SWAMP Phase I

Slocan Wetlands Assessment and Monitoring Project

Prepared for:

Slocan Solutions Society, Slocan Lake Stewardship Society,
BC Wildlife Federation, & Slocan River Streamkeepers

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SWAMP
Slocan Wetland Assessment & Monitoring Project

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Glossary

The following is a list of terms and acronyms that are commonly used throughout this document.

ArcGIS	A Geographic Information System software package used for making and viewing digital maps.
BEC	Biogeoclimatic Ecosystem Classification. A provincial system of defining ecosystem types at a variety of scales, from landscape level to site specific.
Ecosystems-at-risk	Provincial system that tracks the status of ecosystems and uses a variety of rank factors to determine which are at risk.
Edaphic	Nature of soils based on texture, drainage, or chemical properties.
Edatopic Grid	A two-dimensional table using the soil nutrient regime and soil moisture regime for ecosystem classification to the site series level.
Ericaceous	The heather family; also vascular plants that are tolerant of acidic growing conditions.
Hydrodynamic Index	Five categories that describe the magnitude of vertical and lateral water movement in wet soils.
Hydrophytic	Plants adapted to growing in a partial or entire aquatic environment.
Gleysol	Soils of the Gleysolic order have properties that indicate prolonged periods of intermittent or continuous saturation with water and reducing conditions during their genesis.
Organic	Soil type that is comprised of plant and animal residues at various states of decomposition. Generally greater than 40cm in depth to be called an organic soil.
Regosol	Young soils with little or no horizon development.

Peat	Accumulation of partially decayed organic material.
Orthophoto	A series of digital airphotos that have been geometrically corrected and combined into a seamless image.
RISC	Resources Information Standards Committee. Provincial program that creates standardized procedures and methodologies for data collection, analysis and presentation.
SMR	Soil Moisture Regime. The average amount of soil water available for evapotranspiration by vascular plants.
SNR	Soil Nutrient Regime. The amount of essential soil nutrients available to vascular plants.
SWAMP	Slocan Wetlands Assessment and Monitoring Project
TRIM	Terrain Resource Inventory Mapping. Digital base mapping developed by the provincial government.

Acknowledgements

This project is a joint initiative of the Slocan Solutions Society, Slocan Lake stewardship Society, Slocan River Streamkeepers and BC Wildlife Federation. Numerous people were involved in Phase 1 of SWAMP including Rhia Mackenzie and Marcy Mahr, Richard Johnson (Slocan Solutions Society), Jennifer Yeow (Slocan River Streamkeepers), Margaret Hartley and Sally Hammond (Slocan Lake Stewardship Society), Neil Fletcher (BC Wildlife Federation), and Irene Manley (Fish and Wildlife Compensation Program).

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1.0 Introduction

The Slocan Wetlands Assessment and Mapping Project (SWAMP) is a collaboration between the Slocan Solutions Society, the Slocan Lake Stewardship Society and the Slocan River Streamkeepers. The BC Wildlife Federation (BCWF) is a partner in the Phase 1 portion of the project. Phase 2 will dovetail with the wetland work of both the BCWF and the BC Hydro Fish and Wildlife Compensation Program (FWCP).

This report is intended to be a living document that will be updated and expanded with the completion of SWAMP Phase 2. It contains four sections that describe:

- the SWAMP study area;
- background data used for the project;
- detailed information on what wetlands are, and how they are classified and mapped;
- a sample plan for 2014 field work that includes how to collect data, custom field forms, and a safety plan

2.0 Study Area

The study area includes the full Slocan River watershed, from the Kootenay River at the south, to the watershed divide north of Summit Lake, including the villages of Slocan, New Denver, Winlaw and Silverton, and the numerous unincorporated communities in between such as Passmore, Slocan Park and Krestova (Figure 2.0-1).

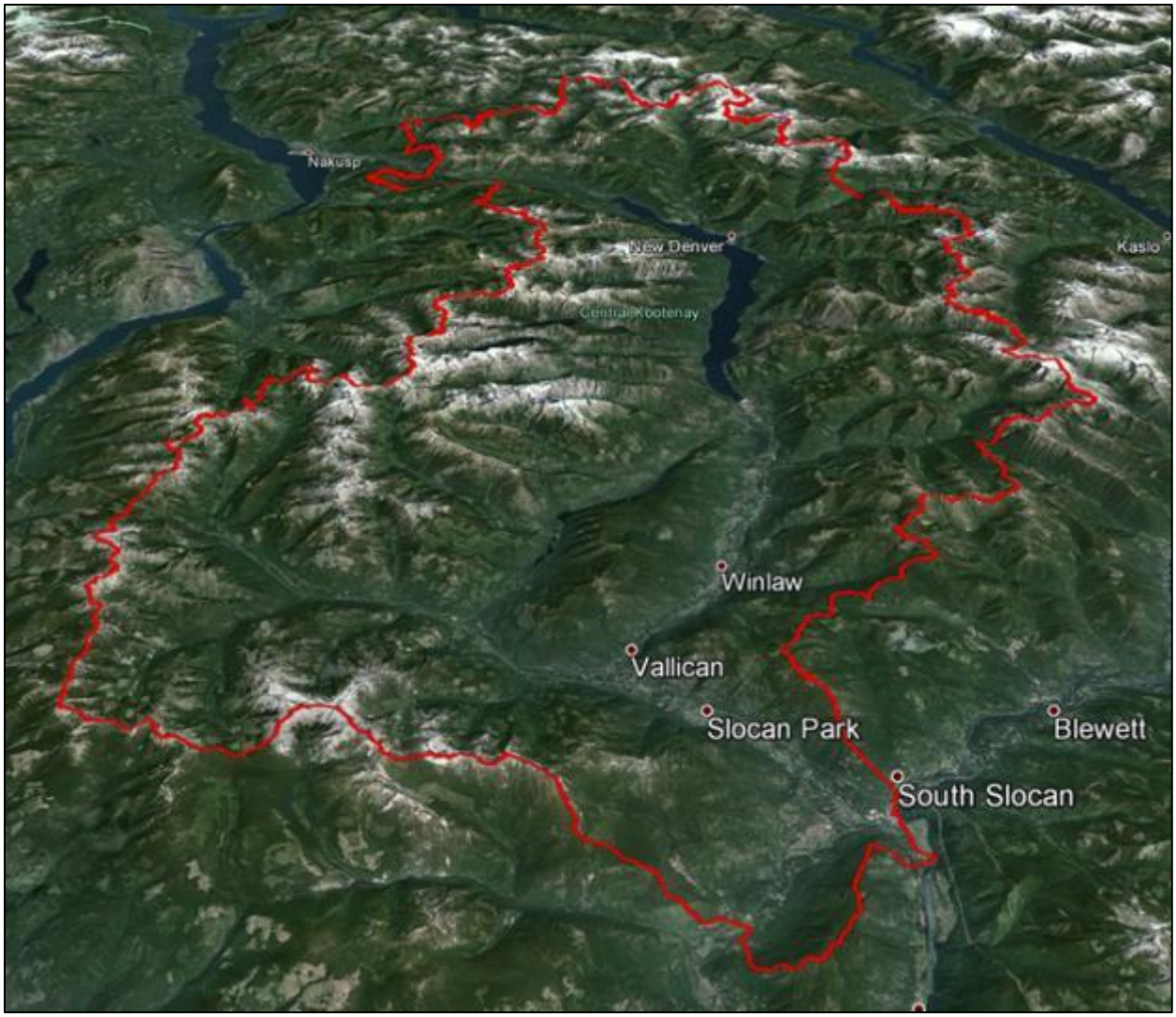


FIGURE 2.0-1. SWAMP STUDY AREA (ADAPTED FROM GOOGLE EARTH).

3.0 Background Data

A search for relevant background data was conducted for SWAMP Phase 1. Through discussions with various government agencies, it was determined that the province-wide wetlands polygon layer from the Freshwater Atlas (obtained through GeoBC) was the most accurate and up to date layer to use for the project. The wetlands layer was derived from the TRIM (Terrain Resource Inventory Mapping) data which was completed in 1996 at a scale of 1:20 000 on air photos that were as much as 15 years out of date at the time of mapping (GeoBC 2014). The provincial wetland layer is typically believed to have captured about 80% of the actual wetlands present in BC (Wetland Network 2014).

While the extents of the provincial wetland polygons generally encompass the actual extent of wetlands, the boundaries are often off to varying degrees, and detail as to the multiple wetland types that typically comprise a wetland complex is lacking. Figure 3.0-1 shows the TRIM 1:20 000 wetland boundaries (black lines) and the newer SWAMP wetland boundaries (interpreted at 1:5 000 or larger)

illustrating both the differences in overall boundaries and the lack of complexity in the TRIM. Note that Figure 3.0-1 also contains adjacent terrestrial ecosystem polygons in the mapping.

FIGURE 3.0-1. EXAMPLE OF TRIM WETLANDS VS SWAMP WETLANDS DELINEATION AT A SCALE OF 1:5 000.

Within the SWAMP study area, TRIM data suggests that there are only 189 wetlands present, with 58 classified as swamps and the other 131 classified as marsh. While the larger complexes and easily distinguishable wetlands are identified in the TRIM layer, a significant number were missed, and the simplistic classification greatly generalizes the many wetlands types that exist. Figure 3.0-2 presents an example of several wetlands from Slocan Park that were not included in the TRIM mapping, which were identified in the more detailed Slocan River Sensitive Ecosystems Inventory Mapping (Durand 2012). Many of these omissions may be due to the TRIM mapping scale (1:20 000), minimum polygon size requirements of the TRIM, and age and quality of imagery used from the TRIM interpretation.

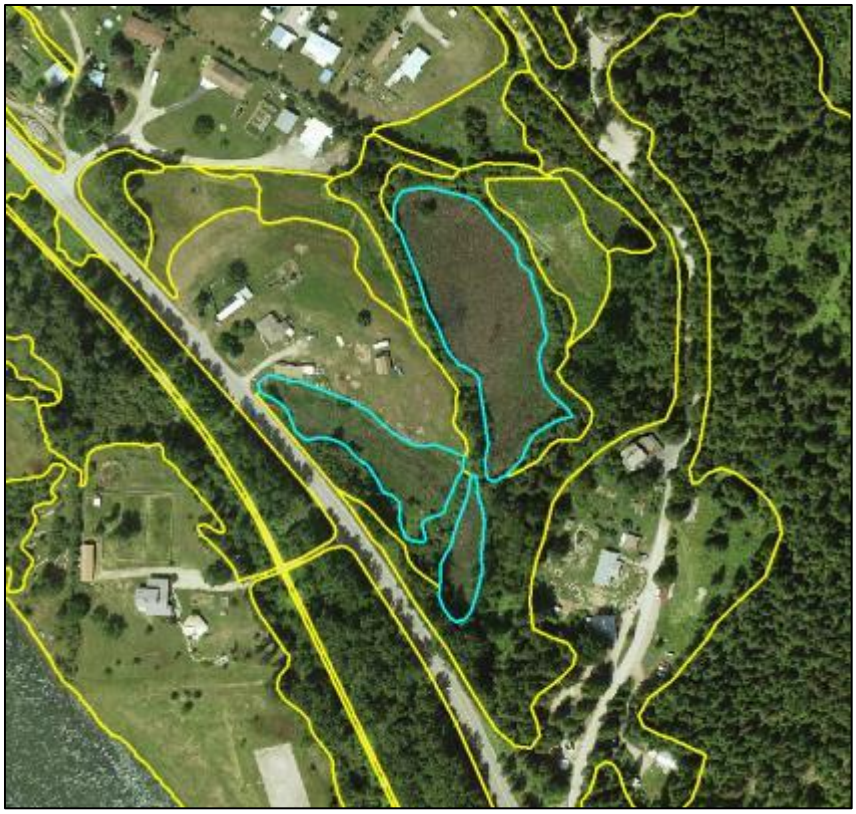


FIGURE 3.0-2 EXAMPLE OF WETLANDS NOT INCLUDED (BLUE OUTLINES) IN THE TRIM LAYER.

It is believed, that the SWAMP project will not only identify and map the true extent of wetlands in the Slocan Watershed, but will also accurately classify the full range of wetlands types that occur.

Additional information that was collected for this project includes:

- Provincial Vegetation Resource Inventory (VRI) mapping
- Provincial Biogeoclimatic Ecosystem Classification (BEC) mapping
- Provincial base layers for lakes, streams, contours, roads, etc.
- Slocan River Sensitive Ecosystems Inventory (SEI) mapping

Base imagery was obtained using the DataBC Imagery Web Map Service (DataBC 2014). This free service is a plug-in to ArcGIS 10.1 that allowed 1m orthophotos (ranging in date from 1995 to 2004) of the study area to be loaded on the fly. The imagery resolution is sufficient for the accurate and consistent delineation of wetlands throughout the study area, but limits classification beyond the Federal Wetland Classes.

4.0 Wetland Classification and Mapping

4.1 Introduction to Wetlands

A wetland is defined as: *land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment* (National Wetlands Working Group 1988). (Canadian System of Wetland Classification 1997)

Wetland ecosystems are found where soils are saturated by water for enough time that the excess water and resulting low oxygen levels influence the vegetation and soil. The water influence can be either seasonal or year-round and occurs either at or above the soil surface or within the root zone of plants. Wetlands can be found in depressions, or areas of flat or undulating terrain. There are two broad categories of wetlands as described by the Canadian System of Wetland Classification (National Wetlands Working Group 1997):

"Organic wetlands:

- Organic wetlands are more simply referred to as peatlands. Peatlands contain more than 40 cm of peat accumulation on which organic soils (excluding Folisols[1]) develop. This depth limit is consistent with soil classification standards established by the Canada Soil Survey Committee (1978).

Mineral wetlands:

- Mineral wetlands are found in areas where an excess of water collects on the surface and which for geomorphic, hydrologic, biotic, edaphic (factors related to soil), or climatic reasons produce little or no organic matter or peat. Gleysolic[2] soils or peaty phases of these soils are characteristics of these wetlands.

- Mineral wetlands are found in mineral soil areas associated with shallow water, which is generally less than 2 m deep. In some of these wetlands, vegetation is lacking and soils are poorly developed as a result of frequent and drastic fluctuations of water levels, wave action, water flow, turbidity, or a high concentration of salts or other toxic substances in the water or in the soil.

[1] Soils of the Folisolic order are composed of upland organic (folic) materials, generally of forest origin, that are either 40 cm or more in thickness, or are at least 10 cm thick if overlying bedrock or fragmental material (Agriculture and Agri-Food Canada 2014a).

[2] Soils of the Gleysolic order have properties that indicate prolonged periods of intermittent or continuous saturation with water and reducing conditions during their genesis. Saturation with water may result from either a high groundwater table or temporary accumulation of water above a relatively impermeable layer, or both (Agriculture and Agri-Food Canada 2014b).

- Mineral wetlands include mineral soil areas that are modified by water control structures (e.g. dams) or that are tilled and planted but if allowed to revert to their original state, become saturated for long periods and are then associated with wet soils (e.g. Gleysols) and hydrophytic vegetation."

The development of wetlands is a dynamic function of climate, hydrology, chemistry, geomorphology, and biology (National Wetlands Working Group 1997). Wetlands are not generally stable ecosystems, rather they are constantly evolving over time (hundreds or thousands of years) as soils develop and water regimes change, resulting in communities that often contain aspects of different wetland types, as well as transitional areas where they are indeterminate between one class or association and another. Therefore, multiple characteristics of wetlands, due to the interaction of various environmental factors, are required to place them in specific classes and associations.

4.2 Wetland Classification

Wetlands in Canada are classified based on the Canadian System of Wetland Classification using five classes: bog, fen, marsh, swamp, and shallow open water (National Wetlands Working Group 1997), and further refined into associations based on the Wetlands of British Columbia (MacKenzie & Moran 2004). The following section describes the main characteristics of each wetland class to aid identification. Upon completion of the Phase 2 of SWAMP (mapping and field sampling), detailed descriptions of all actual wetland classes and associations will be provided.

Environmental conditions that have affected wetland development are used to classify wetlands (National Wetlands Working Group 1997), including:

- Morphology – surface forms, pattern, elevation
- Water source
- Water chemistry (nutrients, base saturation, pH)
- Basin depth and shape
- Plant communities and their structure
- Peat and sediment characteristics
- Soil type (organic, gleysol, etc.)

Figure 4.2-1 (adapted from the Wetlands of British Columbia) provides an overview of the main environmental features for each wetland class (also known as Site Class), as well as the typical vegetation cover and species groups. Figure 4.2-2 (adapted from the Wetlands of British Columbia) depicts the edatopic grid that shows the range of soil moisture, soil nutrients, pH, and hydrodynamic index (water flow and permanence) that each wetland class typically occurs within. Note that shallow open waters do not fit the conceptual model presented in the edatopic grid, and are not included

(MacKenzie & Moran 2003). Figure 4.2-3 contains a key to the wetland classes (National Wetlands Working Group 1997). The following sections describe the five wetland classes, primarily based on the Wetlands of British Columbia (MacKenzie & Moran 2003).

Site Realm/ Group	Site Class	Environmental features	Cover types	Species groups
Wetland Realm		***Wet or Very Wet SMR***		
	Bogs	+/- ombrotrophic pH < 5.5 > 40 cm fibric/mesic peat	Conifer treed or low shrub	Sphagnum mosses, ericaceous shrubs, and conifers
	Fens	Groundwater-fed pH > 5.0 > 40 cm fibric/mesic peat	Graminoid or low shrub	Deciduous shrubs, sedges, and brown mosses
	Marshes	Mineral soils or well-humified peat Protracted shallow flooding (0.1–2.0 m)	Graminoid or forb	Large emergent sedge, grass, forb, or horse-tail species
	Swamps	Mineral soils or well-humified peat Temporary shallow flooding (0.1–1.0 m) Significant water flow	Tall shrub or forested	Conifers, willows, alders, forbs, grasses leafy mosses
	Shallow waters	Permanent deep flooding (0.5–2 m)	Aquatic	Aquatic species Emergent vegetation < 10% cover

FIGURE 4.2-1 SUMMARY OF CHARACTERISTICS FOR WETLAND SITE CLASSES (ADAPTED FROM WETLANDS OF BRITISH COLUMBIA).

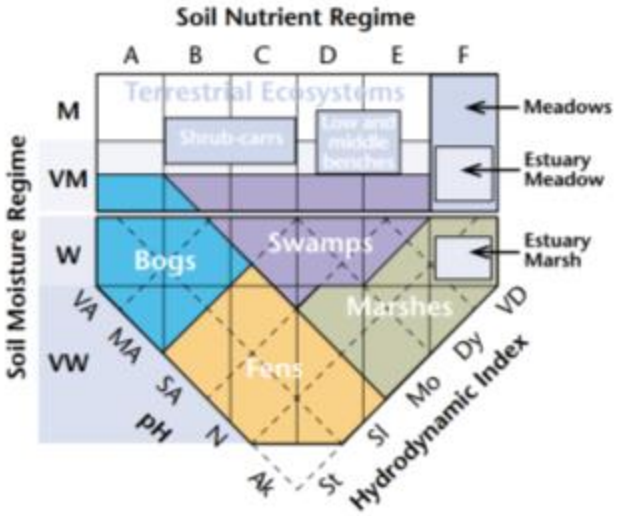


FIGURE 4.2-2 SITE CLASS DISTRIBUTION ON THE MODIFIED EDATOPIC GRID (ADAPTED FROM WETLANDS OF BRITISH COLUMBIA).

1.	Terrain affected by water table at, near or above the land surface and which is saturated for sufficient time to promote wetland or aquatic processes	2. Wetland
2.	Wetland ecosystems characterized by an accumulation of peat	3. Peatland
3.	Peatland dominated by bryophytes and graminoids	4.
4.	Peatland receiving water exclusively from precipitation and not influenced by groundwater; *Sphagnum*-dominated vegetation	Bog
4.	Peatland receiving water rich in dissolved minerals; vegetation cover composed dominantly of graminoid species and brown mosses	Fen
3.	Peatland dominated by trees, shrubs and forbs; waters are rich in dissolved minerals	Swamp
2.	Wetland ecosystems characterized by minimal or no peat accumulation, although thin layers of muck and a mix of mineral and organic muck may be present	5. Mineral Wetland
5.	Wetlands with free surface water persisting above the ground surface for variable periods or not at all. If surface water persists through the summer, water depths are sufficiently shallow to permit survival of woody or herbaceous vegetation which cover more than 25% of the surface area of the wetland	6.
6.	Periodically standing surface water and gently moving, nutrient-rich groundwater, with vegetation dominated by woody plants often more than 1 m high	Swamp
6.	Periodic or persistent standing water or slow moving surface water which is circumneutral to alkaline and generally nutrient-rich. Vegetation is dominated by graminoids, shrubs, forbs or emergent plants	Marsh
5.	Wetlands with free surface water up to 2 m deep, present for all or most of the year, with less than 25% of the surface water area occluded by standing emergent or woody plants. Submerged or floating aquatic plants usually dominate the vegetation.	Shallow Water
1.	Terrain not affected by high water table or excess surface water, or if affected, only for short periods such that hydrophytic vegetation or aquatic processes do not exist.	Upland (non-wetland)

FIGURE 4.2-3 CLASSIFICATION KEY TO WETLAND CLASSES (ADAPTED FROM THE CANADIAN WETLAND CLASSIFICATION SYSTEM).

4.2.1 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 (MacKenzie & Moran 2003). Bogs may or may not contain a cover of slow growing woody, ericaceous shrubs or small stunted trees, generally occurring on hummocks or raised domes (Plate 4.2-1). A thick cover of *Sphagnum* (peat moss) is dominant, while other species that are tolerant of acidic, low nutrient conditions also occur. Bogs are typically located 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 deep peat deposits, generally with poorly decomposed upper layers, that remain saturated throughout the year. While some groundwater flow may occur, it is generally limited, resulting in little input of nutrients. (MacKenzie & Moran 2003)

PLATE 4.2-1 EXAMPLE OF A STUNTED HEMLOCK BOG FROM NORTHWESTERN BC.

4.2.2 Fen

A fen is a nutrient-medium peatland ecosystem dominated by sedges and brown mosses, where mineral-bearing groundwater is within the rooting zone and minerotrophic plant species are common (MacKenzie & Moran 2003). Fens rely on steady groundwater inflow that provides relatively high nutrient contents, and maintains the watertable near the peat surface for most of the growing season, resulting in soils with richer nutrient regimes. They develop on a variety on 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 & Moran 2003), while tall shrubs and trees are absent (Plate 4.2-2). Fens are the most commonly occurring wetland type in BC, occurring in all but the warmest regions. (MacKenzie & Moran 2003)

PLATE 4.2-2 EXAMPLE OF A MID-ELEVATION FEN FROM NORTHERN BC.

4.2.3 Marsh

A marsh is a permanently to seasonally flooded non-tidal mineral wetland dominated by emergent grass-like vegetation (MacKenzie & Moran 2003). 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. (Plate 4.2-3) Shrubs, trees and bryophytes (moss) are generally absent or very sparse, while aquatic plants often occur. 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 occur in warmer climates. Marshes occur in a variety of landscape positions, but most often as pond and lake margins and river backwaters as a component of a larger wetland complex. Peat accumulation is generally limited due to the occurrence in warmer climates and the dynamic water levels, both of which promote decomposition of organic material, resulting in most marshes being comprised mainly of mineral soils. Marshes are generally flooded in the spring, while drier months may see a persistent high water table, or substantial drying and substrate exposure.

