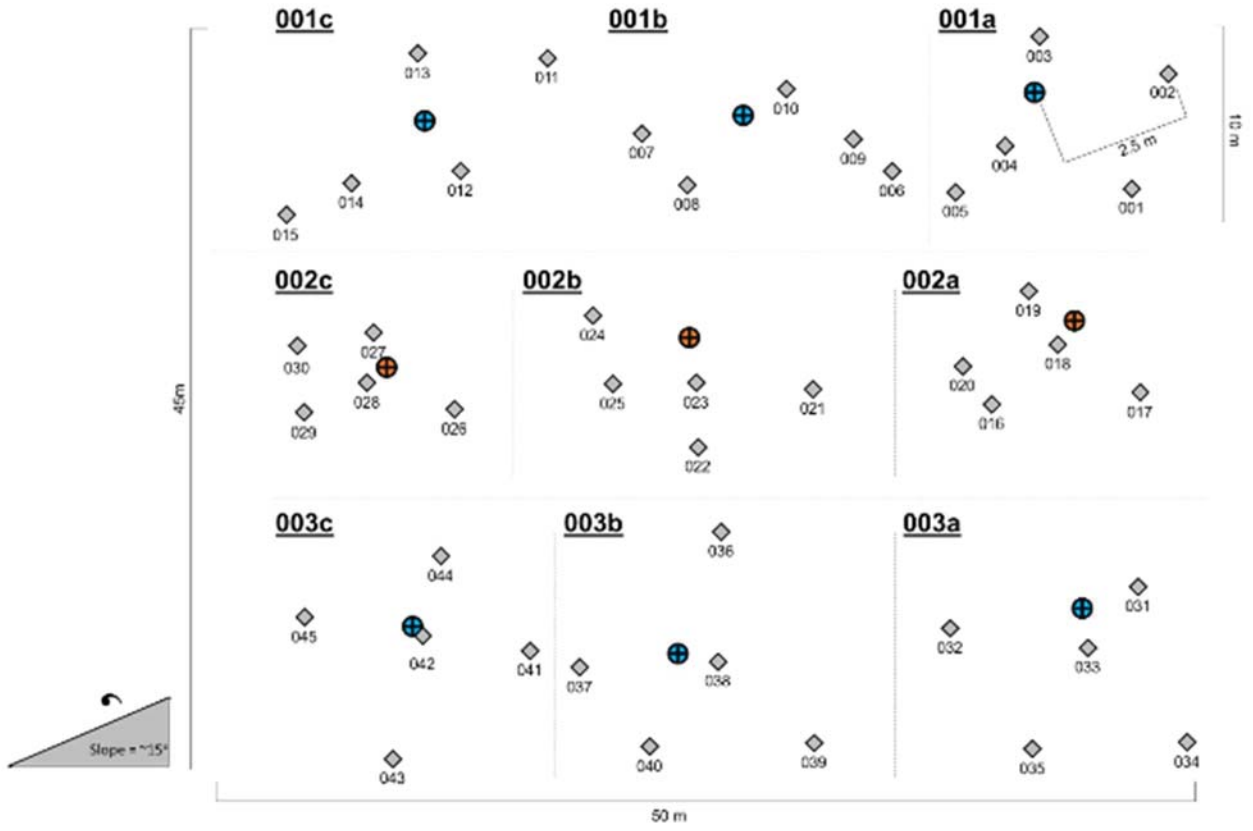


Figure 3.3-2. Field Site ID: CIRSDRU-2018-A-50P-Bear Flats planting grid for *C. drummondii* ex situ propagated seedlings

Plate 3.3-2. *C. drummondii* plug installed, measured, and marked with a round aluminum tag.

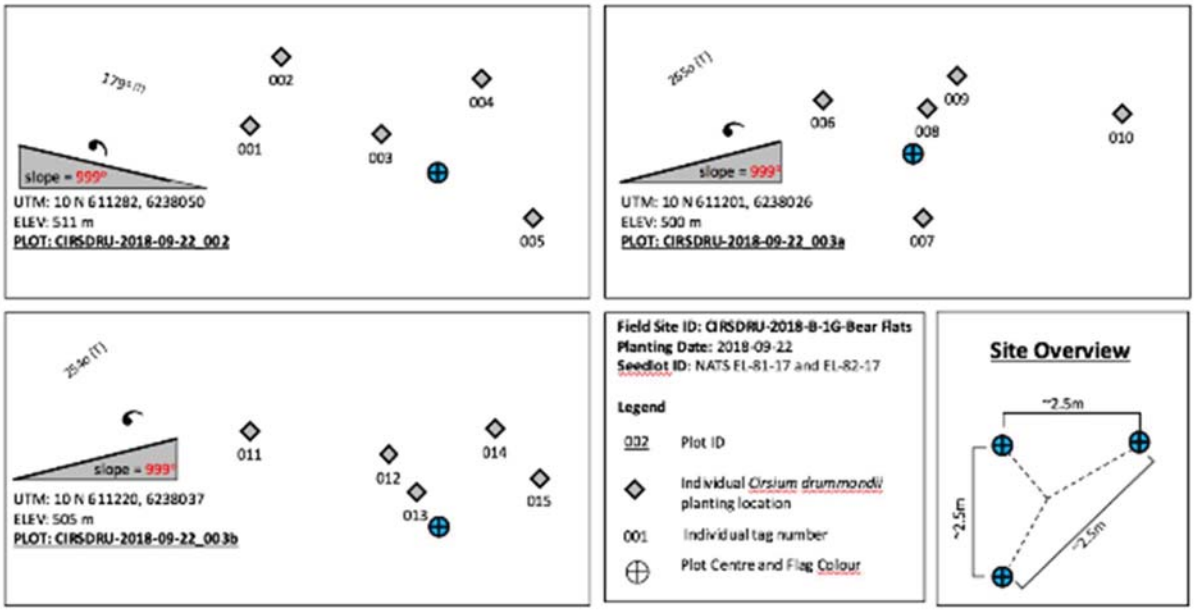


Figure 3.3-3. Field Site ID: CIRSDRU-2018-B-1G-Bear Flats planting grid for *C. drummondii* ex-situ propagated seedlings

3.3.2 Carex xerantica

Two trials for *C. xerantica* were established at Bear Flats in two different locations, identified as sites CAREXER-2018-A-50P- Bear Flats and CAREXER-2018-B-50P- Bear Flats. At each field site, three transects were established and included 14 or 15 plants per row (Plate 3.3-3). Plants were spaced approximately 50 cm apart (Figure 3.3-4, Figure 3.3-5). Individual *C. xerantica* plants were placed within a small hole (5 cm width x 10 cm depth) excavated for the plug. Soil removed from the excavations was mixed with wetted soil from the nursery of origin. Individual plants were systematically tagged with numbered round aluminum tags (Plate 3.3-4) fixed to the ground using 6-inch ground staples. Each plant was watered sufficiently to saturate the surrounding soil matrix, indicated by an even presence of water visible at the surface. An ERPT QA/QC data capture form was completed for each site.

Plate 3.3-3. *C. xerantica* translocation recipient site and flagged planting grid with installed *C. xerantica* individuals.

Plate 3.3-4. *C. xerantica* plug installed, measured, and marked with a round aluminum tag.

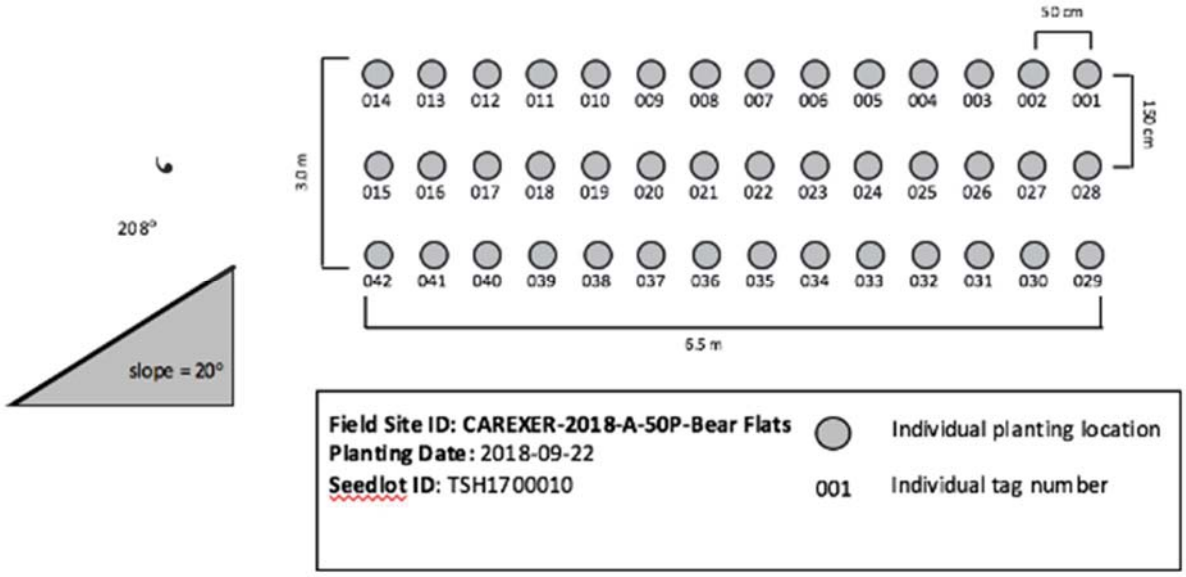


Figure 3.3-4. Field Site ID: CAREXER-2018-A-50P-Bear Flats planting grid for *C. xerantica* ex situ propagated seedlings

