Sensitive Ecosystems Inventory: Coldstream Vernon, 2007

Volume 2: Terrestrial Ecosystem, Terrain, Terrain Stability, and Soil Erosion Potential Mapping, and Expanded Legend

June 2008

Kristi Iverson, Iverson & MacKenzie Biological Consulting Ltd.

Polly Uunila, Polar Geoscience Ltd.

Acknowledgements

The project was funded by The Real Estate Foundation of BC[1], the BC Ministry of Environment, the City of Vernon, the District of Coldstream, the Regional District of the North Okanagan, the Greater Vernon Services Commission, and the Canadian Wildlife Service.

Project management and extension was provided by ***Patrick Allen*** of the Allan Brooks Nature Centre. Field work was completed by ***Kristi Iverson***[2], ***Polly Uunila***[3], ***John Grods***[4], ***Ken MacKenzie***[2] and ***Allison Haney***[5]. Bioterrain, terrain stability, and soil erosion potential mapping was completed by ***Polly Uunila*** and ecosystem mapping was completed by ***Kristi Iverson***. ***Bon Lee***[6] completed digital and cartography work.

This project has adapted material from the reports for the Bella Vista – Goose Lake Range Sensitive Ecosystems Inventory[7] (SEI), Central Okanagan SEI[8], Vernon Commonage SEI[9], and Lake Country SEI[10].

Patrick Allen provided accommodation for the field crew.

We would like to thank the many landowners that gave us permission to access their lands for field sampling.

[1] The mission of the Real Estate Foundation is to support sustainable real estate and land use practices for the benefit of British Columbians.
[2] Iverson & MacKenzie Biological Consulting Ltd.
[3] Polar Geoscience Ltd.
[4] Makonis Consulting Ltd.
[5] Ophiuchus Consulting
[6] Baseline Geomatics Inc.
[7] Iverson and Shypitka 2003
[8] Iverson et al. 2004
[9] Iverson and Uunila 2005
[10] Iverson and Uunila 2006

Introduction

This report presents detailed information on terrain and ecosystems in the District of Coldstream, portions of the City of Vernon, and Kalamalka Park, Kalamalka Protected Area and Cougar Canyon Ecological Reserve of the North Okanagan Valley. It is the second volume in a series of three volumes.

Volume 2, this report, provides detailed information on terrestrial ecosystem mapping (TEM) methods and gives descriptions of each of the ecosystems that occur within the sensitive ecosystems or other important ecosystems categories described in Volume 1. Appendix B of Volume 1 provides tables that can be used to cross-reference between sensitive and other important ecosystems units and terrestrial ecosystem map units in this report.

This report describes the natural setting of the study area and details methods, results and recommendations for bioterrain, terrain stability and soil erosion potential mapping and ecosystem mapping. It is intended for use by professionals that require more detailed ecological and terrain information.

Volume 1[11] is intended for people and organizations that need information to help conserve and protect remaining sensitive and important ecosystems in the Coldstream – Vernon area and other similar areas. It is also intended to provide information and advice to landowners and developers on how to minimize and avoid possible degradation of sensitive ecosystems due to land use and development activities.

Volume 3[12] contains wildlife habitat mapping themes developed from the terrestrial ecosystem mapping (TEM) for the following ten species: Great Basin Spadefoot (*Spea intermontana*), Painted Turtle (*Chrysemys picta*), Western Rattlesnake (*Crotalus oreganus*), Gopher Snake (*Pituophis catenifer* ssp*. deserticola*), Western Screech-owl (*Otus kennicottii* ssp*. macfarlanei*), Long-billed Curlew (*Numenius americanus*), Yellow-breasted Chat (*Icteria virens*), Grasshopper Sparrow (*Ammodramus savannarum*), Swainson's Hawk (*Buteo swainsonii*), and Badger (*Taxidea taxus jeffersonii*). All of these species are considered at risk in the province of B.C. and most are listed under the federal Species at Risk Act. These species provide a cross-section of threatened or endangered amphibians, reptiles, birds, and mammals that depend on a range of different ecosystems in the study area. There are many other threatened and endangered species that likely occur in the study area and are listed in Appendix C of Volume 1, and in each ecosystem chapter of Volume 1 in which they are most likely to occur.

Wildlife habitat mapping portrays the potential importance of each ecosystem to specific animal species through a species-habitat model. The model assigns ratings to different ecosystem units from the TEM based on the needs of the species for particular life requisites. These ratings are displayed on the wildlife habitat maps. Volume 3 is intended for professionals who require more detailed information on wildlife habitat values in the study area than Volume 1 provides.

---

[11] Iverson 2008

[12] Haney and Sarell 2008

Table of Contents

List of Figures

List of Tables

1 Study Area

The study area (Figure 1) lies within the central Okanagan Valley of south-central British Columbia. The boundaries of the study area extend from the northern edge City of Vernon in the north, west to the Bella Vista - Goose Lake Range, east to the edge of the District of Coldstream and south to the Vernon Commonage, District of Coldstream and District of Lake. The area covers 21,195 ha and includes private land, provincial parks and protected areas, regional parks, and provincial crown land.

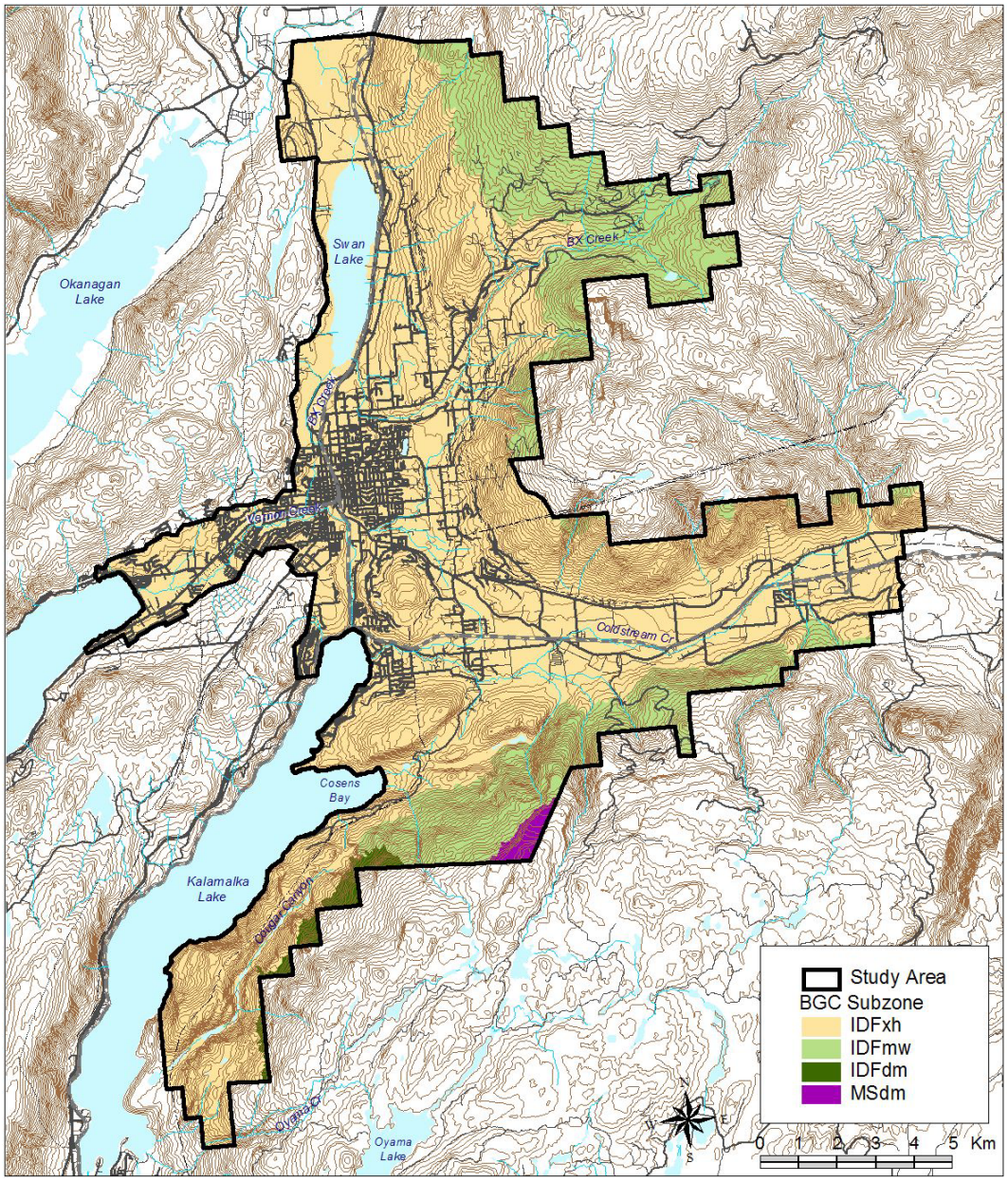


Figure 1. Map of the Coldstream – Vernon study area. Study area boundary is shown in black.

1.1 Landscape Setting

The portion of the study area north of Coldstream Creek lies within the Shuswap Highlands and south of Coldstream Creek lies within the Thompson Plateau; both subdivisions of the Interior Plateau Physiographic Region. The Okanagan Highland and Thompson Plateau are characterized by a gentle, undulating upland surface, separated by large valleys.[13]

Bedrock Geology

The bedrock geology is taken from recent mapping completed by Glombick *et al*. (2004) and Thompson *et al*. (2004) and from Kidston (1993). The formation of the landscape in the Vernon area has taken place over several hundred million years resulting in highly varied geology. The types of bedrock and their distribution for the study area are outlined in a table under the "bedrock" section in Appendix B.

Bedrock from all the major categories, sedimentary, plutonic (intrusive and volcanic) and metamorphic, are found in the Vernon area, however a wide variety of metamorphic rocks are the most common. Characteristics of bedrock, such as structure (i.e. strength, joint spacing, presence of bedding) and mineral composition impact slope stability, potential for wildlife habitat and nutrient regime[14]. These characteristics influence the shape and size of clasts and matrix texture of colluvium and till.

Metamorphic rock that is largely granular in texture, for example gneiss, tends to break down into sand and coarse silt, resulting in a silty-sand textured till. The relatively massive inner core gneiss tends to break into large blocks. Finer-grained metamorphic bedrock of sedimentary origin (i.e. schist, argillite, greenstone, and limestone) tend to break down into silt and fine sand and consequently result in a sandy silt matrix till. Many of the rocks include variable amounts of mica and chlorite. These tend to break into pebble-sized rubble and flaggy slabs and consequently, boulders and blocks generally are not common. Highly foliated and weak bedrock such as phyllite can be unstable at gentler slopes than stronger rock types and does not provide a solid foundation for surface structures. Many metasedimentary rock types tend to be nutrient-rich.

Volcanic rocks break down into rubble and blocks which weather into silt and clay. Widely scattered weathered tuff layers are locally present. These consist largely of clay, and in combination with clay from weathered lavas can produce a noticeably clay-enriched till. Non-siliceous volcanic rocks tend to give rise to medium nutrient regimes. Like intrusive bedrock, rocks with higher silica content (i.e. rhyolite) give rise to poor nutrient regimes.

Well-jointed granitic rocks break into large blocks and boulders and can produce bouldery tills. Weathering breaks the rock down into sand and minor silt and consequently, areas of granitic bedrock tend to produce till with a silty-sand matrix. These rock types tend to produce poor nutrient regimes.

Landscape Evolution

The present physiography dates back two hundred million years ago (early Jurassic) when plate tectonics welded the former Pacific Ocean to the margin of the North American continent. This

---

[13] Holland 1976

[14] EBA Engineering Consultants Ltd. 1998

created ridges of metamorphic and plutonic bedrock orientated in a north-south direction. About 50 million years ago (early Tertiary), plate tectonics caused uplift of the area accompanied by extensive volcanism. A long period of relative stability followed, during which erosion and deposition formed a low-relief landscape with gentle slopes and low hills. During late Tertiary, the area was subject to uplift again, followed by a renewed period of down cutting, and stream valleys incised deeply into the old erosion surface.

Both the upland surface and the steep-sided valleys were completely buried by ice during the Pleistocene glaciation. However, glaciers effected only relatively minor modifications to the older topography. Most of the surficial materials date from the last glaciation.

At the beginning of the last major glacial episode (Fraser Glaciation), ice accumulated in the high mountains and then gradually spread to valleys and lowlands. About 14,500 years ago, when the Cordilleran Ice Sheet was thickest and most extensive at the climax of Fraser Glaciation, ice flowed generally southward across the study area[15]. The rounded ridge tops suggest that the entire area was completely overridden by ice at this time, depositing till at the base of the ice sheet.

Deglaciation occurred between about 14,000 and 11,000 years ago. Deglaciation took place by downwasting so that the uplands emerged from beneath the ice while tongues of ice remained in the valley bottoms[16]. Stagnant ice in the valley bottoms impounded temporary glacial lakes in the Okanagan Valley (Glacial Lake Penticton). Downwasting ice often forms characteristic subglacial and ice-marginal landforms on gentle surfaces, such as, eskers, kames, and meltwater channels.

During post-glacial times, processes have re-worked some glacial sediments and weathered bedrock to redistribute them as colluvium (moved by gravity) and fluvial (moved by water) sediments. Some streams and rivers that have graded to the present day lake level have downcut into glacial deposits creating terraces, benches, and steep-sided scarps. Eolian sediments have been transported by wind and deposited on the gentler slopes throughout the study area. Fine-grained sediments have accumulated in depressions due to slope wash.

Soils[17]

Soil forms the interface between surficial materials (parent materials) and the ecosystems they support. Ecosystems influence the formation of soils and soil affects what types of plants grow at a given site and the productivity of that site. Soil is defined as “naturally occurring, unconsolidated mineral or organic martial at least 10cm thick that occurs at the earth’s surface and is capable of supporting plant growth”[18]. The factors affecting soil formation include: parent material, climate, biota (including the vegetation, wildlife and organisms in the soil), topography (for example: slope, aspect, and slope morphology), and time. The following descriptions of the major soil groups present in the study area are derived from Wittneben (1986). Soil is not mapped in this project but has been included as part of the field data collected to describe the site and the ecosystems at detailed ecological plot locations.

Chernozemic soils (Brown and Darkbrown Chernozems) have developed in the semi-arid lower valley grassland and open forest communities. These are characterized by the formation of an

[15] Fulton 1965
[16] Fulton 1969
[17] This section is adapted from Iverson et al. 2004
[18] Soil Classification Working Group 1998

organic rich (Ah) upper mineral horizon. The Ah horizon forms primarily from the accumulation of organic material from the fine roots of grasses and herbaceous plants.

Brunisolic soils occur throughout the study area. They are common under forested communities on moister and cooler aspects. These soils are present on moderately- to rapidly-drained surficial materials that are medium- to coarse-textured. These are soils that have poorly developed horizons. They were often found in a complex with other soil types including chernozems, luvisols, and gleysols.

Luvisolic soils are present on moderately- to rapidly-drained, clay-rich parent materials such as muddy glaciolacustrine deposits and finer textured tills. The movement of clay particles from the upper horizons to a lower horizon of accumulation (Bt) characterizes these soils. Luvisols underlied some of both forested and grassland communities in the Interior Douglas-fir and Ponderosa Pine Biogeoclimatic Zones.

Organic soils develop under wet conditions where decomposition rates are relatively slow and a net accumulation of organic material (peat) occurs. Most organic soils are poor- to very poorly-drained and are saturated for prolonged periods of time. Organic soils occurred under wetland communities in depressions.

Gleysolic soils develop under moist to wet conditions usually in depressions, toe slopes and on valley bottoms. They are mineral soils formed under periodic, or sustained, reducing conditions caused by saturation, and result in gleyed colours (grey, blue and green). Gleysolic soils are imperfectly to very poorly drained and occurred under moist forest and wetland communities.

Regosolic soils are under-developed soils that lack defined horizonation. Regosols were common on floodplains and talus slopes throughout study area. They develop on recent parent materials such as landslide and river deposits; recently exposed materials such as landslide scarps and eroded banks; or under conditions that suppress soil formation, for example, extremely dry conditions (very rapidly drained, coarse textured soils on southerly aspects). Regosols are often associated with non-vegetated or early successional plant communities.

Solonetzic soils occur on saline parent materials in semiarid to subhumid regions of the British Columbia interior. These soils occur in small non-vegetated or sparsely vegetated pockets in depressions and toe slope positions. These soils are often used as salt licks by wildlife and thus have high wildlife values. They occur in association with chernozemic soils and to a lesser degree with gleysolic and luvisolic soils.

Climate

The study area is located within the northern portion of a dry climatic system resulting in warm, dry conditions[19]. The Coast and Cascade Mountains create a rain shadow effect in the interior of British Columbia, reducing summer and winter precipitation. In summers, hot dry air moves in from the Great Basin to the south.

Within British Columbia, the climate of this region has resulted in semi-arid steppe vegetation with unique geological and landscape features; this has resulted in a diverse and unique assemblage of species in the Okanagan Valley.

[19] Demarchi 1996

Ecoregional and Biogeoclimatic Classification

The study area is located within the Southern Interior Ecoprovince, the northern extension of the Columbia Basin that extends south to Oregon[20]. Situated within the southernmost region of the Interior Plateau of British Columbia, the region lies west of the Columbia Mountains and east of the Coast and Cascade Mountains within the Northern Okanagan Basin Ecosection (NOB), a wide trench formed by parallel fault lines and further carved out by multiple glaciations, the Northern Okanagan Highland Ecosection (NOH), a cool, moist, transitional mountain area, dominated by a rolling upland and the Shuswap Basin Ecosection (SHB) in the higher elevations above the NOB north of Coldstream Creek.

The Ministry of Forests biogeoclimatic ecosystem classification is a system of classifying vegetation based on climatic and topographic patterns[21]. Four biogeoclimatic variants are represented within the study area: the Kettle Dry Mild Interior Douglas-fir Variant (IDFdm1), the Okanagan Very Dry Hot Interior Douglas-fir Variant (IDFxh1), the Shuswap Moist Warm Interior Douglas-fir Variant (IDFmw1), and the Okanagan Dry Mild Montane Spruce Variant (MSdm1). Figure 1 (above) shows the locations of the subzones within the study area.

The **IDFdm1** occurs along the east side of the Okanagan Valley in areas with precipitation amounts transitional between the IDFxh1 and IDFmw1. It has a slightly cooler climate than the IDFmw1 and IDFxh1. Forests are commonly dominated by Douglas-fir and lodgepole pine with some western larch. *The area mapped as IDFdm1 within the study area has very poor access and was not field verified. It occurs between the IDFxh1 and MSdm1 above Cougar Canyon. Provincial biogeoclimatic mapping has this area mapped as IDFxh1 up to the MSdm1, however forest cover mapping indicates a mix of Douglas-fir and lodgepole pine that seems to better fit the IDFdm1.*

The **IDFxh1** is the driest variant of the Interior Douglas-fir zone; it has a long growing season with warm, dry summers, and summer drought. Winters are cool with low to moderate snowfall. Most portions of the IDFxh1 are dominated by mixed open forests of Douglas-fir and ponderosa pine; the study area also has extensive areas of grasslands.

The **IDFmw1** has a warm, dry climatic regime (but is moister than the IDFxh1) and a relatively long growing season with summer drought. It occurs above the IDFxh1 on the east side of the study area. Mature forests are dominated by Douglas-fir with some western redcedar and western larch.

The **MSdm1** occurs at the highest elevations at the eastern edge of the study area. It is characterized by cold winters and moderately short, warm summers. Mature forests are dominated by lodgepole pine with some hybrid white-spruce and subalpine fir; Douglas-fir occurs on warm aspect slopes.

---

[20] The ecoregional classification system was developed and adapted by the Ministry of Environment, Lands & Parks, Wildlife Branch, to provide a systematic view of the small scale ecological relationships within British Columbia . See Demarchi 1996 for further information.

[21] The Biogeoclimatic Ecosystem Classification system was developed by the Ministry of Forests to provide a basis for natural resource management, particularly forest management and range management. See Pojar et al. 1987 for further information.

1.2 Ecology and Disturbance Processes

Historically, frequent low-intensity surface fires maintained grasslands and open Douglas-fir and ponderosa pine forests. Fires were likely ignited by both lightning and First Nations peoples. First Nations people used fire to improve wildlife habitat, root crops (for example, mariposa lily and balsamroot) and likely to fireproof their villages[22]. Most native grassland plants are well adapted to fire through perennating buds or seeds just at or below the ground surface where fire temperatures are cooler[23]. Figure 2 shows a prescribed fire similar to many historical fires.

Figure 2. Understory fire similar to how most historical fires burned.

Frequent fire maintained forest understories dominated by bunchgrasses and shrubs and promoted nutrient cycling. Most grasses, forbs, shrubs and mature trees survived most fires, but small trees likely often died[24]. Historically, forests were mostly very open with grassy, shrubby understories. Moister sites were more productive and likely more closed and shrubby. Fires also contribute to nutrient cycling, releasing nutrients that are otherwise very slowly released through decay processes.

The exclusion of most fires (dating back to the time of intensive grazing in the late 1800's) has lead to striking changes in these ecosystems. Some areas that were formerly grasslands have been encroached upon by trees and are now dominated by trees.

Tree densities are now much higher in forests (Figure 4). Dense forests with accumulated fuels have lead to declines in grass and shrub productivity, increasing susceptibility to insect and disease outbreaks, and a shift from frequent low-severity fires to larger, more intense crown fires[25] such as the Okanagan Mountain fire in the summer of 2003.

Moisture is very limiting in these dry forest ecosystems and available moisture is critical for the survival of ponderosa pine seedlings. Ponderosa pine seedlings, with a deeper taproot, are better able to survive moisture depletion than Douglas-fir seedlings.

Historically, the principal grazing animals were likely deer and elk[26]. Domestic cattle grazing began in the late 1800's and many of the grasslands in the study area have reduced cover of the more grazing-sensitive species such as bluebunch wheatgrass, Idaho fescue, and rough fescue and have more cover of grazing-resistant native grasses such as Columbian needlegrass, junegrass and Sandberg's bluegrass[27]. Some grasslands have been overtaken by invasive alien plants such as knapweed, sulphur cinquefoil and cheatgrass, and annual brome grass. Pockets of late seral and climax grasslands occur primarily on steeper slopes in the study area.

---

[22] Turner 1994; Pokotylo and Froese 1983; Daubenmire 1968
[23] Daubenmire 1968
[24] Agee 1993
[25] Moore et al. 1999; Fule et al. 1997; Daigle 1996
[26] Tisdale 1947
[27] Dormaar et al.1989; McLean and Wikeen 1985; Daubenmire 1940

Figure 3. Encroachment of young ponderosa pine trees onto a grassland ecosystem. With time, this will become a dense forest with few grasslands species.

Figure 4. Ingrown stand resulting from fire exclusion. In this stand, there are likely about 100 times more trees than there were historically.

1.3 Human History

The semi-arid climate of the central Okanagan, with its hot summers and mild winters, has long attracted human habitation. Archaeological evidence indicates that humans have been present in the Okanagan valley for at least 6000 years. The valley provided water, wildlife for hunting, fish, roots, berries, herbs, and other foods and medicines for First Nations peoples[28].

Following the discovery of gold in British Columbia, ranchers from western Oregon came and settled in the dry interior valleys of B.C. Cattle were turned loose on the unfenced range and by the late 1870's most grasslands had deteriorated due to overgrazing[29].

Early forest harvesting was localised but became industrial and more widespread by the mid-1900's[30]. We observed that all accessible areas of the study area had been selectively harvested, leaving very few large, old trees.

[28] Cannings and Durance 1998; Thomson 2000
[29] Mather 1996
[30] Cannings and Durance 1998

2 Methods and Limitations

This project has used the provincially recognised Terrestrial Ecosystem Mapping standard[31] to map terrain and ecosystems in the study area.

2.1 Terrestrial Ecosystem Mapping

Mapping at a scale of 1:20,000 and survey intensity level four was completed according to the methods in *Standard for Terrestrial Ecosystem Mapping in British Columbia*[32].

In addition to the required map attributes, the following map attributes were also recorded for each polygon:

- structural stage modifiers for shrub ecosystems
- stand composition modifiers (e.g., coniferous, mixed or broadleaf stand),
- seral association for grassland ecosystems,
- disturbance class and subclass,
- quality of the ecosystem (QUAL) for sensitive and other important ecosystems,
- viability of the ecosystem (VIAB) for sensitive and other important ecosystems,
- slope range,
- terrain stability class for the District of Coldstream, and
- soil erosion potential class for the District of Coldstream.

Preliminary Terrain Mapping

Terrain mapping is a method to categorize, describe and delineate characteristics of surficial materials (the loose materials on top of bedrock), landforms, and geomorphological processes (the active mechanism that continue to shape the landscape) within the natural landscape[33].

A terrain map is a map of surficial materials; it shows the surficial material type and thickness combined with surface expression or landform type (and geological processes if applicable). Each surficial material type is classified based on its genesis. It has its own characteristics of deposition and therefore physical properties such as texture and consolidation.

Terrain maps are the basis for many kinds of land use planning including terrain stability, ecosystem mapping, planning of urban roads and development, assessment of geological hazards, and aggregate mining. Terrain mapping with an ecological emphasis is called bioterrain mapping. Bioterrain mapping forms the basis of terrestrial ecosystem mapping (TEM) by delineating polygons with similar ecological conditions such as soil moisture, aspect, and vegetation characteristics.

---

[31] Resources Inventory Committee 1998
[32] Resources Inventory Committee 1998
[33] Ministry of Forests 1999

Terrain mapping is based on air photo interpretation, which is then ground-truthed in the field. For this project, terrain mapping followed the standard British Columbia procedures for terrain classification[34], mapping methods[35], terrain stability mapping[36] (five-class system) and bioterrain mapping methods[37].

Project terrain mapping was more detailed than is typical as criteria for both bioterrain and terrain stability mapping were used during polygon delineation. Delineation was based on the following characteristics:

- terrain type;
- material depths;
- drainage;
- slope breaks;
- slope position;
- aspect: cool (from 285 to 135°) and warm (from135 to 285°);
- geomorphological processes;
- surface expression and slope morphology (e.g., concave or convex);
- terrain stability class;
- soil erosion potential class;
- vegetation changes;
- riparian zones and corridors; and
- any other ecologically significant areas such as cliffs, talus slopes, and ponds.

Preliminary terrain mapping was completed in 2005 on colour aerial photographs at a scale of approximately 1: 15 000 (Table 1) by Polly Uunila, P.Geo. The mapping included slope gradient range (in percent) and terrain stability class for the portion of the study area within the District of Coldstream. The linework was transferred to a digital map base by mono-restitution and the terrain labels were entered into the database. Appendix B: Terrain Legend provides a description of all materials and geomorphological processes mapped. Figure 5 shows an example of a terrain polygon label.

