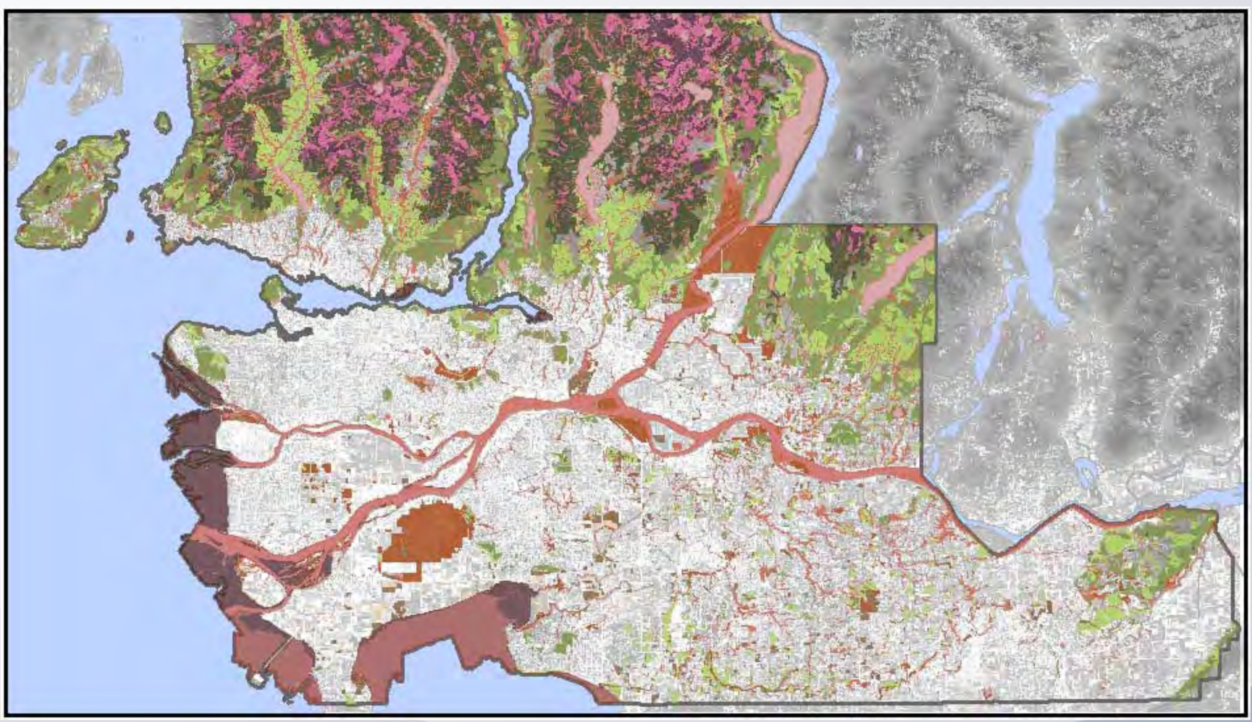
January, 2014

Sensitive Ecosystem Inventory
for Metro Vancouver & Abbotsford
2010-2012

TECHNICAL REPORT

Prepared by:
Del Meidinger, Meidinger Ecological Consultants Ltd.,
Josephine Clark, Metro Vancouver, and
David Adamoski, Metro Vancouver



metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION
www.metrovancouver.org
8413224

EXECUTIVE SUMMARY

A Sensitive Ecosystem Inventory (SEI) was conducted for Greater Vancouver Regional District (Metro Vancouver) and Abbotsford from January 2010 – May 2012. The project was initiated in response to the need for up-to-date, standardized ecological information for the entire region to support future decision making.

Provincial SEI standards were followed to identify and map ecologically significant and relatively unmodified 'Sensitive Ecosystems', including wetlands, older forests and woodlands. In addition 'Modified Ecosystems' such as seasonally flooded agricultural fields and young forests, which are human modified but still have ecological value and importance to biodiversity were included in the mapping process. The project area totaled 367,000 ha, consisting of over 330,000 ha of terrestrial lands plus several thousand hectares of rivers, freshwater bodies, intertidal and estuarine zones.

Three main approaches were used to build the inventory of polygons. Existing Terrestrial Ecosystem Mapping (TEM) was used to generate SEI values in the Coquitlam, Capilano and Seymour watersheds; the Regional Parks network; and Mount Seymour and Indian Arm Provincial Parks. Riparian fringe and gully SEI classes could often not be directly translated from TEM so had to be newly generated. SEI mapping from earlier projects was available for Bowen Island and Sumas Mountain, and this was adjusted where necessary and used to complete the inventory for these areas. For remaining areas with no existing TEM, SEI mapping was developed through image interpretation followed by selective field checks to confirm and inform mapping decisions. For new mapping, 20% of polygons were checked in the field.

Two sets of digital format aerial imagery (orthophotography) from 2007 and 2009 were the primary image sources used and together provided complete coverage of the project area. Polygons were delineated at 1:5,000 (new mapping) to 1:10,000 - 1:20,000 (originating from TEM). Sites as small as 0.5 ha were mapped, with the exception of some “Modified Ecosystems”, where only larger instances were mapped, e.g., greater than 2.5 ha for old fields and seasonally flooded agricultural fields. Some sites originating from TEM were smaller than 0.5 ha and these were also included in the inventory.

Spatial information and associated attributes are stored in an ArcGIS 10 geodatabase. Key attributes of class and subclass, structural stage, stand composition, condition and size were recorded for each component within a polygon. Although a polygon can have up to three ecosystem components, attempts were made to map as many pure sites as possible (i.e. one component). Other attributes of biogeoclimatic unit, landscape context, disturbance factors and ecosystem 'quality' were recorded for the polygon as a whole.

The ‘quality’ of an SEI polygon is determined through evaluation of condition, landscape context and size. Condition is an assessment of disturbance factors within and immediately adjacent to a polygon. Landscape context is an assessment of the land cover around a polygon and is a measure of the degree of fragmentation. Size is also considered because larger sites are generally better able to function more naturally than smaller sites of the same ecosystem.

Quality assurance (QA) was conducted throughout the mapping exercise. At the completion of the mapping, an independent QA was conducted using a randomly selected array of polygons, which determined that class was mapped correctly 91% of the time and subclass 86% of the time. Condition was found to be evaluated correctly 87% of the time, and received an acceptability score of 93%. These figures meet the desired accuracy standards set at the start of the project.

Users of the SEI must take into account certain limitations inherent with this type of dataset and consider how those limitations may impact the intended use of the information. This includes differences between the dataset and actual site conditions that could be due to human error, classification difficulties, and changes to the site occurring after the date of the imagery or field work. The dataset is considered accurate at the scale it was delineated at and should not be enlarged beyond this. The SEI does not replace the need for on-site assessments to support any decisions made for a particular area.

Analyses of the dataset shows that 52% (189,400 ha) of the Project Area (367,000 ha) supports 'sensitive' (43%) or 'Modified' (9%) ecosystems. Higher quality ecosystem ratings (grades of 'A' or 'B') were seen for 84% of these sites (146,600 ha). The location of sensitive and high quality ecosystems is concentrated within the northern watersheds and rugged mountainous areas If the focus is placed on the 'Regional Core' - the more urbanized southern part of the region that excludes the large parks and estuaries under Provincial management, watersheds and other higher elevation areas – only 15% is considered 'sensitive', and 7% is made up of 'modified' ecosystems. The average quality score also declines as sites tend to be more degraded and fragmented. Table 1 provides figures for the Project Area, the Metro Vancouver Region, and the Regional Core.

Table 1: Amount and Distribution of Ecosystems within the SEI Project Area

	Project Area, in ha	Metro Vancouver Region, in ha	Regional Core, in ha
Total Area	366,900 (100%)	325,800 (100%)	170,100 (100%)
Sensitive Ecosystems	155,900 (43%)	150,500 (46%)	25,100 (15%)
Modified Ecosystems	33,500 (9%)	30,200 (9%)	12,000 (7%)
Sensitive and Modified Ecosystems	189,400 (52%)	180,700 (56%)	37,000 (22%)
High Quality (A or B)[1]	146,600 (84%)	143,500 (86%)	15,200 (42%)
Lower Quality (C, D or E)[1]	28,100 (16%)	23,200 (14%)	21,000 (58%)

[1] Not all ecosystems graded for quality

Finally, Section 13 makes a number of recommendations for future work and improvements to the existing dataset. These include ensuring the dataset is maintained through regular updates, and improving the mapping where the quality assurance assessment has identified issues.

Table of Contents

1. Introduction

A Sensitive Ecosystem Inventory (SEI) was conducted over the Greater Vancouver Regional District (Metro Vancouver) and Abbotsford region from January 2010 – May 2012. A GIS database was produced, following a provincial inventory standard.

At the end of 2009, a multi-departmental team within Metro Vancouver recommended that a sensitive ecosystem inventory be completed for the region. This team examined what ecological data was needed to support a variety of different plans and projects, reviewed what was available within Metro Vancouver, and data that could be obtained from municipalities and other agencies. The team concluded that Metro Vancouver must lead in the creation of a standardized ecological mapping layer for the Region. This information will not only benefit Metro Vancouver in its planning efforts, but will also be beneficial to member municipalities, agencies and institutions who are often challenged with not possessing the necessary ecological information when land and environmental decisions are being considered.

The ecological mapping layer needed to:

- be standardized in terms of scale, manner in which the data is collected, and types of information collected;
- include some assessment of the condition or naturalness of each ecosystem occurrence, (i.e., a scaling from pristine to disturbed);
- be cost effective as it is a very large area; and,
- be useful to multiple projects.

A Sensitive Ecosystem Inventory was selected because it:

- is a standard methodology, developed by the Province, with official standards available;
- has been fully tested and applied in many areas of B.C. including, e.g., Sunshine Coast and East Vancouver Island;
- was specifically designed to be:
  - cost effective for mapping large areas,
  - easily interpreted and understood,
  - useful to a wide range of staff; and,
- has a strong link to Terrestrial Ecosystem Mapping (TEM), which is available for parts of Metro Vancouver;

As such, it was felt that the resulting product would be recognized, understood, and would align with other SEI's occurring adjacent to Metro Vancouver (e.g. Howe Sound Islands, Sunshine Coast).

Sensitive & Modified Ecosystems

"A Sensitive Ecosystem is one that is at-risk or ecologically fragile in the provincial landscape" – Provincial SEI Standards 2006

SEI maps contain ecosystems that are:

- "At-risk" (red or blue listed);
- rare;
- ecologically fragile; or,
- ecologically important because of the diversity of species they support.

Included within the larger SEI inventory are both **'Sensitive Ecosystems'** (e.g. Wetlands, Old Forest); and, **'Modified Ecosystems'**[1] (i.e., human modified but with significant ecological and biological value). Modified Ecosystems (ME) are particularly important in landscapes where there has been a loss of sensitive ecosystems. Young Forest and Seasonally Flooded Agricultural Fields are examples of 'Modified Ecosystems'.

2. Geographical Extents and Reporting Areas

The full Project Area for the SEI is shown in Figure 1 and encompasses the Metro Vancouver region and Abbotsford. It totals 367,000 ha and includes a small area that extends beyond the Metro Vancouver and Abbotsford boundaries and into Electoral Area G. SEI data was available from a previous project[2] that mapped the whole of Sumas Mountain. Rather than creating unnatural breaks in the mapping by cutting the dataset at the administrative boundary, all of the Sumas Mountain data was included. In this report, figures and analysis are provided for the entire Project Area, the Metro Vancouver region, and an area termed the Regional Core. The Regional Core is the more urbanized southern part of the region and excludes the large parks and estuaries under Provincial management, watersheds and other higher elevation areas (see Figure 1).

[1] The Provincial SEI Standards (2006) use the term 'Other Important Ecosystem' to describe 'Modified Ecosystems'. They are intended to be equivalent.

[2] Fraser Valley Conservancy and the City of Abbotsford SEI, 2010

3. Identification and Mapping Approach

The area reviewed during the SEI was approximately 367,000 ha, consisting of over 330,000 ha of terrestrial lands plus several thousand hectares of rivers, freshwater bodies, intertidal and estuarine zones (Figure 1).

For practical and budgetary reasons, the project was conducted in several phases.

Phase 1: Design and development of classification framework. The first step in 2010 was to determine the logical steps to conduct the inventory. It involved:

- identification of the classification units to be mapped in Metro Vancouver, based on the provincial system;
- assessment of existing mapping, including Metro Vancouver & Provincial TEM (Terrestrial Ecosystem Mapping), VRI (Vegetation Resources Inventory), FREMP (Fraser River Estuary Management Program), CWS (Canadian Wildlife Service) Wetlands, and Biogeoclimatic, for use in SEI mapping. Assessment included determining how these inventories might need to be supplemented (e.g., riparian mapping); and,
- development and testing of a cost-effective approach for use in areas where new mapping would be required.

Metro Vancouver conducted this phase with the assistance of *Meidinger Ecological Consultants Ltd.*

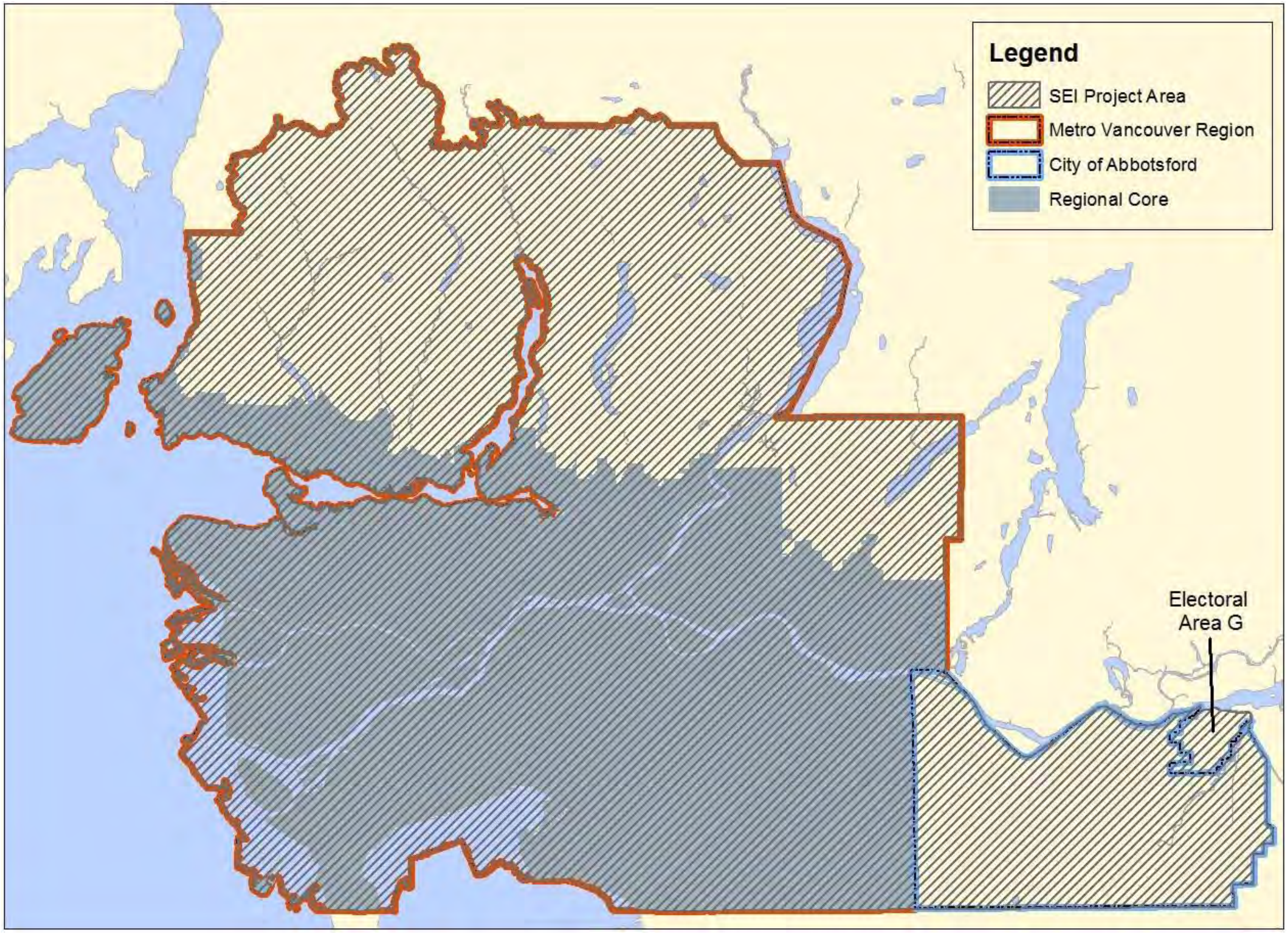


Figure 1: Sensitive Ecosystem Inventory Project Area

Phase 2: Reconciling Terrestrial Ecosystem Mapping

Upon review of the Metro Vancouver Terrestrial Ecosystem Mapping in Phase 1, it was evident that some reconciliation of map units would be required before the TEM could be used most effectively for the SEI. *B.A. Blackwell & Associates Ltd.* conducted this portion, and a new TEM database and description of Metro Vancouver map units were produced.

Phase 3: Identifying, mapping and labeling Riparian and Wetland sensitive ecosystems

Two approaches were used in this phase:

- *Terrestrial Ecosystem Mapping Areas*: Where TEM was available (Figure 2), mapped Riparian and Wetland areas were identified. Then other Riparian sensitive ecosystems were delineated and labeled. This was conducted by *B.A. Blackwell & Associates Ltd.*
- *Areas requiring new mapping*: For these areas, Riparian and Wetland sensitive ecosystems were identified, delineated and labeled. *Madrone Environmental Services Ltd.* mapped this area.

Phase 4: Incorporating the Fraser River Ecosystem Mapping into SEI

In this phase, ecological data mapped by the Fraser River Estuary Management Plan (FREMP) (see Figure 5) was translated into sensitive ecosystems and re-mapped. It used existing polygon line work to make the product consistent in scaling with the overall SEI. *Madrone Environmental Services Ltd.* conducted this step.

Phase 5: Mapping the remaining sensitive ecosystems

The remaining Sensitive and Modified ecosystems were mapped and assessed for condition. This included only areas without previous TEM mapping. In addition, a sizeable portion of the mapping was field checked. This was done by *Madrone Environmental Services Ltd.*

Phase 6: Identifying remaining sensitive ecosystems in TEM areas

Riparian mapping was added to the TEM database and remaining sensitive ecosystems identified and assessed for condition. Metro Vancouver conducted this phase.

Phase 7: Map remaining Modified Ecosystems

Seasonally Flooded Agricultural Fields and Old Fields were mapped, field checked and assessed for condition by Metro Vancouver.

Phase 8: Integrating biogeoclimatic mapping

Down-scaled biogeoclimatic mapping was required in several areas and *Meidinger Ecological Consultants Ltd.* conducted this exercise. Metro Vancouver performed the digitizing; *Madrone Environmental Services Ltd*. then integrated this into the SEI mapping.

Phase 9: Running analyses

Landscape context and size were assessed for all sensitive and modified ecosystems. These values were combined with condition to develop an overall measure of quality for every polygon. Metro Vancouver conducted this phase of analysis.

Phase 10: Independent Quality Assurance

Meidinger Ecological Consultants Ltd. conducted an accuracy assessment of the final mapping and attribution.

Phase 11: Integrate other SEIs

SEI mapping from earlier projects was available for Sumas Mountain (Fraser Valley Conservancy/City of Abbotsford product) and Bowen Island (Islands Trust product). During 2013, adjustments were made (where necessary) to align the mapping with Metro Vancouver's inventory, before combining them into one dataset. Riparian fringe and gully were delineated and added into the mapping for both areas, and condition was assessed. *B.A. Blackwell & Associates Ltd.* completed the work for Sumas Mountain. Bowen Island was done by Metro Vancouver.

Phase 12: Incorporate eelgrass mapping for Bowen Island (to be completed)

During 2013 The Islands Trust are completing eelgrass mapping for the Howe Sound Islands. This information will be incorporated into the inventory within the study area during 2014.

Throughout all phases of the project extensive quality assurance (QA) took place between contractors, Metro Vancouver staff, and the third party professional, Del Meidinger (*Meidinger Ecological Consultants Ltd.*). Multiple reviews of the mapping were also conducted as the project progressed. Project meetings were frequently held between consultants, Metro Vancouver and Del Meidinger. Representatives of Metro Vancouver also participated in field verification trips.

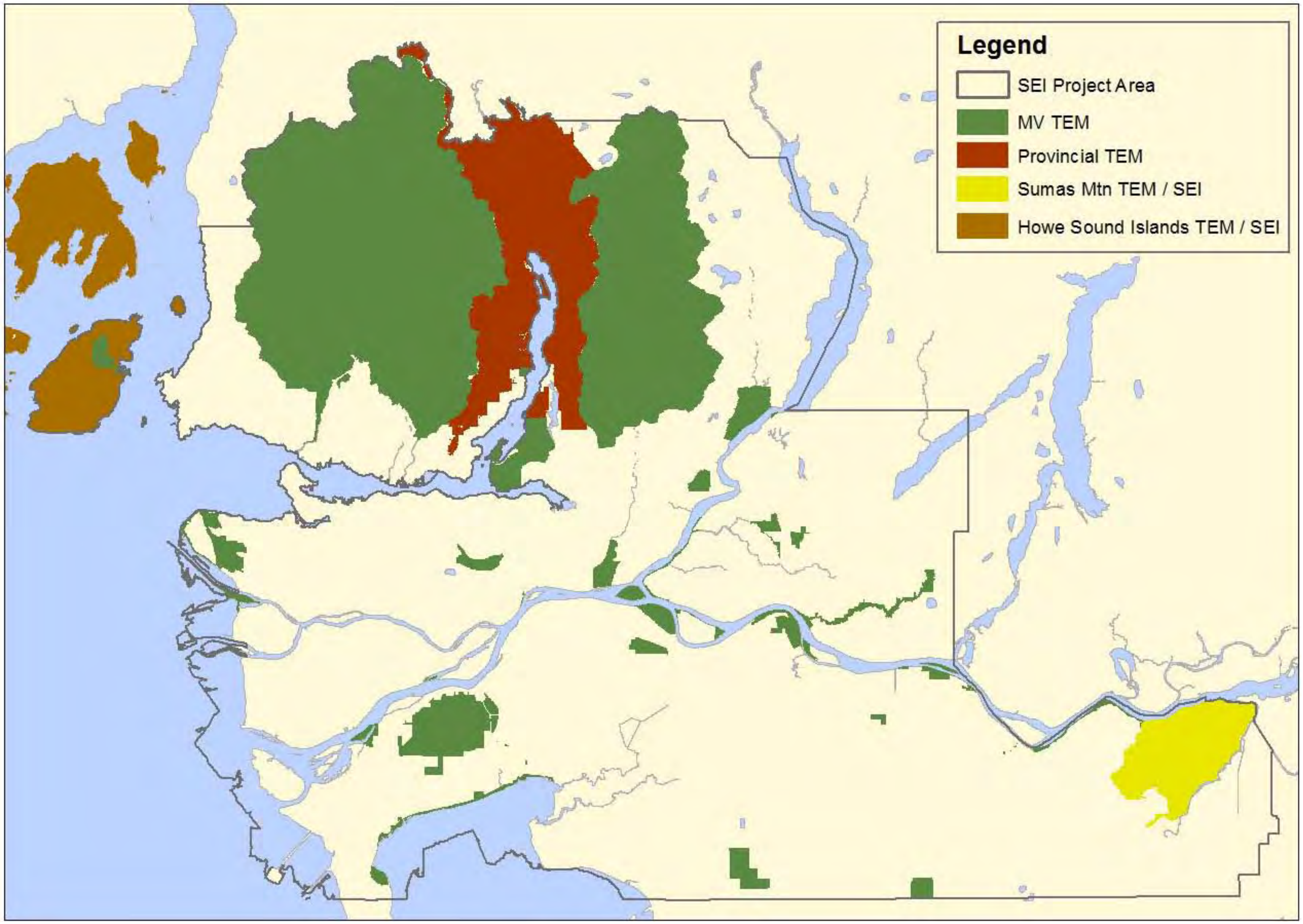


Figure 2: TEM and SEI datasets available within the Project Area

4. Mapping Units

Sensitive Ecosystems

The following units comprise the sensitive ecosystem mapping units (Table 2).

Old Forest (OF)

Old forests are generally conifer-dominated forest with complex vertical structure, where the canopy tree ages are mostly 250 years old or older, but may include older mixed coniferous stands. Old broadleaf stands are unlikely to occur in Metro Vancouver.

Subclasses:

co – conifer dominated (> 75% stand composition), where canopy tree ages mostly 250 – 400 years old.

mx – mixed conifer and broadleaf trees (< 75% coniferous and < 75% broadleaf composition), where canopy tree ages mostly 250 – 400 years old.

vo – very old: canopy trees are mostly 400 years old or older.

Mature Forest (MF)

Mature forests are generally greater than 80 years old and less than 250 years old. Mature forests are not as structurally complex as old forests, but can function as essential habitat areas for many wildlife species and as primary connections between ecosystems in a highly fragmented landscape. A minimum polygon size of 5 ha was used for inclusion in the Mature Forest sensitive ecosystem class. Broadleaf Mature Forest polygons (any size), and Coniferous Mature Forest and Mixed Mature Forest polygons of less than 5 ha are considered Modified Ecosystems.

Subclasses:

co – conifer dominated (> 75% stand composition), > 5 ha.

mx – mixed conifer and broadleaf (< 75% conifer and < 75% broadleaf composition), > 5 ha.

Woodland (WD)

Woodlands are open forests as a result of site conditions, i.e., they are ecological woodlands. They are found on dry sites, mostly on south facing slopes of rocky knolls and bedrock-dominated areas. The stands can be conifer dominated or mixed conifer and arbutus (or broadleaf hardwoods, e.g., Garry oak) stands and because of the open canopy, will often include non-forested openings, generally on shallow soils and bedrock outcroppings.

Subclasses:

co – conifer dominated ecological woodlands (> 75% conifer composition of total tree cover).

mx – mixed conifer and broadleaf ecological woodlands (< 75% conifer and < 75% broadleaf composition comprises the total tree cover).

Riparian (RI)

Riparian ecosystems are associated with and influenced by freshwater. They generally occur along rivers, streams, and creeks, but for SEI, also include fringes around lakes. These ecosystems are influenced by factors such as erosion, sedimentation, flooding, and/or subterranean irrigation due to proximity to the water body. This Class includes all vegetation developmental stages, i.e., structural stages 1 through 7, but only in a natural or semi-natural state.

Subclasses:

fl – low bench floodplain: flooded at least every other year for moderate periods of growing season; plant species adapted to extended flooding and abrasion, low or tall shrubs most common.

fm – medium bench floodplain: flooded every 1-6 years for short periods (10-25 days); broadleaf or mixed forest dominated by species tolerant of flooding and periodic sedimentation.

fh – high bench floodplain: only periodically and briefly inundated by high waters, but lengthy subsurface flow in the rooting zone; typically conifer-dominated floodplains of larger coastal rivers.

ff – fringe: narrow linear communities along open water bodies (rivers, streams, lakes and ponds) where there is no floodplain – see Appendix I for mapping guidelines.

gu – gully: watercourse is within a steep sided V-shaped gully or ravine; generally only minimal area of flooding but gully is important due to proximity to water and sensitive due to steeper slopes.

ca – canyon**:** watercourse is within a steep sided U-shaped canyon; generally only minimal area of flooding but canyon is important due to proximity to water, steep valley walls, and somewhat unique microclimate of canyon.

ri – river: river and associated gravel bars, and wider streams. Both “two-lined streams” and wider single-line streams are mapped as separate polygons. This river and stream subclass may be noted as a polygon component if large enough to be considered an important polygon component.

mf – mudflat: freshwater tidal mudflats.

Wetland (WN)

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 is generally seasonal or year-round and occurs either at or above the soil surface or within the root zone of plants. Wetlands are usually found in areas of flat or undulating terrain. They encompass a range of plant communities that includes western red cedar/skunk cabbage swamps, cattail marshes, and peat-moss dominated bogs. Estuarine vegetation is in a separate Class for this SEI to emphasize the different flooding frequency (mostly diurnal) and water chemistry (brackish). Therefore, the wetland class is for freshwater wetlands.

Subclasses:

bg – bog: acidic, nutrient-poor wetlands that characteristically support peat-mosses and ericaceous shrubs such as Labrador tea and bog-rosemary. Being generally isolated from mineral rich groundwater or surface water, their primary source of water and nutrients is from rainfall.

fn – fen: underlain by sedge or brown moss peat, fens are closely related to bogs. In addition to rainfall, fens receive mineral and nutrient-enriched water from upslope drainage or groundwater. Thus a broader range of plants, including shrubs and small trees, is able to grow.

ms – marsh: characterized by permanent or seasonal flooding by nutrient-rich waters. Marsh classification may include some areas of diurnal flooding of fresh water above the normal high high-tide, due to high river water levels. Examples include freshwater marshes that are dominated by rushes, sedges or grasses.

sp – swamp: wooded wetlands dominated by 25% or more cover of flood-tolerant trees or shrubs. Swamps are characterized by periodic flooding and nearly permanent sub-surface waterflow through mixtures of mineral and organic materials, swamps are high in nutrient, mineral and oxygen content.

sw – shallow water: wetlands characterized by water less than 2m in depth in mid-summer; transition between deep water bodies and other wetland ecosystems (i.e. bogs, swamps, fens, etc.); often with vegetation rooted below the water surface.

wm – wet meadow: transitional wetlands that receive water from run-off or seepage – periodically saturated but not inundated with water; vegetation a grassy overall mixture of moisture-tolerant grasses, low sedges, rushes and forbs. In other SEI projects, wet meadows are mapped in estuarine areas but in Metro Vancouver we have an Estuarine Class so they are included there. Almost all reed canarygrass meadows in Metro Vancouver are degraded swamps, marshes, or possibly low-bench floodplains – natural reed canarygrass meadows are potentially present in some situations, but native canarygrass is extremely difficult to differentiate from the more common exotic.

Herbaceous (HB)

The herbaceous class is comprised of non-forested ecosystems (i.e., less than 10% tree cover), and are generally associated with shallow soils, often with bedrock outcroppings, coarse-textured soils, or natural disturbances (wind or wave action); includes a variety of natural ecosystems such as large, bedrock-controlled openings within forested areas, coastal headlands, shorelines vegetated with grasses and herbs, sometimes low shrubs, and moss and lichen communities on rock outcrops.

Subclasses:

hb – herbaceous: central concept of the category; non-forested, generally shallow soils, often with exposed bedrock; predominantly a mix of grasses and forbs, but also lichens and mosses.

cs – coastal herbaceous: criteria as for ‘hb’ but influenced by proximity to ocean; windswept shoreline and slopes; > 20% vegetation of grasses, herbs, mosses and lichens.

vs – vegetated shoreline: low-lying rocky shoreline, soil pockets in rock cracks and crevices; salt-tolerant vegetation, generally with < 20% vegetation cover.

sh – shrub: > 20% of total vegetation cover is shrub cover, with grasses and herbs.

Sparsely Vegetated (SV)

Areas of low vascular vegetation cover, generally 5 – 10%, but may be greater in some patches; may have high cover of mosses, liverworts and lichens.

Subclasses:

cl – cliff: steep to very steep slopes, often with exposed bedrock; may include steep-sided sand bluffs**.**

ro – rock outcrop: exposed bedrock, usually at the top of knolls or on portions of steeper slopes.

ta – talus: generally steep slopes comprised of rubbly blocks of rock.

sd – sand dunes: ridge or hill, or beach area of windblown sand; may be more or less vegetated depending on depositional activity; beach dunes will have low cover of salt-tolerant grasses and herbs.

st – spit: finger-like beach extension of sand and gravel deposited by longshore drifting; low to moderate cover of salt-tolerant grasses and herbs.

Estuarine (ES)

Estuarine ecosystems are found at the confluence of rivers with the sea where they are influenced by occasional or diurnal tidal inundation and brackish water. The vegetation reflects the brackish water conditions to varying degrees, depending on the position in the estuary and the magnitude of freshwater outflow. Estuarine ecosystems are distinguished from intertidal ecosystems by the degree of freshwater input – intertidal ecosystems are influenced by saltwater tidal inundation with little to no freshwater input, except by rainfall runoff.

Subclasses:

sp – estuary swamp: treed or shrubby ecosystems in brackish lagoons, on channel and estuary edges with occasional tidal flooding and waterlogged, slightly saline soils.

md – estuary meadow: found in the high intertidal zone of estuaries where tidal flooding occurs less frequently than daily and is tempered by freshwater mixing. Species composition is relatively diverse, typically with a mix of graminoids and forbs.

ms – estuary marsh: intertidal ecosystem that is flooded and exposed during most tidal cycles; usually simple communities dominated by salt-tolerant emergent graminoids and succulents.

tf – estuary tidal flat: large flats of silts, sands or pebbles, flooded and exposed in most tidal cycles; macroalgae common.

Intertidal & Shallow Sub-tidal (IT)

Mudflats, beaches and rocky shorelines influenced by diurnal tidal cycles with little to no freshwater input (primarily through rainfall runoff). The intertidal ecosystems link the marine and terrestrial environments.

Subclasses:

mf – mudflats: non-vegetated mudflats or with varying amounts of algae.

bs – beaches: well- to sparsely-vegetated or non-vegetated beaches and shorelines.

el – eelgrass: intertidal & shallow subtidal eelgrass beds.

Freshwater Lakes & Ponds (FW)

Freshwater ecosystems include bodies of water such as lakes and ponds that usually lack floating vegetation. Areas dominated by floating vegetation should be mapped as wetland: shallow water.

Subclasses:

la – lake: naturally occurring, static body of open water greater than 2m deep and generally greater than 8 ha, with little to no floating vegetation; deeper water than a pond.

pd – pond: naturally occurring, small body of open water, greater than 2m deep and generally up to 8 ha, with little to no floating vegetation; shallower water than a lake.

Alpine (AP)

Ecosystems above or near tree-line – mostly non-forested but includes treed islands and windblown, shrubby treed patches termed krummholz.

Subclasses:

hb – herbaceous: alpine or high subalpine ecosystems dominated by forb or graminoid vegetation.

kr – krummholz: alpine ecosystems dominated by trees with shrubby, ‘windblown’ form

pf – parkland forest: ecosystems in the high subalpine, near treeline, where trees are mostly erect and occur in distinct patches or clumps.

ds – dwarf shrub: alpine or high subalpine ecosystems dominated by dwarf shrubs – mountain-heathers dominate.

ts – tall shrub: cold climate influenced shrub communities – generally snow accumulation areas below the alpine but not due to avalanching.

av – avalanche tracks: subalpine ecosystems influenced by repeated snow avalanches; shrub or herb dominated.

Modified Ecosystems

Modified Ecosystems (Table 3) are mapped to identify important elements of biodiversity or recruitment sites for ecosystems at risk or important wildlife habitat requiring recovery or restoration.

Seasonally Flooded Agricultural Fields (FS)

Seasonally Flooded Agricultural Fields are lands that have been modified for agricultural use, and have important wildlife habitat value during specific times of the year. These fields are located primarily in low-lying areas such as valley bottoms and deltas of large alluvial rivers and creeks. In some cases they are found on moisture-receiving sites, usually in association with lakeshores, or lowlands adjacent to coastal bays. They are usually former wetlands, and in many cases, are located adjacent to surviving wetlands such as marshes, swamps, and wet meadows. In such cases, other environmental factors such as poor drainage or a high water table contribute to flooding during the fall/winter rainy season. A minimum size of 2.5 ha was used.

Mature Forest (MF)

Mature forests are generally greater than 80 years old and less than 250 years old. For coniferous or mixed stands, a polygon size of less than 5 ha is used for inclusion as a Modified ecosystem – polygons of greater size would be classified as a sensitive ecosystem. Broadleaf-dominated polygons of any size are considered Modified Ecosystems. These mature forests are not as valuable as old forests as far as representing the at-risk ecosystems, but can be important habitat areas for many wildlife species and serve as primary connections between ecosystems in a highly fragmented landscape.