PLATE 4.2-3 EXAMPLE OF A CATTAIL MARSH FROM SOUTHWESTERN BC.

4.2.4 Swamp

A swamp is a nutrient-rich wetland ecosystem where significant groundwater inflow, periodic surface aeration, and/or elevated microsites allows growth of large trees or tall shrubs under subhydric

conditions (MacKenzie & Moran 2003). Swamps are dominated by conifer or broadleaf trees (often on mounded microsites), or tall shrubs (Plate 4.2-4). Herbaceous species are variable, and can range from thick to sparse covers, while bryophytes are generally limited. 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. 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. They typically occur on mineral soils that have a surface layer of well decomposed organic material. (MacKenzie & Moran 2003)

PLATE 4.2-4 EXAMPLE OF A SWAMP WETLAND FROM CENTRAL INTERIOR BC.

4.2.5 Shallow 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 & Moran 2003). These aquatic wetlands are simplistic communities that typically have less than 10% cover of emergent

species (Plate 4.2-5). 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. Aquatic wetlands typically 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).

PLATE 4.2-5 EXAMPLE OF A SHALLOW OPEN WATER WETLAND FROM LITTLE SLOCAN LAKES.

4.3 Wetlands of the Slocan Watershed

The full extent and type of wetlands that occur in the study area are currently unknown. The Biogeoclimatic Ecosystem Classification (BEC) for the study area contains limited information on wetlands, often only giving basic wetland classes and defaulting to the provincial *Wetlands of British Columbia* (MacKenzie & Moran 2004). The regional BEC guidebook is currently under revision and the future edition is expected to contain significantly more detail regarding wetlands and riparian ecosystems.

Searches were done using the BC Conservation Data Centre (CDC) website to generate lists of known wetland types for the Regional District of the Central Kootenay and the Ministry of Environment Region 4 – Kootenays (Table 4.3-1 and 4.3-2). These lists contain both common (BC Yellow list or No Status) and listed ecosystems (BC Red and Blue list) that are expected to be relatively comprehensive for the study area, although they likely contain ecosystems that do not occur in the area. As well, it is possible that there are wetland associations that will be found in the study area that are currently undescribed. Most of the wetlands listed on Table 4.3-1 and 4.3-2 are described in greater detail in *Wetlands of British Columbia*. Some wetland types, such as *Carex* spp. */ Sphagnum* spp. from Table 4.3-1, are generic names that are used to describe known wetlands from one or more mapping or inventory projects in the region, but where detailed descriptions are not available or where the wetland does not fit into any existing classification.

TABLE 4.3-1 POTENTIAL WETLANDS IN THE REGIONAL DISTRICT OF THE CENTRAL KOOTENAY (CDC 2014)

Scientific Name	English Name	BC List	Ecosystem Group
Alnus incana / Spiraea douglasii / Carex sitchensis	mountain alder / hardhack / Sitka sedge	Yellow	Wetland - Mineral: Wetland Swamp (Ws)
Betula nana / Carex aquatilis	scrub birch / water sedge	Blue	Wetland - Peatland: Wetland Fen (Wf)
Calamagrostis canadensis / Aulacomnium palustre	bluejoint reedgrass / glow moss	No Status	Wetland - Peatland: Wetland Fen (Wf)
Calamagrostis canadensis - Carex spp.	bluejoint reedgrass - sedges	No Status	Wetland - Peatland: Wetland Fen (Wf)
Carex aquatilis / Sphagnum spp.	water sedge / peat-mosses	Yellow	Wetland - Peatland: Wetland Fen (Wf)
Carex lasiocarpa / Drepanocladus aduncus	slender sedge / common hook-moss	Blue	Wetland - Peatland: Wetland Fen (Wf)
Carex nigricans Herbaceous Vegetation	black alpine sedge Herbaceous Vegetation	No Status	Wetland - Mineral: Wetland Alpine (Wa)
Carex utriculata - Carex aquatilis	beaked sedge - water sedge	Yellow	Wetland - Mineral: Wetland Marsh (Wm);Wetland - Peatland: Wetland Fen (Wf)
Dulichium arundinaceum Herbaceous Vegetation	three-way sedge	Red	Wetland - Mineral: Wetland Marsh (Wm)
Eriophorum angustifolium - Caltha leptosepala	narrow-leaved cotton-grass - white mountain marsh-marigold	Yellow	Wetland - Peatland: Wetland Fen (Wf)
Eriophorum angustifolium - Carex limosa	narrow-leaved cotton-grass - shore sedge	Blue	Wetland - Peatland: Wetland Fen (Wf)
Menyanthes trifoliata - Carex lasiocarpa	buckbean - slender sedge	Blue	Wetland - Peatland: Wetland Fen (Wf)
Schoenoplectus acutus Deep Marsh	hard-stemmed bulrush Deep Marsh	Blue	Wetland - Mineral: Wetland Marsh (Wm)
Thuja plicata - Picea engelmannii x *glauca / Lysichiton americanus*	western redcedar - hybrid white spruce / skunk cabbage	Yellow	Wetland - Mineral: Wetland Swamp (Ws)
Trichophorum cespitosum / Campylium stellatum	tufted clubrush / golden star-moss	Blue	Wetland - Peatland: Wetland Fen (Wf)

TABLE 4.3-2 POTENTIAL WETLANDS IN MOE REGION 4 - KOOTENAY (CDC 2014)

Scientific Name	English Name	BC List	Ecosystem Group
Alnus incana / Spiraea douglasii / Carex sitchensis	mountain alder / hardhack / Sitka sedge	Yellow	Wetland - Mineral: Wetland Swamp (Ws)
Betula nana / Carex aquatilis	scrub birch / water sedge	Blue	Wetland - Peatland: Wetland Fen (Wf)
Calamagrostis canadensis / Aulacomnium palustre	bluejoint reedgrass / glow moss	No Status	Wetland - Peatland: Wetland Fen (Wf)
Calamagrostis canadensis - Carex spp.	bluejoint reedgrass - sedges	No Status	Wetland - Peatland: Wetland Fen (Wf)
Carex aquatilis / Sphagnum spp.	water sedge / peat-mosses	Yellow	Wetland - Peatland: Wetland Fen (Wf)
Carex enanderi Herbaceous Vegetation	Enander's sedge Herbaceous Vegetation	No Status	Wetland - Mineral: Wetland Alpine (Wa)
Carex lasiocarpa / Drepanocladus aduncus	slender sedge / common hook-moss	Blue	Wetland - Peatland: Wetland Fen (Wf)
Carex nigricans Herbaceous Vegetation	black alpine sedge Herbaceous Vegetation	No Status	Wetland - Mineral: Wetland Alpine (Wa)
Carex spp. */ Aulacomnium palustre*	sedges / glow moss	No Status	Wetland - Peatland: Wetland Fen (Wf)
Carex spp. - *Potentilla* spp.	sedges - cinquefoils	No Status	Wetland - Peatland: Wetland Bog (Wb)
Carex spp. */ Sphagnum* spp.	sedges / peat-mosses	No Status	Wetland - Peatland: Wetland Bog (Wb)
Carex utriculata - Carex aquatilis	beaked sedge - water sedge	Yellow	Wetland - Mineral: Wetland Marsh (Wm);Wetland - Peatland: Wetland Fen (Wf)
Deschampsia cespitosa Community	tufted hairgrass Community	Blue	Terrestrial - Grassland: Alkali Meadow (Ga);Wetland - Mineral: Wetland Marsh (Wm)
Dulichium arundinaceum Herbaceous Vegetation	three-way sedge	Red	Wetland - Mineral: Wetland Marsh (Wm)
Equisetum fluviatile - Carex utriculata	swamp horsetail - beaked sedge	Blue	Wetland - Mineral: Wetland Marsh (Wm)
Eriophorum angustifolium - Caltha leptosepala	narrow-leaved cotton-grass - white mountain marsh-marigold	Yellow	Wetland - Peatland: Wetland Fen (Wf)
Eriophorum angustifolium - Carex limosa	narrow-leaved cotton-grass - shore sedge	Blue	Wetland - Peatland: Wetland Fen (Wf)
Eriophorum angustifolium Herbaceous Vegetation	narrow-leaved cotton-grass Herbaceous Vegetation	No Status	Wetland - Mineral: Wetland Alpine (Wa)
Eriophorum scheuchzeri Herbaceous Vegetation	Scheuchzer's cotton-grass Herbaceous Vegetation	Red	Wetland - Mineral: Wetland Alpine (Wa)
Menyanthes trifoliata - Carex lasiocarpa	buckbean - slender sedge	Blue	Wetland - Peatland: Wetland Fen (Wf)
Picea mariana / Carex aquatilis / Sphagnum spp.	black spruce / water sedge / peat-mosses	Yellow	Wetland - Peatland: Wetland Bog (Wb)
Picea mariana / Menyanthes trifoliata / Sphagnum spp.	black spruce / buckbean / peat-mosses	Blue	Wetland - Peatland: Wetland Bog (Wb)
Picea mariana - Pinus contorta / Kalmia spp. */ Sphagnum* spp.	black spruce - lodgepole pine / kalmias / peat-mosses	Blue	Wetland - Peatland: Wetland Bog (Wb)
Salix barclayi / Carex aquatilis / Aulacomnium palustre	Barclay's willow / water sedge / glow moss	Yellow	Wetland - Peatland: Wetland Fen (Wf)
Salix sitchensis / Carex sitchensis	Sitka willow / Sitka sedge	Blue	Wetland - Mineral: Wetland Swamp (Ws)
Schoenoplectus acutus Deep Marsh	hard-stemmed bulrush Deep Marsh	Blue	Wetland - Mineral: Wetland Marsh (Wm)
Thuja plicata / Lysichiton americanus / Sphagnum spp.	western redcedar / skunk cabbage / peat-mosses	Red	Wetland - Mineral: Wetland Swamp (Ws)

Thuja plicata - Picea engelmannii x *glauca / Lysichiton americanus*	western redcedar - hybrid white spruce / skunk cabbage	Yellow	Wetland - Mineral: Wetland Swamp (Ws)
Trichophorum cespitosum / Campylium stellatum	tufted clubrush / golden star-moss	Blue	Wetland - Peatland: Wetland Fen (Wf)
Typha latifolia Marsh	common cattail Marsh	Blue	Wetland - Mineral: Wetland Marsh (Wm)

4.4 Preliminary Wetland Mapping

Preliminary mapping of key wetlands has been on-going since 2012. Mapping originated with the Slocan River Sensitive Ecosystems Inventory (SEI) project that focused on lowland areas along the Slocan River and included wetland, riparian, aquatic, and terrestrial ecosystems. Wetland specific mapping was completed for SWAMP Phase 1 in key large complexes throughout the study area. To date, both mapping exercises have used the SEI classification system that is currently limited to identifying wetlands to the Federal Class level (Table 4.4-1). The provincial wetland layer is used for remainder of the study area that has not yet been assessed.

The provincial wetland layer shows 189 wetlands in the Study Area comprising an area of 557 hectares. Of those, 131 are classified as marshes and 58 classified as swamps. Figure 4.4-1 shows the location of the wetlands from the provincial layer, with the size exaggerated to make them visible on a map of the entire watershed.

TABLE 4.4-1 APPLICABLE SEI WETLAND, RIPARIAN AND FRESHWATER CLASSES AND SUBCLASSES (ADAPTED FROM DURAND 2012)

RI: Riparian		Ecosystems associated with and influenced by freshwater
RI	fh: high bench	High bench floodplain terraces
RI	fm: medium bench	Medium bench floodplain terraces
RI	fl: low bench	Low bench floodplain terraces
RI	ff: fringe	Narrow, linear community along watercourses that generally lack floodplains and floodplain communities
RI	ri: river	River and creeks, including gravel bars
WN: Wetland		Terrestrial – freshwater transitional areas.
WN	ms: marsh	Graminoid or forb-dominated nutrient-rich wetlands
WN	sp: swamp	Shrub or tree-dominated wetlands
WN	ow: shallow water	Permanently flooded, water less than 2m deep at mid-summer
WN	fn: fen	Herbaceous or shrub wetlands, moderate nutrients, wet throughout growing season.
WN	bg: bog	Acidic, sphagnum dominated, closed basin wetlands
FW: Lakes and Ponds		
FW	pd: pond	Open water > 2 m deep and generally < 50 ha.
FW	la: lake	Open water > 2 m deep and generally > 50 ha.

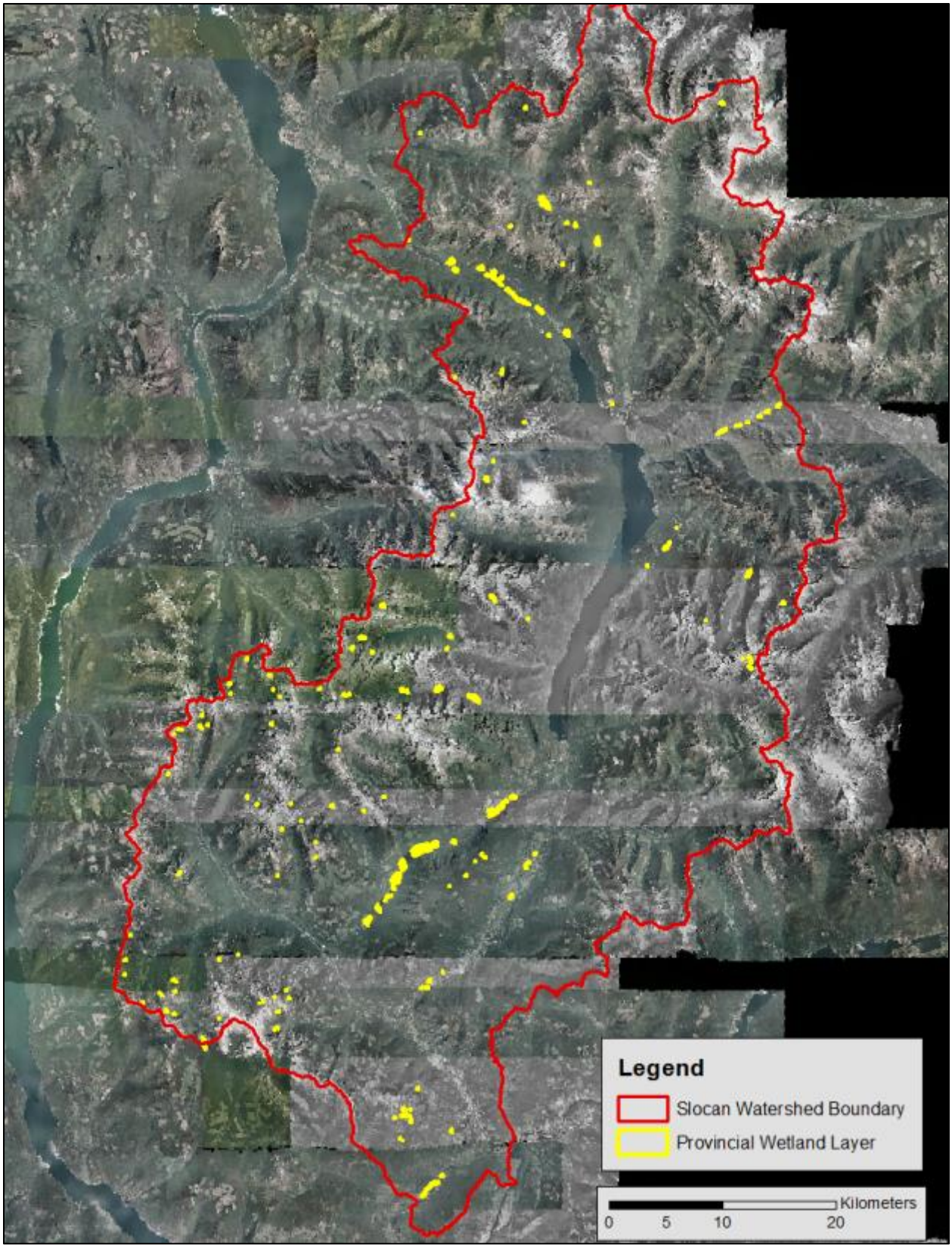


FIGURE 4.4-1 PROVINCIAL WETLAND LAYER SHOWING WETLANDS OCCURRING IN THE STUDY AREA.

5.0 2014 Field Sample Plan

The following sections describe locations and methodology for initial wetland inventory and classification work, as well as a field form, safety plan, and quality controls.

5.1 Potential Sample Locations

There are two proposed objectives for initial field sampling:

1. Classification and mapping of key lowland wetland complexes that are known to be of high value and/or have a higher potential to be threatened by various land uses (logging, development, etc.).

2. Classification and mapping of as many types and conditions of wetlands as possible, including higher elevation and alpine areas to determine the full breadth of ecosystems that occur in the study area.

Target wetlands for objective one will focus on areas that have been mapped through SWAMP Phase 1 and the Slocan River Sensitive Ecosystems Inventory. These areas are already known to be important complexes and generally accessible. While they most likely contain repetitions of similar wetland types, they include a variety of conditions (disturbed vs natural) and are distributed throughout a large portion of the study area, with the exception of largely occurring only in low to mid elevation areas. Figure 5.1-1 provides an overview map of the target wetlands. A detailed map of the target wetlands (Figures 5.1-2 to 5.1-10), along with brief discussions of the expected wetland types and their condition, is presented in the remainder of Section 5.1.

Target wetlands for objective two will focus on wetlands that are likely or known to contain wetland classes that have not previously been sampled (i.e. fens), and will include representative sites from the full extent of the study area. Of particular interest are higher elevation wetlands, however as access will be a significant constraint, few higher elevation areas will be sampled. If required, a permit will be obtained from the Ministry of Environment to allow for sampling of wetlands in provincial parks, as they generally are much more accessible via park trails.

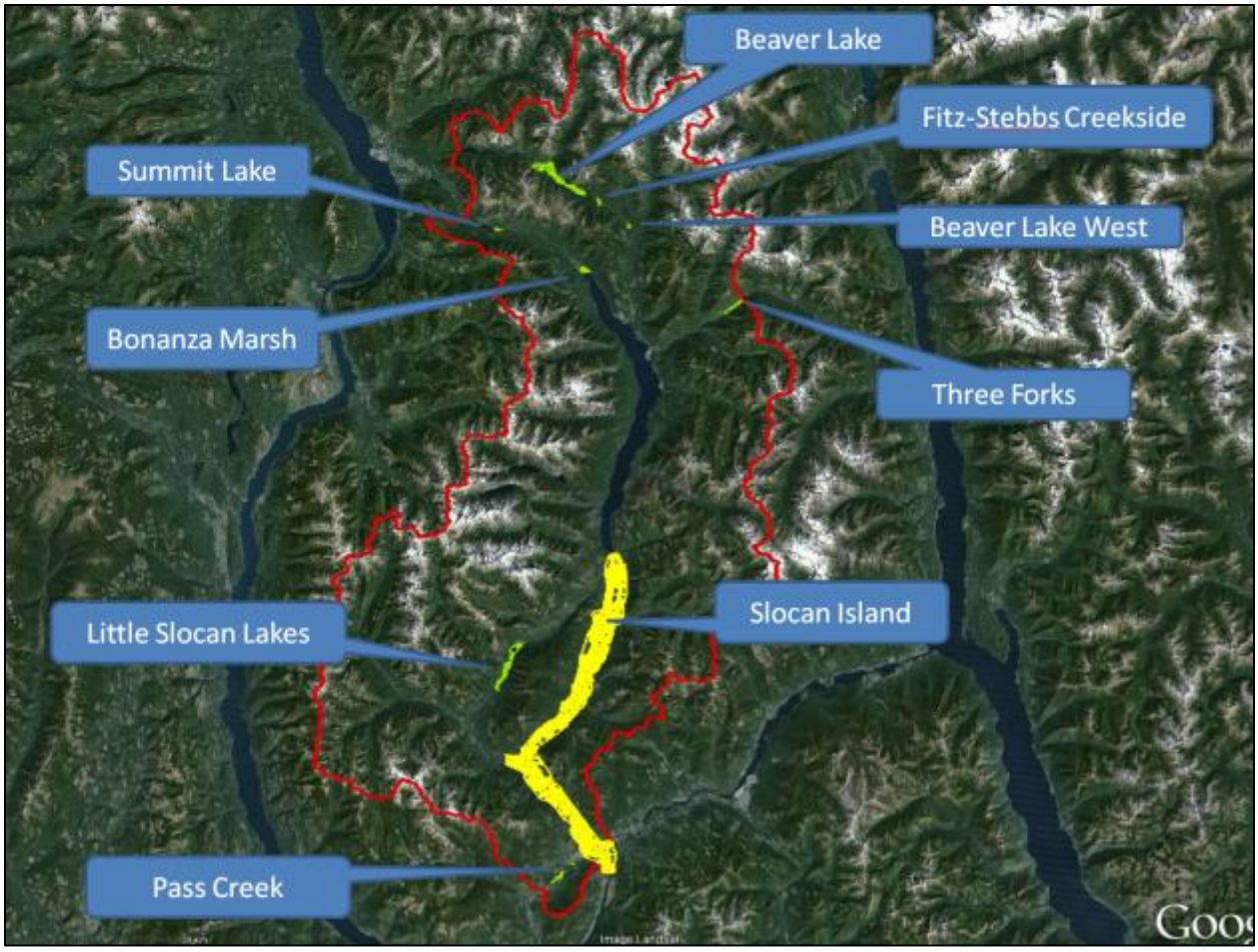


FIGURE 5.1-1 SWAMP TARGET WETLANDS FOR 2014.

Pass Creek

The Pass Creek wetlands encompass roughly 36 hectares (including immediately adjacent terrestrial area) in the southwest corner of the study area (Figure 5.1-2). It is dominated by willow and alder swamps, with a large complex of marsh and shallow open water. Mid bench riparian and or riparian fringe also occur. Most of the wetlands are expected to have been historically disturbed by clearing and farming/pasture.

