Sensitive Ecosystems Inventory: Kelowna, 2007

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

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THE REAL ESTATE FOUNDATION OF BRITISH COLUMBIA

City of Kelowna

BRITISH COLUMBIA

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This project has adapted material from the reports for the Bella Vista – Goose Lake Range Sensitive Ecosystems Inventory[8] (SEI), Coldstream Vernon SEI[9], Commonage SEI[10], Lake Country SEI[11] and Central Okanagan SEI[12].

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

?? reviewed the draft version of this report.

[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] City of Kelowna
[3] Iverson & MacKenzie Biological Consulting Ltd.
[4] Polar Geoscience Ltd.
[5] Makonis Consulting Ltd.
[6] Working on behalf of Timberline Forest Inventory Consultants Ltd. at that time
[7] Baseline Geomatics Inc.
[8] Iverson and Shypitka 2003
[9] Iverson and Uunila 2008
[10] Iverson and Uunila 2005
[11] Iverson and Uunila 2006
[12] Iverson et al. 2004

Introduction

This report presents detailed information on terrain and ecosystems in the City of Kelowna in the central portion of the Okanagan Valley. It is the second volume in a series of two 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[13] is intended for people and organizations that need information to help conserve and protect remaining sensitive and important ecosystems in the Kelowna area and other similar areas. It is also intended to provide information and advice to the City of Kelowna, landowners, and developers on how to minimize and avoid possible degradation of sensitive ecosystems due to land use and development activities.

[13] Iverson 2008b

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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 follow the boundaries of the City of Kelowna. The study area was mapped in two separate pieces: the South Slopes area was updated from the Central Okanagan SEI and the remainder of the City of Kelowna was newly mapped. The area covers 21,445 ha (the City of Kelowna excluding Okanagan Lake) and includes private land and regional parks, and crown land. Error! Reference source not found. shows an overview of the study area.

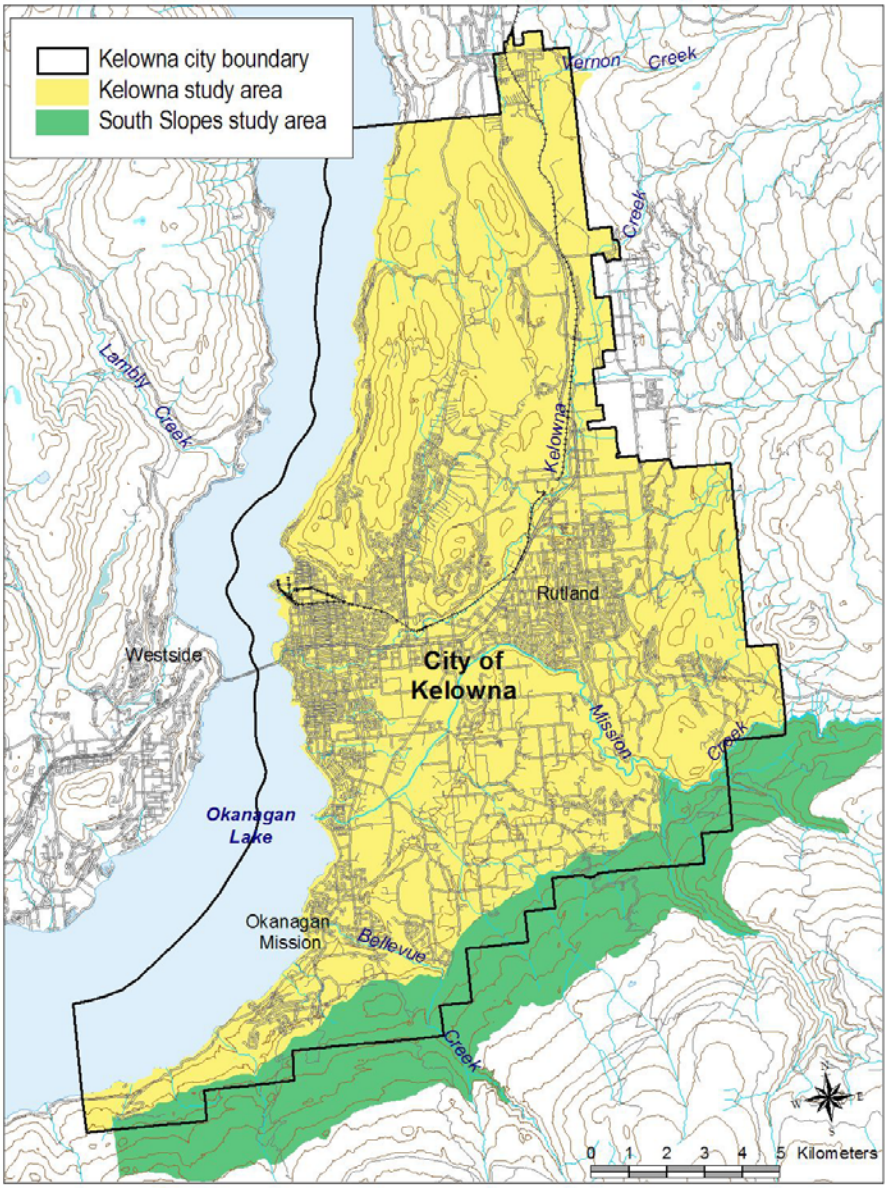

Figure 1. Kelowna SEI study area boundary is shown in black (boundary of the City of Kelowna). The newly mapped portion of the City of Kelowna is shown in yellow and the updated South Slopes portion of the study area is shown in green.

1.1 Landscape Setting

The Okanagan Valley is a major valley of the Interior Plateau. It is situated in the Thompson Plateau, a low relief upland area that represents a Late Tertiary erosion surface. Uplift, faulting and erosion created the major valleys in the Thompson Plateau, including the Okanagan Valley. Okanagan Lake occupies the main trench and Duck, Kalamalka, and Wood Lakes occupy a parallel valley to the east. Okanagan Lake drains to the south into the Okanagan River through Osoyoos Lake and into the United States. The Okanagan drainage is a tributary of the Columbia River. The valley generally lies north-south in the study area.

Bedrock Geology

The slopes of the study area are underlain by a variety of bedrock types of various ages. Characteristics of bedrock, such as structure (i.e. strength, joint spacing, and 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. The following describes the bedrock in the study area by geographic location from north to south[15].

The northern edge is underlain by middle Jurassic-aged, intrusive bedrock of the Okanagan Plutonic Suite, including granodiorite and granite. Well-jointed, granitic rocks break into large blocks and boulders and can produce bouldery tills. On weathering, the rock breaks 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.

The west-facing slopes in the McKinley Landing area are underlain by Carboniferous to Permian-aged volcaniclastic rocks of the Harper Ranch Group. The core of the study area is underlain by Eocene-aged volcanic rocks of the Penticton Group. An impressive exposure of layered lava flows can be seen on the south face of Layercake Mountain. Bedrock derived from volcanic flows gives rise to cliffs, ledges and rubbly talus. 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, produce a noticeably clay-enriched till. Non-siliceous volcanic rock (i.e. basalt) tends to give rise to medium nutrient regimes. Like intrusive bedrock, rock with higher silica content (i.e. rhyolite) gives rise to poor nutrient regimes.

The Mission and Crawford Estates areas of Kelowna are underlain by Eocene-aged sedimentary rocks of the Penticton Group, including mudstone, siltstone, shale, and fine clastic sedimentary rocks. Fine-grained sedimentary bedrock breaks down into silt and clay and, where bedded, the rock tends to fracture along bedding planes to produce slab-shaped clasts. These rock types are relatively nutrient rich.

The eastern and southern perimeter of the City of Kelowna is underlain by Proterozoic to Paleozoic-aged metamorphic rocks of the Shuswap Assemblage. These are the oldest rocks in the study area and are paragneiss; gneiss that is formed by the severe metamorphosis of sedimentary rock. This group also includes zones of less metamorphosed sedimentary rock such as schist, amphibolite and quartzite. Field observations revealed that the Monashee Group rocks

[14] EBA Engineering Consultants Ltd., 1998

[15] Sources: Templeman-Kluit ,1989; Glombick et al., 2004; and The Map Place, 2008

form ledges, overhangs, fissures and blocky talus that have important wildlife habitat values. Metamorphic rock that is largely granular in texture, for example gneiss, tends to break down into sand and coarse silt, resulting in silty sand 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) tends 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 uncommon. 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.