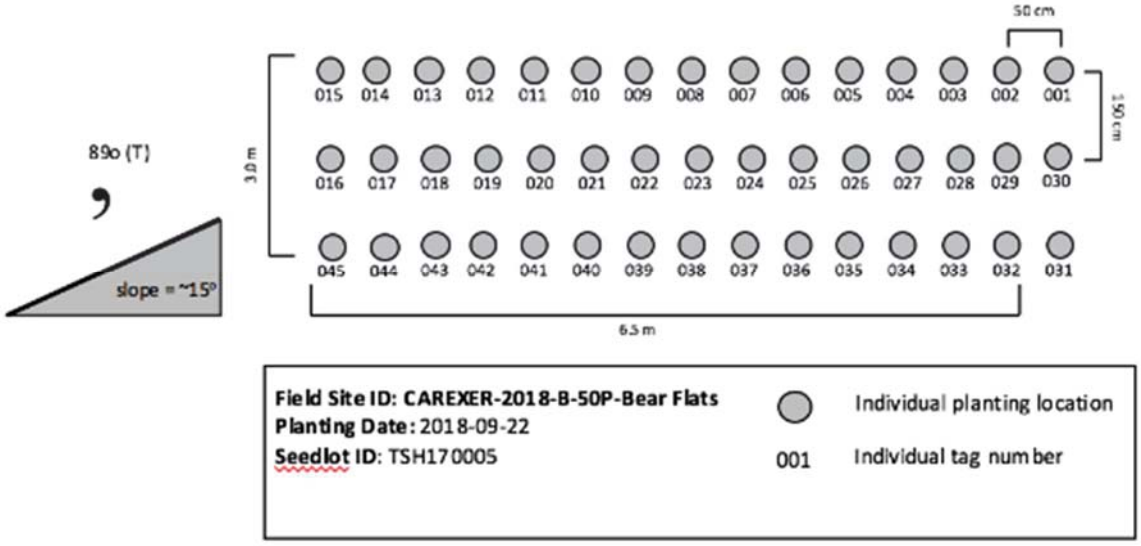


Figure 3.3-5. Field Site ID: CAREXER-2018-B-50P-Bear Flats planting grid for *C. drummondii* ex situ propagated seedlings

3.3.3 Carex sprengelii

One trial for *C. sprengellii* was established at Bear Flats, identified as sites CAREXER-2018-A-50P- Bear Flats. One plot with two rows was established. Each row includes three plants approximately 4 m apart (Figure 3.3-6). A narrow trowel was used to remove a 5-cm diameter circle of grass sod. A small hole was excavated to a depth of approximately 15 cm.

Excavations were filled with a mixture of wetted soil from the nursery of origin. A small depression was made in the centre to allow for insertion of seedlings. Individual *C. sprengelii* seedlings were then placed in the depression and covered to the base of the seedling with the remaining soil. Individual plants were systematically tagged with numbered round aluminum tags (Plate 3.3-5) fixed to the ground using 6-inch ground staples. Each plant was then watered sufficiently to ensure saturation of the surrounding soil matrix, indicated by an even presence of water visible at the surface. An ERPT QA/QC data capture form was completed for the site.

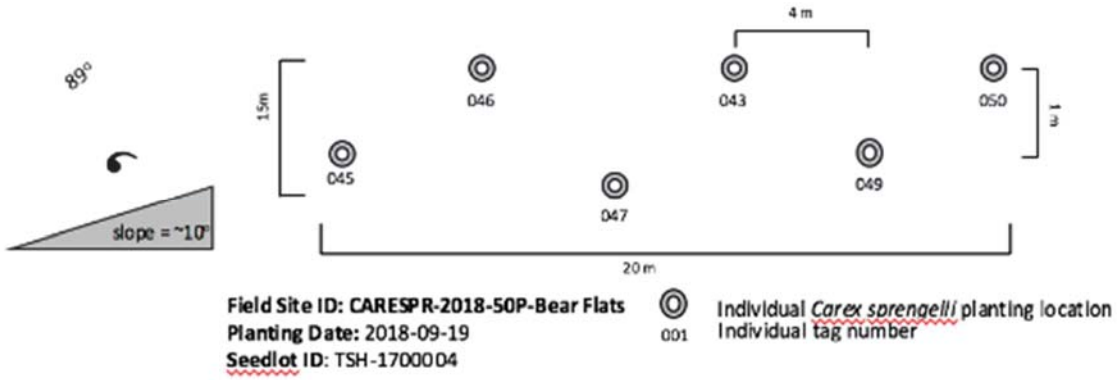


Figure 3.3-6. Field Site ID: Transects and sub-plots established for the *C. sprengelii* experimental translocation trials

Plate 3.3-5. *C. sprengelii* plug installed, measured, and marked with a round aluminum tag.

3.3.4 *Oxytropis campestris* var. *davisii*

One trial for *O. campestris* var. *davisii* , identified as OXYTCAM3-2018-50P, was established along the Peace River west of Taylor, BC. The site design includes three transects: two 45-m transects and one 50-m transect (Figures 3.3-7 through 3.3-9; Plates 3.3-6 through 3.3-8). Along each transect, subplots were laid out at 5-m intervals and included the following plant groupings:

- two plants from NATS Nursery and two plants from Twin Sisters Nursery with a 1-m^2 quadrat;

- one wild seedling within the centre of the quadrat at randomly selected intervals along a transect; and
- two wild transplants with a mixture of native and nursery soils from NATS or Twin Sisters at randomly selected intervals along a transect.

Plants were placed within the excavated holes and then the holes were filled with soil and cobbles. Leaf litter was placed around the plant to mimic natural conditions observed in the field. Individual plants were systematically tagged with numbered round aluminum tags (Plate 3.3-9) fixed to the ground using 6-inch ground staples.

Plate 3.3-6. Field Site ID: OXYTCAM3-2018-A-50P-Peace River- Transect 1.

Plate 3.3-7. Field Site ID: OXYTCAM3-2018-A-50P-Peace River- Transect 2.

Plate 3.3-8. Field Site ID: OXYTCAM3-2018-A-50P-Peace River- Transect 3.

Plate 3.3-9. *O. campestris* var. *davisii* plug installed, measured, and marked with a round aluminum tag.

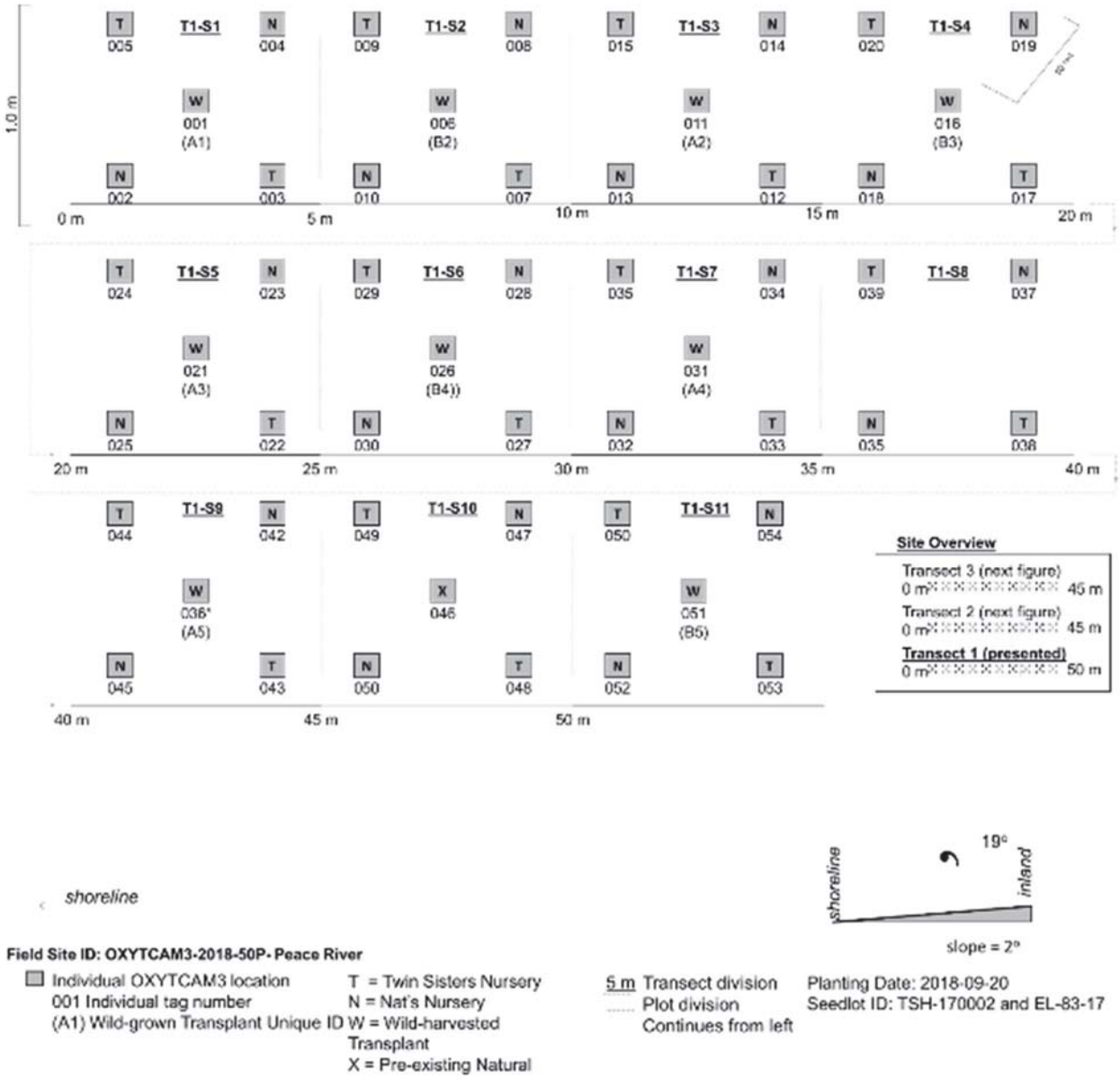


Figure 3.3-7. Transect 1 and Sub-plots Established for the *O. campestris* var. *davisii* Experimental Translocation Trials