Subclasses:

co – conifer dominated (> 75% of stand composition), < 5 ha.

mx – mixed conifer and broadleaf (< 75% coniferous and < 75% broadleaf composition), < 5 ha.

bd – broadleaf dominated (> 75% of stand composition), any size.

Young Forest (YF)

Young forests are generally greater than 30 – 40 years old and less than 80 years old, and greater than 5 ha to be considered a Modified Ecosystem. Young forests can be important habitat areas for many wildlife species and serve as primary connections between ecosystems in a highly fragmented landscape. This subclass also includes young woodlands.

Subclasses:

co – conifer dominated (> 75% of stand composition), > 5 ha.

mx – mixed conifer and broadleaf (< 75% coniferous and < 75% broadleaf composition), > 5 ha.

bd – broadleaf dominated (> 75% of stand composition), > 5 ha.

Old Field (OD)

Lands formerly cultivated or grazed but later abandoned. Old-field sites can provide important habitat for wildlife species in human-influenced landscapes. As an intermediate stage in succession, without management they will eventually become forest – some may have been wetlands where the drainage has been altered in order to farm. A minimum size of 2.5 ha was used.

Freshwater Reservoirs (FW)

Reservoirs of any size are included in the Freshwater Class but as a 'modified ecosystem'. This also includes smaller, modified ponds. Even though the natural hydrology of reservoirs is modified, they are still important freshwater habitat.

Subclasses:

rs – reservoir: artificial body of water, of any size.

Non SE/ME Ecosystems

Three non SE/ME ecosystems were occasionally mapped (Table 4).

YS

Patches of young forest too small (less than 5 ha) to be included as an ME. Stand age of greater than 30 years and younger than 80 years.

XX

Non SE, ME or YS ecosystem type.

Table 2: Sensitive Ecosystems (SE) for Metro Vancouver

SE Class	SE Subclass	Brief Description
OF: Old Forest		Forests > 250 yrs
OF	co: coniferous	Conifer dominated (> 75% of stand composition)
OF	mx: mixed	Mixed conifer and broadleaf (< 75% conifer and < 75% broadleaf stand composition)
OF	vo: very old	Forests > 400 yrs
MF: Mature Forest		Forests > 80 yrs, < 250 yrs, > 5 ha
MF	co: coniferous	Conifer dominated (> 75% of stand composition)
MF	mx: mixed	Mixed conifer and broadleaf (< 75% conifer and < 75% broadleaf stand composition)
WD: Woodland		Dry site, open stands with 50% or less tree cover
WD	co: coniferous	Conifer dominated (> 75% of stand composition)
WD	mx: mixed	Mixed conifer and broadleaf (< 75% conifer and < 75% broadleaf stand composition)
RI: Riparian		Ecosystems associated with and influenced by freshwater
RI	ff: fringe	Narrow band near ponds or lake shorelines, or streams with no floodplain
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	gu: gully	Watercourse is in a steep V-shaped gully
RI	ri: river	River and wider stream watercourses including gravel bars
RI	ca: canyon	Watercourse is within a steep sided U-shaped canyon
RI	mf: mudflat	Freshwater tidal mudflat
WN: Wetland		Terrestrial – freshwater transitional areas.
WN	bg: bog	Nutrient-poor wetlands on peat-moss organic soils
WN	fn: fen	Groundwater-fed sedge-peat wetlands

SE Class	SE Subclass	Brief Description
WN	ms: marsh	Graminoid or forb-dominated nutrient-rich wetlands
WN	sp: swamp	Shrub or tree-dominated wetlands
WN	sw: shallow water	Permanently flooded, water < 2m deep at mid-summer.
WN	wm: wet meadow	Briefly inundated, graminoid-dominated meadows.
HB: Herbaceous		Non-forested ecosystems; usually shallow soils, often with bedrock outcrops.
HB	hb: herbaceous	Inland sites dominated by herbs; generally shallow soils.
HB	cs: coastal herbaceous	Influenced by proximity to the ocean: > 20% vegetation cover of grasses, herbs, mosses and lichens
HB	vs: vegetated shoreline	Low-lying rocky shorelines with < 20% vegetation.
HB	sh: shrub	Shrubs > 20% cover, with grasses and herbs.
SV: Sparsely Vegetated		Areas with 5 – 10% vascular vegetation (may be greater in patches); often with mosses, liverwort and lichen cover
SV	cl: cliff	Steep slopes, often with exposed bedrock.
SV	ro: rock outcrop	Rock outcrops – areas of bedrock exposure, variable vegetation cover.
SV	ta: talus	Dominated by rubbly blocks of rock, variable vegetation cover.
SV	sd: sand dune	Ridge, hill or beach area of windblown sand; variable vegetation cover
SV	st: spit	Finger-like beach extension of sand and gravel deposits with low to moderate cover of salt-tolerant grasses and herbs.
ES: Estuarine		Ecosystems at marine, freshwater & terrestrial interface
ES	sp: swamp	Treed or shrubby ecosystems
ES	md: meadow	Tall forb and graminoid vegetation that develops in the high intertidal and supra-tidal zones of estuaries
ES	ms: marsh	Vegetation of salt-tolerant emergent graminoids and succulents, flooded and exposed during most tidal cycles

SE Class	SE Subclass	Brief Description
ES	tf: tidal flat	Large flats of silts, sands, or pebbles flooded and exposed in most tidal cycles – macroalgae common
IT: Intertidal & shallow sub-tidal		Ecosystems at marine and terrestrial interface
IT	mf: mudflats	Mudflats, with algae or not
IT	bs: beaches	Beaches and rocky shorelines, vegetated or not
IT	el: eelgrass	Intertidal and shallow sub-tidal eelgrass beds
FW: Freshwater Lakes and Ponds		Freshwater bodies of water
FW	la: lake	Natural or semi-natural open water > 2m deep; > 8 ha
FW	pd: pond	Natural or semi-natural open water > 2m deep, < 8 ha
AP: Alpine		Ecosystems above or near the treeline
AP	hb: herbaceous	Alpine ecosystems dominated by forbs or graminoid vegetation
AP	kr: krummholz	Alpine ecosystems dominated by krummholz trees
AP	pf: parkland forest	Ecosystems at the transition between alpine and subalpine where trees occur in distinct clumps
AP	ds: dwarf shrub	Alpine/high subalpine ecosystems dominated by dwarf shrubs
AP	ts: tall shrub	Taller shrub ecosystems influenced by cold microclimate or snow accumulation.
AP	av: avalanche tracks	Avalanche tracks, consisting of shrub and herb ecosystems

Table 3: Modified Ecosystems (ME) for Metro Vancouver

ME Class	ME Subclass	Brief Description
MF: Mature Forest		Small patches of co or mx forest (< 5 ha) or any size of bd where stands > 80 yrs, < 250 yrs
MF	co: coniferous	Conifer dominated (> 75% of stand composition), < 5 ha
MF	mx: mixed	Mixed conifer and broadleaf (< 75% conifer and < 75% broadleaf stand composition), < 5 ha
MF	bd: broadleaf	Broadleaf dominated (> 75% of stand composition), **any size**
YF: Young Forest		Large patches of forest (> 5 ha) – stands > 30 yrs, < 80 yrs
YF	co: coniferous	Conifer dominated (> 75% of stand composition)
YF	mx: mixed	Mixed conifer and broadleaf (< 75% conifer and < 75% broadleaf stand composition)
YF	bd: broadleaf	Broadleaf dominated (> 75% of stand composition)
FS: Seasonally Flooded Agricultural Fields		Annually flooded cultivated fields or hay fields > 2.5 ha
FW: Freshwater Reservoirs		
FW	rs: reservoir	Artificial water body of any size
OD: Old Field		Large (> 2.5 ha), abandoned-field ecosystems

Table 4: Non SE/ME's for Metro Vancouver

Non SE/ME Class	Brief Description
YS: Young Forest (small)	Small patches of forest (< 5 ha) - stands > 30 yrs, < 80 yrs
XX	Non SE, ME or YS ecosystem type

Mapping Conventions

Salt versus fresh water influence

The salinity gradient from freshwater to brackish water to saltwater influences the development of riparian, freshwater wetland, estuarine and intertidal ecosystems. Floristic composition and other features can be used to determine the type of ecosystem, however this assessment is only reliable through ground-truthing. As only a portion of the polygons would be field checked, a convention was followed. A combination of SEI definitions, background reports and professional discretion was used when deciding where the boundaries occurred between Intertidal (IT), Estuary (ES), Wetland (WN) and Riparian (RI) SEI classes.

Estuarine ecosystems are found at the confluence of rivers with the sea, where they are influenced by occasional or diurnal tidal inundation and brackish water. The vegetation reflects the brackish water conditions to varying degrees, depending on the position in the estuary and the magnitude of freshwater outflow. Estuarine ecosystems are distinguished from intertidal ecosystems by the degree of freshwater input. Intertidal ecosystems are influenced by saltwater tidal inundation with little to no freshwater input, except by rainfall runoff.

Reference reports (e.g., Neilson-Welch and Smith, 2001) indicate that salt water influence up the Fraser River ends at the mid-point of Annacis Island in the South Arm and at the eastern end of Mitchell Island in the North Arm. It was assumed that saltwater influence does not penetrate past Mud Bay at the mouth of the Serpentine and Nicomekl Rivers (due to tidal dams). Therefore, polygons along the Fraser River and to the east of these areas were classified as Wetland (WN) or Riparian (RI) rather than Estuarine (ES) or Intertidal (IT) (see Figure 3).

Freshwater tidal areas were classified as either riparian or freshwater wetlands rather than estuarine or intertidal.

Figure 3: Salt vs fresh water influence cut off

Overlap between mapping units (trumping)

In cases where an ecosystem occurrence could be assigned to more than one Sensitive Ecosystem unit (e.g., a wetland in the riparian zone) it was designated to the more sensitive unit. The following rules were applied:

- Wetlands take priority over all other classes
- Riparian classes generally take priority over other classes except wetlands.
- The following classes/subclasses take priority over riparian fringe and gully:
  - Avalanche tracks (AP:av)
  - Woodland (WD)
  - Herbaceous shrub (when it is truly natural) (HB:sh)
  - Sparsely Vegetated cliff and talus (SV:cl, SV:ta)
  - Estuarine (ES)
  - Intertidal (IT)

Reed canarygrass dominated areas

Areas dominated by reed canarygrass can be difficult to classify in a Sensitive Ecosystem unit. These are generally areas that have been cleared and often drained for agriculture, and then abandoned. Reed canarygrass is very invasive and forms dense swards, which slows succession to native plants. See Appendix IV for further information on mapping areas of reed canarygrass.

Old field mapping

Old fields are one type of early successional ecosystem – others include blackberry thickets, shrublands, or regenerating forests. As abandoned fields, they vary in vegetation cover – from mostly weedy plants, to well-established graminoid- or forb-dominated communities, with varying amounts of shrubs or regenerating trees. Those 'old fields' that have well-established herbaceous vegetation with some structural diversity are known to be important wildlife habitat. Once taller trees or shrubs dominate the vegetation of these areas, wildlife value decreases for a period of time, until the stand thins out.

Appendix V outlines the criteria to be used for the inclusion of sites to the 'Old Field' class of the Metro Vancouver SEI.

Seasonally Flooded Agricultural Fields

There are difficulties inherent in identifying this class because flooding will vary within a wet season (larger areas will be flooded during some months than other) as well as between years. Therefore the determination of what is flooded will change depending on when the orthophotos were taken or when a site was visited. In an attempt to prevent over-classification of this class and to restrict delineation to areas that are most likely flooded on an annual basis, agricultural fields were only classified as seasonally flooded if they were observed to be extensively flooded in more than one orthophoto source (i.e. more than one year), or one orthophoto source and a site visit. Approximately 50% of candidate seasonally flooded agricultural fields were field checked - compared to an average of 20% for all new mapping – in order to achieve greater accuracy for this class.

5. Mapping Data Sources

The Metro Vancouver SEI's area is approximately 367,000 ha in size (see Figure 1). Of this, approximately 85,000 ha is urban and industrial lands. Metro Vancouver TEM mapping was available for 75,000 ha (Regional Parks and watersheds). TEM/SEI projects conducted for Sumas Mountain and the Howe Sound Islands provided data for a further 11,000 ha; Provincial TEM mapping was available for 17,000 ha of Indian Arm and Mount Seymour. Therefore, the datasets that provide a more direct cross-over to SEI, and lands that require little to no mapping due to the lack of vegetation, cover approximately 187,000 ha. Of the remaining area, approximately 100,000 ha are lands that required some mapping effort, with the remainder being agricultural land.

The following data sources were used in the mapping of Sensitive and Modified Ecosystems:

Imagery:

- Orthophoto images were used for visual inspection of vegetation cover and disturbance factors, and for drawing polygon boundaries outside areas with TEM or FREMP mapping. Two images were available that provided full coverage:
  - April 2009
  - Early summer 2007 (northern part of the study area only)
- 3-D PurVIEW© images were developed for areas with greater relief to assist with ecosystem mapping. The 2007 image set of the northern area was converted by *Integrated Mapping Technologies (IMT)* In 2013 PurVIEW files were created from the April 2009 imagery for Sumas Mountain by *4DGIS Ltd*.
- BING images (http://www.bing.com/maps/), in particular the 'Bird's eye' version, were used to view summer imagery and oblique views to improve SEI label interpretation.
- Google Earth images (http://**earth**.**google**.com) were used to look at winter and historical imagery to assist in the identification of seasonally flooded fields and old fields.

Existing large scale, polygonized map products were used to inform the SEI and as base polygons, where appropriate. These include:

- Terrestrial Ecosystem Mapping (TEM) – available for the Regional Parks system and the Watersheds, Indian Landscape Unit, Indian Arm and Mount Seymour Provincial Parks (Figure 2). TEM to SEI cross-walk tables (Appendix XII) were developed to convert TEM to SEI. Riparian fringes and gullies are not mapped in TEM so these had to be integrated with the TEM coverage to produce the SEI mapping.
- Vegetation Resources Inventory (VRI) – available on the north shore for Watersheds and adjacent areas (Figure 4). Approximately 156,000 ha within the study area has VRI of some detail. The most detailed area is Electoral Area A (33,000 ha), plus the Metro Vancouver watershed TEM area. VRI data assisted with determining stand age for Forest Classes and structural stage, particularly for the Indian Landscape Unit TEM where structural stage was not mapped. Occasionally VRI polygon boundaries were used in the mapping of sensitive ecosystems.

- Fraser River Estuary Management Plan (FREMP) Habitat Mapping – approximately 24,000 ha of mapping available for the Fraser River estuary and some additional intertidal areas (Figure 5). The FREMP linework was copied into the Metro Vancouver SEI database although some polygon merging was necessary due to project polygon size limitations, and adjustment to reflect change; in addition, adjacent polygons of the same SEI class and subclass were merged. The FREMP polygons that were assessed as not meeting the SE, ME or YS (Young Forest of less than 5 ha size) units were not included in the final Metro Vancouver SEI data set. The FREMP information was examined and incorporated into the SEI label where appropriate. For example, the FREMP dataset contains details of species observed at sites that were field checked. All resulting polygons were checked using imagery and the attributes modified, if necessary.
- Burrard Inlet Environmental Action Program (BIEAP) Habitat Inventory (Figure 5) provided polygon boundaries and some information for attribution.
- SEI mapping from earlier projects was available for Sumas Mountain (Fraser Valley Conservancy/City of Abbotsford) and Bowen Island (The Islands Trust). As both projects originated from TEM data, the Metro Vancouver TEM to SEI crosswalk tables (Appendix XII) were used as a guide to confirm that development of the SEI layer aligned with elsewhere in the Metro Vancouver inventory, and adjustments were made where necessary. Riparian fringe and gully were not mapped in the original projects so these classes were delineated and added into the mapping for both areas. PurVIEW 3D imagery was used for Sumas Mountain to assist with the riparian delineation process. Further information on the process of incorporating these datasets is available in Appendix VII (Sumas Mountain) and Appendix IX (Bowen Island).

Topography:

- Municipal digital elevation models/contours were used wherever possible. They were helpful in determining wetland vs. upland conditions and the shape and depth of stream valleys.
- TRIM contours were used in the northern areas to assist with the riparian fringe vs. gully determination, although 3-D imagery was the primary source for such determination.

Waterbodies and Stream Network:

- The Metro Vancouver and Abbotsford stream mapping was used in riparian mapping.

Biogeoclimatic subzone/variant mapping, two sources were used**:**

- Provincial coverage (1:250,000) (http://www.for.gov.bc.ca/hre/becweb/resources/maps/gis_products.html)
- TEM coverages: TEM includes biogeoclimatic attribution, which provides a down-scaled product more suitable for the scale of SEI mapping
- These sources were combined. It was necessary to modify and ‘downscale’ the provincial coverage in the northern mountainous areas not covered by TEM. In addition, the provincial coverage in the valley was reconciled with the Regional District Parks TEM mapping.

Metro Vancouver Land Cover Classification (LCC, 2012) and **Provincial Baseline Thematic Mapping** (1992), used in the determination of landscape context around SEI polygons.

The following available data sources were **not used**:

- Other municipal mapping (e.g. ESA mapping) – not useful to initial mapping of sensitive ecosystem Classes / Subclasses.
- Canadian Wildlife Service (CWS) Wetlands Mapping – available for the Fraser Lowlands only. Determined to be problematic at scale of SEI mapping.
- Municipal vegetation mapping (e.g., Surrey) – not used in this version. The Surrey mapping should be compared to the SEI to determine how the two products can complement each other.

Figure 4: Extents of Vegetation Resources Inventory (VRI) mapping

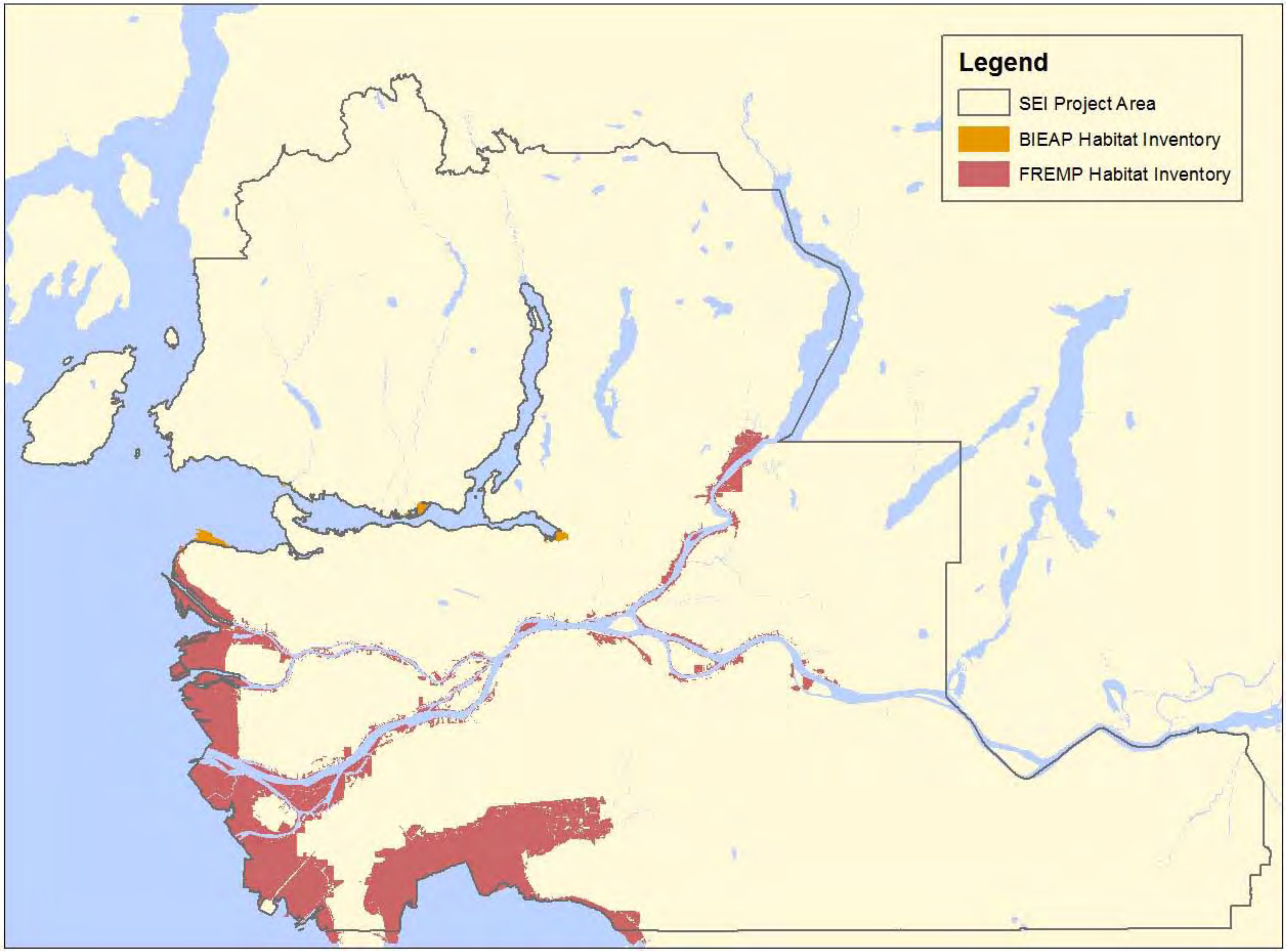


Figure 5: FREMP/BIEAP habitat mapping

6. New Mapping - Delineating and Attributing Polygons

For areas of new mapping, two sets of digital format aerial imagery (orthophotography) were used to locate and map SEI features in the project area. The 2007 and 2009 imagery together provided full coverage of the SEI area with some overlap. Where overlap occurred, an attempt was made to view both images for comparison in SEI label interpretation.

In addition, BING Maps Bird's eye Images (http://www.bing.com/maps/) were referenced for summer imagery, and street level views to improve SEI label interpretation. The most common application of Bing Maps was for assisting in interpreting broadleaf from mixed stands, and to look for the presence of vegetation on small water bodies (differentiating between a Wetland, shallow water (WN:sw) and a Freshwater, pond (FW:pd)) that was not always visible on the early spring (2007) or fall (2009) imagery. It was also used to differentiate between swamps and marshes, and determine structural stages.

A combination of two methods of photo interpretation were used to identify SEI polygons; viewing 2-dimensional (2D) orthophotos on screen for the relatively flat majority of the project area, and using a combination of 2D, and 3-dimensional (3D) viewing software (PurVIEW) for the northern section of the project area and Sumas Mountain (riparian fringe and gully only).

The 2D and 3D methods were used to delineate Sensitive and Modified ecosystem polygons. Both methods used the same background datasets such as elevational data (contours) and hydrological data (streams and marshes).

Each polygon was mapped at 1:5,000 or better. On completion of the photo interpretation, a set of polygons (linework drawn around SEI features) was produced that delineate the boundaries of each Sensitive and Modified Ecosystem.

Complexed Versus Pure Polygons

An attempt was made to map as many pure sites or polygons as possible, thus avoiding confusion around where one type of eco-sensitive area is located adjacent to another. In many cases, however, there were no distinct boundaries between ecosystems that could be appropriately delineated. In other cases, often with small wetlands, the sites were too small to include as their own polygon and were therefore merged with adjacent features where appropriate. These sites are referred to as ecosystem complexes.

The goal during the mapping was to aim for 80-85% of the polygons to be labeled with one component and subclass. This was not intended to be a "hard" rule, but to act as a guide to polygon delineation.

Attribution

For each component within a polygon, the following attributes were documented: class, subclass, structural stage (and substage, if applicable), stand composition (where applicable) and decile of the component. A polygon can have up to three ecosystem components.

In addition, a condition rank of A (best condition) to E (very degraded, poor condition) was also assigned (see Appendix III), and accompanied by up to four disturbance codes (see Appendix II).

Polygons were viewed at a larger scale – generally 1:1,000 – for attribution.

Appendix II contains the complete data structure and data dictionary.

Structural Stage

Structural stages range from 1 (sparsely vegetated or moss/lichen dominated) to 7 (old forest) (Appendix II). This information is considered essential for ease of interpretation for future management plans and practices.

Where "linear", riparian features such as Riparian gully or Riparian fringe were mapped, structural stages were assigned based on the dominant structure. The exception was related to condition, where an old (structural stage 7) or mature (structural stage 6) riparian fringe changed to a recently logged (structural stage 2 to 4) fringe. New polygons were created in those cases to reflect the change in condition.

High Elevation Forest

High elevation forests in the Mountain Hemlock Biogeoclimatic Zone, such as parkland forests (AP:pf) are typically stunted in size due to the harsh environment that they grow (e.g. shorter growing seasons, colder winter temperatures, thin low nutrient soils, etc.), but can be upwards of 300+ years. The distinction between 'old' and 'mature' forest (structural stages 7 versus 6) can be difficult under these circumstances because they look much smaller than lower elevation old forest units. To determine class, subclass and structural stage, ecologists (mappers) take into account and balance a number of factors including age, structure and conditions affecting each site. If no disturbance was evident, the mapper typically defaulted to old forest structural stage 7.

Due to the extremely poor growing conditions and assumed regular disturbance events (heavy snow movement, ice crystal blasting), krummholtz (AP:kr) were all assigned structural stage 3. This stage reflects the stunted height (typically less than 5m in height) that is typical of their seral climax condition. Some of the Alpine krummholtz sites could be greater than 300 years in age.

Woodlands

Woodland sites were mapped as WD:co (coniferous) or WD:mx (mixed with Arbutus), and typically consist of the dry, forested "02" site series that are associated with exposed rock outcrops and cliffs, often with a warm aspect, steep slope or crest position. Tree cover was typically low at these sites (not much more than 50%). As with higher elevation forests, woodland units occur on poor condition sites and can be stunted in size. These dry sites may also experience fire disturbance more often than typical coastal forest units.

In order to assign structural stage to Woodland units, mappers looked for uneven texture and no evidence of disturbance to indicate older stands. Structural stages 5, 6 and 7 were mapped for the Woodland unit. At present, all these structural stages of woodland are in as sensitive ecosystems but for management purposes, younger structural stage woodland sites (5) may be considered as Modified Ecosystems.

Mapping Riparian Fringe and Gully

Riparian gullies are deeper in cross-section than fringes, and confined to the steeper terrain on either side of a stream.

Riparian fringes are located adjacent to lakes, ponds, streams and rivers, and include ecosystems that do not fit any of the other riparian sensitive ecosystem subclasses. The riparian fringe (RI:ff) sensitive ecosystem is intended to designate natural and semi-natural plant communities 'fringing' rivers, streams, lakes and ponds, where there is:

- no floodplain landform (high bench, medium bench, low bench)
- no gully or canyon
- regular subsurface irrigation of the rooting zone
- rarely flooding

Generally, vegetation indicating subsurface irrigation – tall shrub and broadleaf tree communities – are common in fringe ecosystems, and the vegetation is generally distinct from adjacent uplands or wetlands. However, the riparian fringe class is also intended to include vegetation that fringes streams, rivers, lakes or ponds that do not meet the criteria above, in other words, the vegetation may not be distinct and the soils may not be subject to subsurface irrigation. The reason these are included in this class is that all vegetation adjacent to freshwater is of greater importance as habitat.

A key was developed to help with the consistency of the process in the fragmented landscape over much of Metro Vancouver (Appendix I).

Measured buffers were applied to waterbody and stream layers in ArcGIS to guide the delineation of riparian gullies, floodplain benches and fringes. However, in many cases the buffers required cutting and/or merging to account for adjacent disturbance, changes in vegetation types or to include forest surrounding the riparian unit.

Dissolving stream and lake fringes into one polygon was done if the characteristics of the area allowed for it. New polygons were made where there were distinct differences in vegetation or slope breaks (i.e. flat ground along lake vs. a gully leading down to the lake). Riparian fringes were often digitized without the addition of buffers when their boundaries could clearly be seen, especially in urban locations.

Multi-part polygons were sometimes created to join riparian polygons separated by small roads and breaks.

7. Developing the SEI from Existing TEM data

SEI mapping can be modeled from other ecosystem mapping products including Terrestrial Ecosystem Mapping (TEM). Several TEM datasets were available within the Metro Vancouver region (see Figure 2) and could be used to generate the SEI in these areas – Seymour, Capilano and Coquitlam watersheds, the Regional Parks network, Sumas Mountain and Bowen Island. The general process of developing the SEI from TEM is described here and more detailed accounts for the individual datasets are provided in Appendices VI, VII and IX. The crosswalk tables used to translate TEM map units to SEI map units are provided in Appendix XII.

Data Assessment and Standardization

A comprehensive analysis and summary of the data available and coding used within each TEM database was always the first step. This provided the basis for identifying and reconciling inconsistencies. The watersheds TEM data required a more significant process of reconciliation as the data was older and created through a series of projects. This process is described in detail in Appendix VI. Mostly data was found to be complete in all the TEM datasets with the exception of the Indian Landscape Unit TEM where structural stage was not mapped during the original project and is required to develop SEI. In this instance stand age data from VRI was used to help fill in this information.

TEM to SEI cross

'Crosswalk tables' were developed by Meidinger Ecological Consultants Ltd. to guide the conversion from TEM map unit to the most appropriate SEI map unit. If after this conversion the different components within a polygon crossed to identical SEI map units, and had identical structural stage and stand composition, these could be 'rolled-up'. For example:

Table 5: TEM to SEI within polygon roll-up

Original TEM components	Straight cross to SEI units	Final rolled up SEI components
60% HM (struc stg 6, stand comp C)	60% MFco	80% MFco
20% DF (struc stg 6, stand comp C)	20% MFco	20% WNsp
20% RC	20% WNsp	

Using GIS, boundaries were dissolved between polygons that after the roll up were identical to their neighbor (in SE class, subclass, structural stage, stand composition, BGC unit and disturbance codes). The step was not taken for the Regional Parks[3] dataset because a TEM level of detail in the polygons was required for later uses of the dataset.

[3] Except for Lynn Headwaters Regional Park which is a large, wilderness Park and was treated in the same way as the watersheds.

Incorporation of any classes or subclasses not mapped in the original TEM

Riparian Fringe and Gully

These two major subclasses were not usually specifically mapped in the TEM datasets used. Therefore they were not generated by our process above and had to be developed and incorporated separately. The first step for this process was to create a riparian fringe/gully GIS layer. The best available streams, river and freshwater bodies data was collated and assessed for inclusion. Sections considered "non-riparian" (ditches, culverts etc) were removed, and the resulting data was reviewed in relation to the orthophotos to clean up any odd or incorrect pieces. The final layer was then buffered (see Appendix I for buffer distances). Buffers were then reviewed in relation to orthophotos and refined based on what vegetation was actually present. Areas that did not represent potential riparian vegetation were deleted (e.g. parking lots, fields, landscaping, buildings, etc.) and any obvious areas of riparian fringe/gully that were missed initially were delineated. Within the buffer layer polygons were classified as either fringe or gully depending on whether the contour layer indicated the presence of a V-shaped gully or not.

The riparian fringe and gully polygons were then merged into the SEI layer generated from the TEM data. The result is the original larger sensitive ecosystem polygons broken up by riparian fringes and gullies. If one or more of the original components are not 'trumped' by riparian fringe/gully, these components remain in the newly delineated riparian polygons. For example:

Table 6: Component 'trumping' by riparian fringe

Original SEI polygon	Resulting polygons	
	Non-riparian polygon	Riparian polygon
60% Old Forest, coniferous (OF:co)	60% OF:co	60% RI:ff
40% Woodland, coniferous (WD:co)	40% WD:co	40% WD:co

The merging of fringe and gully polygons into the watersheds, Lynn Headwaters Regional Park, Provincial Parks and Indian LUT data was treated slightly differently to elsewhere. In these large wilderness areas where stream densities high, the merging process could result in a very large increase in the total number of polygons as one original polygon could be broken up by several fringes or gullies, resulting in as many as 10+ new polygons. In order to avoid a huge swelling in the number of polygons, multi-part polygons were allowed in these areas, i.e. all parts of the original polygon that are non-riparian were left joined, and all riparian fringe/gully polygons cut out of this original polygon were also left joined. So even though spatially they are broken up, they are still considered the same polygon (see Figure 6).

Figure 6: Example of a multipart forested polygon dissected by a multipart riparian fringe polygon

Elsewhere (all other Regional Parks, Sumas Mountain and Bowen Island) multi-part polygons were not permitted.

Old Field and Seasonally Flooded

These classes were often not identified, or were identified following a different set of criteria than that developed for this SEI. Therefore areas with TEM data were reassessed to identify Old Field and Seasonally Flooded Agricultural Fields for inclusion.

Shoreline

Shoreline areas (Bowen Island) were found to not have been classified in as much detail or using the same classes as the Metro Vancouver SEI so these areas were reassessed and further detail added where required to ensure alignment with the rest of the study area.

8. Biogeoclimatic Mapping

Development

Two sources of biogeoclimatic (BGC) mapping were available for the area:

1. Large-scale biogeoclimatic mapping is available for the areas of TEM mapping as part of the TEM map
2. The provincially-available BGC mapping. It is at a small scale even though delivered in 1:20,000 format

Although the Vegetation Resources Inventory (VRI) maps include biogeoclimatic zonation, it is only noted to the BGC zone in this area – not subzone. This is not additional mapping as the source is the provincial BGC mapping.

When these two sources were combined, there were some issues. For example,

- Parkland not mapped separately in provincial mapping for this area
- Missing bits of CWHvm1 at the south end of the watershed TEM (between CWHdm and vm2)

A down-scaled version of the provincial coverage was derived for the mountainous portion of the area by reconciling the elevation/aspect 'rules' for various areas and then mapping to TRIM contours. This ‘fixed’ the two issues noted above. In addition, in the valley bottom, the provincial coverage was reconciled with the more detailed TEM BGC coverage from the Regional Parks. This reconciled BGC map was used in the SEI. Although the changes were not field checked, the linework is consistent with the more detailed TEM BGC mapping.

In this process, it was evident that the BGC mapping in TEM is not necessarily correct for MH parkland and Alpine Tundra – it follows the physiognomy of the vegetation cover, which is not the correct way to map these units (i.e., parkland and alpine go up and down in elevation with the vegetation response to slope, aspect, exposure, etc) rather than mapping regional climates. At some point, this may have to be reconciled if provincial mapping is downscaled to a TEM scale throughout Metro Vancouver.

Appendix VIII provides details on the BGC downscaling process for Sumas Mountain including information on how field work data was used to determine where zonation should differ from both the provincial BGC mapping and the reconciled BGC map developed for this SEI.

Incorporation

As the BGC classification does not change the SEI unit or any other attributes, it was incorporated at the end. The BGC layer was intersected with the mapping to add in the BGC unit. BGC splits created more, smaller polygons (e.g., a large riparian gully starting in the high elevation and going down to the valley bottom, passing through 3 BGC zones and subzones) that although of one SEI subclass, could have differing vegetation due to the climatic zones. As a result of this process, some small polygons (less than 0.5 ha) and multi-part polygons were sometimes created.

9. Condition, Context, Size and Quality

The ‘quality’ of an SEI polygon is determined through an evaluation of condition, landscape context and size (see Appendix III). This value, along with the condition, context, and size values, are available in the SEI database. The methodology is based on the CDC / NatureServe method for assessing ecosystem ‘viability’, but has been modified for use in this inventory. The three factors contribute to the quality value in different ‘weights’, depending on the type of ecosystem.

Condition is an assessment of disturbance factors within and immediately adjacent to a polygon (see Appendix III). It was assessed during the polygon attribution by observing features in and around the polygon. Up to four disturbance factors are noted for a polygon so that the reason for the evaluation is clear (see Appendix II for the disturbance codes). Mappers attempted to include the disturbance type with the greatest influence first, followed by lesser disturbance types. In many cases, all disturbance types had an equal influence on the condition of the site. Condition presumes that disturbance within and immediately adjacent to a polygon impacts on its quality by impacting on the species composition – affecting the likelihood of invasive or exotic species. An ‘A’ to ‘E’ grade of condition is provided for each component present in the polygon (see Table 7).