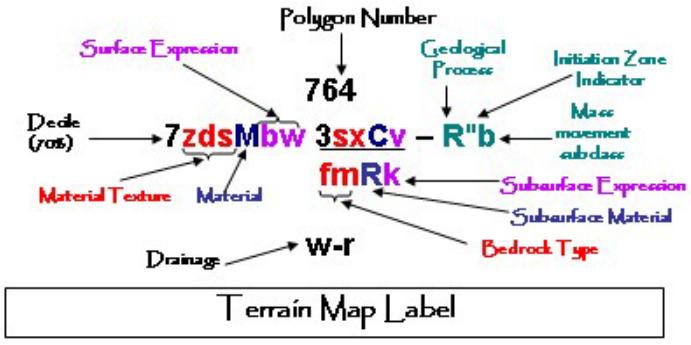


Figure 5. Sample terrain map label.

---

[34] Howes and Kenk 1997
[35] Resources Inventory Committee 1996
[36] Ministry of Forests 1999
[37] Resources Inventory Committee 1998

Table 1. Mapsheets and aerial photographs used for mapping the study area.

TRIM Mapsheets	082L014 082L015 082L024 082L025 082L034 082035
Flight Line and Air Photo Numbers (from north to south)	30BCC94048: No. 046-050 30BCC94043: No. 043-049 30BCC94043: No. 089-097 30BCC94048: No. 132-139 30BCC94043: No. 178-183 30BCC94044: No. 019-033 30BCC94052: No. 122-136 30BCC94049: No. 044-053 30BCC94054: No. 060-067 30BCC94089: No. 101-105 30BCC94099: No. 071-073 30BCC94089: No. 177-179

Field Sampling

A field-sampling plan was developed using aerial photographs and forest cover maps with the following objectives in mind:

- verify the presence, quality, and condition of sensitive ecosystems
- identify other ecosystems
- verify terrain labels
- verify ecosystems in at least 10% of the polygons
- gather detailed data for unclassified ecosystems

Landowners were contacted prior to fieldwork and many landowners granted us access to sample on their lands. Field sampling took place in June and July 2007. A team of three scientists conducted field sampling: a plant ecologist (Kristi Iverson, R.P.Bio. and John Grods, R.P. Bio.), a terrain and soil specialist (Polly Uunila, P.Geo.), and a wildlife habitat ecologist (Allison Haney and Ken MacKenzie).

Three types of sample plots were used to identify and assess ecosystems and terrain: detailed ecological plots (FS882), ground inspections, and visual inspections (Appendix A: Field Plot Forms). Field sampling procedures for detailed ecological plots and ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[38]. We followed guidelines from the

[38] B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1998

Standard for Terrestrial Ecosystem Mapping in British Columbia[39] for visual inspection data collection. Additionally, we collected the pertinent information from a site conservation evaluation form developed by the B.C. Conservation Data Centre to evaluate the condition and ecological integrity of all sensitive ecosystems as per the Standard for Mapping Ecosystems at Risk in British Columbia[40].

For the portion of the study area within the District of Coldstream, additional information regarding terrain stability and soil erosion potential was collected by Polly Uunila, P.Geo. including terrain stability and soil erosion potential classes, signs of instability or erosion, and any other pertinent information regarding stability and soil erosion potential classes. P. Uunila spent an extra two days in the field to focus on refining the criteria for terrain stability and soil erosion potential.

The location of all detailed ecological plots, ground inspection plots, and visual inspections were either recorded by GPS or marked on project aerial photographs. Site locations were digitally captured and are shown on the terrestrial ecosystem map.

Forested and grassland ecosystems were identified using existing site series described in *A Field Guide for Site Identification and Interpretation for the Kamloops Forest Region*[41]. Non-forested units such as wetlands and rock outcrops and grassland seral associations were adopted from previous projects: the Bella Vista – Goose Lake Range SEI[42] and the Central Okanagan SEI[43]. Additional wetland units mapped are taken from the provincial wetland classification[44]. These units were originally described based on field data and units were developed in conjunction with Dennis Lloyd, the Ministry of Forests and Range's Regional Ecologist in Kamloops.

Approximately 1% of the plots were detailed ecological plots (Table 2 and Figure 1), 20% were ground inspections, and 79% were visual inspections. We checked a total of 13% of the polygons (TEM Survey Intensity 4, a total of 3185 polygons in 21,195 ha[45]). Detailed ecological field plots were used to sample high quality sensitive ecosystems and unclassified ecosystems. Ground inspections were used to sample sensitive ecosystems and representative examples of site series. Visuals were primarily used to verify ecosystem units, structural stages, or terrain.

Table 2. Numbers and types of plots conducted at field sites.

FS882	Ground Inspections	Visuals	TOTAL
5	84	325	414

[39] Resources Inventory Committee 1998
[40] Ministry of Environment Ecosystems Branch 2006
[41] Lloyd et al. 1990
[42] Iverson and Shypitka 2003
[43] Iverson and Cadrin 2003
[44] MacKenzie and Moran 2004
[45] Survey intensity level 4 has 60-100 hectares per inspection or 15-25% polygon inspection. Although we only checked 13% of polygons, the detailed mapping resulted in a large number of polygons and our hectares per inspection was only 51 hectares (survey intensity level 3).

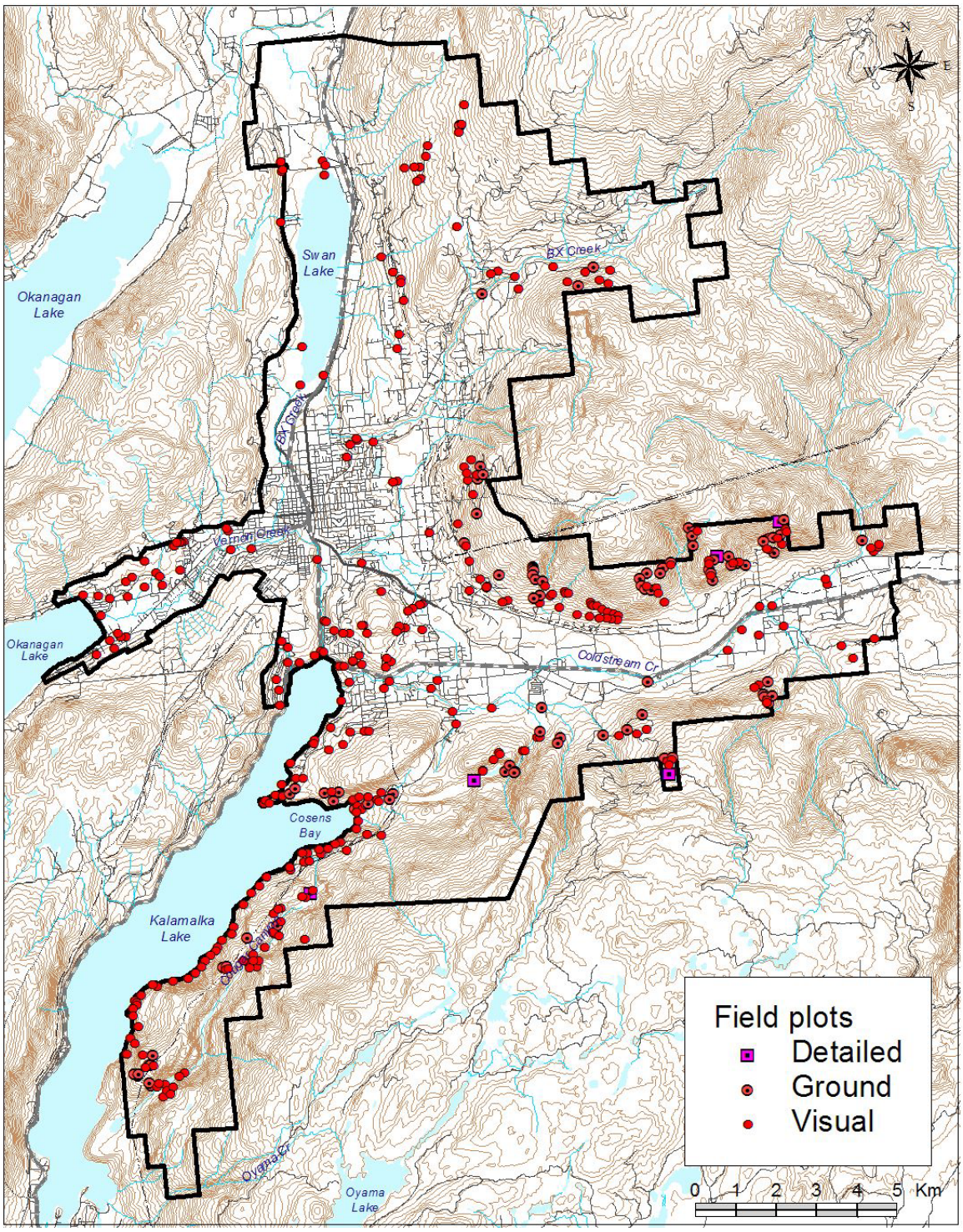


Figure 6. Location of all field plots for the Coldstream – Vernon SEI study area.

Final Terrain Mapping

After field verification in the summer of 2007, Polly Uunila, P.Geo. updated terrain attributes in the database and added soil erosion potential class to each polygon within the District of Coldstream based on field observations and air photo interpretation. The database was updated to reflect any changes to polygon labels.

Expanded Legend Development

The expanded legend describes the terrain, soils, and vegetation of each ecosystem mapped in the study area. The vegetation and terrain descriptions in the expanded legend provided information for the wildlife biologists to develop wildlife habitat ratings (Volume 3; Haney and Sarell 2008).

The expanded legend also provides technical mapping information for each ecosystem unit: the map code, the ecosystem name, the site series number (if applicable), a listing of the assumed modifiers for each unit, and the modifier combinations that were mapped.

Site Series and Site Unit Mapping

Ecosystem units were mapped according to the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[46]. Site series were identified according to Lloyd et al. (1990). Two-letter codes have been assigned to all site series in the master list available at: ftp://ftp.env.gov.bc.ca/dist/wis/tem/mapcodes_jan2003.xls[47]. For ecosystems not included in current site series classifications, new ecosystem units were previously approved by the Ministry of Forests' Regional Ecologist. Sparsely vegetated, non-vegetated and anthropogenic units follow the two-letter codes and descriptions in Table 3.1 of the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[46].

Core polygon attributes collected for all polygons are shown below in Table 3. Site modifiers were also used to describe ecosystems. Up to two site modifiers may be present with each ecosystem unit. Site modifiers represent different site conditions than those of the typical situation, as defined in the master list, for each site series. Each site series has a set of assumed site modifiers under the typical situation. Where a site series is mapped in its typical situation, site modifiers are not included in the map label.

The site series code and site modifier(s) are followed by a structural stage designation, one through seven. Structural stage modifiers were used to subdivide shrub and herb structural stages. Stand composition modifiers indicate the dominant stand composition and were mapped for all forested ecosystems. Seral associations were mapped for grassland ecosystems.

Definitions and descriptions for all site modifiers, structural stage, structural stage modifier, and stand composition modifiers can be found in the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[48].

---

[46] Resources Inventory Committee 1998
[47] Resources Inventory Committee 2000a
[48] Resources Inventory Committee 1998

Up to three ecosystems units were noted for each polygon. The percentage of each ecosystem unit present is indicated by deciles ranging from 1 to 10 (1=10%; 10=100%; Figure 7).

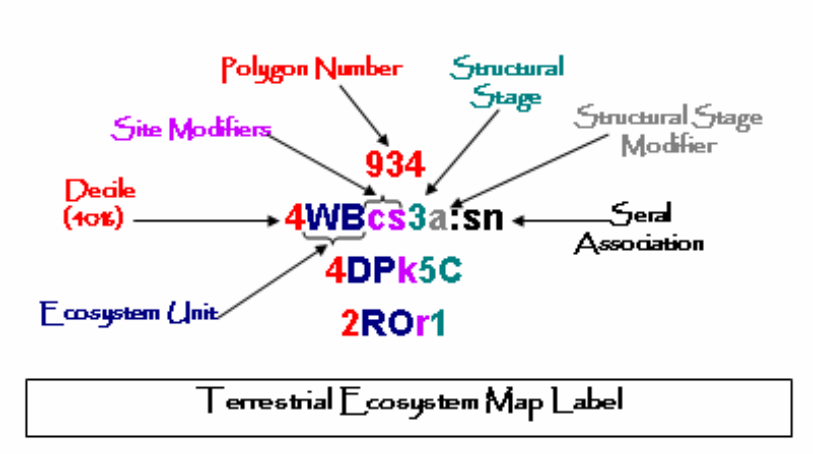


Figure 7. Example of a terrestrial ecosystem map label.

Table 3. Core attributes collected for all polygons.

Project- or Mapsheet-Specific Attributes - repeated for all polygons
Project name
Ecosystem mapper
Terrain mapper
Survey intensity level
Polygon-Specific Attributes - unique for each polygon
Record one of each of the following elements or classes per polygon:
Mapsheet number
Polygon number
Data source
Ecosection unit
Biogeoclimatic unit (zone and subzone; variant and phase required if present)
Geomorphological processes (when present)
Soil drainages
Record up to three ecosystem and/or terrain units per polygon:
Ecosystem attributes
• Decile
• Site series
• Site modifier(s)
• Structural stage
Terrain attributes
• Decile
• Terrain texture (optional but should be done where possible; record up to three for each component)
• Surficial material (record one for each component; could include a surficial subtype)
• Qualifiers (when present, record one for each component)
• Geomorphological processes when present
• Soil drainage classes
• Surface expression (record up to three for each component)

Data Management

Non-spatial information includes field plot data and polygon attribute data. Spatial data includes polygon linework and locations of field verification sites.

Field Plot Data

Data from field plots were entered into a digital database using Resources Inventory Committee standard software (VENUS Version 5). Both manual and electronic quality assurance were completed for the VENUS database. This database was used to sort data into ecosystem units, create the project vegetation species list, and develop the expanded legend. The range of environmental conditions, terrain units, and vegetation communities over which ecosystem units were distributed is described in the expanded legend (Appendix C: Expanded Legend).

Non-spatial Data

We captured the core set of polygon attributes required to meet the provincially accepted *Standard for Terrestrial Ecosystem Mapping (TEM) - Digital Data Capture in British Columbia*[49] (Table 3). Table 4 lists the optional attributes we also applied in this project. We applied two "user-defined" polygon attributes for all occurrences of sensitive ecosystems: condition and viability and three user-defined polygon attributes for all polygons within the District of Coldstream: slope range, terrain stability class and soil erosion potential class. We ran quality assurance error checking routines to ensure the attribute databases were free of errors.

Table 4. List of Optional Attributes

Attribute
Structural stage modifiers
Stand Appearance
Seral Association (for grasslands only)
Disturbance Class and Subclass

Spatial Digital Data

Ecosystems were represented visually on maps and the digital data required to produce this representation were maintained according to standards outlined in the TEM Digital Data Capture Standards[50]. The Terrain Resource Information Management (TRIM) was used as the mapping base. The linework mapped by the bioterrain and ecosystem specialists was captured through monorestitution. Monorestitution is the digital transfer of features by digitising directly from aerial photos using TRIM control points to georeference the data, and TRIM digital elevation models to correct for slope. The process allows for adjustments in polygon shape and size related to the third dimension. Standard quality assurance routines were applied to ensure accurate mapping.

2.2 Terrain stability

This interpretation was added to the District of Coldstream portion of the study area only. Terrain stability mapping identifies relative stability using a polygon-based five class rating system ranging from class I (stable) to class V (unstable) (Table 5). Terrain stability classes indicate a polygon's susceptibility to the initiation of mass movement (gravity induced) processes including landslides, debris flows, rotational slumps, earthflows, and rock slides. Terrain stability maps are used to plan development including forestry, roads, and urban development.

Objectives

The objective of the terrain stability theme is to provide a map, based on the bioterrain information, which will identify areas prone to instability on a regional planning scale. This map will aid in locating building development, roads, green space and other land uses while reducing slope failures caused by human development and the impact of naturally occurring slope failure on development. ***The use of terrain stability maps does not preclude the need for on-site field inspections***.

[49] Resources Inventory Committee 2000b
[50] Resources Inventory Committee 2000b

Methods

Terrain stability is evaluated by air photo interpretation. Each terrain component was evaluated using the 5 class rating system (**I**, stable to **V**, unstable; Table 5). Conventional terrain stability mapping assigns one rating for the entire polygon and, where there is a complex of terrain types in one polygon, the polygon is rated according to the terrain with the highest class (i.e., least stable). Within the District of Coldstream, 15.5% of polygons were field verified (Terrain Survey Intensity Level D).

Table 5. Definitions and management implications for terrain stability classes.[51]

Stability Class	Interpretation
I	• No significant stability problems exist.
II	• There is a low likelihood of landslides following disturbance or development. • Minor slumping is expected along road cuts and excavations.
III	• Stability problems can develop. • Follow BMP to reduce the likelihood of causing slope failure. • Minor slumping is expected along road cuts and excavations. There is a low likelihood of landslide initiation following disturbance or road construction. • Assessment by qualified geotechnical professional recommended.
IV	• Expected to contain areas with a moderate likelihood of landslide initiation following development, disturbance or road construction. • These areas should be avoided. Use caution when planning intensive land use above or below these areas. • Assessment by qualified geotechnical professional recommended.
V	• Expected to contain areas with a high likelihood of landslide initiation. Signs of existing instability present. • Avoid these areas. Do not plan intensive land use above or below these areas. • Assessment by qualified geotechnical professional recommended.

[51] Adapted from Ministry of Forests 1999

Criteria used to assess terrain stability[52] are shown below in Table 6.

Table 6. Guidelines for assessment of terrain stability classes.

Dominant texture	Typical surficial material	Terrain Stability Class				
		I	II	III	IV	V
fine s, z, zs, sz, c, m	LG, C1	<10 %	10-25 %	25-40 %	>35%	all materials and landforms that are unstable, including rockfall;
sdm, dsm	M	<15 %	15-30 %	30-45 %	>45 %	
dzs, zds, sg,	M, F, FG, C	<20 %	20-40 %	40-50 %	>50 %	
a, x	C	<25 %	25-50 %	50 -60 %	>60 %	polygons with: -F"k, -F"m, -F"u, -R"s, -R"r, -R"d, -R"b
resistant bedrock	R	<25 %	25-50 %	50-70 %	>70 %	

Numerical ranges in the table refer to the dominant range of slopes in percent. See Appendix B for definitions of texture and surficial material type.

Criteria are based chiefly on slope steepness, material type, texture, and the presence of geomorphological processes. The criteria were used as general guide with adjustments being made, as necessary, for specific conditions such as soil drainage and slope morphology. The mapper also considers local knowledge, field data, reports and mapping from this study area and in relevant adjacent studies. Each terrain polygon was rated individually in order to permit additional local factors to be taken into account when necessary. These additional local factors include:

- ***Slope smoothness/irregularity***: A slope morphology that includes irregular, near-surface bedrock may be rated as more stable than a similar slope with smooth underlying bedrock, because bedrock irregularities can reduce the likelihood of a landslide in surficial materials. The irregular bedrock acts to pin surficial materials in place, thus the potential for instability is less than on a slope of similar overall steepness but with a smoother profile.
- ***Drainage***: In general, wet slopes are more unstable than dry slopes. Wet slopes may be prone to slope failures through a reduction in normal stress due to high pore water pressure in the soil. Where imperfectly-drained areas are mapped on slopes with gradients that occur within the upper end of a slope steepness class range, the polygon may be rated one terrain stability class higher. Where rapidly drained areas are mapped on slopes with gradients that occur on the lower end of a slope steepness range, the polygon may be rated one stability class lower.
- ***Slope position***: In general, lower slopes and concavities are relatively wet because they receive moisture from a large area upslope; thus they may be classified as a terrain stability class higher than a similar slope that is located in a shedding slope position.

[52] 'Terrain stability' is sometimes also referred to as 'slope stability'

2.3 Soil Erosion Potential

This interpretation was added to the District of Coldstream portion of the study area. Soil Erosion Potential ratings are based on the soil's susceptibility to erosion when vegetation, humus, and other protective layers are removed, not on the polygon's current condition. For this study, erosion is defined as the particle-by-particle removal of soil by running water. Polygons are not rated for wind erosion as different factors contribute to surface erosion by wind.

Erosion occurs where a soil susceptible to erosion is exposed to surface runoff. Areas where soil is commonly exposed and disturbed include: landslide scars, landscaping sites, road cuts, construction sites, excavation sites, areas subject to heavy traffic (for example: foot, bike, motorised vehicles, and heavy machinery), landings, trails, dirt roads, and severe burns. Surface runoff occurs in natural and artificial streams, where water is diverted or concentrated, over relatively impermeable surfaces, in seepage areas, during snow melt, and as a result of storm events. Combinations of the above can intensify surface runoff. Water can be diverted, accelerated, or concentrated by topography, ditch lines, storm sewer lines, irrigation, landscaping, gutters, drainage pipes, leaky structures, and artificial surfaces.

Objectives

The objective of the soil erosion potential theme was to provide a preliminary mapping tool, based on the bioterrain mapping, which identifies areas prone to surface erosion on a regional planning scale. This tool can be used to prevent or reduce soil erosion by identifying areas of very high erosion potential that should be avoided and by applying remedial and preventative measures in moderate to high-risk areas. ***The use of soil erosion potential maps does not preclude on-site field inspection.***

Methods

Soil erosion potential mapping was based on a five-class rating scheme ranging from very low (VL) where no problems of erosion were expected to very high (VH) (Table 7). Ratings were typically assigned through air photo interpretation. Where a single polygon could have more than one rating, the highest value (most conservative) was used (average value is not appropriate). Within the District of Coldstream, 15.5% of polygons were field verified (Terrain Survey Intensity Level D).

Table 7. Definitions and management implications for soil erosion potential classes.

Class	Rating	Definition and Implications
VL	Very low	• No erosion or very minor erosion. • No significant erosion problems expected.
L	Low	• Minor erosion.
M	Moderate	• Erosion problems should be anticipated. • Expect moderate erosion where exposed soils are subject to surface runoff. • Assessment by qualified sediment and erosion control professional recommended.
H	High	• Major erosion problems should be anticipated. • Expect significant erosion where exposed soils are subject to surface runoff. • Disturbed soils are a potential source of sediment. • Assessment by qualified sediment and erosion control professional recommended.
VH	Very high	• Severe surface erosion problems should be anticipated. • Surface erosion is active in these areas and they are existing sources of sediment. • Severe surface and gully erosion problems can occur if water is channelled into these areas. • Runoff from these areas can carry significant amounts of sediment into streams. • Assessment by qualified sediment and erosion control professional recommended.

Criteria for assessing soil erosion potential were based on soil texture, material thickness and slope gradient (Table 8).

Table 8. Guidelines for assessment of soil erosion potential.

SURFICIAL MATERIAL CHARACTERISTICS		DOMINANT GRADIENT RANGE (%)			
		0 – 40%	30 – 60%	> 50%	>40%
Dominant texture Decreasing erodibility	Typical surficial material	smooth, irregular, benched, terraced slopes	moderate to moderately steep slopes	single gullies and scarps	dissected slopes (-V)
fine s, z, c, m	LG, E, C1	H	H, VH	VH	VH
coarse s, ds, gs, sdm, sdz	FG, C, M, F	M	H	H, VH	VH
dzs, zds	M	L	M	H	VH
sg, sd, sr, sx	F, FG, C, M	L	L, M	M	H, VH
x, a	C	VL	VL	L	L
resistant bedrock	R	VL	VL	VL	VL
organics (peat bogs)	O	VL	-	-	-

See Appendix B for definitions of texture and surficial material type.

The criteria were used as a general guide and adjustments were made, as necessary, for specific conditions such as slope position and geomorphic processes. Each terrain polygon was rated individually to permit additional local factors to be taken into account. These local factors included:

- ***Soil drainage:*** Polygons with imperfectly drained soils (seepage present) were rated one class higher;
- ***Slope position***: Lower slopes and concavities tend to be more susceptible to erosion because they generally receive more moisture compared to a middle slope. As a result a polygon may be rated one class higher if it is a receiving site. In contrast, upper slopes are generally less susceptible to erosion as they receive less water as compared to a middle slope and may be rated one class lower;
- ***Slope morphology***: An irregular slope is generally less susceptible to erosion than a smooth slope. A polygon may be rated one class lower if a slope is irregular enough to inhibit some erosion potential; and
- ***Geomorphic Processes***: If a polygon contains an active geomorphic process that is deemed to increase the erosion, such as gullying or slope failure, the soil erosion potential class may be rated one class higher.

2.4 Mapping Limitations

TEM & SEI Mapping Limitations

The SEI and TEM information is intended for use in alerting local and regional decision-makers of the presence of important ecosystems and ecological features. The SEI and TEM do not replace the need for on-site assessments of areas where land use changes are proposed or contemplated.

The accuracy of polygon boundaries is limited by the scale (1:15,000) and date (1994) of the aerial photographs on which the sites are delineated. Field data and orthophotos from 2003 were used to update the mapping where urban development had occurred since the date of the aerial photographs. ***Data should not be enlarged beyond the scale of the photos as this may result in unacceptable distortion and faulty registration with other data sets.***

Given the continuing land-uses within the study area, including human settlement and agricultural development, attributes of some polygons may have changed since the date of the aerial photographs or field work. Wherever possible, polygons were updated to reflect changes noted at the time of field work.

One of the primary limitations of aerial photograph interpretations is the limited ability to see disturbances such as grazing and invasive plants. The mapper applies information based on extrapolation from adjacent areas or current land use, and based on the tone and texture seen on the aerial photographs. Some grasslands may have been incorrectly assigned to a seral association.

There is limited ability to delineate polygons around small sensitive features or ecosystems. In most cases, these ecosystems are captured as a small component of a larger polygon dominated by another ecosystem. Many polygons are a complex of ecosystems and sensitive ecosystems may only occupy a portion of that polygon.

Field verification was limited by access. Not all private land owners granted permission to sample on their property. Finally, many important wildlife habitat features are difficult to capture in ecosystem maps unless they correlate well with certain ecosystems. It is likely that important habitat features such as snags, tree cavities, and coarse woody debris are present but are not included in TEM polygons.

Terrain Mapping Limitations

As with the TEM and SEI mapping, the ***bioterrain, terrain stability and soil erosion potential mapping does not replace the need for on-site assessments for areas of proposed development***. The accuracy of polygon boundaries is limited by the scale (1:15,000) and date (1994) of the aerial photographs on which the polygons are delineated. The information and analyses contained in this report are based on observations of land-surface conditions and the current understanding of terrain and erosion. The following factors have not been taken into account by this study: subsurface conditions not detectable by airphoto interpretations or surface observations (subsurface hydrologic conditions, for example), events whose time of occurrence and severity cannot be predicted (storm events, for example), management practices, and land-use.

Additional factors affecting the accuracy of the terrain mapping and the reliability of the air photo interpretation are described below in Table 9.

Table 9. The factors affecting the reliability of terrain mapping.