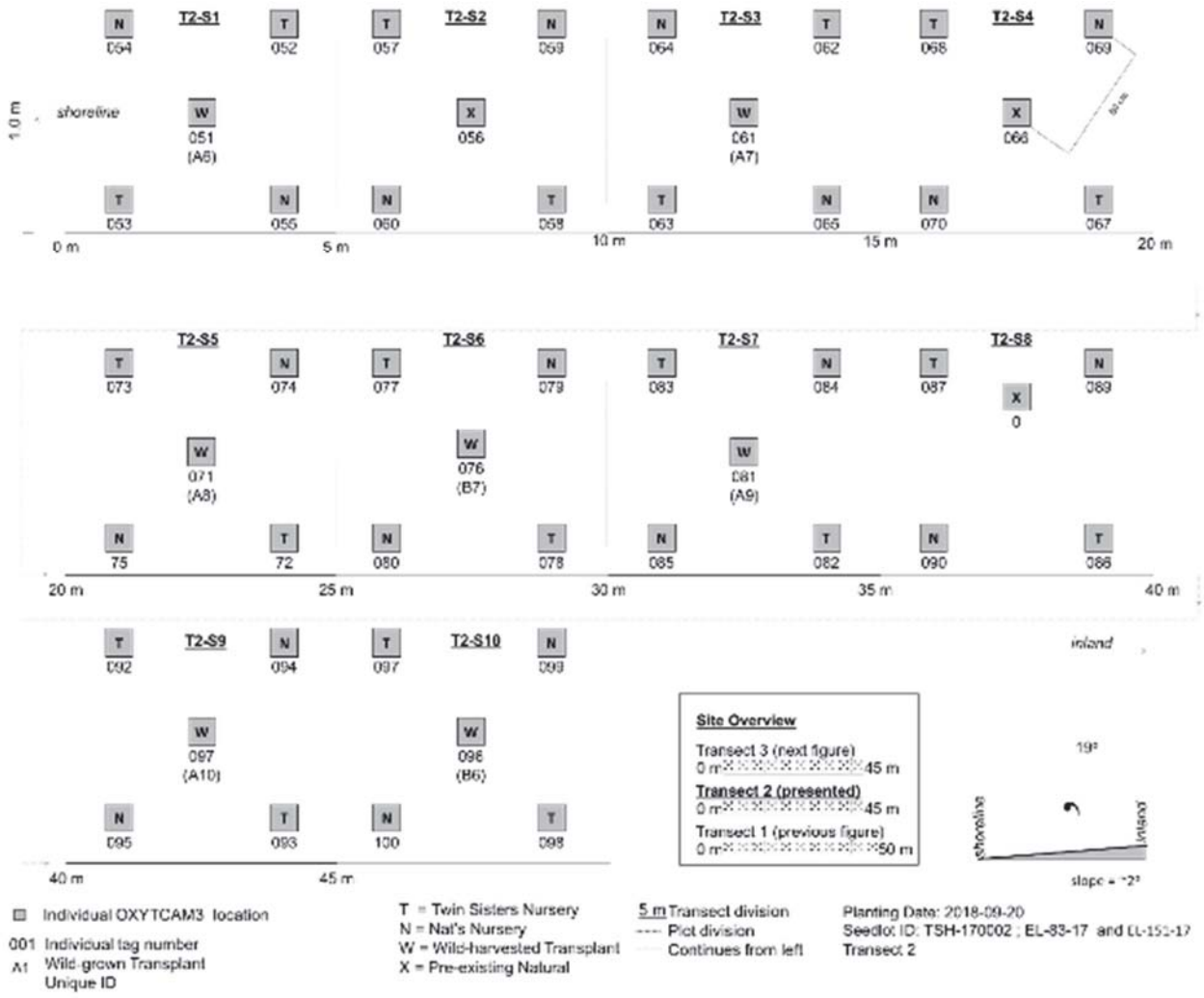


Figure 3.3-8. Transect 2 and Sub-plots Established for the *O. campestris* var. *davisii* Experimental Translocation Trials

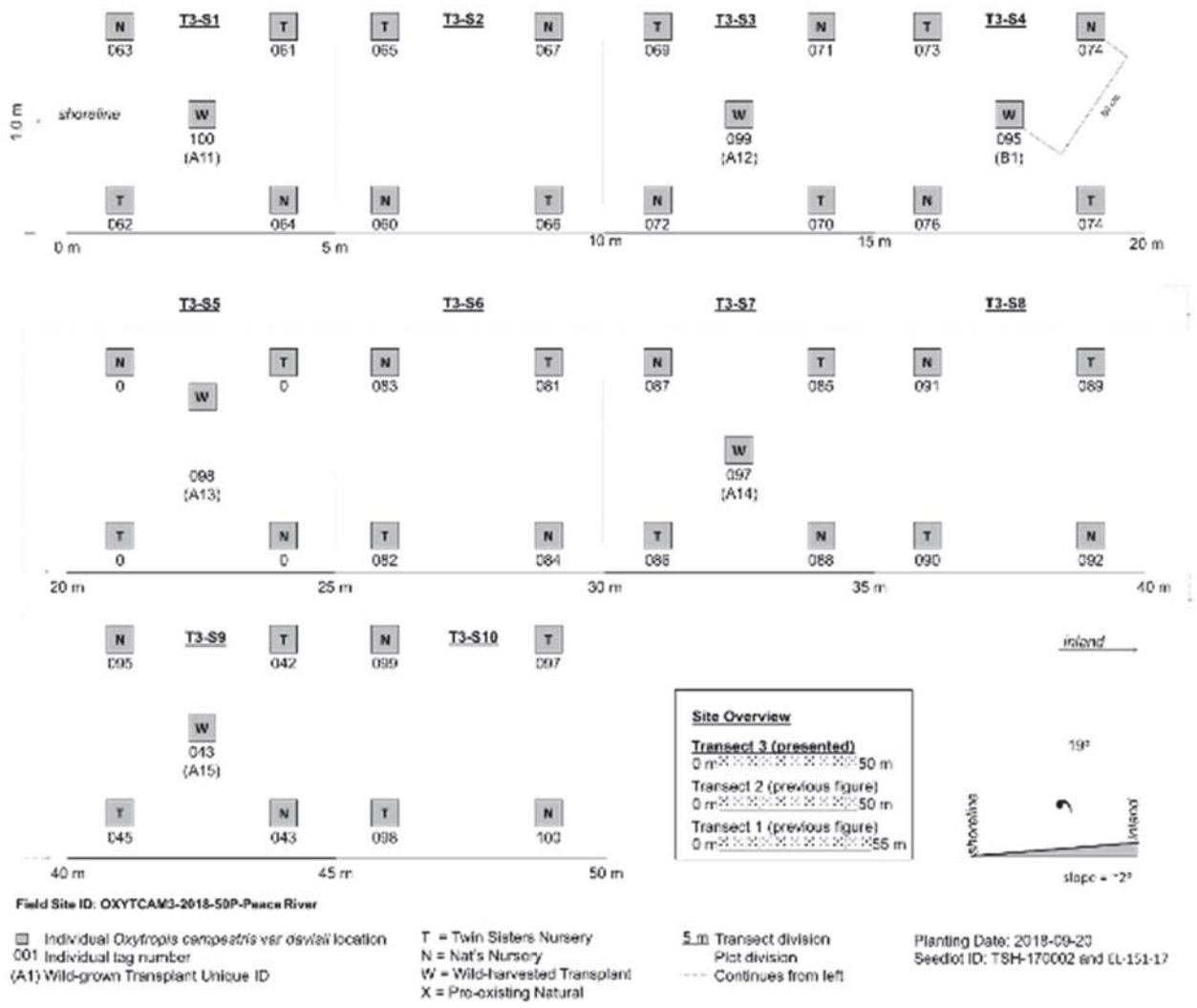


Figure 3.3-9. Transect 3 and Sub-plots Established for the *O. campestris* var. *davisii* Experimental Translocation Trials

3.3.5 Polypodium sibiricum

One trial for *P. sibiricum* , identified as POLYSIB-2018-72P, was established at Bull Mountain near the town of Hudson's Hope. *P. sibiricum* seedlings and soils were wetted and then gently inserted into the crevices and/ or moss substrate of the cliff face located at Bull Mountain. Soil was packed around the seedlings and care was taken to ensure that plants were affixed to the substrate. Individual plants were systematically tagged with numbered rectangular aluminum tags (Plates 3.3-10 and 3.3-11) buried within the crevice or moss substrate. An ERPT QA/QC data capture form was completed for the site.

Plate 3.3-10. *P. polypodium* translocation recipient site and marked individuals.