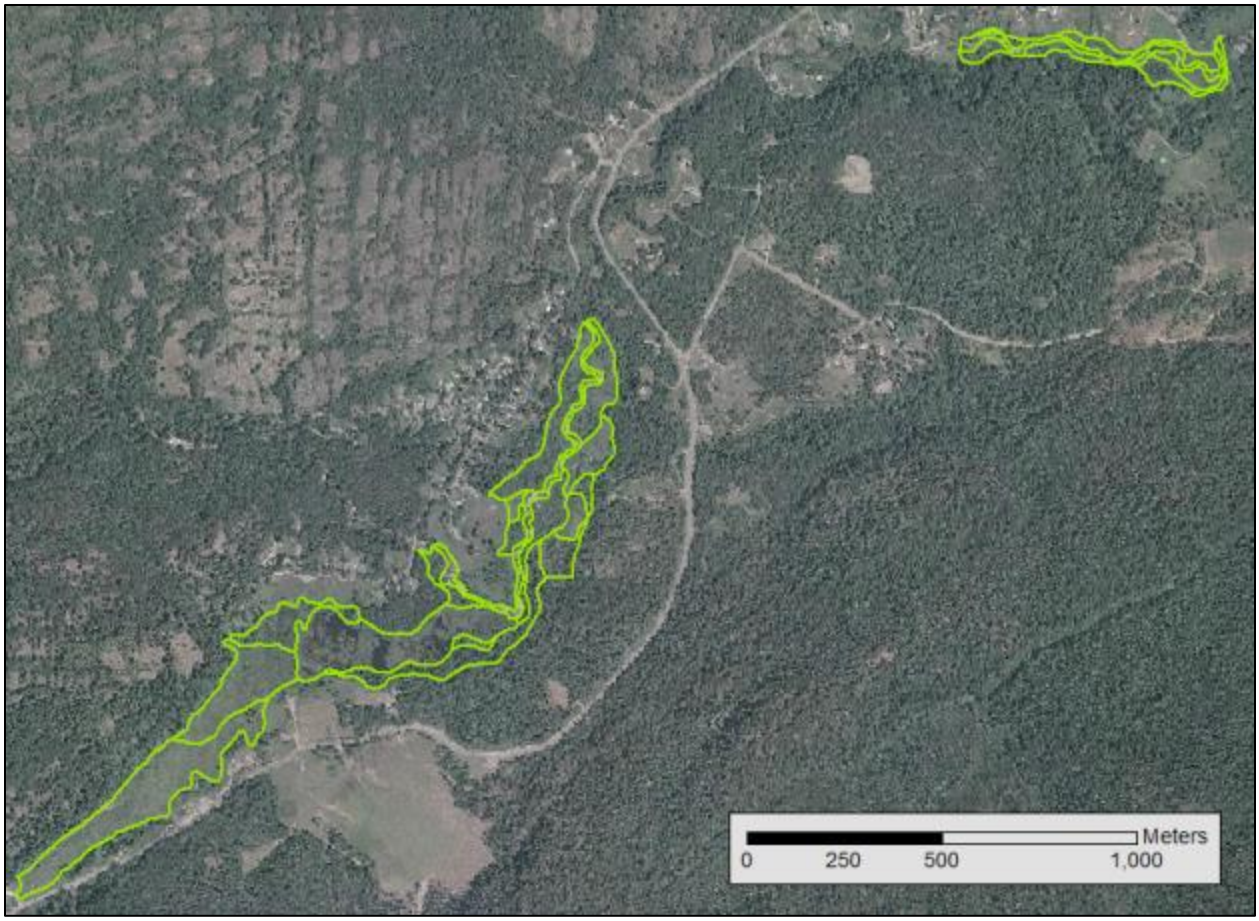


FIGURE 5.1-2 PASS CREEK WETLANDS.

Little Slocan Lakes

The Little Slocan Lakes area covers an area of 258 hectares, with the pond/lake portions comprising roughly 150 hectares (Figure 5.1-3). This area contains a variety of wetlands, including shrub and treed swamp, multiple types of marsh, and shallow open water. It also contains low and mid bench floodplains, creeks, and the ponds. It is considered to be relatively intact, with properly functioning wetlands that are largely free of recent disturbance. It is one of the largest wetland complexes in the study area.

FIGURE 5.1-3 LITTLE SLOCAN LAKES

Slocan Island

Slocan Island is located in the main stem of the Slocan River. It is roughly 80 hectares in size and is dominated by mid and high bench floodplain forests (Figure 5.1-4). Numerous small swamps and marshes occur, mainly in old side and flood channels. The island has a significant disturbance history,

including clearing and cattle ranging. Many of the wetlands are compromised by a high cover of weedy species.

FIGURE 5.1-4 SLOCAN ISLAND WETLANDS

Three Forks

The Three Forks wetland complex is one of the higher elevation wetlands targeted in this study. It is roughly 33 hectares in size, and occurs as a narrow linear complex along Highway 31A between New Denver and Kaslo (Figure 5.1-5). It consists of a series of beaver controlled ponds, swamps and marshes. It is believed to be a moderately disturbed complex that still contains valuable wildlife habitat.

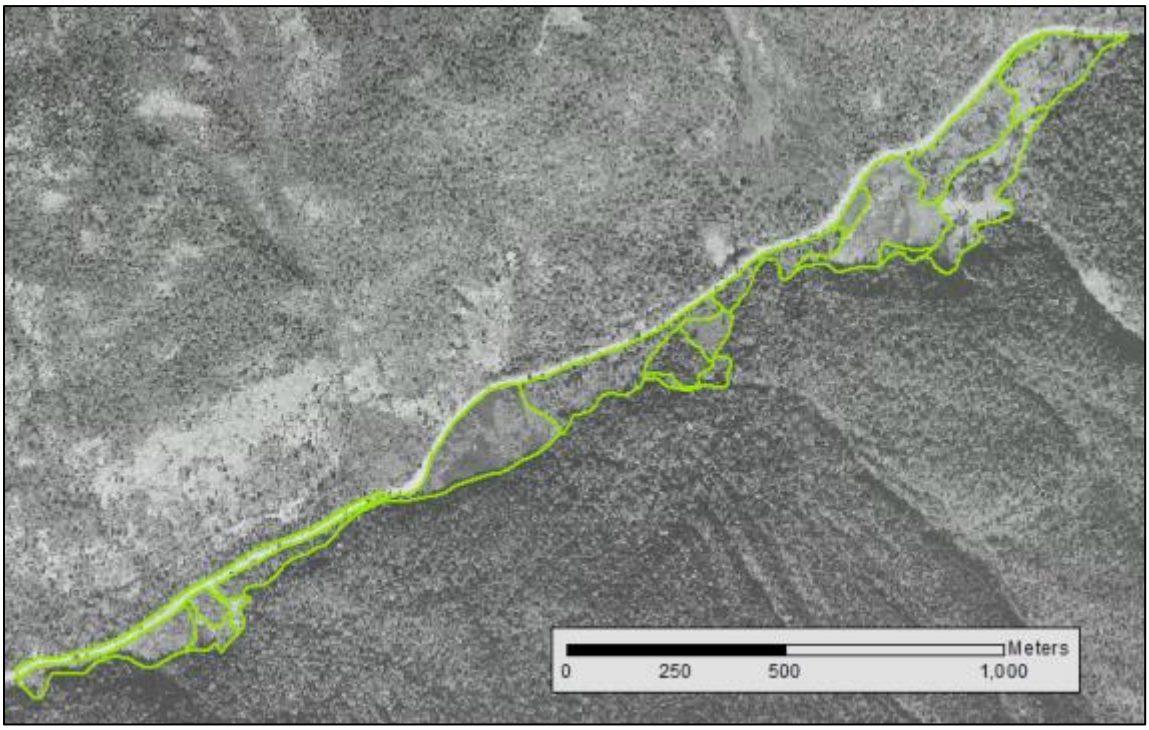


FIGURE 5.1-5 THREE FORKS WETLANDS

Bonanza Marsh

The Bonanza Marsh wetland encompasses roughly 46 hectares on the north end of Slocan Lake (Figure 5.1-6). It consists of a large complex of marsh, shallow open water and shrubby swamp, and likely contains treed swamps in the upland transitional areas. Portions have been disturbed, and weeds are likely common throughout, but the complex is unique on Slocan Lake and of significant ecological value.

FIGURE 5.1-6 BONANZA MARSH WETLANDS

Summit Lake

The Summit Lake wetland complex occurs on the eastern edge of Summit Lake. It encompasses roughly 20 hectares of marsh and shrubby swamp, as well as a portion of shallow open water and upland forest that may contain some treed swamp Figure 5.1-7). It is one of the larger marshes in the study area, and although disturbed by the highway to the south and other past uses, it is likely of high ecological value and moderate condition.

Beaver Lake West

The Beaver Lake West wetland is a small 5 hectare complex downstream of Beaver Lake. The wetland consists of several small swamps, riparian floodplain, and potentially a small marsh (Figure 5.1-8). It appears to be an untouched area and should be valuable representation of swamps and floodplain forests.

FIGURE 5.1-7 SUMMIT LAKE WETLANDS

FIGURE 5.1-8 BEAVER LAKE WEST WETLANDS

Fitz-Stebbs Creekside

The Fitz-Stebbs Creekside wetland is a 15 hectare complex location between Beaver Lake and Beaver Lake West. It consists of large treed swamp and both low and mid-bench floodplain forests (Figure 5.1-9). The swamp portion appears to be intact, while portions of the floodplain forest are likely modified by the adjacent forest service road.

FIGURE 5.1-9 FITZ-STEBBS CREEKSIDE WETLANDS

Beaver Lake

The Beaver Lake complex is the largest, at roughly 420 hectares, targeted in the SWAMP project. It has numerous wetland types mixed with floodplain forest and upland forest. Marshes, shallow open water,

shrub and treed swamp all occur, and there is the potential for the occurrence of bog or fen wetlands (Figure 5.1-10). The possibility of a bog or fen makes the Beaver Lake complex one of the most interesting and potentially important wetland complexes in the study area. Although portions of the upland forest have been logged, and a forest service road runs adjacent and upslope to the entire complex, it is expected that the ecological condition of the complex will be good overall.

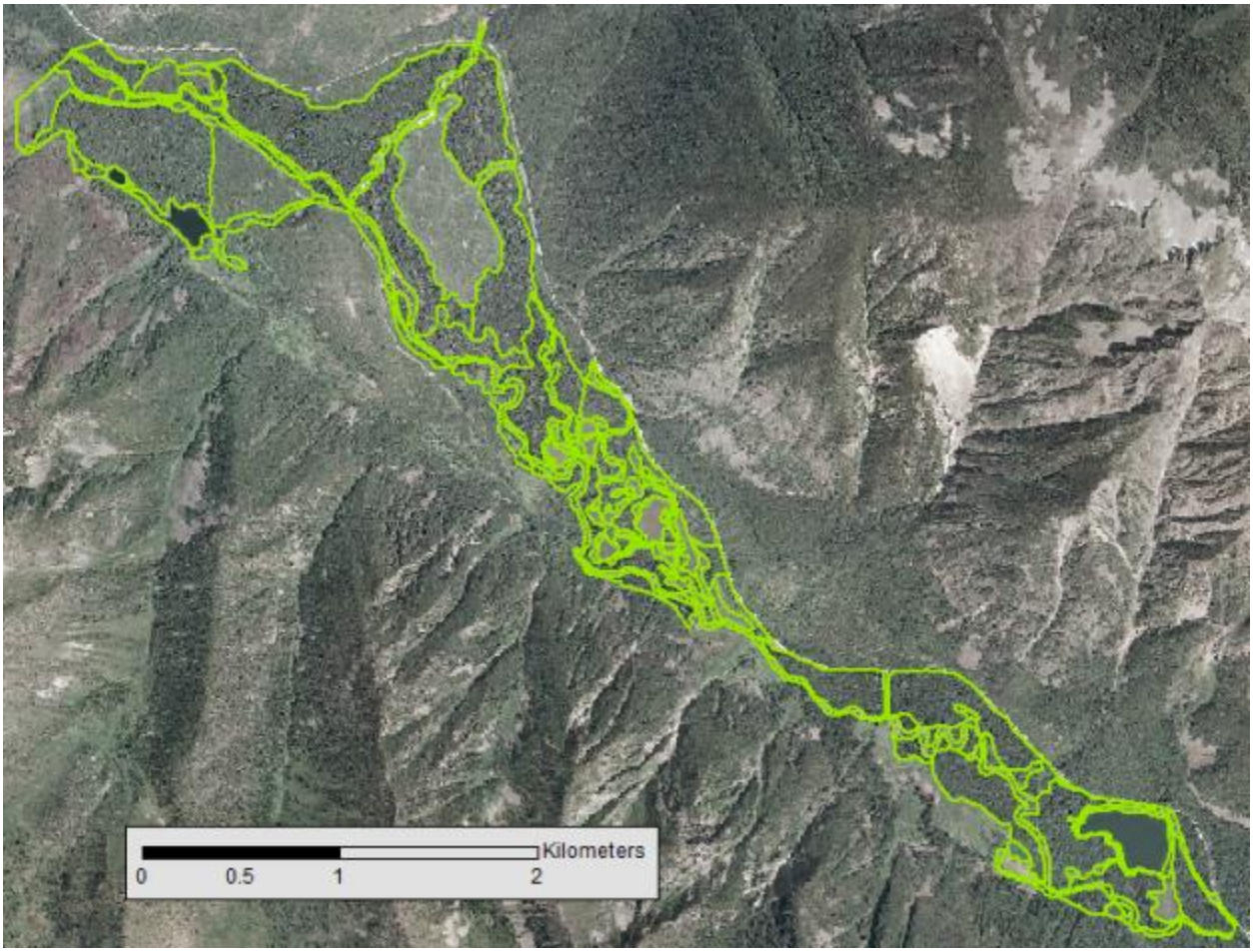


FIGURE 5.1-10 BEAVER LAKE WETLANDS

5.2 Field Survey Procedures

A generalized procedure for data collection and mapping verification, based in part on methodologies contained in the Field Manual for Describing Terrestrial Ecosystems (RISC 2010) is presented in the following sections. These procedures are for the core component of SWAMP, classifying wetlands and assessing ecological integrity, and will be used as the basis for all field work. Additional forms and methodologies (not included in this report) will be used where appropriate for the collection of additional data (such as CABIN assessments and water chemistry) from a select number of sites.

5.2.1 Pre-work

- Determine target study area and pre-plan survey route
- Complete a safety form
- Print field maps, forms, and if desired add pre-selected plot locations in GPS
- Use check list to ensure the crew has all the necessary equipment
- Check mapping to determine BEC subzone and potential listed ecosystems

5.2.2 Selecting Plot Location

Plot selection is one of the more difficult aspects of wetland sampling and mapping verification. It is important to select a sample site that is representative of the wetland you are trying to describe. The plot should be located in a homogenous part of the wetland, with care taken to avoid transitional areas (between wetland types and from wetland to upland ecosystems). Before selecting a plot location, take the time to traverse the area observing the landscape, and local features, surface topography, and changes in the vegetation community. Note and avoid any recent disturbance if possible. Plot size is generally 20m x 20m, but can be adjusted to suit the site (i.e. long and narrow if necessary). It is useful to measure the plot size and mark with flagging tape until you get comfortable doing a visual estimation.

5.2.3 Data Collection

Field data will be collected using three different methods; expert, technician, and volunteer. For professional biologists and contracted experts, provincial forms (FS882) from Describing Ecosystems in the Field (RISC 2010) will be used and data collection will follow the normal methodologies (or other RISC forms or custom forms as necessary). For technician lead field crews, a custom form has been made to facilitate data collection (Figure 5.2-1). The form is sufficient to enable the collection of the core information needed to classify wetlands and evaluate ecological integrity. In wetlands where additional data, such as CABIN assessments will be performed, additional forms will be required. For volunteer crews, a simplified form has been created (Figure 5.2-1). It is expected that these crews will be mainly doing initial reconnaissance of new and unmapped wetlands. The form is designed to enable them to collect information necessary to classify wetlands to the SEI level, or to provide simple location information and a basic description.

The following sections describe the information that is to be entered on the Technician and Volunteer Field Forms. Unless otherwise noted, all figures are adapted from the Field Manual for Describing Terrestrial Ecosystems (RISC 2010). For most sections, additional information can be found in the Field Manual or the Wetlands of British Columbia (Mackenzie and Moran 2004). Appendix 1 contains full size, printable versions of the field forms.

SWAMP Assessment Form - Technician

Site Information

Date:	Plot:	Surv:
Wetland Name:		Private/Crown:
Photos:		
UTMs:		Waypoint:
Slope:	Elevation:	Aspect:
MesoSlope: ☐ Upper ☐ Mid ☐ Lower ☐ Toe ☐ Depression ☐ Level		Microtopography:

Hydrology

pH:	Conductivity:	Water Colour: ☐ Tea ☐ YB Turbid ☐ GB Turbid ☐ GB Clear ☐ BG Clear	
HDI: ☐ Stagnant ☐ Sluggish ☐ Mobile ☐ Dynamic ☐ Very Dynamic			% Open Water:

Soils

Mineral Soil Drainage: ☐ Very Rapidly ☐ Rapidly ☐ Well ☐ Moderately Well ☐ Imperfectly ☐ Poorly ☐ Very Poorly		
Mineral Soil Texture: ☐ Sandy (LS, S) ☐ Loamy (SL, L, SCL, FSL) ☐ Silty (SIL, SI) ☐ Clayey (SICL, CL, SC, SIC, C)		
CF: ☐ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%	O. Soil Texture: ☐ Fibric ☐ Mesic ☐ Humic	O. Soil Depth:
Von Post: 1 2 3 4 5 6 7 8 9 10	O. Soil Moisture: ☐ Aqueous ☐ Peraquic ☐ Aquic ☐ Subaquic ☐ Perhumid ☐ Humid	
SMR: ☐ Moist ☐ Very Moist ☐ Wet ☐ Very Wet	SNR: ☐ Very Poor ☐ Poor ☐ Medium ☐ Rich ☐ Very Rich ☐ Hyper	

Wetland Classification

BGC Unit:	Site Series:	Structural Stage:
SEI Class:	SEI Sub Class:	Confidence:

	%	BGC Classification	SEI Classification
WL1%			
WL2%			
WL3%			

SWAMP Assessment Form - Volunteer

Site Information

Date:	Plot:	Surv:
Wetland Name:		Private/Crown:
Photos:		
UTMs:		Waypoint:
Slope:	Elevation:	Aspect:
MesoSlope: ☐ Upper ☐ Mid ☐ Lower ☐ Toe ☐ Depression ☐ Level		Microtopography:

Hydrology

HDI: ☐ Stagnant ☐ Sluggish ☐ Mobile ☐ Dynamic ☐ Very Dynamic	% Open Water:

Soils

Mineral Soil Drainage: ☐ Very Rapidly ☐ Rapidly ☐ Well ☐ Moderately Well ☐ Imperfectly ☐ Poorly ☐ Very Poorly		
Organic ☐ Mineral ☐	SMR: ☐ Moist ☐ V. Moist ☐ Wet ☐ Very Wet	SNR: ☐ V. Poor ☐ Poor ☐ Medium ☐ Rich ☐ V. Rich

Wetland Classification

SEI Class:	SEI Sub Class:	Confidence:

	%	SEI Classification
WL1%		
WL2%		
WL3%		

Classification Notes

Vegetation

Total % Tree (A): Shrub (B): Herb (C): Moss/Lichen (D):

Species	%	Species	%	Species	%

Wildlife

Wildlife/Notes/Description

Ecosystem Integrity

Connectivity Index		Invasive Plant Cover	
Land Use Index		Composition	
Buffer Index		Water Source	
Absolute Patch Size		Hydroperiod	
Relative Patch Size		Hydrologic Connectivity	
Veg. Structure		Physical Patch Types	
Woody Veg. Regeneration		Soil Disturbance	
Native Plant Cover		TOTAL	

Notes:

Vegetation

Total % Tree (A): Shrub (B): Herb (C): Moss/Lichen (D):

Species	%	Species	%	Species	%

Wildlife

Wildlife/Notes/Description

Ecosystem Integrity

Connectivity Index		Invasive Plant Cover	
Land Use Index		Composition	
Buffer Index		Water Source	
Absolute Patch Size		Hydroperiod	
Relative Patch Size		Hydrologic Connectivity	
Veg. Structure		Physical Patch Types	
Woody Veg. Regeneration		Soil Disturbance	
Native Plant Cover		TOTAL	

Notes:

FIGURE 5.2-1 TECHNICIAN AND VOLUNTEER FIELD FORMS

5.2.3.1 Site Information

Date:

Record the date as Day/Month/Year

Plot:

Create a unique plot identifier using a combination of crew initials and numbers. i.e. RD001, RD002, etc.

Surv:

Record the names of all crew members.

Wetland Name:

Record the name of the wetland that is being surveyed. If the name is not known, a nearby location name can be used.

Private/Crown:

Record if the wetland is on crown or private land, and if known the landowner name.

Photos:

Record the digital image name/number of photos taken of the plot. A minimum for each plot should be: photo of plot form to embed location and date in images, photos of each cardinal direction (North, East, South, West), general photos of the plot, wetland, and any species that are important to record.

UTMs:

Record the UTMs from the GPS. Northing first, easting second.

Waypoint:

Enter a GPS waypoint name from the GPS.

Slope:

If the wetland is sloped, record the % slope with a clinometer. If flat, enter “0” or “999”

Elevation:

Enter the plot elevation in metres from the GPS.

Aspect:

If the wetland is sloped, measure the aspect with a compass and record in degrees. The aspect is taken from the same direction as the slope, i.e. the direction in which water would drain.

MesoSlope:

Check the box for the mesoslope position of the plot. Mesoslope is the position of the plot along a 300m plane (Figure 5.2-2). Only those typically associated with wetlands are included on the form.

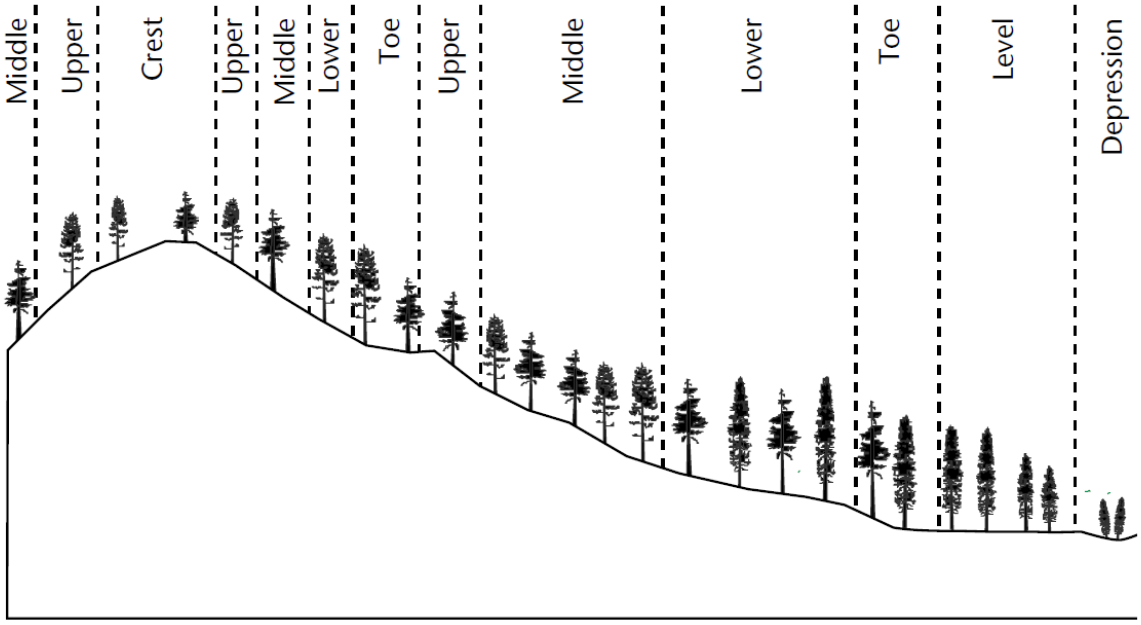


FIGURE 5.2-2 MESOSLOPE (RISC 2010)

Microtopography:

Enter the type of microtopographic featre(s) that occur in the weltland (5.2-3). Only dominant features are recorded. Smooth, hummocked and mounded are the ones that are most likley to be seen in the SWAMP study area.