Factors	Notes on this study
Skill and experience of the mapper	Pretyping, bioterrain, terrain stability and soil erosion potential and project completion by Polly Uunila, a resident of the North Okanagan, who has completed several terrain mapping projects locally and numerous projects throughout the province
Number of mappers	One mapper
Continuity	Good.
Quality control	Spot checked by Kristi Iverson
Vegetation cover	In general, the vast areas of grasslands and open forest allowed the mapper a good view of landform features while mapping.
Complexity of the landscape	Variable. The rock-controlled portion of the landscape is predictable and fairly straightforward. The thick valley fill on the lower slopes is more complex. Many of the smaller riparian corridors are not mapped.
Quality and scale of the airphotos	Colour photos. Appropriate photo scale for the scale of the final mapping. Generally of good quality, however many steep, west-facing slopes are shadowed and the air photos were 13 years old at the time of project completion.
Distribution of field checking	A majority of the study area is private land, and access to many properties was denied. Overall, the project team was able to check a representation of most ecosystems throughout the study area. Many steeper slopes were inaccessible.
Terrain Survey Intensity Level (TSIL)	TSIL D[53]/C[54] completed for project which is appropriate for mapping landforms and ecosystems, however a greater percentage of the checks on steeper slopes is ideal for Terrain Stability and Soil Erosion Potential themes.
Interpretative criteria for Soil Erosion Potential and Slope Stability	Inadequate field data from this study but good data was available from comparable studies done in adjacent areas.
Quality of the topographic base	Good.
Transfer of linework into digital format	Good. Checked during data entry.
Transfer of terrain symbols into digital format	The database is free of terrain coding errors. As every polygon was not checked against the original mapping on the airphotos, it is possible that data entry errors occurred. Spot-checking indicated that errors are not common.
Edit of final maps	No stand-alone bioterrain map was created so no final edit was done. The Soil Erosion Potential and Terrain Stability maps were spot checked against the original mapping on photos.

[53] TSIL D is defined as 1 - 20% of polygons inspected or 0 to 0.1 checks/ha
[54] TSIL C is defined as 20 - 50% of polygons inspected or 0.5 to 1.0 checks/ha

3 Results

3.1 Terrestrial Ecosystem Mapping Results

Table 10, Table 12, Table 12 and Table 13 below list the ecosystems mapped in the study area for each subzone, the area they covered, the percentage of the subzone, and the percentage of the study area landbase. Appendix C: Expanded Legend provides a complete description of each ecosystem.

Table 10. Ecosystem Units mapped in the IDFdm1, their area, their percent of the IDFdm1 and their percent of the study area.

IDFdm1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of IDFdm1	% of study area
DP /04	Douglas-fir – Pinegrass – Kinnikinnick	49.2	24.7	0.2
DT /01	Douglas-fir – Lodgepole pine – Pinegrass – Twinflower	63.9	32.1	0.3
DW /03	Douglas-fir / Ponderosa pine – Bluebunch wheatgrass - Pinegrass	43.3	21.7	0.2
SB /00	Selaginella – Bluebunch wheatgrass	0.3	0.2	0.002
SD /06	Hybrid white spruce – Douglas-fir – Dogwood - Gooseberry	14.0	7.1	0.07
SO /00	Saskatoon – Mock orange Talus	2.9	1.5	0.01
SP /05	Douglas-fir – Western larch – Spruce – Pinegrass	16.9	8.5	0.08
TA /00	Talus	1.5	0.7	0.007
WJ /02	Bluebunch wheatgrass – Junegrass	7.0	3.5	0.03
TOTAL		**199.1**	**100**	**0.9**

Table 11. Ecosystem Units mapped in the IDFmw1, their area, their percent of the IDFmw1 and their percent of the study area.

IDFmw1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of IDFmw1	% of study area
BI /00	Blockfield	5.1	0.1	0.02
BM /00	Bulrush marsh	0.04	0.0009	0.0002
CB /00	Cutbank	1.5	0.03	0.007
CF /00	Cultivated Field	133.6	3.0	0.6
CL /00	Cliff	1.1	0.03	0.005
CT /00	Cattail Marsh	2.4	0.05	0.01
DF /01	Douglas-fir / Western redcedar – Falsebox – Prince's pine	2252.1	50.8	10.6
DP /04	Douglas-fir – Pinegrass – Feathermoss	518.0	11.7	2.4
DS /02	Douglas-fir / Ponderosa pine – Snowberry – Bluebunch wheatgrass	249.4	5.6	1.2
FW /00	Idaho fescue – Bluebunch wheatgrass	18.5	0.4	0.09
GP /00	Gravel Pit	0.6	0.01	0.003
OW /00	Shallow Open Water	0.4	0.008	0.002
PP /03	Douglas-fir – Penstemon – Pinegrass	456.3	10.3	2.1
RD /06	Western redcedar – Devil's club – Foamflower	127.5	2.9	0.6
RE /00	Reservoir	3.9	0.09	0.02
RF /00	Prairie rose – Idaho fescue	46.8	1.1	0.2
RO /00	Rock	1.2	0.03	0.006
RR /05	Western redcedar / Douglas-fir – Dogwood	419.9	9.5	2.0
RW /00	Rural	87.8	2.0	0.4
RZ /00	Road Surface	7.5	0.2	0.04
SB /00	Selaginella – Bluebunch wheatgrass	1.3	0.03	0.006
SE /00	Sedge meadow	0.8	0.02	0.004
SO /00	Saskatoon – Mock orange Talus	12.7	0.3	0.06
TA /00	Talus	8.2	0.2	0.04
WB /00	Bluebunch wheatgrass – Balsamroot	74.2	1.7	0.4
Ws01	Mountain alder – Skunk cabbage – Lady fern swamp	2.1	0.05	0.01
TOTAL		**4432.9**	**100**	**20.9**

Table 12. Ecosystem Units mapped in the IDFxh1, their area, their percent of the IDFxh1 and their percent of the study area.

IDFxh1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of IDFxh1	% of study area
AS /98	At – Snowberry – Kentucky bluegrass	173.9	1.1	0.8
BE /00	Beach	3.6	0.02	0.02
BM /00	Bulrush Marsh	79.6	0.5	0.4
BN /96	Kentucky bluegrass – Stiff needlegrass	14.1	0.09	0.07
BR /00	Baltic Rush Marsh-Meadow	13.6	0.08	0.06
CB /00	Cutbank	4.8	0.03	0.02
CD /00	ActFd –Common Snowberry – Red-osier Dogwood Riparian	208.0	1.3	1.0

IDFxh1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of IDFxh1	% of study area
CF /00	Cultivated Field	4804.4	29.2	22.7
CG /00	Reed Canarygrass Marsh	0.6	0.004	0.003
CL /00	Cliff	28.6	0.2	0.1
CN /00	Canal	4.8	0.03	0.02
CO /00	Cultivated Orchard	459.9	2.8	2.2
CT /00	Cattail Marsh	51.3	0.3	0.2
CW /00	Choke cherry – Bluebunch wheatgrass rocky bluff	33.9	0.2	0.2
DP /01	FdPy – Pinegrass	557.0	3.4	2.6
DS /07	FdPy – Snowberry – Spirea	793.4	4.8	3.7
DW /03	FdPy – Bluebunch wheatgrass – Pinegrass	466.9	2.8	2.2
ES /00	Exposed Soil	26.1	0.2	0.1
FO /00	FdPy –Saskatoon – Mock orange	128.7	0.8	0.6
FW /91	Idaho fescue – Bluebunch wheatgrass	548.4	3.3	2.6
GC /00	Golf Course	49.6	0.3	0.2
GP /00	Gravel Pit	35.4	0.2	0.2
LA /00	Lake	288.5	1.8	1.4
OW /00	Shallow Open Water	137.0	0.8	0.6
PB /02	FdPy – Bluebunch wheatgrass – Balsamroot	1043.3	6.3	4.9
PD /00	Pond	18.9	0.1	0.1
RE /00	Reservoir	18.0	0.1	0.1
RF /97	Prairie Rose – Idaho fescue	183.3	1.1	0.9
RN /00	Railway	0.8	0.005	0.004
RO /00	Rock Outcrop	32.6	0.2	0.2
RS /00	Western redcedar / Douglas-fir – False Solomon's Seal	18.5	0.1	0.1
RW /00	Rural	822.1	5.0	3.9
RZ /00	Road Surface	44.2	0.3	0.2
SA /00	Antelope brush – Selaginella	115.1	0.7	0.5
SB /00	Selaginella – Bluebunch wheatgrass rock outcrop	348.8	2.1	1.6
SD /08	SxwFd – Douglas maple – Dogwood	183.7	1.1	0.9
SO /00	Saskatoon – Mock orange Talus	65.0	0.4	0.3
SP /04	FdPy – Snowbrush – Pinegrass	361.0	2.2	1.7
TA /00	Talus	41.2	0.2	0.2
UR /00	Urban/Suburban	2547.6	15.5	12.0
WB /93	Bluebunch wheatgrass – Balsamroot	1690.0	10.3	8.0
WS /09	Willow – Sedge Wetland	5.6	0.03	0.03
Ws01	Mountain alder – Skunk cabbage – Lady fern swamp	4.8	0.03	0.02
TOTAL		**16,456.2**	**100**	**77.6**

Table 13. Ecosystem Units mapped in the MSdm1, their area, their percent of the MSdm1 and their percent of the study area.

MSdm1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of MSdm1	% of study area
DP /02	Douglas-fir – Big sage - Pinegrass	7.7	7.3	0.04
PG /03	Lodgepole pine – Grouseberry – Cladonia	1.8	1.7	0.009
PP /04	Lodgepole pine – Pinegrass - Kinnikinnick	26.2	24.7	0.1
RZ /00	Road	1.6	1.5	0.008
SF /01	Hybrid white spruce – Falsebox – Feathermoss	49.7	46.8	0.2
SG /06	Hybrid white spruce – Gooseberry	8.1	7.6	0.04
SH /07	Hybrid white spruce – Trapper's tea – Horsetail	2.3	2.1	0.01
SO / 00	Saskatoon – Mock orange Talus	3.2	3.0	0.01
TA /00	Talus	4.8	4.5	0.02
WS /08	Willow – Sedge	0.8	0.8	0.004
TOTAL		**106.3**	**100**	**0.5**

3.2 Terrain Results for the City of Vernon, Kalamalka Provincial Park and Protected Areas and Cougar Canyon Ecological Reserve

The following describes, in general, the terrain in the City of Vernon portion of the study area. The surficial geology was complex and varied throughout the lower slopes and valley bottom. Most of the surficial materials found in the area consisted of sediment deposited near the end of the most recent glaciation (i.e. till, glaciofluvial and glaciolacustrine sediments) and by recent processes that have reworked and downcut through these sediments depositing surficial materials such as fluvial sediments, colluvium and eolian silts and sands. At one stage during deglaciation, a large meltwater channel, following the present day path of Vernon Creek from Kalamalka Lake to Okanagan Lake, downcut through a sequence of Fraser Glaciation sediments (glaciolacustrine overlying till) then Pre-Fraser glaciation sands and gravels[55]. This sequence outcrops in the escarpment between the Ministry of Forests office and the DND lands.

Glaciofluvial terraces were mapped along either side of the mid-reach of BX Creek. The midslopes east of Vernon are largely covered by till with scattered outcrops of bedrock. Discontinuous thin veneers of eolian sediments may be found on gentler slopes. Glaciofluvial sediments were mapped at the mouths of some meltwater channels. On the upper slopes east of Vernon, till deposits tended to be thinner and less extensive than lower on the slope. Bedrock-controlled terrain was more frequent on the upper slopes where outcrops were covered by a partial veneer of weathered bedrock on the gentler slopes and colluvium on steeper slopes.

The following describes in general the terrain for Kalamalka Provincial Park, Kalamalka Protected Area and Cougar Canyon Ecological Reserve. The area consisted of bedrock-controlled terrain that was partially covered by thin veneers of collvium, till and weathered bedrock. Aprons of talus

[55] Kidston 1993

flanked cliffs throughout this area. The headscarp of a large bedrock slump and its deposit were located upslope from Deep Lake. Gentler slopes along the valley bottoms and lower slopes (i.e. adjacent to Cosens Bay and the valley east of Cosens Bay) were covered by thicker deposits of till as well as glaciofluvial and glaciolacustrine sediments in localized pockets. Colluvial fans and cones and talus were common on the lower slopes in Cougar Canyon. The valley floor of Cougar Canyon consisted of a chain of marshes and small lakes.

3.3 Terrain, Terrain Stability, and Soil Erosion Potential Results for the District of Coldstream

In general, the landscape and surficial geology was quite variable and complex. The following geomorphological processes were mapped in the District of Coldstream:

- slumps in bedrock;
- laterial spreading in bedrock;
- tension cracks in bedrock;
- rockfall;
- debris slides; and
- piping.

These processes included active processes that were evident on the 1994, 1:15,000 scale air photos and were observed during field work in 2007. Additional geomorphological processes may be present but were not mapped for the following possible reasons:

- the features were too small to be visible on the air photos;
- the features were in shadows or under forest cover; or
- the events have occurred since 1994.

The following gives brief and general descriptions of the distribution of surficial geology, terrain stability, and soil erosion potential from the valley bottom to higher slopes in the Coldstream Valley that lie within the municipal boundaries.

- **Valley bottom**: The Coldstream Creek valley bottom consisted largely of fluvial (fan and floodplain) deposits and glaciofluvial sediments. At the lower end of the valley, there were large areas of glaciolacustrine sediments as well.

  Stability issues in this area included potential slumping in glaciolacustrine sediments. The soils more susceptible to erosion included fluvial silts and sands, lacustrine and glaciolacustrine sediments.

- **Lower slopes**: The lower slopes, for example, adjacent to the south and southwest end of Kalamalka Lake, Coldstream estates area, Noble Canyon and along the Coldstream Creek valley, contained areas of thick sediments including glaciofluvial, till, glaciolacustrine and undifferentiated sediments. These landforms tended to be sloping benches dissected by gullies created by post-glacial streams and erosion. Areas of bedrock covered by little or no colluvium were scattered throughout these slopes. Veneers of eolian sediments were found discontinuously on the gentler surfaces

Stability issues in this area included debris slides in gullies dissecting thick sediments, piping in the escarpment near the College, rockfall, and potential slumping in glaciolacustrine sediments. A small tension crack was found in the field on the ridge top between McKergow Pond and Middleton Way. The soils more susceptible to erosion included fluvial and glaciofluvial silts and sands, eolian silts and sands, and glaciolacustrine sediments. Slopes containing gullies incised through thick surficial materials were areas with high potential for erosion.

- **Mid slopes**: The midslopes were largely covered by blankets and veneers of till with scattered bedrock outcrops and associated colluvium and weathered bedrock. Patches of very thin veneers of eolian sediments covered gentler slopes. Many single gullies dissected the Coldstream Valley slopes.

  Potentially unstable terrain in this area included talus slopes, slopes greater than about 50%, and steep-sided single gullies. The large bedrock slump deposit was mapped as potentially unstable. The soils more susceptible to erosion included eolian and slope-wash silts and sands, and moderately steep to steep slopes of till. Slopes containing gullies incised through thick surficial materials were areas of high potential for erosion.

- **Upper slopes**: These slopes were typically moderately steep to steep, bedrock-controlled terrain. The bedrock was discontinuously covered by thin till and colluvium. Talus slopes flanked bedrock cliffs. There was a large bedrock slump deposit located above Deep Lake and lateral spreading and bedrock slumping in the plateau basalts at the edge of the Aberdeen plateau.

  The single gullies and rockfall comprised the largest amount of potentially unstable and unstable terrain within this area. In general, open slopes steeper than about 50% and dissected slopes steeper than about 45% were assigned terrain stability class IV. Steeper bedrock-controlled slopes with a partial veneer of surficial materials were rated as terrain stability class IV. The bedrock slumps and tension cracks located in the Thompson Plateau basalt along the southern edges of the study area were mapped as potentially unstable and unstable. The soils more susceptible to erosion included moderately steep to steep slopes of till. Slopes containing gullies incised through thick surficial materials were areas of high potential for erosion.

3.4 Terrain Recommendations for the District of Coldstream

It is recommended that Qualified Registered Professional conduct more detailed assessments of the following:

- The large bedrock slump located above Deep Lake to determine the potential for further movement in the slide mass and the potential downslope impacts.
- The stability and potential downslope impact (Middleton Way side of ridge) from the small tension crack found on the ridge top between McKergow Pond and Middleton Way.

The following recommendations are standard to avoid problems during development in areas that are prone to erosion or instability[56]:

- Use Best Management Practices, for example as outlined in the document *Best Management Practices for Erosion and Sediment Control-Upland Works*[57] . In and adjacent to riparian zones,

[56] adapted from Iverson *et al.* 2004

it is particularly critical to avoid disturbances of soils susceptible to erosion. Best Management Practices as outlined in *Best Management Practices for Erosion and Sediment Control-Instream Works*[58] should be followed as well as all legal requirements outlined in the *Fisheries Act* and the provincial *Water Act*.

- Conscientious drainage planning is essential during road construction. Local drainage patterns have slowly been created since deglaciation. This process took thousands of years to evolve, and is in a sensitive equilibrium with the volume of water discharge. All natural drainage patterns, even minor ephemeral channels should be maintained. This is also important upslope of steeper areas as redirected drainage will affect the steep slopes below. Natural drainage patterns should be maintained through comprehensive stormwater planning that maintains natural water flow patterns by using stormwater source control strategies that return 90% of the precipitation to their natural drainage pathways.
- Sloughing of cut banks along roads may develop due to emergence of shallow subsurface water. Design road patterns to minimize cut and fills, and armour ditches with rock or vegetation where erosion is likely to occur. Ditches should be inspected regularly and cleaned or otherwise maintained when necessary.
- Ensure that culvert size is adequate and that the discharge points are properly armoured if necessary to reduce local erosion. Seeding together with geotextiles and armouring with rock are effective for controlling erosion.
- Minimize areas of soil disturbance for each development site or phase construction so that site clearing is minimized at any given time.
- Grass seeding may be an effective means of reducing soil erosion potential on bare surfaces such as cut banks and other disturbed areas. These areas could be lined with material such as weed-free straw to control erosion until grass becomes established. Grass seed used must be weed-free.
- Road construction should be avoided during wet weather and when the ground is wet due to snowmelt.
- Bare, compacted surfaces, even on gentle slopes, are particularly vulnerable to erosion by running water. Minimize disturbance of soils by having equipment use designated trails. Avoid leaving tracks aligned in the downhill direction that will channel runoff water and increase erosion. On steeper areas, these trails may require armouring to prevent surface erosion. Trails that are not part of the permanent road network should be scarified and rehabilitated and planted with native vegetation species adapted to the specific site.
- On steep slopes, construction should be minimized, but where unavoidable, all appropriate measures should be used to prevent soil and site degradation.
- Qualified registered professionals should evaluate the risk of a debris flow/torrent impacting development on the fan.
- Areas down slope of unstable glaciolacustrine scarps are also areas that could be impacted by landslide runout. Stability of glaciolacustrine scarps can be affected by over-irrigation,

---

[57] City of Kelowna 1998b
[58] City of Kelowna 1998a

redirection of water (ditches and watercourses) onto the scarp, and addition of weight at the edge of the scarp (i.e., buildings, pools, trees, fill etc.). The force of the wind on tall trees and buildings can increase the forces that contribute to rotational slumps in thick glaciolacustrine materials.

- Glaciolacustrine materials are also susceptible to piping and collapse. It is recommended that qualified registered professionals investigate ground conditions in areas of thick glaciolacustrine material even in class **I** and **II** terrain.
- Where development is planned within or near polygons containing terrain stability classes **III, IV** and **V**, on-site inspections is required by a qualified registered professional, such as a Geotechnical Engineer, to determine more precisely the nature and extent of the unstable areas.
- Where development is planned within polygons containing soil erosion potential **M, H** and **VH**, on-site inspections is required by a qualified registered professional.
- Class **V** terrain is unstable and should be avoided.

References

Agee, J.K. 1993. Fire ecology of Pacific Northwest forests. Island Press, Washington, D.C.

B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests. 1998. *Field Manual for Describing Terrestrial Ecosystems*. Land Management Handbook Number 25. Province of British Columbia, Victoria, B.C.

Cannings, R.J. and E. Durance. 1998. Human use of natural resources in the South Okanagan and Lower Similkameen valleys *in* Smith, I.M., and G.G.E. Scudder, eds. Assessment of species diversity in the Montane Cordillera Ecozone. Burlington: Ecological Monitoring and Assessment Network, 1998.

City of Kelowna. 1998a. Best Management Practices for Erosion and Sediment Control – Instream Works.

City of Kelowna. 1998b. Best Management Practices for Erosion and Sediment Control – Upland Daubenmire, R.F. 1940. Plant succession due to overgrazing in the *Agropyron* bunchgrass prairie of southeastern Washington. Ecology 21:55-64.

Daigle, P. 1996. Fire in the dry interior forests of British Columbia. Extension Note 08. B.C. Ministry of Forests Research Branch. Victoria, B.C.

Daubenmire, R. 1968. Ecology of fire in grasslands. Advanced Ecological Research 5:209-266.

Daubenmire, R.F. 1940. Plant succession due to overgrazing in the *Agropyron* bunchgrass prairie of southeastern Washington. Ecology 21:55-64.

Demarchi, D. 1996. An Introduction to the Ecoregions of British Columbia, Draft. Ministry of Environment Lands, & Parks, Victoria, B.C.

Dormaar, J.F., S. Smoliak, and W.D. Willms. 1989. Vegetation and soil responses to short-duration grazing on fescue grasslands. Journal of Range Management 42:252-256.

EBA Engineering Consultants Ltd. 1998. Detailed and Reconnaissance Terrain Mapping, Salmon Arm, BC. Unpub. report prepared for the Salmon Arm Forest District.

Fulé, P.Z., W.W. Covington, and M.M. Moore. 1997. Determining reference conditions for ecosystem management of southwestern ponderosa pine forests. Ecol. Appl. 7:895-908.

Fulton, R.J., 1965. Surficial Geology, Vernon, British Columbia, Geological Survey of Canada, Map 1245A, map scale 1:126,720.

Fulton, R.J., 1969. "Glacial Lake History, Southern Interior Plateau, British Columbia". GSC Paper 69-37, 14 pp.

Glombick, P., R. I. Thompson, and K. L. Daughtry. 2004. Geology, Oyama, British Columbia; Geological Survey of Canada, Open File 4372, scale 1:50,000.

Haney, A. and M. Sarell. 2008. Sensitive Ecosystems Inventory: Coldstream - Vernon, 2007. Volume 3: Wildlife Habitat Mapping. Unpublished report prepared for the Allan Brooks Nature Centre.

Holland, S. S. 1976. Landforms of British Columbia: A Physiographic Outline, Bulletin 48, British Columbia, Bulletin no. 46, British Columbia Ministry of Energy, Mines and Petroleum Resources, Queen's Printer, Victoria, British Columbia.

Howes, D.E. and E. Kenk (ed.). 1997. Terrain classification system for British Columbia. Revised edition. MOE Manual 10. B.C. Min. Environ. and B.C. Min. Crown Lands. Victoria, B.C.

Iverson, K. 2008. Sensitive Ecosystems Inventory: Coldstream – Vernon, 2007. Volume 1: Methods, Ecological Descriptions, Results, Conservation Tools, and Management Recommendations. Unpub. report prepared for the Allan Brooks Nature Centre.

Iverson, K., C. Cadrin, D. S. Filatow, and C. Erwin. 2004. Sensitive Ecosystems Inventory: Central Okanagan, 2000 – 2001. Volume 2: Terrestrial Ecosystem Mapping, Surface Erosion and Slope Stability, and Expanded Legend. Unpub. report prepared for the Regional District of the Central Okanagan.

Iverson, K., and S. Shypitka. 2003. Sensitive Ecosystems Inventory: Bella Vista – Goose Lake Range. Volume 2: Terrestrial Ecosystem Mapping, Soil Erosion and Slope Stability, and Expanded Legends. Unpub. report prepared for the Okanagan Indian Band and Allan Brooks Nature Centre.

Iverson, K., and P. Uunilla. 2005. Sensitive Ecosystems Inventory: Vernon Commonage. Volume 2: Terrestrial Ecosystem Mapping and Expanded Legends. Unpub. report prepared for the Ministry of Environment and Allan Brooks Nature Centre.

Iverson, K., and P. Uunilla. 2005. Sensitive Ecosystems Inventory: Lake Country. Volume 2: Terrestrial Ecosystem Mapping, Soil Erosion and Slope Stability, and Expanded Legends. Unpub. report prepared for the District of Lake Country and Ministry of Environment.

Kidston, J. 1993. Vernon, a Geological Guide. Vernon, British Columbia.

Lloyd, D., K. Angrove, G. Hope, and C. Thompson. 1990. A guide to site identification and interpretation for the Kamloops Forest Region. Land management handbook no. 23. BC Ministry of Forests. Victoria, B.C.

MacKenzie, W. H. and J. R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Land management handbook no. 52. B.C Ministry of Forests. Victoria, B.C.

Mather, K. 1996. Bunchgrass and beef: bunchgrass ecosystems and the early cattle industry in the Thompson Okanagan. http://www.livinglandscapes.bc.ca/thomp-ok/article-LL/index-beef.html

McLean, A., and S. Wikeem. 1985. Rough fescue response to season and intensity of defoliation. Journal of Range Management 38:100-103.

Ministry of Environment Ecosystems Branch. 2006. Standard for Mapping Ecosystems at Risk: An Approach to Mapping Ecosystems at Risk and Other Sensitive Ecosystems. Version 1.0. Victoria, B.C.

Ministry of Forests. 1999. Mapping and Assessing Terrain Stability Guidebook (second edition). Forest Practices Code of British Columbia. http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/terrain/index.htm

Moore, M.M., W.W. Covington, and P. Z. Fulé. 1999. Reference conditions and ecological restoration: a southwestern ponderosa pine perspective. Ecol. Appl. 9:1266-1277.

Pojar, J., K. Klinka, and D.V. Meidinger. 1987. Biogeoclimatic ecosystem classification in British Columbia. For. Ecol. and Manage. 22:119-154.

Pokotylo, D.L. and P.D. Froese. 1983. Archaeological evidence for prehistoric root gathering on the southern interior plateau of British Columbia: a case study from Upper Hat Creek Valley. Canadian Journal of Archaeology 7:128-156.

Resources Inventory Committee. 2000a. Provincial site series mapping codes and typical environmental conditions. Ecosystems Working Group. Victoria, B.C. http://www.publications.gov.bc.ca

_____. 2000b. Standard for Terrestrial Ecosystem Mapping (TEM) – Digital Data Capture in British Columbia, Version 3.0. Victoria, B.C.

_____. 1998. Standard for Terrestrial Ecosystem Mapping in British Columbia. Victoria, B.C.

_____. 1996. Guidelines and Standards for Terrain Mapping in British Columbia. Victoria, B.C. http://srmwww.gov.bc.ca/risc/pubs/EarthSci/012/index.htm

Soil Classification Working Group. 1998. The Canadian System of Soil Classification, Third Edition. Ottawa, NRC Research Press.