Plate 3.3-11. *P. polypodium* plug installed and marked with a rectangular aluminum tag.

4. PLAN FORWARD

The information collected from the previous year's data collection will be used to inform revisions to the 2019 monitoring program and to select future recipient sites.

The monitoring program will document a suite of parameters designed to evaluate the efficacy of translocation methods in relation to the stated objectives of the program (Sutter 1996 in Monks and Coates 2002; Austin 2004; Vallee et al. 2004; Maslovat 2009; Vaino 2011). All actions associated with the translocation will be fully documented; the goal is to retain as much information as possible on the pathway of a given plant (e.g., from seed collection to planting) to facilitate post-hoc assessments of success. Specifically, the monitoring program will measure, document, and evaluate the following:

- the efficacy of the methods used to 1) characterize donor and recipient sites, 2) collect and store plant propagules, 3) conduct ex-situ propagation, and 4) translocate the rare plant species from the host site to the recipient sites;
- the efficacy of the techniques used for managing the translocated plant propagules (e.g., site preparation, watering; Carlsen et. al 2011; Rynear et. al. 2013);
- the survival of the translocated rare plant species through monitoring of individuals, threats, resilience, and persistence (Pavlik 1996; Vallee et al. 2004, Maslovat 2009, Weeks et al. 2011); and
- the success of follow-up procedures applied to address any declines in survival or fitness of the translocated plants.

The information gained from the experimental approach will be used to identify which approaches are effective and to isolate inadequacies in specific methods or management. Monitoring the success or failure of the methods will assist in identifying opportunities for improvement within an adaptive management framework. Importantly, this information can also help to inform other translocation projects, thereby improving the overall success of translocation efforts for rare plant conservation. The approach of the adaptive management strategy includes assessment and revisions to each of the program phases, where warranted. The program-specific adaptive management diagram is in progress.

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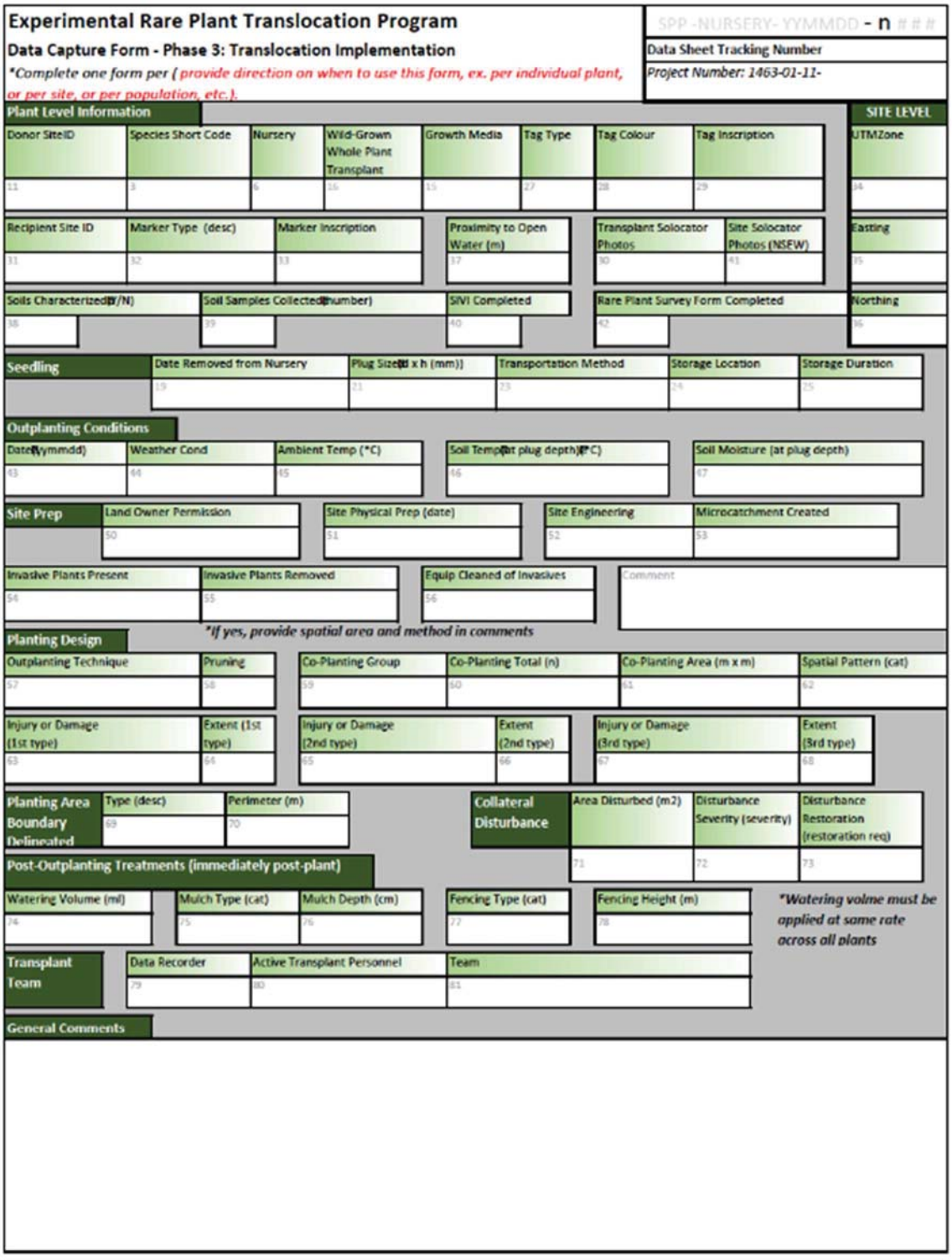
APPENDIX A. DATA CAPTURE FORM



Experimental Rare Plant Translocation Program

Data Capture Form - Phase 3: Translocation Implementation

**Complete one form per (provide direction on when to use this form, ex. per individual plant, or per site, or per population, etc.).*

SPP -NURSERY- YYMMDD - n # # #

Data Sheet Tracking Number

Project Number: 1463-01-11-

Plant Level Information

Donor SiteID	Species Short Code	Nursery	Wild-Grown Whole Plant Transplant	Growth Media	Tag Type	Tag Colour	Tag Inscription
11	3	6	16	15	27	28	29

SITE LEVEL

UTMZone	Easting	Northing
34	35	36

Recipient Site ID	Marker Type (desc)	Marker Inscription	Proximity to Open Water (m)	Transplant Solocator Photos	Site Solocator Photos (NSEW)
31	32	33	37	30	41

Soils Characterized (Y/N)	Soil Samples Collected (number)	SIVI Completed	Rare Plant Survey Form Completed
38	39	40	42

Seedling

Date Removed from Nursery	Plug Size (d x h (mm))	Transportation Method	Storage Location	Storage Duration
19	21	23	24	25

Outplanting Conditions

Date (yymmdd)	Weather Cond	Ambient Temp (°C)	Soil Temp (at plug depth) (°C)	Soil Moisture (at plug depth)
43	44	45	46	47

Site Prep

Land Owner Permission	Site Physical Prep (date)	Site Engineering	Microcatchment Created
50	51	52	53

Invasive Plants Present	Invasive Plants Removed	Equip Cleaned of Invasives	Comment
54	55	56	

**If yes, provide spatial area and method in comments*

Planting Design

Outplanting Technique	Pruning	Co-Planting Group	Co-Planting Total (n)	Co-Planting Area (m x m)	Spatial Pattern (cat)
57	58	59	60	61	62

Injury or Damage (1st type)	Extent (1st type)	Injury or Damage (2nd type)	Extent (2nd type)	Injury or Damage (3rd type)	Extent (3rd type)
63	64	65	66	67	68

Planting Area Boundary Delineated	Type (desc)	Perimeter (m)
	69	70

Collateral Disturbance	Area Disturbed (m2)	Disturbance Severity (severity)	Disturbance Restoration (restoration req)
	71	72	73

Post-Outplanting Treatments (immediately post-plant)

Watering Volume (ml)	Mulch Type (cat)	Mulch Depth (cm)	Fencing Type (cat)	Fencing Height (m)
74	75	76	77	78