Types of microtopographic features:

cha	**channelled** – incised water tracks or channels
dom	**domed** – raised bogs
gul	**gullied** – geomorphic ridge and ravine patterns
hmk	**hummocked** – mounds composed of organic materials
lob	**lobed** – solifluction lobes
mnd	**mounded** – mounds composed of mineral materials
net	**netted** – net vegetation patterns from freeze-thaw action in alpine or subarctic terrain
pol	**polygonal** – polygonal patterns associated with permafrost
rib	**ribbed** – wetland pattern with raised ridges perpendicular to direction of water flow
smo	**smooth** – surface relatively flat
tus	**tussocked** – associated with tussock-forming graminoids
und	**undulating** – controlled by bedrock

FIGURE 5.2-3 MICROTOPOGRAPHY (RISC 2010)

5.2.3.2 Hydrology

pH:

Measure the pH from standing water. Ideally three measurements should be taken and the average recorded on the form. When taking pH, the meter should be left in the water until the number stabilizes (stops rising or falling). It should be placed in standing water that has not been recently disturbed. The following descriptions were taken from Wetlands of BC (Mackenzie and Moran 2004):

"pH (acidity/alkalinity) is a correlate measure of base cation availability. This is primarily of importance for peatlands and less important for hydrologically dynamic systems. Five categories are recognized from Very Acid to Alkaline. Generally, as acidity increases, available base cations decrease, resulting in reduced site productivity.

- Very Acid (VA): (<4.5 pH) sites are true bogs with high cover of *Sphagnum* Group I or III mosses and few minerotrophic indicators.

- Moderately Acid (MA): (4.5–5.5 pH) sites still have high *Sphagnum* cover but minerotrophic indicators also occur. Peatland sites are considered bogs in this guide but would be poor fens or poor swamps using a "classic" definition.

- Slightly Acid (SA): (5.5–6.5 pH) sites are fens or swamps. *Tomenthypnum*, *Warnstorfii*, and *Drepanocladus* brown mosses are typical for sites with a stagnant or sluggish hydrodynamic index.

- Neutral (N): (6.5–7.4 pH) sites are fens, swamps, or marshes. Species are often a combination of species found on slightly acid and alkali sites.

- Alkaline (Ak): (>7.4 pH) sites are dominated by minerophilic bryophytes such as *Scorpidium* or *Campylium* mosses on peatland sites. Alkali-tolerant species occur in marshes."

Conductivity:

Measure the conductivity from standing water. Ideally three measurements should be taken and the average recorded on the form. It should be placed in standing water that has not been recently disturbed, especially where the disturbance has increased turbidity.

Water Colour:

Check the appropriate box that best describes water colour. Water should be removed and observed in the palm of your hand or in a jar so as to not influence the colour by reflections or substrate colour.

- Tea – looks like a cup of black tea.
- YB Turbid – Yellow Brown and turbid.
- GB Turbid – Green Brown and turbid.
- GB Clear – Green Brown and clear.
- BG Clear – Blue Green and clear.

Hydrodynamic Index (HDI):

Check the box that best describes the Hydrodynamic Index of the wetland. For the SWAMP study area, Very Dynamic is very unlikely to occur. Most wetlands should fall in the Sluggish or Mobile category, with the potential for Stagnant and Dynamic. The following descriptions were taken from Wetlands of BC (Mackenzie and Moran 2004):

"The Hydrodynamic Index has five categories that describe the magnitude of vertical and lateral water movements in the soil on Wet and Very Wet sites.

- Stagnant (St): Stagnant to very gradually moving soil water. Vertical fluctuations minimal. Permanent surface saturation but minimal or no surface flooding. Basins or

hollows with stable water regimes. Abundant organic matter accumulation and high bryophyte cover.

- Sluggish (Sl): Gradual groundwater movement through peat or fine-textured mineral soils along a hydrological gradient. Minor vertical watertable fluctuations. Semipermanent soil saturation with some elevated microsites or brief periods of surface aeration. Hollows, slopes, and water tracks in basins or lake flats not directly influenced by the waterbody. Abundant peat accumulation and bryophyte cover.

- Mobile (Mo): Distinct flooding and drawdown or pronounced lateral water movements. Peripheral areas of peatlands, sites adjacent to open water tracks, small rivulets or ponds, small potholes with relatively stable water regimes, protected lake embayments, or backmarshes in estuaries. Can have deep but well-decomposed accumulations of peat. Patchy bryophyte cover.

- Dynamic (Dy): Significant lateral flow and/or strong vertical watertable fluctuations through mineral soils. Potholes in arid climates that experience significant drawdown, wave-exposed shores, floodplain back channels, and protected estuary sites. Little organic accumulation, few bryophytes.

- Very Dynamic (VD): Highly dynamic surface water regime. Exposed tidal sites, shallow potholes in arid climates that experience significant drawdown, wave-exposed shores, and sites directly adjacent to and influenced by river flow. No organic accumulation or bryophytes."

% Open Water:

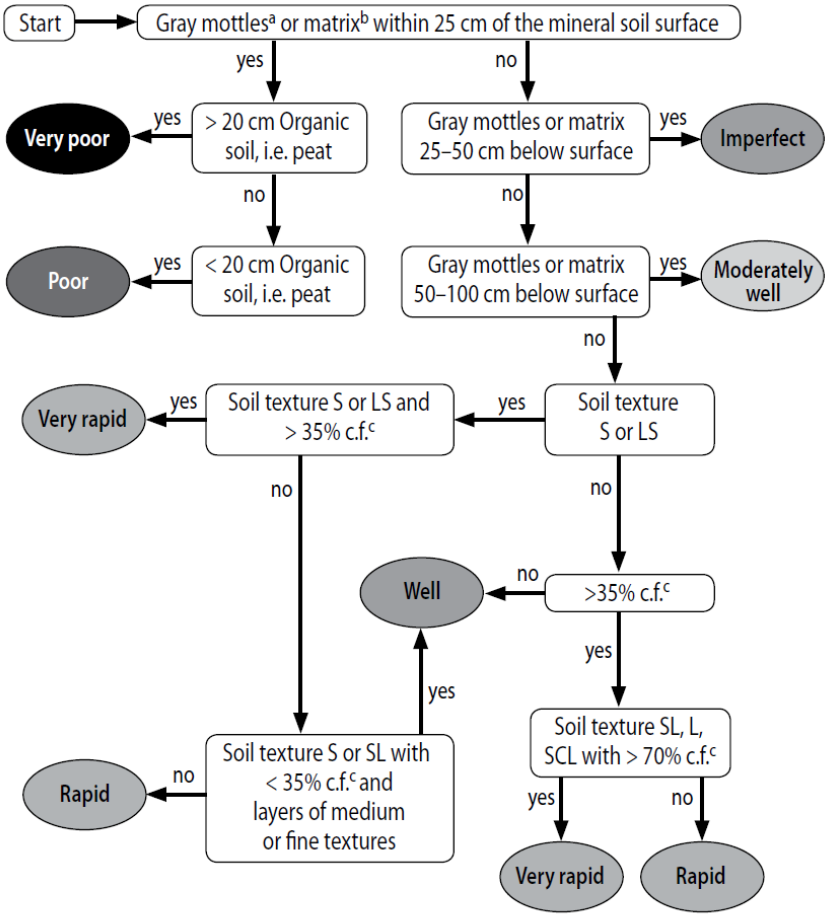
Record the estimated percent of the wetland that contains open water.

5.2.3.3 Soils

Soil descriptions are made using the soil auger, tape measure, and your fingers. Ideally, multiple quick soil cores should be done from different areas within the plot to make sure the core you use for the descriptions is representative of the site.

Mineral Soil Drainage:

Mineral soil drainage classes describe the speed and extent to which water is removed from a mineral soil in relation to additions. Check the box that best describes the wetland. Note that most wetlands will be either poorly or very poorly drained. Floodplain systems can be quite variable relative to the substrate they occur on (i.e. well drained sand; rapidly drained gravel and cobble), as well as the substrate depth and the state of decomposition of organic material. The following descriptions and table (Figure 5.2-4 and 5.2-5) will assist with the determination of soil drainage. Note that the coarse fragment percentage, soil texture, and some visual descriptions of the mineral soil are required for most of the classifications.



a Exclude mottles that are faint or few in number
b Exclude gray 'Ae' horizons
c Coarse fragment (c.f.) content by volume

FIGURE 5.2-4 MINERAL SOIL DRAINAGE KEY (RISC 2010)

Code	Name	Description
x	Very rapidly drained	Water is removed from the soil very rapidly in relation to supply. Water source is precipitation and available water storage capacity following precipitation is essentially nil. Soils are typically fragmental or skeletal, shallow, or both.
r	Rapidly drained	Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Water source is precipitation. Soils are generally coarse textured.
w	Well drained	Water is removed from the soil readily, but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Water source is precipitation. On slopes, subsurface flow may occur for short durations, but additions are equalled by losses. Soils are generally intermediate in texture and lack restricting layers.
m	Moderately well drained	Water is removed from the soil somewhat slowly in relation to supply because of imperviousness or lack of gradient. Precipitation is the dominant water source in medium- to fine- textured soils; precipitation and significant additions by subsurface flow are necessary in coarse-textured soils.
i	Imperfectly drained	Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is the major source. If subsurface water or groundwater (or both) is the main source, the flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the main source if available water storage capacity is high; contribution by subsurface or groundwater flow (or both) increases as available water storage capacity decreases. Soils generally have a wide range of texture, and some mottling is common.
p	Poorly drained	Water is removed so slowly in relation to supply that the soil remains wet for much of the time that it is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface or groundwater flow (or both), in addition to precipitation, are the main water sources. A perched water table may be present. Soils are generally mottled and/or gleyed.
v	Very poorly drained	Water is removed from the soil so slowly that the water table remains at or near the surface for most of the time the soil is not frozen. Groundwater flow and subsurface flow are the major water sources. Precipitation is less important, except where there is a perched water table with precipitation exceeding evapotranspiration. Typically associated with wetlands. For organic wetlands, also evaluate the soil moisture subclass, and when entering on the form, separate from drainage by a slash. For example, v/ac.

FIGURE 5.2-5 MINERAL SOIL DRAINAGE (RISC 2010)

Mineral Soil Texture:

Check the box that best reflects the mineral soil texture (from the mineral soil portion of the core if present). If no mineral soil present in the core, leave this section blank or cross out. Multiple descriptions and keys are presented below to aid with this assessment (Figures 5.2-6 to 5.2-8). Soil texturing is a skill that takes considerable practise to become comfortable with.

Hand texturing guide [a]

	Non-grainy (<20% sand)	**Slightly grainy** (20–50% sand)	**Grainy** (50–80% sand)	**Very grainy** (>80% sand)
Very sticky (>40% clay)	Silty clay	Clay	Sandy clay	–
Sticky (25–40% clay)	Silty clay loam	Clay loam	Sandy clay loam	–
Slightly sticky (10–25% clay)	Silt loam or silt	Loam [b]	Sandy loam	–
Non-sticky (<10% clay)	–	–	–	Loamy sand or sand

a Sand and clay limits are approximate.

b Loams contain balanced proportions of sand, silt and clay and exhibit physical properties intermediate between them.

Properties of soil separates

Properties of fine fraction	
Clay:	– very hard when dry; feels smooth and is very sticky when wet; feels smooth when placed between teeth.
Silt:	– slightly hard to soft when dry; powder is floury when dry; feels slippery or soapy and only slightly sticky or non-sticky when wet; silt cannot be felt as grains between thumb and forefinger, but can be felt as a fine grittiness when placed between teeth.
Sand:	– loose grains when dry; very grainy when felt between thumb and forefinger; non-sticky when wet.

FIGURE 5.2-6 MINERAL SOIL TEXTURE (RISC 2010)

Procedure for Using Key for Hand Texturing

The field tests (outlined below and used in sequence with the accompanying key) are provided as another means to assist in the field determination of soil texture.

1. Organic matter test: Well-decomposed organic matter (humus) imparts silt-like properties to the soil. It feels floury when dry and slippery or spongy when moist, but not sticky and not plastic. However, when subjected to a taste test (see below), it feels non-gritty. It is generally very dark when moist or wet, and stains the hands brown or black.
2. Graininess test: Rub the soil between your fingers. If sand is present, it will feel "grainy." Determine whether sand comprises more or less than 50% of the sample. Sandy soils often sound abrasive when worked in the hand.
3. Moist cast test: Compress some moist (not wet) soil by clenching it in your hand. If the soil holds together (i.e., forms a "cast"), then test the durability of the cast by tossing it from hand to hand. The more durable it is (e.g., like Plasticine), the more clay is present.
4. Stickiness test: Wet the soil thoroughly and compress between thumb and forefinger. Determine the degree of stickiness by noting how strongly the soil adheres to the thumb and forefinger when you release the pressure, and by how much it stretches. Stickiness increases with clay content.
5. Taste test: Work a small amount of soil between your front teeth. Silt particles are distinguished as fine "grittiness" (e.g., like driving on a dusty road), unlike sand, which is distinguished as individual grains (i.e., graininess). Clay has absolutely no grittiness.
6. Soapiness test: Slide thumb and forefinger over wet soil. Degree of soapiness is determined by how soapy/slippery it feels and how much resistance to slip there is (i.e., from clay and sand particles).
7. Worm test: Roll some moist soil on your palm with your finger to form the longest, thinnest "worm" possible. The more clay there is in the soil, the longer, thinner, and more durable the worm will be. Try with wetter or drier soil to ensure that you have the correct moisture content (best worm).

FIGURE 5.2-7 MINERAL SOIL TEXTURE PROCEDURE (RISC 2010)

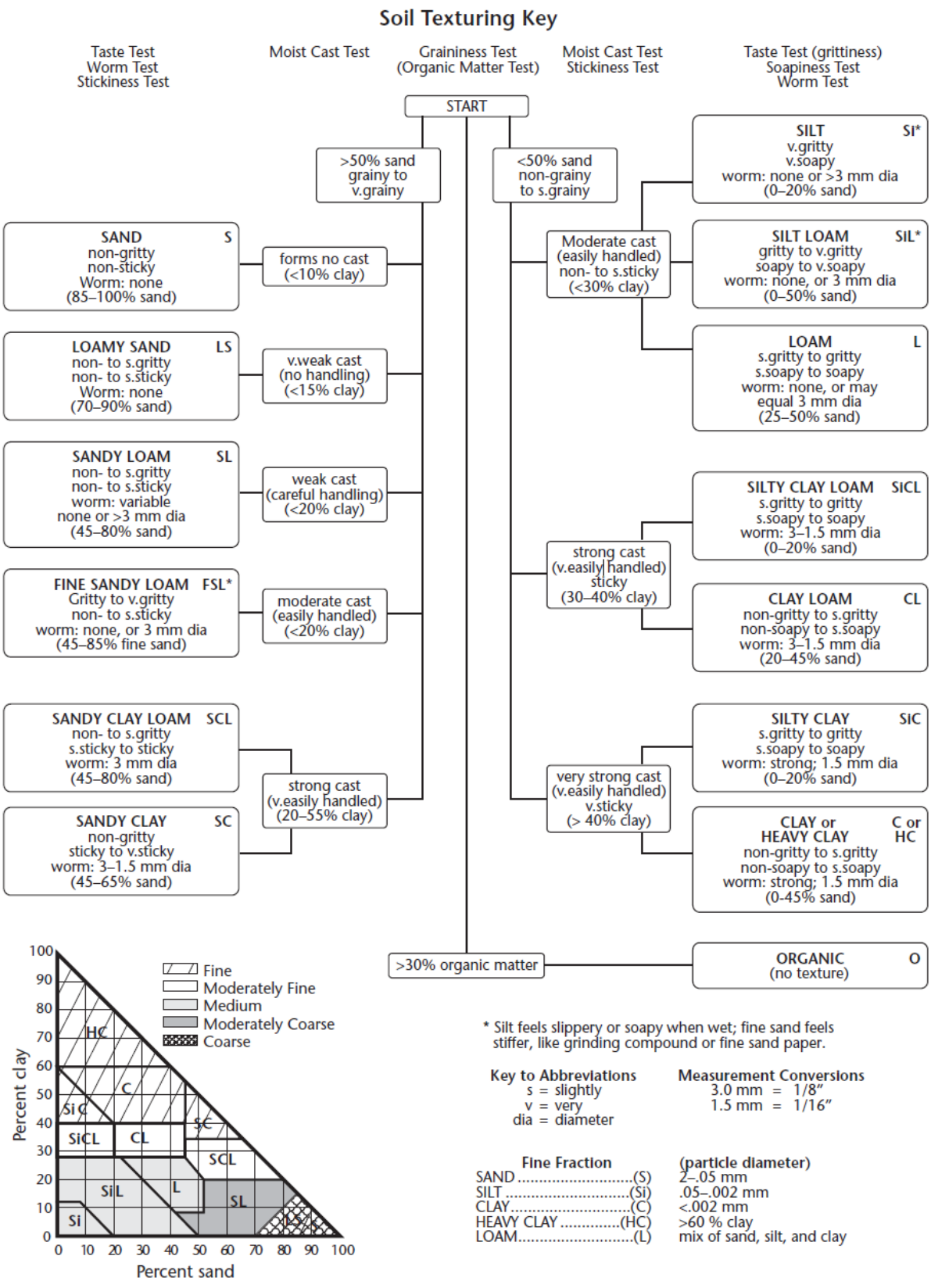


FIGURE 5.2-8 SOIL TEXTURING KEY (RISC 2010)

Coarse Fragments:

Check the box that best reflects the percent of course fragments found in the mineral soil portion of the soil core (if mineral soil is present). The below figure (Figure 5.2-9) indicates rock sizes that are included in the CF percent.

28. Percent Coarse Fragments

Estimate the percent coarse fragment (> 2 mm diameter) volume in each size class and record the total percent. Coarse fragments should fit through a sieve of the diameter limit specified below. A coarse fragment has a long axis (A); the diameter should be measured at the widest point when looking down the A-axis (B-axis). (Figure 2.5) Describe the coarse fragment shape using the type codes in Table 2.31.

TABLE 2.31 Size classes and type codes for coarse fragments

	Shape type: R, S, A[a]	Shape type: T
Size Classes	**Diameter (cm)**	**Length (cm)**
G - Gravel	< 7.5	< 15
C - Cobbles	7.5–25	15–38
S - Stones and boulders	>25	> 38

[a] type codes: **R** = rounded; **S** = subrounded and subangular; **A** = angular; **T** = thin, flat.

FIGURE 5.2-9 PERCENT COARSE FRAGMENTS (RISC 2010)

Organic Soil Texture:

Check the box that best reflects the type of organic soil texture. This is technically performed on the mid-tier of soil development (depth of 40 to 120cm), but for our purposes the important portion of the soil that we wish to describe is either the dominant material or the portion that contains the majority of the root mass. In the description below (Figure 5.2-10), Of is Fibric, Om is Mesic, and Oh is Humic.

Of	An O horizon comprised largely of poorly decomposed plant residues that are readily identifiable as to origin. It has 40% or more rubbed fibre (i.e., fibre that remains after rubbing a sample about 10 times between thumb and forefinger). These materials are classified in the von Post scale of decomposition (defined below, in Item 18, "Fabric") as class 1 to class 4.
Om	An O horizon comprised of partly decomposed plant residues which are at a stage of decomposition intermediate between Of and Oh horizons. Rubbed fibre usually ranges between 10 and 40% by volume. These materials are classified in the von Post scale of decomposition as class 5 or 6.
Oh	An O horizon of well-decomposed plant residues that for the most part have been transformed into humic materials. The rubbed fibre content is less than 10% by volume. These materials are usually classified in the von Post scale of decomposition as class 7 or higher, and very rarely as class 6.

FIGURE 5.2-10 ORGANIC SOIL TEXTURE (RISC 2010)

Organic Soil Depth:

Record the depth, in centimeters, of the organic horizon(s). Soils generally require an organic layer of greater than 40cm to be classified as an organic soil.

von Post:

Circle the von Post rate of decomposition class that best describes the wetland soil. If unsure, two values can be circled to indicate a range, but a note should be included indicating the most likely class. To assess the von Post class, take a small sample of organic material from the organic soil horizon. Squeeze the sample and observe the water colour that comes out, as well as the material itself. Figure 5.2-11 provides descriptions of the von Post classes.

Code/Class	Description
1	Undecomposed; plant structure unaltered; yields only clear water coloured light yellow brown.
2	Almost undecomposed; plant structure distinct; yields only clear water coloured light yellow brown.
3	Very weakly decomposed; plant structure distinct; yields distinctly turbid brown water, no peat substance passes between the fingers, residue not mushy.
4	Weakly decomposed; plant structure distinct; yields strongly turbid water, no peat substance escapes between the fingers, residue rather mushy.
5	Moderately decomposed; plant structure evident, but becoming indistinct; yields much turbid brown water, some peat escapes between the fingers, residue very mushy.
6	Strongly decomposed; plant structure somewhat indistinct, but more evident in the squeezed residue than in the undisturbed peat; about one-third of the peat escapes between the fingers, residue strongly mushy.
7	Strongly decomposed; plant structure indistinct, but recognizable; about one-half of the peat escapes between the fingers.
8	Very strongly decomposed; plant structure very indistinct; about two-thirds of the peat escapes between the fingers, residue almost entirely resistant remnants such as root fibres and wood.
9	Almost completely decomposed; plant structure almost unrecognizable; nearly all the peat escapes between the fingers.
10	Completely decomposed; plant structure unrecognizable; all the peat escapes between the fingers.

FIGURE 5.2-11 VON POST RATE OF DECOMPOSITION (RISC 2010)

Organic Soil Moisture:

Check the box that best describes the organic soil moisture subclass to indicate the length of time the soil is saturated (Figure 5.1-12). This assessment is based on observations of soil and standing water at the time of year in which you do the survey, as it is also expressed in the type and amount of vegetation that occurs on a site. For instance, if you are assessing the wetland during August, and there is still standing water, then the subclass is likely Aqueous or Peraquic.

Code	Moisture subclass	Description	Saturation period (mo.)	Moist period (mo.)
aq	Aqueous	Free surface water	11.5–12	< 0.5
pa	Peraquic	Soil saturated for very long periods	> 10	< 2
ac	Aquic	Soil saturated for moderately long periods	4–10	2–8
sa	Subaquic	Soil saturated for short periods	< 4	8–11.5
ph	Perhumid	No significant water deficits in growing season	< 2	8–11.5
hu	Humid	Very slight deficits in growing season	< 0.5	> 11.5

FIGURE 5.2-12 ORGANIC SOIL MOISTURE (RISC 2010)

Soil Moisture Regime (SMR):

Check the box that best described the Soil Moisture Regime (SMR) of the wetland. The following descriptions were taken from Wetlands of BC (Mackenzie and Moran 2004 to aid with the assessment:

"Soil Moisture Regime (SMR) is the average amount of soil water annually available for evapotranspiration by vascular plants over several years (Pojar et al. 1987). There are nine moisture categories from Very Dry to Very Wet. Wetlands are found only on Wet to Very Wet sites. Related ecosystem classes are also found on Moist and Very Moist sites. The wetland edatopic grid is therefore limited to this range. The definitions for soil moisture categories used in the guide are defined as:

- Moist (M): No water deficit occurs. Current need for water does not exceed supply; temporary groundwater table may be present. Unless otherwise limited, supports forest.
- Very Moist (VM): Rooting-zone groundwater present during the growing season (water supply exceeds demand). Groundwater table > 30 cm below the surface. Unless otherwise limited, supports forest.