Landscape Evolution[16]

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 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[17]. 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[18]. 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.

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[16] adapted from Iverson et al. 2004
[17] Fulton 1965
[18] Fulton 1969

Soils[19]

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 material at least 10cm thick that occurs at the earth's surface and is capable of supporting plant growth"[20]. 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 soil types are derived from Wittneben (1986). Further descriptions of soil horizons and soil taxonomy can be found in The Canadian System of Soils Classification[21]. The following paragraphs describe the major soil groups present in the study area. Soils were not mapped in this project but soil information was collected as part of the field data at ground inspection sites (see Field Sampling, page 11).

Chernozemic soils (brown and dark brown chernozems) have developed in the semi-arid lower valley grassland and open forest communities. These are characterized by the formation of an organic rich (Ah) upper mineral horizon. The Ah horizon forms from the accumulation of organic material primarily from the roots of grasses.

Brunisolic soils occurred throughout the study area. They were common under forested communities on moister and cooler aspects. These soils were present on moderately- to rapidly-drained surficial materials that are medium- to coarse-textured. These are soils that have poorly developed horizons. They have characteristics of other soils groups but have not developed sufficiently to meet the criteria to belong to other orders. They are 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. These soils are characterized by the movement of clay particles from the upper horizons to a lower horizon of accumulation (Bt). Luvisols occurred under both forested and grassland communities in the Interior Douglas-fir and Ponderosa Pine 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 occur under wetland communities in depressions, along lake margins and on floodplains.

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 water saturation, and result in gleyed colours (grey, blue, and green). Gleysolic soils are imperfectly to very poorly drained and occur under wet forests and wetland communities.

Regosolic soils are under-developed soils that lack defined horizons. 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

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[19] This section is adapted from Iverson et al. 2004

[20] Soil Classification Working Group 1998

[21] Soil Classification Working Group 1998

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 B.C. interior. No solonetzic soils were recorded during fieldwork; however, they likely occurred 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[22]. 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. Together with unique geological and landscape features, this has resulted in a diverse and unique assemblage of species in the Okanagan Valley.

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[23]. 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 North Okanagan Basin Ecosection (NOB), a wide trench formed by parallel fault lines and further carved out by multiple glaciations.

The Ministry of Forests biogeoclimatic ecosystem classification is a system of classifying vegetation based on climatic and topographic patterns[24]. Two biogeoclimatic variants are represented within the study area: the Okanagan Very Dry Hot Interior Douglas-fir Variant (IDFxh1) and the Okanagan Very Dry Hot Ponderosa Pine Variant (PPxh1). Figure 2 shows the locations of the subzones within the study area.

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 IDFxh1 occurs along the south-eastern portion of the study area at higher elevations.

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[22] Demarchi 1996

[23] 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.

[24] 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.

The PPxh1 is the driest forested zone in British Columbia[25]. Occurring only at lower elevations in the southern valleys of British Columbia, it is at the northern extent of a much larger range that runs south through eastern Washington and Oregon. Cool winters with low snowfall and hot dry summers with growing-season moisture deficits result in a mosaic of open forests and grasslands. The PPxh1 covers the majority of the City of Kelowna.

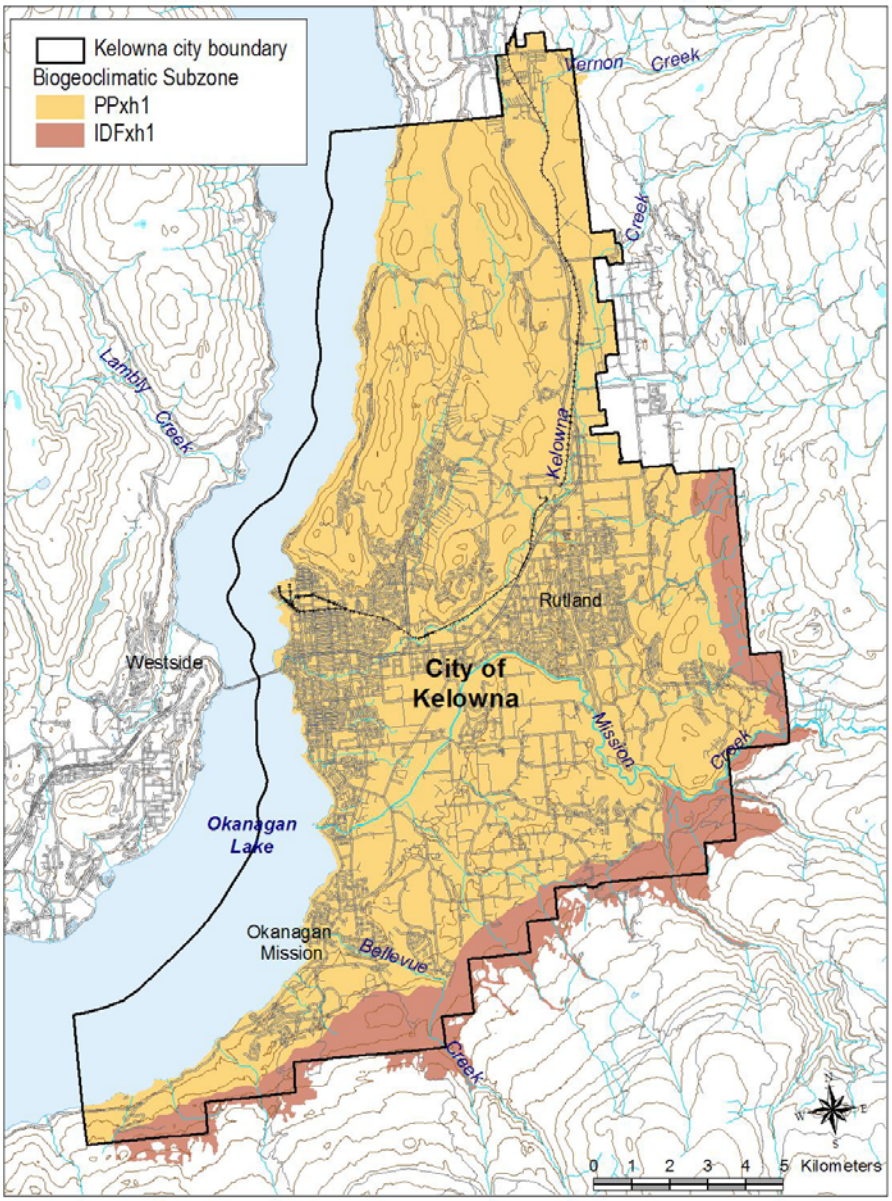

Figure 2. Biogeoclimatic subzones present in the study area.

[25] Lloyd et al. 1990

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[26]. 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[27]. Figure 2 shows a prescribed fire similar to many historical fires.

Figure 3. 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[28]. 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 5). 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[29] 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[30]. 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[31]. Some grasslands have been overtaken by invasive alien plants such as knapweed, sulphur cinquefoil and cheatgrass, an annual brome grass. Pockets of late seral and climax grasslands occur primarily on steeper slopes in the study area.

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

Figure 4. Encroachment of young ponderosa pine trees onto a grassland ecosystem. With time, this will become a dense forest with few grasslands species.

Figure 5. 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[32].

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[33].

Early forest harvesting was localized but became industrial and more widespread by the mid-1900's[34]. We observed that all accessible areas of the study area had been selectively harvested, leaving very few large, old trees.

[32] Cannings and Durance 1998; Thomson 2000
[33] Mather 1996
[34] Cannings and Durance 1998

2 Methods and Limitations

2.1 Terrain Mapping

Terrain mapping is a classification system used to describe the surficial material (the loose materials on top of bedrock) and their textures, surface expressions (the three dimensional shape of the surficial materials), and geomorphological processes (the active mechanism that continue to shape the landscape) in a given area.