Landscape context is an assessment of the land cover around a polygon. The land cover / land use around a polygon influences factors such as hydrology, movement and diversity of wildlife and other species, etc. and is a measure of degree of fragmentation. These are factors that influence the function of the ecosystem. The context assessment has been automated (see Appendix III). The result was a rating of landscape context for each polygon and these were converted to ‘A’ to ‘E’ values (see Table 7) for ease of interpretation.

Larger polygons are generally better able to function more naturally than smaller polygons of the same ecosystem. Therefore size is considered in the quality assessment and a rating was calculated for each ecosystem component within a polygon. Again, the final results were converted to an ‘A’ to ‘E’ grade (see Table 7).

For each component, the results of the condition, context and size assessments were weighted according to ecosystem type and combined. The quality scores for each component are summed to generate the final, combined quality score for the polygon which is expressed as an ‘A’ to ‘E’ grade (see Table 7).

Table 7: 'A' to 'E' grade descriptions

Grade	Descriptor
A	Excellent
B	Good
C	Moderate
D	Poor
E	Very Poor

10. Map Specifications

The final SEI map is an ArcGIS 10 file geodatabase with the following specifications.

Polygon Delineation

Polygons for new mapping were delineated at 1:5,000 or better. Those from existing map products were delineated at a range of scales from (see Table 8 below).

Table 8: Polygon delineation scales for the various mapping sources

Source of Mapping	Polygon Delineation Scale
New mapping	1: 5,000
MV Watersheds TEM	1: 15,000
MV Regional Parks TEM	1: 10,000 (or better)
Provincial Parks and Indian LUT TEM	1: 20,000
FREMP Habitat Inventory	1: 20,000 2 scales: coarse (min. polygon size of 2,500m^2) and detailed (min. polygon size of 225m^2) – but polygons were often combined for use in the SEI
Sumas Mountain TEM/SEI	1: 15,000
Howe Sound Islands TEM/SEI	1: 10,000

For new mapping, mappers were instructed to delineate polygons that were as uniform as possible in SEI Class and subclass. Simple polygons, i.e., of one entity, were encouraged, however, for both cost and pragmatic reasons, some polygons are of two or three map entities.

Polygon Attributes

The full database attribute structure is in Appendix II. Key polygon attributes include:

- Sensitive / Modified Ecosystem Class and Subclass (if applicable) for up to three components, including for each component:
  - Structural stage
  - Stand composition
  - Condition
  - Size class
- Biogeoclimatic unit
- Landscape context
- Disturbance factors
- Quality

Data Specifications

The database is an ArcGIS 10 file geodatabase, in UTM zone 10 NAD 83 (GRS1980).

Minimum Polygon Size

- Overall: 0.5 ha except:
    - Young forest – outside of Sea and Lulu Islands and the Burrard Peninsula, the minimum polygon size for young forest is 1 ha (see Figure 7)[4].
    - Old field and seasonally flooded agricultural field – a larger minimum polygon size of 2.5 ha was used.
    - In Regional Parks smaller SE and ME polygons were already mapped.

The process of incorporating splits for BGC unit created some polygons smaller than the minimum polygon sizes (see Section 8 - Biogeoclimatic mapping).

Accuracy

The mapping was designed to meet the following accuracy specifications:

- At least 98 percent for inclusion of areas as Sensitive Ecosystems, i.e., areas that should be included as sensitive ecosystems are, in fact, included.
- At least 90 percent for inclusion of areas as Modified Ecosystems – the difficulty of mapping Seasonally Flooded Agricultural Fields and Old Fields suggests that a higher accuracy would likely require very high levels of field checking.
- At least 90 percent at the class level, i.e., that the Sensitive or Modified ecosystem is in the correct class.
- At least 80 percent at subclass level, i.e., that the ecosystem is in the correct subclass.

[4] Young forest patches of < 5 ha are not considered an ME but were mapped as useful additional information

Figure 7: Young Forest minimum polygon size

Fieldwork / Survey Intensity

During the field component of the project (Phase 5), the goal was to verify the linework and associated labels for as many SEI polygons as possible to meet the accuracy levels stated above.

Field surveys were based on location, potential sensitivity, access, and funding. Information gathered during the field survey included, at a minimum: SEI Class, subclass, structural stage, structural stage modifier and stand composition, where applicable.

For new mapping, 20% of polygons were checked in the field. Existing map products used as inputs to the SEI were field sampled to varying levels, provided below in Table 9.

Table 9: Field sampling intensities for the various mapping sources

Source of Mapping	Field Sampling Intensity
New mapping	20%
MV Watersheds TEM	35%
MV Regional Parks TEM	35%
Provincial Parks and Indian LUT TEM	10%
FREMP Habitat Inventory	25%
Sumas Mountain TEM/SEI	28%
Howe Sound Islands TEM/SEI	17%

Quality Assurance

Quality assurance (QA) was conducted throughout the mapping exercise. Appendix X outlines QA procedures that were followed. Considerable QA was conducted early on with each mapping phase as it was considered to be most effective and efficient to deal with issues and come up with solutions early in the mapping. The contractors involved in the mapping also conducted internal Quality Control.

At the completion of the mapping[5], an independent QA was conducted using a randomly selected array of polygons. The report of this assessment is in Appendix XI. In summary, the following results were obtained from a sample of 706 polygons:

- Class was mapped correctly 91% percent of the time
- Subclass was mapped correctly, when applicable, 86% of the time

Subclass assessment values are shown in Table XI-6 of Appendix XI.

Based on a sample of 650 polygons, condition was evaluated correctly 87% of the time, and received an acceptability score of 93%.

[5] 2012 and revised Nov 2013 to include Bowen Island and Sumas Mountain mapping

11. Limitations

Users of the SEI must take into account certain limitations inherent with this type of dataset and consider how they may impact their intended use.

Although every attempt has been made to create an accurate and consistent map product, there may be occasions where the information recorded in the dataset differs from the actual conditions on site. This may be due to human error, difficulties in distinguishing between similar classes/subclasses, or seasonal interpretation issues due to when the imagery was captured. The quality assurance report highlights which classes/subclasses this is more likely to have occurred. Changes may have also occurred to the site after the date of the imagery or field work and so will not be reflected in the mapping.

The dataset is considered accurate at the scale it was delineated at, so 1:5,000 for all new mapping, and 1:10,000 to 1:20,000 for mapping originating from existing mapping products such as TEM.. These are the scales the dataset should be viewed at. Use at further enlarged scales risks making incorrect assumptions with the data. The mappers may have zoomed in closer to check identification calls but this cannot be assumed.

The SEI is intended to flag the existence of important ecological features and provide initial information about them. It does not replace the need for on-site assessments to support any decisions taken for a particular area.

12. SE / ME Class Distribution & Summary Statistics

Almost 190,000 ha are identified as supporting 'sensitive' or 'modified' ecosystems, translating to 52% of the Project Area. The vast majority of these ecosystems are sensitive (43%) as opposed to modified (9%) (Figure 8). These ecosystems are concentrated within the northern watersheds and rugged mountainous areas. If the focus is placed on the 'Regional Core' - the more urbanized southern part of the region that excludes the large parks and estuaries under Provincial management, watersheds and other higher elevation areas – only 15%is considered 'sensitive' and 7% is made up of 'modified' ecosystems.

The variation of quality within these sites follows a similar pattern (Figure 9). For the Project Area, 84% of these sites are of a grade 'B' or 'A' (good to excellent quality). This amounts to over 146,000 ha of sensitive lands having good or excellent quality. Another 15,000 ha is grade 'C' (moderate quality), with 13,000 ha having rating of grade 'D' or 'E' (poor or very poor quality). Similar to the distribution of SEI polygons, grade 'A' and 'B' quality sites dominate the northern part of the region and intertidal areas. Urbanized areas generally support lower quality sites. As a result, ecosystem types that tend to occur at the more developed lower elevations, such as wetlands and the 'Modified Ecosystems' tend to have lower quality grades ('C' or below) as much of their condition and context has been compromised through more intensive human activities.

These figures are summarized in Table 10 below and Figures 8 and 9 that follow. The total area of SE and ME sites in the Project Area are displayed by class and subclass are shown in Tables 11-15.

The area statistics and maps are an overview of limited aspects of the mapping. Many other analyses are possible and could be of interest to various users.

Table 10: Amount and Distribution of Ecosystems within the SEI Project Area

	Project Area, in ha	Metro Vancouver Region, in ha	Regional Core, in ha
Total Area	366,900 (100%)	325,800 (100%)	170,100 (100%)
Sensitive Ecosystems	155,900 (43%)	150,500 (46%)	25,100 (15%)
Modified Ecosystems	33,500 (9%)	30,200 (9%)	12,000 (7%)
Sensitive and Modified Ecosystems	189,400 (52%)	180,700 (56%)	37,000 (22%)
High Quality (A or B)[1]	146,600 (84%)	143,500 (86%)	15,200 (42%)
Lower Quality (C, D or E)[1]	28,100 (16%)	23,200 (14%)	21,000 (58%)

[1] Not all ecosystems assessed for quality

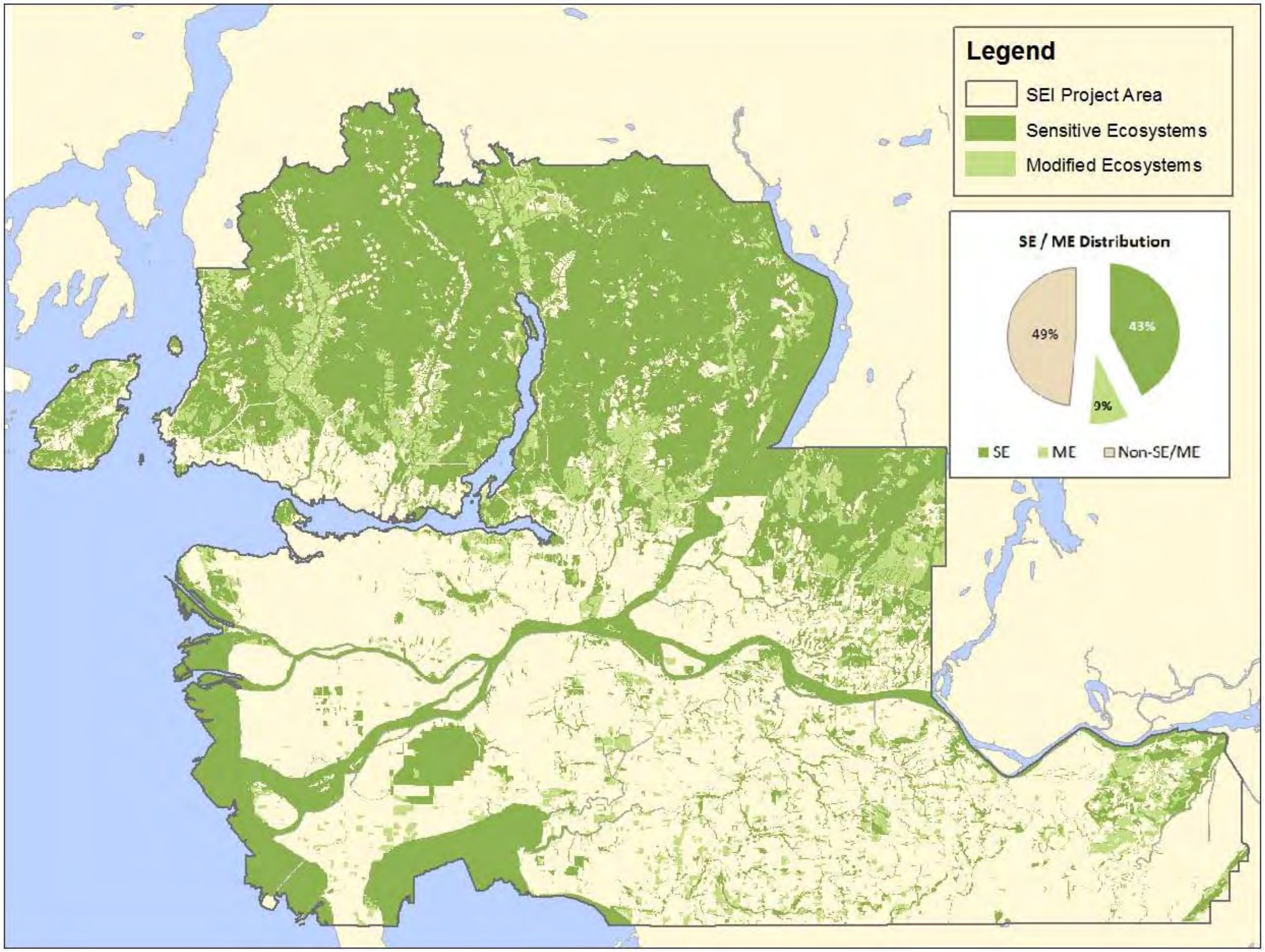


Figure 8: Distribution of Sensitive and Modified Ecosystems throughout the Project Area

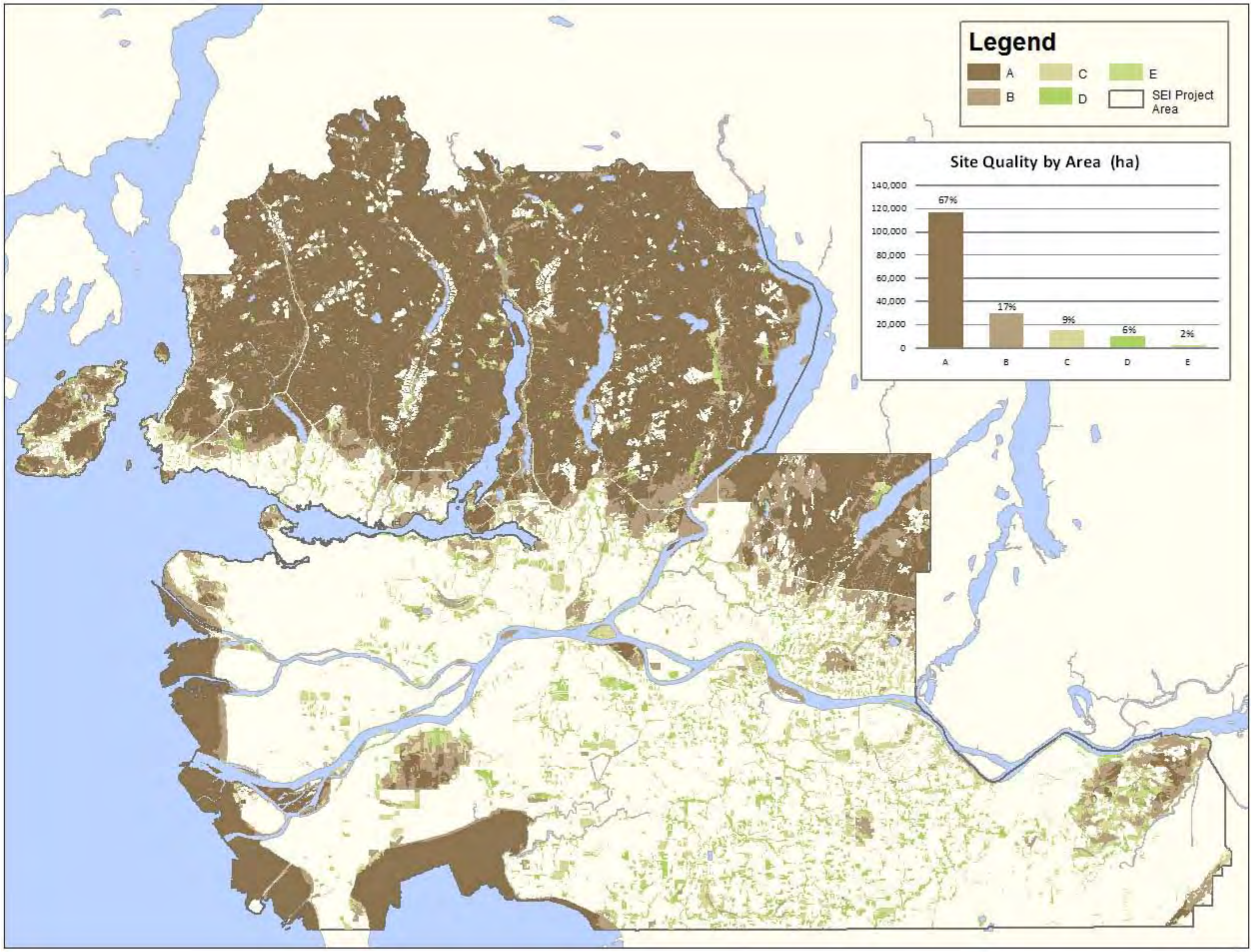


Figure 9: Quality Ratings of Sensitive and Modified Ecosystems throughout the Project Area

Table 11: Total area of Terrestrial, Wetland, Intertidal and Estuarine Sensitive Ecosystems by class and subclass

Sensitive Ecosystem Class / Subclass			
Terrestrial, Wetland, Intertidal and Estuarine Sensitive Ecosystems	**AREA (ha)** Project Area	MV Region	Regional Core
Alpine (AP)	**14,521**	**14,521**	**0**
avalanche tracks (av)	4,244	4,244	0
dwarf shrub (ds)	1,579	1,579	0
herbaceous (hb)	51	51	0
krummholz (kr)	515	515	0
parkland forest (pf)	8,114	8,114	0
tall shrub (ts)	17	17	0
Estuarine	**8,368**	**8,368**	**1,092**
meadow (md)	285	285	144
marsh (ms)	2,118	2,118	771
swamp (sp)	73	73	70
tidal flat (tf)	5,893	5,893	107
Herbaceous (HB)	**115**	**114**	**87**
coastal herbaceous (cs)	100	100	79
herbaceous (hb)	4	4	3
vegetated shoreline (vs)	11	11	6
Intertidal & Shallow Sub-Tidal (IT)	**7,970**	**7,969**	**136**
beaches (bs)	232	232	119
eelgrass beds (el)	3,816	3,816	5
mudflats (mf)	3,922	3,922	11
Mature Forest (MF)	**23,778**	**22,177**	**7,658**
coniferous (co)	19,517	19,372	5,665
mixed (mx)	4,260	2,805	1,992
Old Forest (OF)	**34,388**	**34,379**	**126**
coniferous (co)	33,683	33,680	123
mixed (mx)	10	4	3
very old (vo)	695	695	0
Riparian (RI)	**24,579**	**22,503**	**7,695**
canyon (ca)	2	2	0
fringe (ff)	16,095	15,264	5,072
high bench (fh)	1,007	999	124
low bench (fl)	480	433	268
medium bench (fm)	1,139	926	787
gully (gu)	5,855	4,879	1,445
Sparsely Vegetated (SV)	**9,286**	**9,235**	**87**
cliff (cl)	162	118	2
rock outcrop (ro)	4,370	4,366	59
sand dune (sd)	27	27	25
talus (ta)	4,728	4,725	0
Wetland (WN)	**10,297**	**9,680**	**6,809**
bog (bg)	3,034	3,034	2,914
fen (fn)	182	182	46
marsh (ms)	1,633	1,562	446
shallow water (sw)	4,478	3,994	2,964
swamp (sp)	960	899	429
wet meadow (wm)	10	10	10
Woodland (WD)	**5,689**	**5,624**	**316**
coniferous (co)	5,395	5,392	149
mixed (mx)	293	232	167
TOTAL	**138,989**	**134,572**	**24,005**

Table 12: Total area of Aquatic Sensitive Ecosystems by class and subclass

Sensitive Ecosystem Class / Subclass			
Aquatic Sensitive Ecosystems	AREA (ha)		
	Project Area	MV Region	Regional Core
Freshwater (FW)	**7,188**	**7,095**	**403**
lakes (la)	6,531	6,519	235
ponds (pd)	656	577	169
Riparian (RI)	**9,757**	**8,793**	**665**
mudflats (mf)	289	263	105
river (ri)	9,468	8,530	560
TOTAL	**16,945**	**15,889**	**1,068**

Table 13: Total area of Terrestrial Modified Ecosystems by class and subclass

Modified Ecosystem Class / Subclass			
Terrestrial Modified Ecosystems	AREA (ha)		
	Project Area	MV Region	Regional Core
Mature Forest (MF)	**5,127**	**4,376**	**2,172**
broadleaf (bd)	1,113	632	565
coniferous (co)	3,107	3,033	1,030
mixed (mx)	908	711	577
Old Field (OD)	**2,993**	**2,774**	**2,776**
Seasonally Flooded Agr Fields (FS)	**1,008**	**927**	**927**
Young Forest (YF)	**24,187**	**21,970**	**5,910**
broadleaf (bd)	4,100	3,052	2,683
coniferous (co)	17,003	16,829	1,653
mixed (mx)	3,085	2,089	1,575
TOTAL	**33,316**	**30,046**	**11,785**

Table 14: Total area of Aquatic Modified Ecosystems by class and subclass

Modified Ecosystem Class / Subclass			
	AREA (ha)		
Aquatic Modified Ecosystems	Project Area	MV Region	Regional Core
Freshwater (FW)			
reservoirs (rs)	161	148	147
TOTAL	**161**	**148**	**147**

Table 15: Summary areas of Sensitive and Modified Ecosystems

SUMMARIES			
	AREA (ha)		
	Project Area	MV Region	Regional Core
Terrestrial, Wetland, Intertidal and Estuarine Ecosystems			
Sensitive	138,989	134,572	24,005
Modified	33,316	30,046	11,785
TOTAL	**172,306**	**164,618**	**35,790**
Aquatic Ecosystems			
Sensitive	16,945	15,889	1,068
Modified	161	148	147
TOTAL	**17,105**	**16,037**	**1,215**
Sensitive Ecosystems	155,934	150,460	25,073
Modified Ecosystems	33,477	30,194	11,932
INVENTORY TOTALS	**189,411**	**180,655**	**37,005**

13. Improvements & Future Work

A number of recommendations are made for future work and improvements to the existing dataset:

Maintaining the dataset

If this dataset is to continue to be a useful resource for Metro Vancouver and others it must be kept current through regular or semi-regular updates. We recommend that either a portion of the SEI is reviewed and updated each year, or a complete review is done every 5 years.

Cleaning up from the BGC merge

The merging process with the downscaled biogeoclimatic layer created a number of quite small polygons along the boundary areas, and many multipart polygons. These should be assessed and cleaned up. This only applies to areas of new mapping, not that originating from TEM.

Very old forest

Data on the location of very old forests was only available for one part of the study area (the Lower Seymour Conservation Reserve) so this subclass is only mapped there. An assessment should take place as to whether it can be feasibly mapped elsewhere in the study area. If it cannot, it may not be worth keeping this subclass as we know it is significantly under mapped.

Eelgrass

Photo-interpretation alone cannot be relied upon to identify and map this subclass given its location in the intertidal and sub-tidal zone. Fieldwork including the use of boats is necessary. Thanks to work done by the FREMP Habitat Inventory (2006) and the Islands Trust (for the Howe Sound Islands, to be completed 2013) we are confident that the most significant areas of eelgrass in the region are mapped and included in the inventory. However due to the challenges in identifying this subclass we cannot be sure there are not other small areas remaining. It is not a recommendation at this time to complete this potential gap because surveying costs would be high and the expected returns (in terms of identified areas) small.

Implement recommendations in QA report

Several recommendations were made that if acted upon could improve the mapping further (see Appendix XI).

Further field work

Additional field work particularly focusing on those classes and subclasses that received lower scores in the QA assessment would also improve the mapping.

Suggested changes to SEI classification

The Herbaceous and Sparsely Vegetated classes were found to be somewhat problematic during this project. We propose that changes be made to the SEI classification that parallel the 'Realms' in the Biogeoclimatic Classification for non-forested ecosystems report. The realms focus on the ecological drivers and categorizes non-forested ecosystems into classes such as: Grassland (excessively hot and dry), Rock (lack of soils or unstable), Alpine or Subalpine (excessively snowy/cold), Wetland (overly wet soils), Estuarine (tidal flooding, brackish), Avalanche (repeated snow avalanching), Flood (repeated, prolonged flooding), Beach (salt water spray and flooding), etc. – as some SEI classes already do (e.g. Wetlands, Estuarine, Alpine).

We propose eliminating the Herbaceous Class and instead having a new 'Beachland Class' which will include the two coastal subclasses (currently in Herbaceous), dunes and spits (currently in Sparsely Vegetated), and Intertidal Beaches and Shoreline (as they are often mixed with these others) as follows:

Beachland Class (BL): Beachland: dunes, spits, and Headlands: coastal headlands

- BL:sd - sand dunes (currently SV:sd)
- BL:sp - spits (currently SV:sp)
- BL:cs - coastal herbaceous (currently HB:cs)
- BL:vs - vegetated shoreline (currently HB:vs)
- BL:bs – beaches and shorelines (currently IT:bs)

This leaves 3 subclasses from the Sparsely Vegetated class that could be better described as a new Rock Class (RO):

- RO:ro - Rock outcrop (currently SV:ro)
- RO:ta - Talus (currently SV:ta)
- RO:cl - Cliff (currently SV:cl)

These are 1:1 changes so could be easily made.

14. References

Churchill, J. 2010. Howe Sound Terrestrial Ecosystem Mapping (TEM) to Sensitive Ecosystem Mapping Standards. Report to Islands Trust by Madrone Environmental Services Ltd. 29 pp.

Clark, J. and Meidinger, D. 2011. Metro Vancouver Sensitive Ecosystem Inventory Mapping Procedures. 42 pp.

Durand, R. and Wilkinson, K. 2010. Sensitive Ecosystems Inventory Mapping of Sumas Mountain (Draft). Report to Fraser Valley Conservancy and City of Abbotsford. 122 pp.

Fuller, R. and Forest Information Systems. 2000. Ecosystem Mapping of the Indian Arm and Mount Seymour Provincial Parks. Report for BC Parks. 120 pp.

Green, R. 2010. Alignment and Adjustment of Metro Vancouver's Existing TEM datasets. Report to Metro Vancouver by *B.A. Blackwell & Associates Ltd*. 44 pp.

Green, R. 2013. Sumas Mountain Ecological Data Complication. Report to Metro Vancouver by B.A. Blackwell & Associates Ltd. 9 pp.

Madrone Environmental Services Ltd. 2009. Terrestrial Ecosystem Mapping (TEM) for Howe Sound Islands – Bowen, Gambier, Keats, Anvil and Other Associated Islands

Ministry of Environment. 2006. Standard for Mapping Ecosystems at Risk in British Columbia – An Approach to Mapping Ecosystems at Risk and Other Sensitive Ecosystems. 98 pp.

Neilson-Welch, L and Smith, L. 2001. Saline water intrusion adjacent to the Fraser River, Richmond, British Columbia. Can.Geotech. J. 38: 67-82.

Timberline. 2006. Terrestrial Ecosystem Mapping of the Indian Landscape Unit (Soo Timber Supply Area. 26 pp.

Tripp, T. and Churchill, J. 2012. Regional Sensitive Ecosystem Inventory (SEI) for the Metro Vancouver and Abbotsford Area. Report to Metro Vancouver by Madrone Environmental Consultants. 46 pp.

15. Appendices

Appendix I: Guidelines for Mapping the Riparian Fringe Sensitive Ecosystem

The riparian fringe (RI:ff) sensitive ecosystem is intended to designate natural and semi-natural plant communities 'fringing' rivers, streams, lakes and ponds, where there is:

- no floodplain landform (high bench, medium bench, low bench)
- no gully or canyon
- regular subsurface irrigation of the rooting zone
- rarely flooding

Generally, the vegetation will indicate that there is subsurface irrigation – tall shrub and broadleaf tree communities are common in fringe ecosystems, and the vegetation is generally distinct from adjacent uplands or wetlands.

However, the Riparian fringe class is also intended to include vegetation that fringes streams, rivers, lakes or ponds that does not meet the criteria above, in other words, the vegetation may not be distinct and the soils may not be subject to subsurface irrigation. The reason these are included in this class is that all vegetation adjacent to freshwater is of greater importance as habitat.

This latter situation creates mapping issues in that vegetation needs to be separated into a riparian ecosystem where it may not be evident where to draw a boundary. The following table and key are intended to help with this process.

Table I-1 provides a detailed breakdown of fringe width in relation to riparian and freshwater characteristics.

Table I-1: Riparian and Freshwater ecosystem characteristics and their influence on fringe width

Overall gradient < 35% (or known fish-bearing stream)		
Stream Class	**Stream Width (m)**	**Minimum Fringe Width**
1	> 20	50
2	5 – 20	30
3	1.5 – 5	20
4	< 1.5	20
Overall gradient > 35% (or known non fish-bearing stream)		
5	> 3	20
6	<= 3	0
Freshwater subclass		
Lake		50
Pond		20
Reservoir > 8 ha		50
Reservoir < 8 ha		20

If stream class information is not available, single-lined streams have a minimum fringe width of 20m and double-lined streams, 50m.

KEY: Riparian fringe: adjacent to lakes, ponds, streams and rivers – ecosystem does not fit any of the other riparian sensitive ecosystem subclasses:

1. Cultural vegetation or non-vegetated …… do not map RI:ff
1. Natural or semi-natural vegetation.
    2. Distinct riparian vegetation adjacent to freshwater … map RI:ff to vegetation boundary that delineates riparian fringe.
    2. Riparian vegetation not distinct.
        3. Moister soils due to sub-irrigation from freshwater source is evident … map RI:ff to edge of moister soils.
        3. Moister soils either not evident or appear to be a wetland rather than riparian.
            4. If wetland, map as WN and append appropriate subclass.
            4. If otherwise, map RI:ff as follows:
                5. Vegetation encompasses two sensitive ecosystems, or riparian and an 'modified ecosystem'.
                    6. Vegetation band wide – map as two polygons. Map the RI:ff for a reasonable width, based on the width and gradient of the stream (Table I-1) and map the rest in the appropriate Class/Subclass.
                    6. Vegetation band narrow – map as a complex.
                5. Vegetation beyond the riparian fringe is not in an SEI or ME Class/Subclass.
                    6. Vegetation band wide – map RI:ff based on the width and gradient of the stream (Table I-1) but erring towards inclusion of adjacent vegetation, if sensible to do so.
                    6. Vegetation band narrow – map as RI:ff.

Differentiating gully vs. fringe ecosystems can be challenging in the steeper terrain of the north shore. Fringes can be differentiated from gullies by the 'depth' and shape of the contours, with gully contours generally appearing V-shaped.

Appendix II: SEI Data Model[6]

Field Name	Alias	Description	Type	Length	Light
SourceName	Source Name	Field to identify the agency or organization where the data originates	Text	12	
SourceDate	Source Date	Date the data was sourced or created	Date	12	
Jursidiction	Jurisdiction	Internal MV field. MV department the data is associated with	Text	20	
Location	Location	Used only when polygon originates from MV TEM. Internal MV field. Specific name of park or watershed	Text	40	
Classification	Classification	Used only when polygon originates from MV TEM. Internal MV field. Type of ecological or administrative unit	Text	30	
TEM_PolyNbr	TEM Poly No.	Used only when polygon originates from TEM. Identifying number for the related polygon in the TEM dataset	Long Int		
SEI_PolyNbr	SEI Poly No.	Polygon Number - An identifying number for polygon being mapped	Long Int		Y
SmplType	Sample Type	Field check of polygon - describes the level of field checking done on the current polygon	Text	2	Y
PlotNo	Plot No.	Field Plot number	Text	10	
ProjType	Project Type	Project Type - Indicates the type of mapping project	Text	9	
Proj_ID	Project ID	Project Identification - A unique identifier for each project	Text	5	
EcoMap	Eco Mapper	First initial and surname of mapper	Text	15	
EcoSec	Ecosection	Ecosection Label - Component of the hierarchical Ecoregion Classification system	Text	3	
BGC_Unit	BGC Unit	Combination of BGC Zone/subzone/variant	Text	7	Y
SEDec_1	Ecosystem 1 Decile	Ecosystem Decile of Ecosystem Component 1 - Proportion of the polygon covered by ecosystem component 1, in deciles.	Short Int		Y
SECl_1	Ecosystem 1 Class	Sensitive Ecosystem Class of Ecosystem Component 1	Text	2	Y
SEsubcl_1	Ecosystem 1 Subclass	Sensitive Ecosystem Subclass of Ecosystem Component 1	Text	2	Y
Strct_S1	Stuc Stg, Ecosystem 1	Structural Stage of Ecosystem Component 1	Text	2	Y
StrctMod_1	Struc Stg Mod, Ecosystem 1	Structural Stage Substage or Modifier of Ecosystem Component 1	Text	2	Y

[6] Two versions of the database are available. The complete version and a simplified, 'light' version. The fields provided in the light version are indicated in the far right hand column of the table.