- Wet (W): Rooting-zone groundwater present during the growing season (water supply exceeds demand). Groundwater table between 0 and 30 cm below the surface. Can support tall shrubs and trees.
- Very Wet (VW): Groundwater table at or above the ground surface during the growing season. Will not support tall shrubs or trees but can support low shrubs."

Soil Nutrient Regime (SNR):

Check the box that best reflects the Soil Nutrient Regime (SNR) of the wetland. To accurately assess the SNR, it is necessary to use all the information previously collected in the soils section and portions of the Site Information section. The following table (Figure 5.2-13), taken from Wetlands of BC (Mackenzie and Moran 2004), can be used to determine SNR.

SNR	A Very Poor	B Poor	C Medium	D Rich	E Very Rich	F Hyper
Available nutrients	very low	low	average	plentiful	abundant	excess alkali or salt accumulation
Water pH	<5.0	4.5 – 6.0	5.0 – 6.5	6.0 – 7.4	6.5 – 8.0	8.0+
vonPost of surface tier	1 – 3	3 – 6	4 – 7	7 – 10	8 – 10	
Ground - water flow through site	stagnant		seasonal seepage		continuous seepage	
C:N ratio	High		Medium		Low	
Surface tier material	Fibrimor		Mesimor	Saprimoder	Marl	Mineral
Water colour	tea colored; yellowish-deep brown and turbid		green-brown and clear	green-brown and turbid		blue-green and very clear (alkaline)
Colour of surface peat	pale		dark			
Surface tier saturation	always saturated		seasonal exposure of substrate	diurnal exposure of substrate		

FIGURE 5.2-13 SOIL NUTRIENT REGIME (MACKENZIE AND MORAN 2004)

5.2.3.4 Wetland Classification

This section is used to record the SEI and/or BGC classification. If the BGC classification (provincial site series) cannot be determined, or if the site is significantly disturbed, then the more simplistic SEI classification can be used. These classifications require much of the previous information, and the vegetation information, so it is usually the last thing completed on the form.

BGC Unit:

Enter the Biogeoclimatic unit in which the wetland occurs. This should be determined before going into the field, as it determines which site series may occur in the area, and which guide book to use. For the main target wetlands, Summit Lakes, Pass Creek and Little Slocan Lakes occur in the ICHdw1 while the others occur in the ICHmw2. Wetlands mapped in the Slocan SEI generally occur in the ICHdw1. The below figure (5.2-14) will assist with BGC determination for the main wetlands. Smaller wetlands, particularly higher elevation ones, will require the GIS to determine the BGC in which they occur.

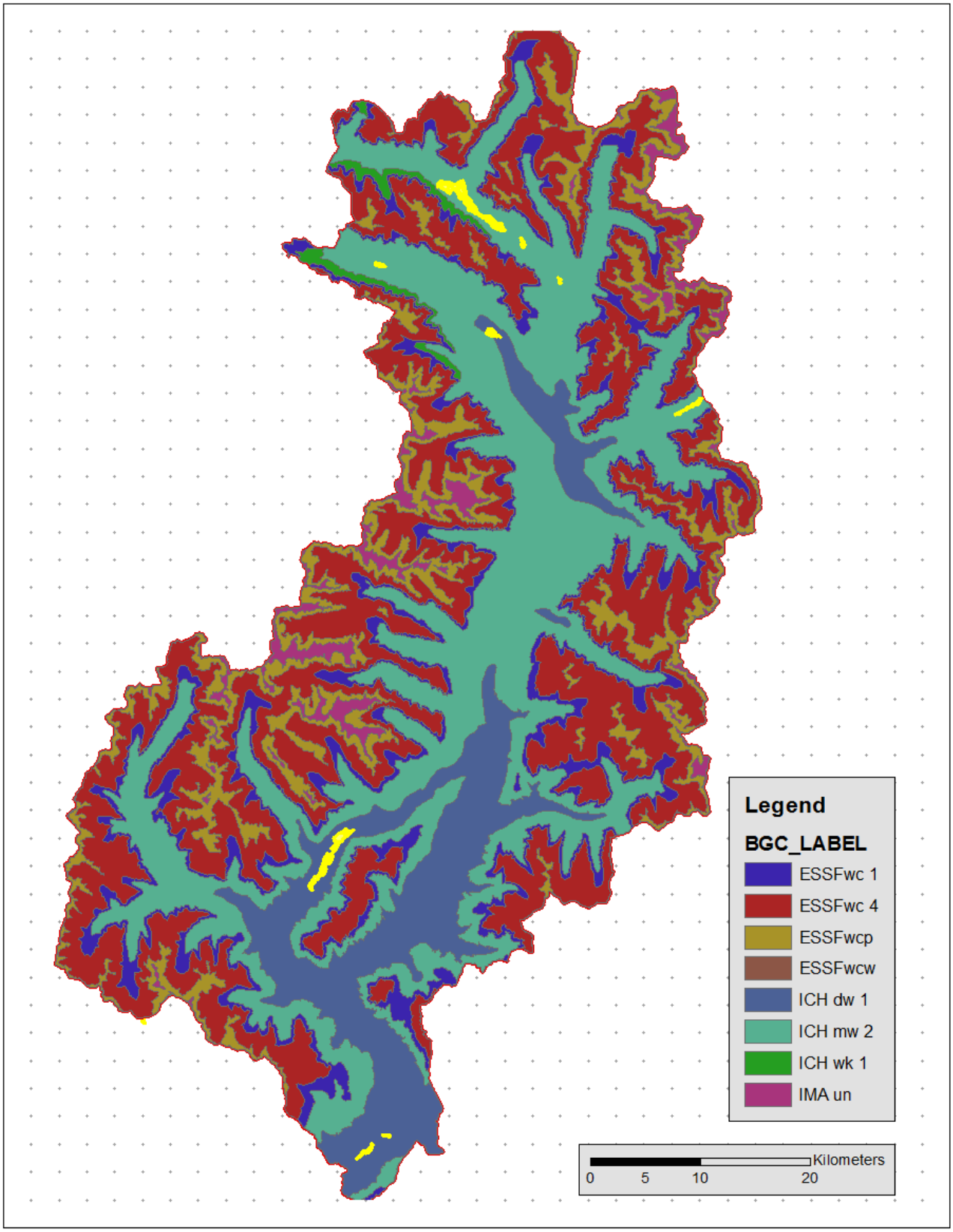


FIGURE 5.2-14 BGC MAP (GEO BC 2014)

Site Series:

The site, soil hydrology and vegetation information is all used to determine the site series of the wetland. For disturbed sites, the site series generally is not applicable, and it is very possible that no site series currently exists to describe a specific wetland. In those circumstances, the SEI classification can be used in its place, with a note on the form indicating that a site series could not be assigned. Specific wetland site series require the use of Wetlands of British Columbia.

Structural Stage:

Record the structural stage along with stand composition modifiers and canopy structure modifiers. These are entered as codes such as 5tC for a young two-storied conifer forest. Figure 5.2-15 provides the structural stage codes and descriptions, as well as the codes and descriptions for the modifiers.

Post-disturbance stages, or environmentally limited structural development:

1 **Sparse/cryptogam**[1] Either the initial stages of primary succession, or a very early stage of cohort establishment following a stand-destroying disturbance, or a cryptogam community maintained by environmental conditions (e.g., bedrock, boulder fields, talus); bryophytes or lichens can be dominant; time since disturbance is < 20 years for normal forest succession; sparse tree, shrub and herb cover: either sparsely vegetated overall (low cover of vascular plants and cryptogams, if present), or dominated by cryptogams.

- **1a** **Sparse** – less than 10% vegetation cover.
- **1b** **Bryoid** – bryophyte-dominated.
- **1c** **Lichen** – lichen-dominated.

Stand initiation stages or environmentally induced structural development:

2 **Herb** Early successional stage or a herb community maintained by environmental conditions (e.g., very wet, warm & dry, or late snow site) or disturbance (e.g., avalanche track, flooding, intensive grazing, animal burrowing); generally dominated by herbs (forbs, graminoids, ferns), although herb cover can be low if sparsely vegetated overall as long as herbs characterize the vegetation; trees and shrubs are usually absent or sparse, however shrub cover and stature as compared to herb cover and stature determines whether the site is considered herbaceous; time since disturbance is < 20 years for normal forest succession; many non-forested communities are perpetually maintained in this stage.

- **2a** **Forb-dominated** – includes non-graminoid herbs and ferns.
- **2b** **Graminoid-dominated** – includes grasses, sedges, reeds, and rushes.
- **2c** **Aquatic** – floating or submerged plants dominate; (sedge communities growing in marshes with standing water are classed as 2b).
- **2d** **Dwarf shrub-dominated** – dominated by dwarf woody species such as kinnikinnick, dwarf willows, or mountain-heathers (see Table 3.1 in Vegetation section).

3 **Shrub/Herb** Early successional stage or a shrub community maintained by environmental conditions (e.g., wet soils, cold air accumulation) or disturbance (e.g., avalanche track); tree cover sparse but tree seedlings and advance regeneration may be abundant; either dominated by shrubby vegetation, or if sparsely vegetated overall, shrub cover and stature characterizes the community as a shrubland.

- **3a** **Low shrub** – dominated or characterized by shrubby vegetation < 2 m tall; time since disturbance < 20 years for normal forest succession; may be perpetuated indefinitely by environmental conditions (e.g., cold air basins) or disturbance.

1 Cryptogam: Term generally refers to plants that reproduce by spores – it is used here to refer to lichens, mosses and liverworts.

FIGURE 5.2-15 KEY TO STRUCTURAL STAGE AND MODIFIERS (RISC 2014)

3b **Tall shrub** – dominated or characterized by shrubby vegetation that is 2–10 m tall; time since disturbance < 40 years for normal forest succession; may be perpetuated indefinitely.

Stem exclusion stages:

4 Pole/Sapling Trees > 10 m tall, typically densely stocked, and have overtopped shrub and herb layers; younger stands are vigorous (usually > 15–20 years old); older stagnated stands (up to 100 years old) are also included; self-thinning and vertical structure are not yet evident in the canopy; time since disturbance usually < 40 years; up to 100+ years for dense (5000 – 15000+ stems per ha) stagnant stands.

5 Young Forest Self-thinning has become evident and the forest canopy has begun to differentiate into distinct layers (dominant, main canopy, and overtopped); vigorous growth and a more open stand than in the Pole/Sapling stage; begins as early as age 30 (e.g., broadleaf or vigorous conifer stands) and extends to 50–80 years, depending on tree species and ecological conditions; in forest stands at environmental extremes, a very open Young Forest structure may develop initially (single cohort) or over a period of time (multi-cohort) – use the 'open' modifier for such conditions.

Understorey reinitiation stage:

6 Mature Forest Trees established after the last stand-replacing disturbance have matured; a second cycle of shade-tolerant trees may have become established; shrub and herb understories become well developed as the canopy opens up; time since disturbance is generally 80–140 years for BGCs with Natural Disturbance Type (NDT) 3[2] and 80–250 years for NDT 1, 2 & 4[3]. See BECdb database[4] for the current NDTs.

Old-growth stages:

7 Old Forest Stands of old age with complex structure; patchy shrub and herb understories are typical; regeneration is usually of shade-tolerant species with composition similar to the overstorey; long-lived seral species may be present in some ecosystem types or on edaphic sites. Old growth structural attributes will differ across biogeoclimatic units and ecosystems.

2 NDT 3 BGC units include all biogeoclimatic units within the following zones or subzones, as well as the specific variants: BWBS, MS, SBPS, ESSFdc, ESSFdk, ESSFdm, ESSFdv, ESSFxc, ICHdk, ICHdw, ICHdm, ICHmk1, ICHmk2, ICHmk4, ICHmw1, ICHmw3, ICHxw, SBSdh, SBSdk, SBSdw, SBSmc, SBSmh, SBSmk, SBSmm, SBSmw and SBSwk3.

3 NDT 1, 2 & 4 BGC units comprise all other biogeoclimatic units

4 BECdb database: http://www.for.gov.bc.ca/hre/becweb/resources/codes-standards/standards-becdb.html

FIGURE 5.2-15 KEY TO STRUCTURAL STAGE AND MODIFIERS (RISC 2014) CONT.

7a **Old Forest** Stands with moderately to well developed structural complexity; stands comprised mainly of shade-tolerant tree species in canopy and regeneration layers, although older seral trees from a disturbance such as fire may still dominate the upper canopy; fire-maintained stands may have a 'single-storied' appearance (see modifiers); time since stand-replacing disturbance is generally 140 – 250 years for biogeoclimatic units with Natural Disturbance Type (NDT) 3[2] and > 250 years for NDT 1, 2 & 4.[3] See BECdb database[4] for the current NDTs.

7b **Very Old Forest** Very old stands having complex structure with abundant large-sized trees, snags and coarse woody debris (size is relative to the specific ecosystem); snags and CWD occur in all stages of decomposition; stands are comprised entirely of shade-tolerant overstorey species with well-established canopy gaps; time since stand-replacing disturbance generally > 250 years for BGCs with Natural Disturbance Types (NDT) 3[2] and > 400 years for NDT 1, 2 & 4.[3]

Structural stage modifiers Modifiers for stand composition, canopy structure, and disturbance history can be used to provide additional information for characterizing stands. For example, 6/Coth – describes an open, two-storied, silviculturally-modified mature coniferous forest structural stage.

Stand composition modifiers (stages 3–7 only) A description of the leaf-types of trees in a stand provides general information on the appearance and structure of the stand and is helpful as a broad descriptor of stand composition.

C = coniferous (> 75% of total tree cover is coniferous)

B = broadleaf (> 75% of total tree cover is broadleaf)

M = mixed (neither coniferous or broadleaf account for > 75% of total tree cover)

Canopy structure modifiers (stages 4–7 only) (see Figure 1.2): Overstorey tree structure can vary within any given structural stage due to edaphic differences or disturbance history. Below-ground vs. above-ground competition may also result in different structural modifiers at the same stage of structural development. Below-ground competition is evident in very dry stands and results in very open stands.

s = single-storied Closed or open forest stand dominated by the overstorey crown class (dominant and co-dominant trees); intermediate and suppressed trees comprise less than 20% of all crown classes combined.[5]

t = two-storied Closed or open forest stand co-dominated by distinct overstorey and intermediate crown classes; the suppressed crown class is lacking or comprises less than 20% of all crown classes combined.[5]

m = multistoried Closed or open forest stand with all crown classes well represented; each of the intermediate and suppressed classes comprise greater than 20% of all crown classes combined.[5]

5 Based on either basal area or percent cover estimates.

FIGURE 5.2-15 KEY TO STRUCTURAL STAGE AND MODIFIERS (RISC 2014) CONT.

SEI Class:

Enter the appropriate SEI class from Table 5.2-1.

TABLE 5.2-1 SEI WETLAND, RIPARIAN AND FRESHWATER CLASSES AND SUBCLASSES.

RI: Riparian		Ecosystems associated with and influenced by freshwater
RI	fh: high bench	High bench floodplain terraces
RI	fm: medium bench	Medium bench floodplain terraces
RI	fl: low bench	Low bench floodplain terraces
RI	ff: fringe	Narrow, linear community along watercourses that generally lack floodplains and floodplain communities
RI	ri: river	River and creeks, including gravel bars
WN: Wetland		Terrestrial – freshwater transitional areas.
WN	ms: marsh	Graminoid or forb-dominated nutrient-rich wetlands
WN	sp: swamp	Shrub or tree-dominated wetlands
WN	ow: shallow water	Permanently flooded, water less than 2m deep at mid-summer
WN	fn: fen	Herbaceous or shrub wetlands, moderate nutrients, wet throughout growing season.
WN	bg: bog	Acidic, sphagnum dominated, closed basin wetlands
FW: Lakes and Ponds		
FW	pd: pond	Open water > 2 m deep and generally < 50 ha.
FW	la: lake	Open water > 2 m deep and generally > 50 ha.

SEI Sub Class:

Enter the appropriate SEI subclass from Table 5.2-1.

Confidence:

This field is used for a brief comment indicating the confidence in the SEI or BGC classification. Indicate if you strongly believe the classification is correct, or if it is just best fit, etc.

WL1%, WL2%, WL3%

This table is used to describe wetlands that occur as complexes. Up to three different SEI class/subclasses or site series can be recorded for each mapped polygon. Typically the plot occurs with one of the wetland types, while the rest are visual observations. Enter the estimated percent of the polygon covered by each wetland type (in increments of 10%) and the SEI and/or site series classifications. If possible, also enter the full structural stage with modifiers for each wetland type. Other ecosystem types can also be recorded here if the polygon contains terrestrial ecosystems, disturbed areas, or freshwater ecosystems. For these areas the expanded SEI legend can be used (Table 5.2-2).

TABLE 5.2-2 SEI CLASS, SUBCLASS AND DESCRIPTIONS.

SEI Class	SEI Subclass	Brief Description
Sensitive Ecosystems		
OF: Old Forest		Forests > 140 yrs
OF	co: coniferous	Conifer > 75% of stand
OF	mx: mixed	Stand composition > 25% conifer and > 25% broadleaf
RI: Riparian		Ecosystems associated with and influenced by freshwater
RI	fh: high bench	High bench floodplain terraces
RI	fm: medium bench	Medium bench floodplain terraces
RI	fl: low bench	Low bench floodplain terraces
RI	ff: fringe	Narrow, linear community along watercourses that generally lack floodplains and floodplain communities
RI	ri: river	River and creeks, including gravel bars
WN: Wetland		Terrestrial – freshwater transitional areas.
WN	ms: marsh	Graminoid or forb-dominated nutrient-rich wetlands
WN	sp: swamp	Shrub or tree-dominated wetlands
WN	ow: shallow water	Permanently flooded, water less than 2m deep at mid-summer
WN	fn: fen	Herbaceous or shrub wetlands, moderate nutrients, wet throughout growing season.
WN	bg: bog	Acidic, sphagnum dominated, closed basin wetlands
FW: Lakes and Ponds		
FW	pd: pond	Open water > 2 m deep and generally < 50 ha.
Other Important Ecosystems (OIE)		
MF: Mature Forest		Forests > 80 yrs, < 140 yrs
MF	co: coniferous	Conifer-dominated (> 75% of stand composition)
MF	mx: mixed	Stand composition > 25% conifer and > 25% broadleaf
MF	bd: broadleaf	Broad-leaf dominated (> 75% of stand composition), any size
WD: Woodland		Dry site, open stands with between 10 and 25% tree cover
WD	co: coniferous	Conifer > 75% of stand
WD	mx: mixed	Conifer > 25% and broadleaf > 25% of composition
SV: Sparsely Vegetated		Areas with 5 – 10% vascular vegetation.
SV	cl: cliff	Steep slopes, often with exposed bedrock.
SV	ro: rock outcrop	Rock outcrops – areas of bedrock exposure.
SV	ta: talus	Dominated by rubbly blocks of rock.
SV	es: exposed soil	Any area of exposed soil that is not in other definitions.
Not Sensitive (NS)		
NS: Not Sensitive		Disturbed and permanently developed/modified areas.
YF: Young Forest		Large patches of forest – stands > 30 yrs, < 80 yrs
YF	co: coniferous	Conifer-dominated (> 75% of stand composition)
YF	mx: mixed	Stand composition > 25% conifer and > 25% broadleaf
YF	bd: broadleaf	Broad-leaf dominated (> 75% of stand composition)
PS: Pole Sapling		Trees > 10 m tall, usually 10 - 15 yrs

PS	co: coniferous	Conifer-dominated (> 75% of stand composition)
PS	mx: mixed	Stand composition > 25% conifer and > 25% broadleaf
PS	bd: broadleaf	Broad-leaf dominated (> 75% of stand composition)
HB: Herbaceous		Non-forested ecosystems; usually shallow soils, often with bedrock outcrops.
HB	hb: herbaceous	Non-forested, often shallow soils, lichens, moss, or grass/herb dominated.
HB	sh: shrub	Dominated by shrubby vegetation (<10m in height)
FS: Seasonally Flooded Agricultural Fields		Annually flooded cultivated fields or hay fields.
OD: Old Field		Large, old field ecosystems.

5.2.3.5 Vegetation

Dominant vegetation is entered in this section of the form. It is not necessary to identify every species, but it is important to identify as many of the dominant species from each layer as possible. Weeds and invasive species are also important to record, even if they cannot be identified. Photographs and samples can be taken of species that are of interest and those that need to be properly identified in the office.

Total Percent by Layer

Enter the total percent cover for all layers, and the total percent cover for each layer. The descriptions below (Figure 5.2-16) indicate how to differentiate between vegetation layers. Note that for the purposes of SWAMP, further subdivision within layers is not required.

Vegetation Layers

All vegetation is assigned to one of the following layers. Criteria for A and B layers and sub-layers are depicted in Figure 3.1.

A. The *tree layer* includes all woody plants greater than 10 m tall. Three sub-layers are recognized:

A1 **Dominant trees** - includes the dominant (tallest) trees of the main canopy, which may be veterans of one or more fires (previously classed as A0), or the tallest trees of the same age class as the main canopy; usually a minor portion of the stand composition.

A2 **Main tree canopy (codominant trees)** - the main layer of tree cover, composed of trees whose crowns form the upper layer of foliage; typically the major portion of the stand composition.

A3 **Sub-canopy trees** - includes trees greater than 10 m high that do not reach the main canopy; may form a distinct secondary canopy; often a mixture of trees of various heights younger than those in the main canopy or may be suppressed trees of the same age; includes "intermediate" and "overtopped" trees (terminology of MFR Resources Inventory Branch).

B. The *shrub layer* includes all woody plants less than 10 m tall, except low (usually < 15 cm tall) woody or trailing plants which are considered part of the herb layer (see Table 3.1). Established tree regeneration more than two years of age and less than 10 m in height is considered part of the shrub layer. Two sub-layers are recognized:

B1 **Tall shrub layer** - includes all woody plants 2–10 m tall, including shrubs and advance tree regeneration and trees in poorly growing stands where the canopy is less than 10 m high.

B2 **Low shrub layer** - includes all woody plants less than 2 m high, except low (< 15 cm) woody or trailing plants (see Table 3.1); includes shrubs and established tree regeneration more than two years old and dwarfed or immature specimens of species normally considered in the shrub category (e.g., young *Vaccinium membranaceum*, or dwarf alpine forms of normally taller shrubs).

C. The *herb layer* includes all herbaceous species, regardless of height, and some low woody plants less than 15 cm tall (see Table 3.1).

D. The *moss, lichen, liverwort and seedling layer* includes all bryophytes, terrestrial lichens, and liverworts, and tree seedlings less than two years old that occur on mineral soil and humus.

Dr - *Mosses, lichens, liverworts* that occur on rock.

Dw - *Mosses, lichens, liverworts* that occur on wood.

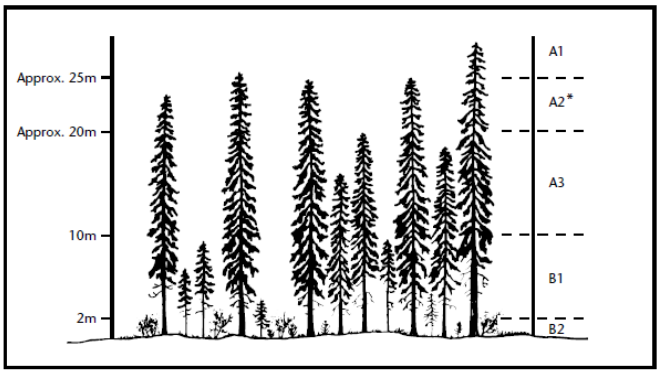


FIGURE 5.2-16 KEY TO VEGETATION LAYERS (RISC 2014)

Species and Percent Cover

Enter the species name (scientific names, not common names if possible) and estimated percent cover of each species. If a species occurs in two layers (i.e. shrub and tree) it should be recorded twice and the percent cover entered for each. The following descriptions and figures (Figures 5.2-17 to 5.2-19) will assist with percent cover estimates.