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 geomorphological 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.

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[35], mapping methods[36], terrain stability mapping[37] (five-class system) and bioterrain mapping methodology[38].

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:

- terrain type;
- material depths;
- drainage;
- slope breaks;
- slope position;
- aspect: cool (from 285 to 135°) and warm (from 135 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

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

- any other ecologically significant areas such as cliffs, talus slopes, and ponds or wetlands.

The bioterrain pre-fieldwork mapping was completed by Anthony Collett, P.Geo. of Timberline Forest Inventory Consultants Ltd. in 2005 under a separate contract with the Ministry of Water, Land and Air Protection (WLAP)[39]. Terrain units were delineated on a DiAP Viewer using 1:10,000 scale, 2003, colour digital imagery. Each polygon was labelled with a terrain symbol and drainage class. Existing bioterrain mapping completed for project areas adjacent to Kelowna was obtained from the City of Kelowna, and B.C. Ministries of WLAP and Sustainable Resource Management, and used for edge matching to the Kelowna area. Integrated Mapping Technologies of Vancouver, B.C., converted the spatial files into a format for viewing on DiAP Viewer.

Under the current contract with the City of Kelowna, Polly Uunila, P.Geo. of Polar Geoscience Ltd. field checked the bioterrain polygons and completed the post-fieldwork editing of the bioterrain mapping using DiAP Viewer. At the request of the City of Kelowna, slope range (in percent), terrain stability class and soil erosion potential class were added to each polygon.

Field Sampling

Polly Uunila, P.Geo., a terrain specialist spent a total of 15 days collecting terrain information, including 7 days sampling with an ecosystem specialist.

Two types of sample plots were used to identify and assess ecosystems and terrain: ground inspections, and visual inspections (Appendix A: Field Plot Forms). Field sampling procedures for ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[40]. We followed guidelines from the *Standard for Terrestrial Ecosystem Mapping* in British Columbia[41] for visual inspection data collection. Additional plot data from the original field sampling for the South Slopes in 2001, including one detailed ecological plot, was also used for the mapping in that area (terrain data were collected by D. Spaeth Filatow, P.Geo.).

Additional information regarding terrain stability and erosion potential was collected by Polly Uunila, P.Geo. and included terrain stability and erosion potential classes, signs of instability or erosion, and any other pertinent information regarding stability and erosion potential classes. P. Uunila spent an extra five days in the field to focus on refining the criteria for terrain stability and soil erosion potential.

The location of all ground inspection plots, and visual inspections were either recorded by GPS or marked on hard copy orthophotos (Figure 6). Site locations were digitally captured and are shown on the terrestrial ecosystem map.

Sampling statistics are presented below.

Table 1. Sites visited with terrain data.

FS882	Ground Inspections	Visuals	TOTAL
1	74	268	343

[39] Collett and Uunila 2005

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

[41] Resources Inventory Committee 1998

Table 2. Field Checking Statistics for terrain mapping.

Total Area	Total Number of Polygons	Total Number of Field Sites	Percentage Polygons Field Checked	Field Checks per 100 ha
21,445 ha	3837	343	9 %	1.6

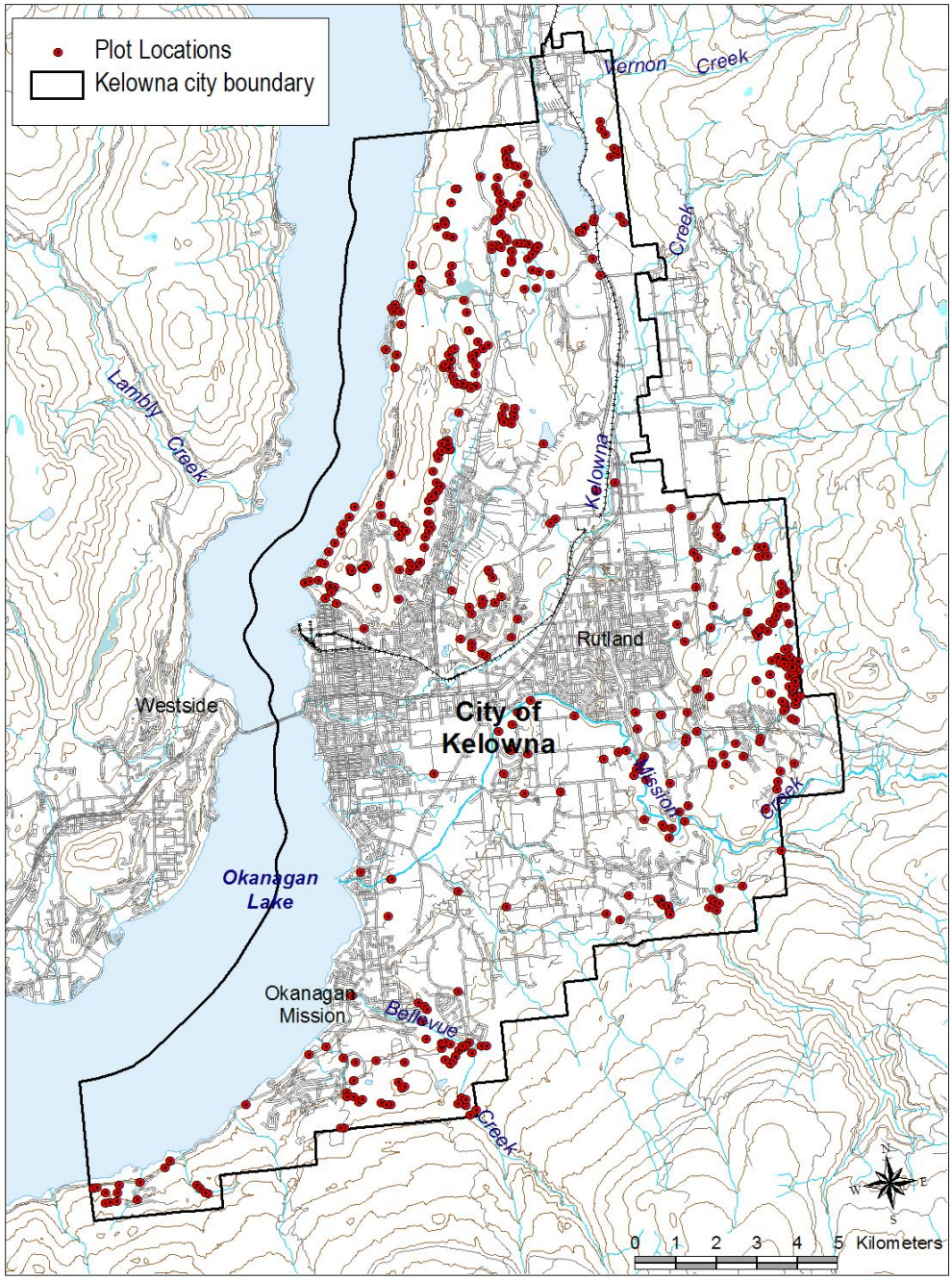

Figure 6. Location of all field plots for the Kelowna SEI study area.

Final Terrain Mapping

Following field work, revisions were made to the pre-typed polygon boundaries using DiAP Viewer with digital 1:10,000 scale imagery from 2006. At this stage, many of the polygon boundaries were adjusted and new ones added to account for additions of terrain stability and soil erosion potential classes to each polygon. Where possible, the purpose of the changes was to delineate polygons of internally uniform terrain stability class while maintaining an emphasis on important ecological elements, such as surficial material, aspect and drainage. For polygons where this was not possible, the most conservative terrain stability class and soil erosion potential class was assigned to the polygon. A major disadvantage to using DiAP is that the mapper cannot check polygon labels at the same time as viewing the polygons on screen, thus every bioterrain label was redone. While viewing the polygons on-screen, the mapper dictated terrain symbols into a dictaphone. The mapper then entered the polygon data into the provincial standard MS Excel database.