Field Name	Alias	Description	Type	Length	Light
Stand_A1	Stand Comp, Ecosystem 1	Stand Composition Modifier of Ecosystem Component 1 - Differentiates forest stands based on coniferous, broadleaf and mixed stand composition	Text	1	Y
SEDec_2	Ecosystem 2 Decile	Ecosystem Decile of Ecosystem Component 2 - Proportion of the polygon covered by ecosystem component 2, in deciles.	Short Int		Y
SECl_2	Ecosystem 2 Class	Sensitive Ecosystem Class of Ecosystem Component 2	Text	2	Y
SEsubcl_2	Ecosystem 2 Subclass	Sensitive Ecosystem Subclass of Ecosystem Component 2	Text	2	Y
Strct_S2	Struc Stg, Ecosystem 2	Structural Stage of Ecosystem Component 2	Text	2	Y
StrctMod_2	Struc Stg, Ecosystem 2	Structural Stage Substage or Modifier of Ecosystem Component 2	Text	2	Y
Stand_A2	Stand Comp, Ecosystem 2	Stand Composition Modifier of Ecosystem Component 2 - Differentiates forest stands based on coniferous, broadleaf and mixed stand composition	Text	1	Y
SEDec_3	Ecosystem 3 Decile	Ecosystem Decile of Ecosystem Component 3 - Proportion of the polygon covered by ecosystem component 3, in deciles.	Short Int		Y
SECl_3	Ecosystem 3 Class	Sensitive Ecosystem Class of Ecosystem Component 3	Text	2	Y
SEsubcl_3	Ecosystem 3 Subclass	Sensitive Ecosystem Subclass of Ecosystem Component 3	Text	2	Y
Strct_S3	Struc Stg, Ecosystem 3	Structural Stage of Ecosystem Component 3	Text	2	Y
StrctMod_3	Struc Stg, Ecosystem 3	Structural Stage Substage or Modifier of Ecosystem Component 3	Text	2	Y
Stand_A3	Stand Comp, Ecosystem 3	Stand Composition Modifier of Ecosystem Component 3 - Differentiates forest stands based on coniferous, broadleaf and mixed stand composition	Text	1	Y
Microsite	Microsite	Microsite - ecosystem representing < 10% of the polygon	Text	4	
Condition_SE1	Condition, Ecosystem 1	Condition assessment of the first component present in the polygon. A (best) to E (worst)	Text	1	Y
ConditionNo_SE1	Condition (Num), Ecosystem 1	Condition assessment for component 1 expressed as a number. 5 (best) to 1 (worst)	Short Int		
Condition_SE2	Condition, Ecosystem 2	Condition assessment of the second component present in the polygon. A (best) to E (worst)	Text	1	Y

Field Name	Alias	Description	Type	Length	Light
ConditionNo_SE2	Condition (Num), Ecosystem 2	Condition assessment for component 2 expressed as a number. 5 (best) to 1 (worst)	Short Int		
Condition_SE3	Condition, Ecosystem 3	Condition assessment of the third component present in the polygon. A (best) to E (worst)	Text	1	Y
ConditionNo_SE3	Condition (Num), Ecosystem 3	Condition assessment for component 3 expressed as a number. 5 (best) to 1 (worst)	Short Int		
Disturb_1	Disturbance (1^{st})	Disturbance (of greatest importance)	Text	7	Y
Disturb_2	Disturbance (2^{nd})	Disturbance	Text	7	Y
Disturb_3	Disturbance (3^{rd})	Disturbance	Text	7	Y
Disturb_4	Disturbance (4^{th})	Disturbance (of least importance)	Text	7	Y
Context	Context	Landscape context assessment for the entire polygon. A (best) to E (worst)	Text	1	Y
ContextNo	Context (Num)	Landscape context assessment for the polygon expressed as a number. 5 (best) to 1 (worst)	Short Int		
WSize_SE1	Weighted Size, Ecosystem 1	Area of polygon covered by ecosystem component 1. Only completed for components > 2 deciles. This is an intermediate field used to calculate the Size grade only.	Double		
SumWSize_SE1	Sum Weighted Size, Ecosystem 1	Summed area of ecosystem occurrence. The weighted size of the component within the current polygon, combined with the weighted size of adjacent polygon components of the same sensitive ecosystem class/subclass (Only applicable to Regional Parks polygons. Elsewhere, SumWSize_SE1 is the same as WSize_SE1). This is an intermediate field used to calculate the Size grade only.	Double		
Size_SE1	Size, Ecosystem 1	Size grade for component 1. A (best) to E (worst). Based on SumWSize_SE1	Text	1	Y
SizeNo_SE1	Size (Num), Ecosystem 1	Size grade for component 1 expressed as a number. Based on SumWSize_SE1	Short Int		
WSize_SE2	Weighted Size, Ecosystem 2	Area of polygon covered by ecosystem component 2. Only completed for components > 2 deciles. This is an intermediate field used to calculate the Size grade only..	Double		
SumWSize_SE2	Sum Weighted Size, Ecosystem 2	Summed area of ecosystem occurrence. The weighted size of the component within the current polygon, combined with the weighted size of adjacent polygon components of the same sensitive ecosystem class/subclass (Only applicable to Regional Parks polygons. Elsewhere, SumWSize_SE2 is the same as WSize_SE2). This is an intermediate field used to calculate the Size grade only.	Double		

Field Name	Alias	Description	Type	Length	Light
Size_SE2	Size, Ecosystem 2	Size grade for component 2. A (best) to E (worst). Based on SumWSize_SE2	Text	1	Y
SizeNo_SE2	Size (Num), Ecosystem 2	Size grade for component 2 expressed as a number. Based on SumWSize_SE2	Short Int		
WSize_SE3	Weighted Size, Ecosystem 3	Area of polygon covered by ecosystem component 3. Only completed for components > 2 deciles. This is an intermediate field used to calculate the Size grade only.	Double		
SumWSize_SE3	Sum Weighted Size, Ecosystem 3	Summed area of ecosystem occurrence. The weighted size of the component within the current polygon, combined with the weighted size of adjacent polygon components of the same sensitive ecosystem class/subclass (Only applicable to Regional Parks polygons. Elsewhere, SumWSize_SE3 is the same as WSize_SE3). This is an intermediate field used to calculate the Size grade only.	Double		
Size_SE3	Size, Ecosystem 3	Size grade for component 3. A (best) to E (worst). Based on SumWSize_SE3	Text	1	Y
SizeNo_SE3	Size (Num), Ecosystem 3	Size grade for component 3 expressed as a number. Based on SumWSize_SE3	Short Int		
QualityNo_SE1	Quality (Num), Ecosystem 1	Quality assessment for component 1, combination of condition, landscape context and size ratings	Double		
WQuality_SE1	Weighted Quality (Num), Ecosystem 1	Quality rating (QualityNo_SE1) weighted by the proportion of the polygon covered by component 1	Double		
QualityNo_SE2	Quality (Num), Ecosystem 2	Quality assessment for component 2, combination of condition, landscape context and size ratings	Double		
WQuality_SE2	Weighted Quality (Num), Ecosystem 2	Quality rating (QualityNo_SE2) weighted by the proportion of the polygon covered by component 2	Double		
QualityNo_SE3	Quality (Num), Ecosystem 3	Quality assessment for component 3, combination of condition, landscape context and size ratings	Double		
WQuality_SE3	Weighted Quality (Num), Ecosystem 3	Quality rating (QualityNo_SE3) weighted by the proportion of the polygon covered by component 3	Double		
WCombQuality	Weighted Quality (Num), all	Total quality rating for the polygon, combining the weighted quality ratings for each component (WQuality_SE1, WQuality_SE2, WQuality_SE3)	Double		
Quality	Quality	Final quality grade for the polygon (based on WCombQuality) expressed as A (best) to E (worst)	Text	1	Y
QualityNo	Quality (Num)	Final quality grade for the polygon (based on WCombQuality) expressed as a number – 5 (best) to 1 (worst)	Short Int		

Field Name	Alias	Description	Type	Length	Light
SE_ME_1	SE/ME, Ecosystem 1	Status of component 1 as a sensitive, modified or non-sensitive ecosystem	Text	3	Y
SE_ME_2	SE/ME, Ecosystem 2	Status of component 2 as a sensitive, modified or non-sensitive ecosystem	Text	3	Y
SE_ME_3	SE/ME, Ecosystem 3	Status of component 3 as a sensitive, modified or non-sensitive ecosystem	Text		Y
WSize_SE1_BASIC	Area, Ecosystem 1	Area of polygon covered by ecosystem component 1	Double		Y
WSize_SE2_BASIC	Area, Ecosystem 2	Area of polygon covered by ecosystem component 2	Double		Y
WSize_SE3_BASIC	Area, Ecosystem 3	Area of polygon covered by ecosystem component 3	Double		Y
PolyCom	Polygon Comment	Polygon comments	Text	250	
AmendDate	Amend Date	Date of amendment	Date		
AmendComment	Amend Comment	Brief details of the amendment made	Text	50	
AmendMapper	Amend Mapper	First initial and surname of the mapper who made the amendment	Text	15	
Comp1Lgnd	Comp 1 Legend	Class and type (sensitive, modified or non-sensitive) of Ecosystem Component 1. Labeling field.	Text	50	
Comp2Lgnd	Comp 2 Legend	Class and type (sensitive, modified or non-sensitive) of Ecosystem Component 2. Labeling field.	Text	50	
Comp3Lgnd	Comp 3 Legend	Class and type (sensitive, modified or non-sensitive) of Ecosystem Component 3. Labeling field.	Text	50	

Field Descriptions[7]

SourceName

Code	Description
Acres Int.	Acres International Consortium (GVRD Ecological Inventory)
Blackwell	B.A. Blackwell and Associates Ltd.
Diamondhead	Diamond Head Consulting Ltd.
FIS	FIS (GVRD Ecological Inventory)
Hemmera	Hemmera
MV	Metro Vancouver
Madrone	Madrone Environmental Services
Raincoast	Raincoast Applied Ecology
Timberline	Timberline Natural Resource Group

Jurisdiction

Code	Description
O&M	Metro Vancouver Operations and Maintenance Dept.
Parks	Metro Vancouver Regional Parks Dept.
Non MV	Non Metro Vancouver lands

SmplType[8]

Code	Description
A	Aircall – data recorded from low-flying helicopter
D	Desktop verified - photo interpretation checked using another imagery source
E	Full plot – data recorded on FS882 forms from the ground
G	Ground inspection plot – data recorded on GIF cards from the ground
P	Photo interpretation – data interpreted from ortho/air photo
V	Visual inspection – abridged data recorded on plot card
VF	Visually inspected by FREMP

ProjType

Code	Description
NEM	Terrestrial ecosystem mapping without terrain
NEMNSS	Terrestrial ecosystem mapping with no bioterrain or structural stage
NEMSEI	Terrestrial ecosystem mapping (without bioterrain) and sensitive ecosystem inventory
SEI	Sensitive ecosystem inventory
TEM	Terrestrial ecosystem mapping

[7] Self explanatory fields not included

[8] Not always available for records originating from TEM due to merging process (the Watersheds and Lynn Headwaters Regional Park). Refer to original TEM datasets for exact locations of field checked polygons

EcoSec

Code	Description
FRL	Fraser Lowlands
GEL	Georgia Lowland
NWC	Northwestern Cascade Ranges
SOG	Strait of Georgia
SPR	Southern Pacific Ranges

BGC_Unit

Code	Description
CDFmm	Moist Maritime Coastal Douglas Fir Subzone
CWHdm	Dry Maritime Coastal Western Hemlock Variant
CWHxm1	Eastern Very Dry Maritime Coastal Western Hemlock Variant
CWHvm1	Submontane Very Wet Maritime CWH Variant
CWHvm2	Montane Very Wet Maritime CWH Variant
MHmm1	Windward Moist Maritime MH Variant
MHmmp	Parkland Moist Maritime MH Variant
CMA	Coastal Mountain-heather Alpine

SECl_1-3

Code	Description
AP	Alpine
ES	Estuarine
FS	Seasonally Flooded Agricultural Field
FW	Freshwater
HB	Herbaceous
IT	Intertidal
MF	Mature Forest
OD	Old Field
OF	Old Forest
RI	Riparian
SV	Sparsely Vegetated
WD	Woodland
WN	Wetland
XX	Non SE or ME
YF	Young Forest
YS	Young Forest (small)[9]

[9] Young Forest patches of < 5 ha are not considered an SE or ME

SEsubcl_1-3

Code	Description
av	avalanche tracks
bd	broadleaf
bg	bog
bs	beaches and rocky shorelines
ca	canyon
cl	cliff
co	coniferous
cs	coastal herbaceous
ds	dwarf shrub
el	eelgrass
ff	fringe
fh	high bench floodplain
fl	low bench floodplain
fm	medium bench floodplain
fn	fen
gu	gully
hb	herbaceous
kr	krummholz
la	lake
md	meadow
mf	mudflat
ms	marsh
mx	mixed
pd	pond
pf	parkland forest
ri	river
ro	rocky outcrop
rs	reservoir
sd	sand dune
sh	shrub
sp	swamp
st	spit
sw	shallow water
ta	talus
tf	tidal flat
ts	tall shrub
vo	very old
vs	vegetated shoreline
wm	wet meadow
xx	non SE or ME

Strct_S1-3 and **StrctMod_1-3** (see below for further details on structural stage definitions)

Code - Strct	Code - StrctMod	Description
1	a	Sparse/cryptogam: Sparse
1	b	Sparse/cryptogam: Bryoid
1	c	Sparse/cryptogam: Lichen
2	a	Herb: Forb-dominated
2	b	Herb: Graminoid-dominated
2	c	Herb: Aquatic
2	d	Herb: Dwarf shrub
3	a	Shrub/Herb: Low shrub
3	b	Shrub/Herb: Tall shrub
4		Pole/Sapling
5		Young Forest
6		Mature Forest
7	a	Old Forest: old
7	b	Old Forest: Very old
	99	Attribute not assessed (from original TEM)

Stand_A1-3

Code	Description
B	Broadleaf - > 75% of total tree cover is broadleaf
C	Coniferous - > 75% of total tree cover is coniferous
M	Mixed - Neither coniferous or broadleaf is > 75% of total tree cover

Disturb_1-4
(see *Field Manual for Describing Terrestrial Ecosystems* for additional codes).
Adjacent disturbance assessed within 15m of polygon

Code	Description
A	Atmospheric related effects
Aesn	Heavy snow
Aw	Windthrow
B	Biotic (plant and animal) effects
Bb	Beaver tree cutting
Bd	Grazing
Bv	Aggressive vegetation
Bvbk	Aggressive vegetation - blackberry
Bvbs	Aggressive vegetation – Birch salal woodland
Bvrcg	Aggressive vegetation – reed canary grass
Dc	Disposal – chemical spill or disposal
Dg	Domestic garbage disposal
Fc	Overstorey crown fire
Fh	Fire - harvest related
Fn	Fire confirmed - natural
Fs	Fire suspected
G	Gap replacement
H	Harvesting
Hbad	Buildings or structures (adjacent)
Hbw	Buildings or structures (within)
Hla	Human log accumulation
Hmh	Modified hydrology, e.g., dikes, man-modified lake/pond
Hmv	Modified vegetation, e.g., agriculture, recreation fields (adjacent)
Ho	Harvesting - old
Hr	Harvesting - recent
Hrad	Roads (adjacent)
Hrw	Roads (within)
Hs	Harvesting - recent, selective
Htad	Trails (adjacent)
Htr	Tree removal – recent
Htw	Trails (within polygon)
Huad	Utility right-of-way (adjacent)
Huw	Utility right-of-way (within)
I	Inundation
L	Landslide
Lc	Forest harvesting – clearcut system
Le	Forest harvesting – selective system
Ll	Land clearing
Ls	Selective logging
Lt	Active talus
M	Plant or site modification effects
Mc	Herbicide (chemical) use
Mg	Planted or seeded to grasses
Mh	Planted or seeded to herbs
Ms	Planted or seeded to shrubs
Mt	Planted or seeded to trees

Code	Description
Mw	Mowed
P	Unknown (watersheds only)
S	Soil disturbances
Sa	Cultivation (agriculture)
Sc	Snow creep
Se	Excavation
Sf	Sidecast Fill
Shp	Soil disturbance – harvesting of peat
Sr	Road bed, abandoned
T	Terrain related effects
Ta	Avalanching
Tq	Rock quarrying (incl. open pit mines)
Ts	Terrain failures
V	Vehicle tracks
W	Water related effects
Wb	Windthrow by cutblock boundaries
Wd	Water table control (diking, damming)
We	Water table depression
Wi	Inundation

SEI_ME_1-3

Code	Description
ME	Modified Ecosystem
SE	Sensitive Ecosystem
XX	Non SE, ME or YS ecosystem type
YS	Small patches of young forest (< 5 ha) (not an SE or ME)

Condition_SE1-3 and **Context** and **Size_SE1-3** and **Quality**

Code	Description
A	Excellent
B	Good
C	Moderate
D	Poor
E	Very Poor

ConditionNo_SE1-3 and **ContextNo** and **SizeNo_SE1-3** and **QualityNo**

Code	Description
5	Excellent
4	Good
3	Moderate
2	Poor
1	Very Poor

Structural Stage Definitions

(As per Land Management Handbook 25: Field Manual for Describing Terrestrial Ecosystems, 2010)

1 Sparse/cryptogam

Initial stages of primary and secondary succession; bryophytes and lichens often dominant, can be up to 100%; time since disturbance less than 20 years for normal forest succession, may be prolonged (50–100+ years) where there is little or no soil development (bedrock, boulder fields); total shrub and herb cover less than 20%; total tree layer cover less than 10%.

Substages:

1a Sparse. Less than 10% vegetation cover;

1b Bryoid. Bryophyte-dominated communities (greater than 1⁄2 of total vegetation cover).

1c Lichen. Lichen-dominated communities (greater than 1⁄2 of total vegetation cover).

2 Herb

Early successional stage or herbaceous communities maintained by environmental conditions or disturbance (e.g., snow fields, avalanche tracks, wetlands, grasslands, flooding, intensive grazing, intense fire damage); dominated by herbs (forbs, graminoids, ferns); some invading or residual shrubs and tress may be present; tree layer cover less than 10%, shrubby layer cover less than or equal to 20% or less than 1/3 of total cover; time since disturbance less than 20 years for normal forest succession; may herbaceous communities are perpetually maintained in this stage.

Substages:

2a Forb-dominanted. Herbaceous communities dominated (greater than 1⁄2 o the total herb cover) by non- graminoid herbs, including ferns.

2b Graminoid-dominated. Herbaceous communities dominated (greater than 1⁄2 of the total herb cover) by grasses, sedges, reeds, and rushes.

2c Aquatic. Herbaceous communities dominated (greater than 1⁄2 of the total herb cover) by floating or submerged aquatic plants; does not include sedges growing in marshes with standing water (which are classed as 2b).

2d Dwarf shrub. Communities dominated (greater than 1⁄2 of the total herb cover) by dwarf woody species such as *Phyllodoce empetriformis, Cassiope mertensiana, Cassiope tetragona, Arctostaphylos alpina, Salix reticulata,* or *Rhododendron lapponicum*. (See list of dwarf shrubs assigned to the herb layer in the Field Manual for Describing Terrestrial Ecosystems).

3 Shrub/Herb

Early successional stage or shrub communities maintained by environmental conditions or disturbance (e.g., snow fields, avalanche tracks, wetlands, grasslands, flooding, intensive grazing, intense fir damage); dominated by shrubby vegetation; seedlings and advance regeneration may be abundant; tree layer cover less than 10%; shrub layer cover greater than 20% or greater than or equal to 1/3 of total cover.

Substages:

3a Low shrub. Communities dominated by shrub layer vegetation less than 2 m tall; may be perpetuated indefinitely to environmental conditions or repeated disturbance; seedlings and advance regeneration may be abundant; time since disturbance less than 20 years for normal forest succession.

3b Tall shrub: Communities dominated by shrub layer vegetation that are 2–10 m tall; may be perpetuated indefinitely by environmental conditions or repeated disturbance; seedlings and advance regeneration may be abundant; time since disturbance less than 40 years for normal forest succession.

4 Pole/Sapling

Trees greater than 10m tall, typically dense stocked, have overtopped shrub and herb layers; younger stands are vigorous (usually greater than 10–15 years old); older stagnated stands (up to 100 years old) are also included; self-thinning and vertical structure not yet evident in the canopy – this often occurs by age 30 in vigorous broadleaf stands, which are generally younger than coniferous stand at the same structural stage; time since disturbance ins usually less than 40 years for normal forest succession; u to 100+ years for dense (5,000 - 15,000+ stems per hectare) stagnant stands.

5 Young Forest

Self-thinning has become evident and the forest canopy has begun differentiation into distinct layers (dominant, main canopy, and overtopped); vigorous growth and a more open stand than in the pole/sapling sate; time since disturbance is generally 40–80 years but may begin as early as age 30, depending on tree species and ecological conditions.

6 Mature Forest

Trees established after the last disturbance have matured; a second cycle of shade tolerant trees may have become established; understories become well developed as the canopy opens up; time since disturbance is generally 80–250 years for stands within the CWH.

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 edaphic sites. Old growth structural attributes will differ across biogeoclimatic units and ecosystems.

Substages:

7a Old Forest. Stands with moderately to well developed structural complexity; stands composed mainly of shade-tolerant and regenerating tree species, although older seral and long- lived trees from a disturbance such as fire may still dominate the upper canopy; fire- maintained stands may have a ‘single-storied’ appearance; time since stand replacing disturbance generally greater than 250 years for stands within the CWH.

7b Very Old Forest. Very old stands having complex structure with abundant large-sized trees, snags and coarse woody debris; snags and coarse woody debris 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 greater than 400 years for stands within the CWH.

Appendix III: Evaluation of Quality of SEI Polygons

Evaluation of Condition, Context, Size and Quality

The CDC / NatureServe Method assesses 'viability' (or ecological integrity) through three factors:

- Size
- Condition
- Landscape context

The weighting of these factors depends upon the ecosystem – which are most or least important, and what are the key factors influencing the ecosystem. For example, if it is normally of large size, e.g., a **matrix** ecosystem, then size is important in maintaining integrity, and is weighted highest. For **small patch** or **linear** ecosystems, landscape context is considered most important, as the changes in the context can greatly influence the ecosystem. Size is determined in a specific manner – aggregating polygons that are connected or are separated by less that certain distances (less in modified vs. natural environments). This is primarily to determine size of an 'element occurrence' of a plant association for both rarity ranking and viability assessment.

Although the intent of the CDC system[10] differs from the needs of Metro Vancouver for the SEI, the principles of the assessment can be applied to determine the quality of polygons. Landscape context and condition are the most significant values – especially for the type of Sensitive Ecosystems and the fragmentation of most of Metro Vancouver – and can be combined, with polygon size, into a 'quality' score for individual polygons.

The following criteria for assessing landscape context and condition are proposed for Metro Vancouver:

Assessing Landscape Context: Land use/cover in a larger area around a polygon determines the ecological processes that influence the function of the ecosystem. Natural or semi-natural vegetation functions most 'naturally'. Modified vegetation can impact on the migration of species or propagules, and can impact on processes such as water flow. Significantly modified vegetation is more likely to have a greater impact than slightly modified vegetation. Highly built-up areas have the greatest impact, as they are generally low in vegetation cover and have greatly modified the water movement through the system (e.g., percolation, subsurface flow, flooding regime).

An automated process was developed to assess landscape context for all SE and ME polygons and is described in detail below.

[10] To determine the likelihood that a specific ecosystem example will be maintained over time – the highest ranked ecosystems have the greatest likelihood – and to determine how many occurrences of high quality vs. moderately high quality, etc. exist

Assessing Condition: Factors influencing the condition of the ecosystem are outlined in Table III-5. Factors that can be observed on the remote imagery and are likely to impact on the species composition and values associated with the sensitive ecosystem class were selected. For example, although the proportion of exotic species and cover of invasive species is an important component of condition, it is difficult to impossible to assess with the available remote imagery – however, the likelihood of exotic or invasive species can be assessed by the type of vegetation or land cover adjacent to the polygon (i.e., proportion of unnatural edge) and, the degree of disturbance within and adjacent to the polygon (up to 15m). The resulting assessment also uses the edge criteria shown in Table III-6. The most likely disturbance codes can be found in the data dictionary (Appendix II).

Aggressive invasive species can completely alter the species composition of a native community and severely impact on condition. Where these can be identified, for example reed canarygrass invasion, the condition class should reflect the altered species composition.

For complex polygons, condition needs to be assessed for each component of the polygon and then compiled for the polygon as a whole using a weighted average. To facilitate rapid assessment, components of 20% or less will not be assessed.

Assessing Size: Size criteria are proposed in Table III-7. For complex polygons, the area of each ecosystem component rather than the area of the whole polygon was used to assess size i.e. Area of ecosystem component = (% of ecosystem component/100%) * Area of whole polygon. Again, only components that make up more than 20% of a polygon were assessed.

A different methodology had to be used to assess size for Regional Parks polygons. In these areas, the inventory was developed by translating TEM mapping to SEI. There was a need to retain the TEM level of spatial detail (because of how the data will be later used in Parks), so adjacent polygons that were the same SEI class and subclass were NOT merged as they would have been in other places. Therefore, if size was assessed on the individual polygons it would have resulted in lower grades compared to elsewhere. To remedy this, an intermediate data layer was created with all the merges completed as they would have been elsewhere. The combined polygon sizes were then applied back to the original polygons so the assessment could take place on the 'true' ecosystem size.

Combining Scores

Table III-8 provides the weighting to be applied to combine the three scores into one for each component. The quality scores for each component are summed to generate the final, combined quality score for the polygon. For display of quality, Table III-1 below converts the resulting value into a class:

Table III-1: Conversion from combined quality score to quality grade

Combined quality score	Quality grade (numeric)	Quality grade (letter)	Quality grade descriptor
> 4.2 – 5.0	5	A	Excellent
> 3.4 – 4.2	4	B	Good
> 2.6 – 3.4	3	C	Moderate
> 1.8 – 2.6	2	D	Poor
0.1 – 1.8	1	E	Very Poor

Landscape context – automated assessment using land cover mapping

The following procedure was implemented to assess landscape context for SEI polygons:

Step 1: A seamless layer (the 'analysis surface') was created for the whole region using the recent Land Cover Classification (LCC) completed by Metro Vancouver (2012) with the Metro Vancouver SEI polygons burned into it. The Provincial Baseline Thematic Mapping was used around the very edge of the region in case the assessment area for an SEI polygon fell outside the boundary of the LCC.

Step 2: Each SE/ME polygon was buffered by 1128.38m from the outside edge to create an assessment area for that polygon. This buffer distance was chosen because it created an area of approximately 4 km^2 (for most polygons). This buffer/area evaluated land cover over a large enough area to include outside, modifying influences on each polygon.

Step 3: A GIS model was created which used this buffer to clip an area from the analysis surface and calculate the percentage of this area made up by natural/semi natural vegetation, anthropogenic vegetation, or no vegetation (i.e. a built up, developed area). These classes were defined and coded as follows:

Table III-2: Context Class definitions

ContextClass	Description
0	Built up environment, Roads and Urban
1	Urban Mix (urban plus some anthropogenic vegetation)
2	Grass/Herb (non SE/ME), Water (non SE/ME), Seasonally Flooded Agricultural Fields (ME), Freshwater reservoirs (ME)
3	Shrub (non SE/ME), Old Field (ME)
4	Conifer, Broadleaf, Mixed (non SE/ME),
5	All other SEs and MEs

Step 4: The percentage area of each class was then multiplied by an adjustment factor:

Table III-3: Adjustment factors for Context Classes

ContextClass	Adjustment Factor
0	0%
1	10%
2	25%
3	40%
4	60%
5	100%

For example, if the assessment area around a polygon was made up of 60% SE/ME cover and 40% herb (non SE/ME) cover, e.g., playing fields, then the total score for the polygon would be ((60 * 100%) + (40 * 25%))/100 = 70%

Step 5: This value was converted to a class using the following table:

Table III-4: Conversion from index range to final score

Context index range	Context grade (numerical)	Context grade (letter)
>= 4.1 and < 5	5	A
>= 3.1 and < 4.1	4	B
>= 2.1 and < 3.1	3	C
>= 1.1 and < 2.1	2	D
< 1.1	1	E

So in the example given the final score would be B (5 * 70% = 3.5)

Table III-5: Condition factors influencing ratings for sensitive ecosystems of Metro Vancouver

Notes:

- See Table III-6 for determining edge effects and Appendix II, Field Descriptions, for disturbance codes – balance all factors (disturbance level and type, amount and type of edge)
- Use judgment when assessing ‘unnatural edge’, including the type, age and structure of modified vegetation
- Aggressive invasives can impact condition much more than expected using criteria in table
- Freshwater, Riparian river and Seasonally Flooded Agricultural Fields are not assessed for condition

SEI Class	A	B	C	D	E
Old Forest	• **vo** or **co** subclass • no unnatural edge • no disturbance	• **vo** or **co** subclass and < 20% unnatural edge, or **mx** subclass and no unnatural edge • no disturbance	• **vo** or **co** subclass and < 50% unnatural edge, or **mx** subclass and <20% unnatural edge • some disturbance	• **any** subclass • <75% unnatural edge • moderate disturbance	• **any** subclass • > 75% unnatural edge • sign’t disturbance
Mature Forest	• **co** subclass • no unnatural edge • no disturbance	• **co** subclass and < 20% unnatural edge, or **mx** subclass and no unnatural edge • no disturbance	• **co** subclass and < 50% unnatural edge; or **mx** subclass and <20% unnatural edge • possibly some disturbance	• **any** subclass • <75% unnatural edge • moderate disturbance	• **any** subclass • > 75% unnatural edge • sign’t disturbance
Young Forest	• **co** subclass • no unnatural edge • no disturbance	• **co** subclass and < 20% unnatural edge, or **mx** subclass and no unnatural edge • no disturbance	• **co** or **mx** subclass and < 50% unnatural edge; or **bd** subclass and <20% edge • possibly some disturbance	• **co** or **mx** subclass and < 75% unnatural edge; or **bd** subclass and <50% edge • moderate disturbance	• **any** subclass • > 75% unnatural edge • sign’t disturbance
Woodland	• trees old • no unnatural edge • no disturbance	• trees mature and no unnatural edge; or trees old and < 20% unnatural edge • no or some disturbance	• trees old or mature and < 50% unnatural edge; trees young and <20% unnatural edge • no or some disturbance	• trees old or mature and < 75% unnatural edge; trees young and <50% unnatural edge • mod. disturbance	• trees old or mature and > 75% unnatural edge; trees young and <75% unnatural edge • sign’t disturbance

SEI Class	A	B	C	D	E
Riparian (naturally non-forested)	• no unnatural edge • no anthro disturbance evident • natural hydrology	• < 25% unnatural edge • possibly some anthro disturbance • possibly slightly altered drainage or water level control	• 25 – 50% unnatural edge • substantial anthro disturbance • substantial drainage or water level control	• 50 – 75% unnatural edge • substantial anthro disturbance • sign't drainage or water level control	• > 75% unnatural edge • sign't anthro disturbance • severely disrupted hydrology
Riparian (forested)	• no unnatural edge • no anthro disturbance evident • old or mature forest • natural hydrology	• old or mature forest and <25% unnatural edge • young forest and no unnatural edge • possibly some anthro disturbance • possibly slightly altered drainage or water level control	• old or mature forest and 25-50% unnatural edge • young forest and <25% unnatural edge • substantial anthro disturbance • substantial drainage or water level control	• old or mature forest and 50-75% unnatural edge • young forest and 25-50% unnatural edge • substantial anthro disturbance • sign't drainage or water level control	• old or mature forest and >75% unnatural edge • young forest and >50% unnatural edge • sign't anthro disturbance • severely disrupted hydrology
Wetland – swamp (forested)	• old or mature forest • no unnatural edge • no disturbance	• old or mature forest • < 35% unnatural edge • no disturbance	• old or mature forest and > 35% unnatural edge; or young forest and < 20% unnatural edge • some disturbance	• old or mature forest and > 60% unnatural edge; or young forest and < 50% unnatural edge • moderate disturbance	• young forest and > 50% unnatural edge • sign't disturbance
Wetland – all others	• no unnatural edge • no anthro disturbance evident • natural hydrology	• < 25% unnatural edge • possibly some anthro disturbance • possibly slightly altered drainage or water diversion	• 25 – 50% unnatural edge • moderate anthro disturbance • substantial drainage or water diversion	• 50 – 75% unnatural edge • substantial anthro disturbance • substantial drainage or water diversion	• > 75% unnatural edge • sign't anthro disturbance • severely disrupted hydrology
Herbaceous	• no unnatural edge • no anthro disturbance evident	• < 25% unnatural edge • possibly some anthro disturbance	• 25 – 50% unnatural edge • moderate anthro disturbance	• 50 – 75% unnatural edge • substantial anthro disturbance	• > 75% unnatural edge • sign't anthro disturbance

SEI Class	A	B	C	D	E
Alpine	• no unnatural edge • no anthro disturbance evident	• < 25% unnatural edge • possibly some anthro disturbance	• 25 – 50% unnatural edge • moderate anthro disturbance	• 50 – 75% unnatural edge • substantial anthro disturbance	• > 75% unnatural edge • sign't anthro disturbance
Sparsely vegetated	• no unnatural edge • no anthro disturbance evident	• < 25% unnatural edge • possibly some anthro disturbance	• 25 – 50% unnatural edge • moderate anthro disturbance	• 50 – 75% unnatural edge • substantial anthro disturbance	• > 75% unnatural edge • sign't anthro disturbance
Estuarine	• no unnatural edge • no anthro disturbance evident	• < 25% unnatural edge • possibly some anthro disturbance	• 25 – 50% unnatural edge • moderate anthro disturbance	• 50 – 75% unnatural edge • substantial anthro disturbance	• > 75% unnatural edge • sign't anthro disturbance
Intertidal & shallow sub-tidal	• no unnatural edge • no anthro disturbance evident	• < 25% unnatural edge • possibly some anthro disturbance	• 25 – 50% unnatural edge • moderate anthro disturbance	• 50 – 75% unnatural edge • substantial anthro disturbance	• > 75% unnatural edge • sign't anthro disturbance
Old field[11]	• Texture/structure is patchy and unevenly distributed • High amount of area to edge; lots of wide open space • Some recent disturbance evident • 100% soft, natural edge; or up to 25% natural but hard edge	• Texture/structure is quite patchy and unevenly distributed • Quite high amount of area to edge • Some recent disturbance evident • < 25% unnatural edge	• Texture/structure is fairly patchy but starting to clump • Moderate amount of area to edge • Moderate recent disturbance evident • 25-50% unnatural edge • Possible presence of reed canarygrass (<10%)	• Texture/structure is more clumped than patchy • Quite low amount of area to perimeter • Substantial recent disturbance • 50-75% unnatural edge • Possible high shrub/tree cover, 30-40% • Poss presence of reed canarygrass (<30%)	• Texture/structure is quite clumped • Low amount of area to perimeter; site is narrow and/or of a convoluted shape • Sign`t recent disturbance • >75% unnatural edge • Poss high shrub/tree cover, 30-40% • Poss sign't reed canarygrass (<80%)

[11] See Appendix V for more information on assessing condition for Old Fields

Table III-6: Criteria for determining edge effects[12]

SEI Class	Good to OK edge	Unnatural edge[13]	Comment
Forest: Old, Mature, Young	Natural or semi-natural vegetation	Anthropogenic vegetation or non-vegetated	Edge effect allows invasives, change in vegetation composition
Woodland	Natural or semi-natural vegetation	Anthropogenic vegetation or non-vegetated	Edge effect allows invasives, change in vegetation composition
Riparian	Natural or semi-natural vegetation; river & assoc features; lake or pond	Anthropogenic vegetation; non-vegetated; dike?	Riparian vegetation can vary; edge effect more significant on edge away from water; decreases with stature of vegetation
Wetland	Natural or semi-natural vegetation; lake or pond	Anthropogenic vegetation; non-vegetated.	Generally only a minimal impact of edge. Only considers immediate landscape effects rather that broader landscape impacts on hydrology
Herbaceous	Natural or semi-natural vegetation	Anthropogenic vegetation or non-vegetated	Difficult to have a standard rule for distance of edge impact, but also unlikely to be able to observe on imagery
Sparsely Vegetated	Natural or semi-natural vegetation; natural landform of subclass	Anthropogenic vegetation, urban, industrial, roads, etc.	Difficult to have a standard rule for distance of edge impact; but also unlikely to be able to observe on imagery
Estuarine	Natural or semi-natural vegetation; water body; natural estuarine landforms	Anthropogenic vegetation, urban, industrial, roads, etc.	Difficult to have a standard rule for distance of edge impact; but also unlikely to be able to observe on imagery
Intertidal / shallow subtidal	Natural or semi-natural vegetation; sea; natural intertidal landforms	Anthropogenic vegetation, urban, industrial, roads, etc.	Difficult to have a standard rule for distance of edge impact; but also unlikely to be able to observe on imagery
Alpine	Natural or semi-natural vegetation	Anthropogenic vegetation or non-vegetated	Difficult to have a standard rule for distance of edge impact, but also unlikely to be able to observe on imagery
Old field	Soft (not forested) natural, semi-natural or unnatural vegetation	Urban, industrial, roads etc	See Appendix V for more information on assessing Old Field

[12] Not assessed for Freshwater, Riparian river and Seasonally Flooded Agricultural Fields
[13] Very young/young vegetation (e.g., a clear cut) should be considered moderate edge

Table III-7: Size factors influencing ratings for sensitive ecosystems of Metro Vancouver[14]

SEI Class	A	B	C	D	E
Old Forest	>40 ha	18 – 40 ha	6 –18 ha	2 – 6 ha	<2 ha
Mature Forest SEI	>40 ha	18 – 40 ha	6 – 18 ha	2 – 6 ha	<2 ha
Young Forest	>40 ha	18 – 40 ha	6 – 18 ha	2 – 6 ha	<2 ha
Woodland	>20 ha	10 – 20 ha	5 – 10 ha	2 – 5 ha	<2 ha
Riparian	>20 ha	10 – 20 ha	5 – 10 ha	2 – 5 ha	<2 ha
Wetland – swamp (forested)	>20 ha	8 – 20 ha	3 – 8 ha	1 – 3 ha	<1 ha
Wetland – all others	>20 ha	8 – 20 ha	3 – 8 ha	1 – 3 ha	<1 ha
Herbaceous	>20 ha	10 – 20 ha	5 – 10 ha	2 – 5 ha	<2 ha
Alpine	>20 ha	10 – 20 ha	5 – 10 ha	2 – 5 ha	<2 ha
Sparsely vegetated	>20 ha	8 – 20 ha	3 – 8 ha	1 – 3 ha	<1 ha
Estuarine	>20 ha	10 – 20 ha	5 – 10 ha	1 – 5 ha	<1 ha
Intertidal & shallow sub-tidal	>20 ha	10 – 20 ha	5 – 10 ha	1 – 5 ha	<1 ha
Old field	>20 ha	10 – 20 ha	5 – 10 ha	1 – 5 ha	<1 ha

[14] Not assessed for Freshwater, Riparian river and Seasonally Flooded Agricultural Fields

Table III-8: Weighting factors for combining quality attributes[15]

SEI Class	SEI Subclass	Size	Condition	Landscape Context
OF: Old Forest				
OF	co: coniferous	20	45	35
OF	mx: mixed	20	45	35
OF	vo: very old	20	45	35
MF: Mature Forest				
MF	co: coniferous	20	45	35
MF	mx: mixed	20	45	35
WD: Woodland				
WD	co: coniferous	15	35	50
WD	mx: mixed	15	35	50
RI: Riparian				
RI	ff: fringe	20	35	45
RI	fh: high bench floodplains	20	35	45
RI	fm: medium bench floodplains	20	35	45
RI	fl: low bench floodplains	20	35	45
RI	gu: gully	20	35	45
RI	ca: canyon	20	35	45
RI	mf: mudflat	20	30	45
WN: Wetland				
WN	bg: bog	20	35	45
WN	fn: fen	20	35	45
WN	ms: marsh	20	35	45
WN	sp: swamp	20	35	45
WN	sw: shallow water	20	35	45
WN	wm: wet meadow	20	35	45
HB: Herbaceous				
HB	hb: herbaceous	15	35	50
HB	cs: coastal herbaceous	15	35	50

[15] Not assessed for Freshwater, Riparian river and Seasonally Flooded Agricultural Fields

SEI Class	SEI Subclass	Size	Condition	Landscape Context
HB	vs: vegetated shoreline	15	35	50
HB	sh: shrub	15	35	50
SV: Sparsely Vegetated				
SV	cl: cliff	15	35	50
SV	ro: rock outcrop	15	35	50
SV	ta: talus	15	35	50
SV	sd: sand dune	15	35	50
SV	sp: spit	15	35	50
ES: Estuarine				
ES	sp: swamp	20	35	45
ES	md: meadow	20	35	45
ES	ms: marsh	20	35	45
ES	tf: tidal flat	20	35	45
IT: Intertidal & shallow sub-tidal				
IT	mf: mudflats	15	35	50
IT	bs: beaches	15	35	50
IT	el: eelgrass	15	35	50
AP: Alpine				
AP	hb: herbaceous	15	35	50
AP	kr: krummholz	15	35	50
AP	pf: parkland forest	15	35	50
AP	ds: dwarf shrub	15	35	50
AP	ts: tall shrub	15	35	50
AP	av: avalanche tracks	15	35	50

ME Class	ME Subclass	Size	Condition	Landscape Context
MF: Mature Forest				
MF	co: coniferous	20	45	35
MF	mx: mixed	20	45	35
MF	bd: broadleaf	20	45	35
YF: Young Forest				
YF	co: coniferous	20	45	35
YF	mx: mixed	20	45	35
YF	bd: broadleaf	20	45	35
OD: Old Field		25	45	30

Appendix IV Mapping Areas Dominated by Reed Canarygrass

Category	**Marsh**	**Swamp**	**Riparian**	**Old field**	
	SEI	**SEI**	**SEI**	**ME**	**non-SEI/ME**
Explanation	Marsh situations - low-lying areas near watercourses with 'natural' boundaries, i.e., reasonable probability of being a marsh. Soils rich organics or mineral. Drainage may be modified by past ditching. These are the wettest sites with reed canarygrass so shrub growth is minimal - slightly dryer sites in similar situations are modified swamps.	Level to depressional sites that are flooded, but not as prolonged as marshes. Soils generally richer organics, or well-humified organic veneers. Drainage may be modified.Evidence of past clearing - boundaries often unnatural (e.g., straight lines). Adjacent sites are treed or shrubby and ingress or growth is evident.	Definite riparian situation adjacent to significant watercourse where clearing is evident. Dryer sites that marshes or swamps. Soils show evidence of flood events and lack significant organic horizons.	Cleared field in an agriculture landscape. Not a wetland. Soils may have seepage but do not have significant flooding or saturation through impeded drainage. Generally level, but may have some slope.	Other upland situations where 'old field' class does not apply.
Key features	Graminoid physiognomy (few to no shrubs)	Shrubs or trees present	Shrubs or trees may be present.	Shrubs or trees may be present.	Shrubs or trees may be present.
	Protracted flooding	Impeded drainage	Riparian floodplain	Upland situation	Upland situation
	Natural-looking boundaries	Evidence of clearing	Cleared	Definite evidence of clearing	Clearing for some other reason - e.g., forest harvesting.
	Level areas near watercourses	Level areas near watercourses or depressions	Floodplain bench near river		
Condition assessment	Degraded marsh	Degraded swamp, degree depending upon the amount of ingress of shrubs and trees	Poor quality riparian.	Depends upon degree of ingress of shrubs and trees.	