Thompson, R. I. and J.L.E. Unterschutz, 2004. Geology, Vernon, British Columbia; Geological Survey of Canada, Open File 4375, scale 1:50,000.

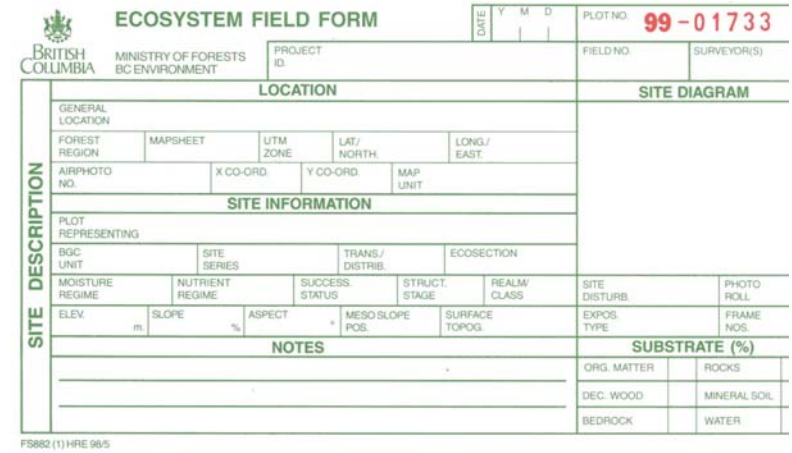
Thomson, D. 2000. The response of Okanagan Indians to European settlement. http://www.livinglandscapes.bc.ca/thomp-ok/indian/indian.html

Tisdale, E.W. 1947. The grasslands of the southern interior of British Columbia. Ecology 28:346-382.

Turner, N.J. 1994. Burning mountain sides for better crops: aboriginal landscape burning in British Columbia. Interior Journal of Ecoforestry 10:116-122.

Wittneben, U. 1986. Soils of the Okanagan and Similkameen Valleys. MOE Technical Report 18, Victoria, BC.

Appendix A: Field Plot Forms



ECOSYSTEM FIELD FORM

BRITISH COLUMBIA — MINISTRY OF FORESTS / BC ENVIRONMENT

DATE (Y M D) | PLOT NO. 99-01733 | PROJECT ID. | FIELD NO. | SURVEYOR(S)

SITE DESCRIPTION

LOCATION | SITE DIAGRAM

GENERAL LOCATION

FOREST REGION | MAPSHEET | UTM ZONE | LAT./ NORTH. | LONG./ EAST.

AIRPHOTO NO. | X CO-ORD. | Y CO-ORD. | MAP UNIT

SITE INFORMATION

PLOT REPRESENTING

BGC UNIT | SITE SERIES | TRANS./ DISTRIB. | ECOSECTION

MOISTURE REGIME | NUTRIENT REGIME | SUCCESS. STATUS | STRUCT. STAGE | REALM/ CLASS | SITE DISTURB. | PHOTO ROLL

ELEV. m. | SLOPE % | ASPECT ° | MESO SLOPE POS. | SURFACE TOPOG. | EXPOS. TYPE | FRAME NOS.

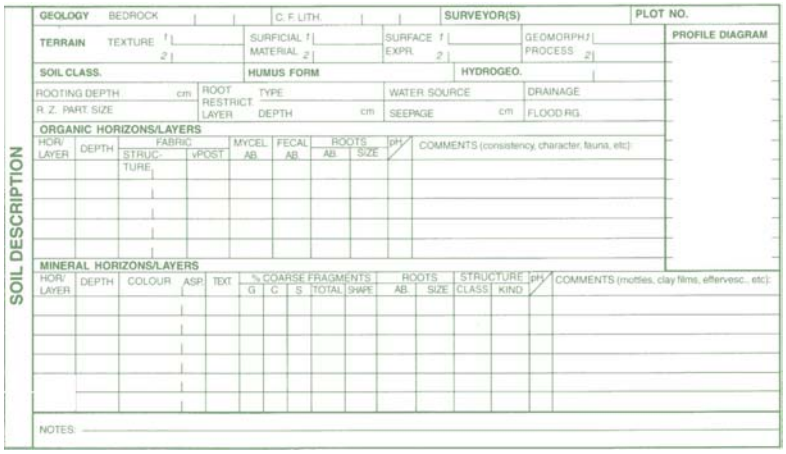
NOTES | SUBSTRATE (%)

ORG. MATTER | ROCKS

DEC. WOOD | MINERAL SOIL

BEDROCK | WATER

FS882 (1) HRE 98/5



SOIL DESCRIPTION

GEOLOGY BEDROCK | C. F. LITH. | SURVEYOR(S) | PLOT NO.

TERRAIN TEXTURE 1 / 2 | SURFICIAL 1 / MATERIAL 2 | SURFACE 1 / EXPR. 2 | GEOMORPH 1 / PROCESS 2 | PROFILE DIAGRAM

SOIL CLASS. | HUMUS FORM | HYDROGEO.

ROOTING DEPTH cm | ROOT RESTRICT. LAYER | TYPE | DEPTH cm | WATER SOURCE | SEEPAGE cm | DRAINAGE | FLOOD FIG.

R. Z. PART. SIZE

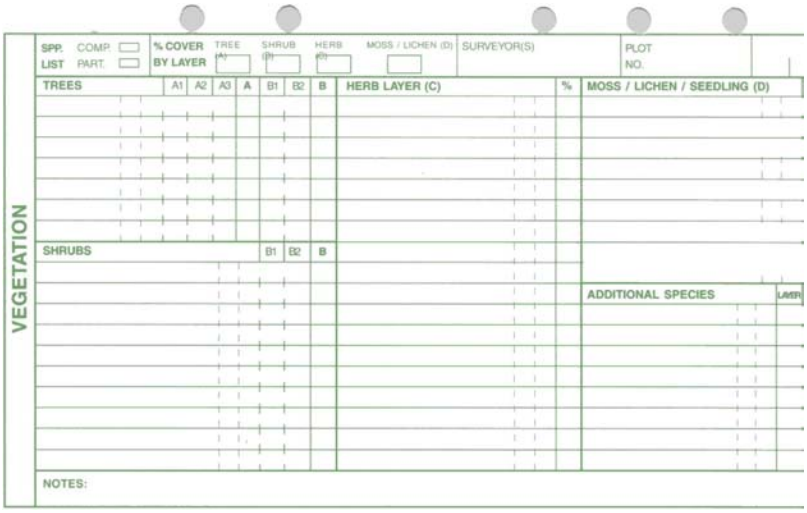
ORGANIC HORIZONS/LAYERS

HOR/ LAYER | DEPTH | FABRIC: STRUCTURE, vPOST | MYCEL. AB. | FECAL AB. | ROOTS AB. | ROOTS SIZE | pH | COMMENTS (consistency, character, fauna, etc):

MINERAL HORIZONS/LAYERS

HOR/ LAYER | DEPTH | COLOUR | ASP. | TEXT | % COARSE FRAGMENTS: G, C, S, TOTAL, SHAPE | ROOTS: AB., SIZE | STRUCTURE: CLASS, KIND | pH | COMMENTS (mottles, clay films, effervesc., etc):

NOTES:



VEGETATION

SPP. LIST: COMP. / PART. | % COVER BY LAYER: TREE (A) | SHRUB (B) | HERB (C) | MOSS / LICHEN (D) | SURVEYOR(S) | PLOT NO.

TREES: A1 | A2 | A3 | A | B1 | B2 | B

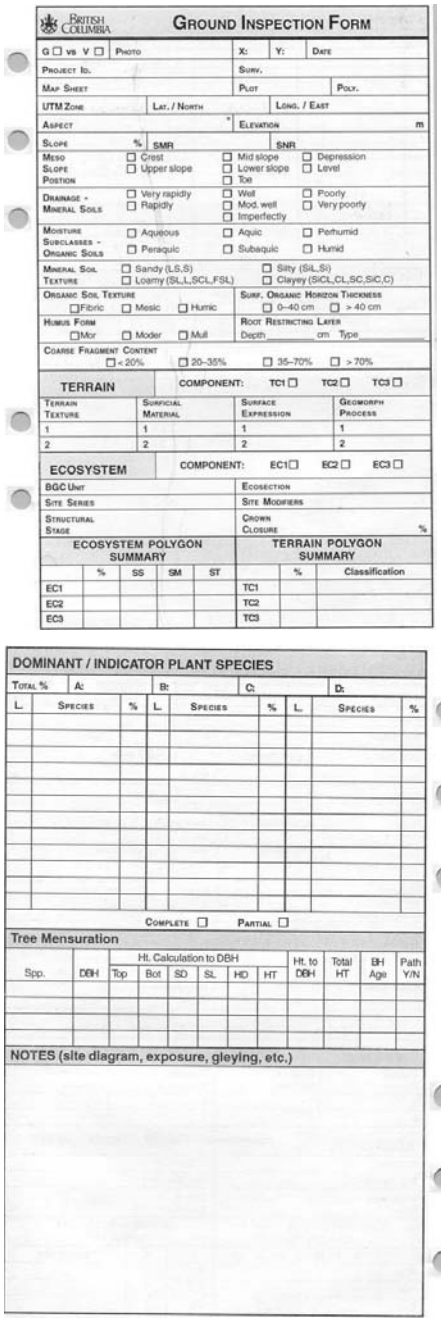
SHRUBS: B1 | B2 | B

HERB LAYER (C) | %

MOSS / LICHEN / SEEDLING (D)

ADDITIONAL SPECIES | LAYER

NOTES:



BRITISH COLUMBIA

GROUND INSPECTION FORM

G ☐ VS V ☐	PHOTO	X:	Y:	DATE
PROJECT ID.		SURV.		
MAP SHEET		PLOT		POLY.
UTM ZONE	LAT. / NORTH		LONG. / EAST	
ASPECT	°	ELEVATION		m
SLOPE %	SMR		SNR	

MESO SLOPE POSITION	☐ Crest	☐ Mid slope	☐ Depression	
	☐ Upper slope	☐ Lower slope	☐ Level	
		☐ Toe		
DRAINAGE - MINERAL SOILS	☐ Very rapidly	☐ Well	☐ Poorly	
	☐ Rapidly	☐ Mod. well	☐ Very poorly	
		☐ Imperfectly		
MOISTURE SUBCLASSES - ORGANIC SOILS	☐ Aqueous	☐ Aquic	☐ Perhumid	
	☐ Peraquic	☐ Subaquic	☐ Humid	

MINERAL SOIL TEXTURE: ☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL) ☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)

ORGANIC SOIL TEXTURE: ☐ Fibric ☐ Mesic ☐ Humic

SURF. ORGANIC HORIZON THICKNESS: ☐ 0–40 cm ☐ > 40 cm

HUMUS FORM: ☐ Mor ☐ Moder ☐ Mull

ROOT RESTRICTING LAYER: Depth _____ cm Type _____

COARSE FRAGMENT CONTENT: ☐ < 20% ☐ 20–35% ☐ 35–70% ☐ > 70%

TERRAIN

COMPONENT: TC1 ☐ TC2 ☐ TC3 ☐

	TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1				
2				

ECOSYSTEM

COMPONENT: EC1 ☐ EC2 ☐ EC3 ☐

BGC UNIT	ECOSECTION
SITE SERIES	SITE MODIFIERS
STRUCTURAL STAGE	CROWN CLOSURE %

ECOSYSTEM POLYGON SUMMARY					TERRAIN POLYGON SUMMARY		
	%	SS	SM	ST		%	Classification
EC1					TC1		
EC2					TC2		
EC3					TC3		

DOMINANT / INDICATOR PLANT SPECIES

TOTAL % | A: | B: | C: | D:

L.	SPECIES	%	L.	SPECIES	%	L.	SPECIES	%

COMPLETE ☐ PARTIAL ☐

Tree Mensuration

Spp.	DBH	Ht. Calculation to DBH						Ht. to DBH	Total HT	BH Age	Path Y/N
		Top	Bot	SD	SL	HD	HT				

NOTES (site diagram, exposure, gleying, etc.)

VISUAL& CONSERVATION EVALUATION FORM		
PROJ. ID.		**SURV.**
PLOT#	**AIR PHOTO #**	**DATE**
UTM ZONE	LAT./NORTH	LONG./EAST
BGC UNIT	SITE SERIES	SITE MOD
STR STAGE	ASPECT °	ELEVATION m
SLOPE %	SMR/SNR	MESO SLOPE
SOIL DRAINAGE	SOIL TEXTURE	COARSE FRAG%
TERRAIN COMPONENT 1:		

DOMINANT / INDICATOR VEGETATION SPECIES

TOTAL	**A:**	**B:**	**C:**	**D:**

SPECIES	L	%	SPECIES	L	%	SPECIES	L	%

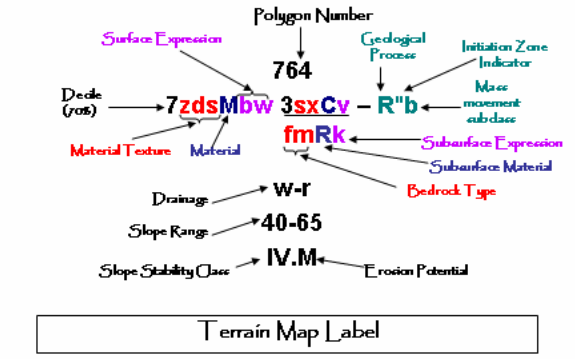
COMPLETE ❒ PARTIAL ❒

ECOSYSTEM POLYGON SUMMARY						**TERRAIN POLYGON SUMMARY**		
	%	**SS**	**SM**	**ST**	**CC**		**%**	Classification
EC1						**TC1**		
EC2						**TC2**		
EC3						**TC3**		

CONSERVATION EVALUATION FORM			
PROJECT IDENTIFICATION		**DATE:**	
PROJECT ID:		**PLOT #:**	
POLY #:	**SEI CLASS:SUBCLASS:**		
ECOLOGICAL COMMUNITY			
CONSERVATION INFORMATION			
OWNER/JURISDICTION:			
DISTURBANCE:		**KNOWN THREATS:**	
ADJACENT LAND USE:		**OTHER FACTORS:**	
ALIEN SPP.:			
SUCCESS. STATUS:		**EST. SIZE COMM:**	**(ha)**
FRAGMENTATION OF ECOLOGICAL COMMUNITY			
❒ < 5% FRAGMENTED ❒ 5 - 25 % FRAGMENTED ❒ > 25% FRAGMENTED			
EVALUATION SUMMARY			
LANDSCAPE CONTEXT:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
ECOLOGICAL INTEGRITY:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
CONDITION:	EXCELLENT ❒ GOOD ❒ FAIR ❒ POOR ❒		
NOTES(AT-RISK SPECIES, WILDLIFE OBSV., ACCURACY INFO, ETC)			
OBSERVER	NAME:		
ADDRESS:			
EMAIL:		PHONE/FAX:	
SUBMIT DATA			
B.C. Conservation Data Centre **P.O. Box 9358, Stn. Prov. Gov't, Victoria, BC. V8W 9M2** Include: FS882 or GIF or VENUS file ❒ air photos with polygon marked ❒ map product(s) ❒ ground photos ❒			

Appendix B: Terrain Legend

Terrain Polygon Symbols



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

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

e.g., 7Mv 3Rs indicates that the polygons contains approximately 70% "Mv" and 30%"Rs".
e.g., 6Mb 3Cv 1Rs indicates that the polygons contains approximately 60% "Mb" , 30%"Cv", and 10% “Rs”.

Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock: e.g., Mv / Rr indicates that "Mv" overlies "Rr".

Material	
Code	**Name**
A	Anthropogenic
C	Colluvium
C1	Slope wash
D	Weathered bedrock
E	Eolian
F	Fluvial materials
FA	"Active" fluvial materials
FG	Glaciofluvial materials
L	Lacustrine sediments
LG	Glaciolacustrine sediments
M	Till
O	Organic materials
R	Bedrock
U	Undifferentiated materials

Texture	
Code	**Name**
c	clay
z	silt
s	sand
p	pebbles
k	cobbles
b	boulders
a	blocks
d	mixed fragments
g	gravel
r	rubble
x	angular fragments
m	mud
y	shells
e	fibric
u	mesic
h	humic

Surface Expression	
Code	**Name**
a	moderate slope(s)
b	blanket (>1m thick)
c	cone
d	depression
f	fan
h	hummocky
j	gentle slope(s) (5-27%)
k	moderately steep slope (49-70%)
m	rolling topography
p	plain (0-5%)
r	ridges
s	steep slope(s) (>70%)
t	terrace(s)
u	undulating topography
v	veneer (≤1m thick)
w	mantle of variable thickness
x	thin veneer (10-25cm)

Detailed Descriptions of Surficial Materials

Anthropogenic Material (A)

Anthropogenic materials are deposits that are sufficiently reworked or redistributed by human activities that their original character is lost. Examples include gravel pits and fill used for roads and other construction.

Colluvium (C)

Colluvium accumulated during post-glacial times as a result of gravity-induced slope movement, for example, rock fall and soil creep. The physical characteristics of colluvium are closely related to its source and mode of accumulation. Four processes generally create colluvial deposits; (1) rockfall from bedrock bluffs, (2) soil creep in weathered bedrock, (3) mass movement processes in surficial materials (debris flows and debris slides), and (4) rockslides and rock slumps.

Rockfall from bedrock bluffs typically forms talus slopes (Ck). Talus is loosely packed rubble or blocks with little interstitial silt and sand near the surface, and is rapidly drained. Within the study area talus is scattered throughout flanking bedrock cliffs.

Colluvial veneers (Cv) and blankets (Cb) develop where weathered bedrock or surficial materials have been loosened and moved downslope by gravitational processes such as soil creep. It is loosely packed and usually rapidly drained. Colluvial veneers and very thin veneers are most common on upper, moderately steep and steep gradient slopes and as discontinuous, very thin veneers on bedrock-controlled terrain. The matrix texture of the colluvium reflects the bedrock or surficial materials it is derived from.

Colluvial fans (Cf) and cones (Cc) form at the base of steep gullies due to deposition by debris flows (-Rd). These deposits are generally compact, and sorting may range from poorly sorted to well sorted. The deposit may or may not be matrix supported, and the matrix is usually sand. Colluvial cones and fans are common at the mouths of the large single gullies.

Deep-seated slumps in bedrock and surficial materials result in hummocky, irregular colluvial deposits (Chu). Rock slumps contain blocks and rubble with little or no interstitial silt and sand. Rotational slumps have developed in some portions of the plateau basalt cliffs due to failure along vertical joints and horizontal weak layers. A large slump is located upslope from Deep Lake.

Slope Wash (C1)

Slope wash is a result of rainfall events in which non-channellized overland flow carries surface material from a steeper area to a gentler area down slope. The material is generally derived from eolian sediments. Slope wash generally does not travel far and comes to rest on gentler slopes of 0 to 15 %. In the study area, it was commonly found as a partial veneer overlying till, fluvial or lacustrine deposits. The typical texture is silty sand or sandy silt with generally less than 5 % coarse fragments. It commonly includes some imperfect drainage as it accumulates in receiving sites and is often vegetated by shrubs and sometimes aspen.

Weathered Bedrock (D)

Weathered bedrock has been modified *in situ* by mechanical and chemical weathering and the matrix texture reflects the bedrock that it was derived from. The material is typically loosely packed

and well drained. In the study area, weathered bedrock is found as a discontinuous very thin veneer (Dx) overlying gently sloping or undulating bedrock outcrops.

Eolian Sediments (E)

Eolian sediments were transported and deposited by wind. They typically occur as a thin cap (Ev) over other materials, but may locally thicken into a blanket or dunes. Eolian veneers are found on the gentler slopes scattered throughout the study area. These deposits typically consist of silt and fine sand and often form the Ah horizon in Chernozemic soils.

Fluvial Materials (F, F^A)

Fluvial materials were deposited in post-glacial time by streams. Fluvial materials consist of loosely packed, non-cohesive sands and silt with some gravel. In the study area, fluvial materials are present mainly as small portions of a polygon that include a stream. Fluvial materials are generally mapped as floodplains (Fp, F^Ap) or gentle fluvial areas (Fj) with imperfect to poor drainage. Modern-day floodplains are located along major valley bottom streams in the study area, including Coldstream, Vernon, and BX Creeks. Post-glacial fans are common at the mouths of the many gullies throughout the study area. Large fans are located along Coldstream Valley and at the mouth of BX Creek.

Glaciofluvial Materials (F^G)

Glaciofluvial materials were deposited by glacial meltwater streams at the end of the Fraser Glaciation. Sands and gravels accumulated along ice margins and on top of melting ice (FGu) and downstream of melting ice (FGf and FGp). In some areas, rivers were made and quickly abandoned depositing blankets of sands and gravels over top of till (FGb). In a few areas, postglacial streams have incised into outwash plains and fans transforming them into terraces (FGt) and creating erosional slopes (FGk). In general, glaciofluvial materials created well-drained and relatively dry sites due to the highly porous and permeable sands and gravels. The material is non-cohesive and therefore susceptible to erosion, and will tend to ravel when exposed on steep slopes and road cuts. Glaciofluvial sands and gravels are potential sources of aggregate.

In the study area, glaciofluvial materials consisted of gravely sands with minor amounts of silt. These deposits ranged from well stratified to unstratified and well-sorted to moderately-sorted. Large deposits of glaciofluvial sediments are located at the mouths of the larger meltwater channels and gullies, for example, discontinuously along the Coldstream Valley, Vernon Creek and as a large raised delta along 48th Avenue and Silver Star road east of the Pleasant Valley Road intersection.

Lacustrine (L)

Lacustrine materials were deposited from standing bodies of water. Fine sand, silt, or clay that have been suspended in the water settle to the lake bed creating sediments that are commonly stratified and fine textured. These sediments may be exposed when the lake is drained. In the study area, lacustrine materials occur in shallow ponds that are periodically inundated (szLp and szLv). Sediments are also deposited at the margins lakes by wave action, such as on the beaches of Okanagan, Swan and Kalamalka Lakes. These materials generally consist of sand and gravel.

Glaciolacustrine (L^G)

Glaciolacustrine materials were deposited from glacial or ice-dammed lakes that were present during and shortly after glaciation. Glaciolacustrine materials generally consist of well to moderately well stratified fine sand, silt, or clay with occasional lenses of till or glaciofluvial material.

Glaciolacustrine materials are generally only slowly permeable, and so the presence of even a thin layer of this material is sufficient to cause impeded drainage, perched water tables, and surface seepage. These conditions may promote instability in some situations. These fine-textured materials are also susceptible to surface erosion by running water.

In the study area, Glacial Lake Penticton, at it's maximum, reached a level of 503 m above sea level[59]. Large deposits from this glacial lake are present along the major valley bottoms from Swan Lake to the mouth of Coldstream Creek and from East Hill to Okanagan Landing.

Till (M)

Till was deposited directly by glacier ice and typically consists of poorly sorted silt, sand and gravels. In general, till on slopes is well drained and moderately-well drained, and imperfectly drained in depressions.

On the mid to upper slopes, discontinuous veneers and blankets of till cover much of the gentle to moderately steep slopes. Patches of very thin veneers of till cover areas of undulating bedrock.

Throughout the study area, the typical till is a noncohesive, silty sandy basal till (terrain texture label "zds" or "dzs"). A finer textured basal till (terrain texture label "smd") was observed in some soil pits and road cuts..

Organics (O)

Organic materials form where decaying plant material accumulates in poorly or very poorly drained areas. In the study area, organic materials are uncommon, but may occur as veneers (Ov) or very thin veneers (Ox) in some of the wetlands.

Undifferentiated Material (U)

This material type is used to describe material that is too complex to be represented by the usual terrain symbols. Undifferentiated material is a layered sequence of surficial materials that have been exposed on an erosional slope. There is usually a sequence of three or more layers. In the study area, this symbol is used to map thick sequences of surficial materials in various valley bottom locations (for example at the north end of Kalamalka Lake and along Vernon Creek between Kalamalka Lake and Polson Park.

Bedrock (R)

Bedrock was mapped where it outcrops at the surface. Polygons mapped with thin or very thin material (Cv, Dx, Mv, Mx), may also have a small proportion of bedrock outcrops. Bedrock outcrops are scattered throughout the study area.

---

[59] Kidston, 1993

Bedrock type and distribution within the study area[60].

Age		Bedrock Group or Suite	General Bedrock Type	Specific Rock Types	Location
Tertiary	Miocene	Thompson Plateau Basalt	Volcanic	Basalt, commonly as columnar jointed cliffs	south edge of Aberdeen plateau
	Eocene	Eocene Andesitic Volcanic Facies	Volcanic	Andesite to Dacite flows, volcanic breccia, intercalations of sandstone and conglomerate	- hillslope north of Lavington - hillslope west of Kin Race track - hillslope above Kal Lake by college
		Eocence basal sandstone facies	Sedimentary	Sandstone, siltstone, shale, conglomerate	- top of Middleton Mountain - Black rock
	Paleocene to Eocene			porphyry dykes	small ridges scattered throughout study area
Cretaceous		Cosens Bay Pluton	Intrusive	foliated granodiorite and granite	hillslope to the south and upslope from Cosens Bay
Jurassic		Okanagan Plutonic Suite	Intrusive	Monzonite, quartz monzonite, diorite, quartz diorite, granodiortie and granite	lower Vernon hill including Coldstream estates and north
Triassic		Slocan Group	Metamorphic	Phyllite, argillite, quartzite, minor tuffaceous rocks	Vernon Hill and surrounding ridge
Permian and/or Jurassic		Coldstream Ultramafic rocks	Metamorphic	diorite, pyroxenite, amphibolite, hartzburgite, serpentinite, and schist	- lower hillslope south of Lavington (above Brewer Road) - two outcrops on the west and south side of Middleton Mountain - hillslope north and upslope from Kin Beach
Permian		Harper Ranch Group	meta-sedimentary rock	siltstone, sandstone, argillite, conglomerate, breccia, phyllite, quartzite, limestone, minor marble, hornfels, skarn with intercalations of metavolcanic rocks	- western midslopes of - Vernon Hill - Goose Lake area west of Swan Lake - North end of the Commonage
			sedimentary	crystalline limestone	- above Davidson Orchards, Bella Vista - band through DND lands, north edge of the Commonage midslope outcrops north and south Lavington
			volcanic	andesitic flows and agglomerate, breccia, tuff, and limestone blocks	- hillslope south of Lavington - lower hillslope north of Lavington (Brewer and Crastor Creeks)

[60] adapted from Glombrick et al. 2004 and Thompson et al. 2004

Age	Bedrock Group or Suite	General Bedrock Type	Specific Rock Types	Location
Devonian to Permian	Sitkum Amphibole Schist	Metamorphic	schist	- North side of Kalamalka Lake Provincial Park - lower slopes either side of Coldstream Creek halfway between Lavington and Coldstream Creek Ranck
Devonian	Silver Creek Formation	Metamorphic	schist, sillimanite, quartzite, marble, amphibolite	- BX, Silver Star - lower Vernon Hill - Kalamalka Lake Provincial Park - hillslope south of Coldstream Creek Ranch
	Silver Creek Marble	Metamorphic	marble	north edge of Middleton Mountain
	Chase Formation	Metamorphic	quartzite, calcsilicate	- narrow bands scattered midslope from Kalamalka Lake Provincial Park to King Edward Lake Forest Service Road - the BX and hillslope east of Swan Lake
Paleo- and/or Mesoproterozoic	Tsuius Schist	Metamorphic	schist, gneiss, amphibolite, quartzite	- the BX and hillslope east of Swan Lake - narrow bands scattered midslope from Kalamalka Lake Provincial Park to King Edward Lake Forest Service Road - west-facing hillslope above south end of Kalamalka Lake
	Calc-Silicate gneiss	Metamorphic	gneiss, marble, schist, amphibolite	north-facing slope and ridge near the south end of Kalamalka Lake

Geological Processes	
Code	**Name**
-E	Glacial meltwater channels
-F	Slow mass movement (failing, slumps)
-F"	Slow mass movement initiation zone
-Fk	Tension cracks
-Fm	Slump in bedrock
-Fp	Lateral Spread in Bedrock
-H	Kettled
-L	Surface seepage
-P	Piping
-R	Rapid mass movement (slides and falls)
-R"	Rapid mass movement initiation zone
-Rb	Rockfall
-Rd	Debris flow
-Rs	Debris slide
-U	Inundation
-V	Gully Erosion

Drainage	
Code	**Name**
x	very rapidly drained
r	rapidly drained
w	well drained
m	moderately well drained
i	imperfectly drained
p	poorly drained
v	very poorly drained

Where two drainage classes are shown:

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

Description of Geological Processes

Channeled by Meltwater (-E, -EV)

Meltwater channels form alongside, beneath, or in front of a glacier or ice sheet. Glacial meltwater channels are typically sinuous in plan, flat-floored, and steep-sided in cross-section. The floors of the meltwater channel may contain glaciofluvial sediments, indicative of the water flow that once took place here.