South Slopes Bioterrain Mapping

A narrow strip of bioterrain mapping completed by Deepa Spaeth Filatow, P.Geo. for the Regional District of the Central Okanagan in 2004 covers the southern edge of the current City of Kelowna project area (part of the South Slopes portion of the Central Okanagan TEM and SEI). Limited field checking was completed in this area under the current contract. The new mapping was edge matched to the work completed in 2004 to provide seamless coverage. The original polygon boundaries and terrain symbols were not altered. Under the current project, the following changes were made to the 2004 database in order to be consistent with the methods and match the criteria used for the interpretations used for the new mapping (please note that the changes are based on the information provided in the databases only; the air photos were not consulted during this analysis):

- soil drainage classes were changed from one class for each component to reflecting the polygon as a whole;
- terrain stability and soil erosion potential classes were changed from one class for each component to one class per polygon. The criteria used to assign classes are based on the same criteria used on the new mapping, and where more that one class is present in a polygon, the most conservative class was assigned.

2.2 Terrestrial Ecosystem Mapping

This project has used the provincially recognised Terrestrial Ecosystem Mapping standard[42] to map ecosystems in the study area.

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*[43].

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

- structural stage modifiers for shrub ecosystems

[42] Resources Inventory Committee 1998
[43] Resources Inventory Committee 1998

- 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, and
- soil erosion potential class

Field Sampling

A field-sampling plan was developed using 1:10,000 orthophotos from 2006 with the following objectives in mind:

- verify the presence, quality, and condition of sensitive ecosystems
- identify other ecosystems
- verify terrain labels including terrain stability and erosion potential
- verify ecosystems in at least 10% of the polygons and terrain information in at least 20% of the polygons
- gather detailed data for unclassified ecosystems

Landowners were contacted by the City of Kelowna prior to fieldwork and many landowners granted us access to sample on their lands. Field sampling took place in August, September and October 2007. A team of two scientists conducted field sampling: a plant ecologist (Kristi Iverson, R.P.Bio. completed the majority of the field work and John Grods, R.P. Bio. completed one day of field work), and a terrain specialist (Polly Uunila, P.Geo.). A total of 10 days were spent collecting ecological information.

Two types of sample plots were used to identify and assess ecosystems and terrain: ground inspections, and visual inspections (Appendix A: Field Plot Forms). Field sampling procedures for ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[44]. We followed guidelines from the *Standard for Terrestrial Ecosystem Mapping* in British Columbia[45] 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[46]. Additional plot data from the original field sampling for the South Slopes in 2001, including one detailed ecological plot, was also used for the mapping in that area (ecological and terrain data were collected by K. Iverson and D. Spaeth Filatow, P.Geo.).

Additional information regarding terrain stability and erosion potential was collected by Polly Uunila, P.Geo. and included terrain stability and erosion potential classes, signs of instability or erosion, and any other pertinent information regarding stability and erosion potential classes. P. Uunila

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[44] B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1998
[45] Resources Inventory Committee 1998
[46] Ministry of Environment Ecosystems Branch 2006

spent an extra five days in the field to focus on refining the criteria for terrain stability and soil erosion potential.

The location of all ground inspection plots, and visual inspections were either recorded by GPS or marked on hard copy orthophotos. Site locations were digitally captured and are shown on the terrestrial ecosystem map. See Figure 6 above for plot locations.

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*[47]. Most non-forested units such as wetlands and rock outcrops and grassland seral associations were adopted from previous projects: the Lake Country SEI[48], Vernon Commonage SEI[49], Bella Vista – Goose Lake Range SEI[50] and the Central Okanagan SEI[51]. 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. Additional wetland units mapped were adopted from the provincial wetland classification[52].

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. Plot sampling statistics are presented below.

Table 3. Sites visited with ecological data.

FS882	Ground Inspections	Visuals	TOTAL
1	40	207	248

Table 4. Field Checking Statistics for TEM.

Total Area	Total Number of Polygons	Total Number of Field Sites	Percentage Polygons Field Checked	Field Checks per 100 ha
21,445 ha	3837	248	6.5 %	1.2

Expanded Legend Development

The expanded legend describes the terrain, soils, and vegetation of each ecosystem mapped in the study area. 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.

[47] Lloyd et al. 1990
[48] Iverson and Uunila 2005
[49] Iverson and Uunila 2006
[50] Iverson and Shypitka 2003
[51] Iverson et al. 2004
[52] MacKenzie and Moran 2004

Site Series and Site Unit Mapping

Following field work, revisions were made to the pre-typed polygon boundaries using a DiAP Viewer with digital 1:10,000 scale imagery from 2006. In addition to the polygons added during terrain mapping, new polygons were added to account for sensitive ecosystems. A major disadvantage to using DiAP is that the mapper could not view terrain labels at the same time as viewing the polygons on screen, thus there was limited use of the bioterrain mapping. While viewing the polygons on-screen, the mapper dictated ecosystem symbols into a dictaphone. The mapper then entered the polygon data into the provincial standard MS Excel database.

Ecosystem units were mapped according to the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[53]. 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[54]. For ecosystems not included in current site series classifications, new ecosystem units were previously approved by the Ministry of Forests' Regional Ecologist and new wetland units follow the four alphanumeric codes assigned in the provincial classification. 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*[53].

Core polygon attributes collected for all polygons are shown below in Table 5. A sample terrestrial ecosystem map label is shown below in Figure 7. 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). Stand composition modifiers indicate the dominant composition of the overstory trees (broadleaf, coniferous or mixed) 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*[55].

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

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[53] Resources Inventory Committee 1998
[54] Resources Inventory Committee 2000a
[55] Resources Inventory Committee 1998

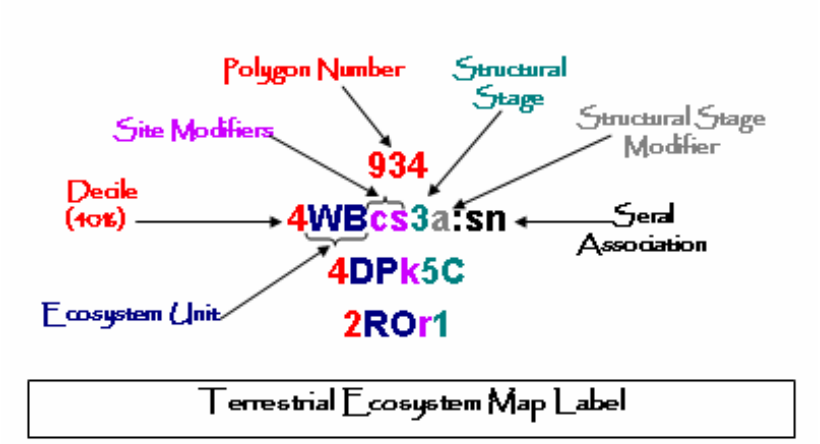

Figure 7. Example of a terrestrial ecosystem map label.

South Slopes Terrestrial Ecosystem Mapping

A narrow strip of TEM completed by Kristi Iverson for the Regional District of the Central Okanagan (RDCO) in 2004 covers the southern edge of the current City of Kelowna project area. The entire South Slopes project area including both the City of Kelowna and RDCO was updated to reflect changes following the 2003 wildfire and changes resulting from residential development. Using a DiAP viewer and 1:10,000 scale digital imagery from 2006, polygon attributes were updated for polygons within the perimeter of the wildfire. Any areas with recent urban or industrial developments within the South Slopes project boundaries were also updated.

Ecosystems are permanent entities unless the soil has been removed or significantly altered. Thus, structural stage, disturbance class and subclass, and condition and viability were the primary attributes that were updated in the database. New polygons were delineated and ecosystem units were changed in areas that had undergone residential or industrial development.