Appendix V: Criteria for Mapping the Old Field class

‘Old Fields’ are lands formerly cultivated or grazed but later abandoned. Old-field sites can provide important habitat for wildlife species in human-influenced landscapes. As an intermediate stage in succession, without management they will eventually become forest – some may have been wetlands where the drainage has been altered in order to farm.

Old fields are one type of early successional ecosystem – others include blackberry thickets, shrublands, or regenerating forests. As abandoned fields, they vary in vegetation cover – from mostly weedy plants, to well-established graminoid- or forb-dominated communities, with varying amounts of shrubs or regenerating trees. What types of these early successional ecosystems are important or sensitive ecosystems? Some may have been wetlands and as such are included in the wetland SEI Class, even though the vegetation may be modified considerably from what would occur in a natural wetland. Those ‘old fields’ that have well-established herbaceous vegetation with some structural heterogeneity are known to be important wildlife habitat. Once taller trees or shrubs dominate the vegetation, the wildlife value decreases for a period of time, until the stand thins out.

This document outlines the criteria to be used for the inclusion of sites to the ‘Old Field’ class of the Metro Vancouver SEI as an ‘Modified Ecosystem’ type. There are challenges involved with the identification of this class. It is a human modified ecosystem type and represents an early stage of secondary succession. MEs are described as ecosystems known to have significant ecological and biological values associated with them but they are not defined as Sensitive Ecosystems, generally because they have been substantially altered by human use. However, their consideration may be critical to capturing key elements of biodiversity as they may provide recruitment sites for ecosystems at-risk or important wildlife habitat requiring recovery or restoration.

At what stage of development do old fields meet these criteria? Very early in development they would not be considered an ME and later on when a site is beginning to be dominated by shrubs and/or trees it would also not be considered an ME. The challenge is in deciding at what stage it is of increased importance to wildlife species and therefore should be included in the inventory. Additionally, to confidently and thoroughly identify Old Field habitat would ideally require some knowledge of how the area is being managed, plus a site visit. Time and resources do not allow for this, at least at this first run of the SEI. Identification will be based on imagery analysis and only about 20% of sites will be field verified.

Due to these difficulties, it is important to set out clear criteria to guide the mapping of this class and ensure the integrity of the inventory is maintained (i.e. we are only including sites we can justify as being ‘important’). It is also critical we keep within budgetary and time restraints.

Criteria

The primary assumption behind these criteria is that the importance of an Old Field is its increased value to wildlife (compared to other areas of young successional vegetation) as a result of the presence of considerable herbaceous vegetation with some species diversity, and possibly a proportion of trees or shrubs providing vertical structure. The criteria also outline the factors considered important when assessing condition.

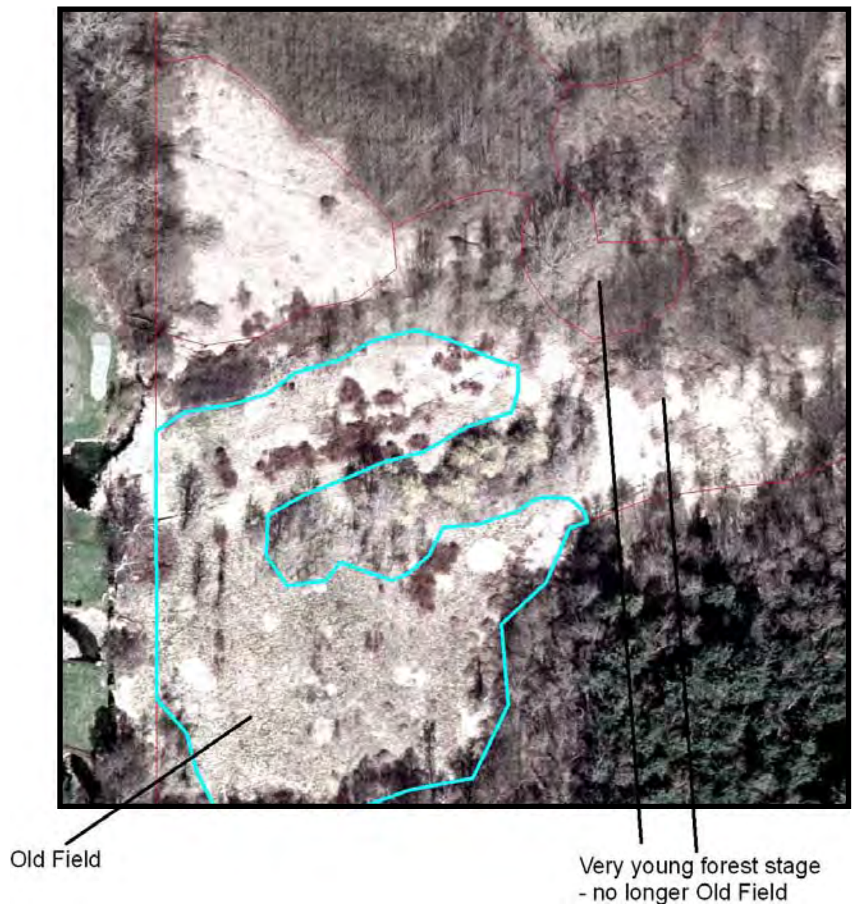
1. Size – During the pilot stage sites were identified down to 1 ha. However, it was not feasible to continue this throughout the study due to resource constraints – a size limit 2.5 ha was used.
2. Vegetation cover – There must be a well-developed herbaceous cover (usually graminoid dominated).
3. A lower limit for succession, i.e. a minimum vegetation cover and some species diversity should be evident, but not necessarily vertical structure. Differences in texture must be visible from the imagery, indicating there has been time for some species diversity to develop.
4. An upper limit for succession – Once a site has more than 40% shrub cover it will be considered too developed to be included as Old Field (see Example 1). Some trees may be present but these should be few and scattered. The best condition sites will have less than 30% shrub cover.
5. Better condition sites exhibit a mosaic of vegetation types, with herbaceous ‘texture’ or shrubs/trees distributed in an uneven and patchy way. Sites that are homogenous overall, with even texture or structure clumped in one area only, will be omitted from the class.
6. Shape – The best examples of Old Fields will have a low perimeter to area ratio, i.e. wide open spaces with a large area to the amount of edge are better than skinny, convoluted shapes with a low amount of area to edge.
7. Edge type- ‘Soft’ edge transitions provide better conditions than ‘hard’ edge; natural edge is better than unnatural edge. Examples of hard and unnatural edges are buildings and roads; a hard but natural edge would be mature forest; a soft, semi-natural edge type is agricultural fields or landscaped grass; wetlands and riparian areas (low structural stages) would provide a soft and natural edge. A few trees adjacent to an old field would improve condition but not if there are so many trees the area is hemmed in.
8. Reed canarygrass – Sites that have become completely dominated by reed canarygrass (>80%) are considered to be of such low condition that they will not be included in the inventory. If a site has reed canarygrass present but is not dominated by it, it will be included but given a lower condition score.
9. Powerlines – Areas under powerlines tend to be managed in ways that produce old field-like conditions and so as long as they meet all the above criteria they will be included in this class.

Areas that are excluded from old field include:

- Open, weedy vegetation, with mineral soil exposure, even if >10% shrub cover

- >40% shrub cover
- Treed or shrubby communities with < 40% cover but the cover is evenly distributed, i.e., there are essentially no open patches of herbaceous vegetation
- Texture/structure is very clumped and not distributed at all throughout the site
- Reed canarygrass dominates (>80%)
- Very young forest
- Shrub thickets.

Example 1 – Boundary Bay Old Field. Sites such as those adjacent to this old field would be left out as they are too dominated by trees and shrubs:



Old Field condition

Soft semi-natural edge = agriculture, landscaped grass

Natural hard edge = Forest, dense woodland

Unnatural edge = Concrete

Soft natural edge = all other types of natural ecosystem

Table V-1: Assessing Old Field condition

A	B	C	D	E
• Texture/structure is patchy and unevenly distributed • High amount of area to edge; lots of wide open space • Some recent disturbance evident • 100% soft, natural edge; or up to 25% natural but hard edge	• Texture/structure is quite patchy and unevenly distributed • Quite high amount of area to edge • Some recent disturbance evident • < 25% unnatural edge	• Texture/structure is fairly patchy but starting to clump • Moderate amount of area to edge • Moderate recent disturbance evident • 25-50% unnatural edge • Possible presence of reed canarygrass (<10%)	• Texture/structure is more clumped than patchy • Quite low amount of area to perimeter • Substantial recent disturbance • 50-75% unnatural edge • Possible high shrub/tree cover of 30-40% • Possible presence of reed canarygrass (<30%)	• Texture/structure is quite clumped • Low amount of area to perimeter; site is narrow and/or of a convoluted shape • Significant recent disturbance • >75% unnatural edge • Possible high shrub/tree cover of 30-40% • Possible significant presence of reed canarygrass (<80%)

Assessing condition requires weighing the impact of various factors:

Factors that lower condition:

- 30-40% shrub cover (> 40% the site will not be included)
- Hard and/or unnatural edge
- Low amount of area to edge (i.e. narrow, convoluted shapes with little open area)
- Clumping of texture/structure (if texture/structure is completely clumped in one patch the site will not be included)
- Presence of reed canarygrass
- Significant disturbance

Factors that improve condition:

- Mosaic of textures/structures (uneven patchiness)
- High amount of area to edge (i.e. wide open space)
- < 30% shrub, no more than the odd tree scattered
- Soft, natural edges (soft unnatural would be moderate condition). Soft but with a few trees adjacent would also be good edge
- Little disturbance

Table V-2: Relative importance of different factors at each condition level

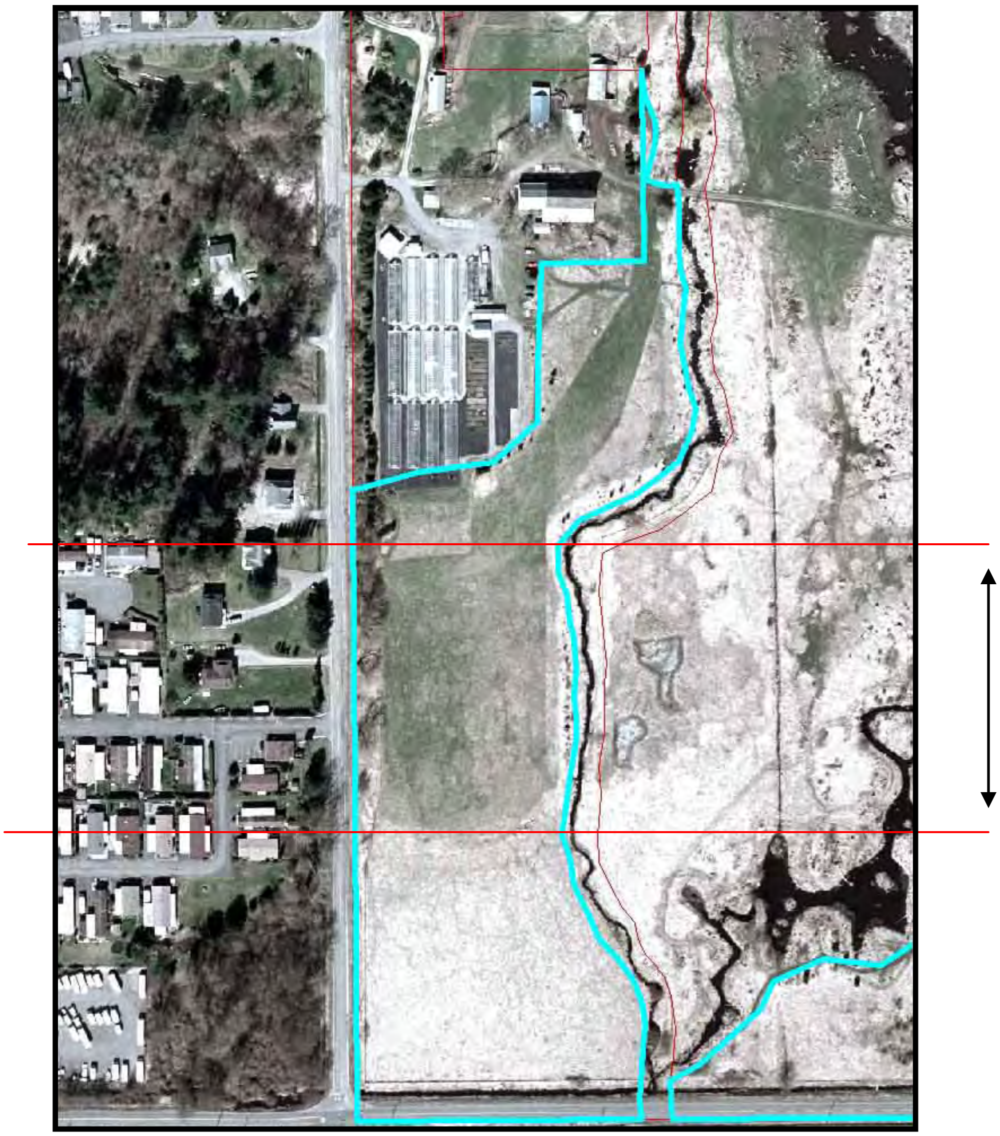
	A	B	C	D	E
Texture/structure					
Patchiness	■■■■■	■■■■	■■■	■■	■
Eveness	■	■■	■■■	■■■■	■■■■■
Area to perimeter ratio	■■■■■	■■■■	■■■	■■	■
Recent disturbance level	■	■■	■■■	■■■■	■■■■■
Edge					
Unnatural	-	■	■■	■■■	■■■■
Soft, natural	■■■■■	■■■■	■■■	■■	■
Hard, natural	■	■■■	■■■	■■■■■	■■■■■
Soft, semi-natural	-	■■	■■■	■■■■	■■■■■
Reed canarygrass cover	-	-	■	■■	■■■
Tree/shrub cover	■■	■■	■■	■■■■	■■■■■

On the following pages are examples of condition states from Regional Parks, using the above tables. NB: Most old field sites within the Regional Parks network would not meet a 2.5 ha cut off.

Examples 2, 3 and 4 – these are in the TEM database as Old Field but would largely not meet the criteria set out above.; Example 3 (Aldergrove Lake) has too little texture or structure; Example 4 (Minnekhada) too much tree and shrub cover, not enough herbaceous cover left.

Example 2 Aldergrove Lake

Rationale - Texture can be seen in the middle section so would be cut out and included as Old Field. The remainder of the area has no structure or texture evident and appears to be mostly mowed, so would not be included in the inventory as Old Field



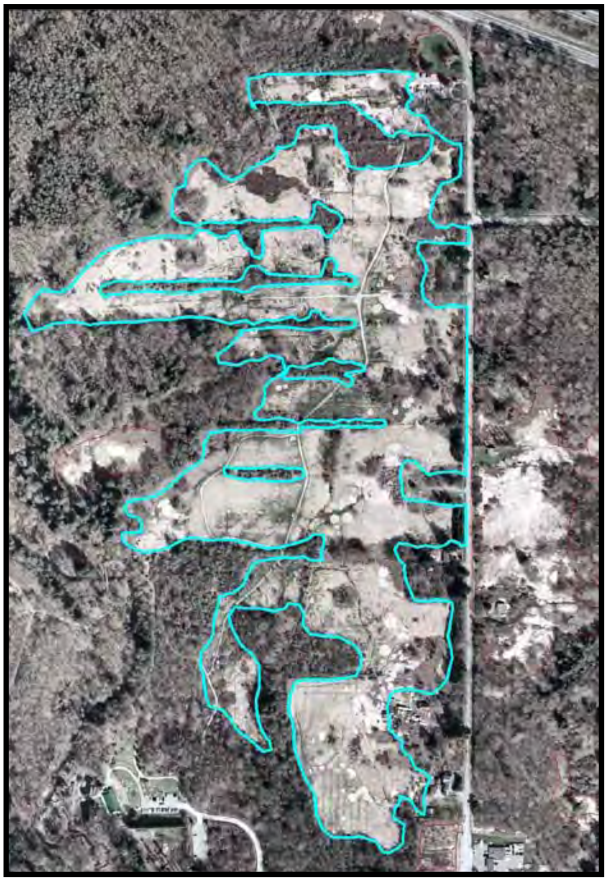
Example 3 Aldergrove Lake
Rationale - Not included in SEI as Old Field because it has too little texture or structure

Example 4 Minnekhada
Rationale - Not included as Old Field in SEI because there is too much tree and shrub cover, not enough herbaceous cover left.

Example 5 Boundary Bay
Rationale - Does not meet the criteria to be included in the SEI as Old Field. Too much shrub cover.

Example 6 An ‘E’ condition Old Field (Campbell Valley)
Rationale – West side is too developed. East side would be included as old field, with a 'D' condition. Edge fits into 'C' condition but high cover of reed canarygrass lowers this to an 'E'.

Example 7 A ‘C’ condition Old Field (Tynehead)
Rationale – Variety of textures and structure, spread unevenly throughout the site. Mostly hard-natural edge but also some soft-natural. Some disturbance.



Example 8 A 'B' condition Old Field (Colony Farm)
Rationale - Some reed canary grass but overall, the site has good texture and structure patchily dispersed, and only hard-natural or soft-natural edges. Large open areas.

Example 9 an 'A' condition Old Field (Campbell Valley)
Rationale – Good structure and texture, unevenly distributed throughout. 100% soft-natural or hard-natural edge. Minimal disturbance.

Appendix VI: Alignment and Adjustment of Metro Vancouver's Existing TEM Datasets

Extract from a report by B.A. Blackwell & Associates Ltd. to Metro Vancouver (2010)

Introduction

Terrestrial Ecosystem Mapping (TEM) has been completed for Metro Vancouver's three watersheds, as well as all regional parks, conservancy areas, reserves, and greenways. This mapping has been undertaken through a number of separate projects dating from 1994 through to 2007. Specific objectives of the mapping varied amongst these projects. For example, mapping of the Seymour, Capilano, and Coquitlam watersheds (completed 1995-1996) was aimed at providing an ecological framework for estimating the effects of forest disturbance on water quality. Mapping of the Lower Seymour Conservation Reserve (completed 1997), was designed to provide an ecological framework to support planning and management of the then-called Seymour Demonstration Forest. Mapping of the Metro parks, reserves and greenways (completed 2005-2007) was primarily designed for the ecological integrity component of the Wildfire Risk Management System for GVRD Parks. A secondary objective was to provide an ecological framework to support park management and planning. Although all mapping generally followed the conceptual approach of the provincial Terrestrial Ecosystem Mapping (TEM) method, the mapping spanned a 13 year period with accompanying evolution in standards, attribute coding, database structure, etc. Finally, because of the differing objectives and to some extent, budgets amongst the projects, deliverable content and format varied.

The result of the above factors is that data generated from these individual projects varies in a number of ways. To create a clean seamless database, it has to undergo a standardization process so that the database structure is consistent, all field codes are consistent, and a standardized database dictionary is generated that describes the revised data.

Metro Vancouver is in the process of developing a Sensitive Ecosystem Inventory (SEI) for the geographic area under its jurisdiction. To maximize mapping efficiency, the intent is to incorporate existing ecosystem inventory data that is suitable for deriving SEI classes. The TEM data described above is mapped to a level of detail and contains suitable attributes for deriving most SEI classes, and including Riparian classes which are the focus of this project. This requires a careful review of all mapped attributes and mapping methodology for TEM databases to develop a suitable process for deriving SEI classes. Some additional stratification is also required to delineate units which were not captured in the original inventory, in particular riparian fringe units.

The specific objectives of this project are to:

1. standardize the available terrestrial ecosystem mapping data for Metro Vancouver, including attribute database structure, field codes, and database dictionary.

2. generate riparian SEI data for the area covered by the above TEM data. This includes deriving riparian classes from existing TEM polygon data, and creating new riparian fringe polygons for areas not recognized in the TEM data.

Methods

Data Standardization

Preliminary assessment

Metro Vancouver produced a preliminary database consisting of merged TEM data from the five original sources: Capilano, Coquitlam, and Seymour watersheds, Lower Seymour Conservation Reserve (LSCR), and Regional Parks. This was originally going to serve as the authoritative data since considerable effort has gone into its development. However, in a preliminary review, some inconsistencies were noted that were not in the original source data and which likely occurred during subsequent processing. Given the amount of effort required to identify and correct data conversion discrepancies as well as make the necessary conversions recognizing the five data sources, we decided to go back to the original source data and process each dataset separately.

The original TEM source data was obtained from Metro Vancouver. The first step was to do a comprehensive analysis and summary of the field codes for each individual database. This provided the basis for identifying and reconciling inconsistencies, and formulating the standardization plan. Because of the evolution of these projects over 13 years, each data source was unique. Table VI-1 summarizes the key differences.

Table VI-1: Summary of differences among five TEM data sources

Source	Key Features
Capilano Watershed	Data for 3 site components included Site modifiers combined into 1 field No stand data No fuel type data
Coquitlam Watershed	Data for 3 site components included No site modifiers No stand data No fuel type data
Seymour Watershed	Data for 1 site component included Site modifiers combined into 1 field No stand data

	No fuel type data
LSCR	Data for 3 site components included Site modifiers in 3 separate fields No stand data No fuel type data
Regional Parks	Data for 3 site components included Site modifiers in 3 separate fields Stand data included Fuel type data included

Standardized site unit codes

Although there were differences in database structure, the field codes for primary fields in the watersheds/LSCR were consistent. However, these datasets differed from the Regional Parks data. A standardized set of site unit codes was developed based on the Regional Park data as it was the most recent and most comprehensive. Two conversion tables were produced; one for the watersheds/LSCR and one for Parks. These tables contained the biogeoclimatic unit and all original site unit codes contained in the source data, and their equivalent standardized codes. Standardized codes included one set from the original Metro Vancouver data which used a combination of numeric and alphabetic site unit codes which are consistent[16] with the Regional Field Guide for Site Identification and Interpretation (Green and Klinka 1994). An additional set of codes were included which are consistent with the provincial 2-letter mapcode system.

Adding forest cover and aspect to watershed/LSCR data

The next step was to add forest cover data and aspect classes to the watershed/LSCR data. As part of the original ecological inventory, a separate forest inventory database was produced for the same spatial data used for the ecosystem inventory. This data was obtained from Metro Vancouver, and selected forest cover fields extracted. These included tree species, stand age, stand height, and crown closure. Diameter (DBH) was not available in the source data. A tree species label consistent with the Parks data was created from amalgamation of the original individual species data. This was based on the first three species only, where major and minor species were identified with parentheses based on greater or less than 30% composition. A stand composition modifier field was added based on the relative composition of deciduous/coniferous species using all original tree species fields. Finally, a new field for aspect was added to the data, and 3 aspect classes were assigned based on analysis of average polygon slope and aspect using a TRIM-derived digital elevation model.

[16] For site series recognized in the provincial BEC system.

The TEM and forest cover data were then "unioned" in ArcMap, where the spatial features are intersected and attributes from both features amalgamated. Given that the two layers share the same polygons, this effectively added the forest cover attributes to the TEM database. Two issues were identified in this process. There was a slight displacement of spatial data between TEM and forest cover for several of the original units (e.g. Seymour, Coquitlam). This resulted in thousands of tiny slivers after the union. These were cleaned by through a deslivering process that locked on the original TEM polygons. The other issue was that a small number of new polygons had been added to the TEM data after the original inventory. These didn't occur in the forest cover data. Generally these related to harvest blocks that were created after the date of the inventory photography. These were identified based on a shrub-herb structural stage, recent harvest disturbance class, but old stand age. In these cases, the stand attributes (species, age, height, crown closure) were deleted as they represented the original pre-harvest stand.

One thing to note is that there are cases where the stand features (e.g. age) may be inconsistent with TEM structural stages. This mainly reflects the differences between the two datasets. The TEM structural stage recognizes polygon components while forest cover attributes do not. For example, a polygon with a shrub-herb avalanche in component 1 and old forest 01 in component 2 will have one set of forest cover attributes for the whole polygon that would reflect the old forest stand.

Building the standardized attribute database

All data processing was done using an ESRI Personal Geodatabase, with attribute tables modified and built in Microsoft Access 2003. Each individual data unit (Capilano, Seymour, Coquitlam, LSCR, Parks) was processed separately given their unique data structure. The standard set of TEM data fields provided by Metro Vancouver was added to the database resulting from steps above. For each standard field, attributes were added from the original data using a series of "update" queries. Attributes were adjusted where required during the process. For example, component composition values were converted from percent to deciles, original site unit codes were converted to new standardized codes using the conversion tables described above, site modifiers were split where they had originally been combined and codes adjusted to standard codes where required, etc. Information for reference fields such as Sourcename, Jurisdiction, and Location were taken from the combined TEM data provided by Metro Vancouver. Once all the new fields were completed, a series of error checks were done to identify inconsistencies and to ensure all component deciles summed to 10. Finally, all cases where data was collected but blank were coded as "null". In cases where data was not collected a code of 999 was used (99 if 2-character).

Adding riparian and wetland sensitive ecosystem codes

Riparian and wetland Sensitive Ecosystem classes were assigned according to the TEM attribute data. Wetlands were included mainly to assist in the derivation of final Riparian polygons described below. For each component, an SE class and subclass was assigned based on site unit and site modifiers. A code of XX:xx was used where riparian/wetland were not applicable but where other components in the polyon were. Ecosystem component deciles were assigned based on the original TEM deciles, except where multiple components were assigned identical SE class/subclass, their decile values were amalgamated.

Merging data

Once completed, all data fields except the new standardized set were deleted from each of the unit databases. All five completed unit data were then merged in ArcMap. A final check of spatial features was done to ensure no errors occurred in the attribute processing and data merge steps.

Creating Riparian Sensitive Ecosystem Data

Processing available data to create a database of riparian polygons required a relatively complex series of steps. These were developed after a thorough review of available data and review of a pilot analysis with Metro Vancouver staff. Aside from assigning sensitive ecosystem riparian/wetland classes to TEM data, and deriving river polygons, each park and watershed were processed individually to maintain control over all changes. The completed units were then merged into a single riparian layer. The following is a synopsis of data processing steps.

Create river polygon data.

Stream data for the project area was obtained from Metro Vancouver. For the watershed/LSCR, the hydrology data provided by Operations and Maintenance was used. This was their most current data and included fish classification data. For all other areas, the stream coverage provided by Parks was used. River polygons were created from this data based on extracting 2-sided lines classified as banks. All polygons identified as rivers in the TEM data were also extracted. The stream data rivers and TEM rivers were subsequently merged. Where these appeared to overlap, the sections that best fit the existing rivers visible in orthophotos were retained. The result was a feature class of river polygons for the entire project area.

Processing Parks.

Individual parks were processed in the following steps.

Assemble component data

River polygons, streams, and riparian/wetland SE polygons extracted from the TEM data were clipped out using park boundaries generated from the original TEM data. The stream data was then reviewed and segments considered “non-riparian” such as ditches, culverted sections, etc. were identified from the stream attributes and deleted. The remaining stream data was then reviewed in relation to the orthophoto data to clean up any odd or incorrect pieces. The result formed the final stream layer.

Buffers were then assigned to the river and stream features. For streams, a 20m buffer was used and for river polygons a 50m buffer was used. Fish classification data was not consistently available for Parks stream data so further buffer refinement was not used. Buffers of 50m width were also created around lake polygons identified in the TEM data. All buffers were merged and dissolved to create a single buffer layer. Buffers were then reviewed in relation to orthophotos and areas that did not represent potential riparian vegetation were deleted (e.g. parking lots, fields, landscaping, buildings, etc.).

The orthophotos were reviewed in relation to available data and any obvious areas that appeared to represent riparian sensitive ecosystem (SE) classes and were not captured in the TEM data were delineated (Figure VI-1).

Figure VI-1: RI:gu polygons delineated in Pacific Spirit Park based on local knowledge and orthophoto features

Merge and process component data

The component data was then "unioned" in ArcMap, resulting in a new layer that included all polygons and attributes from TEM-derived riparian/wetland, buffers, and new riparian polygons if delineated. The resulting data table was edited in Access 2003 in order to create the final riparian classes. The basic classification strategy used the following criteria:

- Wetland SE class was considered more important ("trumped") riparian SE class. All polygons that were dominated by WN were deleted as these would be included in the subsequent SE classification project. Polygons where WN was a minor component were retained.

- Avalanche track SE subclass was considered more important ("trumped") riparian SE class. All polygons that were dominated by AP:av were deleted as these would be included in the subsequent SE classification project. Within the Parks data this only applied to Lynn Headwaters.

- TEM-derived riparian classes were assigned to the final SE fields.

- All other remaining areas were classified as riparian fringe (buffers that fall outside of TEM-derived riparian polygons).

After the data was processed following these criteria, it was dissolved on the new SE fields to create the riparian layer. This was subsequently edited to remove any slivers or other irregular polygons. Figures VI-2 to VI-5 illustrate the process for creating riparian polygon for a portion of Glen-West Ck. park.

Figure VI-2: Glen-West Ck stream and lake buffer

Figure VI-3: Glen-West Ck. TEM-derived riparian polygons

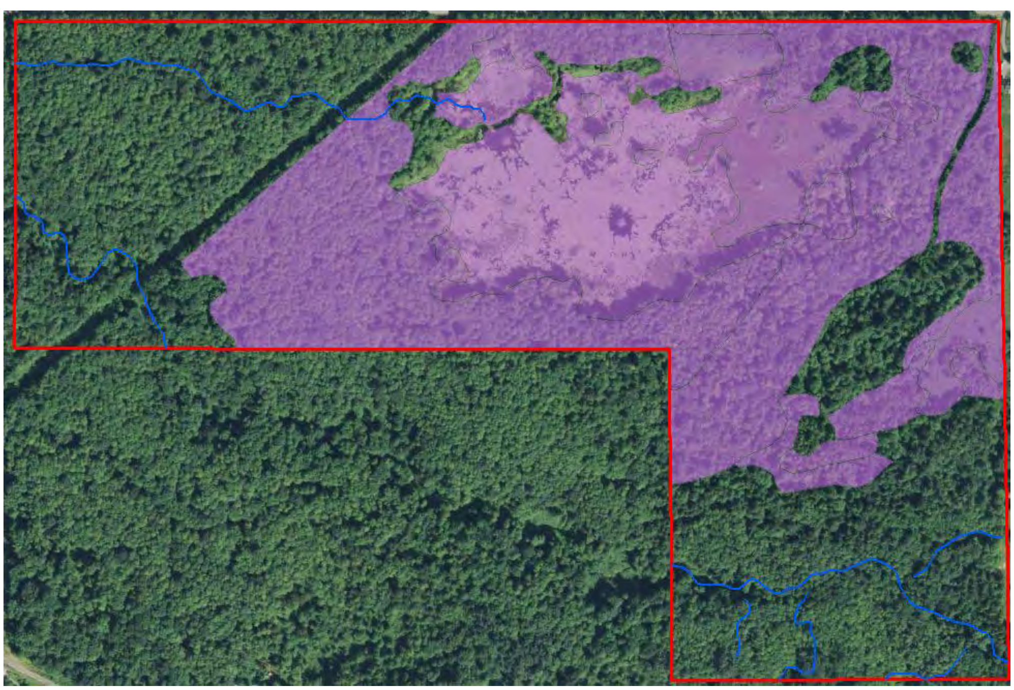


Figure VI-4: Glen-West Ck. TEM-derived wetland polygons

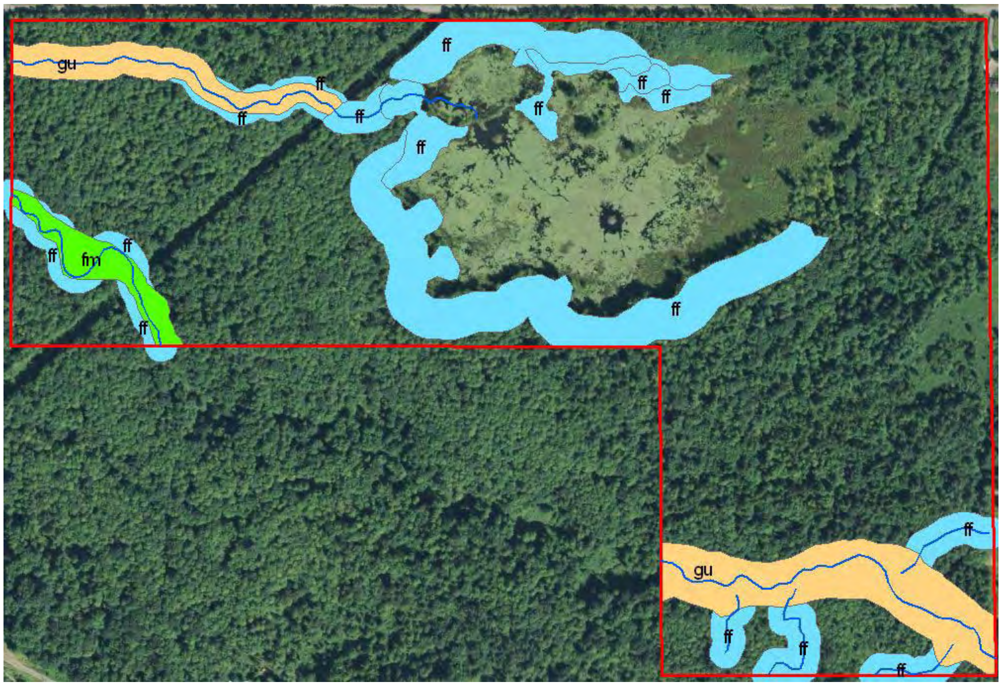


Figure VI-5: Glen-West Ck. final riparian polygons

Processing Watersheds/LSCR and Lynn Headwaters

The three watersheds, the LSCR and Lynn Headwaters differed from the rest of the project area because of their distinct mountainous terrain. In particular, they feature very high stream densities, strong relief, and subalpine and alpine ecosystems. In addition, the watersheds/LSCR represent legacy TEM data collected using somewhat different methodologies compared to the Parks inventory. The general process for identifying riparian areas was similar to that used with Parks, with a few additional steps.