Many meltwater channels are located within the study area and range from large to small and are incised through bedrock and surficial materials. The largest and most prominent meltwater channels in the study area are Cougar Canyon and Bear Creek from Deep Lake to Cosens Bay.

Slow Mass Movement (-F, -F"k, -F"m, -F"p)

Slow mass movement refers to slope failures where movement occurs slowly or where the displaced material moves only a short distance downslope. The double prime symbol (") indicates the initiation zone of slow mass movement. Tension cracks are indicated by the subclass "k" (-Fk). Failures occurring in bedrock are indicated by the subclass "m" (e.g. –Fm). Failures occurring in thick surficial materials are indicated by the subclass 'u' (e.g. -Fu).

Tension cracks (-Fk) are open fissures commonly located near ridge tops. They indicate slow slope spreading, and may be the precursor to catastrophic slope failure. An example of tension cracks in the study area are along the northern edge of the Aberdeen Plateau near cliff faces in the Thompson Plateau basalt, and there is a small tension crack on the ridge top between McKergow Pond and Middleton Way.

A slump in bedrock (-Fm) refers to a rotational slump where portions of the slide mass remains internally cohesive. Lateral Spread in Bedrock (-Fp) refers to lateral spread in a fractured mass of bedrock. Rotational slumps and lateral spread develop due to failure along vertical joints and horizontal weak layers. In the study area, slumps are present along bluffs in the Thompson Plateau basalt. These deposits are at a gentler slope than the angle of repose and the planimetric width of the deposits are much wider than the bluff they originated from. There is a large bedrock slump located from the northern edge of Aberdeen Plateau to the shores of Deep Lake. According to Glombick *et al*. (2004), the slide has occurred in metamorphic rocks three different formations, including the Silver Creek Formation, Chase Formation and the Tsuius Schist. Above the headscarp is the edge of the Thompson Plateau Basalt flanked by a large apron of talus that is clearly visible throughout Coldstream. The slide deposit was not field checked thus it is not known if there is ongoing movement.

Kettled (-H)

Kettled topography consists of hummocky undulating terrain, which developed when blocks of glacial ice buried by or surrounded by glaciofluvial gravels and ablation till melted.

Surface Seepage (-L)

Seepage is mapped where relatively wet soils are widespread in a polygon. This commonly occurs where soils are on slowly permeable materials such as till, where thin surficial materials overlie

bedrock, and on lower slopes where shallow subsurface water is received from a relatively large catchment area further upslope. They may also occur where groundwater is concentrated at the surface by a physical conduit such as a geological fault. In the study area, areas of abundant surface seepage were uncommon and generally spread throughout the study area. An example of seepage in the study area is upslope of Highway 97 along Swan Lake.

Piping (-P)

Piping refers to subsurface erosion of a surficial material, commonly glaciolacustrine, forming subterranean pipes and pitted ground surfaces. When a subsurface pipe collapses, a gully is formed. In the study area, piping was observed between the Okanagan College parking lot and Kickwillie Loop at the top edge of a gully that is actively ravelling. In this area, a thin blanket of glaciolacustrine sediments overlies glaciofluvial sediments.

Rapid Mass Movement (-R, -R"b, -R"d, -R"s)

Rapid mass movement refers to downslope movement by falling, rolling or sliding of debris derived from surficial material or bedrock. Where a double prime symbol (**"**) is used with a mass movement process (e.g., -R"s), slope failure has initiated within the polygon. Mass movement symbols without the double prime symbol (e.g., **-**Rb) indicate a polygon that contains the transport or deposition zone of rapid mass movement. Transportation zones are generally not recognized as areas where landslides initiate; they may contribute additional volume of transported material to a failure. Transport and deposition zones represent hazardous areas downslope of slides or rockfall.

Rockfall (-Rb, -R"b) occurs when either a single block or a mass of bedrock falls, bounces and rolls downslope. In the study area, rockfall from local outcrops created talus slopes, colluvial veneers and blankets. Polygons with rockfall were scattered throughout the study area in association with local bedrock outcrops or cliffs.

Debris flows (-Rd) initiate in steep gullies and debris slides (-Rd) initiate on steep hillsides. They occur when a mass of surficial material slides rapidly downslope often as a result of the loss of soil strength due to high pore water pressure. Debris slides (non-channelized movement of debris) and debris flows (channelized movement of debris) are initiated on steep slopes where material slides along a shear plane. The shear plane often coincides with the boundary between more permeable and less permeable material (e.g., between weathered and unweathered material or between surficial material and bedrock). Debris flows and debris slides are triggered by heavy rain, water from snow melt, or rain on snow events, and result from loss of soil strength due to high pore water pressure. During wet conditions, slides are also triggered by wind stress on trees, tree throw, impact of falling rocks from up slope, and vibrations due to earthquakes or human activity. In logged areas, debris slides that occur several years after logging can be due to the loss of soil strength that results from root decay. Diverted drainage from roads commonly triggers failure of sidecast material and may initiate landslides some distance downslope. A debris flow may move downslope for several hundred metres or more before it is arrested by gentler terrain or by de-watering, or it may enter a trunk stream. Debris flows are effective agents of erosion, commonly increasing the volume of material as it progresses downslope. Debris slides and debris flows are significant potential sources of stream sediment and a hazard to activities or structures (roads, culverts) located in runout zones.

In the study area, debris slides and flows are not common. These processes tend to occur on steep slopes, including gullies. The presence of colluvial fans and cones at the mouths of gullies indicate post-glacial mass movement.

Inundation (-U)

Inundation refers to areas that are seasonally flooded, for example marshlands.

Gully Erosion (-V)

Gullies are small ravines with V-shaped cross sections that can form in either glacial drift or bedrock. Gully erosion is mapped in two kinds of terrain: (i) slopes with several parallel shallow gullies in drift materials (dissected slope) and (ii) single gullies where streams have exploited joints in bedrock or have cut down into thick drift. Gullied terrain is an indicator of either former or active erosion, and the symbol serves to identify material that is potentially subject to erosion or mass movement (e.g., Uk-V). Gully side slopes and steep headwalls are common sites of slope failures and are classed as potential unstable (Class IV) where there is no evidence of instability and unstable (Class V) where there is evidence of instability. In the study area, gully erosion was mapped in polygons scattered throughout the study area.

Slope Range
Slopes are given in percentages as a range. For example, '20-45' indicates that the majority of the slopes in the polygon are between 20% and 45%.

Terrain stability Classes[61]	
Class	**Interpretation**
I	• No significant stability problems exist.
II	• There is a low likelihood of landslides following disturbance or development. • Minor slumping is expected along road cuts and excavations.
III	• Stability problems can develop. • Follow BMP to reduce the likelihood of causing slope failure. • Minor slumping is expected along road cuts and excavations. There is a low likelihood of landslide initiation following road construction. • On-site inspection required by geotechnical staff.
IV	• Expected to contain areas with a moderate likelihood of landslide initiation following development, disturbance or road construction. • These areas should be avoided. Use caution when planning intensive land use above or below these areas. • On-site inspection required by geotechnical staff
V	• Expected to contain areas with a high likelihood of landslide initiation. Signs of existing instability present. • Avoid these areas. Do not plan intensive land use above or below these areas. • On-site inspection required by geotechnical staff

Soil Erosion Potential Classes[62]		
Class	**Rating**	**Management Implications**
VL	Very low	• Negligible or very minor soil erosion.
L	Low	• Expect minor erosion of fines in ditch lines and disturbed soils.
M	Moderate	• Expect moderate erosion when water is channelled down road surfaces or ditches and over exposed soils.
H	High	• Significant erosion problems can be created when water is channelled onto or over exposed soil on these sites.
VH	Very high	• Severe surface and gully erosion problems can be created when water is channelled onto or over exposed soils at these sites.

[61] Adapted from Ministry of Forests 1999
[62] Adapted from Ministry of Forests 1999

Appendix C: Expanded Legend

COLDSTREAM VERNON EXPANDED LEGEND – IDFdm1

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	**Douglas-fir – Pinegrass – Kinnikinnick**	**IDFdm1**	**04**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is common on slightly drier sites including warm aspects. The overstory is dominated by Douglas-fir and the understory is dominated by kinnikinnick and pinegrass.

List of mapped units:

DPks	cool aspect (NNW or ESE), slope >25%, shallow soils (50-100cm)	DPsw	shallow soils (50-100cm); warm aspect, slope >25%
DPs	shallow soils (50-100cm)		

SITE INFORMATION

Common Terrain Types:

- deep morainal or glaciolacustrine materials on moderate slopes

Slope position:	middle and upper
Slope (%):	0 – 50
Aspect:	neutral to warm
Soil Moisture Regime:	submesic
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DT	**Douglas-fir/Lodgepole pine – Pinegrass – Twinflower**	**IDFdm1**	**01**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is common on mesic sites. The overstory is dominated by Douglas-fir and lodgepole pine; the understory is dominated by pinegrass with some kinnikinnick and twinflower. The forest overstory shifts from lodgepole pine to Douglas-fir as it matures. Logged sites have scattered shrubs (snowberry, birch-leaved spirea, soopolallie, saskatoon and falsebox) with abundant pinegrass and kinnikinnick.

List of mapped units:

DTg	occurs in a gully	DTks	cool aspect, slope >25%, shallow soils (50-100cm)
DTk	cool aspect, slope >25%	DTs	shallow soils (50-100cm)

SITE INFORMATION

Common Terrain Types:

- deep morainal or glaciolacustrine materials on moderate slopes

Slope position:	middle and upper
Slope (%):	0 – 50
Aspect:	neutral to warm
Soil Moisture Regime:	mesic - submesic
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DW	**Douglas-fir/Ponderosa pine – Bluebunch wheatgrass – Pinegrass**	**IDFdm1**	**03**

Typic unit occurs on warm slopes with deep, medium textured soils on ridges or crests (d, j, w are assumed modifiers).

This forest ecosystem occurs on very dry sites, often with some exposed bedrock. The overstory is dominated by open Douglas-fir and ponderosa pine; the understory is dominated by bluebunch wheatgrass and kinnikinnick. Shrubs are scattered and infrequent.

List of mapped units:

DWjv	very shallow soils (<20cm deep), gentle slope <25%, some exposed bedrock	DWs	shallow soils (20-50cm deep)
DWkv	very shallow soils (<20cm deep), cool aspect, slope >25%, some exposed bedrock	DSv	very shallow soils (<20cm deep), some exposed bedrock

SITE INFORMATION

Common Terrain Types:

- shallow and very shallow till, weathered bedrock, colluvial slopes, and rock

Slope position:	upper, crest
Slope (%):	0 – 60
Aspect:	none, warm, or slightly cool
Soil Moisture Regime:	xeric – very xeric
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	**Selaginella – Bluebunch wheatgrass rock outcrop**	**IDFdm1**	**00**

Typic unit occurs on gentle slopes with very shallow soils (assumed modifiers are j and v)

This grassland ecosystem commonly occurs on bedrock outcrops. The bedrock is generally low relief and unfractured. This is an uncommon unit in the study area. Selaginella and rusty steppe moss with some grasses and forbs dominate these sites. There is scattered saskatoon. This unit is commonly scattered as small sites in a forested matrix.

SITE INFORMATION	
Common Terrain Types:	
• rock, very thin morainal and colluvial veneers and weathered bedrock	
Slope position:	crest, upper
Slope (%):	0 – 50
Aspect:	variable
Soil Moisture Regime:	xeric – very xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SD	**Hybrid white spruce/Douglas-fir – Dogwood - Gooseberry**	**IDFdm1**	**06**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is commonly associated with gullies with intermittent or permanent streams or subsurface water flow. This is an uncommon unit in the study area. These are diverse, rich sites with mixed coniferous (Douglas-fir) and deciduous (paper birch and aspen) overstories. The understories are dominated by diverse mixture of shrubs including abundant red-osier dogwood with some thimbleberry, Sitka alder and black gooseberry. Forbs and mosses are scattered and uncommon on these sites.

List of mapped units:

SDg	gullies, usually associated with permanent or intermittent creeks	SDgw	occurs in gullies on warm aspects

SITE INFORMATION

Common Terrain Types:

- gentle morainal, fluvial, and slopewash sites

Slope position:	lower, toe
Slope (%):	0-15%
Aspect:	none
Soil Moisture Regime:	subhygric - hygric
Soil Nutrient Regime:	rich (medium)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	**Saskatoon – Mock orange Talus**	**IDFdm1**	**00**

Typic unit occurs on both warm and cool steep slopes with deep, coarse textured soils (blocky) (c and d are assumed modifiers).

This ecosystem is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. This is an uncommon unit in the study area. Scattered trees (Douglas-fir or aspen) and scattered shrubs (snowberry, saskatoon) grow in soil pockets between blocks. Vegetation cover is generally higher on sites with smaller blocks and more soil. Cool aspects more commonly have trees on them. Sites that are dominated by shrubs will not necessarily develop into a forested structural stage.

List of mapped units:

SOk	cool aspect, slope 60-70%	SOsw	shallow soils (generally 50-100cm) warm aspect; slope 60-70%

SITE INFORMATION

Common Terrain Types:

- rubbly colluvial slopes

Slope position:	lower to upper
Slope (%):	60 – 70%
Aspect:	all
Soil Moisture Regime:	subxeric – xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SP	**Douglas-fir / Western Larch – Hybrid white spruce – Pinegrass**	**IDFdm1**	**05**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is common on slightly moister receiving sites and some gullies, but without streams. The overstory is dominated by Douglas-fir, lodgepole pine, Western larch, and hybrid white spruce; the understory is dominated by abundant pinegrass with some kinnikinnick and scattered forbs. The forest overstory shifts from lodgepole pine to the other conifers as it matures.

List of mapped units:			
SPg	occurs in a gully	SPgw	warm aspect gully, slope >25%

SITE INFORMATION	
Common Terrain Types:	
• deep morainal materials on gentle or moderate slopes	
Slope position:	lower, toe
Slope (%):	0 – 25
Aspect:	none, variable
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
TA	**Talus**	**IDFdm1**	**N/A**

Steep colluvial deposits of angular rock fragments that result from rockfall. These sites have less than 10% vegetation cover.

List of mapped units:			
TAk	cool aspect, slope 60-70%	TAw	warm aspect, slope 60-70%

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WJ	**Bluebunch wheatgrass – Junegrass**	**IDFdm1**	**02**

Typic unit occurs on warm aspects with deep, medium-textured soils (assumed modifiers are d, m, and w)

This grassland ecosystem occasionally occurs on moderately steep to steep warm slopes. Often surface soils are actively ravelling on steeper slopes. Bluebunch wheatgrass and junegrass with grassland forbs dominate these sites.

List of mapped units:

WJs shallow soils (20-100cm deep)

SITE INFORMATION

Common Terrain Types:

- morainal blankets and veneers and colluvial veneers

Slope position:	middle, upper, crest
Slope (%):	40 – 65%
Aspect:	south, southwest, west
Soil Moisture Regime:	subxeric – submesic
Soil Nutrient Regime:	medium

COLDSTREAM VERNON EXPANDED LEGEND – IDFmw1

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BI	**Blockfield**	**IDFmw1**	**00**

Level or gently sloping areas covered by angular blocks of rock that have not undergone significant downslope movement.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BM	**Bulrush Marsh**	**IDFmw1**	**00**

Typic unit occurs on level sites with deep, fine-textured soils (assumed modifiers are d, f, and j).

This unit is equivalent to the *Great bulrush marsh* association (Wm06) in the provincial classification (MacKenzie and Moran 2004).

This marsh wetland ecosystem commonly occurs on small ponds adjacent to shallow open water as a fringe along the shoreline. This unit is uncommon in the study area. It typically occurs as a complex with shallow open water (OW). Water depths are up to 1.5 m but water levels draw down significantly in the summer. These sites are most commonly dominated by hard-stemmed bulrush, with some floating aquatic plants (duckweed, bladderwort and water smartweed). Vegetation species diversity is typically low on these sites. Soils are typically mineral, sometimes with a thin organic veneer.

SITE INFORMATION	
Common Terrain Types:	
• lacustrine veneer over morainal blanket	
Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhydric - hydric
Soil Nutrient Regime:	rich

	Structural Stage	2b	
Rushes	*Schoenoplectus acutus*	***	hard-stemmed bulrush
Herbs	*Lemna minor*	**	common duckweed
	Utricularia macrorhiza	*	greater bladderwort

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CB	**Cutbank**	**IDFmw1**	**N/A**
Part of a road corridor which is created by excavation or erosion of the hillside.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CF	**Cultivated Field**	**IDFmw1**	**N/A**
These are agricultural fields with tilled soils and planted crops or ground cover. Mapped units: CFy – Cultivated fields that flood seasonally. Often former riparian ecosystems adjacent to streams that have been converted to fields.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CL	**Cliff**	**IDFmw1**	**N/A**
These are steep, vertical or overhanging rock faces. Typically there are scattered plants such as saskatoon and cliff ferns occurring in rock fractures or soil pockets.			
List of mapped units:			
CLz	very steep warm aspect		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CT	**Cattail Marsh**	**IDFmw1**	**00**

Typic unit occurs on level sites with deep, medium-textured soils (assumed modifiers are d, j, m).

This unit is equivalent to the *Cattail marsh* association in the provincial classification (MacKenzie and Moran 2004).

This marsh wetland ecosystem occurs as a fringe on pond edges or in depressions, often adjacent to shallow open water (OW). This unit is rare in the study area. Water depths are typically up to 1 m in spring but draw down to the soil surface by late summer; soils remain saturated for most of the season. Some wetlands convert to cattail marshes when they are subject to nutrient loading. These sites are dominated by cattails with few other species. Soils are typically mineral, but may have a thin organic veneer on top. (Photo from IDFxh1)

List of mapped units:

CTx drier than typical, water table has dropped and standing water is very ephemeral.

SITE INFORMATION

Common Terrain Types:

- thin organic veneer over lacustrine materials

Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhydric
Soil Nutrient Regime:	rich

	Structural Stage	2a	
Herbs	*Typha latifolia*	****	common cattail
	Lemna minor	**	common duckweed
Mosses	*Bryum* sp.	**	thread moss

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DF	**Douglas-fir/Western Redcedar – Falsebox – Prince's pine**	**IDFmw1**	**01**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is commonly associated with mesic gently sloping sites. Mature forests have an overstory dominated by western redcedar with a sparse understory.

List of mapped units:

DFc	coarse-textured soils (glaciofluvial)	DFs	shallow soils (50-100cm)
DFck	coarse-textured soils (glaciofluvial); cool aspect, slope >25%	DFsw	shallow soils (50-100cm); warm aspect (often SE or NW), slope >25%
DFf	fine-textured soils (glaciolacustrine)	DFt	glaciofluvial or fluvial terrace
DFk	cool aspect, slope >25%	DFw	warm aspect (often SE or NW), slope >25%
DFks	cool aspect, slope >25%, shallow soils (50-100cm)		

SITE INFORMATION

Common Terrain Types:

- deep morainal, glaciofluvial, and glaciolacustrine materials on level and gentle slopes
- moderate to steep cool aspect morainal and colluvial slopes

Slope position:	lower to middle
Slope (%):	0-30; steeper on cool aspects
Aspect:	all
Soil Moisture Regime:	mesic – submesic
Soil Nutrient Regime:	medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DF	Douglas-fir/Western Redcedar – Falsebox – Prince's pine	IDFmw1	01

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	***	***	***	****	***	western redcedar
	Pseudotsuga menziesii var. *glauca*			**	***	***	Douglas-fir
	Pinus contorta	**	***	**	*		lodgepole pine
	Betula papyrifera	**	**	**			paper birch
Shrubs	*Paxistima myrsinities*	**	*	**	***	***	falsebox
	Acer glabrum		*	**	***	***	Douglas maple
	Spirea betulifolia	***	**	**	**	**	birch-leaved spirea
Grasses	*Calamagrostis rubescens*	**	*	**	**	**	pinegrass
Herbs	*Epilobium angustifolium*	****	*				fireweed
	Linnaea borealis	*	*	**	**	**	twinflower
	Aster conspicuous	**	*	**	**	**	showy aster
Mosses and Lichens	*Pleurozium shreberi*		*	**	***	***	red-stemmed feathermoss
	Brachythecium sp.	**	*	*	*	*	
	Peltigera spp.	*	*	**	**	**	pelt lichens
PLOTS			CVG303	CVG304 CVV323 CVG004 CVG024	CVG008 CVG010 CVG023		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	**Douglas-fir – Pinegrass – Feathermoss**	**IDFmw1**	**04**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is common on warm aspects. The overstory is dominated by Douglas-fir and the understory is dominated by pinegrass with showy aster, snowberry and other scattered shrubs and forbs.

List of mapped units:

DPc	coarse-textured soils (generally glaciofluvial)	DPs	shallow soils (50-100cm)
DPck	coarse-textured soils; cool aspect (NNW or ESE), slope >25%	DPsw	shallow soils (50-100cm); warm aspect, slope >25%
DPk	cool aspect (NNW or ESE), slope >25%	DPw	warm aspect, slope >25%
DPks	cool aspect (NNW or ESE), slope >25%, shallow soils (50-100cm)		

SITE INFORMATION

Common Terrain Types:

- deep morainal or glaciolacustrine materials on moderate to steep warm aspect slopes

Slope position:	middle and upper
Slope (%):	35 – 85
Aspect:	southeast to west
Soil Moisture Regime:	subxeric to submesic
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	Douglas-fir – Pinegrass – Feathermoss	IDFmw1	04

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	***	***	***	Douglas-fir
Shrubs	*Symphoricarpos albus*	****	*	**	**	**	common snowberry
	Spirea betulifolia	***	*	**	***	***	birch-leaved spirea
	Paxistima myrsinities	**	*	*	*	*	falsebox
Grasses	*Calamagrostis rubescens*	***	**	***	***	****	pinegrass
Herbs	*Aster conspicuus*	***	**	***	***	***	showy aster
	Arnica cordifolia	***	**	***	***	***	heart-leaved arnica
Mosses and Lichens	*Brachythecium albicans*	*	*	*	**	**	lawn moss
	Peltigera spp.	*		*	*	**	dog pelt
	Dicranum sp.	*	*	*	*	*	heron's bill moss
PLOTS				CVG306			

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	**Douglas-fir/Ponderosa pine – Snowberry – Bluebunch wheatgrass**	**IDFmw1**	**02**

Typic unit occurs on gentle slopes with deep, medium textured soils on ridges or crests (d, j, m and r are assumed modifiers).

This forest ecosystem occurs on very dry sites, often with some exposed bedrock.

List of mapped units:

DSkv	very shallow soils (<20cm deep), very steep cool aspect, slope >70%	DSvw	very shallow soils (<20cm deep), warm aspect, slope >25%
DSsw	shallow soils (20-100cm deep), warm aspect, slope >25%	DSvz	very shallow soils (<20cm deep), very steep warm aspect, slope >70%
DSv	very shallow soils (<20cm deep)		

SITE INFORMATION

Common Terrain Types:

- shallow till and colluvial slopes, rock

Slope position:	upper, crest
Slope (%):	0 – 60
Aspect:	none or warm
Soil Moisture Regime:	xeric
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	Douglas-fir/Ponderosa pine – Snowberry – Bluebunch wheatgrass	IDFmw1	02

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	****	***	***	Douglas-fir
Shrubs	*Amelanchier alnifolia*	*	*	*	**	**	saskatoon
Grasses	*Pseudoroegneria spicata*	**		*	*	**	bluebunch wheatgrass
Herbs	*Balsamorhiza sagittata*	**	**	***	***	***	arrow-leaved balsamroot
	Lupinus sericeus	***	**	***	***	***	silky lupine
	Achillea millefolium	**	*	**	**	**	yarrow

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	**Idaho fescue – Bluebunch wheatgrass**	**IDFmw1**	**00**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, m)

This grassland ecosystem occurs on gentle warm aspects, levels sites, and cool aspects. A mixture of Idaho fescue and bluebunch wheatgrass with balsamroot and other herbs dominates late seral sites, but late seral sites are uncommon in the study area and no climax sites were observed. Soils are typically dark brown or black chernozems. Most of these sites are highly disturbed and some have a significant component of weeds. These are described below.

FW:kc *$Knapweed – Cheatgrass seral association*
This is an early seral association dominated by knapweed, sulphur cinquefoil, and cheatgrass with few or no native bunchgrasses remaining on these sites.

FW:wk $*Bluebunch wheatgrass – Knapweed seral association*
This is a mid- to late-seral seral association. On these sites there is still a reasonable component of bluebunch wheatgrass with knapweed, sulphur cinquefoil, or cheatgrass.