**Watering volme must be applied at same rate across all plants*

Transplant Team	Data Recorder	Active Transplant Personnel	Team
	79	80	81

General Comments

APPENDIX B. 2018 EXPERIMENTAL RARE PLANT TRANSLOCATION SUMMARY

2018 Experimental Rare Plant Translocation Summary

Rare Plant Species		Propagule Collection by Year				Ex-situ Propagation		Translocation Implementation		Clearing Timing
		2017		2018		2018		2018	2018	
Scientific Name	English Name	Collection successful (Yes or No)	Summary	Collection successful (Yes or No)	Summary	Propagation successful (Yes or No)	Number of Plants	Translocation Carried Out (Yes or No)	Number of Plants Transplanted	Season and Year
Artemisia herriotii	Herriot's sage	No	Several attempts to collect seeds occurred between July and November but none of the visited plants had developed mature seeds.	no attempt	Lower priority species due to the number of available occurences for collection. Propagule collection efforts will occur within the Middle Reservoir in 2019.	na	na	na	na	Summer 2015 - Spring 2016 Summer 2018 - Spring 2020 Winter 2017/2018 - Spring 2019 Winter 2021/2022
Carex sprengelii	Sprengel's sedge	Yes	Collected from Bear Flats.	Yes	Collected from Bear Flats.	Yes	12 (6 held back)	Yes	6	Winter 2017/2018 - Spring 2019
Carex torreyi	Torrey's sedge	no attempt	Lower priority species in 2017 collection year as the occurences are located in quarries that were not scheduled for use in 2018.	No	Several attempts to collect propagules from the occurrence at Industrial 85th Avenue. The first visit occured in June; however, none of the visited plants had mature seeds. The second visit was unsuccessful due to lack of access.	na	na	na	na	not available
Carex xerantica	dry-land sedge	Yes	Collected from Area E.	No	Lower priority species due to the number of plants being stored at the native plant nurseries for transplant and/or use as a seed bank One attempt was made to collect from Area E on August 13th but the seeds had already dispersed.	Yes	450 plants. 363 remaining plants available for transplant and/or use in creating a seed bank.	Yes	87 plants	Winter 2017/2018 - Spring 2019 and some areas not available
Chrysosplenium iowense	Iowa golden-saxifrage	No	No attempt.	No	Species not detected during the June 21st site visit along the right bank of Peace River upstream from Wilder Creek. Only *Chrysosplenium tetandrum* was detected.	na	na	na	na	Winter 2017/2018 - Spring 2019
Cirsium drummondii	Drummond's thistle	Yes	Collected from Watson Slough.	Yes	Collected from south side of Hwy 29 east of Farrell Creek.	Yes	971 plants. 911 remaining plants available for use in creating a seed bank.	Yes	65 plants	Summer 2015 - Spring 2016 Summer 2018 - Spring 2020 Summer 2020 - Spring 2021
Erigeron pacalis	Peace daisy	No	Species not detected in August after 9 person hours at the documented occurence.	No	Species not detected.	na	na	na	na	The only known documented occurence is located outside of the inundation area but near the high water mark.
Oxytropis campestris* var. *davisii	Davis' locoweed	Yes	Collected from 2 occurences along the Peace River and 1 occurrence near the mouth of the Halfway River.	Yes	Collected from 7 occurences along the Peace River.	Yes	1075 plants. Approximately 925 remaining plants available for transplant and/or use in creating a seed bank.	Yes	150 plants	Summer 2018 - Spring 2020 Winter 2017/2018 - Spring 2019
Penstemon gracilis	slender penstemon	No	Several attempts to collect seeds. The first visit occured in July; however, none of the plants had mature seeds. The second attempt occured in August; however, the plants had been browsed such that no seed collection was possible.	No	Collection attempted on July 30th at the occurrence on the northwest side of Don Phillips Way but the plants did not have mature seeds	na	na	na	na	Element occurrences will be visited in the spring of 2019 for seed collection and in the fall for cuttings collection.

2018 Experimental Rare Plant Translocation Summary

Rare Plant Species		Propagule Collection by Year				Ex-situ Propagation		Translocation Implementation		Clearing Timing
		2017		2018		2018		2018	2018	
Scientific Name	English Name	Collection successful (Yes or No)	Summary	Collection successful (Yes or No)	Summary	Propagation successful (Yes or No)	Number of Plants	Translocation Carried Out (Yes or No)	Number of Plants Transplanted	Season and Year
Polypodium sibiricum	Siberian polypody	Yes	Collected from Portage Mountain.	no further collection required	Future propagule collection efforts for P. sibiricum are not planned at this time as there are nearly 700 seedlings housed at NATS Nursery from which additional spores have been collected.	Yes	815 plants. 780 remaining plants available for transplant and/or use in creating a spore bank.	Yes	35 plants	Fall 2017-Winter 2018. There are additional element occurrence locations in areas west of the project not slated for clearing.
Ranunculus rhomboideus	prairie buttercup	No	New species to the program; plants unavailable for seed collection in July 2017 due to early seed maturation (mid-June).	Yes	Collected from north of the Hwy 29 realignment corridor in the Cache Creek area.	na	na	na	na	Summer 2018 - Spring 2020
Schizachyrium scoparium	little bluestem	No	Not detected.	No	Several sites were revisted but no *S. scoparium* was detected.	na	na	na	na	None of the reported locations fall within areas slated for clearing.

Appendix 10. Bald Eagle Nest Surveys – Summary for 2018

MEMORANDUM

Date:	December 7, 2018
To:	Brock Simons, Terrestrial Biodiversity Specialist, Site C Clean Energy Project
From:	Beth Boyce, M.Sc., EPt and Charlie Palmer, P.Biol., R.P.Bio. Hemmera
File:	989619-05
Re:	Bald Eagle Nest Surveys – Summary for 2018

1.0 INTRODUCTION

This memo summarizes the findings of the bald eagle (*Haliaeetus leucocephalus*) nest surveys on the Peace River conducted in May and June 2018. The purpose of the surveys was to document the status of known bald eagle nests along the Peace River, the status of known nests at wetlands near the Site C transmission line, and to determine if new bald eagle nests had been constructed in either area. This is a continuation from the surveys that were completed in 2016-17 (Hemmera 2016, 2018) and during baseline studies for the Site C Clean Energy Project.

The primary objectives of the bald eagle nest surveys were to:

1. Determine the activity status (active/not active) and productivity of bald eagle nests in the study area (footprint plus disturbance buffer between the Alberta border and Hudson's Hope).
2. Provide the data to BC Hydro for use in guiding mitigation during ongoing and upcoming construction activities.

Data collected during this survey provides information on nest status (i.e., if it is still present), activity (i.e., birds observed on the nest), and productivity (i.e., presence of eggs or chicks).

2.0 METHODS

Known bald eagle nest locations (Hemmera 2018) along the Peace River and at natural wetlands adjacent to the Site C transmission line right-of-way were surveyed over three days in May and June 2018 (May 16, June 1 and 13), following the methods outlined by the Resources Inventory Committee (RIC 2001). The survey was conducted from a helicopter with a two-person crew consisting of a crew lead and a technician. The flights took place between two hours after sunrise and two hours before sunset to avoid contrasting shadows. The helicopter maintained a minimum 50 m height above nests. Previously identified nest locations from past aerial surveys (Hemmera 2018) were visited. New nests observed during the survey were added to the database, and nest status and activity data were collected for new nests and previously observed nests. Incidental observations of bald eagle nests reported by other crews working for BC Hydro were also visited. Nests that were no longer present in 2017 (e.g., nest disintegrated, host tree natural failure or host tree felled) were not visited in 2018.

After surveys, the results were provided to BC Hydro in Excel (.csv) format, including applicable comments and coordinates for each nest. Hemmera has also provided BC Hydro with an Access database that contains the combined 2017 and 2018 data.

Results from the surveys in 2017 indicate that the data obtained from the mid-May and mid-June surveys have much more information for deriving productivity than the early May survey data, suggesting that two surveys only are necessary for achieving project objectives (Hemmera 2018). However, due to uncertainty regarding inter-annual variability, three surveys were conducted again in 2018 with the first survey completed in mid-May.

Productivity for bald eagle nests was calculated as the sum of estimated productivity from active nests divided by the number of active nests. Productivity for each nest was estimated according to the following assumptions:

- The number of chicks in a nest at the last observation reflects the number fledged, except nests with three chicks which were only assumed to fledge two chicks.
- Occupied nests included those with evidence of adults present at any one of the three field surveys.
- No second clutches.

Fledging success for bald eagles raised in nests with multiple chicks is much-reduced and chicks from the third-laid eggs are unlikely to survive (Gerrard and Bortolotti 1988, as cited in Buehler 2000). In two chick broods, both chicks generally survive (e.g., only two chicks from 37 two-chick broods in Saskatchewan died [Bortolotti 1986]).

Second clutches in natural populations of bald eagle are not observed (Buehler 2000), likely due to the long duration of breeding, as speculated by Newton (1977). Exceptions are known when eggs or nestlings are artificially removed as part of captive breeding programs (Morrison and Walton 1980, Wood and Collopy 1993), or eggs are lost early in the season (Steenhof and Newton 2007). No second clutches have been observed or are expected in the study area.

3.0 SURVEY RESULTS

Observations at each known bald eagle nest site were recorded, with statuses of “active”, “inactive”, “not detected”, or “unknown”, assigned to each nest (**Table 3.1**). Observations of stick nests being used by species other than bald eagles, and discovered during these surveys, are included in **Appendix A**.