Avalanche polygons were extracted from the TEM data and manually reviewed in relation to the orthophotos to identify those which were clearly dominated by avalanche and were not complex slopes of avalanche tracks and forested ecosystems. This formed an additional component to integrate into the riparian assessment.

In the watershed/LSCR data, ravine (e.g. gully) polygons were mapped as part of the 1:20,000 bioterrain delineations. In many cases these were identified with ravine site modifiers or site units. These were assigned RI:gu SE classes in the TEM-derived riparian data. In the Coquitlam watershed, no site modifiers were included so mapped polygons flanking creeks were manually assessed in relation to orthophoto data and assigned a RI:gu class if they appeared to represent ravines. Polygons assigned site unit “93” are rock ravines in the original inventory. These were reviewed in relation to orthophoto data and assigned RI:gu SE class if they were vegetated.

The stream data for the watersheds/LSCR had complete fish classification data. Because of this detail, an additional buffer width was used. Streams classed as S2 were assigned a 30m buffer, while 2-sided rivers and all other streams were assigned 50m and 20m buffers, respectively.

As part of processing the data, the buffer polygons were reviewed in relation to orthophotos to identify and delete areas that did not represent potential riparian vegetation. Most of this included non or sparsely forest rock in the Mountain Hemlock parkland and Coastal Mountain-heather Alpine.

The classification strategy used to assign riparian attributes in the final dataset resulting from union of all components was similar to that followed for the Parks data. Because of the complexity of the polygons reflecting the high stream density and the TEM-derived riparian features, there were considerably more slivers and other anomalies that had to be manually edited from the data.

Figures VI-6 to VI-9 illustrate the process for creating riparian polygon for a portion of Capilano watershed.

Figure VI-6: Capilano watershed stream buffer

Figure VI-7: Capilano watershed TEM-derived riparian polygons (no wetlands in this area)

Figure V-8: Capilano watershed avalanche polygons

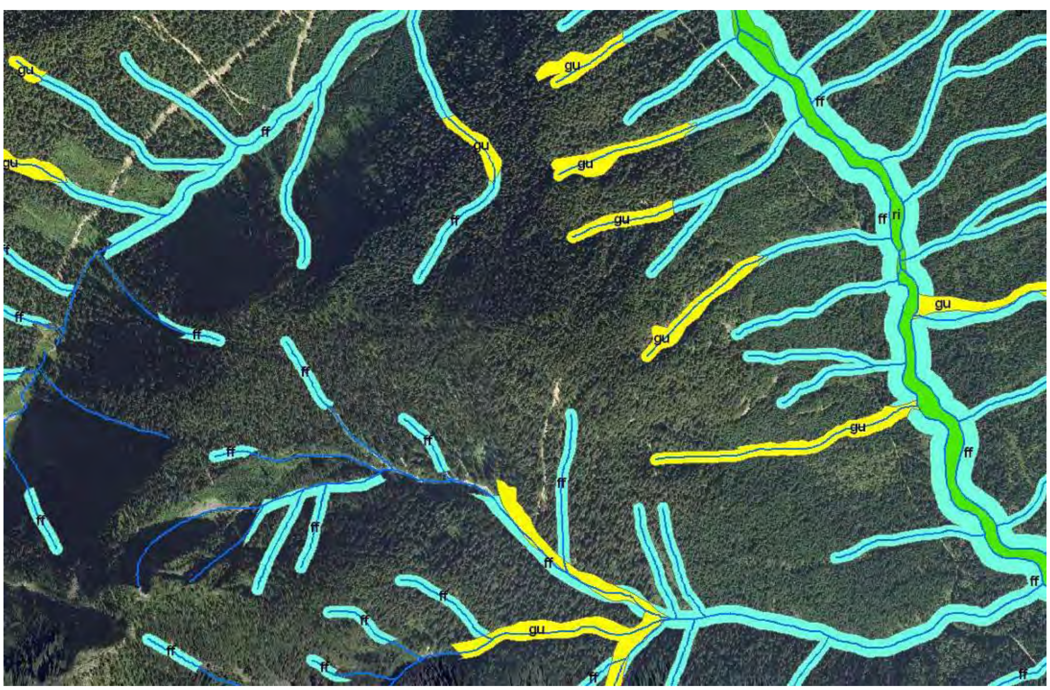


Figure VI-9: Capilano watershed final riparian polygons

References

Green, R.N. and K. Klinka. 1994. A field guide to site identification and interpretation for the Vancouver Forest Region. Land Manag. Hnbk. No. 28. B.C. Min. For., Victoria, B.C.

MacKenzie, W.H. and J.R. Moran. 2004. Wetlands of British Columbia. Res. Br., B.C. Min. For., Victoria, B.C. Land Manage. Handb. No. 52.

Appendix VII: Sumas Mountain Ecological Data Compilation

Extract from a report by B.A. Blackwell & Associates Ltd. to Metro Vancouver – "Sumas Mountain Ecological Data Compilation. Background for Metro Vancouver Parks Wildfire Risk Management System (WRMS) 2013 Update"

Introduction

WRMS analysis was extended to the recently acquired Sumas Mountain Regional Park located northeast of Abbotsford, B.C. (Figure VII-1). The WRMS analysis focused on an area encompassed by a 500m buffer surrounding park properties. This area spanned the City of Abbotsford and the FVRD Electoral Area G. Data to support development of ecological integrity layers for the WRMS analysis included terrestrial ecosystem mapping (TEM) and sensitive ecosystem inventory (SEI). This section describes the compilation and standardization of these data.

TEM Data

The available TEM database for the Sumas Mountain area was completed by TAARA Environmental in 2010 (Durand, 2010). This data covers the majority of Sumas Mountain but was delivered as two separate packages for the City of Abbotsford SEI (City of Abbotsford Lands) and the Fraser Valley Conservancy SEI (FVRD Electoral Area G). The mapping methodology was the same for both areas. The 500m buffer project area around the Metro Vancouver Parks properties is covered completely by the TAARA data, with the exception of some small pieces of agricultural land along the western boundary.

The TEM data was generated following standard provincial methodology (RISC 1996). The core attributes are consistent with the Metro Parks TEM database with the exception of site modifiers which were not included in the Sumas TEM data. Missing these attributes does not significantly impact the intended applications of the data. The data was reviewed and considered suitable for the WRMS application, with the exception of the distribution of the 04 site series which appeared somewhat overmapped, with 04-leading polygons comprising approximately 34% of the project area.

The TEM database was standardized to be consistent with the Metro Parks regional TEM data. This included adjusting the 04 site series polygon composition as needed, standardizing the attribute database structure to the Metro Parks model, incorporating the TAARA field inspection location data into the polygon Sample Type field, and filling in the data gaps along the western boundary.

Digital stereo airphoto imagery was obtained for the project area, controlled to the provincial TRIM DEM, and associated Purview photo models generated. This was used for viewing and adjusting polygon attributes directly in an ArcMap geodatabase environment using the PurView 3D mapping system. Field work was conducted to review site series classification in a number of polygons dominated by 04 site series in the mapping data. A total of 14 plots were established. The results of this assessment were used to review all polygons with an 04 component using the PurView mapping system. The attribute database was adjusted as required. Table VII-1 summarizes the results of the site series 04 adjustment.

Table VII-1: Polygon composition of 04 site series before and after adjustment

Site series 04 presence	% of project area	
	Original	After adjustment
None	51%	61%
In component 1	34%	18%
In component 2	12%	17%
In component 3	3%	5%

The PurView mapping system was also used to fill in the TEM data gap along the western boundary. This area was dominated by agricultural fields, with a minor area of floodplain ecosystems.

SEI Data

Sensitive Ecosystem Inventory (SEI) data was processed to meet two objectives: a) to derive ecological integrity layers for the WRMS analysis, and b) to fill in a data gap in the recently completed SEI for Metro Vancouver and Abbotsford regions (Meidinger et al. 2012). The SEI data gap encompassed the majority of Sumas Mountain, including the McKee Peak Planning Area to the south. The approach was to focus on deriving an SEI database for the data gap, which would also serve for the WRMS analysis. The TAARA TEM data included SEI classification using the provisional classes and subclasses from Metro Parks at the time of mapping. However, the “riparian fringe” class was not mapped due to concerns over excessive riparian density. For the McKee Peak area, TEM data was available from a 2006 project completed by Madrone Environmental Services (Reid 2006), however this did not include SEI classification data.

The McKee Peak data was processed to generate an SEI database, exclusive of riparian fringe classification. TEM label data was translated into a TEM database format. Stand composition modifiers were added based on assessment of polygons using the most recent digital orthophoto data. SEI classes were assigned according to “TEM to SEI crosswalk tables” and procedures described in Meidinger et al. (2012). Finally, the database structure was standardized to the Metro Parks SEI data format. The TAARA SEI data was standardized to the Metro SEI database structure (Meidinger et al. 2012). All SEI codes were checked and adjusted as needed to be consistent with the Metro standard (e.g. NS class not used in Metro data, YF polys < 5 ha in size changed to YS, etc.). Polygons with identical SEI attributes were rolled up as per Meidinger et al (2012). Once both datasets were standardized, they were merged into a single provisional SEI database for the entire Sumas Mountain project area.

Riparian fringe/gully polygons were mapped separately for the entire SEI project area using the PurView digital mapping system. This was conducted in three passes. In the first pass, riparian fringe/gully polygons were delineated following the procedures described in Meidinger et al (2012). The Metro Parks stream database was used as a guide for identifying stream locations, recognizing there are spatial inaccuracies in this data. Very small streams that looked ephemeral based on large scale image analysis were excluded. In the second pass, detailed stream data for the City of Abbotsford portion of the project area were obtained from a Sensitive Habitat Inventory and Mapping (SHIM) inventory conducted from 2006-2009. Stream locations were located by GPS and detailed attributes collected including watercourse type and width. Mapped fringe from the first pass was deleted around watercourses classified as culverts, ditches, ephemeral, or intermittent. All fish-bearing streams were identified to ensure riparian fringe was mapped, with the remaining streams less than 0.5m wide reviewed carefully using the PurView mapping system and riparian fringe added where required. Metro Parks staff reviewed the data at this stage and in the third pass, revisions were made based on their suggestions. Once riparian polygons were finalized, the standard SEI attribute database was appended and SEI attributes assigned to each polygon based on interpretation of the imagery using PurView. The riparian polygons were then merged back into the SEI database following procedures described by Meidinger et al (2012) for “incorporating riparian polygons for watersheds/LSCR and Lynn Headwaters”. Slivers < 0.1 ha were dissolved in ArcMap, then an additional polygon cleaning process was completed to manually remove additional sliver or irregular polygons. The final step was to assign SEI condition class to each polygon using the PurView mapping system and following procedures described by Meidinger et al (2012).

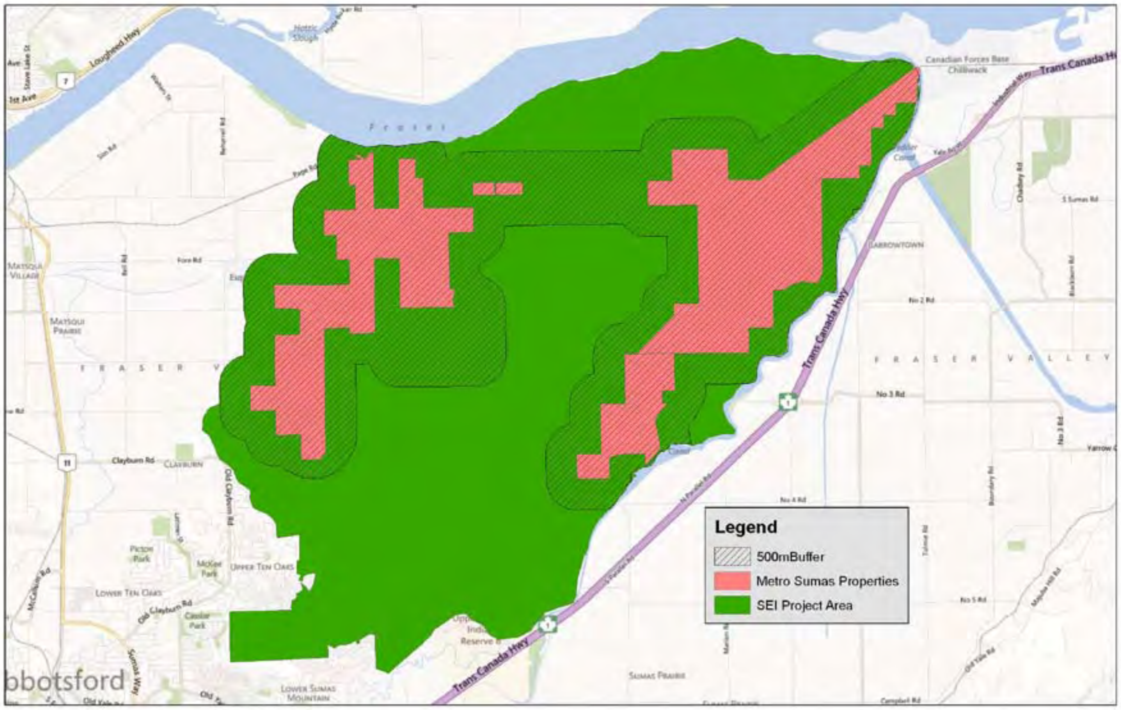


Figure VII-1: Metro Regional Park property, 500m buffer WRMS project area, and SEI project area

References

Durand, R. 2010. City of Abbotsford Sumas Mountain Sensitive Ecosystems Inventory. Contract report to City of Abbotsford by TAARA Environmental.

Meidinger, D., J. Clark, and D. Adamoski. 2012. Sensitive Ecosystem Inventory for Metro Vancouver and Abbotsford – 2010-2012. Metro Vancouver Internal Report.

Reid, H. 2006. Terrestrial Ecosystem Mapping – McKee Peak, Abbotsford, B.C. Contract report to City of Abbotsford by Madrone Environmental Services.

Appendix VIII: Biogeoclimatic Zonation of Sumas Mountain

In the TEM and SEI mapping of Sumas Mountain, undertaken by consultants to the Fraser Valley Conservancy (FVC), the biogeoclimatic zonation concepts and mapping followed the provincial biogeoclimatic linework. In the conduct of the SEI for Metro Vancouver and Abbotsford, we modified the provincial mapping to a more local scale and in doing so also modeled 'missing' biogeoclimatic units in the provincial mapping. Of relevance to the Sumas Mountain area is that the provincial mapping does not recognize the CWHvm1 – the Submontane variant of the Very Moist CWH – due to the scale of the provincial mapping. The CWHvm1 occurs between the lower elevation CWHdm (Dry Maritime CWH) and the Montane variant of the CWHvm (CWHvm2).

Figure VIII-1 shows the biogeoclimatic mapping of Sumas Mountain. Three sources of mapping are shown on this map:

1. The pink lines are the provincial mapping;
2. The coloured polygons the original Sumas Mtn. SEI mapping conducted for the Fraser Valley Conservancy; and,
3. The green lines show the modified BGC mapping produced for the MetroVancouver and Abbotsford SEI.

When conducting the SEI mapping over MetroVancouver and Abbotsford, in addition to the provincial biogeoclimatic (BGC) mapping, there was BGC mapping available in more localized TEM mapping – both in Regional District Parks scattered throughout and over the whole area of the watersheds in the northern mountains. These two sources of were combined and regional scale coverage obtained through the following steps:

1. BGC mapping in the northern mountains was evaluated and used where it was reasonable and consistent. In general, the watershed mapping was OK – some modifications were made to the parkland and alpine boundaries.
2. For the rest of the northern mountains, including both the provincial park BGC mapping and areas without BGC mapping, BGC elevation/aspect rules were developed from consideration of watershed BGC mapping and forest cover attributes in VRI. This modeling process 'downscaled' the provincial coverage and added in 'missing' BGC units, like the CWHvm1.
3. The provincial coverage over the valley area was reconciled with the more detailed BGC mapping within the Regional District Parks TEM mapping.

To reconcile the differences in the BGC mapping of Sumas Mountain shown in Figure VIII-1, the field data collected during the conduct of the Sumas Mtn. TEM & SEI was reviewed. The following modifications were made to the BGC mapping.

CWHdm vs. CWHxm1

The linework between sources for these two units is quite similar. In comparison to the CWHdm, and from a broad perspective, the CWHxm1 has less vine maple, less *Plagiothecium undulatum*, some vanilla-leaf, minor ocean-spray and baldhip rose on circum-mesic sites, and arbutus on dry sites. The presence of each of these species in the field data was queried and their locations compared to the BGC linework but the distributions did not provide any resolution of which mapping was best to use. Overall, the CWHxm1 occurs in the valley bottom – whereas the CWHdm is on the mountain slopes. The boundary between these two units in the MV mapping follows an elevational boundary at a more local scale than the provincial mapping – so it was selected to map the boundary between these two units.

CWHvm1 & CWHvm2 vs. CWHdm

There are several issues related to these three BGC units: 1) the extent of the CWHvm and its boundary with the CWHdm; 2) whether CWHvm1 occurs on mountain; and 3) whether CWHvm1 and CWHvm2 both occur.

In a logical elevation sequence, the CWHvm1 occurs above the CWHdm and below the CWHvm2. It is differentiated from the CWHdm by common amabilis fir and Alaskan blueberry (which hare also in the CWHvm2). The CWHvm1 is differentiated from the vm2 by the absence of yellow-cedar and mountain hemlock, and less *Rhytidiopsis robusta*.

Although there is *Rhytidiopsis robusta* on the mountain, there is no yellow-cedar or mountain hemlock – which would seem to indicate that CWHvm2 is not present. Of the five plots with some *R. robusta*, four are in the area mapped by MV as CWHvm1 or 2, but only one is in the area of CWHvm2 mapped by the FVC (although two more are close to the boundary). The presence of this moss is not definitive though, as one observation is well into the CWHdm.

The range of distribution of amabilis fir and Alaskan blueberry is only within the MV CWHvm2, i.e., not as low as the CWHvm1 boundary. In addition, 3 of 6 plots occur in the MV CWHvm2 polygon, but not in the FVC CWHvm2.

In addition to querying the field data, the visual plots were scanned for reference to these species.

Based on the assessment of field data and mapping, we decided that CWHvm2 does not occur on the mountain, that the boundary of CWHvm1 is higher in elevation than in the northern mountains, and corresponds to the CWHvm1/CWHvm2 boundary in Figure VIII-1. The reason for the CWHvm1 occuring at a higher elevation than in the north could be related to the isolation of this mountain in the valley, with perhaps greater heat being generated in the valley and impacting on the mountain, and the relatively small area of higher elevation forest. It could also be related to logging and fire history, but using available evidence, it definitely appears that the CWHvm is higher in elevation on Sumas Mountain.

Implementation

In order to adjust the BGC zonation as outlined above and apply to the SEI, the TEM ecosystems were modified, where necessary, to their equivalent ecosystem in the new

BGC by looking at both the type of ecosystem (forest, non-forest) and edatopic equivalent (e.g., 5D). Figure VIII-2 shows the final SEI polygons, with adjusted BGC lines.

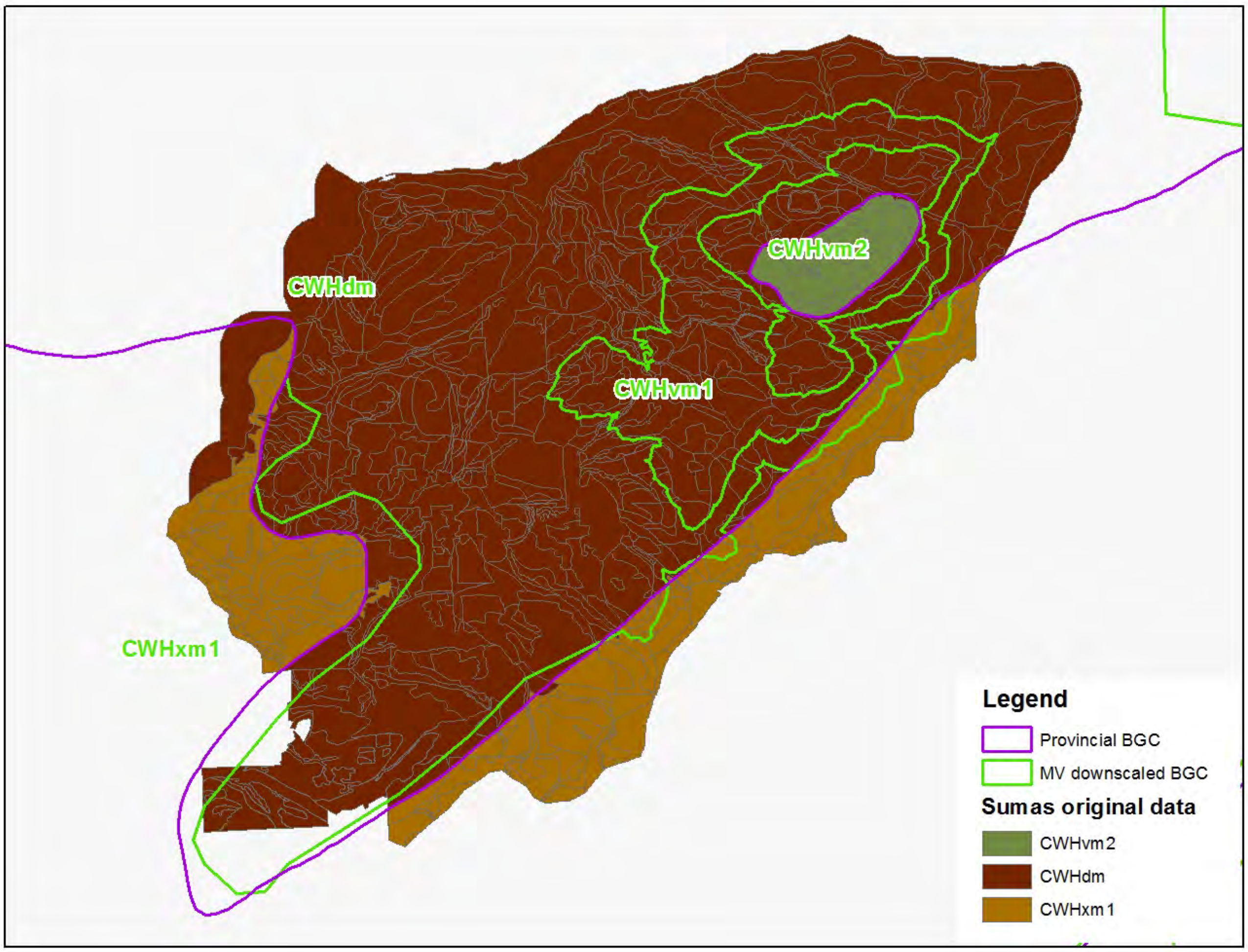


Figure VIII-1: Original Sumas biogeoclimatic zones

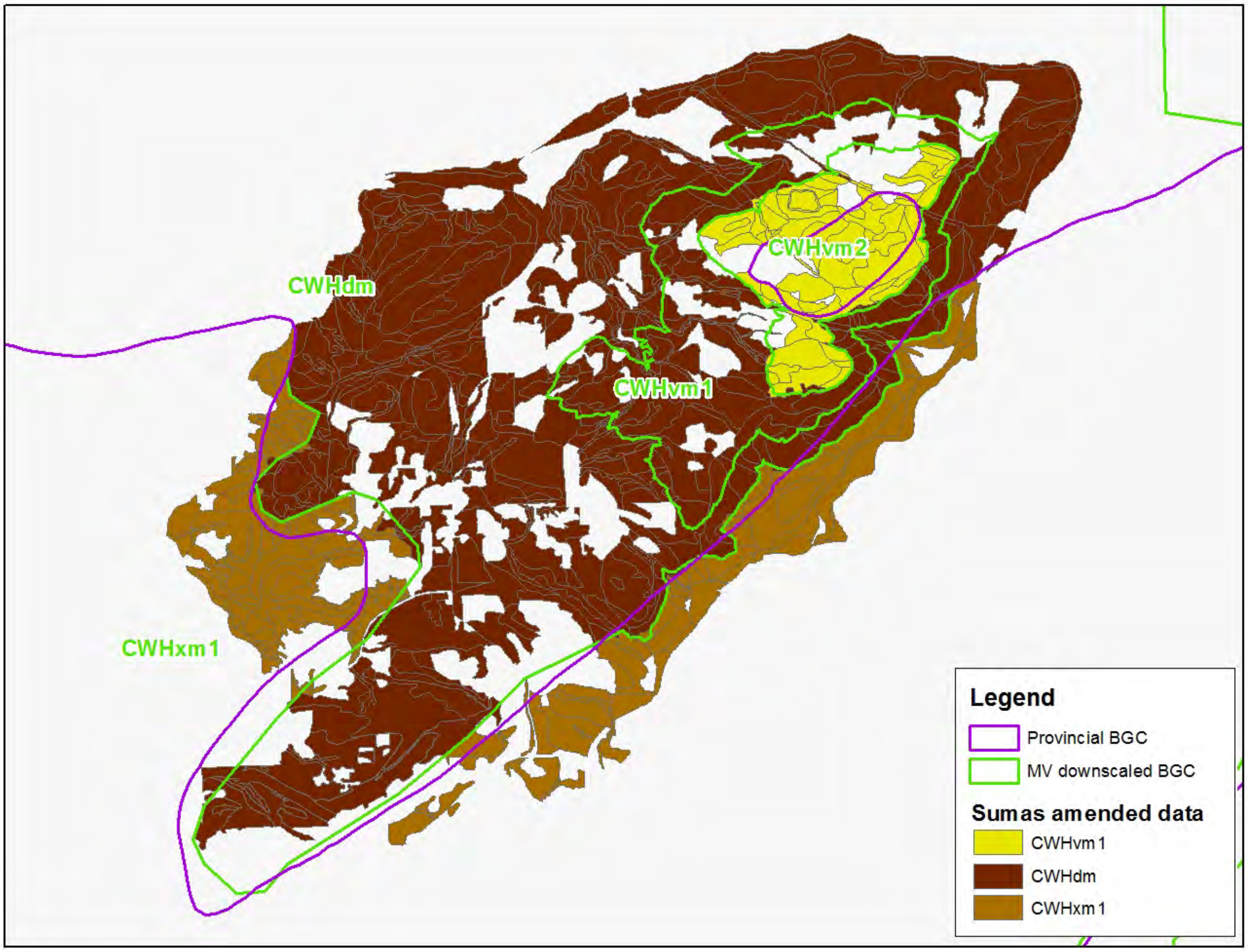


Figure VIII-2: Amended Sumas biogeoclimatic zones[17]

[17] Only SEI polygons shown

Appendix IX: Incorporating Bowen Island TEM/SEM data

Terrestrial Ecosystem Mapping was created for the Howe Sound Islands (including Bowen) in 2009 by Madrone Environmental Consultants, under contract to the Islands Trust. In 2010 the TEM was converted to modified Sensitive Ecosystem Inventory (SEI) classes and subclasses, called Sensitive Ecosystem Mapping (SEM).

For the Howe Sound Islands that fall within the Metro Vancouver region (Bowen Island, Bowyer Island and a few other small islands), this existing dataset was used to populate the Metro Vancouver SEI. A few modifications were necessary to ensure the data aligned with the rest of the inventory and these are documented below.

Biogeoclimatic mapping – Similarly to elsewhere in the Project Area, the biogeoclimatic mapping was downscaled to fix issues noted with the provincially-available biogeoclimatic layer (see Section 8).

Riparian fringe/gully – As with many other areas where SEI values were generated from existing mapping, riparian fringe and gully had to be delineated and added in. This was done in a similar manner as elsewhere with TEM mapping (see Section 7), using stream mapping, contour data, and visual assessment to develop a riparian layer which is then incorporated.

Old Field – This class was not included in the original mapping so the area was assessed, referring to the criteria documented in Appendix V. No sites were identified.

Seasonally Flooded Agricultural Fields – This class was included in the original mapping but using different criteria[18] to that used in Metro Vancouver's SEI. The area was reassessed following the protocol outlined in Section 4. No sites were identified.

Freshwater – Freshwater areas were classified as ponds if they were < 8 ha and lakes if they were > 8 ha. Reservoirs (RE in TEM) would have been classified as Freshwater Reservoirs in the SEI but none were present on the islands of interest.

Woodland – The ecosystem Douglas fir-Shore Pine-Cladina (Map code DC) was considered a forested SEM type in the original mapping. In the Metro Vancouver SEI this unit (and other '02' site series) was considered to be a better fit in the Woodland class so in keeping with the rest of inventory, these areas were reclassified as Woodland sites.

Herbaceous and Sparsely Vegetated classes – Some differences in the classification systems were present for these classes. The original mapping did not include a Sparsely Vegetated class but had additional subclasses within the Herbaceous class that overlapped with the Metro Vancouver Sparsely Vegetated class. The differences were as follows:

[18] Sites classified in the original TEM as Cultivated Fields without slope or shallow soil modifiers were crossed to Seasonally Flooded Agricultural Fields in the SEM

Table IX-1: Classification system differences for Herbaceaous and Sparsely Vegetated classes

TEM unit	SEM (original mapping)	SEI (Metro Vancouver's mapping)
RO	Herbaceous: rocky outcrop	Sparsely Vegetated: rocky outcrop
SC	Herbaceous: herbaceous	Sparsely Vegetated: rocky outcrop (inland); Herbaceous: coastal herbaceous or Herbaceous: vegetated shoreline (coastal)

The TEM unit SC (Cladina-Wallace's selaginella) was felt to be a better fit as a Sparsely Vegetated unit when found inland, and an Herbaceous unit when found by the coast, rather than as Herbaceous: herbaceous. The structural stage of all mapped SC is 1b (sparse/bryoid: bryophyte or lichen dominated). The unit is described as being found on "gentle slope, upper slope and crest positions, very shallow soils, very dry and rapidly drained". Although the HB: hb unit is also found on dry sites, it is "predominantly a mix of grasses and forbs". As such, these polygons were included with SV: ro, or where on the coast, with the coastal variations of HB.

Shoreline – Further detail was added to the shoreline mapping and classified using several subclasses not present in the original SEM mapping. These are Intertidal: beaches; Intertidal: mudflats; Herbaceous: coastal herbaceous; and, Herbaceous: vegetated shoreline.

Wetlands – Several sites in the original TEM were classified as Ws50 (Pink spirea-Sitka sedge) and crossed to Wetland: fen in the SEM mapping. Upon examination, it was felt that Wetland: swamp was a better fit for these units.

Non-contiguous forest blocks – In some areas where development is interspersed with forest, further detail was added by pulling out only the larger areas of contiguous forest, rather than representing the area as a complex of non-sensitive ecosystem with forest.

Updating for change – Updates were made to the mapping where necessary, if changes had occurred since the original work.

Crippen Regional Park – Metro Vancouver had TEM data for Crippen Regional Park on Bowen Island and this mapping was used to generate the SEI in this area rather than the Islands Trust TEM/SEM mapping.

Appendix X: Quality Assurance Procedures

Introduction

The Metro Vancouver Sensitive Ecosystem Inventory is being conducted over 2 – 3 years by both contract and staff specialists, incorporating multiple data sources. As such, quality assurance procedures are critical to ensure mapping consistency and quality.

Principles

The following principles will form the basis of QA for the SEI:

- The Mapping Procedures for the Metro Vancouver Sensitive Ecosystems Inventory is a critical document for ensuring consistency in mapping.
- QA is to be conducted at various times throughout the mapping
- QA activities and assessments will be documented.
- All participants in the SEI have a responsibility for QA.

Procedures & Documentation

The SEI is being completed over several project areas. For each area of mapping, the following QA procedures are recommended.

Initial QA

The goals of early QA are to ensure that:

- the mapping is following standards,
- the mapping is consistent with other SEI mapping that has been conducted, and,
- new issues are identified and dealt with early on.

Initial QA can result in efficiency in the mapping and therefore cost-effective implementation.

Initial QA will be conducted on one or more sample areas, representative of the range of conditions in the project areas.

Documentation should note the initial QA steps that were undertaken and document issues that were identified and their resolution. The mappers should document the steps they have taken to ensure consistency in their mapping. The mapping procedures may need to be updated to clarify aspects that were unclear or not covered.

On-going QA

The goal of the mid-project QA is to determine, on an on-going basis, whether mapping is consistent with the mapping procedures and other SEI mapping in the District.

On-going QA is an iterative process between mappers and QA personnel. In order for the mapping to proceed in efficiently, coordination between participants is essential. The focus should be on QA of early stages of mapping.

Documentation should note the QA steps that were undertaken and note whether there were any issues that required consultation and/or resolution. Again, the mapping procedures may require updating.

Final QA

QA at completion of a project area will evaluate the mapping and provide a QA report including an assessment of the map quality and where it could be improved in subsequent iterations of the SEI. Contributions from the mappers on issues they encountered and their resolution can ensure a comprehensive QA report.

A reasonable number of polygons should be evaluated and their acceptability documented – the number dependent upon the project area. This should be a combination of remote assessment and field visitation, with the balance depending upon resources. Statistics on the proportion of acceptably mapped polygons should be determined, at both the SEI Class and Subclass level (see Section 10).

Table X-1: QA Responsibilities

Participant	Responsibilities
Mappers	Ensure that all mapping adheres to Metro Vancouver SEI mapping procedures and digital standards. Provide QA personnel with all materials required to complete QA for each stage of the project. Identify mapping issues or procedures requiring clarification from QA personnel or SEI coordinator. Document internal QC procedures to ensure consistency in mapping. Contribute to documentation of final QA of the mapping by, e.g., identifying mapping issues encountered and how they were dealt with, among others Update mapping, as required by the QA comments, ensuring that updates are applied to the whole project.
QA personnel	Ensure that all mapping adheres to Metro Vancouver SEI mapping procedures and that there is consistency in the mapping. Document all relevant communications about project QA. Prepare a QA Report. Recommend updates to Metro Vancouver SEI mapping procedures where necessary to improve clarity or deal with emerging issues. Notify the SEI coordinator of issues or concerns regarding any aspect of the mapping.
SEI	Ensure that all mapping adheres to MV SEI mapping standards – inventory and

coordinator	digital. Co-ordinate the scheduling and sequence of work between the mappers and QA personnel. Facilitate resolution of mapping issues during conduct of mapping and QA. Ensure that Metro Vancouver SEI mapping standards are updated, as necessary.