List of mapped units:

FWk	cool aspect (>25% slope)	FWs	shallow soils (50-100cm)
FWks	cool aspect, shallow soils (20-100cm)		

SITE INFORMATION

Common Terrain Types:

- morainal and glaciofluvial blankets, often with an eolian veneer

Slope position:	lower to upper
Slope (%):	0-35% (up to 60% on cool aspects
Aspect:	all
Soil Moisture Regime:	mesic
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	Idaho fescue – Bluebunch wheatgrass	IDFmw1	00

	Structural Stage Seral Association	2 FW	2 FW:kc	2 FW:wk	
Grasses	*Festuca idahoensis*	****			Idaho fescue
	Pseudoroegneria spicata	***		***	bluebunch wheatgrass
	Koeleria macrantha	**			junegrass
	Bromus tectorum or *Bromus japonicus*		****	***	cheatgrass or Japanese brome
Herbs	*Balsamorhiza sagittata*	***	*	**	arrowleaf balsamroot
	Lupinus sericeus	**	*	**	silky lupine
	Eriogonum heracleoides	**	*	**	parsnip-flowered buckwheat
	Erigeron speciosus	**	*	**	showy daisy
	Potentilla recta		***	**	sulphur cinquefoil
Mosses and Lichens	*Cladonia* spp.	**			clad lichens
	Tortula ruralis	**		*	sidewalk moss
	Peltigera rufescens or *Peltigera ponojensis*	**			felt pelt felt pelt
PLOTS		CVV337			

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GP	**Gravel Pit**	**IDFmw1**	**N/A**
These are areas of used for extraction of gravel and sand.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
OW	**Shallow Open Water**	**IDFmw1**	**N/A**
These are areas of permanent open water that are less than 2m deep. There is less than 10% emergent vegetation but floating aquatics such as bladderwort are often present. Shallow open water commonly occurs in association with marsh ecosystems.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PP	**Douglas-fir – Penstemon – Pinegrass**	**IDFmw1**	**03**

Typic unit occurs on significant warm slopes with deep, medium textured soils (d, m, and w are assumed modifiers).

This forest ecosystem is characterized by an open Douglas-fir canopy with a mixed pinegrass – shrub – forb understory.

List of mapped units:

PPc	coarse-textured soils	PPr	ridge or crest
PPck	coarse-textured soils; cool aspect (NNW or ESE), slope >25%	PPrs	ridge or crest, shallow soils (20-100cm deep)
PPjs	gentle slope, shallow soils (generally 20-50cm deep)	PPs	shallow soils (20-100cm deep)
PPks	cool aspect (NNW or ESE), slope >25%; shallow soils (20-50cm deep)	PPsz	shallow soils (20-100cm deep); very steep warm aspect; slope >70%
PPkv	cool aspect (NNW or ESE), slope >25%, very shallow soils (<20cm deep)		

SITE INFORMATION

Common Terrain Types:

- moderate to steeply slope till and colluvium

Slope position:	middle and upper
Slope (%):	50-70
Aspect:	south – west
Soil Moisture Regime:	submesic – subxeric
Soil Nutrient Regime:	medium, poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PP	Douglas-fir – Penstemon – Pinegrass	IDFmw1	03

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	**	****	***	***	Douglas-fir
	Pinus ponderosa	*	**	**	**	**	ponderosa pine
Shrubs	*Spirea betulifolia*	***	*	***	***	***	birch-leaved spirea
	Symphoricarpos albus	**	*	***	***	***	common snowberry
	Amelanchier alnifolia	**	*	**	**	**	saskatoon
Grasses	*Calamagrostis rubescens*	***	**	***	****	****	pinegrass
Herbs	*Aster conspicuus*	***	**	***	***	***	showy aster
	Arnica cordifolia	***	**	***	***	***	heart-leaved arnica
Mosses and Lichens	*Brachythecium albicans*	*	*	*	**	**	lawn moss
	Pleurozium shreberi	*		*	*	**	red-stemmed feathermoss
	Dicranum sp.	*	*	*	*	*	heron's bill moss
PLOTS				CVG307	CVG027 CVG030		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RD	**Western redcedar – Devil's club – Foamflower**	**IDFmw1**	**06**

Typic unit occurs on gentle toe slopes or depressions with seepage and deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem occurs on moist sites with seepage. Mature forests are dominated by western redcedar and hybrid white spruce with an understory characterized by Devil's club and rich forbs. Seral forests are often deciduous and are dominated by paper birch and trembling aspen.

List of mapped units:

RDa	active floodplain	RDgw	gully, warm aspect, slope >25%
RDg	gully	RDt	fluvial terrace; adjacent to creek

SITE INFORMATION

Common Terrain Types:

- Fluvial and slopewash colluvial materials on gentle toe slopes

Slope position:	toe
Slope (%):	0 – 10
Aspect:	none
Soil Moisture Regime:	hygric (subhygric)
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RD	Western redcedar – Devil's club – Foamflower	IDFmw1	06

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	**	****	****	***	***	western redcedar
	Picea engelmannii x glauca	**	***	***	**	**	hybrid white spruce
	Betula papyrifera	**	**	**	*	*	paper birch
	Populus tremuloides	**	*	*	*		trembling aspen
Shrubs	*Oplopanax horridus*		*	**	***	***	Devil's club
	Symphoricarpos albus	***	*	**	**	**	common snowberry
	Cornus stolonifera	**	*	**	**	**	red-osier dogwood
Herbs	*Aralia nudicaulus*	**	*	*	*	**	wild sarsaparilla
	Equisetum arvense	**	*	*	*	*	common horsetail
Mosses	*Mnium* or *Plagiomnium* spp.			*	**	**	leafy mosses
	Brachythecium sp.	*	*	*	**	**	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RE	Reservoir	IDFmw1	N/A
An artificial basin created by the impoundment of water behind a human-made structure such as a dam, berm, dyke, or wall.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	**Prairie Rose – Idaho fescue**	**IDFmw1**	**00**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, and m)

This shrubland ecosystem commonly occurs in moisture collecting depressions, seepage slopes and swales in grassland areas. This unit sometimes occurs as patches on grassland slopes. These sites are dominated by shrubs, primarily snowberry and roses. Forbs and grasses are scattered in openings between shrubs. Soils are very rich black chernozems. (Photo from IDFxh1)

List of mapped units:

RFk	cool aspect, slope >25%	RFsw	shallow soils (usually 50-100cm), warm aspect, slope >25%
RFks	cool aspect, slope >25%; shallow soils (usually 50-100cm)	RFw	warm aspect, slope >25%
RFs	shallow soils (usually 50-100cm)		

SITE INFORMATION

Common Terrain Types:

- morainal blankets

Slope position:	mid, toe, depression
Slope (%):	0-25
Aspect:	none, variable
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	**Prairie Rose – Idaho fescue**	**IDFmw1**	**00**

	Structural stage	**3**	
Shrubs	*Symphoricarpos albus*	*****	common snowberry
	Rosa acicularis	***	prickly rose
	Spirea betulifolia	***	birch-leaved spirea
Forbs	*Lupinus sericeus*	**	silky lupine
	Fritillaria affinis	**	chocolate lily
PLOTS		CVG009 CVV008	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RO	**Rock Outcrop**	**IDFmw1**	**N/A**

These are areas of exposed bedrock with less than 10% vegetation cover. On sites with fractured bedrock, some plants may be growing out of rock cracks.

List of mapped units:

ROk	cool aspect, slope >25%	ROz	very steep warm aspect, slope >70%
ROw	warm aspect, slope >25%		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RR	**Western redcedar/Douglas-fir – Dogwood**	**IDFmw1**	**05**

Typic unit occurs on gentle to level lower slopes, receiving sites with deep, medium textured soils (d, j and m are assumed modifiers).

This moist forest ecosystem is found on receiving sites and sometimes adjacent to small creeks. It has a rich understory characterized by abundant thimbleberry.

List of mapped units:

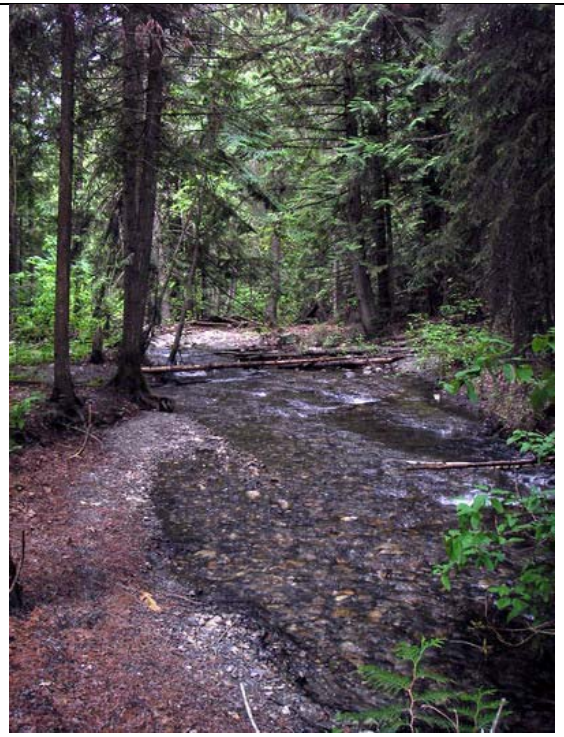
RRg	gully	RRn	occurs on a fluvial fan
RRgk	gully, cool aspect, slope >25%	RRs	shallow soils, generally 50-100cm deep
RRgw	gully, warm aspect, slope >25%	RRsw	shallow soils, generally 50-100cm deep; warm aspect, slope >25%
RRk	cool aspect, slope >25%	RRw	warm aspect, slope >25%
RRks	cool aspect, slope >25%; shallow soils, generally 50-100cm deep		

SITE INFORMATION

Common Terrain Types:

- slopewash, fluvial and till

Slope position:	toe (middle)
Slope (%):	0 – 20
Aspect:	none, all
Soil Moisture Regime:	subhygric (hygric)
Soil Nutrient Regime:	rich



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RR	**Western redcedar/Douglas-fir – Dogwood**	**IDFmw1**	**05**

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	****	***	***	Douglas-fir
	Thuja plicata	**	**	**	**	**	Western redcedar
	Betula papyrifera	**	***	**	**	**	paper birch
Shrubs	*Rubus parviflorus*	****	***	****	*****	*****	thimbleberry
	Acer glabrum	**	*	**	***	***	Douglas maple
	Symphoricarpos albus	***	*	**	***	***	common snowberry
Herbs	*Osmorhiza berteroi*	**	*	**	**	**	mountain sweet-cicely
	Maianthemum stellatum	***		**	**	**	star-flowered false Solomon's seal
	Viola canadensis	**	*	**	**	**	Canada violet
Mosses	*Mnium* or *Plagiomnium* spp.	*	*	*	**	**	leafy mosses
	Brachythecium sp.	*	*	*	**	**	ragged mosses
PLOTS					CVV336	9901767	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RW	**Rural**	**IDFmw1**	**N/A**
Rural areas of human settlement with scattered houses intermingled with native vegetation or cultivated areas.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RZ	**Road Surface**	**IDFmw1**	**N/A**
A gravel or paved road used for vehicular travel.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	**Selaginella – Bluebunch wheatgrass rock outcrop**	**IDFmw1**	**00**

Typic unit occurs on gentle slopes with very shallow soils (assumed modifiers are j and v)

This grassland ecosystem commonly occurs on bedrock outcrops. The bedrock is generally low relief and unfractured. This is an uncommon unit in the study area. Selaginella and rusty steppe moss with some grasses and forbs dominate these sites. This unit is commonly scattered as small sites in a grassland matrix.

SB:cg *Cheatgrass seral association*
This seral association is dominated by cheatgrass or sulphur cinquefoil with selaginella and rusty steppe moss.

List of mapped units:

SBw warm aspect, slope >25%

SITE INFORMATION

Common Terrain Types:

- rock, very thin morainal and colluvial veneers and weathered bedrock

Slope position:	crest, upper
Slope (%):	0 – 50
Aspect:	variable
Soil Moisture Regime:	xeric – very xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	Selaginella – Bluebunch wheatgrass rock outcrop	IDFmw1	00

	Structural Stage Seral stage	2a SB	2a SB:$cg	
Shrubs	*Amelanchier alnifolia*	*	*	saskatoon
Grasses	*Pseudoroegneria spicata*	**	*	bluebunch wheatgrass
	Poa secunda	**	**	Sandberg's bluegrass
	Bromus japonicus or tectorum	*	***	Japanese brome or cheatgrass
Herbs	*Selaginella densa*	***	***	compact selaginella
	Eriogonum heracleoides	*	*	parsnip-flowered buckwheat
	Potentilla recta		**	sulphur cinquefoil
Mosses and Lichens	*Cladonia* spp.	**	*	clad lichens
	Tortula ruralis	***	**	sidewalk moss
	Polytrichum piliferum	***	*	awned haircap moss

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SE	**Sedge Meadow**	**IDFmw1**	**00**

Typic unit occurs on level sites with deep, organic soils (d, j and p are assumed modifiers).

This is a generalized wetland ecosystem that has variable site conditions and plant composition. Vegetation is dominated by sedges and brown mosses.

SITE INFORMATION	
Common Terrain Types: • Organic	
Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric – hydric
Soil Nutrient Regime:	medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	**Saskatoon – Mock orange Talus**	**IDFmw1**	**00**

Typic unit occurs on both warm and cool steep slopes with deep, coarse textured soils (blocky) (c and d are assumed modifiers).

This ecosystem is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. This is an uncommon unit in the study area. Scattered trees (Douglas-fir or aspen) and scattered shrubs (snowberry, saskatoon) grow in soil pockets between blocks. Often cliff ferns (a very characteristic species) and scattered grasses are found growing in soil pockets. Vegetation cover is generally higher on sites with smaller blocks and more soil. Cool aspects more commonly have trees on them. Sites that are dominated by shrubs will not necessarily develop into a forested structural stage.

List of mapped units:

SOk	cool aspect, slope 60-70%	SOw	warm aspect; slope 60-70%
SOks	cool aspect, slope 60-70%, shallow soils (generally 50-100cm deep)		

SITE INFORMATION

Common Terrain Types:

- rubbly colluvial slopes

Slope position:	lower to upper
Slope (%):	60 – 70%
Aspect:	all
Soil Moisture Regime:	subxeric – xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	**Saskatoon – Mock orange Talus**	**IDFmw1**	**00**

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	**	**	**	***	Douglas-fir
	Populus tremuloides	*	**	**	**	**	trembling aspen
Shrubs	*Amelanchier alnifolia*	**	**	**	**	**	saskatoon
	Symphoricarpos albus	**	**	**	**	**	common snowberry
	Prunus virginiana	*	*	*	*	*	choke cherry
Herbs	*Woodsia scopulorum*	*	*	*	*	*	cliff fern
	Calamagrostis rubescens	**	**	**	**	**	pinegrass
	Lomatium spp.	*	*	*	*	*	desert-parsely

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
TA	**Talus**	**IDFmw1**	**N/A**
Steep colluvial deposits of angular rock fragments that result from rockfall. These sites have less than 10% vegetation cover.			
List of mapped units:			
TAk	cool aspect, slope usually 60-70%	TAw	warm aspect, slope usually 60-70%

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	**Bluebunch wheatgrass – Balsamroot**	**IDFmw1**	**00**

Typic unit occurs on warm aspects with deep, medium-textured soils (assumed modifiers are d, m, and w)

This grassland ecosystem commonly occurs on moderately steep to steep warm slopes. Often surface soils are actively ravelling on steeper slopes. Bluebunch wheatgrass and balsamroot dominate these sites. Bunchgrasses are more widely spaced than on gentler slopes. Many of these sites are highly disturbed and some have a significant component of weeds. These are described below.

WB:kc *$Knapweed – Cheatgrass seral association*
This is an early seral association dominated by knapweed, sulphur cinquefoil, and cheatgrass with few or no native bunchgrasses remaining on these sites.

WB:wk $*Bluebunch wheatgrass – Knapweed seral association*
This is a mid- to late-seral seral association. On these sites there is still a reasonable component of bluebunch wheatgrass with knapweed, sulphur cinquefoil, or cheatgrass.

List of mapped units:

WBjs	gentle slope, shallow soils (20-100cm deep)	WBs	shallow soils (20-100cm deep)
WBks	cool aspect (NNW or ESE), slope >25%; shallow soils (20-100cm deep)	WBv	very shallow soils (<20cm deep)
WBrs	ridge or crest, shallow soils (20-100cm deep)		

SITE INFORMATION

Common Terrain Types:

- morainal blankets and veneers and colluvial veneers

Slope position:	middle, upper, crest
Slope (%):	25 – 65%
Aspect:	south, southwest, west
Soil Moisture Regime:	subxeric – submesic
Soil Nutrient Regime:	medium – poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	Bluebunch wheatgrass – Balsamroot	IDFmw1	00

	Structural Stage Seral Association	2b WB	2a WB:kc	2b WB:wk	
Grasses	*Pseudoroegneria spicata*	***	*	**	bluebunch wheatgrass
	Koeleria macrantha	**		*	junegrass
	Bromus tectorum	*	****	***	cheatgrass
Herbs	*Balsamorhiza sagittata*	***	**	***	arrowleaf balsamroot
	Lupinus sericeus	***	**	***	silky lupine
	Eriogonum heracleoides	**	**	**	parsnip-flowered buckwheat
	Potentilla recta		***	**	sulphur cinquefoil
Mosses	*Cladonia* spp.	**		*	clad lichens
Lichens	*Tortula ruralis*	**		*	sidewalk moss
PLOTS		CVG026	CVG011	CVG012	

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Ws01	**Mountain Alder – Skunk Cabbage – Lady Fern Swamp**	**IDFmw1**	**Ws01**

Typic unit occurs on level sites with deep, mineral soils (d, j and m are assumed modifiers). Equivalent to Ws01 unit of the same name in the provincial wetland classification (MacKenzie and Moran 2004)

This shrubby swamp ecosystem usually occurs along creeks or areas with poor drainage and continuous seepage near the surface. Soils are usually mineral with a thin organic veneer.

SITE INFORMATION	
Common Terrain Types: • morainal or fluvial with thin organic veneer	
Slope position:	level
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric – hydric
Soil Nutrient Regime:	medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Ws01	Mountain Alder – Skunk Cabbage – Lady Fern Swamp	IDFmw1	Ws01

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	**	****	****	***	***	Western redcedar
Shrubs	*Alnus incana*	****	***	****	*****	*****	mountain alder
	Cornus stolonifera	**	*	**	**	**	red-osier dogwood
Sedges	*Carex disperma*	**	**	**	**	**	soft-leaved sedge
Herbs	*Lysichiton americanus*	****	***	***	***	****	skunk cabbage
	Equisetum arvense	**	**	**	**	**	common horsetail
	Dryopteris expansa	***		**	**	**	spiny wood fern
	Mitella nuda	**	*	**	**	**	common mitrewort
Mosses	*Drepanocladus aduncus*	***	***	***	***	***	common hook-moss
	Mnium or *Plagiomnium* spp.	*	*	*	**	**	ragged mosses
PLOTS		9901777					

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

COLDSTREAM VERNON EXPANDED LEGEND – IDFxh1

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AS	**Trembling aspen – Snowberry – Kentucky bluegrass**	**IDFxh1**	**98**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, and m)

This forest ecosystem commonly occurs in large, broad depressions in grassland areas. These sites collect moisture from surrounding grassland areas. They have an overstory of trembling aspen and a shrubby understory dominated by snowberry and roses.

List of mapped units:

AScw	coarse-textured soils, warm aspect, slope >25%	ASk	cool aspect; slope >25%
ASfk	fine-textured soils, cool aspect, slope <25%	ASsw	shallow soils (50-100cm deep), warm aspect, slope >25%
ASg	occurs in a gully	ASw	warm aspect; slope >25%
ASgw	occurs in a warm aspect gully, slope >25%		

SITE INFORMATION

Common Terrain Types:

- morainal blankets, colluvial slopewash

Slope position:	lower, toe, depression, mid
Slope (%):	0 – 10 (30)
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AS	Trembling aspen – Snowberry – Kentucky bluegrass	IDFxh1	98

	Structural Stage	3	4	5	6	7	
Trees	*Populus tremuloides*	*	***	***	***	***	trembling aspen
Shrubs	*Amelanchier alnifolia*	***	*	*	*	*	saskatoon
	Prunus virginiana	**	**	**	**	**	choke cherry
	Symphoricarpos albus	*****	****	*****	*****	*****	common snowberry
	Rosa spp.	**	**	**	**	**	roses
Grasses	*Calamagrostis rubescens*	**	*	**	**	**	pinegrass
Herbs	*Osmorhiza berteroi*	*	*	*	**	**	mountain sweet-cicely
	Thalictrum occidentalis	**	*	*	*	*	western meadowrue
Mosses	*Brachythecium* sp.		*	*	*	*	ragged moss
PLOTS		CVG054		CVG054			

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites
Wetter sites may have water birch, drier sites have more Oregon-grape and little or no Douglas maple.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BE	**Beach**	**IDFxh1**	**N/A**
The area that expresses sorted sediments reworked in recent time by wave action. Occurs at lake edges.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BM	**Bulrush Marsh**	**IDFxh1**	**00**

Typic unit occurs on level sites with deep, fine-textured soils (assumed modifiers are d, f, and j).

This unit is equivalent to the *Great bulrush marsh* association (Wm06) in the provincial classification (MacKenzie and Moran 2004).

This marsh wetland ecosystem commonly occurs on small ponds adjacent to shallow open water as a fringe along the shoreline. This unit is uncommon in the study area. It typically occurs as a complex with shallow open water (OW). Water depths are up to 1.5 m but water levels draw down significantly in the summer. These sites are most commonly dominated by hard-stemmed bulrush, with some floating aquatic plants (duckweed, bladderwort and water smartweed). Vegetation species diversity is typically low on these sites. Soils are typically mineral, sometimes with a thin organic veneer.

SITE INFORMATION	
Common Terrain Types:	
• lacustrine veneer over morainal blanket	
Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhydric - hydric
Soil Nutrient Regime:	rich

	Structural Stage	**2**	
Rushes	*Schoenoplectus acutus* or *tabernaemontani*	****	hard-stemmed or soft-stemmed bulrush
Herbs	*Lemna minor*	**	common duckweed
PLOTS		CVG006	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BN	**Kentucky bluegrass – Stiff needlegrass**	**IDFxh1**	**96**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, and m)

This ecosystem commonly occurs in moisture-collecting swales and depressions in grasslands and grassland openings. These sites are generally quite small and are dominated by grasses with scattered forbs. All sites observed were disturbed and dominated by Kentucky bluegrass. This ecosystem is likely dominated by needlegrasses at climax but the presence of Kentucky bluegrass may prevent these ecosystems from returning to a climax state.

SITE INFORMATION	
Common Terrain Types: • thick morainal blankets	
Slope position:	toe, depression
Slope (%):	0 – 15
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	medium – rich

	Structural Stage	2b	
Grasses	*Poa pratensis*	****	Kentucky bluegrass
	Elymus repens	**	quackgrass
Herbs	*Taraxacum officinale*	**	dandelion

Species – non-native species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Comments: no late seral or climax sites were observed so it is not known what climax vegetation is but may be dominated by Columbia needlegrass and forbs.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BR	**Baltic Rush Marsh-Meadow**	**IDFxh1**	**00**

Typic unit occurs on level sites with deep, fine-textured soils (assumed modifiers are d, f, and j).

This unit is equivalent to the *Baltic rush marsh* association (Wm07) in the provincial classification (MacKenzie and Moran 2004).

This marsh-meadow wetland ecosystem occurs in areas where water draws down below the soil surface most summers (seasonal flooding). This unit is rare in the study area. These sites are dominated by baltic rush. Field sedge may also occur in slightly drier situations. Soils are typically mineral.

List of mapped units:

BRg occurs in a gully (with a broad, nearly level bottom)

SITE INFORMATION

Common Terrain Types:

- lacustrine veneer over thick morainal or glaciofluvial materials

Slope position:	toe, depression, (lower)
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	rich

	Structural Stage	2b	
Rushes	*Juncus balticus*	***	baltic rush
Sedges	*Carex praegracilis*	**	field sedge
Grasses	*Poa pratensis*	**	Kentucky bluegrass
	Elymus repens	***	quackgrass
Forbs	*Potentilla anserina*	**	common silverweed

Species – non-native species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CB	**Cutbank**	**IDFxh1**	**N/A**
Part of a road corridor which is created by excavation or erosion of the hillside.			
List of mapped units:			
CBw	warm aspect, slope >25%		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CD	**Black cottonwood/Douglas-fir –Common Snowberry – Red-osier Dogwood**	**IDFxh1**	**00**

Typic unit occurs on level or very gently sloping sites with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is rare but was found along larger creeks and along the edge of Kalamalka Lake. Forests are dominated by black cottonwood, sometimes with Douglas-fir and paper birch. The understory is typically rich and shrubby, often dominated by Nootka rose, mock orange, snowberry and red-osier dogwood. Forbs are uncommon and scattered.

List of mapped units:

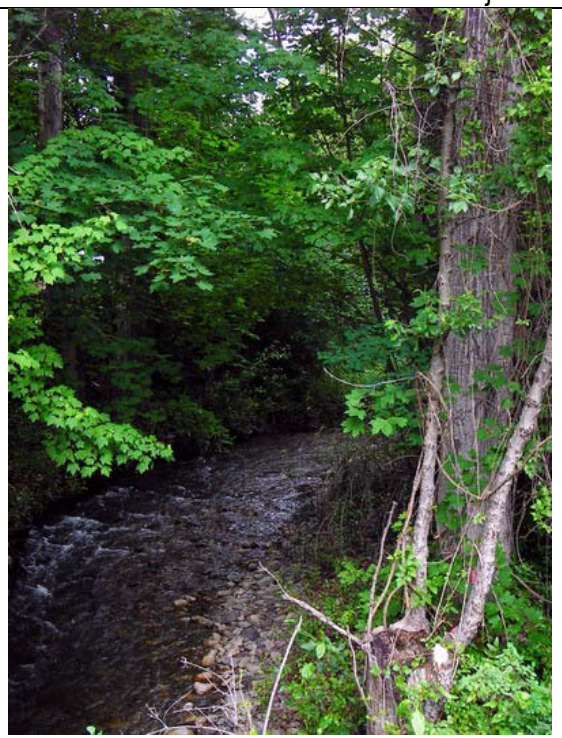
CDa	active floodplain	CDgw	occurs in a warm aspect gully
CDg	occurs in a gully	CDt	occurs on a fluvial terrace adjacent to a creek

SITE INFORMATION

Common Terrain Types:

- fluvial and colluvial slopewash

Slope position:	lower and toe
Slope (%):	0-15
Aspect:	none
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CD	Black cottonwood/Douglas-fir –Common Snowberry – Red-osier Dogwood	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Populus balsamifera* ssp. *trichocarpa*	**	***	***	***	***	black cottonwood
	Pseudotsuga menziesii var. *glauca*			*	*	*	Douglas-fir
Shrubs	*Symphoricarpos albus*	***	**	***	***	***	common snowberry
	Cornus stolonifera	***	**	**	**	**	red-osier dogwood
	Acer glabrum	***	**	***	***	***	Douglas maple
	Rosa nutkana	**	*	**	**	**	Nootka rose
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
Herbs	*Equisetum arvense*	**	*	*	*	**	common horsetail
	Osmorhiza berteroi	*	*	*	*	*	mountain sweet-cicely
Mosses	*Mnium* spp.	*	*	*	*	*	leafy mosses
PLOTS				CVG055	CVG051	CVG001 CVG311	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name		BGC	Site Series Number
CF	**Cultivated Field**		**IDFxh1**	**N/A**
These are agricultural fields with tilled soils and planted crops or ground cover.				
List of mapped units:				
CFx	drier than typical, retains some grassland habitat values	CFy	moister than typical, has temporary standing water, may be part of a former riparian floodplain	

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CG	**Reed Canarygrass Marsh**	**IDFxh1**	**00**

Typic unit occurs on level sites with deep, fine-textured soils (assumed modifiers are d, f, and j).