Table 3.1 2018 bald eagle nest survey summary results, May and June 2018

Nest ID	Year nest first observed*	2018 Status			Nest comment
		May 16	June 1	June 13	
6	Pre-2014	Active	Active	Active	Adult and chicks
8	Pre-2014	Active	Active	Active	Adult and chicks
13	Pre-2014	Active	Active	Active	Adult and chicks
25	Pre-2014	Inactive	Inactive	Inactive	Nest in good shape but empty
29	Pre-2014	Active	Active	Active	Adult and chicks
38	Pre-2014	Active	Active	Active	Adult and chicks
62c	Pre-2014	Inactive	Inactive	Inactive	Nest in good shape but empty
100	Pre-2014	Inactive	Inactive	Inactive	Nest in good shape but empty
101	Pre-2014	Active	Active	Active	Adult and chicks
104	Pre-2014	Active	Active	Active	Adult and chicks
121	Pre-2014	Active	Active	Active	Adult and chicks
122	Pre-2014	Inactive	Inactive	Inactive	Nest condition deteriorating
127	Pre-2014	Not detected	Inactive	Inactive	Empty
128	Pre-2014	Active	Active	Active	Adult and chicks
132	Pre-2014	Active	Active	Active	Adult and chicks
133	Pre-2014	Active	Active	Active	Adult and chicks
137	Pre-2014	Not found	Not detected	Not detected	Unable to re-locate nest in 2018. Re-survey required to confirm absence,
138	Pre-2014	Inactive	Inactive	Inactive	Nest condition deteriorating
144	Pre-2014	Active	Active	Active	Adult and chicks
146	Pre-2014	Active	Active	Active	Adult and chicks
147	Pre-2014	-	-	Active	Adult and chicks
155	Pre-2014	Inactive	Active	Active	Adult and chicks
203	Pre-2014	Active	Active	Inactive	Adult only
218	Pre-2014	Inactive	Inactive	Inactive	Nest condition deteriorating
219	Pre-2014	Active	Active	Active	Adult and chicks
222	Pre-2014	Active	Active	Active	Adult and chicks
223	Pre-2014	Inactive	Inactive	Inactive	Nest in good shape but empty
224	Pre-2014	Inactive	Inactive	Inactive	Nest condition deteriorating
225	Pre-2014	Not detected	Not detected	Not detected	No BAEA in the area
302	2014	-	-	Active	Adult and chicks
303	2014	Inactive	Not detected	Not detected	Unable to re-locate nest in 2018. Re-survey required to confirm absence,
400	2016	Active	Active	Active	Adult and chicks

Nest ID	Year nest first observed*	2018 Status			Nest comment
		May 16	June 1	June 13	
500	2016	Not detected	Not detected	Not detected	Tree and nest gone
600	2017	Active	Inactive	Inactive	Eggs were seen on the visit 1, but not on subsequent visits.
601	2017	Inactive	Inactive	Inactive	Nest in good shape but empty
602	2017	Inactive	Inactive	Inactive	Nest condition deteriorating
604	2017	Active	Inactive	Inactive	Adults and eggs seen on visit 1 but nest empty on subsequent visits
607	2017	Active	Active	Active	Adult and chicks
608	2017	-	-	Active	Adult and chicks
610	2017	Inactive	Inactive	Inactive	Nest condition deteriorating
612	2017	Not detected	Not detected	Not detected	Tree and nest gone
701	2018	Inactive	Inactive	Inactive	Nest in good shape but empty
702	2018	Active	Inactive	Inactive	Adults seen with no eggs on the first visit. Nest in good shape but empty.
705	2018	Active	Inactive	Inactive	Adults and chicks seen on visit 1 but not subsequently. Adults seen nearby.
707	2018	-	Active	Active	Chicks
708	2018	-	-	Inactive	Old nest. Unoccupied.
709	2018	-	-	Active	Adult and chicks
710	2018	Unknown	Unknown	Unknown	Observed by third party on July 18, 2018

Notes:
'*' - Year first observed for nests recorded before 2014 is not known as the Site C EIS does not provide this detail, but rather only that that BAEA nest surveys were conducted and the nests found in 2006, 2008, and 2011. Surveys were conducted in 2012, but no nests were detected.
Active – nest present and BAEA using nest; Inactive – nest present but unused; not detected- nest not detected; unknown – incidental observation from third party, nest status unconfirmed by Hemmera; '-' nest not surveyed.
Grey rows show nests that do not need to be re-surveyed in future years.

In 2018, 48 bald eagle nests were surveyed and 44 were observed. Of the 44 nests observed, seven bald eagle nests were newly identified in 2018; six were identified as bald eagle nests during the surveys and one was reported as a bald eagle nest by a third party (Nest ID 710).

During the 2018 surveys, two of the nests re-visited, Nest ID 500 and 612 were not detected because the tree and nest were gone (**Table 3.1**). Nest ID 500 and 612 will not be re-surveyed in 2019. Nest ID 137 and 303 were not able to be re-located during the 2018 field surveys. However, the trees in the area were still present, and therefore the status of these two nests could not be confirmed in 2018. A new nest may have been built near each of these locations (Nest ID 702 and 701 respectively) which may explain the absence of nest ID 137 and 303, both of which will be revisited in 2019 to confirm absence.

Of the bald eagle nests in **Table 3.1**, 28 were observed to be active at least once during the 2018 surveys, and of those, 22 were observed with at least one chick in the nest (**Table 3.2**).

Table 3.2 Active bald eagle nests and assumed productivity, May and June 2018

Nest ID	May 16	June 1	June 13	Estimated Productivity (# fledged)
6	Adult, Chick (1)	Chick (1)	Adult, Chick (1)	1
8	Adult, Chick (1)	Chick (1)	Adult, Chick (1)	1
13	Adult, Chick (1)	Chick (1)	Chick (1)	1
29	Adult, Chicks (2)	Adult, Chicks (2)	Adult, Chicks (2)	2
38	Adult, Chick (1)	Chick (1)	Chick (1)	1
101	Adult, Chick (1)	Adult, Chicks (2)	Adult, Chicks (2)	2
104	Adult, Chicks (2)	Adult, Chicks (2)	Adult, Chicks (2)	2
121	Adult, Chicks (2)	Adult, Chicks (2)	Adult, Chicks (2)	2
128	Adult, Chick (1)	Chick (1)	Chick (1)	1
132	Adult, Chicks (2)	Adult, Chicks (2)	Adult, Chicks (2)	2
133	Adult	Adult, Chicks (2)	Adult, Chick (1)	1
144	Chicks (2)	Chicks (2)	Adult, Chicks (2)	2
146	Adult, Chicks (3)	Adult, Chick (1)	Chick (1)	1
147	-	-	Adult	0
155	Inactive	Adult	Adult, Chick (1)	1
203	Adult	Adult	Inactive	0
219	Adult, Chicks (2)	Adult, Chicks (1)	Adult, Chicks (2)	2
222	Adult, Chicks (2)	Adult, Chicks (2)	Chick (2)	2
302	-	-	Adult, Chicks (3)	2
400	Adult, Chicks (2)	Adult, Chicks (2)	Chicks (2)	2
600	Adult	Inactive	Inactive	0
604	Adult, Eggs (2)	Inactive	Inactive	0
607	Adult, Chick (1)	Adult, Chicks (2)	Adult, Chicks (2)	2
608	-	-	Adult, Chicks (1)	1
702	Adult	Inactive	Inactive	0
705	Adult, Chick (1)	Inactive	Inactive	0
707	-	Chicks (2)	Chicks (2)	2
709	-	-	Adult, Chick (1)	1
Total				**34**

Notes: Active – nest present and BAEA using nest; Inactive – nest present but unused; '-' nest not surveyed.

The number of chicks in active nests ranged from zero (adult or adults present, but no chicks) to three (**Table 3.2**). Estimated average productivity for active bald eagle nests in the study area in 2018 is estimated to be 1.21 young per active nest.

The number of nests for each status category and estimated average productivity of active nests in 2017 and 2018 have been provided in **Table 3.3**. Fewer bald eagle nests were observed on the Peace River during 2018, however, average estimated productivity per active nest was slightly higher than that calculated for 2017 (**Table 3.3**).

Table 3.3 Year 1 and 2 Bald Eagle Nest Activity and Productivity on the Peace River

Nest Status	2017	2018
Active	34	28
Inactive	7	15
Not Detected	18	4
Unknown	-	1
Total	**59**	**48**
Estimated Productivity	**1.15**	**1.21**

Note: unknown – incidental observation from third party, nest status unconfirmed by Hemmera

4.0 DISCUSSION AND RECOMMENDATIONS

The 2018 surveys represent the second year of productivity monitoring of bald eagle nests in the study area. Productivity on the Peace River in this study is comparable with other areas where pesticides have not affected productivity in bald eagles (Elliot and Norstrom 1997). Examples from other studies include 0.88 to 1.24 young produced per occupied site in the Aleutian archipelago, Alaska (Anthony et al 1999), 0.72-1.18 young fledged per occupied site in Oregon (Isaacs et al 1983), 1.56 eggs or downy young per nest from between 19 and 43 active nests in Alaska (Hodges 1982), and 1.14 young/nest from 109 active nests in north central Florida (McEwan and Hirth 1979). The aerial survey methods used in this study on the Peace River are like those used in some of the other studies reported (Hodges 1982, Elliot and Norstrom 1998).

Bald eagle nesting phenology in the Peace is asynchronous; some bald eagles were observed incubating eggs on nests at the same time as other bald eagles were brood-rearing or had chicks that had already fledged. Some bald eagles were observed establishing nests very late in the recognised “nesting season” from February 5 – June 25 (MOE 2013), such that one nest (Nest ID 155) that was inactive during the May survey recorded no chicks until the last survey in mid-June (**Table 3.2**). This asynchronous nesting makes surveying for productivity difficult, particularly late in the season when the leaves from host trees obscure nests and the precise number of fledged chicks are difficult to discern. However, estimates of productivity gained by helicopter observations using consistent methods should form a useful basis for comparison of relative productivity between nests (including artificial platform nests) and years.

Continued challenges with obtaining precise productivity metrics include (i) the large size of the study area (~200 km long), which to survey in one day requires stable weather conditions that sometimes don't coincide with desirable survey timing, (ii) limiting visitations to limit disturbance of bald eagles and (iii) observability during mid-June and later surveys being diminished due to leaves obscuring nest visibility.