SEI Completion QA Report

Upon completion of the SEI, the individual project 'Final QA' reports should be compiled into an overall evaluation of the SEI. The statistics can be area weighted to provide a reasonable overall set of statistics. The report can also discuss the use and limitations of the SEI, based on its quality and known issues.

Appendix XI: Quality Assurance Report

Introduction

This report documents the independent quality assurance (QA) that has been conducted on the Metro Vancouver Sensitive Ecosystem Inventory[19]. Contractors also conducted internal Quality Control (QC) on their mapping. Independent QA was conducted at various times throughout the mapping, but with a focus early on, in order to ensure that:

- The mapping followed standards,
- It was consistent with other SEI mapping that has been conducted, and,
- New issues were identified and dealt with early on.

Initial and On-going QA

Table XI-1 identifies the formal QA feedback that was provided to contractors during the conduct of the mapping. Numerous discussions, meetings, and e-mails were also exchanged on issues throughout the mapping.

Table XI-1: Quality Assurance Feedback to Contractors

Date	Area	Number of polygons reviewed
Dec. 2010	Deer Lake Park riparian & wetlands	18
Jan. 2011	South Fraser riparian & wetlands	55
Jan. 2011	Southern MV riparian & wetlands (JL, TW)	37
Jan. 2011	Northern MV riparian & wetlands	27
April 2011	FREMP riparian & wetlands	70
May 2011	Parks riparian & wetlands	128
May 2011	Watersheds riparian & wetlands	100
June 2011	Map sheet 17 – other ecosystems	60
August 2011	Map sheets 5, 16, 17. 25, 26, 44, 47, 57, 56	187

In addition, feedback was provided during the mapping of the Modified Ecosystem classes – Old Field & Seasonally Flooded Agriculture Fields.

Final QA

Once the main mapping phase was complete, in March 2012, a sample of polygons was selected from the entire mapped area. Initially, a random sample of one percent of

[19] Revised Nov. 2013

polygons was selected – 242 polygons. This sample answers the question of how 'good' the mapping is overall – but does not sample many types adequately in order to determine how well the various subclasses are mapped. Therefore, a subsequent sample that focused on achieving a minimum number of samples of each mapped subclass was obtained. The rule set for the complete sample is shown in Table XI-2. The resulting sample distribution for the 553 polygons is shown in Table XI-3 (based on leading ecosystem in a polygon).

Table XI-2: Rule Set for Random Selection of Polygons for Quality Assurance in May 2012

Number of polygons of type mapped	Sample criteria
> 2000	1 %
> 1000	1.5 %
> 500	2 %
> 100	3 % but min. of 10
<= 100	Minimum of 7

After the Bowen and Sumas project areas were completed in October 2013, an additional 152 polygons were selected. This is about a 10% sample (1,515 polygons in total). The minimum of 7 criteria was maintained in order to try to have enough polygons to evaluate each mapping unit – however, in some cases there were not 7 polygons of the type.

Polygons were assessed remotely using available imagery, including:

- Metro Vancouver watershed image
- BING images
- Google Earth historical images

In addition, all data sources available to mappers were consulted including municipal contours, VRI, FREMP, TEM, streams and waterbodies, and TRIM. Although assessment was conducted remotely, more image sources were consulted to assess polygon mapping and condition, and it is likely that more time per polygon was spent on QA versus mapping.

Polygons were scored by an overlap assessment – for example, if a polygon was mapped as 80% ecosystem A and 20% ecosystem B, but the QA suggested the ratio as 60% A : 40% B, the overlap score would be 80%, i.e., the mapper got the full 60% of A and 20% of B.

Condition was scored as 100% if ‘correct’, i.e., QA assessment agreed with mapping – 50% if off by one class (considered an acceptable difference). In-between values were assigned if, e.g., one condition class was correct and another off by one class.

A summary of the results of the QA is show in Tables XI-6 and XI-7.

Table XI-3: Number of polygons sampled for each Class and Subclass (within Class)

Count	Class															
Subclass	**AP**	**ES**	**FS**	**FW**	**HB**	**IT**	**MF**	**OD**	**OF**	**RI**	**SV**	**WD**	**WN**	**YF**	**YS**	**Total**
av	15															15
bd							16							16	7	39
bg													13			13
bs						14										14
cl											10					10
co							30		36			24		27	6	123
cs					13											13
ds	10															10
el						7										7
ff										63						63
fh										11						11
fl										11						11
fm										17						17
fn													8			8
gu										29						29
hb	4															4
kr	7															7
la				9												9
md		6														6
mf						10				7						17
ms		10											13			23
mx							23		1			13		18	3	58
pd				16												16
pf	15															15
ri										10						10
ro											16					16
rs				7												7
sd											7					7
sp		7											26			33
sw													17			17
ta											22					22
tf		8														8
ts	4															4
vo									10							10
vs					8											8
wm													4			4
(blank)			10					12								22
Grand Total	**55**	**31**	**10**	**32**	**21**	**31**	**69**	**12**	**47**	**148**	**55**	**37**	**81**	**61**	**16**	**706**

Table XI-4: Summary of Overlap Scores

	Number	Class Overlap	Subclass Overlap
One percent - 2012	242	91.2	87.3
Additional sample - 2012	311	91.7	83.3
Entire sample - 2012	553	91.5	85.0
2012 & 2013 samples	706	91.5	85.9

Table XI-5: Summary of Condition Assessment Scores

	Number	Percent Correct	Percent Correct and Acceptable
One percent – 2012	234	84.0	90.4
Additional sample – 2012	274	87.5	92.1
Entire sample - 2012	508	85.8	91.3
2012 & 2013 samples	650	87.5	92.6

The goal in the mapping was to have the Class be correct at least 90% of the time; the subclass correct more than 80%. The final QA assessment indicates that this goal was met (TableXI-4).

To determine how well each Class / Subclass was mapped, the results were summarized by Class and Subclass (Table XI-6) using the leading ecosystem for a polygon to assign a polygon to a cell in the table (as a high proportion of polygons are entirely or mostly one ecosystem, this approach is valid). In most cases, the mapping was of reasonable quality when evaluated at the class or subclass. The following classes/subclasses had some issues:

Herbaceous Class (80% overlap score):

- HB:vs – vegetated shoreline (50% overlap score)
    - 8 polygons assessed (100% sample)
    - 3 polygons better mapped as HB:cs, IT:bs, IT:st or RI:ff
    - **if corrected as noted, no further action required**

Wetland Class (83% overlap score):

- WN:sw – shallow water (54% overlap score)

  - 17 polygons assessed
  - Issue is the proportion of FW:pd (or FW:la) versus WN:sw
  - **recommend reassessing at an appropriate time** – it is a fairly large task due to large number of polygons and need to use multiple imagery sources (dates)
- Other subclasses mapped well or reasonably well
  - WN:wm – 75%
  - WN:bg – 89%
  - WN:fn – 89%
  - WN:ms – 85%
  - WN:sp – 77%

Alpine Class (92% overlap score)

- AP:ts – tall shrub (35% overlap score)
  - 4 polygons assessed – 4 in database
  - one considered to be AP:av, one appeared to be an error as looks like OF:co, the other looked like WD and SV:ro/ta
  - there may be polygons called AP:av that could be in this subclass, from TEM mapping – could review AP:av polygons in the CWHvm2
  - **if corrected as noted, no further action required**
- AP:ds – dwarf shrub (60% overlap score)
  - 10 polygons assessed – 102 in database
  - almost always a component of AP:ds, but also AP:kr
  - **recommend assessing more polygons – perhaps re-mapping**
- Other subclasses mapped well
  - AP:hb is 73% but only 4 polygons and 'corrections' will improve mapping

Condition by class and subclass is shown in Table XI-7. Overall, condition is mapped reasonably well and does not need to be evaluated by class/subclass.

Concluding Remarks

Based on this quality assurance assessment, the mapping is well done – some issues have been noted but these can be 'fixed', if time permits, relatively easily. The 'errors' that were observed were not generally significant – i.e., they were calls that differed between very closely related classes/subclasses. For example, mature vs. old forest or mature vs. young forest; wetland shallow water vs. freshwater pond; rock outcrop vs talus, etc.

This assessment was not conducted with on-the-ground information – there are significant issues associated with trying to conduct a true 'accuracy assessment' over such a large area (cost) and with considerable private land (access).

Table XI-6: Percent overlap scores for Classes and Subclasses

Average	Class															
Subclass	**AP**	**ES**	**FS**	**FW**	**HB**	**IT**	**MF**	**OD**	**OF**	**RI**	**SV**	**WD**	**WN**	**YF**	**YS**	**Total**
av	95															95
bd							86							94	61	85
bg													89			89
bs						75										75
cl											90					90
co							96		93			98		93	93	95
cs					92											92
ds	60															60
el						100										100
ff										92						92
fh										95						95
fl										73						73
fm										95						95
fn													89			89
gu										77						77
hb	73															73
kr	81															81
la				89												89
md		93														93
mf						91				96						93
ms		84											85			85
mx							84		100			72		85	87	82
pd				83												83
pf	89															89
ri										81						81
ro											83					83
rs				71												71
sd											86					86
sp		96											77			81
sw													54			54
ta											85					85
tf		98														98
ts	35															35
vo									94							94
vs					50											50
wm													75			75
(blank)			95					95								95
Grand Total	**79**	**92**	**95**	**82**	**76**	**86**	**89**	**95**	**93**	**88**	**85**	**89**	**76**	**91**	**78**	**86**

Table XI-7: Percent correct and acceptable condition scores by Class and Subclass

Condition Score	**Class:**													
Sub-class	AP	ES	HB	IT	MF	OD	OF	RI	SV	WD	WN	YF	YS	Total
av	100													100
bd					86							78	93	84
bg											96			96
bs				96										96
cl									100					100
co					88		97			98		83	100	92
cs			100											100
ds	100													100
el				100										100
ff								94						94
fh								91						91
fl								86						86
fm								88						88
fn											100			100
gu								84						84
hb	100													100
kr	100													100
md		96												96
mf				100				93						97
ms		88									96			92
mx					74		0			100		89	100	84
pf	100													100
ro									100					100
sd									100					100
sp		93									88			89
sw											93			93
ta									100					100
tf		94												94
ts	88													88
vo							95							95
vs			94											94
wm											75			75
(blank)						100								100
Total	99	92	98	98	83	100	95	91	100	99	92	83	97	93

Appendix VIII: TEM to SEI Crosswalk Tables

TEM to SE Crosswalk Table - BGC Zone: CDFmm

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	*vo: very old*	Fd - Salal	01	DS	7b	C	0.5
		FdBg - Oregon grape	04	DG	7b	C	0.5
		CwFd - Kindbergia	05	RK	7b	C	0.5
		CwBg - Foamflower	06	RF	7b	C	0.5
		Cw - Vanilla-leaf	12	RV	7b	C	0.5
	co: coniferous	Fd - Salal	01	DS	7a	C	0.5
		FdBg - Oregon grape	04	DG	7a	C	0.5
		CwFd - Kindbergia	05	RK	7a	C	0.5
		CwBg - Foamflower	06	RF	7a	C	0.5
		Cw - Vanilla-leaf	12	RV	7a	C	0.5
	mx: mixed	Fd - Salal	01	DS	7	M	0.5
		FdBg - Oregon grape	04	DG	7	M	0.5
		CwFd - Kindbergia	05	RK	7	M	0.5
		CwBg - Foamflower	06	RF	7	M	0.5
		Cw - Vanilla-leaf	12	RV	7	M	0.5
MF: Mature Forest							
MF	*co: coniferous*	Fd - Salal	01	DS	6	C	5
		FdBg - Oregon grape	04	DG	6	C	5
		CwFd - Kindbergia	05	RK	6	C	5
		CwBg - Foamflower	06	RF	6	C	5
		Cw - Vanilla-leaf	12	RV	6	C	5
	mx: mixed	Fd - Salal	01	DS	6	M	5
		FdBg - Oregon grape	04	DG	6	M	5
		CwFd - Kindbergia	05	RK	6	M	5
		CwBg - Foamflower	06	RF	6	M	5
		Cw - Vanilla-leaf	12	RV	6	M	5
WD: Woodland							
WD	*co: coniferous*	FdPl - Arbutus	02	DA	7	C	0.5
		Fd - Oniongrass	03	DO	7	C	0.5
	mx: mixed	FdPl - Arbutus	02	DA	7	M	0.5
		Fd - Oniongrass	03	DO	7	M	0.5
	co: coniferous	FdPl - Arbutus	02	DA	6	C	0.5
		Fd - Oniongrass	03	DO	6	C	0.5
	mx: mixed	FdPl - Arbutus	02	DA	6	M	0.5
		Fd - Oniongrass	03	DO	6	M	0.5
RI: Riparian							
RI	*ff: fringe*						0.5
	fh: high bench floodplains	Cw - Snowberry	07	RS			0.5

RI	***fm: medium bench floodplains***	Act - Red-osier dogwood	08	CD			0.5
	fl: low bench floodplains	Act - Willow	09	CW			0.5
	gu: gully						0.5
	ca: canyon						0.5
	mf: mudflats						0.5
	ri: river	River	RI	RI			0.5
		Gravel bar	GB	GB			0.5
WN: Wetland							
WN	***bg: bog***	Pl - Sphagnum	10	LS			0.5
	fn: fen	Fen	35	FS			0.5
	ms: marsh	Marsh	36	MA			0.5
		Reed canarygrass	30	RG			0.5
	sp: swamp	Reed canarygrass	30	RG			0.5
		Hardhack	31	RG			0.5
		Cw - Skunk cabbage	11	RC			0.5
		Cw - Indian-plum	13	RP			0.5
		Cw - Slough sedge	14	CS			0.5
		Ep - Hardhack	23	BH			0.5
		Tall Shrub Swamp	33	WS			0.5
		Ep – Crab apple	28	BC			0.5
	sw: shallow water	Open water	OW	OW			0.5
	wm: wet meadow						0.5
HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	cs: coastal herbaceous						0.5
	vs: vegetated shoreline						0.5
	sh: shrub						0.5
SV: Sparsely Vegetated							
SV	***cl: cliff***	Cliff	CL	CL			0.5
	ro: rock outcrop	Rock outcrop	RO	RO			0.5
	ta: talus	Talus	TA	TA			0.5
	sd: sand dune	Large-headed sedge Dune	43	LH			0.5
		Dunegrass Dune	44	LM			0.5
	st: spit						0.5

ES: Estuarine							
ES	***sp: swamp***	Ep – Crab apple	28	BC			0.5
	md: meadow						0.5
	ms: marsh	Seashore saltgrass marsh	45	SM			0.5
		Typha-Lamb's quarters marsh	46	TL			
	tf: tidal flat	Tidal flat	47	TF			0.5
IT: Intertidal & shallow sub-tidal							
IT	***mf: mudflats***	Mudflats	MU	MU			0.5
	bs: beaches	Beaches	BE	BE			0.5
	el: eelgrass						0.5
FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
NOTES:							
28 - Check for WN:sp or ES:sp 30 - Check for WN:ms, WN:sp, OD or non SE/ME							

TEM to ME Crosswalk Table - BGC Zone: CDFmm

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	***co: coniferous***	Fd - Salal	01	DS	6	C	0.5
		FdBg - Oregon grape	04	DG	6	C	0.5
		CwFd - Kindbergia	05	RK	6	C	0.5
		CwBg - Foamflower	06	RF	6	C	0.5
		Cw - Vanilla-leaf	12	RV	6	C	0.5
	mx: mixed	Fd - Salal	01	DS	6	M	0.5
		FdBg - Oregon grape	04	DG	6	M	0.5
		CwFd - Kindbergia	05	RK	6	M	0.5
		CwBg - Foamflower	06	RF	6	M	0.5
		Cw - Vanilla-leaf	12	RV	6	M	0.5
	bd: broadleaf	Fd - Salal	01	DS	6	B	0.5
		FdBg - Oregon grape	04	DG	6	B	0.5
		CwFd - Kindbergia	05	RK	6	B	0.5
		CwBg - Foamflower	06	RF	6	B	0.5
		Cw - Vanilla-leaf	12	RV	6	B	0.5

YF: Young Forest							
YF	***co: coniferous***	Fd - Salal	01	DS	5	C	5
		FdBg - Oregon grape	04	DG	5	C	5
		CwFd - Kindbergia	05	RK	5	C	5
		CwBg - Foamflower	06	RF	5	C	5
		Cw - Vanilla-leaf	12	RV	5	C	5
	mx: mixed	Fd - Salal	01	DS	5	M	5
		FdBg - Oregon grape	04	DG	5	M	5
		CwFd - Kindbergia	05	RK	5	M	5
		CwBg - Foamflower	06	RF	5	M	5
		Cw - Vanilla-leaf	12	RV	5	M	5
	bd: broadleaf	Fd - Salal	01	DS	5	B	5
		FdBg - Oregon grape	04	DG	5	B	5
		CwFd - Kindbergia	05	RK	5	B	5
		CwBg - Foamflower	06	RF	5	B	5
		Cw - Vanilla-leaf	12	RV	5	B	5
FS: Seasonally Flooded Agricultural Fields							**2.5**
OD: Old Field							
OD		Reed canarygrass	30	RG			2.5
		Old Field	OF	OF			2.5
FW: Lakes & Ponds (Freshwater)							
FW	***re: reservoir***	Reservoir	RE	RE			0.5
NOTES:							
30 - Check for WN:ms, WN:sp, OD or non SE/ME							

TEM to SE Crosswalk Table - BGC Zone: CDFmm
Burns Bog

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	*vo: very old*	06 CwBg-Foamflower	RF		7b	C	0.5
		05 CwFd-Kindbergia	RK		7b	C	0.5
		Pine-salal forest	LG		7b	C	0.5
		Bi-salal woodland	BS		7b	C	0.5
	co: coniferous	06 CwBg-Foamflower	RF		7a	C	0.5
		05 CwFd-Kindbergia	RK		7a	C	0.5
		Pine-salal forest	LG		7a	C	0.5
		Bi-salal woodland	BS		7a	C	0.5
	mx: mixed	06 CwBg-Foamflower	RF		7	M	0.5
		05 CwFd-Kindbergia	RK		7	M	0.5
		Pine-salal forest	LG		7	M	0.5
		Bi-salal woodland	BS		7	M	0.5
MF: Mature Forest							
MF	*co: coniferous*	06 CwBg-Foamflower	RF		6	C	5
		05 CwFd-Kindbergia	RK		6	C	5
		Pine-salal forest	LG		6	C	5
		Bi-salal woodland	BS		6	C	5
	mx: mixed	06 CwBg-Foamflower	RF		6	M	5
		05 CwFd-Kindbergia	RK		6	M	5
		Pine-salal forest	LG		6	M	5
		Bi-salal woodland	BS		6	M	5
WD: Woodland							
	co:				6,7	C	0.5
	mx: mixed				6,7	M	0.5
RI: Riparian							
RI	*ff: fringe*						0.5
	fh: high bench floodplains					C?	0.5
	fm: medium bench floodplains					M?	0.5
	fl: low bench floodplains					D?	0.5
	gu: gully						0.5
	ca: canyon						0.5
	mf: mudflats						0.5
	ri: river						0.5

WN: Wetland							
WN	***bg: bog***	white beakrush-Sphagnum	RS				0.5
		10 Pl-Sphagnum	LS				0.5
		Tawny cottongrass-	CS				0.5
		Common rush-Sphagnum	JS				0.5
		Pine-salal forest	LG				0.5
		Bi-salal woodland	BS				0.5
		white beakrush-3way sedge	RD				0.5
	fn: fen						0.5
	ms: marsh	woolgrass wetland	WG				0.5
	sp: swamp	Bi-Reed canarygrass	BC				0.5
		Reed canarygrass-hardhack	CH				0.5
		Hardhack shrub	HH				0.5
		11 Cw-Skunk cabbage	RC				0.5
	sw: shallow water	open water	OW				0.5
		yellow waterlily watershield	WW				0.5
	wm: wet meadow	Bracken wet meadow	BL				0.5
HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	cs: coastal herbaceous						0.5
	vs: vegetated shoreline						0.5
	sh: shrub						0.5
SV: Sparsely Vegetated							
SV	***cl: cliff***						0.5
	ro: rock outcrop	Rock outcrop	RO				0.5
	ta: talus						0.5
	du: sand						0.5
	sp: spit						0.5
ES: Estuarine							
ES	***sp: swamp***						0.5
	md: meadow						0.5
	ms: marsh						0.5
	tf: tidal flat						0.5
FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
NOTES:							
LG - Check for WN:bg or Forest							
BS - Check for WN:bg or Forest							

TEM to ME Crosswalk Table - BGC Zone: CDFmm
Burns Bog

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	***co: coniferous***	06 CwBg-Foamflower	RF		6	C	0.5
		05 CwFd-Kindbergia	RK		6	C	0.5
		Pine-salal forest	LG		6	C	0.5
		Bi-salal woodland	BS		6	C	0.5
	mx: mixed	06 CwBg-Foamflower	RF		6	M	0.5
		05 CwFd-Kindbergia	RK		6	M	0.5
		Pine-salal forest	LG		6	M	0.5
		Bi-salal woodland	BS		6	M	0.5
	bd: broadleaf	06 CwBg-Foamflower	RF		6	B	0.5
		05 CwFd-Kindbergia	RK		6	B	0.5
		Pine-salal forest	LG		6	B	0.5
		Bi-salal woodland	BS		6	B	0.5
YF: Young Forest							
YF	***co: coniferous***	06 CwBg-Foamflower	RF		5	C	5
		05 CwFd-Kindbergia	RK		5	C	5
		Pine-salal forest	LG		5	C	5
		Bi-salal woodland	BS		5	C	5
	mx: mixed	06 CwBg-Foamflower	RF		5	M	5
		05 CwFd-Kindbergia	RK		5	M	5
		Pine-salal forest	LG		5	M	5
		Bi-salal woodland	BS		5	M	5
	bd: broadleaf	06 CwBg-Foamflower	RF		5	B	5
		05 CwFd-Kindbergia	RK		5	B	5
		Pine-salal forest	LG		5	B	5
		Bi-salal woodland	BS		5	B	5
FS: Seasonally Flooded Agricultural Fields							**2.5**
OD: Old Field							**2.5**
FW: Lakes & Ponds (Freshwater)							
FW	***re: reservoir***	Reservoir	RE	RE			0.5
NOTES:							

LG - Check for WN:bg or Forest
BS - Check for WN:bg or Forest

TEM to SE Crosswalk Table - BGC Zone: CWHxm1

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	*vo: very old*	HwFd - Kindbergia	01	HK	7b	C	0.5
		FdHw - Salal	03	DS	7b	C	0.5
		Fd - Sword fern	04	DF	7b	C	0.5
		Cw - Sword fern	05	RS	7b	C	0.5
		HwCw - Deer fern	06	HD	7b	C	0.5
		Cw - Foamflower	07	RF	7b	C	0.5
		Cw - Salmonberry	13	RB	7b	C	0.5
	co: coniferous	HwFd - Kindbergia	01	HK	7a	C	0.5
		FdHw - Salal	03	DS	7a	C	0.5
		Fd - Sword fern	04	DF	7a	C	0.5
		Cw - Sword fern	05	RS	7a	C	0.5
		HwCw - Deer fern	06	HD	7a	C	0.5
		Cw - Foamflower	07	RF	7a	C	0.5
		Cw - Salmonberry	13	RB	7a	C	0.5
	mx: mixed	HwFd - Kindbergia	01	HK	7	M	0.5
		FdHw - Salal	03	DS	7	M	0.5
		Fd - Sword fern	04	DF	7	M	0.5
		Cw - Sword fern	05	RS	7	M	0.5
		HwCw - Deer fern	06	HD	7	M	0.5
		Cw - Foamflower	07	RF	7	M	0.5
		Cw - Salmonberry	13	RB	7	M	0.5
MF: Mature Forest							
MF	*co: coniferous*	HwFd - Kindbergia	01	HK	6	C	5
		FdHw - Salal	03	DS	6	C	5
		Fd - Sword fern	04	DF	6	C	5
		Cw - Sword fern	05	RS	6	C	5
		HwCw - Deer fern	06	HD	6	C	5
		Cw - Foamflower	07	RF	6	C	5
		Cw - Salmonberry	13	RB	6	C	5
	mx: mixed	HwFd - Kindbergia	01	HK	6	M	5
		FdHw - Salal	03	DS	6	M	5
		Fd - Sword fern	04	DF	6	M	5
		Cw - Sword fern	05	RS	6	M	5
		HwCw - Deer fern	06	HD	6	M	5
		Cw - Foamflower	07	RF	6	M	5
		Cw - Salmonberry	13	RB	6	M	5
WD: Woodland							
WD	*co: coniferous*	FdPl - Cladina	02	DC	7	C	0.5
		FdPl - Cladina	02	DC	6	C	0.5
	mx: mixed	FdPl - Cladina	02	DC	7	M	0.5
		FdPl - Cladina	02	DC	6	M	0.5

RI: Riparian							
RI	***ff: fringe***						0.5
	fh: high bench floodplains	Ss - Salmonberry	08	SS			0.5
	fm: medium bench floodplains	Act - Red-osier dogwood	09	CD			0.5
		CwSs - Red-osier dogwood - Skunk	21	RD			0.5
	fl: low bench floodplains	Act - Willow (Fl50 - Sitka willow - False lily-of-the-valley)	10	CW			0.5
	gu: gully						0.5
	ca: canyon						0.5
	mf: mudflats						0.5
	ri: river	River	RI	RI			0.5
		Gravel bar	GB	GB			0.5
WN: Wetland							
WN	***bg: bog***	Pl - Sphagnum	11	LS			0.5
		Bog	34	BG			0.5
		Hw - Sphagnum	25	HP			0.5
	fn: fen	Sweet gale	41	SX			0.5
	ms: marsh	Marsh	36	MA			0.5
		Reed canarygrass	30	RG			0.5
	sp: swamp	Reed canarygrass	30	RG			0.5
		Hardhack	31	HG			0.5
		*CwSs - Skunk cabbage (Ws53 - Cw - Sword fern - Skunk cabbage)	12	RC			0.5
		*Cw - Black twinberry	14	RT			0.5
		*Cw - Slough sedge	15	CS			0.5
		Cw - Hardhack	22	RH			0.5
		Ep - Hardhack	23	BH			0.5
		Forest Swamp	24	TP			0.5
		Tall shrub swamp	33	WS			0.5
		Ep – Crab apple	28	BC			0.5
	sw: shallow water	Aquatics	37	AQ			0.5
		Open water	OW	OW			0.5
	wm: wet meadow						0.5
HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	cs: coastal herbaceous						0.5
	vs: vegetated shoreline						0.5
	sh: shrub						0.5

SV: Sparsely Vegetated							
SV	***cl: cliff***	Cliff	CL	CL			0.5
		Cw - Fern bluffs	20	RM			0.5
	ro: rock outcrop	Rock outcrop	RO	RO			0.5
	ta: talus	Talus	TA	TA			0.5
	sd: sand dune	Dunegrass dune	44	LM			0.5
	st: spit						0.5
ES: Estuarine							
ES	***sp: swamp***	Ep – Crab apple	28	BC			0.5
	md: meadow						0.5
	ms: marsh						0.5
	tf: tidal flat						0.5
IT: Intertidal & shallow sub-tidal							
IT	***mf: mudflats***	Mudflats	MU	MU			0.5
	bs: beaches	Beaches	BE	BE			0.5
	el: eelgrass						0.5
FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
NOTES:							
28 - Check for WN:sp or ES:sp 30 - Check for WN:ms, WN:sp, OD or non SE/ME							

TEM to ME Crosswalk Table - BGC Zone: CWHxm1

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	***co: coniferous***	HwFd - Kindbergia	01	HK	6	C	0.5
		FdHw - Salal	03	DS	6	C	0.5
		Fd - Sword fern	04	DF	6	C	0.5
		Cw - Sword fern	05	RS	6	C	0.5
		HwCw - Deer fern	06	HD	6	C	0.5
		Cw - Foamflower	07	RF	6	C	0.5
		Cw - Salmonberry	13	RB	6	C	0.5

MF	*mx: mixed*	HwFd - Kindbergia	01	HK	6	M	0.5
		FdHw - Salal	03	DS	6	M	0.5
		Fd - Sword fern	04	DF	6	M	0.5
		Cw - Sword fern	05	RS	6	M	0.5
		HwCw - Deer fern	06	HD	6	M	0.5
		Cw - Foamflower	07	RF	6	M	0.5
		Cw - Salmonberry	13	RB	6	M	0.5
	bd: broadleaf	HwFd - Kindbergia	01	HK	6	B	0.5
		FdHw - Salal	03	DS	6	B	0.5
		Fd - Sword fern	04	DF	6	B	0.5
		Cw - Sword fern	05	RS	6	B	0.5
		HwCw - Deer fern	06	HD	6	B	0.5
		Cw - Foamflower	07	RF	6	B	0.5
		Cw - Salmonberry	13	RB	6	B	0.5
YF: Young Forest							
YF	*co: coniferous*	HwFd - Kindbergia	01	HK	5	C	5
		FdHw - Salal	03	DS	5	C	5
		Fd - Sword fern	04	DF	5	C	5
		Cw - Sword fern	05	RS	5	C	5
		HwCw - Deer fern	06	HD	5	C	5
		Cw - Foamflower	07	RF	5	C	5
		Cw - Salmonberry	13	RB	5	C	5
	mx: mixed	HwFd - Kindbergia	01	HK	5	M	5
		FdHw - Salal	03	DS	5	M	5
		Fd - Sword fern	04	DF	5	M	5
		Cw - Sword fern	05	RS	5	M	5
		HwCw - Deer fern	06	HD	5	M	5
		Cw - Foamflower	07	RF	5	M	5
		Cw - Salmonberry	13	RB	5	M	5
	bd: broadleaf	HwFd - Kindbergia	01	HK	5	B	5
		FdHw - Salal	03	DS	5	B	5
		Fd - Sword fern	04	DF	5	B	5
		Cw - Sword fern	05	RS	5	B	5
		HwCw - Deer fern	06	HD	5	B	5
		Cw - Foamflower	07	RF	5	B	5
		Cw - Salmonberry	13	RB	5	B	5
FS: Seasonally Flooded Agricultural Fields							**2.5**
OD: Old Field							**2.5**
OD		Reed canarygrass	30	RG			2.5
		Old Field	OF	OF			2.5
FW: Lakes & Ponds (Freshwater)							
FW	*re: reservoir*	Reservoir	RE	RE			0.5
NOTES:							
28 - Check for WN:sp or ES:sp							
30 - Check for WN:ms, WN:sp, OD or non SE/ME							
OF - Check for inclusion to OD class							

TEM to SE Crosswalk Table - BGC Zone: CWHdm

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	***vo: very old***	FdHw - Salal	03	DS	7b	C	0.5
		Hw - Flat moss	01	HM	7b	C	0.5
		Fd - Sword fern	04	DF	7b	C	0.5
		Cw - Sword fern	05	RS	7b	C	0.5
		HwCw - Deer fern	06	HD	7b	C	0.5
		Cw - Foamflower	07	RF	7b	C	0.5
		Cw - Salmonberry	13	RB	7b	C	0.5
	co: coniferous	FdHw - Salal	03	DS	7a	C	0.5
		Hw - Flat moss	01	HM	7a	C	0.5
		Fd - Sword fern	04	DF	7a	C	0.5
		Cw - Sword fern	05	RS	7a	C	0.5
		HwCw - Deer fern	06	HD	7a	C	0.5
		Cw - Foamflower	07	RF	7a	C	0.5
		Cw - Salmonberry	13	RB	7a	C	0.5
	mx: mixed	FdHw - Salal	03	DS	7	M	0.5
		Hw - Flat moss	01	HM	7	M	0.5
		Fd - Sword fern	04	DF	7	M	0.5
		Cw - Sword fern	05	RS	7	M	0.5
		HwCw - Deer fern	06	HD	7	M	0.5
		Cw - Foamflower	07	RF	7	M	0.5
		Cw - Salmonberry	13	RB	7	M	0.5
MF: Mature Forest							
MF	***co: coniferous***	FdHw - Salal	03	DS	6	C	5
		Hw - Flat moss	01	HM	6	C	5
		Fd - Sword fern	04	DF	6	C	5
		Cw - Sword fern	05	RS	6	C	5
		HwCw - Deer fern	06	HD	6	C	5
		Cw - Foamflower	07	RF	6	C	5
		Cw - Salmonberry	13	RB	6	C	5
	mx: mixed	FdHw - Salal	03	DS	6	M	5
		Hw - Flat moss	01	HM	6	M	5
		Fd - Sword fern	04	DF	6	M	5
		Cw - Sword fern	05	RS	6	M	5
		HwCw - Deer fern	06	HD	6	M	5
		Cw - Foamflower	07	RF	6	M	5
		Cw - Salmonberry	13	RB	6	M	5
WD: Woodland							
WD	***co: coniferous***	FdPl - Cladina	02	DC	7	C	0.5
		Cw - Fern bluffs	20	RM	7	C	0.5
	mx: mixed	FdPl - Cladina	02	DC	7	M	0.5
		Cw - Fern bluffs	20	RM	7	M	0.5

WD	***co: coniferous***	FdPl - Cladina	02	DC	6	C	0.5
		Cw - Fern bluffs	20	RM	6	C	0.5
	mx: mixed	FdPl - Cladina	02	DC	6	M	0.5
		Cw - Fern bluffs	20	RM	6	M	0.5
RI: Riparian							
RI	***ff: fringe***						0.5
	fh: high bench floodplains	Ss - Salmonberry	08	SS			0.5
	fm: medium bench floodplains	Act - Red-osier dogwood	09	CD			0.5
	fl: low bench floodplains	Act - Willow (Fl50 - Sitka willow - False lily-of-the-valley)	10	CW			0.5
	gu: gully						0.5
	ca: canyon						0.5
	mf: mudflats						0.5
	ri: river	River	RI	RI			0.5
		Gravel bar	GB	GB			0.5
WN: Wetland							
WN	***bg: bog***	Pl - Sphagnum	11	LS			0.5
		Bog	34	BG			0.5
	fn: fen	Sweet gale	41	SX			0.5
		Fen	35	FS			0.5
	ms: marsh	Marsh	36	MA			0.5
		Reed canarygrass	30	RG			0.5
	sp: swamp	Reed canarygrass	30	RG			0.5
		Hardhack	31	HG			0.5
		CwSs - Skunk cabbage	12	RC			0.5
		Cw - Black twinberry	14	RT			0.5
		Cw - Slough sedge	15	CS			0.5
		Cw - Hardhack	22	RH			0.5
		Ep - Hardhack	23	BH			0.5
		Tall shrub swamp	33	WS			0.5
	sw: shallow water	Aquatics	37	AQ			0.5
		Open water	OW	OW			0.5
	wm: wet meadow						0.5
HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	cs: coastal herbaceous						0.5
	vs: vegetated shoreline						0.5
	sh: shrub						0.5

SV: Sparsely Vegetated							
SV	***cl: cliff***	Cliff	CL	CL			0.5
		Cw - Fern bluffs	20	RM			0.5
	ro: rock outcrop	Rock outcrop	RO	RO			0.5
	ta: talus	Talus	TA	TA			0.5
	sd: sand dune	Large-headed sedge dune	43	LH			0.5
		Dunegrass dune	44	LM			0.5
	st: spit						0.5
ES: Estuarine							
ES	***sp: swamp***						0.5
	md: meadow						0.5
	ms: marsh						0.5
	tf: tidal flat						0.5
IT: Intertidal & shallow sub-tidal							
IT	***mf: mudflats***	Mudflats	MU	MU			0.5
	bs: beaches	Beaches	BE	BE			0.5
	el: eelgrass						0.5
FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
NOTES:							
30 - Check for WN:ms, WN:sp, OD or non SE/ME							

TEM to ME Crosswalk Table - BGC Zone: CWHdm

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	***co: coniferous***	FdHw - Salal	03	DS	6	C	0.5
		Hw - Flat moss	01	HM	6	C	0.5
		Fd - Sword fern	04	DF	6	C	0.5
		Cw - Sword fern	05	RS	6	C	0.5
		HwCw - Deer fern	06	HD	6	C	0.5
		Cw - Foamflower	07	RF	6	C	0.5
		Cw - Salmonberry	13	RB	6	C	0.5