This marsh-meadow wetland ecosystem occurs in areas where water draws down below the soil surface most summers (seasonal flooding). This unit is rare in the study area. These sites have thick, often continuous cover of reed canarygrass with few or no other species. These sites may have been dominated by other marsh species such as large water sedges previously. Soils are typically fine-textured and mineral.

SITE INFORMATION

Common Terrain Types:

- lacustrine veneer over thick morainal or glaciofluvial materials

Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	rich

	Structural Stage	**2**	
Grasses	*Phalaris arundinacea*	****	Reed canarygrass
PLOTS		CVV356	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CL	**Cliff**	**IDFxh1**	**N/A**
These are steep, vertical or overhanging rock faces. Typically there are scattered plants such as saskatoon and cliff ferns occurring in rock fractures or soil pockets.			
List of mapped units:			
CLq	very steep cool aspect	CLz	very steep warm aspect

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CN	**Canal**	**IDFxh1**	**N/A**
An artificial watercourse created for transport, drainage, and/or irrigation purposes.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CO	**Cultivated Orchard**	**IDFxh1**	**N/A**
Agricultural areas for growing fruit trees.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CT	**Cattail Marsh**	**IDFxh1**	**00**

Typic unit occurs on level sites with deep, medium-textured soils (assumed modifiers are d, j, m).

This unit is equivalent to the *Cattail marsh* association in the provincial classification (MacKenzie and Moran 2004).

This marsh wetland ecosystem occurs as a fringe on pond edges or in depressions, often adjacent to shallow open water (OW). This unit is rare in the study area. Water depths are typically up to 1 m in spring but draw down to the soil surface by late summer; soils remain saturated for most of the season. Some wetlands convert to cattail marshes when they are subject to nutrient loading. These sites are dominated by cattails with few other species. Soils are typically mineral, but may have a thin organic veneer on top.

List of mapped units:

CTg	occurs in a gully, usually small and disturbed	CTx	drier than typical, water table has dropped in recent years and flooding is very temporary.

SITE INFORMATION

Common Terrain Types:

- thin organic veneer over lacustrine materials

Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhydric
Soil Nutrient Regime:	rich

	Structural Stage	2a	
Herbs	*Typha latifolia*	****	common cattail
	Lemna minor	**	common duckweed
Mosses	*Bryum* sp.	**	thread moss
PLOTS		CVV006	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CW	**Choke cherry – Bluebunch wheatgrass rocky bluff**	**IDFxh1**	**00**

Typic unit occurs on gentle slopes with very shallow soils (assumed modifiers are j and v)

This ecosystem commonly occurs on bedrock bluffs where the bedrock is quite fractured. This unit is uncommon in the study area. Exposed bedrock usually occupies 30-50% of the area. Shrubs are common, typically occurring in cracks in the rocks. Grasses, forbs, lichens and mosses occur in small soil pockets scattered in amongst the bedrock.

List of mapped units:

CWk	cool aspect, slope >25%	CWw	warm aspect, slope >25%
CWq	very steep cool aspect, slope >70%	CWz	very steep warm aspect; slope >100%
CWr	ridge or crest		

SITE INFORMATION

Common Terrain Types:

- rock and very thin colluvial and morainal veneers

Slope position:	crest, upper
Slope (%):	0 – 100+
Aspect:	all
Soil Moisture Regime:	very xeric – xeric
Soil Nutrient Regime:	very poor – poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CW	Choke cherry – Bluebunch wheatgrass rocky bluff	IDFxh1	00

	Structural Stage	3	
Shrubs	*Amelanchier alnifolia*	**	saskatoon
	Philadelphus lewisii	***	mock-orange
	Symphoricarpos albus	**	common snowberry
	Prunus virginiana	**	choke cherry
Grasses	*Pseudoroegneria spicata*	**	bluebunch wheatgrass
Herbs	*Woodsia scopulina*	*	mountain cliff fern
	Selaginella densa	*	compact selaginella
	Artemisia frigida	*	pasture sage
Mosses	*Tortula ruralis*	**	sidewalk moss
PLOTS		CVG033 CVG313 CVG314	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	**Douglas-fir/Ponderosa pine – Pinegrass**	**IDFxh1**	**01**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is commonly associated with mesic gently sloping sites. This is the most common forest unit in the study area. Forests are moderately closed with mixed Douglas-fir and ponderosa pine overstories, although historically they would have been quite open. The understory has abundant pinegrass with scattered snowberry, birch-leaved spirea, tall Oregon-grape, grasses, herbs and mosses. This unit is also common on cool aspects (DPk) where there is usually more of a moss layer. Mature (structural stage 6) and old (structural stage 7) forests are uncommon because most of the large trees historically present on these sites have been logged. Because of fire exclusion, most sites have become ingrown with higher densities of smaller stems. Grazing and ingrowth have together reduced the presence of bunchgrasses which were likely historically common.

List of mapped units:

DPck	coarse-textured soils (glaciofluvial), cool aspect, slope >25%	DPks	cool aspect (usually NW to E), shallow soils (generally 50-100cm)
DPf	occurs on fine-textured glaciolacustrine soils	DPs	shallow soils (generally 50-100cm)
DPfk	fine-textured glaciolacustrine soils, cool aspect, slope >25%	DPt	occurs on a glaciofluvial or high fluvial terrace
DPgs	occurs in a gully with shallow soils (50-100cm deep)	DPw	warm aspect (usually SE or NW), slope usually 25-35%
DPk	cool aspect, slope <25%		

SITE INFORMATION

Common Terrain Types:

- deep morainal materials on gentle slopes
- moderate to steep cool aspect morainal and colluvial slopes (deep or variable thickness)

Slope position:	level, middle
Slope (%):	0-30; up to 70% on cool aspects
Aspect:	all
Soil Moisture Regime:	mesic – submesic
Soil Nutrient Regime:	medium (poor)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	Douglas-fir/Ponderosa pine – Pinegrass	IDFxh1	01

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	****	***	***	Douglas-fir
	Pinus ponderosa	**	***	***	**	**	ponderosa pine
Shrubs	*Symphoricarpos albus*	****	*	**	**	**	common snowberry
	Spirea betulifolia	***	*	**	**	**	birch-leaved spirea
	Amelanchier alnifolia	**	*	**	**	**	saskatoon
Grasses	*Calamagrostis rubescens*	***	*	**	***	***	pinegrass
	Festuca idahoensis	**		*	*	*	Idaho fescue
Herbs	*Arnica cordifolia*	**	*	*	*	**	heart-leaved arnica
	Achillea millefolium	**	*	*	*	*	yarrow
Mosses and Lichens	*Rhytidiadelphus triquetrus*			*	**	**	electrified cat's tail moss
	Pleurozium schreberi	*	*	*	**	**	red-stemmed feathermoss
	Peltigera canina	*		*	*	*	dog pelt
PLOTS					CVG039 CVV050	CVG064	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	**Douglas-fir/Ponderosa pine – Snowberry – Spirea**	**IDFxh1**	**07**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is commonly associated with gently sloping sites that are receiving some moisture. This is an uncommon forested ecosystem in the study area. These forests typically have moderately closed Douglas-fir overstories with very shrubby understories dominated by snowberry with some Oregon-grape, Douglas maple, and saskatoon. Often there is scattered Kentucky bluegrass with some heart-leaved arnica and other scattered forbs. There is a minimal moss layer with scattered patches of ragged mosses. Because these sites are moist, they may have had a longer fire-return interval than adjacent mesic and drier forests. These sites also tend to recover more quickly after disturbance (such as logging) because they are moister and more productive.

Although these sites are productive and vegetation recovers relatively quickly following disturbances such as logging, the moist soils on these sites are sensitive to disturbance and are difficult to find places for septic fields. Alterations in subsurface water flow present considerable risks to soil stability.

List of mapped units:

DSck	coarse-textured soils, cool aspect, slope >25%	DSks	cool aspect, shallow soil (50-100cm), slope >25%
DSg	gully	DSn	occurs on a fluvial fan
DSgk	cool aspect gully, slope >25%	DSs	shallow soils (generally 50-100cm)
DSgs	gully, shallow soils (generally 50-100cm)	DSsw	shallow soils (generally 50-100cm), warm aspect, slope >25%
DSgw	warm aspect gully, slope >25%	DSt	occurs on a fluvial terrace, unlikely to flood in most years
DSk	cool aspect	DSw	warm aspect (usually SE or NW, sites with some compensating moisture)

SITE INFORMATION

Common Terrain Types:

- gentle to moderate morainal slopes, fluvial benches, slope wash in gullies

Slope position:	lower and toe
Slope (%):	0-15% (up to 50% on cool aspects)
Aspect:	none, cool
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	Douglas-fir/Ponderosa pine – Snowberry – Spirea	IDFxh1	07

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	*****	****	****	***	Douglas-fir
	Populus tremuloides	**	*	**	*		trembling aspen
Shrubs	*Symphoricarpos albus*	*****	***	****	****	****	common snowberry
	Acer glabrum	***	**	**	***	***	Douglas maple
	Mahonia aquifolium	**		*	**	**	tall Oregon-grape
	Spirea betulifolia	***	*	**	**	**	birch-leaved spirea
Grasses	*Calamagrostis rubescens*	**		*	*	**	pinegrass
	Elymus glaucus	**		*	*	**	blue wildrye
Herbs	*Osmorhiza berteroi*	***	*	**	**	**	mountain sweet-cicely
Mosses	*Brachythecium* sp.			*	**	**	ragged moss
PLOTS		CVG052					

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Amount of trembling aspen varies from none to a significant part of the overstory (mixed); Douglas maple is often more abundant in mixed and deciduous overstories.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DW	**Douglas-fir/Ponderosa pine – Bluebunch wheatgrass - Pinegrass**	**IDFxh1**	**03**

Typic unit occurs on moderate to steep warm aspects with deep, medium textured soils (d, m and w are assumed modifiers).

This forest ecosystem is common on moderate to steep warm aspects (excluding southeast and west aspects which are usually /04 sites). This is an uncommon unit in the study area. It sometimes occurs on cooler aspects were soils are shallower and on ridges and crests where soils are not shallow enough to be the IDFxh1 /02 (PB). Mixed ponderosa pine – Douglas-fir forests are open and dominated by bunchgrasses, particularly bluebunch wheatgrass with scattered forbs (mostly balsamroot). Idaho fescue and sometimes rough fescue occur on sites that have not been heavily grazed. Mosses and lichens are scattered and uncommon. Ingrowth is commonly present, but drier conditions have helped keep most stands somewhat open.

List of mapped units:

DWc	coarse-textured soils (usually glaciofluvial)	DWks	cool aspect (generally NW or ESE), shallow soils (20 – 50cm)
DWck	coarse-textured soils, cool aspect (generally ESE or NW), slope >25%	DWkv	cool aspect (generally NW or ESE), very shallow soils (<20cm); exposed bedrock present
DWjs	gentle slope (generally 20-25% slope, warm aspect or slight ridge or crest), shallow soils	DWs	shallow soils (20-100cm)
DWjv	gentle slope (often a slight crest), very shallow soils <20cm deep, exposed bedrock present	DWv	very shallow soils (<20cm)

SITE INFORMATION

Common Terrain Types:

- steep warm aspect thin to thick colluvial and morainal slopes
- glaciofluvial and occasionally on glaciolacustrine slopes

Slope position:	middle and upper
Slope (%):	(30) 35 – 60%
Aspect:	south, southwest, west (also cool aspects on very shallow soils)
Soil Moisture Regime:	subxeric (submesic)
Soil Nutrient Regime:	poor – medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DW	**Douglas-fir/Ponderosa pine – Bluebunch wheatgrass - Pinegrass**	**IDFxh1**	**03**

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	***	***	***	***	Douglas-fir
	Pinus ponderosa	**	****	***	**	**	ponderosa pine
Shrubs	*Amelanchier alnifolia*	**	*	**	**	**	saskatoon
	Symphoricarpos albus	**	*	**	**	**	common snowberry
Grasses	*Pseudoroegneria spicata*	****	**	***	***	****	bluebunch wheatgrass
	Festuca idahoensis	**	*	**	**	**	Idaho fescue
	Koeleria macrantha	**	*	**	**	**	junegrass
Herbs	*Balsamorhiza sagittata*	***	*	**	***	***	arrowleaf balsamroot
	Achillea millefolium	*	*	*	*	*	yarrow
	Antennaria microphylla or *Antennaria parviflora* or *Antennaria umbrinella*	**	*	*	*	*	white pussytoes Nuttall's pussytoes umber pussytoes
Mosses	*Cladonia* spp.	**	*	**	**	**	clad lichens
Lichens	*Tortula ruralis*	**	*	**	**	**	sidewalk moss
PLOTS				CVG002	CVG022 CVG058	CVG065 CVG310	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
ES	**Exposed Soil**	**IDFxh1**	**N/A**

These are areas of exposed soils and typically include recent disturbances such as soil erosion.

List of mapped units:

ESk cool aspect

ESw warm aspect

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FO	**Douglas-fir / Ponderosa pine –Saskatoon – Mock orange**	**IDFxh1**	**00**

Typic unit occurs on steep slopes with deep, coarse-textured (rocky) soils (c, and d are assumed modifiers).

This forest ecosystem is commonly associated with steep colluvial sites with rocky soils. This is an uncommon unit in the study area. It occurs on both cool (FOk) and warm (FOw) aspects. The soil matrix is a mixture of both angular rocks and sandy, silty material. The overstory is generally open and dominated by Douglas-fir with scattered ponderosa pine. Understories are often quite shrubby with snowberry, saskatoon and mock orange. There is usually scattered bluebunch wheatgrass. Small rocks dominate a large portion of the soil surface.

List of mapped units:

FOgk	occurs in a cool aspect gully, slope >25%	FOs	shallow soils (20-100cm deep)
FOk	cool aspect (>25%)	FOsw	shallow soils (20-100cm deep), warm aspect (slope >25%)
FOks	cool aspect (>25%), shallow soils (20-100cm deep)	FOw	warm aspect (slope >25%)

SITE INFORMATION

Common Terrain Types:

- moderate and steep rocky colluvial slopes

Slope position:	lower to upper
Slope (%):	60-75%
Aspect:	all
Soil Moisture Regime:	submesic – subxeric
Soil Nutrient Regime:	medium, poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FO	Douglas-fir / Ponderosa pine –Saskatoon – Mock orange	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	***	***	***	***	Douglas-fir
	Pinus ponderosa	**	**	**	**	**	ponderosa pine
Shrubs	*Symphoricarpos albus*	*****	***	***	****	****	common snowberry
	Spirea betulifolia	***	*	*	**	**	birch-leaved spirea
	Philadelphus lewisii	**		*	**	**	mock-orange
	Amelanchier alnifolia	****	**	**	***	***	Saskatoon
Grasses	*Pseudoroegneria spicata*	***	**	**	***	***	bluebunch wheatgrass
	Calamagrostis rubescens	***	**	**	***	***	pinegrass
Herbs	*Lomatium dissectum*	*	*	*	*	*	fern-leaved desert parsley
Mosses	*Tortula ruralis*	*		*	*	*	sidewalk moss
PLOTS				CVG301	CVG021 CVG031 CVG037 CVG057		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	**Idaho fescue – Bluebunch wheatgrass**	**IDFxh1**	**91**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, m)

This grassland ecosystem occurs on gentle warm aspects, levels sites, and cool aspects. A mixture of Idaho fescue and bluebunch wheatgrass with balsamroot and other herbs dominates late seral sites, but late seral sites are uncommon in the study area and no climax sites were observed. Soils are typically dark brown or black chernozems. Most of these sites are highly disturbed and some have a significant component of weeds. These are described below.

FW:fc *$Idaho fescue – Cheatgrass seral association*
This is a mid- to late-seral association dominated by Idaho fescue with significant cover of invasive annual bromes, especially cheatgrass, and a variety of native grassland forbs.

FW:kc *$Knapweed – Cheatgrass seral association*
This is an early seral association dominated by knapweed, sulphur cinquefoil, and cheatgrass with few or no native bunchgrasses remaining on these sites.

FW:nc *$Columbia needlegrass – Cheatgrass seral association*
This is an early seral association dominated by Columbia needlegrass with significant cover of invasive annual bromes, especially cheatgrass, and a variety of native grassland forbs.

FW:wk $*Bluebunch wheatgrass – Knapweed seral association*
This is a mid- to late-seral seral association. On these sites there is still a reasonable component of bluebunch wheatgrass with knapweed, sulphur cinquefoil, or cheatgrass.

List of mapped units:

FWf	fine-texture glaciolacustrine soils	FWks	cool aspect, shallow soils (50-100cm)
FWfk	fine-texture glaciolacustrine soils; cool aspect, slope >25%	FWs	shallow soils (50-100cm)
FWk	cool aspect (>25% slope)	FWw	warm aspect (generally SE or NW), slope >25%

SITE INFORMATION

Common Terrain Types:

- morainal and glaciofluvial blankets, often with an eolian veneer (no coarse fragments, fine-sandy loam)

Slope position:	lower to upper
Slope (%):	0-35% (up to 60% on cool aspects)
Aspect:	all
Soil Moisture Regime:	mesic
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	Idaho fescue – Bluebunch wheatgrass	IDFxh1	91

	Structural Stage Seral Association	2 FW	2 FW:fc	2 FW:kc	2 FW:nc	2 FW:wk	
Grasses	*Festuca idahoensis*	****	***				Idaho fescue
	Festuca campestris	**					rough fescue
	Pseudoroegneria spicata	***	*		*	***	bluebunch wheatgrass
	Koeleria macrantha	**	*		*		junegrass
	Achnatherum nelsonii		*	**	****	*	Columbian needlegrass
	Bromus tectorum or *Bromus japonicus*		***	****	***	***	cheatgrass or Japanese brome
Herbs	*Balsamorhiza sagittata*	***	**		**	**	arrowleaf balsamroot
	Lupinus sericeus	**	**	*	*	**	silky lupine
	Eriogonum heracleoides	**	**	*	*	*	parsnip-flowered buckwheat
	Lithospermum ruderale	*	*	*	*	*	lemonweed
	Calochortus macrocarpus	*					sagebrush mariposa lily
	Centaurea diffusa		*	***	**	**	diffuse knapweed
	Potentilla recta			***	*	*	sulphur cinquefoil
Mosses and Lichens	*Cladonia* spp.	**	*				clad lichens
	Tortula ruralis	**	*			*	sidewalk moss
	Peltigera rufescens or *Peltigera ponojensis*	**					felt pelt felt pelt
PLOTS		CVG040 CVG041 CVG045 CVG316		CVG044	CVG015		

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GC	**Golf Course**	**IDFxh1**	**N/A**
Flat to gently rolling grass-covered throughways and open areas set out for the playing of golf.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GP	**Gravel Pit**	**IDFxh1**	**N/A**
These are areas of used for extraction of gravel and sand.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
LA	**Lake**	**IDFxh1**	**N/A**
These are areas of permanent open water that are greater than 2m deep and greater than 50ha. Kalamalka Lake.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
OW	**Shallow Open Water**	**IDFxh1**	**N/A**
These are areas of permanent open water that are less than 2m deep. There is less than 10% emergent vegetation but floating aquatics such as bladderwort are often present. Shallow open water commonly occurs in association with marsh ecosystems. **OWx** – drier than typical for a number of years – may only have water in spring and is dry by summer.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PB	**Douglas-fir/Ponderosa pine – Bluebunch wheatgrass – Balsamroot**	**IDFxh1**	**02**

Typic unit occurs on warm aspects with medium-textured shallow soils (m, s and w are assumed modifiers).

This forest ecosystem is commonly associated with shallow or very shallow soils and bedrock outcrops. This unit is uncommon in the study area. Forests are very open with scattered large trees, often growing in bedrock fractures. The understory is variable depending on soil depth with more vegetation occurring on deeper soil pockets. Scattered shrubs and bunchgrasses (usually bluebunch wheatgrass) dominate the understory. A lichen and moss crust may be present on soil pockets on undisturbed sites.

List of mapped units:

PBcd	coarse-textured soils (sandy glaciofluvial), deep soils, surface soils ravelling	PBqv	very steep cool aspect, slope >70%, very shallow soils (<20cm), exposed bedrock present
PBcv	coarse-textured soils (sandy glaciofluvial), shallow soils (50-100cm deep), surface soils ravelling	PBrv	ridge, very shallow soils (<20cm), exposed bedrock present
PBjv	gentle slope (usually low crest), very shallow soils (<20cm), exposed bedrock present	PBv	very shallow soils (<20cm), exposed bedrock present
PBkv	cool aspect (usually NW or ESE), slope >25%, very shallow soils (<20cm), exposed bedrock present	PBvz	very shallow soils (<20cm), exposed bedrock present, very steep warm aspect (slope >100%)

SITE INFORMATION

Common Terrain Types:

- Thin and very thin colluvial, morainal, and weathered bedrock materials over bedrock
- Occasionally occurs on steep sandy glaciofluvial slopes

Slope position:	upper and crest
Slope (%):	0-70%
Aspect:	none, south, southwest
Soil Moisture Regime:	very xeric – subxeric
Soil Nutrient Regime:	poor (very poor, medium)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PB	Douglas-fir/Ponderosa pine – Bluebunch wheatgrass – Balsamroot	IDFxh1	02

	Structural Stage	3	4	5	6	7	
Trees	*Pinus ponderosa*	**	****	***	***	***	ponderosa pine
	Pseudotsuga menziesii var. *glauca*	*	**	**	**	**	Douglas-fir
Shrubs	*Amelanchier alnifolia*	**	*	**	**	**	saskatoon
	Philadelphus lewisii	***	*	**	**	**	mock orange
	Symphoricarpos albus	**	*	**	**	**	snowberry
	Mahonia aquifolium	*		*	*	*	tall oregon-grape
Grasses	*Pseudoroegneria spicata*	****	**	***	***	****	bluebunch wheatgrass
	Bromus tectorum	*	*	*	*	*	cheatgrass
Herbs	*Balsamorhiza sagittata*	***	*	**	**	**	arrowleaf balsamroot
	Selaginella densa	*	*	*	*	*	compact selaginella
	Penstemon fruiticosa	*	*	*	*	*	shrubby penstemon
Mosses and Lichens	*Cladonia* spp.	**	**	**	**	**	clad lichens
	Tortula ruralis	**	**	**	**	**	sidewalk moss
	Polytrichum piliferum	**	**	**	**	***	awned haircap moss
PLOTS			CVG019	CVV302	CVG035	CVG060	

Species – non-native species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PD	Pond	IDFxh1	N/A
A small body of water greater than 2 m deep, but not large enough to be classified as a lake (e.g., less than 50 ha).			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RE	Reservoir	IDFxh1	N/A
An artificial basin created by the impoundment of water behind a human-made structure such as a dam, berm, dyke, or wall.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RF	**Prairie Rose – Idaho fescue**	**IDFxh1**	**97**

Typic unit occurs on gentle slopes with deep, medium-textured soils (assumed modifiers are d, j, and m)

This shrubland ecosystem commonly occurs in moisture collecting depressions, seepage slopes and swales in grassland areas. This unit sometimes occurs as patches on grassland slopes. These sites are dominated by shrubs, primarily snowberry and roses. Forbs and grasses are scattered in openings between shrubs. Soils are very rich black chernozems.

List of mapped units:

RFg	gully	RFn	occurs on a fluvial or colluvial fan
RFgw	warm aspect gully, slope >25%	RFs	shallow soils (usually 50-100cm)
RFk	cool aspect, slope >25%	RFsw	shallow soils (usually 50-100cm), warm aspect, slope >25%
RFks	cool aspect, slope >25%, shallow soils (50-100cm deep)	RFw	warm aspect, slope >25%

SITE INFORMATION

Common Terrain Types:

- morainal blankets

Slope position:	mid, toe, depression
Slope (%):	0-25
Aspect:	none, variable
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

	Structural stage	**3a or 3b**	
Shrubs	*Symphoricarpos albus*	*****	common snowberry
	Rosa spp.	***	roses
Grasses	*Poa pratensis*	**	Kentucky bluegrass
PLOTS		CVG309 CVV376	

Species – non-native species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RN	**Railway Surface**	**IDFxh1**	**N/A**
A railway with fixed rails for single or multiple rail lines.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RO	**Rock Outcrop**	**IDFxh1**	**N/A**
These are areas of exposed bedrock with less than 10% vegetation cover. On sites with fractured bedrock, some plants may be growing out of rock cracks.			

List of mapped units:			
ROq	very steep cool aspect (slope >70%)	ROz	very steep warm aspect (slope >70%)
ROw	warm aspect		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RS	**Western redcedar / Douglas-fir – False Solomon's Seal**	**IDFxh1**	**00**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is commonly associated with fluvial sites (terraces, slopes) and gullies which are influenced by cold air drainage. This is an uncommon unit in the study area. The overstory of these closed forests includes a mixture of western red cedar, Douglas-fir and paper birch. A diverse mixture of shrubs and forbs generally dominates the understory although the understory can be very sparse on sites with very closed canopies (pole sapling and young forests).

List of mapped units:

RSa	active floodplain	RSt	occurs on a fluvial terrace

SITE INFORMATION

Common Terrain Types:

- morainal gullies, fluvial plains and terraces

Slope position:	level, lower and toe
Slope (%):	variable
Aspect:	none
Soil Moisture Regime:	subhygric – hygric
Soil Nutrient Regime:	medium, rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RS	Western redcedar / Douglas-fir – False Solomon's Seal	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	***	****	****	****	****	western red cedar
	Pseudotsuga menziesii var. *glauca*	**	**	***	***	***	Douglas-fir
	Populus balsamifera ssp. *trichocarpa*	***	*	**	**	*	black cottonwood
	Betula paperifera	**	*	*	**	**	paper birch
Shrubs	*Acer glabrum* var. *douglasii*	***	**	**	**	**	Douglas maple
	Paxistima myrsinites	***	**	**	**	**	falsebox
	Symphoricarpos albus	**	*	*	**	**	common snowberry
	Rosa nutkana	**	*	*	*	*	Nootka rose
	Ribes lacustre	**	*	*	*	*	black gooseberry
	Cornus stolonifera	**	*	*	*	*	red-osier dogwood
Grasses	*Elymus glaucus*	***	*	*	*	*	blue wildrye
Sedges	*Carex* spp.	**	*				sedges
Herbs	*Maianthemum stellatum*	***	*	*	*	*	star-flowered Solomon's-seal
	Equisetum arvense	***	*	*	*	*	common horsetail
	Aralia nudicaulis	**	**	**	**	**	sarsaparilla
	Osmorhiza berteroi	**	*	*	*	*	mountain sweet-cicely
	Viola canadensis	*	*	*	*	*	Canada violet
Mosses	*Brachythecium* sp.	*	*	*	*	*	ragged moss
	Mnium sp.	*	**	**	**	**	leafy moss
PLOTS					CVG028		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RW	**Rural**	**IDFxh1**	**N/A**
Rural areas of human settlement with scattered houses intermingled with native vegetation or cultivated areas.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RZ	**Road Surface**	**IDFxh1**	**N/A**
A gravel or paved road used for vehicular travel.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SA	**Antelope Brush - Selaginella**[63]	**IDFxh1**	**00**

Typic unit occurs on gentle slopes with shallow soils (assumed modifiers are j, m and s).