5.0 CLOSING

This Work was performed in accordance with BCO95055 between Hemmera Envirochem Inc. (Hemmera), a wholly owned subsidiary of Ausenco Canada Inc. (Ausenco), and BC Hydro (Client), dated 21 June 2016 (Contract). This Report has been prepared by Hemmera, based on fieldwork conducted by Hemmera, for sole benefit and use by BC Hydro. In performing this Work, Hemmera has relied in good faith on information provided by others, and has assumed that the information provided by those individuals is both complete and accurate. This Work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the Report was produced. The conclusions and recommendations contained in this Report are based upon the applicable guidelines, regulations, and legislation existing at the time the Report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

We have appreciated the opportunity of working with you on this project and trust that this report is satisfactory to your requirements. Please feel free to contact the undersigned regarding any questions or further information that you may require.

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APPENDIX A

Appendix 11. Ground Nesting Raptor Monitoring 2018 Annual Report

Site C Clean Energy Project
Ground Nesting Raptor Monitoring
2018 Annual Report



PRESENTED TO

BC Hydro and Power Authority

Saulteau EBA Environmental Services Joint Venture.
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Site C Clean Energy Project Ground Nesting Raptor Monitoring 2018 Annual Report

FILE: 704-ENV.VENV03095-01.GNRM 2018
March 22, 2019

PRESENTED TO

Site C Clean Energy Project
BC Hydro and Power Authority
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EXECUTIVE SUMMARY

Saulteau EBA Environmental Services Joint Venture (SEES JV) completed surveys of ground nesting raptors (Short-eared Owl [*Asio flammeu*] and Northern Harrier [*Circus cyaneus*]) in the area of BC Hydro and Power Authority's (BC Hydro) Site C Clean Energy Project ("Site C") in spring and summer 2018. The surveys were part of BC Hydro's Ground Nesting Raptor Follow-up Monitoring Program. This report describes the methods used to conduct the surveys and provides a summary of the results.

The ground nesting surveys were completed at two cleared portions of the Site C reservoir along the Peace River and Highway 29 (Bear Flats area). Ground nesting raptor surveys were completed three times over May and June 2018. The surveys were conducted through stationary standwatches. The cleared portions near Highway 29 were accessed on foot and the areas along the Peace River were accessed by boat. No ground nesting raptors were observed at any of the cleared portions of the footprint along the Peace River or Highway 29. No nests or possible nests were observed at any of the areas surveyed. At the present time, there is no evidence of ground nesting raptors nesting within cleared portions of the reservoir. Surveys in 2019 will continue in all cleared areas within the reservoir and in the mitigation properties.

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APPENDICES

1.0 INTRODUCTION

Saulteau EBA Environmental Services Joint Venture (SEES JV) completed surveys of ground nesting raptors in the area of BC Hydro and Power Authority's (BC Hydro) Site C Clean Energy Project ("Site C") in spring and summer 2018. The surveys were part of BC Hydro's Ground Nesting Raptor Follow-up Monitoring Program (BC Hydro 2016). This report describes the methods used to conduct the surveys and provides a summary of the results.

The Ground Nesting Raptor Follow-up Monitoring Program is specifically focussed on two ground nesting raptor species: Short-eared Owl (*Asio flammeus)* and Northern Harrier (*Circus cyaneus)* (Table 1). Other species were recorded during surveys and are reported in Appendix A.

Table 1: Species Covered in the Ground Nesting Raptor Follow-up Monitoring Program

Common Name	Scientific Name	BC List	COSEWIC [1] Status	SARA [2] Status
Short-eared Owl	*Asio flammeus*	Blue	Special Concern	Schedule 1 – Special Concern
Northern Harrier	*Circus cyaneus*	Yellow	-	-

[1] COSEWIC – Committee on the Status of Endangered Wildlife in Canada.
[2] SARA – *Species at Risk Act*.

The objectives of the ground nesting raptor monitoring program are to determine:

- The number of Northern Harrier and Short-eared Owl nesting in areas cleared during reservoir preparation;
- The effects of seasonal headpond flooding on Northern Harrier and Short-eared Owl nests; and
- Use of open fields within mitigation properties being managed to provide nesting habitat for Northern Harrier and Short-eared Owl.

This document reports on the ground nesting raptor surveys that were conducted in 2018.

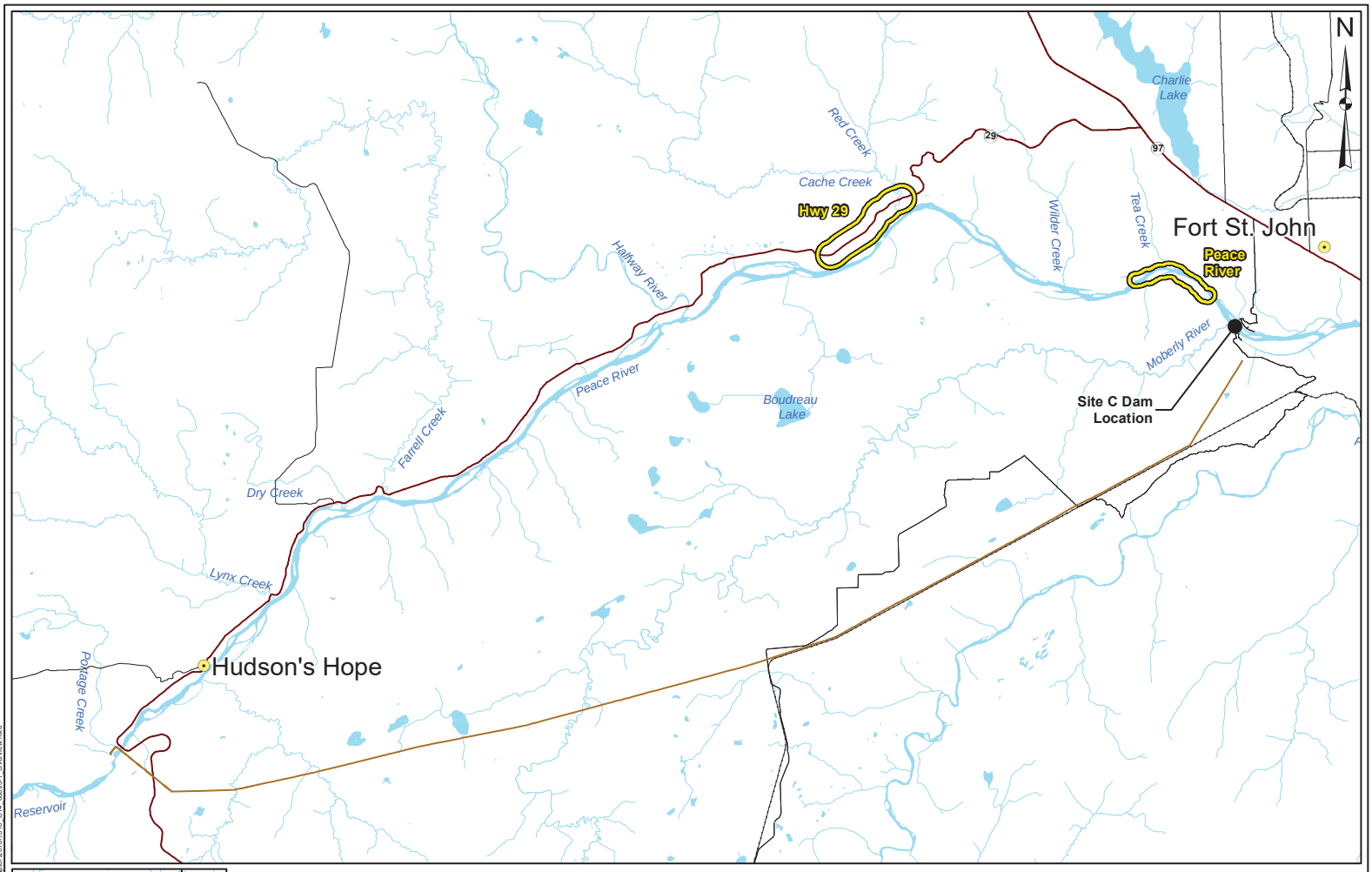
2.0 METHODS

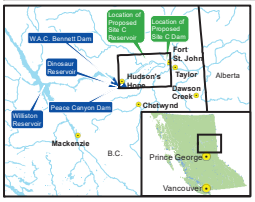
2.1 Survey Areas

Surveys in 2018 were conducted:

- North and south of Highway 29 from Bear Flats to approximately six kilometers west, which had been cleared between 2016 and 2018; and
- Along a portion of the Peace River near Tea Creek that had been cleared between 2016 and 2018 (approximately four kilometers upstream from the construction bridge and continuing approximately eight kilometers further upstream).

These areas are shown in Figure 1. Surveys were not completed in the mitigation properties in 2018.





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Prepared by: Tetra Tech.

Legend

- Survey Area
- Proposed Transmission Corridor
- Railway
- Highway
- Other Road
- Watercourse
- Waterbody

1:300,000

0 8 km

BC Hydro

Figure 1:
Ground Nesting Raptor
Follow-up Monitoring
Survey Locations in 2018

DATE	October 30, 2018	1016-C14-08893-1	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

W:\Projects\WAN\14\94301WEN\00\08-01\GIS\Maps\Raptor\2018\10\16_C14_08893-1_Overview.mxd

2.2 Ground-Nesting Raptor Surveys

Ground nesting raptors were surveyed three times over May and June 2018 to capture early, middle, and late stages of their breeding season (Table 2). The surveys were conducted through stationary standwatches. The cleared Highway 29 area was accessed by foot and the cleared Peace River area was accessed by boat. Methods followed *Inventory Methods for Raptors* (Resources Inventory Committee 2001). Surveys were completed by two teams of two observers. Each team was composed of a biologist with raptor survey experience and an assistant (Appendix B).