MF	mx: mixed	FdHw - Salal	03	DS	6	M	0.5
		Hw - Flat moss	01	HM	6	M	0.5
		Fd - Sword fern	04	DF	6	M	0.5
		Cw - Sword fern	05	RS	6	M	0.5
		HwCw - Deer fern	06	HD	6	M	0.5
		Cw - Foamflower	07	RF	6	M	0.5
		Cw - Salmonberry	13	RB	6	M	0.5
	bd: broadleaf	FdHw - Salal	03	DS	6	B	0.5
		Hw - Flat moss	01	HM	6	B	0.5
		Fd - Sword fern	04	DF	6	B	0.5
		Cw - Sword fern	05	RS	6	B	0.5
		HwCw - Deer fern	06	HD	6	B	0.5
		Cw - Foamflower	07	RF	6	B	0.5
		Cw - Salmonberry	13	RB	6	B	0.5
YF: Young Forest							
YF	co: coniferous	FdHw - Salal	03	DS	5	C	5
		Hw - Flat moss	01	HM	5	C	5
		Fd - Sword fern	04	DF	5	C	5
		Cw - Sword fern	05	RS	5	C	5
		HwCw - Deer fern	06	HD	5	C	5
		Cw - Foamflower	07	RF	5	C	5
		Cw - Salmonberry	13	RB	5	C	5
	mx: mixed	FdHw - Salal	03	DS	5	M	5
		Hw - Flat moss	01	HM	5	M	5
		Fd - Sword fern	04	DF	5	M	5
		Cw - Sword fern	05	RS	5	M	5
		HwCw - Deer fern	06	HD	5	M	5
		Cw - Foamflower	07	RF	5	M	5
		Cw - Salmonberry	13	RB	5	M	5
	bd: broadleaf	FdHw - Salal	03	DS	5	B	5
		Hw - Flat moss	01	HM	5	B	5
		Fd - Sword fern	04	DF	5	B	5
		Cw - Sword fern	05	RS	5	B	5
		HwCw - Deer fern	06	HD	5	B	5
		Cw - Foamflower	07	RF	5	B	5
		Cw - Salmonberry	13	RB	5	B	5
FS: Seasonally Flooded Agricultural Fields							**2.5**
OD: Old Field							
OD		Reed canarygrass	30	RG			2.5
		Old Field	OF	OF			2.5
FW: Lakes & Ponds (Freshwater)							
FW	re: reservoir	Reservoir	RE	RE			0.5
NOTES:							
30 - Check for WN:ms, WN:sp, OD or non SE/ME							

TEM to SE Crosswalk Table - BGC Zone: CWHvm1

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	*vo: very old*	HwBa - Blueberry	01	AB	7b	C	0.5
		HwCw - Salal	03	HS	7b	C	0.5
		CwHw - Sword fern	04	RS	7b	C	0.5
		BaCw - Foamflower	05	AF	7b	C	0.5
		HwBa - Deer fern	06	HD	7b	C	0.5
		BaCw - Salmonberry	07	AS	7b	C	0.5
		BaSs - Devil's club	08	AD	7b	C	0.5
		CwYc - Goldthread	12	YG	7b	C	0.5
	co: coniferous	HwBa - Blueberry	01	AB	7a	C	0.5
		HwCw - Salal	03	HS	7a	C	0.5
		CwHw - Sword fern	04	RS	7a	C	0.5
		BaCw - Foamflower	05	AF	7a	C	0.5
		HwBa - Deer fern	06	HD	7a	C	0.5
		BaCw - Salmonberry	07	AS	7a	C	0.5
		BaSs - Devil's club	08	AD	7a	C	0.5
		CwYc - Goldthread	12	YG	7a	C	0.5
	mx: mixed	HwBa - Blueberry	01	AB	7	M	0.5
		HwCw - Salal	03	HS	7	M	0.5
		CwHw - Sword fern	04	RS	7	M	0.5
		BaCw - Foamflower	05	AF	7	M	0.5
		HwBa - Deer fern	06	HD	7	M	0.5
		BaCw - Salmonberry	07	AS	7	M	0.5
		BaSs - Devil's club	08	AD	7	M	0.5
		CwYc - Goldthread	12	YG	7	M	0.5
MF: Mature Forest							
MF	*co: coniferous*	HwBa - Blueberry	01	AB	6	C	5
		HwCw - Salal	03	HS	6	C	5
		CwHw - Sword fern	04	RS	6	C	5
		BaCw - Foamflower	05	AF	6	C	5
		HwBa - Deer fern	06	HD	6	C	5
		BaCw - Salmonberry	07	AS	6	C	5
		BaSs - Devil's club	08	AD	6	C	5
		CwYc - Goldthread	12	YG	6	C	5
	mx: mixed	HwBa - Blueberry	01	AB	6	M	5
		HwCw - Salal	03	HS	6	M	5
		CwHw - Sword fern	04	RS	6	M	5
		BaCw - Foamflower	05	AF	6	M	5
		HwBa - Deer fern	06	HD	6	M	5
		BaCw - Salmonberry	07	AS	6	M	5
		BaSs - Devil's club	08	AD	6	M	5
		CwYc - Goldthread	12	YG	6	M	5

WD: Woodland							
WD	**co: coniferous**	HwPl - Cladina	02	LC	7	C	0.5
		Cw – Fern bluffs	20	RM	7	C	0.5
		HwPl - Cladina	02	LC	6	C	0.5
		Cw – Fern bluffs	20	RM	6	C	0.5
	mx: mixed	HwPl - Cladina	02	LC	7	M	0.5
		Cw – Fern bluffs	20	RM	7	M	0.5
		HwPl - Cladina	02	LC	6	M	0.5
		Cw – Fern bluffs	20	RM	6	M	0.5
RI: Riparian							
RI	***ff: fringe***						0.5
	fh: high bench floodplains	Ss - Salmonberry	09	SS			0.5
	fm: medium bench floodplains	Act - Red-osier dogwood	10	CD			0.5
	fl: low bench floodplains	Act - Willow (Fl50 - Sitka willow - False lily-of-the valley)	11	CW			0.5
	gu: gully						0.5
	ca: canyon						0.5
	mf: mudflats						0.5
	ri: river	River	RI	RI			0.5
		Gravel bar	GB	GB			0.5
WN: Wetland							
WN	***bg: bog***	Pl - Sphagnum (Wb51 - Plc - Black crowberry - Tough Peat-moss)	13	LS			0.5
		Bog	34	BG			0.5
	fn: fen	Shrub carr		HW			0.5
		Fen	35	FS			0.5
	ms: marsh	Marsh	36	MA			0.5
	sp: swamp	CwSs - Skunk cabbage (Ws54 - CwHw - Skunk cabbage)	14	RC			0.5
		Tall Shrub Swamp	33	WS			0.5
	sw: shallow water	Open water	OW	OW			0.5
	wm: wet meadow						0.5

HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	cs: coastal her						0.5
	vs: vegetated shoreline						0.5
	sh: shrub						0.5
SV: Sparsely Vegetated							
SV	***cl: cliff***	Cliff	CL	CL			0.5
		Cw - Fern bluffs	20	RM			0.5
	ro: rock outcrop	Rock outcrop	RO	RO			0.5
	ta: talus	Talus	TA	TA			0.5
	sd: sand dune						0.5
	st: spit						0.5
ES: Estuarine							
ES	***sp: swamp***						0.5
	md: meadow			AP			0.5
	ms: marsh						0.5
	tf: tidal flat						0.5
IT: Intertidal & shallow sub-tidal							
IT	***mf: mudflats***	Mudflats	MU	MU			0.5
	bs: beaches	Beaches	BE	BE			0.5
	el: eelgrass						0.5
FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
AP: Alpine							
AP	***hb: herbaceous***						0.5
	kr: krummholz						0.5
	pf: parkland forest						0.5
	ds: dwarf shrub						0.5
	ts: tall shrub						0.5
	av: avalanche tracks	Sitka alder – Salmonberry avalanche	38	SA			0.5

TEM to ME Crosswalk Table - BGC Zone: CWHvm1

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	*co: coniferous*	HwBa - Blueberry	01	AB	6	C	0.5
		HwCw - Salal	03	HS	6	C	0.5
		CwHw - Sword fern	04	RS	6	C	0.5
		BaCw - Foamflower	05	AF	6	C	0.5
		HwBa - Deer fern	06	HD	6	C	0.5
		BaCw - Salmonberry	07	AS	6	C	0.5
		BaSs - Devil's club	08	AD	6	C	0.5
		CwYc - Goldthread	12	YG	6	C	0.5
	mx: mixed	HwBa - Blueberry	01	AB	6	M	0.5
		HwCw - Salal	03	HS	6	M	0.5
		CwHw - Sword fern	04	RS	6	M	0.5
		BaCw - Foamflower	05	AF	6	M	0.5
		HwBa - Deer fern	06	HD	6	M	0.5
		BaCw - Salmonberry	07	AS	6	M	0.5
		BaSs - Devil's club	08	AD	6	M	0.5
		CwYc - Goldthread	12	YG	6	M	0.5
	bd: broadleaf	HwBa - Blueberry	01	AB	6	B	0.5
		HwCw - Salal	03	HS	6	B	0.5
		CwHw - Sword fern	04	RS	6	B	0.5
		BaCw - Foamflower	05	AF	6	B	0.5
		HwBa - Deer fern	06	HD	6	B	0.5
		BaCw - Salmonberry	07	AS	6	B	0.5
		BaSs - Devil's club	08	AD	6	B	0.5
		CwYc - Goldthread	12	YG	6	B	0.5
YF: Young Forest							
YF	*co: coniferous*	HwBa - Blueberry	01	AB	5	C	5
		HwCw - Salal	03	HS	5	C	5
		CwHw - Sword fern	04	RS	5	C	5
		BaCw - Foamflower	05	AF	5	C	5
		HwBa - Deer fern	06	HD	5	C	5
		BaCw - Salmonberry	07	AS	5	C	5
		BaSs - Devil's club	08	AD	5	C	5
		CwYc - Goldthread	12	YG	5	C	5
	mx: mixed	HwBa - Blueberry	01	AB	5	M	5
		HwCw - Salal	03	HS	5	M	5
		CwHw - Sword fern	04	RS	5	M	5
		BaCw - Foamflower	05	AF	5	M	5
		HwBa - Deer fern	06	HD	5	M	5
		BaCw - Salmonberry	07	AS	5	M	5
		BaSs - Devil's club	08	AD	5	M	5
		CwYc - Goldthread	12	YG	5	M	5

YF	***bd: broadleaf***	HwBa - Blueberry	01	AB	5	B	5
		HwCw - Salal	03	HS	5	B	5
		CwHw - Sword fern	04	RS	5	B	5
		BaCw - Foamflower	05	AF	5	B	5
		HwBa - Deer fern	06	HD	5	B	5
		BaCw - Salmonberry	07	AS	5	B	5
		BaSs - Devil's club	08	AD	5	B	5
		CwYc - Goldthread	12	YG	5	B	5
FS: Seasonally Flooded Agricultural Fields							**2.5**
OD: Old Field							**2.5**
FW: Lakes & Ponds (Freshwater)							
FW	***re: reservoir***	Reservoir	RE	RE			0.5

TEM to SE Crosswalk Table - BGC Zone: CWHvm2

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	*vo: very old*	HwBa - Blueberry	01	AB	7b	C	0.5
		HwCw - Salal	03	HS	7b	C	0.5
		CwHw - Sword fern	04	RS	7b	C	0.5
		BaCw - Foamflower	05	AF	7b	C	0.5
		HwBa - Deer fern	06	HD	7b	C	0.5
		BaCw - Salmonberry	07	AS	7b	C	0.5
		BaSs - Devil's club	08	AD	7b	C	0.5
		CwYc - Goldthread	09	YG	7b	C	0.5
	co: coniferous	HwBa - Blueberry	01	AB	7a	C	0.5
		HwCw - Salal	03	HS	7a	C	0.5
		CwHw - Sword fern	04	RS	7a	C	0.5
		BaCw - Foamflower	05	AF	7a	C	0.5
		HwBa - Deer fern	06	HD	7a	C	0.5
		BaCw - Salmonberry	07	AS	7a	C	0.5
		BaSs - Devil's club	08	AD	7a	C	0.5
		CwYc - Goldthread	09	YG	7a	C	0.5
	mx: mixed	HwBa - Blueberry	01	AB	7	M	0.5
		HwCw - Salal	03	HS	7	M	0.5
		CwHw - Sword fern	04	RS	7	M	0.5
		BaCw - Foamflower	05	AF	7	M	0.5
		HwBa - Deer fern	06	HD	7	M	0.5
		BaCw - Salmonberry	07	AS	7	M	0.5
		BaSs - Devil's club	08	AD	7	M	0.5
		CwYc - Goldthread	09	YG	7	M	0.5
MF: Mature Forest							
MF	*co: coniferous*	HwBa - Blueberry	01	AB	6	C	5
		HwCw - Salal	03	HS	6	C	5
		CwHw - Sword fern	04	RS	6	C	5
		BaCw - Foamflower	05	AF	6	C	5
		HwBa - Deer fern	06	HD	6	C	5
		BaCw - Salmonberry	07	AS	6	C	5
		BaSs - Devil's club	08	AD	6	C	5
		CwYc - Goldthread	09	YG	6	C	5
	mx: mixed	HwBa - Blueberry	01	AB	6	M	5
		HwCw - Salal	03	HS	6	M	5
		CwHw - Sword fern	04	RS	6	M	5
		BaCw - Foamflower	05	AF	6	M	5
		HwBa - Deer fern	06	HD	6	M	5
		BaCw - Salmonberry	07	AS	6	M	5
		BaSs - Devil's club	08	AD	6	M	5
		CwYc - Goldthread	09	YG	6	M	5

WD: Woodland							
WD	***co: coniferous***	HwPl - Cladina	02	LC	7	C	0.5
		Cw – Fern bluffs	20	RM	7	C	0.5
		HwPl - Cladina	02	LC	6	C	0.5
		Cw – Fern bluffs	20	RM	6	C	0.5
	mx: mixed	HwPl - Cladina	02	LC	7	M	0.5
		Cw – Fern bluffs	20	RM	7	M	0.5
		HwPl - Cladina	02	LC	6	M	0.5
		Cw – Fern bluffs	20	RM	6	M	0.5
RI: Riparian							
RI	***ff: fringe***						0.5
	fh: high bench floodplains						0.5
	fm: medium bench floodplains						0.5
	fl: low bench floodplains						0.5
	gu: gully						0.5
	ca: canyon						0.5
	mf: mudflats						0.5
	ri: river	River	RI	RI			0.5
		Gravel bar	GB	GB			0.5
WN: Wetland							
WN	***bg: bog***	Pl - Sphagnum (Wb51 - Plc - Black crowberry - Tough Peat-moss)	10	LS			0.5
		Bog	34	BG			0.5
	fn: fen	Fen	35	FS			0.5
	ms: marsh	Marsh	36	MA			0.5
	sp: swamp	CwYc - Skunk cabbage (Ws54 - CwHw - Skunk cabbage)	11	RC			0.5
		Tall Shrub Swamp	33	WS			0.5
	sw: shallow water	Open water	OW	OW			0.5
	wm: wet meadow						0.5
HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	sh: shrub						0.5
SV: Sparsely Vegetated							
SV	***cl: cliff***	Cliff	CL	CL			0.5
		Cw - Fern bluffs	20	RM			0.5
	ta: talus	Talus	TA	TA			0.5

FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
AP: Alpine							
AP	***hb: herbaceous***						0.5
	kr: krummholz						0.5
	pf: parkland forest						0.5
	ds: dwarf shrub						0.5
	ts: tall shrub						0.5
	av: avalanche tracks	Sitka alder – Salmonberry avalanche	38	SA			0.5
		Ba – Copperbush avalanche	40	AC			0.5

TEM to ME Crosswalk Table - BGC Zone: CWHvm2

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	***co: coniferous***	HwBa - Blueberry	01	AB	6	C	0.5
		HwCw - Salal	03	HS	6	C	0.5
		CwHw - Sword fern	04	RS	6	C	0.5
		BaCw - Foamflower	05	AF	6	C	0.5
		HwBa - Deer fern	06	HD	6	C	0.5
		BaCw - Salmonberry	07	AS	6	C	0.5
		BaSs - Devil's club	08	AD	6	C	0.5
		CwYc - Goldthread	09	YG	6	C	0.5
	mx: mixed	HwBa - Blueberry	01	AB	6	M	0.5
		HwCw - Salal	03	HS	6	M	0.5
		CwHw - Sword fern	04	RS	6	M	0.5
		BaCw - Foamflower	05	AF	6	M	0.5
		HwBa - Deer fern	06	HD	6	M	0.5
		BaCw - Salmonberry	07	AS	6	M	0.5
		BaSs - Devil's club	08	AD	6	M	0.5
		CwYc - Goldthread	09	YG	6	M	0.5

MF	***bd: broadleaf***	HwBa - Blueberry	01	AB	6	B	0.5
		HwCw - Salal	03	HS	6	B	0.5
		CwHw - Sword fern	04	RS	6	B	0.5
		BaCw - Foamflower	05	AF	6	B	0.5
		HwBa - Deer fern	06	HD	6	B	0.5
		BaCw - Salmonberry	07	AS	6	B	0.5
		BaSs - Devil's club	08	AD	6	B	0.5
		CwYc - Goldthread	09	YG	6	B	0.5
YF: Young Forest							
YF	***co: coniferous***	HwBa - Blueberry	01	AB	5	C	5
		HwCw - Salal	03	HS	5	C	5
		CwHw - Sword fern	04	RS	5	C	5
		BaCw - Foamflower	05	AF	5	C	5
		HwBa - Deer fern	06	HD	5	C	5
		BaCw - Salmonberry	07	AS	5	C	5
		BaSs - Devil's club	08	AD	5	C	5
		CwYc - Goldthread	09	YG	5	C	5
	mx: mixed	HwBa - Blueberry	01	AB	5	M	5
		HwCw - Salal	03	HS	5	M	5
		CwHw - Sword fern	04	RS	5	M	5
		BaCw - Foamflower	05	AF	5	M	5
		HwBa - Deer fern	06	HD	5	M	5
		BaCw - Salmonberry	07	AS	5	M	5
		BaSs - Devil's club	08	AD	5	M	5
		CwYc - Goldthread	09	YG	5	M	5
	bd: broadleaf	HwBa - Blueberry	01	AB	5	B	5
		HwCw - Salal	03	HS	5	B	5
		CwHw - Sword fern	04	RS	5	B	5
		BaCw - Foamflower	05	AF	5	B	5
		HwBa - Deer fern	06	HD	5	B	5
		BaCw - Salmonberry	07	AS	5	B	5
		BaSs - Devil's club	08	AD	5	B	5
		CwYc - Goldthread	09	YG	5	B	5
FW: Lakes & Ponds (Freshwater)							
FW	***re: reservoir***	Reservoir	RE	RE			0.5

TEM to SE Crosswalk Table - BGC Zone: MHmm1

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	***vo: very old***	HmBa - Blueberry	01	MB	7b	C	0.5
		BaHm - Oak fern	03	MO	7b	C	0.5
		HmBa - Bramble	04	AB	7b	C	0.5
		BaHm - Twistedstalk	05	MT	7b	C	0.5
		HmYc - Deer cabbage	06	MD	7b	C	0.5
		YcHm - Hellebore	07	YH	7b	C	0.5
		HmYc – Blueberry-Mountain heather	26	YB	7b	C	0.5
	co: coniferous	HmBa - Blueberry	01	MB	7a	C	0.5
		BaHm - Oak fern	03	MO	7a	C	0.5
		HmBa - Bramble	04	AB	7a	C	0.5
		BaHm - Twistedstalk	05	MT	7a	C	0.5
		HmYc - Deer cabbage	06	MD	7a	C	0.5
		YcHm - Hellebore	07	YH	7a	C	0.5
		HmYc – Blueberry-Mountain heather	26	YB	7a	C	0.5
	mx: mixed	HmBa - Blueberry	01	MB	7	M	0.5
		BaHm - Oak fern	03	MO	7	M	0.5
		HmBa - Bramble	04	AB	7	M	0.5
		BaHm - Twistedstalk	05	MT	7	M	0.5
		HmYc - Deer cabbage	06	MD	7	M	0.5
		YcHm - Hellebore	07	YH	7	M	0.5
		HmYc – Blueberry-Mountain heather	26	YB	7	M	0.5
MF: Mature Forest							
MF	***co: coniferous***	HmBa - Blueberry	01	MB	6	C	5
		BaHm - Oak fern	03	MO	6	C	5
		HmBa - Bramble	04	AB	6	C	5
		BaHm - Twistedstalk	05	MT	6	C	5
		HmYc - Deer cabbage	06	MD	6	C	5
		YcHm - Hellebore	07	YH	6	C	5
		HmYc – Blueberry-Mountain heather	26	YB	6	C	5
	mx: mixed	HmBa - Blueberry	01	MB	6	M	5
		BaHm - Oak fern	03	MO	6	M	5
		HmBa - Bramble	04	AB	6	M	5
		BaHm - Twistedstalk	05	MT	6	M	5
		HmYc - Deer cabbage	06	MD	6	M	5
		YcHm - Hellebore	07	YH	6	M	5
		HmYc – Blueberry-Mountain heather	26	YB	6	M	5

WD: Woodland							
WD	***co: coniferous***	HmBa - Mountain-heather	02	MM	7	C	0.5
		HmBa - Mountain-heather	02	MM	6	C	0.5
	mx: mixed	HmBa - Mountain-heather	02	MM	7	M	0.5
		HmBa - Mountain-heather	02	MM	6	M	0.5
	co: coniferous	Yc – Rhacomitrium bluffs	27	YR	7	C	0.5
		Yc – Rhacomitrium bluffs	27	YR	6	C	0.5
	mx: mixed	Yc – Rhacomitrium bluffs	27	YR	7	M	0.5
		Yc – Rhacomitrium bluffs	27	YR	6	M	0.5
RI: Riparian							
RI	***ff: fringe***						0.5
	fh: high bench floodplains						0.5
	fm: medium bench floodplains						0.5
	fl: low bench floodplains						0.5
	gu: gully						0.5
	ca: canyon						0.5
	mf: mudflats						0.5
	ri: river	River	RI	RI			0.5
		Gravel bar	GB	GB			0.5
WN: Wetland							
WN	***bg: bog***	HmYc - Sphagnum	08	YS			0.5
		Bog	34	BG			0.5
	fn: fen	Sedge burnet meadow		SB			0.5
		Tufted clubrush - Asphodel wetland		CA			0.5
		Fen	35	FS			0.5
	ms: marsh	Marsh	36	MA			0.5
	sp: swamp	YcHm - Skunk cabbage	09	YC			0.5
		Tall Shrub Swamp	33	WS			0.5
		Forest Swamp	24	TP			0.5
	sw: shallow water	Open water	OW	OW			0.5
	wm: wet meadow						0.5
HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	sh: shrub						0.5

SV: Sparsely Vegetated							
SV	***cl: cliff***	Cliff	CL	CL			0.5
		Yc – Rhacomitrium bluffs	27	YR			0.5
	ro: rock outcrop	Rock outcrop	RO	RO			0.5
	ta: talus	Talus	TA	TA			0.5
FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
AP: Alpine							
AP	***hb: herbaceous***	Partridge - sedge meadow		PS			0.5
		Herbaceous meadows		AM			0.5
	kr: krummholz	Mountain heather krummholz		MK			0.5
	pf: parkland forest	Hm – Mountain heather parkland		MH			0.5
		BaBl - Juniper parkland		BJ			0.5
	ds: dwarf shrub	Mountain heather racomitrium scrub		MR	2d/3a		0.5
	ts: tall shrub	Mountain heather racomitrium scrub		MR	3b		0.5
	av: avalanche tracks	Ba - Alaskan blueberry avalanche		AA			0.5
		Indian hellebore - fern		IF			0.5
		Sitka alder – Salmonberry avalanche	38	SA			0.5
		Ba – Copperbush avalanche	40	AC			0.5
NOTES:							
MR - Check structural stage for class assignment							

TEM to ME Crosswalk Table - BGC Zone: MHmm1

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	*co: coniferous*	HmBa - Blueberry	01	MB	6	C	0.5
		BaHm - Oak fern	03	MO	6	C	0.5
		HmBa - Bramble	04	AB	6	C	0.5
		BaHm - Twistedstalk	05	MT	6	C	0.5
		HmYc - Deer cabbage	06	MD	6	C	0.5
		YcHm - Hellebore	07	YH	6	C	0.5
		HmYc – Blueberry-Mountain heather	26	YB	6	C	0.5
	mx: mixed	HmBa - Blueberry	01	MB	6	M	0.5
		BaHm - Oak fern	03	MO	6	M	0.5
		HmBa - Bramble	04	AB	6	M	0.5
		BaHm - Twistedstalk	05	MT	6	M	0.5
		HmYc - Deer cabbage	06	MD	6	M	0.5
		YcHm - Hellebore	07	YH	6	M	0.5
		HmYc – Blueberry-Mountain heather	26	YB	6	M	0.5
	bd: broadleaf	HmBa - Blueberry	01	MB	6	B	0.5
		BaHm - Oak fern	03	MO	6	B	0.5
		HmBa - Bramble	04	AB	6	B	0.5
		BaHm - Twistedstalk	05	MT	6	B	0.5
		HmYc - Deer cabbage	06	MD	6	B	0.5
		YcHm - Hellebore	07	YH	6	B	0.5
		HmYc – Blueberry-Mountain heather	26	YB	6	B	0.5
YF: Young Forest							
YF	*co: coniferous*	HmBa - Blueberry	01	MB	5	C	5
		BaHm - Oak fern	03	MO	5	C	5
		HmBa - Bramble	04	AB	5	C	5
		BaHm - Twistedstalk	05	MT	5	C	5
		HmYc - Deer cabbage	06	MD	5	C	5
		YcHm - Hellebore	07	YH	5	C	5
		HmYc – Blueberry-Mountain heather	26	YB	5	C	5
	mx: mixed	HmBa - Blueberry	01	MB	5	M	5
		BaHm - Oak fern	03	MO	5	M	5
		HmBa - Bramble	04	AB	5	M	5
		BaHm - Twistedstalk	05	MT	5	M	5
		HmYc - Deer cabbage	06	MD	5	M	5
		YcHm - Hellebore	07	YH	5	M	5
		HmYc – Blueberry-Mountain heather	26	YB	5	M	5
	bd: broadleaf	HmBa - Blueberry	01	MB	5	B	5
		BaHm - Oak fern	03	MO	5	B	5
		HmBa - Bramble	04	AB	5	B	5
		BaHm - Twistedstalk	05	MT	5	B	5
		HmYc - Deer cabbage	06	MD	5	B	5
		YcHm - Hellebore	07	YH	5	B	5
		HmYc – Blueberry-Mountain heather	26	YB	5	B	5
FW: Lakes & Ponds (Freshwater)							
FW	*re: reservoir*	Reservoir	RE	RE			0.5

TEM to SE Crosswalk Table - BGC Zone: MHmmp1

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
OF: Old Forest							
OF	*vo: very old*	HmBa - Blueberry	01	MB	7b	C	0.5
		BaHm - Oak fern	03	MO	7b	C	0.5
		HmBa - Bramble	04	AB	7b	C	0.5
		BaHm - Twistedstalk	05	MT	7b	C	0.5
		HmYc - Deer cabbage	06	MD	7b	C	0.5
		YcHm - Hellebore	07	YH	7b	C	0.5
		HmYc – Blueberry-Mountain heather	26	YB	7b	C	0.5
	co: coniferous	HmBa - Blueberry	01	MB	7a	C	0.5
		BaHm - Oak fern	03	MO	7a	C	0.5
		HmBa - Bramble	04	AB	7a	C	0.5
		BaHm - Twistedstalk	05	MT	7a	C	0.5
		HmYc - Deer cabbage	06	MD	7a	C	0.5
		YcHm - Hellebore	07	YH	7a	C	0.5
		HmYc – Blueberry-Mountain heather	26	YB	7a	C	0.5
	mx: mixed	HmBa - Blueberry	01	MB	7	M	0.5
		BaHm - Oak fern	03	MO	7	M	0.5
		HmBa - Bramble	04	AB	7	M	0.5
		BaHm - Twistedstalk	05	MT	7	M	0.5
		HmYc - Deer cabbage	06	MD	7	M	0.5
		YcHm - Hellebore	07	YH	7	M	0.5
		HmYc – Blueberry-Mountain heather	26	YB	7	M	0.5
MF: Mature Forest							
MF	*co: coniferous*	HmBa - Blueberry	01	MB	6	C	5
		BaHm - Oak fern	03	MO	6	C	5
		HmBa - Bramble	04	AB	6	C	5
		BaHm - Twistedstalk	05	MT	6	C	5
		HmYc - Deer cabbage	06	MD	6	C	5
		YcHm - Hellebore	07	YH	6	C	5
		HmYc – Blueberry-Mountain heather	26	YB	6	C	5
	mx: mixed	HmBa - Blueberry	01	MB	6	M	5
		BaHm - Oak fern	03	MO	6	M	5
		HmBa - Bramble	04	AB	6	M	5
		BaHm - Twistedstalk	05	MT	6	M	5
		HmYc - Deer cabbage	06	MD	6	M	5
		YcHm - Hellebore	07	YH	6	M	5
		HmYc – Blueberry-Mountain heather	26	YB	6	M	5

WD: Woodland							
WD	***co: coniferous***	Yc – Rhacomitrium bluffs	27	YR	7	C	0.5
		Yc – Rhacomitrium bluffs	27	YR	6	C	0.5
	mx: mixed	Yc – Rhacomitrium bluffs	27	YR	7	M	0.5
		Yc – Rhacomitrium bluffs	27	YR	6	M	0.5
RI: Riparian							
RI	***ff: fringe***						0.5
	gu: gully						0.5
	ca: canyon						0.5
	ri: river	river	RI	RI			0.5
		gravel bar	GB	GB			0.5
WN: Wetland							
WN	***bg: bog***						0.5
	fn: fen						0.5
	ms: marsh						0.5
	sp: swamp	Tall Shrub Swamp	33	WS			0.5
	sw: shallow	Open water	OW	OW			0.5
	wm: wet meadow						0.5
HB: Herbaceous							
HB	***hb: herbaceous***						0.5
	sh: shrub						0.5
SV: Sparsely Vegetated							
SV	***cl: cliff***	Cliff	CL	CL			0.5
	ro: rock outcrop	Rock outcrop	RO	RO			0.5
	ta: talus	Talus	TA	TA			0.5
FW: Lakes & Ponds (Freshwater)							
FW	***la: lake***	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
AP: Alpine							
AP	***hb: herbaceous***						0.5
	kr: krummholz	Mountain heather krummholz		AK			0.5
		Mountain heather krummholz		MK			0.5
	pf: parkland forest	Hm – Mountain heather parkland	50	MH			0.5
		Lichen - Hm parkland	51	LM			0.5
		BaBl - Juniper parkland		BJ			0.5
		Sedge parkland meadows	52	SS			0.5

AP	*ds: dwarf shrub*	Mountain heather meadows		MH	2d/3a		0.5
		Mountain heather racomitrium scrub		MR	2d/3a		0.5
	ts: tall shrub	Mountain heather racomitrium scrub		MR	3b		0.5
		Mountain heather meadows		MH	3b		0.5
	av: avalanche	Ba – Copperbush avalanche	40	AC			0.5
NOTES:							
MH - Check structural stage for class assignment MH - Provincial Parks MH shrub; Watersheds and Regional Parks MH parkland forest							

TEM to ME Crosswalk Table - BGC Zone: MHmmp1

ME Class	ME Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
MF: Mature Forest							
MF	*co: coniferous*	HmBa - Blueberry	01	MB	6	C	0.5
		BaHm - Oak fern	03	MO	6	C	0.5
		HmBa - Bramble	04	AB	6	C	0.5
		BaHm - Twistedstalk	05	MT	6	C	0.5
		HmYc - Deer cabbage	06	MD	6	C	0.5
		YcHm - Hellebore	07	YH	6	C	0.5
		HmYc – Blueberry-Mountain heather	26	YB	6	C	0.5
	mx: mixed	HmBa - Blueberry	01	MB	6	M	0.5
		BaHm - Oak fern	03	MO	6	M	0.5
		HmBa - Bramble	04	AB	6	M	0.5
		BaHm - Twistedstalk	05	MT	6	M	0.5
		HmYc - Deer cabbage	06	MD	6	M	0.5
		YcHm - Hellebore	07	YH	6	M	0.5
		HmYc – Blueberry-Mountain heather	26	YB	6	M	0.5
	bd: broadleaf	HmBa - Blueberry	01	MB	6	B	0.5
		BaHm - Oak fern	03	MO	6	B	0.5
		HmBa - Bramble	04	AB	6	B	0.5
		BaHm - Twistedstalk	05	MT	6	B	0.5
		HmYc - Deer cabbage	06	MD	6	B	0.5
		YcHm - Hellebore	07	YH	6	B	0.5
		HmYc – Blueberry-Mountain heather	26	YB	6	B	0.5

YF: Young Forest								
YF	co: coniferous	HmBa - Blueberry	01	MB	5	C	5
		BaHm - Oak fern	03	MO	5	C	5
		HmBa - Bramble	04	AB	5	C	5
		BaHm - Twistedstalk	05	MT	5	C	5
		HmYc - Deer cabbage	06	MD	5	C	5
		YcHm - Hellebore	07	YH	5	C	5
		HmYc – Blueberry-Mountain heather	26	YB	5	C	5
	mx: mixed	HmBa - Blueberry	01	MB	5	M	5
		BaHm - Oak fern	03	MO	5	M	5
		HmBa - Bramble	04	AB	5	M	5
		BaHm - Twistedstalk	05	MT	5	M	5
		HmYc - Deer cabbage	06	MD	5	M	5
		YcHm - Hellebore	07	YH	5	M	5
		HmYc – Blueberry-Mountain heather	26	YB	5	M	5
YF	bd: broadleaf	HmBa - Blueberry	01	MB	5	B	5
		BaHm - Oak fern	03	MO	5	B	5
		HmBa - Bramble	04	AB	5	B	5
		BaHm - Twistedstalk	05	MT	5	B	5
		HmYc - Deer cabbage	06	MD	5	B	5
		YcHm - Hellebore	07	YH	5	B	5
		HmYc – Blueberry-Mountain heather	26	YB	5	B	5
FW: Lakes & Ponds (Freshwater)							
FW	re: reservoir	Reservoir	RE	RE			0.5

TEM to SE Crosswalk Table - BGC Zone: CMA

SE Class	SE Subclass	TEM name	TEM #	MoE code	Structural stage	Stand composition	Minimum size (ha)
RI: Riparian							
RI	ff: fringe						0.5
	gu: gully						0.5
	ca: canyon						0.5
	ri: river						0.5
WN: Wetland							
WN	bg: bog						0.5
	fn: fen						0.5
	ms: marsh						0.5
	sp: swamp						0.5
	sw: shallow	Open water	OW	OW			0.5
	wm: wet						0.5
HB: Herbaceous							
HB	hb: herbaceous						0.5
	sh: shrub						0.5
SV: Sparsely Vegetated							
SV	cl: cliff	Krummholz cliffs	63	KC			0.5
		Cliff	CL	CL			0.5
	ro: rock outcrop	Rock outcrop	RO	RO			0.5
	ta: talus	Talus	TA	TA			0.5
FW: Lakes & Ponds (Freshwater)							
FW	la: lake	Lake	LA	LA			8
	pd: pond	Pond	PD	PD			0.5
AP: Alpine							
AP	hb: herbaceous						0.5
	kr: krummholz	Alpine krummholz	62	AK			0.5
	pf: parkland forest						0.5
	ds: dwarf shrub	Mountain heather meadows	60	MM	2d/3a		0.5
		Mountain heather – Rhacomitrium scrub	61	MR	2d/3a		0.5
	ts: tall shrub	Mountain heather meadows	60	MM	3b		0.5
		Mountain heather – Rhacomitrium scrub	61	MR	3b		0.5
	av: avalanche tracks						0.5
NOTES:							
60/61 - Check structural stage for class assignment							