Estimating Percent Cover

In most surveys, only those species growing on the dominant substrate are included in estimates. Percent cover is estimated as the percentage of the ground surface covered when the crowns are projected vertically. Follow the outside perimeter of the projected crown. For the tree layer, distinct holes in the canopy should be subtracted from the estimate. For other layers, small gaps that are not fully covered can be ignored.

- Viewing the layer obliquely, rather than vertically, can result in an over-estimation.
- Avoid biasing estimates because of crown density.
- For species with high cover values, mentally move the plants to a corner of the plot to estimate if they represent one-quarter, one-third, or one-half, or more of the plot.
- For species that almost cover the plot, mentally move them together and estimate how much of the area is not covered by the plants.

FIGURE 5.2-17 ESTIMATING PERCENT COVER (RISC 2014)

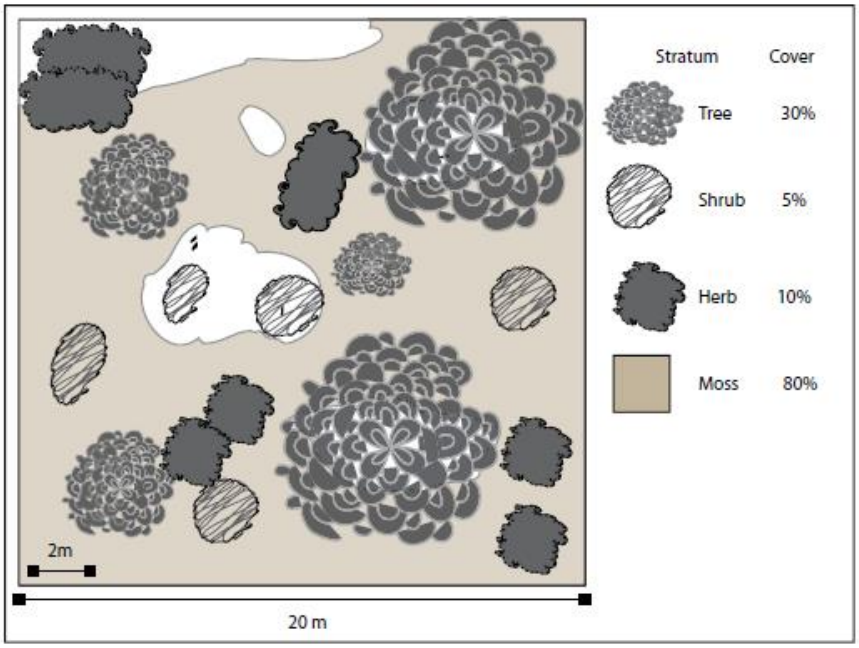


FIGURE 5.2-18 ESTIMATING PERCENT COVER – PLOT SCHEMATIC (RISC 2014)

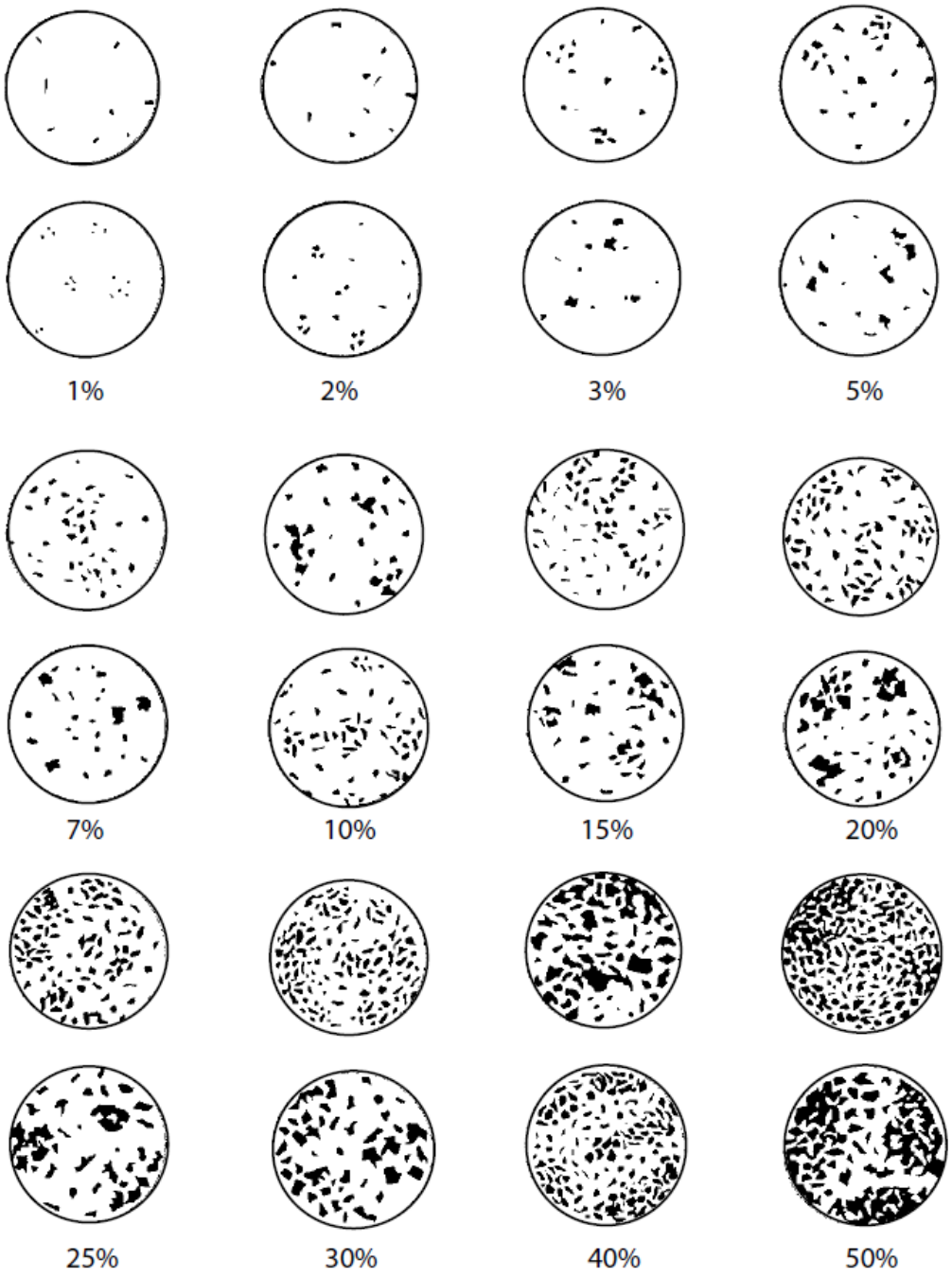


FIGURE 5.2-19 COMPARISON CHARTS OF VISUAL ESTIMATION OF FOLIAGE COVER (RISC 2014)

5.2.3.6 Wildlife

Wildlife/Notes/Description

General notes regarding wildlife observed, wildlife sign, and wildlife habitat provided by the wetland can be entered here.

5.2.3.7 Ecological Integrity

The following ranking system can be used to consistently rank the ecological integrity of wetlands throughout the study area. It is adapted from rapid assessments procedures developed for the US Environmental Protection Agency by NatureServe (Faber-Langendoen et al. (2012a & 2012b) for use in the SWAMP project.

The method is described by Faber-Langendoen et al. (2012b) as:

> "The intent of ecological integrity based rapid assessment methods (RAMs) is to evaluate the complex ecological condition of a selected ecosystem using a specific set of observable field indicators, and to express the relative integrity of a particular occurrence in a manner that informs decision-making, whether for restoration, mitigation, conservation planning, or other ecosystem management goals (Stein et al. 2009). These Level 2 assessments are structured tools combining scientific understanding of ecosystem structure, composition, and processes with best professional judgment in a consistent, systematic, and repeatable manner (Sutula et al. 2006).
>
> The intent of ecological integrity based rapid assessment methods (RAMs) is to evaluate the complex ecological condition of a selected ecosystem using a specific set of observable field indicators, and to express the relative integrity of a particular occurrence in a manner that informs decision-making, whether for restoration, mitigation, conservation planning, or other ecosystem management goals (Stein et al. 2009). These Level 2 assessments are structured tools combining scientific understanding of ecosystem structure, composition, and processes with best professional judgment in a consistent, systematic, and repeatable manner (Sutula et al. 2006).
>
> Level 2 assessments rely primarily on relatively rapid (ca. 2–4 hours) field-based site visits, but this may vary, depending on the purposes of the assessment. They provide the opportunity to do direct, ground based surveys of ecosystem occurrences. RAMs are widely available for wetlands because of the need for mitigation and restoration tools, and they are used by many state wetland programs (Fennessy et al. 2007). Typically three to five metrics are identified for each of the ecological factors, with each metric designed to assess a major ecological factor or attribute."

The ranking system uses a combination of office (GIS analysis and airphoto interpretation), field assessments, and analysis of field data (mainly vegetation lists and percent cover). Each wetland plot should include a completed ecological integrity rank, while the final rank will be generated in the office for the entire complex based on all the individual plot ranks and the GIS analyses.

The system uses a four rank (occasionally 5 rank) assessment with Excellent (A), Good (B), Fair (C) and Poor (D) entered on the score card for each metric (Table 5.2-3). The rank is then converted to a numeric value (A = 5, B = 3.75, C = 2.5, D = 1.25) and the average is multiplied by a weighted value to generate a total for each of six ecological factors. The total of all the ecological factors determines the Ecological Integrity Rank for a given wetland. For wetlands that occur as complexes where multiple plots are surveyed, the Ecological Integrity Rank is an average of all plots. Figure 5.2-3 presents the scorecard, while a smaller version is included on the SWAMP field forms due to size limitations on the form.

The following sections describe the ranking process in detail. Note that AA is used in many of the figures as an acronym for Assessed Area which is equivalent to SWAMP survey plots.

TABLE 5.2-3 ECOLOGICAL INTEGRITY RANK SCORECARD (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

SWAMP Ecological Integrity Scorecard			
RANK FACTORS	**ECOLOGICAL FACTORS**	**METRICS**	**RANK**
Landscape Context	Landscape	Connectivity Index	
		Land Use Index	
		Landscape Rank = Total x 0.10	
	Buffer	Buffer Index	
		Buffer Rank = Total x 0.15	
Size	Size	Absolute Patch Size	
		Relative Patch Size	
		Size Rank = Total x 0.15	
Condition	Vegetation	Structure	
		Regeneration	
		Native Plant Cover	
		Invasive Plant Cover	
		Composition	
		Vegetation Total x 0.24	
	Hydrology	Water Source	
		Hydroperiod	
		Hydrologic Connectivity	
		Hydrology Rank = Total x 0.24	
	Soil	Physical Patch Types	
		Soil Disturbance	
		Soil Rank = Total x 0.12	
ECOLOGICAL INTEGRITY RANK			

Landscape Context

Three assessment metrics are used to assess the landscape context of a wetland. These assessments are primarily office based, but still require field verification.

Landscape Connectivity

Landscape connectivity is defined by Faber-Langendoen et al. (2012b) as "a measure of connectivity assessed using the percent of natural habitat in the surrounding landscape beyond the 100 m buffer, based on an additional 150 m width for the core landscape and an additional 250 m width for the supporting landscape." This measurement is performed in the office on a GIS and confirmed in the field, and ranked using the criteria presented in Figure 5.2-20 and 5.2-21.

Metric Rating	***Landscape Connectivity: ALL WETLANDS***
EXCELLENT (A)	Intact: Embedded in 90-100% natural habitat around AA.
GOOD (B)	Variegated: Embedded in 60-90% natural habitat.
FAIR (C)	Fragmented: Embedded in 20-60% natural habitat.
POOR (D)	Relictual: Embedded in <20% natural habitat.

FIGURE 5.2-20 LANDSCAPE CONNECTIVITY RATINGS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	***Landscape Connectivity: Scaling Rationale***
EXCELLENT	Connectivity is expected to be high; remaining natural habitat is in good condition (low modification); and a mosaic with gradients.
GOOD	Connectivity is generally high, but lower for species sensitive to habitat modification; remaining natural habitat with low to high modification and a mosaic that may have both gradients and abrupt boundaries.
FAIR	Connectivity is generally low, but varies with mobility of species and arrangement on landscape; remaining natural habitat with low to high modifications and gradients shortened.
POOR	Connectivity is essentially absent; remaining natural habitat generally highly modified and generally uniform.

FIGURE 5.2-21 LANDSCAPE CONNECTIVITY RATINGS – SCALING RATIONALE (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Land Use Index

The Land Use Index is defined by Faber-Langendoen et al. (2012b) as "the intensity of human dominated land uses in the surrounding landscape beyond the 100 m buffer, based on an additional 150 m with for the core landscape and an additional 250 m width for the supporting landscape. The Land Use Index metric is measured by documenting the surrounding land use(s) within the core and supporting landscape areas. The assessment should be completed in the office using remote sensing imagery, such as aerial photographs or satellite imagery, then, where feasible, verified in the field, using roads or

transects to verify land use categories. Ideally, both field data as well as remote sensing tools are used to identify an accurate percent of each land use within the landscape area, but remote sensing data alone can be used." Figure 5.2-23 presents the Land Use Index score card that is used to determine this index in the office. Field observations of land use and disturbance are important to verify this rating, particularly as much of the imagery used to map and assess wetlands in SWAMP is 10 or more years old.

Surrounding Land Use Index: Worksheet : Land Use Categories	**Coefficient**	**Core Landscape**		**Supporting L.**	
		% Area	**Score**	**% Area**	**Score**
Paved roads / parking lots	0.00				
Domestic, commercial, or publicly developed buildings and facilities (non-vegetated)	0.00				
Gravel pit / quarry / open pit / strip mining	0.00				
Unpaved roads (e.g., driveway, tractor trail, 4-wheel drive roads)	0.10				
Agriculture (tilled crop production)	0.20				
Intensively developed vegetation (golf courses, lawns, etc.)	0.20				
Vegetation conversion (chaining, cabling, roto-chopping, clearcut)	0.30				
Intense recreation (ATV use / camping / popular fishing spot, etc.)	0.40				
Military training areas (armor, mechanized)	0.40				
Heavy grazing by livestock on pastures or native rangeland	0.40				
Agriculture /permanent crop (vineyard, orchard, nursery, hayed pasture, etc.)	0.40				
Logging or tree removal (50-75% of trees >50 cm dbh removed)	0.50				
Commercial tree plantations / holiday tree farms	0.50				
Recent old fields and other disturbed fallow lands dominated by ruderal and exotic species	0.50				
Moderate grazing of native grassland	0.60				
Moderate recreation (high-use trail)	0.70				
Mature old fields and other fallow lands with natural composition	0.70				
Selective logging or tree removal (<50% of trees >50 cm dbh removed)	0.80				
Light grazing or haying of native rangeland	0.90				
Light recreation (low-use trail)	0.90				
Natural area / land managed for native vegetation	1.00				
A ≥95%, B = 80-94%, C = 40 -79%, D = <40%	**Total Land Use Score**	-		-	
	Total Land Use Rating				
Combined Land Use Index Score (Core score x 2) + (Supporting score x 1) / 3)		-			
Combined Land Use Index Rating					

FIGURE 5.2-22 COMBINED LAND USE INDEX SCORE CARD (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

The final value can then be converted to a metric rating (Figure 5.2-23).

Metric Rating	*Land Use Index: ALL WETLANDS*
EXCELLENT (A)	Average Land Use Score = 1.0-0.95
GOOD (B)	Average Land Use Score = 0.80-0.95
FAIR (C)	Average Land Use Score = 0.4-0.80
POOR (D)	Average Land Use Score = <0.4

FIGURE 5.2-23 LAND USE INDEX METRIC RATING (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Buffer Index

The Buffer Index is defined by Faber-Langendoen et al. (2012b) as "a measure of the overall area and condition of the buffer immediately surrounding the assessment area (100 m radius), using 3 sub-metrics: (a) Percent of AA Having Buffer, (b) Average Buffer Width, and (c) Buffer Condition. Wetland buffers are vegetated, natural areas that surround a wetland." Percent of the wetland having a buffer and buffer width are GIS exercises, while buffer condition should be assessed in the field. The combination of the three sub-metrics are combined into a rank (Figure 5.2-24), which is then used to calculate a Buffer Index Metric Rating (Figure 5.2-25).

Buffer Sub-metrics: ALL WETLANDS			
Sub-metric Ratings	**a. Percent of AA having Buffer**	**b. Average Buffer Width (m)**	**c. Buffer Condition**
EXCELLENT (A)	Buffer is 90 - 100% of AA	Average buffer width is >95 m, adjusted for slope.	Buffer is characterized by abundant (>95%) cover of native vegetation, with intact soils, no evidence of loss in water quality and little or no trash or refuse.
VERY GOOD (A-)	Buffer is >75 - 89% of AA	Average buffer width is 75 -94 m, after adjusting for slope.	Buffer is characterized by substantial (75-95%) cover of native vegetation, intact or moderately disrupted soils, minor evidence of loss in water quality, moderate or lesser amounts of trash or refuse, and minor intensity of human visitation or recreation.
GOOD (B)	Buffer is 50 - 75% of AA	Average buffer width is 50 -74 m, after adjusting for slope.	Buffer is characterized by a moderate (50-75%) cover of native vegetation, and either moderate or extensive soil disruption, moderate to extensive evidence of loss in water quality, moderate or greater amounts of trash or refuse, and moderate intensity of human visitation or recreation.
FAIR (C)	Buffer is 25-49% of AA	Average buffer width is 25-49 m, after adjusting for slope.	Buffer is characterized by a low (25- 50%) cover of native vegetation, barren ground and highly compacted or otherwise disrupted soils, strong evidence of loss in water quality, with moderate or greater amounts of trash or refuse, and moderate or greater intensity of human visitation or recreation.
POOR (D)	Buffer is <25% of AA	Average buffer width is <25 m, after adjusting for slope.	Very low (<25%) cover of native plants, dominant (>75%) cover of non-native plants, extensive barren ground and highly compacted or otherwise disrupted soils, moderate - great amounts of trash, moderate or greater intensity of human visitation or recreation, OR no buffer at all.

FIGURE 5.2-24 BUFFER SUB-METRICS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

The buffer index is adapted from Collins et al. (2006). The index integrates the three sub-metrics, but the Buffer Condition is given half the weight of the Percent of AA with Buffer and the Average Buffer Width, as its influence on overall on-site condition is not as strong as the other two. First convert the letter scores to numeric values (e.g., A = 4, A- = 3.5, B = 3, C = 2, D = 1). Then proceed as follows:

1. Percent of AA with Buffer + Average Buffer Width / 2= Average Buffer Score
2. Average Buffer Score + (Average Buffer Condition X 0.5) / 1.5 = Buffer Index

The merit of integrating the submetrics is that they are closely related, and the overall index puts the metric on a comparable level of distinctiveness with other metrics. See Table 3.5 for the ratings for the Buffer Index Metric.

Table 3.5. Example of a Buffer Index Metric Rating.

Metric Rating	***Buffer Index: ALL WETLANDS***
EXCELLENT (A)	3.5-4.0
GOOD (B)	2.5-3.5
FAIR (C)	1.5-2.5
POOR (D)	1- 1.5

FIGURE 5.2-25 BUFFER INDEX METRIC RATING (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Size

Two assessments of the size of a wetland are included in the assessment. This assessment is done in the office on a GIS and is completed for the entire wetland or wetland complex. Field verification is not required, although verification of the mapped wetland boundary is essential.

Absolute Patch Size

The Absolute Patch Size is defined by Faber-Langendoen et al. (2012b) as “measure of the current absolute size (ha) of the entire wetland type polygon or patch. The metric is assessed with respect to expected patch sizes for the type across its range.” Figure 5.2-26 presents the terminology used to describe patch size, along with definitions. The metric ratings to accompany the patch sizes created for the SWAMP project are contained in Table 5.2-27.

PATCH TYPE	DEFINITION
Matrix	*Ecosystems that form extensive and contiguous cover, occur on the most extensive landforms, and typically have wide ecological tolerances. Disturbance patches typically occupy a relatively small percentage (e.g., <5%) of the total occurrence. In undisturbed conditions,* ***typical occurrences range in size from 2,000-10,000 ha (100 km²) or more.***
Large Patch	*Ecosystems that form large areas of interrupted cover and typically have narrower ranges of ecological tolerances than matrix types. Individual disturbance events tend to occupy patches that can encompass a large proportion of the overall occurrence (e.g., >20%). Given common disturbance dynamics, these types may tend to shift somewhat in location within large landscapes over time spans of several hundred years. In undisturbed conditions,* ***typical occurrences range from 50-2,000 ha.***
Small Patch	*Ecosystems that form small, discrete areas of vegetation cover, typically limited in distribution by localized environmental features. In undisturbed conditions,* ***typical occurrences range from 1-50 ha.***
Linear	*Ecosystems that occur as linear strips. They are often ecotonal between terrestrial and aquatic ecosystems. In undisturbed conditions,* ***typical occurrences range in linear distance from 0.5-100 km.***

FIGURE 5.2-26 DEFINITIONS OF PATCH TYPE AND SIZE (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*Absolute Size Metric (hectares): ALL WETLANDS, BY PATTERN TYPE*						
	MATRIX	***LARGE PATCH***		***SMALL PATCH***		***LINEAR***	
	Matrix (ha)	**Very Large Patch (ha)**	**Large Patch (ha)**	**Medium-Small Patch (ha)**	**Small Patch (ha)**	**Very Small Patch (ha)**	**Linear (length in km)**
EXCELLENT (A)	>25,000	>500	>125	>50	>10	>2	>5 km
GOOD (B)	500-25,000	100-500	25-125	10 - 50	2 - 10	0.5 - 2	1-5 km
FAIR (C)	50-500	20 -100	5 -25	2 -10	0.5-2	0.1-0.5	0.1-1 km
POOR (D)	<50	<20	<5	<2	0.5	0.1	<0.1 km

FIGURE 5.2-27 ABSOLUTE PATCH SIZE METRIC RATING (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

For the purposes of SWAMP Matrix, large patch sizes will not be used. Marshes and shallow open water wetlands will be assessed using the medium-small patch ratings, swamps will use the small patch ratings, fens and bogs will use the very small patch size ratings. Floodplains and other riparian ecosystems will use the linear ratings.

Metric Rating	*Absolute Patch Size: ALL WETLANDS*
EXCELLENT (A)	Patch size is very large compared to other examples of the same type (i.e., top 10% based on known and historic occurrences; most area-sensitive indicator species very abundant within occurrence).
GOOD (B)	Patch size is large compared to other examples of the same type (i.e., within 10-30% based on known and historic occurrences; many area-sensitive indicator species moderately abundant within occurrence).
FAIR (C)	Patch size is medium to small compared to other examples of the same type, (i.e., within 30-70% of known or historic sizes; some area-sensitive indicator species are able to sustain a minimally viable population; many characteristic species are of low abundance but present).
POOR (D)	Patch size is small to very small; occurrence too small to sustain full diversity and function of the type (e.g., smallest 30% of known or historic occurrences; both key area-sensitive indicator species and characteristic species are sparse to absent).