Table 5. 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 done where possible; recorded separately for each component)
• Surficial material (recorded one for each component; sometimes included a surficial subtype)
• Qualifiers (when present, recorded one for each component)
• Geomorphological processes when present
• Soil drainage classes
• Surface expression (recorded up to three for each component)

Data Management

Non-spatial information includes field plot data and polygon attribute data. Spatial data includes polygon boundaries 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 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*[56] (Table 5). Data were recorded on a dictaphone while viewing polygons with a DiAP viewer and the data were subsequently entered into a standard Excel database. Table 6 lists the optional attributes we also applied in this project. We also applied two "user-defined" polygon attributes for all occurrences of sensitive ecosystems: condition and viability and seven user-defined polygon attributes: slope range (slope_1, slope_2, slope_sep, slope_3, slope_4), terrain stability class (Ss_1) and soil erosion potential class (Ep_1). We ran quality assurance error checking routines to ensure the attribute database was free of errors.

Table 6. List of Optional Attributes

Attribute
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[57]. The Terrain Resource Information Management (TRIM) was used as the mapping base. The linework mapped by the bioterrain and ecosystem specialist was captured through digitizing while using a DiAP viewer. Standard quality assurance routines were applied to ensure accurate mapping.

2.3 Terrain stability

Terrain stability mapping identifies relative stability using a polygon-based five class rating system ranging from class I (stable) to class V (unstable) (Table 7). 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 was 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

[56] Resources Inventory Committee 2000b
[57] Resources Inventory Committee 2000b

development. *The use of terrain stability maps does not preclude the need for on-site field inspections*.

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). 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).

Table 7. Definitions and management implications for terrain stability classes.[58]

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. • On-site inspection required by geotechnical professionals.
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 professionals
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 professionals

[58] Adapted from Ministry of Forests 1999

Table 8 outlines the criteria used as a guideline for evaluating terrain stability.

Table 8. Guidelines for assessment of terrain stability classes. 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.

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 %	

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.

2.4 Soil Erosion Potential

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 was defined as the particle-by-particle removal of soil by running water. Polygons were not rated for wind erosion as different factors contribute to surface erosion by wind.

Erosion occurs where soil 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, motorized vehicles, and heavy machinery), landings, trails, dirt roads, and severe burns (e.g. portions of the Okanagan Mountain Park fire in the South Slopes area). 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 9). 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).

Table 9. 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.
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.
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.

Criteria for assessing soil erosion potential were based on soil texture, material thickness and slope gradient (Table 10).

Table 10. Guidelines for assessment of soil erosion potential. See Appendix B for definitions of texture and surfical material type.

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[59])
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 (some wetlands)	O	VL	-	-	-

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 have been rated one class higher if it was 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 have been rated one class lower if a slope was irregular enough to inhibit some erosion potential; and
- *Geomorphic Processes*: If a polygon contained an active geomorphic process that is deemed to increase the erosion, such as gullying or slope failure, the soil erosion potential class may have be rated one class higher.

[59] see Description of Geological Processes: Gully Erosion (-V) page 48

2.5 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 (1:10,000 for most of the City and 1:15,000 for the South Slopes) and date (2006 imagery for all polygon attributes) of the aerial photographs on which the sites are delineated. *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 will change with time.

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.

Terrain Mapping Limitations (including terrain stability and soil erosion potential mapping)

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 (1:10,000) and dates (2003 and 2006) 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 stability and soil erosion potential. 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 11.

Table 11. The factors affecting the reliability of terrain mapping.

Factors	Notes on this study
Skill and experience of the mapper	Pre-typing completed by experienced terrain mapper, Anthony Collett, P.Geo. Final typing, terrain stability and soil erosion potential interpretations and project completion by Polly Uunila, P.Geo. experienced terrain mapper and a former resident of Coldstream, who has completed several terrain mapping projects in the Okanagan. This is the first time P. Uunila has used DiAP. South slopes mapped by Deepa Spaeth Filatow, P.Geo., experienced terrain mapper and resident of Kelowna.
Number of mappers	Three mappers were involved in various stages of the project.
Continuity	Majority of the study area: project started by one mapper and completed by another. Mapping completed on DiAP with high quality digital imagery. South Slopes completed by another mapper on 1:15,000 scale air photos. Placement of linework using the DiAP viewer may be more precise than on the air photos.
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 straight forward. The thick fill in the valley bottom and lower slopes is complex.
Quality and scale of the airphotos	Majority of study area: The imagery is high quality and appropriate for the scale of the final mapping. The imagery on the west-facing slopes above Okanagan Lake from Knox Mountain to the McKinley Landing area was distorted and in shadow. It was difficult to confirm pre-typing polygon boundary placement and to assign terrain, terrain stability and soil erosion potential attributes to many of the polygons on this hill slope. Pre-typing completed on 2003 digital imagery and final typing completed on 2006 digital imagery. South Slopes: Good quality imagery but taken pre-fire (from 1996). Colour photos. Photo scale is smaller than the scale of the final mapping.
Terrain Survey Intensity Level (TSIL)	TSIL D[60] is normal for TEM but is low for Soil Erosion Potential and Terrain Stability 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.

[60] TSIL D is defined as 1-20% of polygons inspected; 9% of polygons were inspected in this project.

Factors	Notes on this study
Quality of the topographic base	Generally good. During the pre-typing, A Collett noted that the surface file, derived from a TRIM digital elevation model (DEM), is not very accurate at the base of deeply incised meltwater channels and river canyons (e.g. Mission Creek canyon). Linework in these areas may not be precisely placed or lines may 'float' above the ground surface when viewed on DiAP Viewer. During the current contract, P. Uunila noted that the images appeared "flat" in small areas at many of the seams of the surfaces.
Linework	The pre-typing was completed on 2003 imagery and the final mapping was completed on 2006 imagery. P. Uunila noted that in some locations (usually steep terrain) there appears to be small shifts in line placement, i.e. the polygon boundary is not on the slope break when viewing the 2003 linework on 2006 imagery.
Database and editing	The database is free of terrain coding errors. It is not possible to conduct an edit of the terrain labels because "labelled air photos" cannot be created in DiAP as with conventional terrain mapping using hard copy air photos. It is likely that errors are uncommon.

Additional limitations specific to Soil Erosion Potential and Terrain Stability ratings are as follows:

1. Soil Erosion Potential and Terrain Stability ratings are based on a method developed primarily for forestry applications. In an urban setting, artificial surfaces make runoff and delivery of sediments into waterways more prevalent. Caution should be exercised even in areas with low soil erosion potential ratings, and areas rated moderate to very high should be treated as sensitive. Polygons with Terrain Stability classes III through V should be considered sensitive and caution should still be taken with drainage in class I and II polygons.
2. Because Soil Erosion Potential and Terrain Stability classes were added after the pre-typing was completed, polygons may include areas of more than one class. One class (the most conservative one) is assigned to each polygon. In contrast, there may be inclusions in the polygon that are too small to isolate for the scale of mapping (typically less than 10% of the polygon) that are more susceptible to erosion or unstable than the assigned interpretive class. For example, a short steep slope within a gently sloping polygon will have higher erosion potential than the indicated Soil Erosion Potential rating for the polygon. In another example, some surficial materials may contain inclusions of finer textured material that are more susceptible to erosion. For example, coarse textured, inter-bedded sands and gravels may contain beds of very fine sand and silt, which are more susceptible to erosion.
3. This study has been conducted at TSIL D (most studies that incorporate Soil Erosion Potential and Terrain Stability are TSIL C-A[61]). The field survey did not focus on M-VH and

[61] TSIL A is defined as 75-100% of polygons field inspected, TSIL B is defined as 50-75% of polygons field inspected, TSIL C is defined as 20-50% of polygons field inspected, and TSIL D is defined as 0-20% of polygons field inspected; 9% of polygons were inspected in this project.

III-V rated polygons, as is the norm (apart from drainage and texture). However, information from several studies completed by P. Uunila in the area was used to establish the criteria for this study.

4. In order to meet the project objectives the mapper incorporated criteria for bioterrain, terrain stability and soil erosion potential into the mapping. This has resulted in a high level of detail (small average polygon size) and utility.