However, in the study area, this unit more commonly occurs on steep slopes on rock outcrops with small ledges and pockets of soil. The bedrock is generally fractured. This is an uncommon unit in the study area. In contrast with areas in the South Okanagan, ***there is no antelope brush on these sites***. Scattered ponderosa pine trees and saskatoon bushes occur in rock fractures. Soil pockets on ledges are dominated by bluebunch wheatgrass with balsamroot, selaginella, and a well-developed microbiotic crust on soil pockets.

List of mapped units:

SAkv	cool aspect, very shallow soils (<20cm deep), exposed bedrock present	SAv	very shallow soils
SAqv	very steep cool aspect (>100% slope), very shallow soils	SAvw	very shallow soils, warm aspect
SArv	ridge or crest, very shallow soils	SAvz	very shallow soils, very steep warm aspect (>100% slope)

SITE INFORMATION

Common Terrain Types:

- rock, very thin morainal and colluvial veneers

Slope position:	crest, upper
Slope (%):	0 – 100
Aspect:	variable
Soil Moisture Regime:	very xeric – xeric
Soil Nutrient Regime:	very poor – poor

[63] Although the plant association name includes antelope brush, antelope brush does not occur in the study area.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SA	Antelope Brush – Selaginella	IDFxh1	00

	Structural Stage	2	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*		*	**	**	**	**	Douglas-fir
	Pinus ponderosa		*	***	***	***	***	ponderosa pine
Shrubs	*Amelanchier alnifolia*	**	**	**	**	**	**	saskatoon
	Spirea betulifolia	*	*	*	*	*	*	birch-leaved spirea
Grasses	*Pseudoroegneria spicata*	***	***	***	***	***	***	bluebunch wheatgrass
Herbs	*Selaginella densa*	**	**	**	**	**	**	compact selaginella
	Penstemon fruticosa	*	*	*	*	*	*	shrubby penstemon
	Woodsia scopulina	*	*	*	*	*	*	mountain cliff fern
Mosses	*Cladonia* spp.	**	**	**	**	**	**	clad lichens
Lichens	*Polytrichum piliferum*	**	**	**	**	***	***	awned haircap moss

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites
Comments: most sites do no progress through the structural stages. Some sites are more suitable for tree growth than others.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	**Selaginella – Bluebunch wheatgrass rock outcrop**	**IDFxh1**	**00**

Typic unit occurs on gentle slopes with very shallow soils (assumed modifiers are j and v)

This grassland ecosystem commonly occurs on bedrock outcrops. The bedrock is generally low relief and unfractured. This is an uncommon unit in the study area. Selaginella and rusty steppe moss with some grasses and forbs dominate these sites. This unit is commonly scattered as small sites in a grassland matrix.

SB:cg *Cheatgrass seral association*
This seral association is dominated by cheatgrass or sulphur cinquefoil with selaginella and rusty steppe moss.

List of mapped units:

SBk	cool aspect, slope >25%	SBw	warm aspect, slope >25%
SBr	ridge	SBz	very steep warm aspect, slope >70%

SITE INFORMATION

Common Terrain Types:

- rock, very thin morainal and colluvial veneers and weathered bedrock

Slope position:	crest, upper
Slope (%):	0 – 50
Aspect:	variable
Soil Moisture Regime:	xeric – very xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	Selaginella – Bluebunch wheatgrass rock outcrop	IDFxh1	00

	Structural Stage Seral stage	2a SB	2a SB:$cg	
Shrubs	*Amelanchier alnifolia*	*	*	saskatoon
Grasses	*Pseudoroegneria spicata*	**	*	bluebunch wheatgrass
	Poa secunda	**	**	Sandberg's bluegrass
	Bromus japonicus or tectorum	*	***	Japanese brome or cheatgrass
Herbs	*Selaginella densa*	***	***	compact selaginella
	Eriogonum heracleoides	*	*	parsnip-flowered buckwheat
	Potentilla recta		**	sulphur cinquefoil
	Centaurea diffusa		**	diffuse knapweed
Mosses and Lichens	*Cladonia* spp.	**	*	clad lichens
	Tortula ruralis	***	**	sidewalk moss
	Polytrichum piliferum	***	*	awned haircap moss

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SD	**Hybrid white spruce/Douglas-fir – Douglas maple – Dogwood**	**IDFxh1**	**08**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is commonly associated with gullies with intermittent or permanent streams or subsurface water flow. This is an uncommon unit in the study area. These are diverse, rich sites with mixed coniferous (Douglas-fir) and deciduous (paper birch and aspen) overstories. The understories are dominated by diverse mixture of shrubs. Forbs and mosses are scattered and uncommon on these sites. These moist sites likely had a longer fire return interval than adjacent upland areas.

Although these sites are productive and vegetation recovers relatively quickly following disturbances such as logging, the moist soils on these sites are sensitive to disturbance and septic fields would be difficult to locate on these sites. Alterations in subsurface water flow present considerable risks to soil stability.

List of mapped units:

SDa	active flood-plain, usually a few cottonwood trees present	SDgw	occurs in gullies on warm aspects
SDg	gullies, usually associated with permanent or intermittent creeks	SDn	occurs on fluvial fan
SDgk	occurs in gullies on cool aspects	SDt	occurs on fluvial terrace, often a few cottonwood trees present

SITE INFORMATION

Common Terrain Types:

- gentle morainal, fluvial, and slopewash sites

Slope position:	lower, toe
Slope (%):	0-15%
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	rich (medium)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SD	Hybrid white spruce/Douglas-fir – Douglas maple – Dogwood	IDFxh1	08

	Structural Stage	3	4	5	6	7	
Trees	*Betula paperifera*	****	***	***	***	**	paper birch
	Pseudotsuga menziesii var. *glauca*	*	****	***	***	***	Douglas-fir
	Populus tremuloides	**	**	**	**	*	trembling aspen
Shrubs	*Symphoricarpos albus*	****	***	***	****	***	common snowberry
	Acer glabrum var. *douglasii*	****	**	***	***	***	Douglas maple
	Rosa nutkana	**	**	**	**	**	Nootka rose
	Cornus stolonifera	**	*	**	**	**	red-osier dogwood
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
Herbs	*Osmorhiza berteroi*	**	*	*	**	**	mountain sweet-cicely
	Galium triflorum	*	*	*	*	*	sweet-scented bedstraw
	Maianthemum stellata	*	*	*	*	*	star-flowered false Solomon's-seal
Mosses	*Brachythecium* sp.	*	*	*	*	*	raggged-moss
	Mnium spp.	*	*	*	*	*	leafy moss
PLOTS		CVV357	CVG302		CVG013 CVG014 CVG036 CVG038 CVG305	9901770	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	**Saskatoon – Mock orange Talus**	**IDFxh1**	**00**

Typic unit occurs on both warm and cool steep slopes with deep, coarse textured soils (blocky) (c and d are assumed modifiers).

This ecosystem is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. This is an uncommon unit in the study area. Scattered trees (Douglas-fir, ponderosa pine or aspen) and scattered shrubs (mock orange, snowberry, saskatoon) grow in soil pockets between blocks. Often cliff ferns (a very characteristic species) and scattered grasses are found growing in soil pockets. Vegetation cover is generally higher on sites with smaller blocks and more soil. Cool aspects more commonly have trees on them. Sites that are dominated by shrubs will not necessarily develop into a forested structural stage. Historically, these sites would not have had enough fuel to burn.

List of mapped units:

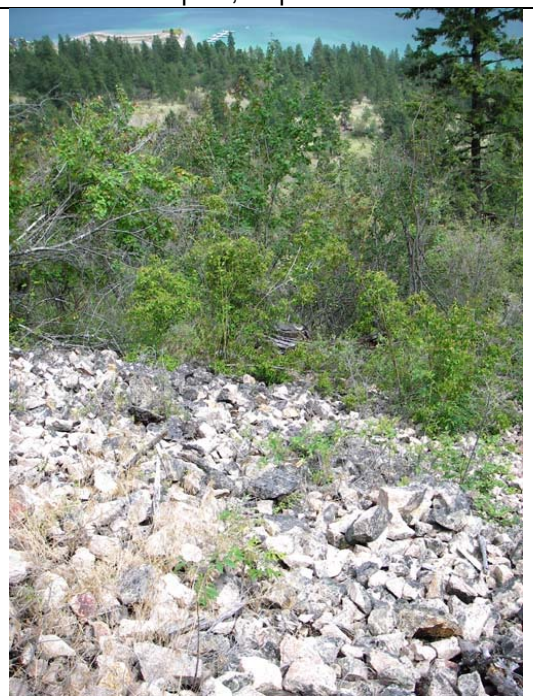
SOk	cool aspect, slope 60-70%	SOsw	warm aspect, slope 60-70%, shallow soils (50-100cm deep)
SOks	cool aspect, slope 60-70%, shallow soils (50-100cm deep)	SOw	warm aspect, slope 60-70%

SITE INFORMATION

Common Terrain Types:

- rubbly colluvial slopes

Slope position:	lower to upper
Slope (%):	60 – 70%
Aspect:	all
Soil Moisture Regime:	subxeric – xeric
Soil Nutrient Regime:	poor



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	Saskatoon – Mock orange Talus	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	**	**	**	***	Douglas-fir
	Pinus ponderosa	*	**	**	**	**	ponderosa pine
Shrubs	*Amelanchier alnifolia*	***	**	**	***	***	saskatoon
	Symphoricarpos albus	**	**	**	**	**	snowberry
	Prunus virginiana	**	**	**	**	**	choke cherry
Herbs	*Woodsia scopulorum*	*	*	*	*	*	cliff fern
	Lomatium spp.	*	*	*	*	*	desert-parsely

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SP	**Douglas-fir/Ponderosa pine – Snowbrush – Pinegrass**	**IDFxh1**	**04**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is associated with moderate to steep slopes on neutral aspects (SPk; northwest and east-southeast). This is a common unit in the study area. It is also found on gently sloping sites with shallow soils (SPs). Occasionally it is found on warm aspects, but generally these are moderately sloping (25-35%) or on 'barely' warm aspects (west-northwest, southeast). The overstory is moderately closed, although historically frequent surface fires would have kept these stands very open and bunchgrasses such as rough fescue were more abundant. Understories are usually a mixture of bunchgrasses (bluebunch wheatgrass and rough fescue) and other grasses with scattered shrubs, forbs and mosses.

List of mapped units:

SPc	coarse-textured soils (usually glaciofluvial)	SPks	cool aspect (usually ESE or NW), slope >25%, shallow soils (20-100cm deep)
SPcs	shallow coarse-textured soils, (20-100cm deep)	SPr	crest or ridge
SPct	coarse-textured glaciofluvial terrace	SPs	shallow soils (20-100cm deep)
SPgw	occurs on warm aspect side of gully	SPsw	shallow soils (20-100cm deep), warm aspect (usually WNW or SE), slope 25-35%
SPk	cool aspect (usually ESE or NW), slope >25%	SPw	warm aspect (usually SE or WNW), slope >25%

SITE INFORMATION

Common Terrain Types:

- thin or thick colluvial and morainal slopes and ridges

Slope position:	middle and upper
Slope (%):	25 – 50%
Aspect:	east-southeast, west-northwest
Soil Moisture Regime:	submesic
Soil Nutrient Regime:	poor – medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SP	**Douglas-fir/Ponderosa pine – Snowbrush – Pinegrass**	**IDFxh1**	**04**

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	***	***	***	***	Douglas-fir
	Pinus ponderosa	*	**	**	**	**	ponderosa pine
Shrubs	*Spirea betulifolia*	***	**	**	**	**	birch-leaved spirea
	Symphoricarpos albus	***	**	**	**	**	common snowberry
	Amelanchier alnifolia	**	*	**	**	**	saskatoon
Grasses	*Calamagrostis rubescens*	**	**	***	***	**	pinegrass
	Pseudoroegneria spicata	***	*	**	**	**	bluebunch wheatgrass
	Festuca campestris	**	*	**	**	**	rough fescue
Herbs	*Balsamorhiza sagittata*	**	*	*	**	**	arrowleaf balsamroot
	Lupinus sericeus	**	*	**	**	**	silky lupine
Mosses	*Cladonia* spp.	**	*	*	*	*	clad lichens
Lichens	*Tortula ruralis*	**	*	**	**	**	sidewalk moss
	Dicranum spp.	*	*	*	*	*	heron's-bill moss
PLOTS					CVG034 CVG056		

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
TA	**Talus**	**IDFxh1**	**N/A**
Steep colluvial deposits of angular rock fragments that result from rockfall. These sites have less than 10% vegetation cover.			
List of mapped units:			
TAk	cool aspect, slope 60-70%	TAw	warm aspect, slope 60-70%

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
UR	**Urban/Suburban**	**IDFxh1**	**N/A**
Residential areas with concentrated houses and buildings that almost continuously cover the area.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	**Bluebunch wheatgrass – Balsamroot**	**IDFxh1**	**93**

Typic unit occurs on warm aspects with deep, medium-textured soils (assumed modifiers are d, m, and w)

This grassland ecosystem commonly occurs on moderately steep to steep warm slopes. Often surface soils are actively ravelling on steeper slopes. Bluebunch wheatgrass and balsamroot dominate these sites. Bunchgrasses are more widely spaced than on gentler slopes. Disturbed sites are mapped as seral associations as described below.

WB:kc *$Knapweed - Cheatgrass seral association*
These are early and very early seral sites. Although there are native forbs, there are few or no native bunchgrasses remaining on these sites. Sites are dominated by invasive plants including knapweed, cheatgrass and sulphur cinquefoil.

WB:nc *$Columbia needlegrass – Cheatgrass seral association*
This is an early seral association dominated by Columbia needlegrass with significant cover of cheatgrass, and a variety of native grassland forbs.

WB:wk $*Bluebunch wheatgrass – Knapweed seral association*
This is a mid- to late-seral seral association. On these sites there is still a reasonable component of bluebunch wheatgrass with knapweed, sulphur cinquefoil, or cheatgrass.

List of mapped units:

WBc	coarse-textured soils (generally glaciofluvial or rocky colluvial)	WBr	ridge or crest
WBcs	coarse-textured soils (generally glaciofluvial or rocky colluvial), shallow (20-100cm deep)	WBrs	ridge or crest, shallow soils (20-100cm deep)
WBf	fine-textured glaciolacustrine soils	WBs	shallow soils (20-100cm)
WBjs	gentle slope, shallow soils (20-100cm deep)	WBsz	shallow soils (20-100cm), very steep warm aspect, slope >70%
WBjv	gentle slope, very shallow soils (<20cm deep), no exposed bedrock	WBv	very shallow soils (<20cm deep), no exposed bedrock
WBn	occurs on glaciofluvial fan	WBvz	very shallow soils (<20cm deep), no exposed bedrock, very steep warm aspect, slope >70%

SITE INFORMATION

Common Terrain Types:

- morainal and glaciofluvial blankets and veneers and colluvial veneers

Slope position:	middle, upper, crest
Slope (%):	25 – 65%
Aspect:	south, southwest, west
Soil Moisture Regime:	subxeric – submesic
Soil Nutrient Regime:	medium – poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	Bluebunch wheatgrass – Balsamroot	IDFxh1	93

	Structural Stage Seral Association	2 WB	2 WB:kc	2 WB:nc	2 WB:wk	
Grasses	*Pseudoroegneria spicata*	****	*		***	bluebunch wheatgrass
	Koeleria macrantha	**	*	*	*	junegrass
	Achnatherum nelsonii	**		***	*	Columbia needlegrass
	Bromus tectorum or *Bromus japonicus*	*	****	***	***	cheatgrass or Japanese brome
Herbs	*Artemisia frigida*	**	*	*	**	pasture sage
	Balsamorhiza sagittata	***	**	**	**	arrowleaf balsamroot
	Lupinus sericeus	**	*	**	**	silky lupine
	Eriogonum heracleoides	*	*	*	*	parsnip-flowered buckwheat
	Centaurea diffusa		****	**	**	diffuse knapweed
	Potentilla recta		***	**	**	sulphur cinquefoil
Mosses	*Cladonia* spp.	**			*	clad lichens
Lichens	*Tortula ruralis*	**		*	*	sidewalk moss
PLOTS		9901778 CVG003 CVG029 CVG032 CVG042 CVG046 CVG047 CVG048 CVG049 CVG050 CVG312 CVG315		CVG017 CVG018	CVG016 CVG053 CVG300 CVG308	

Species – invasive alien species
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WS	**Willow – Sedge Wetland**	**IDFxh1**	**09**

Typic unit occurs in depressions with deep, medium-textured soils (assumed modifiers are d, j, and m)

This unit is a generalized wetland unit equivalent to several swamp and marsh associations in the provincial classification (MacKenzie and Moran 2004).

This swamp (structural stage 3) or marsh (structural stage 2) wetland ecosystem occurs at the edges of ponds and wetlands, forming a shrubby fringe or sedge dominated marsh on mineral soils. This is a very rare unit in the study area. It is dominated by willows or sedges.

SITE INFORMATION

Common Terrain Types:

- lacustrine veneer over morainal or glaciofluvial blanket

Slope position:	level, depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhygric – hygric
Soil Nutrient Regime:	medium, rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WS	Willow – Sedge Wetland	IDFxh1	09

	Structural Stage	2	3	
Shrubs	*Salix* spp.		****	willows
	Cornus stolonifera		***	red-osier dogwood
	Ribes husonianum		**	northern blackcurrant
Sedges	*Carex* spp.	****	**	sedges

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites
***** >50% cover; occurs in 60% or more of sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Ws01	**Mountain Alder – Skunk Cabbage – Lady Fern Swamp**	**IDFxh1**	**Ws01**

Typic unit occurs on level sites with deep, mineral soils (d, j and m are assumed modifiers). Equivalent to Ws01 unit of the same name in the provincial wetland classification (MacKenzie and Moran 2004)

This shrubby swamp ecosystem usually occurs along creeks or areas with poor drainage and continuous seepage near the surface. Soils are usually mineral with a thin organic veneer.

List of mapped units:

Ws01p occurs on organic soils >40cm thick

SITE INFORMATION

Common Terrain Types:

- morainal or fluvial with thin organic veneer

Slope position:	level
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	hygric – hydric
Soil Nutrient Regime:	medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Ws01	Mountain Alder – Skunk Cabbage – Lady Fern Swamp	IDFxh1	Ws01

	Structural Stage	3	4	5	6	7	
Trees	*Thuja plicata*	*	****	****	***	***	Western redcedar
Shrubs	*Alnus incana*	****	***	****	*****	*****	mountain alder
	Cornus stolonifera	**	*	**	**	**	red-osier dogwood
Sedges	*Carex disperma*	**	**	**	**	**	soft-leaved sedge
Herbs	*Lysichiton americanus*	****	***	***	***	****	skunk cabbage
	Equisetum arvense	**	**	**	**	**	common horsetail
	Dryopteris expansa	***		**	**	**	spiny wood fern
	Mitella nuda	**	*	**	**	**	common mitrewort
Mosses	*Drepanocladus aduncus*	***	***	***	***	***	common hook-moss
	Mnium or *Plagiomnium* spp.	*	*	*	**	**	ragged mosses
PLOTS		CVG005				CVG067	

* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of site
***** >50% cover; occurs in 60% or more of sites
Comments: Very limited data; other sites are likely dominated by different species.

COLDSTREAM VERNON EXPANDED LEGEND – MSdm1

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DP	**Douglas-fir – Big sage – Pinegrass**	**MSdm1**	**02**

Typic unit occurs on gentle ridges with shallow soils (j, r and s are assumed modifiers).

This forest ecosystem is common on ridges and crests with very shallow soils. Vegetation is dominated by an overstory of Douglas-fir with an understory dominated by pinegrass, common juniper, scattered forbs and clad lichens. Pinegrass and forbs are more abundant on logged sites (structural stage 3)

List of mapped units:

DPv very shallow soils (<20cm deep, exposed bedrock present)

SITE INFORMATION

Common Terrain Types:

- very shallow colluvial and morainal and weathered bedrock

Slope position:	crest, upper
Slope (%):	0-25%
Aspect:	usually warm
Soil Moisture Regime:	0-1
Soil Nutrient Regime:	poor, medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PG	**Lodgepole pine – Grouseberry – Cladonia**	**MSdm1**	**03**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is uncommon and occurs on cool aspects with very shallow soils in the study area. Vegetation is dominated by an overstory of lodgepole pine with an understory of kinnikinnick, grouseberry, twinflower and clad lichens. Forbs are more abundant on logged sites (structural stage 3).

List of mapped units:

PGkv cool aspect, slope >25%, very shallow soils

SITE INFORMATION

Common Terrain Types:

- very shallow colluvial and morainal

Slope position:	upper
Slope (%):	30-70%
Aspect:	cool
Soil Moisture Regime:	1-2
Soil Nutrient Regime:	poor – medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PP	**Lodgepole pine – Pinegrass – Kinnikinnick**	**MSdm1**	**04**

Typic unit occurs on gentle slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem is uncommon and occurs on shallow soils in the study area. Vegetation is dominated by an overstory of lodgepole pine with an understory of pinegrass, grouseberry, kinnikinnick with scatted shrubs. Shrubs (common juniper, soopolallie, birch-leaved spirea, and falsebox) and forbs are more abundant on logged sites (structural stage 3).

List of mapped units:

PPs shallow soils (20-100cm)

PPsw warm aspect, slope >25%, shallow soils (20-100cm)

SITE INFORMATION

Common Terrain Types:

- shallow colluvial and morainal

Slope position:	upper
Slope (%):	30-70%
Aspect:	none or warm
Soil Moisture Regime:	2-3
Soil Nutrient Regime:	poor – medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RZ	**Road Surface**	**MSdm1**	**N/A**

A gravel or paved road used for vehicular travel.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SF	**Hybrid white spruce – Falsebox – Feathermoss**	**MSdm1**	**01**

Typic unit occurs on gentle to moderate slopes with deep, medium textured soils (d, j and m are assumed modifiers).

This forest ecosystem occurs on zonal and near zonal sites. Forest overstories are dominated by lodgepole pine with some subalpine fir and hybrid white spruce in mature and old stands. The understory is moderately shrubby with falsebox, Sitka alder and black huckleberry. There are scattered grasses and forbs including pinegrass, grouseberry, twinflower and bunchberry with patches of red-stemmed feathermoss. Logged sites (structural stage 3) are shrubbier with some fireweed and more grouseberry.

List of mapped units:

SFks	cool aspect; slope >25%, shallow soils (generally 50-100cm)	SFs	shallow soils (generally 50-100cm)

SITE INFORMATION

Common Terrain Types:

- morainal blankets and veneers

Slope position:	level, mid-slope
Slope (%):	0-30
Aspect:	none or cool
Soil Moisture Regime:	mesic – submesic
Soil Nutrient Regime:	poor – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SG	**Hybrid white spruce – Gooseberry**	**MSdm1**	**06**

Typic unit occurs on gentle lower slope receiving sites with deep, medium textured soils (d, j and m are assumed modifiers).

The forest overstory is mixed hybrid white spruce and subalpine fir. The understory has scattered black gooseberry, grouseberry, bunchberry, baneberry and red-stemmed feathermoss. Logged sites (structural stage 3 are shrubbier with more grouseberry.

SITE INFORMATION

Common Terrain Types:

- morainal blankets

Slope position:	lower, toe
Slope (%):	0 – 25%
Aspect:	none
Soil Moisture Regime:	subhygric – hygric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SH	**Hybrid white spruce – Trapper's tea – Horsetail**	**MSdm1**	**07**

Typic unit occurs on level sites with high water tables and deep, medium textured soils (d, j and m are assumed modifiers).

Forest overstories are mixed hybrid white spruce, lodgepole pine and some subalpine fir in mature and old forests. The understory is characterized by abundant common horsetail with scattered shrubs (Sitka alder, trapper's tea, black gooseberry), forbs (grouseberry), sedges, and leafy mosses.

List of mapped units:

SHg gully

SITE INFORMATION

Common Terrain Types:

- morainal

Slope position:	toe, level, depression
Slope (%):	0 – 10%
Aspect:	none
Soil Moisture Regime:	hygric - subhydric
Soil Nutrient Regime:	rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	**Saskatoon – Mock orange Talus**	**MSdm1**	**00**

Typic unit occurs on both warm and cool steep slopes with deep, coarse textured soils (blocky) (c and d are assumed modifiers).

This ecosystem is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. This is an uncommon unit in the study area. Scattered shrubs (saskatoon, Douglas maple) grow in soil pockets between blocks. Vegetation cover is generally higher on sites with smaller blocks and more soil. Cool aspects more commonly have trees on them. Sites that are dominated by shrubs will not necessarily develop into a forested structural stage.

List of mapped units:

SOw warm aspect, slope 60-70%

SITE INFORMATION

Common Terrain Types:

- rubbly colluvial slopes

Slope position:	lower to upper
Slope (%):	60 – 70%
Aspect:	all
Soil Moisture Regime:	subxeric – xeric
Soil Nutrient Regime:	poor

TA	Talus	MSdm1	N/A

Steep colluvial deposits of angular rock fragments that result from rockfall. These sites have less than 10% vegetation cover.

List of mapped units:

TAw warm aspect, slope >25%

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WS	**Willow – Sedge Wetland**	**MSdm1**	**08**

Typic unit occurs in depressions with deep, medium-textured soils (assumed modifiers are d, j, and m)

This unit is a generalized wetland unit equivalent to several swamp and marsh associations in the provincial classification (MacKenzie and Moran 2004).

This swamp (structural stage 3) or marsh (structural stage 2) wetland ecosystem occurs at the edges of ponds and wetlands, forming a shrubby fringe or sedge dominated marsh on mineral soils. This is a very rare unit in the study area. Structural stage 3 is dominated by willows with some sedges, structural stage 2 is dominated by sedges, especially large water sedges such as beaked sedge.

SITE INFORMATION	
Common Terrain Types: • lacustrine veneer over morainal or glaciofluvial blanket	
Slope position:	level, depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhygric – hygric
Soil Nutrient Regime:	medium, rich