FIGURE 5.2-28 ABSOLUTE PATCH SIZE METRIC RATING COMPARATIVE (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Relative Patch Size

The Relative Patch Size is defined by Faber-Langendoen et al. (2012b) as "a measure of the current size of the wetland (in hectares) divided by the historic wetland size (within most recent period of intensive settlement or 200 years), multiplied by 100." This is an office based GIS analysis that can be verified with field observations. In most circumstances, the historic extent of a given wetland will be unknown and this rating will be left blank. Figure 5.2-29 presents the matric ratings for Relative Patch Size.

Metric Rating	*Relative Patch Size: ALL WETLANDS*
EXCELLENT (A)	Occurrence is at, or only minimally reduced (<5%) from its full original, natural extent, and has not been artificially reduced in size. See note below for interpretation of "reduction."
GOOD (B)	Occurrence is only modestly reduced (5-20%) from its original natural extent. See note below for interpretation of "reduction."
FAIR (C)	Occurrence is substantially reduced (20-50%) from its original, natural extent. See note below for interpretation of "reduction."
POOR (D)	Occurrence is heavily reduced (>50%) from its original, natural extent See note below for interpretation of "reduction." .

FIGURE 5.2-29 RELATIVE PATCH SIZE METRIC RATING (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Condition

The condition assessments are either completed in the field or based on data collected in the field and analyzed in the office. For the vegetation component, specific metric variants have been created for different wetland classes (i.e. bog vs swamp). Testing will be required for SWAMP to determine if these

variants are appropriate for the study area, as they were developed for the US and include wetland types that do not occur in Canada (such as mangrove swamps).

Vegetation Structure

Vegetation Structure is defined by Faber-Langendoen et al. (2012b) as "an assessment of the overall structural complexity of the vegetation layers and growth forms, including presence of multiple strata, age and structural complexity of canopy layer, and evidence of the effects of disease or mortality on structure. In wetlands, vegetation structure can have an important controlling effect on composition and processes. The patch structure is an important reflection of vegetation dynamics and for creating heterogeneity within the community. Plants strongly influence the quantity, quality, and spatial distribution of water and sediment within wetlands." Figures 5.2-30 to 5.2-33 present the metric ratings for wetland classes.

Assessing structure requires significant knowledge of what the expected vegetation structure is in specific wetland classes and even site associations. For instance, cattail marshes are expected to have a homogenous structure will little diversity and little vertical structure, while a bog may range from a floating mat of sphagnum to a combination of stunted trees, low shrubs, and a thick moss layer.

Metric Rating	***V1: Vegetation Structure Variant: FLOODED & SWAMP FOREST***
EXCELLENT (A)	**FLOODED & SWAMP FOREST**: Canopy a mosaic of small patches of different ages or sizes, including old trees and canopy gaps containing regeneration, AND number of live stems of medium size (30-50 cm / 12-20"dbh) and large size (>50 cm / >20" dbh) well within expected range.
GOOD (B)	**FLOODED & SWAMP FOREST:** Canopy largely heterogeneous in age or size, but with some gaps containing regeneration or some variation in tree sizes, AND number of live stems of medium and large size within or very near expected range.
FAIR (C)	**FLOODED & SWAMP FOREST:** Canopy somewhat homogeneous in age or size, AND number of live stems of medium and large size below but moderately near expected range.
POOR (D)	**FLOODED & SWAMP FOREST:** Canopy very homogeneous, in size or age OR number of live stems of medium and large size well below expected range.

FIGURE 5.2-30 VEGETATION STRUCTURE RATING FOR SWAMP FOREST VARIANT (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V3: Vegetation Structure Variant: FRESHWATER MARSH, WET MEADOW & SHRUBLAND [metric variant under development]*
EXCELLENT (A)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND**: Vegetation structure is at or near minimally disturbed natural conditions. Little to no structural indicators of degradation evident.
GOOD (B)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND**: Vegetation structure shows minor alterations from minimally altered from minimally disturbed natural conditions. Structural indicators of degradation are minor (e.g. levels of grazing, mowing).
FAIR (C)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND:** Vegetation structure is moderately altered from minimally disturbed natural conditions. Structural indicators of degradation are moderate (e.g. levels of grazing, mowing).
POOR (D)	**FRESHWATER MARSH, WET MEADOW & SHRUBLAND**: Vegetation structure is greatly altered from minimally disturbed natural conditions. Structural indicators of degradation are strong (e.g. levels of grazing, mowing).

FIGURE 5.2-31 VEGETATION STRUCTURE RATING FOR MARSH AND SHRUB SWAMP VARIANTS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V5: Vegetation Structure Variant: BOG & FEN*
EXCELLENT (A)	**BOG & FEN**: Peatland is supporting structure with little to no evident influence of negative anthropogenic factors. Some very wet peatlands may not have any woody vegetation or only scattered stunted individuals. Woody vegetation mortality is due to natural factors. The site meets near minimally disturbed condition.
GOOD (B)	**BOG & FEN**: Generally, peatland structure has only minor negative anthropogenic influences present or the site is still recovering from major past human disturbances. Mortality or degradation due to grazing, limited timber harvesting or other anthropogenic factors may be present although not widespread. The site can be expected to meet minimally disturbed condition in the near future if negative influences do not continue.
FAIR (C)	**BOG & FEN**: Peatland structure has been moderately influenced by negative anthropogenic factors. Expected structural classes are not present. Human factors may have diminished the condition for woody vegetation. The site will recover to minimally disturbed condition only with the removal of degrading influences and moderate recovery times.
POOR (D)	**BOG & FEN:** Expected peatland structure is absent or much degraded due to anthropogenic factors. Woody regeneration is minimal and existing structure is in poor condition, unnaturally sparse, or depauperate. Recovery to minimally disturbed condition is questionable without restoration or will take many decades.

FIGURE 5.2-32 VEGETATION STRUCTURE RATING FOR BOG AND FEN VARIANTS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V6: Vegetation Structure Variant: AQUATIC VEGETATION [Metric variant under development]*
EXCELLENT (A)	**AQUATIC VEGETATION**: Vegetation structure is at or near minimally disturbed natural conditions. No structural indicators of degradation evident.
GOOD (B)	**AQUATIC VEGETATION:** Vegetation structure shows minor alterations from minimally disturbed natural conditions. Structural indicators of degradation are minor.
FAIR (C)	**AQUATIC VEGETATION**: Vegetation structure is moderately altered from minimally disturbed natural conditions. Structural indicators of degradation are moderate.
POOR (D)	**AQUATIC VEGETATION**: Vegetation structure is greatly altered from minimally disturbed natural conditions. Structural indicators of degradation are strong.

FIGURE 5.2-33 VEGETATION STRUCTURE RATING FOR THE SHALLOW OPEN WATER VARIANT (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Woody Regeneration

Woody Regeneration defined by Faber-Langendoen et al. (2012b) as a combination of "both structural and compositional information, in that regeneration abundance is assessed with respect to native tree and shrub species." It is an assessment used for forested and shrubby wetlands, and can be left blank for all other wetland types. As with the vegetation structure assessment, it requires a solid understanding of specific wetland types to apply the rating. Figure 5.2-34 presents the metric ratings for woody regeneration.

Metric Rating	*Woody Regeneration: ALL WETLANDS (except for Aquatic Vegetation)*
EXCELLENT (A)	Native tree saplings and/or seedlings or shrubs common to the type present in expected amounts and diversity; obvious regeneration.
GOOD (B)	Native tree saplings and/or seedlings or shrubs common to the type present but less amounts and diversity than expected.
FAIR (C)	Native tree saplings and/or seedling or shrubs common to the type present but low amounts and diversity; little regeneration.
POOR (D)	No, or essentially no regeneration of native woody species common to the type.

FIGURE 5.2-34 WOODY REGENERATION METRIC RATINGS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Native Plant Cover

Native Plant Cover is defined by Faber-Langendoen et al. (2012b) as "a measure of the relative percent cover of all plant species in the [wetlands] that are native to the region. The metric is typically calculated by estimating total absolute cover of all vegetation (summing total cover by major strata), subtracting

total exotic species cover, and expressing the total native species cover as a percentage of the total vegetative cover." Figure 5.2-35 contains the metric ratings for Native Plant Cover.

Metric Rating	*Native Plant Species Cover: ALL WETLANDS*
EXCELLENT (A)	>99% relative cover of native plant species.
VERY GOOD (A-)	95-99% relative cover of native plant species
GOOD (B)	85-95% relative cover of native plant species.
FAIR (C)	60-85% relative cover of native plant species.
POOR (D)	<60% relative cover of native plant species.

FIGURE 5.2-35 NATIVE PLANT METRIC RATINGS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Invasive Plant Cover

Invasive Plant Cover is defined by Faber-Langendoen et al. (2012b) as the "percent cover of a selected set of exotic (or more rarely native) species that are considered invasive to the ecosystem being evaluated. This metric consists of evaluating the percent cover of invasive plant species. The protocol is a visual evaluation of invasive plant species cover." The total percent cover observed in the field is used with Figure 5.2-36 to determine the metric rating.

Metric Rating	*Invasive Exotic Plant Species Cover*: ALL WETLANDS
EXCELLENT (A)	Invasive plant species absent or cover is very low (<1% absolute cover).
VERY GOOD (A-)	Invasive plant species present but sporadic (1-3 % cover).
GOOD (B)	Invasive plant species somewhat abundant (4-10% cover).
FAIR (C)	Invasive plant species abundant (10-30% cover).
POOR (D)	Invasive plant species very abundant (>30% cover).

FIGURE 5.2-36 WOODY REGENERATION METRIC RATINGS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Vegetation Composition

Vegetation Composition is defined by Faber-Langendoen et al. (2012b) as "an assessment of the overall species composition and diversity, including by layer, and evidence of species specific diseases or mortality. This metric consists of evaluating the species composition of the vegetation. The protocol is a visual evaluation of variation in overall composition. This metric requires the ability to recognize the major-dominant aquatic, wetland, and riparian plants species of each layer or stratum. The metric is scaled based on the similarity between the described species composition of the vegetation and what is expected based on reference condition."

As with the previous vegetation assessments, an understanding of the typical species and their relative dominance in specific wetland types if required for this assessment. For the most part, the Species Importance tables in the Wetlands of BC will give an indication of the expected diversity and species dominance for most wetland associations. Figure 5.2-37 presents the metric ratings table for vegetation composition.

Metric Rating	*Vegetation Composition: ALL WETLANDS*
EXCELLENT (A)	**Vegetation composition minimally to not disturbed:** i) Typical range of native diagnostic species present, including those native species sensitive to anthropogenic degradation, AND ii) Native species indicative of anthropogenic disturbance (i.e., increasers, weedy or ruderal species) absent to minor.
GOOD (B)	**Vegetation composition with minor disturbed conditions:** i) Some native diagnostic species absent or substantially reduced in abundance, AND ii) Some native species indicative of anthropogenic disturbance (increasers, weedy or ruderal species) are present but minor in abundance.
FAIR (C)	**Vegetation composition with moderately disturbed conditions:** i) Many native diagnostic species absent or substantially reduced in abundance, AND ii) Species are still largely native and characteristic of the type, but they also include increasers, weedy or ruderal species.
POOR (D)	**Vegetation composition with severely disturbed conditions:** i) Most or all native diagnostic species absent, a few may remain in very low abundance, OR ii) Native species from entire strata may be absent or species are dominated by ruderal ("weedy") species, or comprised of planted stands of non-characteristic species, or unnaturally dominated by single species.

FIGURE 5.2-37 WOODY REGENERATION RATINGS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Hydrology

The following section describes assessments used to rate hydrology influences on wetlands. Assessments typically use a combination of office and field work.

Water Source

Water Source is defined by Faber-Langendoen et al. (2012b) as "an assessment of the extent, duration, and frequency of saturated or ponded conditions within a wetland, as affected by the kinds of direct inputs of water into, or any diversions of water away from, the wetland. Water Sources encompass the forms, or places, of direct inputs of water to the [wetland] as well as any unnatural diversions of water from the AA. Diversions are considered a water source because they affect the ability of the [wetland] to function as a source of water for other habitats while also directly affecting the hydrology of the [wetland]."

The Water Source metric is initially assessed in the office using the GIS and airphotos to identify known water sources. Field verification is then completed to confirm the office analysis and check for water sources and alterations not visible on the computer. Metric ratings for Water Source are specific to wetland classes and are presented in Figures 5.2-38 to 5.2-40.

Metric Rating	*V2: Water Source variant: RIVERINE (Non-tidal) Wetlands*
EXCELLENT (A)	Water source is natural, site hydrology is dominated by precipitation, groundwater, and natural runoff from an adjacent freshwater body. System may naturally lack water at times, such as in the growing season. There is no indication of direct artificial water sources. Land use in the local drainage area of the site is primarily open space or low density, passive uses. Lacks point source discharges into or adjacent to the site.
GOOD (B)	Water source is mostly natural, but site directly receives occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic input include developed land or agricultural land (<20%) in the immediate drainage area of the site, or the presence of small storm drains or other local discharges emptying into the site, road runoff, or the presence of scattered homes along the wetland that probably have septic systems. No large point sources discharge into or adjacent to the site.
FAIR (C)	Water source contains a large component of urban runoff, direct irrigation, pumped water, artificially impounded water, or other artificial hydrology. Indications of substantial artificial hydrology include >20% developed or agricultural land adjacent to the site, and the presence of major point sources that discharge into or adjacent to the site.
POOR (D)	Water flow exists but has been substantially diminished by known impoundments or diversions of water or other withdrawals directly from the site, its encompassing wetland, or from areas adjacent to the site or its wetland, OR water source has been severely altered to the point where it no longer supports much vegetation (e.g., flashy runoff from impervious surfaces).

FIGURE 5.2-38 WATER SOURCE RATINGS FOR RIVERINE WETLANDS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V3: Water Source variant: ORGANIC SOIL FLATS, MINERAL SOIL FLATS*
EXCELLENT (A)	Water source is natural, and site hydrology is dominated by precipitation. There is no indication of direct artificial water sources. Land use in the local drainage area of the site is primarily open space or low density, passive uses. Lacks point source discharges into or adjacent to the site.
GOOD (B)	Water source is mostly natural, but site directly receives occasional or small amounts of inflow from anthropogenic sources, or is ditched, causing peatland to dry out more quickly. Indications of anthropogenic input include developed land or agricultural land (<20%) in the immediate drainage area of the site; or the presence of small storm drains, ditches, or other local discharges emptying into the site; road runoff; or the presence of scattered homes along the wetland that probably have septic systems. No large point sources discharge into or adjacent to the site.
FAIR (C)	Water source is moderately impacted by increased inputs into the peatland, artificially impounded water, or other artificial hydrology. Indications of substantial artificial hydrology include >20% developed or agricultural land adjacent to the site, and the presence of major point sources that discharge into or adjacent to the site.
POOR (D)	Water source is substantially impacted by impoundments or diversions of water or other input into or withdrawals directly from the site, its encompassing wetland, or from areas adjacent to the site or its wetland.

FIGURE 5.2-39 WATER SOURCE RATINGS FOR MARSH, SWAMP, AND FLAT FENS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V4: Water Source variant: OTHER HGM (DEPRESSION, LACUSTRINE, SLOPE)*
EXCELLENT (A)	Water source is natural: site hydrology is dominated by precipitation, groundwater, natural runoff from an adjacent freshwater body, or the system naturally lacks water in some periods. There is no indication of direct artificial water sources. Land use in the local drainage area of the site is primarily open space or low density, passive uses. Lacks point source discharges into or adjacent to the site.
GOOD (B)	Water source is mostly natural, but site directly receives occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic input include developed land or agricultural land (<20%) in the immediate drainage area of the site, or the presence of small storm drains or other local discharges emptying into the site, road runoff, or the presence of scattered homes along the wetland that probably have septic systems. No large point sources discharge into or adjacent to the site.
FAIR (C)	Water source is primarily urban runoff, direct irrigation, pumped water, artificially impounded water, or other artificial hydrology. Indications of substantial artificial hydrology include >20% developed or agricultural land adjacent to the site, and the presence of major point sources that discharge into or adjacent to the site.
POOR (D)	Water source exists but has been substantially diminished by known impoundments or diversions of water or other withdrawals directly from the site, its encompassing wetland, or from areas adjacent to the site or its wetland, OR water sources has been severely altered to the point where they no longer support much vegetation (e.g., flashy runoff from impervious surfaces).

FIGURE 5.2-40 WATER SOURCE RATINGS FOR BOGS AND SLOPED FENS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Hydroperiod

Hydroperiod is defined by Faber-Langendoen et al. (2012b) as "an assessment of the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. For all non-riverine wetlands, hydroperiod is the dominant aspect of hydrology. Hydroperiod, or the pattern and balance of inflows and outflows, is a major determinant of wetland functions. The patterns of import, storage, and export of sediment and other water-borne materials are functions of the hydroperiod. In most wetlands, plant recruitment and maintenance are dependent on hydroperiod. For riverine wetlands, hydroperiod is assessed through the patterns of water flow associated with rainfall, snowmelt, dams, and long term weather patterns, i.e. the flow regime (Poff et al. 1997)."

This metric is assessed using field indicators to determine changes in local flow regimes. Figure 5.2-41 presents the indicators for riverine wetlands and Figure 5.2-42 presents indicators for non-riverine wetlands. Initial assessments can be completed in the office with the GIS and airphotos, then confirmed and expanded on in the field. Figures 5.2-43 to 5.2-45 present the metric ratings based on wetland class.

Condition	Field Indicators
Indicators of Channel Equilibrium	- The channel (or multiple channels in braided systems) has a well-defined usual high water line, or bankfull stage that is clearly indicated by an obvious floodplain, topographic bench that represents an abrupt change in the cross-sectional profile of the channel throughout most of the site. - The usual high water line or bankfull stage corresponds to the lower limit of riparian vascular vegetation. - The channel contains embedded woody debris of the size and amount consistent with what is available in the riparian area. - There is little or no active undercutting or burial of riparian vegetation.
Indicators of Active Degradation	- Portions of the channel are characterized by deeply undercut banks with exposed living roots of trees or shrubs. There are abundant bank slides or slumps, or the banks are uniformly scoured and unvegetated. - Riparian vegetation may be declining in stature or vigor, and/or riparian trees and shrubs may be falling into the channel. - The channel bed lacks any fine-grained sediment. - Recently active flow pathways appear to have coalesced into one channel (i.e., a previously braided system is no longer braided).
Indicators of Active Aggradation	- The channel through the site lacks a well-defined usual high water line. - There is an active floodplain with fresh splays of sediment covering older soils or recent vegetation. - There are partially buried tree trunks or shrubs. - Cobbles and/or coarse gravels have recently been deposited on the floodplain. - There are partially buried, or sediment-choked, culverts.

FIGURE 5.2-41 FIELD INDICATORS FOR RIVERINE WETLANDS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Condition	Field Indicators
Reduced Extent and Duration of Inundation or Saturation	- Upstream spring boxes, diversions, impoundments, pumps, ditching, or draining from the wetland. - Evidence of aquatic wildlife mortality. - Encroachment of terrestrial vegetation. - Stress or mortality of hydrophytes. - Compressed or reduced plant zonation. - Organic soils occurring well above contemporary water tables.
Increased Extent and Duration of Inundation or Saturation	- Berms, dikes, or other water control features that increase duration of ponding (e.g., pumps). - Diversions, ditching, or draining into the wetland. - Late-season vitality of annual vegetation. - Recently drowned riparian or terrestrial vegetation. - Extensive fine-grain deposits on the wetland margins.

FIGURE 5.2-42 FIELD INDICATORS FOR NON-RIVERINE WETLANDS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V2: Hydroperiod variant: RIVERINE (Non-tidal)*
EXCELLENT (A)	Most of the channel/riparian zone is characterized by equilibrium conditions, with no evidence of severe aggradation or degradation (based on the field indicators listed in Table 12.1).
GOOD (B)	Most of the channel/riparian zone is characterized by some aggradation or degradation, none of which is severe, and the channel seems to be approaching an equilibrium form (based on the field indicators listed in Table 12.1).
FAIR (C)	Most of the channel/riparian zone is characterized by severe aggradation or degradation (based on the field indicators listed in Table 12.1).
POOR (D)	Most of the channel is concrete or artificially hardened (see field indicators in Table 12.1).

FIGURE 5.2-43 HYDROPERIOD METRIC RATINGS FOR RIVERINE WETLANDS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V3: Hydroperiod variant: ORGANIC SOIL FLATS, MINERAL SOIL FLATS*
EXCELLENT (A)	Stable, saturated hydrology, or naturally damped cycles of saturation and partial drying.
GOOD (B)	Minor altered inflows or drawdown/drying (e.g., ditching).
FAIR (C)	Moderately altered by increased runoff, or drawdown and drying (e.g., ditching).
POOR (D)	Substantially altered by increased inflow from runoff, or significant drawdown and drying (e.g., ditching).

FIGURE 5.2-44 HYDROPERIOD METRIC RATINGS FOR MARSH, SWAMP, AND FLAT FENS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V4: Hydroperiod variant: OTHER HGM (DEPRESSION, LACUSTRINE, SLOPE)*
EXCELLENT (A)	Natural patterns associated with inundation – drawdown, saturation, and seepage discharge.
GOOD (B)	Some alteration to the natural patterns associated with inundation – drawdown, saturation, and seepage discharge.
FAIR (C)	Moderate alteration to the natural patterns associated with inundation – drawdown, saturation, and seepage discharge.
POOR (D)	Significant alteration to the natural patterns associated with inundation – drawdown, saturation, and seepage discharge.

FIGURE 5.2-45 HYDROPERIOD METRIC RATINGS FOR BOGS AND SLOPED FENS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Hydrologic Connectivity

Hydrologic Connectivity is defined by Faber-Langendoen et al. (2012b) as "the ability of the water to flow into or out of the wetland, or to inundate adjacent areas. Hydrologic connectivity between wetlands and adjacent uplands supports key ecologic processes, such as the exchange of water, sediment, nutrients, and organic carbon. Connectivity of both surface and subsurface hydrologic connections, including connections with shallow aquifers and hyporheic zones (zones beneath and

alongside stream beds, where surface water and groundwater mix), is a challenging and often poorly understood aspect of connectivity. The metric is assessed in the field by observing signs of alteration to overbank flooding, channel migration, channel incision, and geomorphic modifications present within the assessment area." The Hydrologic Connectivity metric is wetland class specific as shown by the rating tables in Figures 5.2-46 to 5.2-48.

Metric Rating	***V2: Hydrologic Connectivity variant: RIVERINE (Non-tidal)***
EXCELLENT (A)	Completely connected to floodplain (backwater sloughs and channels). No geomorphic modifications made to contemporary floodplain.
GOOD (B)	Minimally disconnected from floodplain. Up to 25% of stream banks are affected.
FAIR (C)	Moderately disconnected from floodplain due to multiple geomorphic modifications (e.g., dikes, tide gates, and elevated culverts); 25-75% of stream banks are affected.
POOR (D)	Extensively disconnected from floodplain; >75% of stream banks are affected.