Table 2: Survey Dates for Ground-nesting Raptors

Survey Location	First Visit	Second Visit	Third Visit
Highway 29 (Cleared)	9 & 10 May 2018	5 & 6 June 2018	19 June 2018
Peace River (Cleared)	9 May 2018	3 & 8 June 2018	21 June 2018

Surveys in 2018 were completed using standwatches. Standwatch survey stations were placed within cleared portions of the reservoir or in nearby locations areas where cleared portions of the reservoir could be viewed. Stations were spaced so that all of the cleared portions of the reservoir could be surveyed in 2018.

Standwatches were conducted by remaining stationary and scanning for birds for 20 minutes. All surveys were conducted during daylight hours. Surveys were not completed during periods of high wind (greater than Beaufort 3, 12 – 19 km/hr), rain or fog. The standwatch stations were surveyed in a different order for each visit to minimize the effect of time of day on raptor activity and detectability. While travelling to and from standwatch stations, potential hunting perches (e.g., fence posts and short trees) were searched opportunistically for evidence of use by raptors (i.e., pellets).

Short-eared Owl are a crepuscular species and optimal survey timing is in the evening just prior to civil twilight. There are however logistical and safety considerations affecting when surveys can be completed. Surveys in cleared portions of the reservoir require boat access and evening surveys would require boating in very low light or dark conditions after surveys are complete. Boat use at night on the Peace River is not considered a safe work practice by BC Hydro. Detections of Short-eared Owl in most portions of the reservoir have so far relied on flushing owls when travelling to and from standwatch locations or boating close to shore in addition to observing any individuals that may be active during daytime. The Highway 29 area is accessible by road and evening Common Nighthawk surveys were completed in the Cache Creek/Bear Flats area in 2018. Prior to and while conducting the evening Common Nighthawk surveys, surveyors also watched for Short-eared Owls.

The location of standwatch stations are shown in Figures 2 and 3. Not all standwatch stations were surveyed three times. Some stations at Highway 29 were inaccessible at times because active archaeological work was being conducted in the area. The standwatch stations and their visit dates are provided in Table 3.

Table 3: Standwatch Stations Visited in Each Survey Area

Standwatch Station	Visit 1	Visit 2	Visit 3	Comments
Highway 29				
H29SW01	9 May	5 June	19 Jun	
H29SW02	10 May	5 June	19 June	
H29SW03	9 May	5 June	19 June	
H29SW04	10 May	6 June	X	Became an active archaeology site after visit 2
H29SW06	10 May	6 June	X	Became an active archaeology site after visit 2
Peace River				
PRSW01	9 May	8 June	21 June	
PRSW02	9 May	8 June	21 June	
PRSW03	9 May	8 June	21 June	
PRSW04	9 May	8 June	21 June	
PRSW05	9 May	3 June	21 June	
PRSW06	9 May	3 June	21 June	
PRSW07	9 May	3 June	21 June	
PRSW08	9 May	3 June	21 June	

For all raptor observations, species, sex, age, activity, distance and compass direction were recorded. Other bird species were recorded as incidental observations. For Northern Harrier or Short-eared Owl observations, if a pair was observed or there was evidence of nesting behaviour, a visual nest search was conducted to attempt to locate any nest that might be present in the area. Since ground nesting raptors are sensitive to disturbance and ground nests can easily be destroyed by human traffic, surveyors were instructed to observe rather than conduct intensive foot searches to locate a nest.

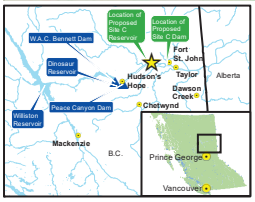
3.0 RESULTS AND DISCUSSION

No ground nesting raptors were observed within the cleared portions of the footprint along Highway 29 or the Peace River. No nests or potential nests were observed at any of the areas surveyed. Surveys of other bird species were also completed in 2018 and some of these were performed in areas near cleared portions of the reservoir. No ground-nesting raptors were observed during other surveys or while travelling through cleared portions of the reservoir.

At the present time, there is no evidence of ground nesting raptors nesting within cleared portions of the reservoir. Areas surveyed in 2016, 2017, and 2018 will be surveyed again in 2019 in addition to newly cleared areas within the reservoir. Additional evening surveys will be conducted in 2019 to enhance the potential for detecting Short-eared Owl. Surveys in the reservoir will continue until the reservoir has filled.

The ground-nesting raptor monitoring data collected in 2018 will be submitted to the BC Ministry of Environment Wildlife Species Inventory (WSI) database[1].

[1] http://www.env.gov.bc.ca/wildlife/wsi/index.htm



Map Notes:
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2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Prepared by: Tetra Tech.
5. Imagery from ESRI; DigitalGlobe.

Legend

● Standwatch Station

1:30,000

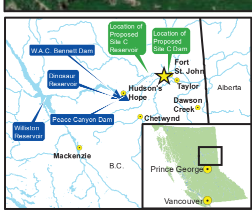
0 400 m

BC Hydro

Figure 2:
Hwy 29
Ground Nesting Raptor
Follow-up Monitoring Surveys

DATE	October 30, 2018	1016-C14-08893-2	R 0

Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



Legend

● Standwatch Station

Map Notes:
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2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Prepared by: Tetra Tech.
5. Imagery from ESRI; DigitalGlobe.

1:20,000

0 400 m

BC Hydro

Figure 3:
Peace River
Ground Nesting Raptor
Follow-up Monitoring Surveys

DATE	October 30, 2018	1016-C14-08893-3	R 0

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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

4.0 REFERENCES

BC Hydro. 2016. Ground Nesting Raptor Follow-up Monitoring Program Plan. Prepared for BC Hydro's Site C Clean Energy Project.

Resources Inventory Committee. 2001. Inventory Methods for Raptors. Standards for Components of British Columbia's Biodiversity No. 11. BC Ministry of Sustainable Resource Management, Environment Inventory Branch, Victoria, BC.

Siddle, C. 2010. Birds of North Peace River (Fort St. John and Vicinity), British Columbia, 1975-1999: Part 1 (Introduction and Nonpasserines: waterfowl through woodpeckers). Wildlife Afield 7(1):12–123.

APPENDIX A
INCIDENTAL WILDLIFE OBSERVATIONS

Table A.1: List of All Wildlife Observed During Ground Nesting Raptor Surveys

Common Name	Scientific Name	BC List	COSEWIC/ SARA [1]	Highway 29	Peace River
Ruffed Grouse	*Bonasa umbellus*	Yellow	-		1
Sora	*Porzana carolina*	Yellow	-	1	
Wilson's Snipe	*Gallinago delicata*	Yellow	-	2	4
Bald Eagle	*Haliaeetus leucocephalus*	Yellow	-	1	3
Red-tailed Hawk	*Buteo jamaicensis*	Yellow	-	3	4
Belted Kingfisher	*Megaceryle alcyon*	Yellow	-		1
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Yellow	-	1	1
American Kestrel	*Falco sparverius*	Yellow	-		1
Merlin	*Falco columbarius*	Yellow	-		1
Alder Flycatcher	*Empidonax alnorum*	Yellow	-		3
Least Flycatcher	*Empidonax minimus*	Yellow	-		1
Red-eyed Vireo	*Vireo olivaceus*	Yellow	-		4
Common Raven	*Corvus corax*	Yellow	-		8
Ruby-crowned Kinglet	*Regulus calendula*	Yellow	-	2	
American Robin	*Turdus migratorius*	Yellow	-		2
Cedar Waxwing	*Bombycilla cedrorum*	Yellow	-		2
Purple Finch	*Haemorhous purpureus*	Yellow	-	1	
Northern Waterthrush	*Parkesia noveboracensis*	Yellow	-		1
Orange-crowned Warbler	*Oreothlypis celata*	Yellow	-	1	1
Yellow Warbler	*Setophaga petechia*	Yellow	-	1	1
Yellow-rumped Warbler	*Setophaga coronata*	Yellow	-		1

Common Name	Scientific Name	BC List	COSEWIC/ SARA [1]	Highway 29	Peace River
Chipping Sparrow	*Spizella passerina*	Yellow	-		2
Clay-colored Sparrow	*Spizella pallida*	Yellow	-		1
Vesper Sparrow	*Pooecetes gramineus*	Yellow	-	1	
Song Sparrow	*Melospiza melodia*	Yellow	-	2	5
Lincoln's Sparrow	*Melospiza lincolnii*	Yellow	-		1
Dark-eyed Junco	*Junco hyemalis*	Yellow	-		1
Western Tanager	*Piranga ludoviciana*	Yellow	-	1	
Red-winged Blackbird	*Agelaius phoeniceus*	Yellow	-	1	
Brown-headed Cowbird	*Molothrus ater*	Yellow	-	1	

APPENDIX B
PROJECT QUALIFIED ENVIRONMENTAL PROFESSIONALS

Name and Affiliation	Project Role
Jeff Matheson, M.Sc., R.P.Bio. Tetra Tech Canada Inc.	Project manager, report reviewer
Camille Roberge, B.Sc. Tetra Tech Canada Inc.	Data entry, report author
Claudio Bianchini, R.P.Bio. Bianchini Biological Services	Field data collection
Todd Heakes Tetra Tech Canada Inc.	Field data collection
Kerrith McKay McKay Environmental Consulting Ltd.	Field data collection

APPENDIX C
LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

NATURAL SCIENCES

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