5. Hazardous areas include the initiation, transport and runout zones of slope mass movement. It should be noted that Terrain Stability classes flag only the initiation zones of slides (as denoted by class V), however runout zones can be any terrain stability class. The runout, transport and deposition zones of slope mass movement can be identified by the geomorphological portion process of the terrain symbol. Thus, geomorpological process should be used in combination with terrain stability class to find the hazardous locations within the study area.

3 Results

3.1 Terrestrial Ecosystem Mapping Results

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 land base. Appendix C: Expanded Legend provides a complete description of each ecosystem.

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

IDFxh1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of IDFxh1	% of study area
AS /98	At – Snowberry – Kentucky bluegrass	26.9	1.3	0.1
BM /00	Bulrush Marsh	0.6	0.03	0.003
BN /96	Kentucky bluegrass – Stiff needlegrass	16.4	0.8	0.08
BR /00	Baltic Rush Marsh-Meadow	3.4	0.2	0.02
CD /00	ActFd –Common Snowberry – Red-osier Dogwood Riparian	10.4	0.5	0.05
CF /00	Cultivated Field	111.5	5.3	0.5
CG /00	Reed Canarygrass Marsh	6.2	0.3	0.03
CL /00	Cliff	4.9	0.2	0.02
CS /00	Common Spikerush Marsh	0.2	0.01	0.001
CT /00	Cattail Marsh	0.5	0.02	0.002
CW /00	Choke cherry – Bluebunch wheatgrass rocky bluff	860.9	41.0	4.0
DP /01	FdPy – Pinegrass	99.9	4.8	0.5
DS /07	FdPy – Snowberry – Spirea	110.9	5.3	0.5
DW /03	FdPy – Bluebunch wheatgrass – Pinegrass	5.1	0.2	0.02
ES /00	Exposed Soil	11.5	0.6	0.05
FC /00	Rough Fescue – Cladina	2.8	0.1	0.01
FO /00	FdPy –Saskatoon – Mock orange	150.9	7.2	0.7
FW /91	Idaho fescue – Bluebunch wheatgrass	20.1	1.0	0.09
GP /00	Gravel Pit	1.5	0.07	0.007
OW /00	Shallow Open Water	50.6	2.4	0.2
PB /02	FdPy – Bluebunch wheatgrass – Balsamroot	4.1	0.2	0.02
PD /00	Pond	7.4	0.4	0.03
RF /97	Prairie Rose – Idaho fescue	0.9	0.04	0.004
RI /00	River	3.9	0.2	0.02
RO /00	Rock Outcrop	14.8	0.7	0.07
RS /00	Western redcedar / Douglas-fir – False Solomon's Seal	61.7	2.9	0.3
RW /00	Rural	15.9	0.8	0.07
RZ /00	Road Surface	2.1	0.1	0.01
SA /00	Antelope brush – Selaginella	7.9	0.4	0.04
SB /00	Selaginella – Bluebunch wheatgrass rock outcrop	19.5	0.9	0.09
SD /08	SxwFd – Douglas maple – Dogwood	1.9	0.09	0.009
SO /00	Saskatoon – Mock orange Talus	148.3	7.1	0.7
SP /04	FdPy – Snowbrush – Pinegrass	3.1	0.2	0.01
TA /00	Talus	51.7	2.5	0.2
UR /00	Urban/Suburban	1.5	0.07	0.007
WA /92	Big sage – Bluebunch wheatgrass – Balsamroot	258.4	12.3	1.2

IDFxh1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of IDFxh1	% of study area
WB /93	Bluebunch wheatgrass – Balsamroot	0.5	0.02	0.002
WS /09	Willow – Sedge Wetland	26.9	1.3	0.1
Ws01 /00	Mountain alder – Skunk cabbage – Lady fern swamp	0.6	0.03	0.003
TOTAL		2098.6	100	9.7

Table 13. Ecosystem Units mapped in the PPxh1, their area, and their percent of the PPxh1 land base in the study area, and their percent of the study area land base.

PPxh1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of PPxh1	% of study area
AK /00	Alkaline pond	24.0	0.1	0.1
AS /00	At – Snowberry – Kentucky bluegrass	33.1	0.2	0.2
BE /00	Beach	5.6	0.03	0.03
BM /00	Bulrush Marsh	12.3	0.06	0.06
BR /00	Baltic Rush Marsh-Meadow	1.9	0.01	0.009
CB /00	Cutbank	33.8	0.2	0.2
CD /00	ActFd –Common Snowberry – Red-osier Dogwood Riparian	237.3	1.2	1.1
CF /00	Cultivated Field	2980.9	15.3	13.8
CG /00	Reed Canarygrass Marsh	3.6	0.02	0.02
CL /00	Cliff	2.3	0.01	0.01
CN /00	Canal	17.0	0.09	0.08
CO /00	Cultivated Orchard	2480.8	12.7	11.5
CT /00	Cattail Marsh	43.6	0.2	0.2
CV /00	Cultivated Vineyard	33.5	0.2	0.2
CW /00	Choke cherry – Bluebunch wheatgrass rocky bluff	14.2	0.07	0.07
DM /08	Fd – Water birch - Douglas maple	68.3	0.4	0.3
DS /07	FdPy – Snowberry – Spirea	110.7	0.6	0.5
ES /00	Exposed Soil	85.0	0.4	0.4
FB /00	Rough fescue – Bluebunch wheatgrass	363.0	1.9	1.7
FC /00	Rough Fescue – Cladina	6.1	0.03	0.03
FO /00	FdPy –Saskatoon – Mock orange	124.1	0.6	0.6
GC /00	Golf Course	496.9	2.6	2.3
GP /00	Gravel Pit	192.7	1.0	0.9
Gs01	Alkali Saltgrass Wet Meadow	8.8	0.04	0.04
Gs02	Nuttall's alkaligrass – Foxtail barley Wet Meadow	0.3	0.001	0.001
Gs03	Field Sedge Wet Meadow	18.8	0.1	0.09
GW /00	Giant Wildrye	0.3	0.001	0.001
LA /00	Lake	163.1	0.8	0.8
MI /00	Mine	1.5	0.008	0.007
OW /00	Shallow Open Water	151.9	0.8	0.7
PC /04	Py – Bluebunch wheatgrass – Cheatgrass	1288.2	6.6	6.0
PD /00	Pond	1.3	0.007	0.006
PF /05	Py – Bluebunch wheatgrass – Rough fescue	654.3	3.4	3.0
PT /02	Py – Red three-awn	519.4	2.7	2.4
PW /01	Py – Bluebunch wheatgrass – Idaho fescue	904.3	4.6	4.2
RE /00	Reservoir	25.9	0.1	0.1
RI /00	River	3.4	0.02	0.02

PPxh1				
Ecosystem Unit Code/ Number	Ecosystem Unit Name	Area (hectares)	% of PPxh1	% of study area
RN /00	Railway	1.5	0.008	0.007
RO /00	Rock Outcrop	4.9	0.02	0.02
RS /00	Western redcedar / Douglas-fir – False Solomon's Seal	8.2	0.04	0.04
RW /00	Rural	1752.0	9.0	8.1
RZ /00	Road Surface	76.5	0.4	0.4
SA /00	Antelope brush – Selaginella	73.6	0.4	0.3
SB /00	Selaginella – Bluebunch wheatgrass rock outcrop	121.1	0.6	0.6
SO /00	Saskatoon – Mock orange Talus	76.6	0.4	0.4
SP /06	FdPy – Snowberry – Pinegrass	161.6	0.8	0.7
SR /00	Snowberry – Rose – Kentucky Bluegrass	12.9	0.07	0.06
TA /00	Talus	11.4	0.06	0.05
UR /00	Urban/Suburban	5453.6	27.9	25.2
WB /00	Bluebunch wheatgrass – Balsamroot	661.6	3.4	3.1
WS /00	Willow – Sedge Wetland	1.1	0.006	0.005
Ws01	Mountain alder – Skunk cabbage – Lady fern swamp	0.2	0.001	0.001
TOTAL		19 529.2	100	90.3

3.2 Terrain Results

In general, the landscape and surficial geology is quite variable and complex. The following geomorphological processes were mapped in the City of Kelowna:

- slumps in bedrock
- slump-earthflow
- slumps in surficial materials
- rockfall
- debris slides

This includes active processes that were evident on the 2006, 1:10,000 scale digital imagery and field observations. Additional geomorphological processes may be present but were not mapped for the following possible reasons:

- the features are too small to be visible on the imagery
- the features are in shadows or under forest cover
- the events have occurred since 2006

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 within the City of Kelowna municipal boundaries.