FIGURE 5.2-46 HYDROLOGIC CONNECTIVITY METRIC RATINGS FOR RIVERINE WETLANDS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	***V3: Hydrologic Connectivity variant: ORGANIC SOIL FLATS, MINERAL SOIL FLATS***
EXCELLENT (A)	No or very little direct connectivity to groundwater. Precipitation is the dominant or only source.
GOOD (B)	Minor hydrological connectivity, as caused by human activity (e.g., ditching).
FAIR (C)	Moderate connectivity caused by human activity (e.g., ditching).
POOR (D)	Substantial to full connectivity caused by human activity.

FIGURE 5.2-47 HYDROLOGIC CONNECTIVIETY METRIC RATINGS FOR MARSH, SWAMP, AND FLAT FENS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	*V4: Hydrologic Connectivity variant: OTHER HGM (DEPRESSION, LACUSTRINE, SLOPE)*
EXCELLENT (A)	No unnatural obstructions to lateral or vertical movement of ground or surface water, or if perched water table then impermeable soil layer (fragipan or duripan) intact. Rising water in the site has unrestricted access to adjacent upland, without levees, excessively high banks, artificial barriers, or other obstructions to the lateral movement of flood flows.
GOOD (B)	Minor restrictions to the lateral or vertical movement of ground or surface waters by unnatural features, such as levees or excessively high banks. Less than 25% of the site is restricted by barriers to drainage. If perched then impermeable soil layer partly disturbed (e.g., from drilling or blasting). Restrictions may be intermittent along the site, or the restrictions may occur only along one bank or shore. Flood flows may exceed the obstructions, but drainage back to the wetland is incomplete due to impoundment.
FAIR (C)	Moderate restrictions to the lateral or vertical movement of ground or surface waters by unnatural features, such as levees or excessively high banks. Between 25-75% of the site is restricted by barriers to drainage. If perched then impermeable soil layer moderately disturbed (e.g., by drilling or blasting). Flood flows may exceed the obstructions, but drainage back to the wetland is incomplete due to impoundment.
POOR (D)	Essentially no hydrologic connection to adjacent wetlands or uplands. Most or all water stages are contained within artificial banks, levees, sea walls, or comparable features. Greater than 75% of wetland is restricted by barriers to drainage. If perched then impermeable soil layer strongly disturbed.

FIGURE 5.2-48 HYDROLOGIC CONNECTIVIETY METRIC RATINGS FOR BOGS AND SLOPED FENS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Soil and Substrate

The following sections pertain to assessments of wetland soils and substrates.

Physical Patch Types

Physical Patch Size is defined by Faber-Langendoen et al. (2012b) as “a checklist of the number of different physical surfaces or features that may provide habitat for species. For each wetland class, there are visible patches of physical structure that typically occur at multiple points along the hydrologic gradient. But not all patch types will occur in all wetland types. Therefore, the rating is based on the percent of total expected patch types for a given wetland class at a site.” This assessment is a combination of office work using the GIS and airphotos to assess the major physical features of a site, and then field verification. It requires a good understanding of features expected to be present in each wetland type. Figure 5.2-49 provides a basic checklist of features for each wetland class and Figure 5.2-50 presents the metric rating table. The presence/absence of each feature is recorded on the checklist and the rating is determined based on the percentage of features that occur vs the number of features that are expected to occur. All features will not necessarily be present for each wetland type. This checklist will likely require modification after field work has been completed to reflect the SWAMP study area.

FLOODED & SWAMP FOREST		FRESHWATER MARSH, WET MEADOW & SHRUBLAND		BOG& FEN	
Open water - Oxbows / Backwater channels / Pools / Tributaries	FS1	Open water - ponds or lakes	M1	Open water margin - Moats / Laggs	BF1
Seeps / Springs - onsite or adjacent	FS2	Open water - pools	M2	Inlet / Outlet Stream (fens)	BF2
Depositional or erosional features, e.g., point bar, flats, bare ground, undercut banks	FS3	Open water - streams	M3	Rivulets	BF3
Debris jams / Woody debris on-site or in adjacent channel	FS4	Seeps / Springs: adjacent or onsite	M4	Springs / Seeps / Shallow open water (fen)	BF4
Tip up mounds / Pits	FS5	Non-vegetated areas (e.g., Bare ground / Mudflat / Sand)	M5	Moss / Aquatic hollows / Bog pools	BF5
Beaver dams / Canals	FS6	Beaver dams / Canals	M6	Floating mats	BF6
Terraces	FS7	Debris jams / Woody debris	M7	Beaver dams / Canals	BF7
Natural levees	FS8	Topographic gradient	M8	Peat flats (bog) / Marl flats (fens)	**BF8**
Upland pockets in floodplain or swamp	FS9	Swale topography	M9	Flarks / Strings	**BF9**
Plant hummocks and hollows	FS10	Plant hummocks / Hollows	M10	Plant hummocks / Hollows	BF10
Animal mounds and burrows	FS11	Animal mounds and burrows	M11	Animal mounds and burrows	BF11
MANGROVE		**SALT MARSH**		**AQUATIC VEGETATION**	
Open water (tidal)	M1	Natural tidal creeks/Creeklets	SM1	Shallow open water (<2 m deep)	AV1
Non-vegetated flats or bare ground	M2	Pannes or Pools	SM2	Non-vegetated flats or bare ground	AV2
Topographic gradient	M3	Mudflats / Sandflats	SM3	Woody debris	AV3
Marl levee	M4	Deposition or erosional features e.g., sand or mud fans, edge sloughing, intertidal rocky shore	SM4	Boulders, rocks, or bedrock	AV4
Prop roots, drop roots, pneumatophores, aerial rootlets, viviparous propagules	M5	Topographic and/or Salinity gradient	SM5	Topographic gradient	AV5
Intertidal barnacle or oyster colonies	M6	Detrital mats	SM6		
Fiddler crab burrows	M7	Intertidal mussel colonies	SM7		
		Fiddler crab burrows	SM8		
OTHER:					

FIGURE 5.2-49 PHYSICAL PATCH SIZE CHECKLIST (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Metric Rating	***Physical Patch Types: ALL WETLAND TYPES***
EXCELLENT (A)	Expected physical patch types for a particular example of wetland type are present (see worksheet for examples).
GOOD (B)	One or two of the expected physical patch types are lacking (give evidence).
FAIR (C)	Several of the expected physical patch types are lacking (give evidence).
POOR (D)	Most or the entire expected physical patch types are lacking (give evidence).

FIGURE 5.2-50 PHYSICAL PATCH SIZE METRIC RATINGS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

Soil Disturbance

Soil Disturbance is defined by Faber-Langendoen et al. (2012b) as "an indirect measure of soil condition based on stressors that increase the potential for erosion or sedimentation of the soils, assessed by evaluating intensity of human impacts to soils on the site." The assessment can use a combination of air photo interpretation (if recent enough and of high resolution) to identify large disturbances, and field verification to observe site level disturbances. Figure 5.2-51 presents the metric ratings for Soil Disturbance.

Metric Rating	***V1: Soil Surface Condition variant: ALL FRESHWATER NON-TIDAL WETLANDS*** (FLOODED & SWAMP FOREST, FRESHWATER MARSH, WET MEADOW & SHRUBLAND, BOG & FEN, AQUATIC VEGETATION)
EXCELLENT (A)	Bare soil areas are limited to naturally caused disturbances such as flood deposition or game trails.
GOOD (B)	Small amounts of bare soil areas due to human causes are present but the extent and impact is minimal. The depth of disturbance is limited to only several centimeters (a few inches) and does not show evidence of ponding, channeling water, or effects of boat traffic. Any disturbance is likely to recover within a few years after the disturbance is removed.
FAIR (C)	Moderate amounts of bare soil areas due to human causes. Soil trampling by livestock can cause 5-10 centimeters (several inches) of soil disturbance. Off-road-vehicles or other machinery may have left some shallow ruts or erosion. Damage is not excessive and the site will recover to potential with the removal of degrading human influences and moderate recovery times.
POOR (D)	Bare soil areas substantial and contribute to altered hydrology or other long-lasting impacts. Deep ruts from Off-road-vehicles or machinery may be present, or livestock soil trampling and/or trails are widespread. Water will be channeled or ponded. The site will not recover without restoration and/or long recovery times.

FIGURE 5.2-51 SOIL DISTURBANCE METRIC RATINGS (ADAPTED FROM FABER-LANGENDOEN ET AL. 2012B)

5.3 Conservation Evaluation

The British Columbia Conservation Data Centre (CDC) provides a conservation evaluation form that can be used to help determine if a given ecosystem should be considered for inclusion on the provincial map of ecosystems-at-risk (Figure 5.3-1). Also located in Appendix 3, this form should be used for any wetland that is listed as red or blue on tables 4.3-1 and 4.3-2, as well as wetlands that are considered to be significant or unique. While most of the form is straight forward to complete, the evaluation summary requires both familiarity with the site, the landscape in which it occurs, and wetland ecology in general. It is described in more detail in the remainder of this section.

CONSERVATION EVALUATION FORM

PROJECT IDENTIFICATION	DATE:
PROJECT ID:	PLOT #:
POLY #:	SEI CLASS:SUBCLASS:
ECOLOGICAL COMMUNITY	
CONSERVATION INFORMATION	
OWNER/JURISDICTION:	
DISTURBANCE:	KNOWN THREATS:
ADJACENT LAND USE:	OTHER FACTORS:
ALIEN SPP.:	
SUCCESS. STATUS:	EST. SIZE COMM: (ha)
FRAGMENTATION OF ECOLOGICAL COMMUNITY	
❒ < 5% FRAGMENTED ❒ 5 - 25 % FRAGMENTED ❒ > 25% FRAGMENTED	
EVALUATION SUMMARY	
LANDSCAPE CONTEXT:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒
ECOLOGICAL INTEGRITY:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒
CONDITION:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒
NOTES(AT-RISK SPECIES, WILDLIFE OBSV., ACCURACY INFO, ETC)	
OBSERVER	NAME:
ADDRESS:	
EMAIL:	PHONE/FAX:
SUBMIT DATA	
CDC, Ministry of Environment, Ecosystems Branch, P.O. Box 9358 Station Provincial Government, Victoria BC V8W 9M2 (fax: 250-387-2733) THANK YOU! Include: FS882 or GIF or VENUS file ❒ air photos with polygon marked ❒ map product(s) ❒ ground photos ❒	

COMPLETING THE CONSERVATION EVALUATION FORM

This form is intended for ecologists familiar with the RISC[1] Standards For Describing Terrestrial Ecosystems In The Field (DTEIF[2]). Submit a ground inspection (GIF) or ecosystem field (FS882) form with copies of air photos and/or maps. This information is necessary to identify and assess the conservation status of at-risk ecological communities.

PROJECT IDENTIFICATION:

Enter the date and GIF or FS882 plot number. If this form is completed as part of an inventory project provide the project name, related polygon number and sensitive ecosystem category, if applicable.

ECOLOGICAL COMMUNITY

Enter the name of the ecological community as on the CDC tracking list

CONSERVATION INFORMATION

OWNER/JURISDICTION: Enter the land owner or land management jusridiction (i.e. Provincial park, TFL #, regional government)

ADJACENT LAND USE: Provide details of land use adjacent to the community (i.e. housing, logging, recreation, etc)

DISTURBANCE: Enter DTEIF site disturbance codes and comments.

KNOWN THREATS: Record any known threats to the ecological community such as fire suppression, invasiveness of alien species, etc.

OTHER FACTORS: Record any other information known about the site

ALIEN SPP.: Note the type and abundance of alien species associated with the ecological community or in the vicinity.

SUCCESS. STATUS: Enter DTEIF successional status codes

EST.SIZE COMM: Enter the estimated size of the community in hectares.

FRAGMENTATION: Indicate the degree of fragmentation within the community

EVALUATION SUMMARY:

Complete this section only if familiar with these terms as defined by CDC. Refer to CDC website - element occurrence ranking factors

NOTES

Record any other information or comments.

OBSERVER

Enter your name and contact information. A CDC ecologist may contact you if additional information or clarity is required.

1. Resource Information Standards Committee
2. Field Manual For Describing Terrestrial Ecosystems, Land Management Handbook 25. 1998, Prov. Of BC., Victoria, BC.

FIGURE 5.3-1 BC CDC CONSERVATION EVALUATION FORM (ADAPTED FROM RISC 2006)

5.4 Recommended Field Equipment

The following equipment is recommended for field work:

- Hip or chest waders
- High visibility vest
- Rain gear (and other clothing as appropriate)
- Clipboard
- GPS

- Map(s)
- Pens and pencils
- Field forms
- Note paper
- pH and conductivity meters
- Plant ID books
- Collection bags
- Soil auger
- Digital camera
- Nylon measuring tape
- First Aid kit (and training)
- Bear spray and/or bangers
- SWAMP wetland classification list/descriptions

Additional equipment that would be beneficial:

- Guide Book - Describing Ecosystems in the Field
- Guide Book - Wetlands of BC
- Compass
- Clinometer
- Binoculars
- Waterproof paper
- Communication device (radio, sat phone, cell phone, etc.)
- Rangefinder

5.5 Safety Plan

A field safety plan should be completed prior to any field work, especially if working alone or in a group of two. Many of the target wetland sites are remote and access may be difficult. The safety plan should include at the minimum:

- Names and contact info for all crew members.
- Emergency contact info for all crew members.
- Relevant health information for all crew members (health concerns, allergies, medications, etc.).
- Location of work (including a map) and any special access instructions.
- Check list of field equipment, especially any necessary medications.
- Daily work plan that includes check in procedures.
- Location and contact information for nearest emergency and medical facilities.

- Identification of potential field hazards and methods to overcome them.

Appendix 4 contains an example of a completed field safety plan that can be used as a template.

5.6 Quality Control

For the purposes of this project, quality control (QC) will focus on accurate classification of wetland types, as well as condition and quality modifiers, and the accuracy of spatial extents (mapped boundary). Training will be completed with all field crews to ensure that data are collected in a consistent manner with as much accuracy as possible. Recognizing that the field program will include a significant number of volunteers with varying degrees of knowledge and experience, all field data will be reviewed by an ecologist before it is used in the mapping or wetland classification and descriptions.

Quality control of spatial accuracy will be completed in the field and will primarily consist of ensuring that wetland boundaries are accurate. This will be completed using a mobile GIS system and high accuracy GPS.

6.0 References

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Appendix 1. SWAMP Field Forms

SWAMP Assessment Form - Technician

Site Information

Date:	Plot:	Surv:
Wetland Name:		Private/Crown:
Photos:		
UTMs:		Waypoint:
Slope:	Elevation:	Aspect:
MesoSlope: ☐ Upper ☐ Mid ☐ Lower ☐ Toe ☐ Depression ☐ Level		Microtopography:

Hydrology

pH:	Conductivity:	Water Colour: ☐ Tea ☐ YB Turbid ☐ GB Turbid ☐ GB Clear ☐ BG Clear	
HDI: ☐ Stagnant ☐ Sluggish ☐ Mobile ☐ Dynamic ☐ Very Dynamic			% Open Water:

Soils

Mineral Soil Drainage: ☐ Very Rapidly ☐ Rapidly ☐ Well ☐ Moderately Well ☐ Imperfectly ☐ Poorly ☐ Very Poorly		
Mineral Soil Texture: ☐ Sandy (LS, S) ☐ Loamy (SL, L, SCL, FSL) ☐ Silty (SiL, Si) ☐ Clayey (SiCL, CL, SC, SiC, C)		
CF : ☐ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%	O. Soil Texture: ☐ Fibric ☐ Mesic ☐ Humic	O. Soil Depth:
Von Post: 1 2 3 4 5 6 7 8 9 10	O. Soil Moisture: ☐ Aqueous ☐ Peraquaic ☐ Aquic ☐ Subaquic ☐ Perhumid ☐ Humid	
SMR: ☐ Moist ☐ Very Moist ☐ Wet ☐ Very Wet	SNR: ☐ Very Poor ☐ Poor ☐ Medium ☐ Rich ☐ Very Rich ☐ Hyper	

Wetland Classification

BGC Unit:	Site Series:	Structural Stage:
SEI Class:	SEI Sub Class:	Confidence:

	%	BGC Classification	SEI Classification
WL1%			
WL2%			
WL3%			

Vegetation

Total %	Tree (A):	Shrub (B):	Herb (C):	Moss/Lichen (D):	
Species	%	Species	%	Species	%

Wildlife

Wildlife/Notes/Description

Ecosystem Integrity

Connectivity Index		Invasive Plant Cover	
Land Use Index		Composition	
Buffer Index		Water Source	
Absolute Patch Size		Hydroperiod	
Relative Patch Size		Hydrologic Connectivity	
Veg. Structure		Physical Patch Types	
Woody Veg. Regeneration		Soil Disturbance	
Native Plant Cover		TOTAL	

Notes:

SWAMP Assessment Form - Volunteer

Site Information

Date:	Plot:	Surv:
Wetland Name:		Private/Crown:
Photos:		
UTMs:		Waypoint:
Slope:	Elevation:	Aspect:
MesoSlope: ☐ Upper ☐ Mid ☐ Lower ☐ Toe ☐ Depression ☐ Level		Microtopography:

Hydrology

HDI: ☐ Stagnant ☐ Sluggish ☐ Mobile ☐ Dynamic ☐ Very Dynamic	% Open Water:

Soils

Mineral Soil Drainage: ☐ Very Rapidly ☐ Rapidly ☐ Well ☐ Moderately Well ☐ Imperfectly ☐ Poorly ☐ Very Poorly

Organic ☐ Mineral ☐	SMR: ☐ Moist ☐ V. Moist ☐ Wet ☐ Very Wet	SNR: ☐ V. Poor ☐ Poor ☐ Medium ☐ Rich ☐ V. Rich

Wetland Classification

SEI Class:	SEI Sub Class:	Confidence:

	%	SEI Classification
WL1%		
WL2%		
WL3%		

Classification Notes

Vegetation

Total %	Tree (A):	Shrub (B):	Herb (C):	Moss/Lichen (D):	
Species	%	Species	%	Species	%

Wildlife

Wildlife/Notes/Description

Ecosystem Integrity

Connectivity Index		Invasive Plant Cover	
Land Use Index		Composition	
Buffer Index		Water Source	
Absolute Patch Size		Hydroperiod	
Relative Patch Size		Hydrologic Connectivity	
Veg. Structure		Physical Patch Types	
Woody Veg. Regeneration		Soil Disturbance	
Native Plant Cover		TOTAL	

Notes:

Appendix 2. Conservation Evaluation Form

The following form is from RISC 2006. It is provided on the following page for printing purposes and also available in Appendix B of the Standard for Mapping Ecosystems at Risk in British Columbia at: http://www.for.gov.bc.ca/hts/risc/pubs/teecolo/habitat/assets/standards_for_mapping_ear_version1.pdf

CONSERVATION EVALUATION FORM			
PROJECT IDENTIFICATION		**DATE:**	
PROJECT ID:		**PLOT #:**	
POLY #:	**SEI CLASS:SUBCLASS:**		
ECOLOGICAL COMMUNITY			
CONSERVATION INFORMATION			
OWNER/JURISDICTION:			
DISTURBANCE:		**KNOWN THREATS:**	
ADJACENT LAND USE:		**OTHER FACTORS:**	
ALIEN SPP.:			
SUCCESS. STATUS:		**EST. SIZE COMM:**	**(ha)**
FRAGMENTATION OF ECOLOGICAL COMMUNITY			
❒ < 5% FRAGMENTED ❒ 5 - 25 % FRAGMENTED ❒ > 25% FRAGMENTED			
EVALUATION SUMMARY			
LANDSCAPE CONTEXT:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
ECOLOGICAL INTEGRITY:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
CONDITION:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
NOTES(AT-RISK SPECIES, WILDLIFE OBSV., ACCURACY INFO, ETC)			
OBSERVER	NAME:		
ADDRESS:			
EMAIL:		PHONE/FAX:	
SUBMIT DATA			
CDC, Ministry of Environment, Ecosystems Branch, P.O. Box 9358 Station Provincial Government, Victoria BC V8W 9M2 (fax: 250-387-2733) THANK YOU! Include: FS882 or GIF or VENUS file ❒ air photos with polygon marked ❒ map product(s) ❒ ground photos ❒			

COMPLETING THE CONSERVATION EVALUATION FORM
This form is intended for ecologists familiar with the RISC[1] Standards For Describing Terrestrial Ecosystems In The Field (DTEIF[2]). Submit a ground inspection (GIF) or ecosystem field (FS882) form with copies of air photos and/or maps. This information is necessary to identify and assess the conservation status of at-risk ecological communities.
PROJECT IDENTIFICATION:
Enter the date and GIF or FS882 plot number. If this form is completed as part of an inventory project provide the project name, related polygon number and sensitive ecosystem category, if applicable.
ECOLOLOGICAL COMMUNITY
Enter the name of the ecological community as on the CDC tracking list
CONSERVATION INFORMATION
OWNER/JURISDICTION: Enter the land owner or land management jusridiction (i.e. Provincial park, TFL #, regional government)
ADJACENT LAND USE: Provide details of land use adjacent to the community (i.e. housing, logging, recreation, etc)
DISTURBANCE: Enter DTEIF site disturbance codes and comments.
KNOWN THREATS: Record any known threats to the ecological community such as fire suppression, invasiveness of alien species, etc.
OTHER FACTORS: Record any other information known about the site
ALIEN SPP.: Note the type and abundance of alien species associated with the ecological community or in the vicinity.
SUCCESS. STATUS: Enter DTEIF succesional status codes
EST.SIZE COMM: Enter the estimated size of the community in hectares.
FRAGMENTATION: Indicate the degree of fragmentation within the community
EVALUATION SUMMARY:
Complete this section only if familiar with these terms as defined by CDC. Refer to CDC website - element occurrence ranking factors
NOTES
Record any other information or comments.
OBSERVER
Enter your name and contact information. A CDC ecologist may contact you if additional information or clarity is required.
1. Resource Information Standards Committee 2. Field Manual For Describing Terrestrial Ecosystems, Land Management Handbook 25. 1998. Prov. Of BC., Victoria, BC.

Appendix 3. Example Safety Plan

The following is a template for a basic field safety plan that should be completed by all field crews prior to working in the field.

SWAMP Field Safety Form	
Date:	Enter the date field work will be completed.
Time in/out:	Enter planned start and end time.
Location:	Description of planned work site. GPS UTMs and/or printed map should be attached with markings indicated planed work location and route.
Field Crew:	Names and contact information for all crew members.
Medical Conditions:	List of any relevant medical conditions or allergies for each crew member (heart condition requiring medication, diabetes, bee sting allergy, etc.).
Emergency Contacts:	Emergency contacts and information for all crew members.
Check-in Contact:	Check in person, contact information, and pre-defined plan for check-ins. For example, if the field crew does not check in within 1 hour of their planned time then the check in contact will notify X. If they do not check in with X hours of the planned time, then 911 will be contacted, etc.
Hazard Assessment:	Assessment of hazards expected for the work area. Normally the same for each site, and includes such things as animal encounters, inclement weather, sun, working near water, driving on logging roads, etc.
Safety Equipment:	Check list of safety equipment that should be brought in the car/truck and in the field. Items such as food, water, medication, bear spray, bear bangers, First AID kit, communication device, tow chain, etc.
Notes:	Room for any additional notes or comments.
Signatures:	Signatures of all field crew members and designated check-in contact.