Valley bottom: The valley bottom consists largely of fluvial (fan and floodplain) deposits, glaciolacustrine and glaciofluvial sediments. Much of the low-lying areas between Wood Lake and the Okanagan Mission, with the exception of the Glenmore area, consist of modern floodplain and fans. These are formed by all of the major creeks including Scotty, Mission, Kelowna, KLO, and

Bellevue Creeks, as well as smaller creeks including Whelan, Brandt, Rumohr and Priest Creeks. Large deposits of glaciolacustrine sediments are found in the Glenmore area and south of the airport. Thin stretches of beach (lacustrine) discontinuously line the shores on Okanagan Lake and Duck Lake.

Stability issues in this area include 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 contain areas of thick sediments including glaciofluvial, till, glaciolacustrine and undifferentiated sediments. Landforms tend to be sloping benches dissected by gullies created by post-glacial streams and erosion. Terraces of glaciolacustrine sediments at elevations lower than about 500 m[62] are located along the lower slopes between East Kelowna and the Okanagan Mission and along the south edge of Dilworth and Knox Mountains. Scattered outcrops of glaciolacustrine sediments are located along the Okanagan lakeshore from Knox Mountain to the McKinley Landing area and along Lakeshore Drive in the Mission. Vast areas of glaciofluvial sediments cover much of the remaining lower slopes. Outcrops of bedrock covered by little or no colluvium are scattered throughout these slopes. Veneers of eolian sediments are found discontinuously on the gentler surfaces

Stability issues in this area include, debris slides in gullies dissecting thick sediments, slumping in glaciolacustrine sediments, and rockfall. 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 are areas with high potential for erosion.

Mid to Upper slopes: Gentle to moderately steep slopes are largely covered by blankets and veneers of till with scattered bedrock outcrops and associated colluvium and weathered bedrock. Moderately steep to steep slopes are largely bedrock outcrops discontinuously covered by thin till and colluvium. Talus slopes flank bedrock cliffs.

Single gullies and rockfall comprise 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 % are assigned terrain stability class IV. Steeper bedrock-controlled slopes with a partial veneer of surficial materials are rated as terrain stability class IV. The soils more susceptible to erosion included moderately steep to steep slopes of till. Slopes containing gullies incised through thick surficial materials are areas of high potential for erosion. The following recommendations are standard for avoidance of problems during development in areas that are prone to erosion or instability[63]:

- Use Best Management Practices, for example as outlined in the document *Best Management Practices for Erosion and Sediment Control-Upland Works*[64] . In and adjacent to riparian zones, it is particularly critical to avoid disturbances of erodable soils. Best Management Practices as outlined in *Best Management Practices for Erosion and Sediment Control-Instream Works*[65] should be followed as well as all legal requirements outlined in the *Fisheries Act* and the provincial *Water Act*.

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[62] Nasmith 1962
[63] adapted from Iverson et al. 2004
[64] City of Kelowna 1998b
[65] City of Kelowna 1998a

- 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 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, 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.

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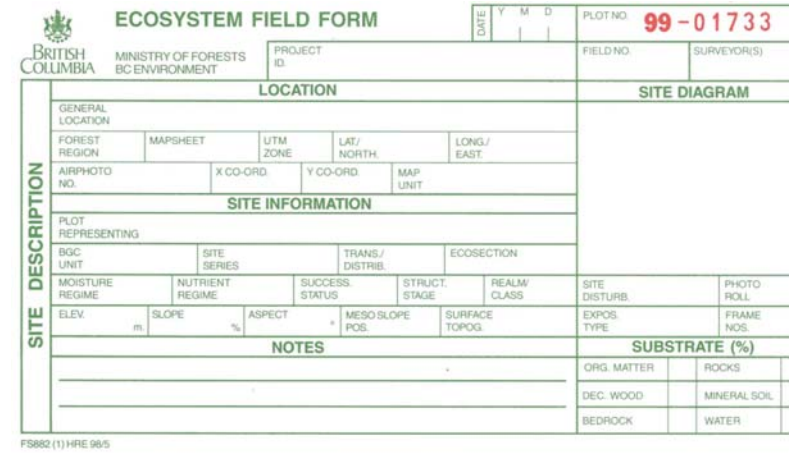
Appendix A: Field Plot Forms



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

SOIL CLASS. | HUMUS FORM | HYDROGEO.

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

R. Z. PART. SIZE | SEEPAGE cm | FLOOD FRQ.

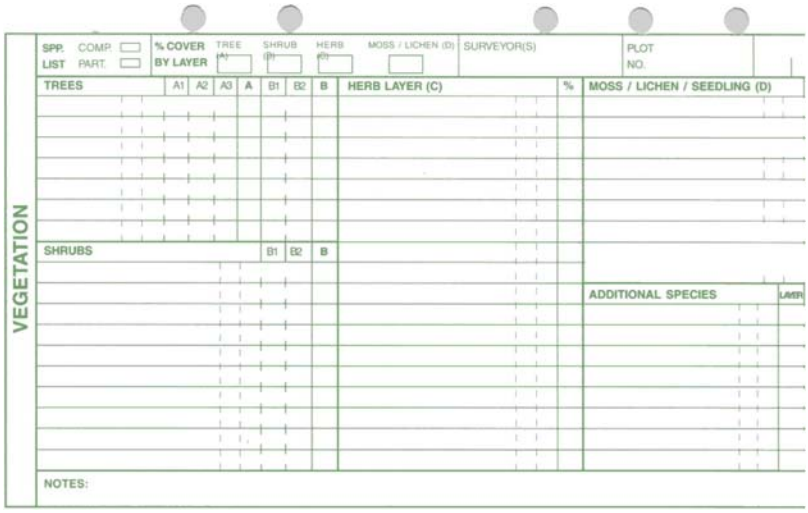
ORGANIC HORIZONS/LAYERS

HOR./ LAYER | DEPTH | FABRIC: STRUCTURE, vPOST | MYCEL. AB. | FECAL AB. | ROOTS AB. 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

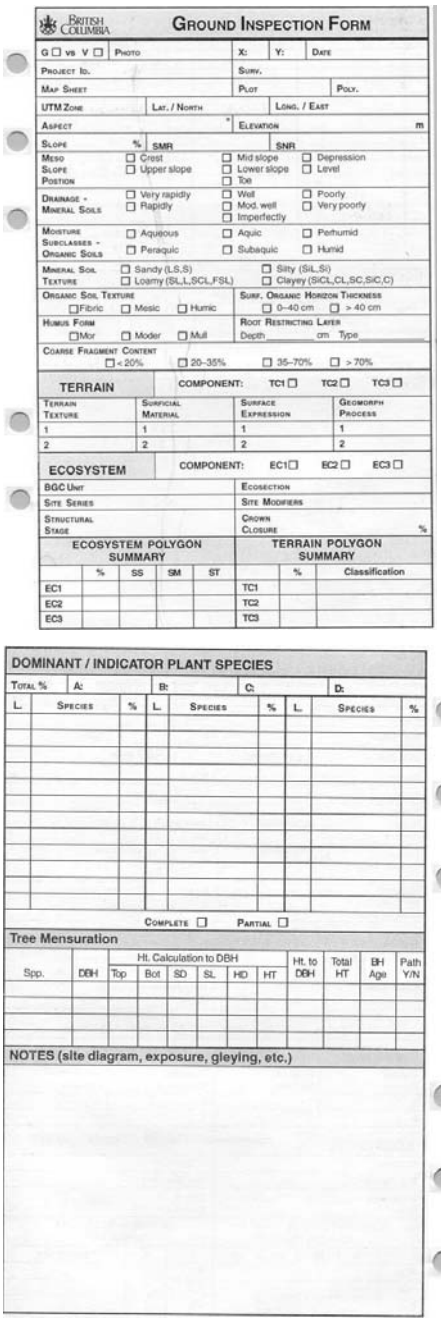
SHRUBS: B1 B2 B

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 ☐ Upper slope ☐ Mid slope ☐ Lower slope ☐ Toe ☐ Depression ☐ Level

DRAINAGE - MINERAL SOILS: ☐ Very rapidly ☐ Rapidly ☐ Well ☐ Mod. well ☐ Imperfectly ☐ Poorly ☐ Very poorly

MOISTURE SUBCLASSES - ORGANIC SOILS: ☐ Aqueous ☐ Peraquic ☐ Aquic ☐ Subaquic ☐ Perhumid ☐ 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	%	SS	SM	ST
EC1				
EC2				
EC3				

TERRAIN POLYGON SUMMARY	%	Classification
TC1		
TC2		
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: Top	Bot	SD	SL	HD	HT	Ht. to DBH	Total HT	BH Age	Path Y/N

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

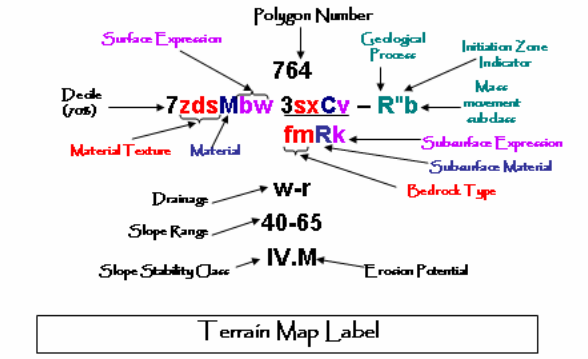
VISUAL& CONSERVATION EVALUATION FORM									
PROJ. ID.					**SURV.**				
PLOT#		**AIR PHOTO #**				**DATE**			
UTM ZONE		LAT./NORTH			LONG./EAST				
BGC UNIT		SITE SERIES			SITE MOD				
STR STAGE		ASPECT	°		ELEVATION	m			
SLOPE	%	SMR/SNR			MESO SLOPE				
SOIL DRAINAGE		SOIL TEXTURE			COARSE FRAG%		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

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 was 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 were 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 were 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 Mission and Kelowna Creeks. Large fans are located at the mouths of Scotty, Mission, KLO, Rumohr, Priest and Bellevue Creeks.

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 erodible, 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 were common on the lowers slopes throughout the study area.

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 occurred 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 and Duck Lakes. These materials generally consisted 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 its maximum, reached a level of about 500 m above sea level[66]. Large deposits from this glacial lake are present in the Glenmore area, south of the airport, lower slopes between East Kelowna and Okanagan Mission and scattered locations along the Okanagan Lake shoreline.

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 was 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 locations along the lower slopes.

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.

[66] Nasmith, 1962

Description of Geological Processes

Geological Processes	
Code	**Name**
-E	Glacial meltwater channels
-F	Slow mass movement (failing, slumps)
-F"	Slow mass movement initiation zone
-Fx	slump-earthflow
-Fm	slump in bedrock
-Fu	slump in surficial materials
-G	Ground disturbance
-H	Kettled
-L	Surface seepage
-R	Rapid mass movement (slides and falls)
-R"	Rapid mass movement initiation zone
-Rb	Rockfall
-Rs	Debris slide
-Ru	Slump in surficial materials
-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.

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.

Slow Mass Movement (-F, -F"x, -F"m, -F"u)

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, and when the double prime symbol is absent from the geomorphological symbol, this indicates the runout and deposition zone. Slump - earthflows are indicated by the subclass "x" (-Fx). 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).

A slump-earthflow (-Fx) is a combined slump (upper part) and earthflow (lower part). This process is mapped in three polygons (2351, 2238 and 2448) within the study area and tends to occur in glaciolacustrine sediments.

A slump in bedrock (-Fm) refers to a rotational slump where portions of the slide mass remains internally cohesive. Rotational slumps develop due to failure along vertical joints and horizontal weak layers. This process is mapped in polygon 2949.

Slumps in surficial materials (-Fu) consist of deep-seated, rotational failures along a zone of weakness within thick deposits. Slumping in fine-grained sediments, such as, glaciolacustrine materials are common. In the study area, this process is mapped in 9 polygons containing glaciolacustrine sediments and one polygon consisting of till.

Ground Disturbance (-G)

Ground disturbance refers to anthropogenic excavations where the remaining exposed surface has remained undisturbed and is *in situ*; for example, the cutslopes in gravel pits, housing developments, and road cuts.

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 along Swamp Road.

Rapid Mass Movement (-R, -R”b, -R”s, -R”u)

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 slides (-Rs) (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 tree removal 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. Debris flows are not mapped in the study area but could be triggered when a debris slide entered a creek. In the study area, debris slides are common (mapped in 45 polygons) especially on steep slopes, commonly gully walls, consisting of thick surficial materials.

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.

Debris Slumps (-Ru): see section on Slow 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 is mapped in polygons scattered throughout the study area.

Slope, Soil Erosion Potential Classes and Terrain Stability Classes

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%.

Soil Erosion Potential Classes[67]		
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.

Terrain stability Classes[68]	
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

[67] Adapted from Ministry of Forests 1999
[68] Adapted from Ministry of Forests 1999

Appendix C: Expanded Legend

KELOWNA 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:

ASg	occurs in a gully	ASw	warm aspect; slope >25%
ASk	cool aspect; 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	*Crataegus douglasii*	***	*	*	*	*	black hawthorn
	Acer glabrum	**	**	**	**	**	Douglas maple
	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					KV038		

* 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
BM	Bulrush Marsh	IDFxh1	Wm06

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[69].

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. 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 *S. tabernaemontani*	****	hard-stemmed or soft-stemmed bulrush
Herbs	*Lemna minor*	*	common duckweed

* 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

[69] MacKenzie and Moran 2004

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 Kentucky bluegrass with Columbian needlegrass and scattered forbs. 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	2	
Grasses	*Poa pratensis*	****	Kentucky bluegrass
	Achnatherum nelsonii	**	Columbian needlegrass
Herbs	*Taraxacum officinale*	**	dandelion
	Potentilla gracilis	**	graceful cinquefoil
	Achillea millefolium	**	yarrow
	Dodecatheon pulchellum	**	few-flowered shooting star
	Ranunculus glaberrimus	*	sagebrush buttercup

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	Wm07

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[70].

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 occurred in slightly drier situations. Soils were mineral.

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	2	
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

[70] MacKenzie and Moran 2004

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 creeks and along the edges of some ponds. Forests were dominated by black cottonwood, sometimes with Douglas-fir and paper birch. The understory was typically rich and shrubby, often dominated by Nootka rose, mock orange, snowberry and red-osier dogwood.

List of mapped units:

CDc	coarse-textured soils	CDg	occurs in a gully
CDct	coarse-textured soils; occurs on a fluvial terrace adjacent to a creek	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

* 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:			
CFt	occurs on a terrace	CFx	drier than typical, retains some grassland habitat values

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 was rare in the study area and is not included in the provincial wetland classification. 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

* 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
CS	Common Spikerush 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 *Common spike-rush marsh* association in the provincial classification[71]. These marsh wetland ecosystems occur in standing water as a fringe around ponds, shallow open water and other marshes. This unit is rare in the study area. The water table often drops to the soil surface in late summer. These sites have a variable mixture of common spikerush, reed canary grass (probably due to disturbance) and some floating aquatic species. Soils are typically mineral, but may have a thin organic veneer on top.

SITE INFORMATION	
Common Terrain Types: • lacustrine	
Slope position:	depression
Slope (%):	0
Aspect:	none
Soil Moisture Regime:	subhydric
Soil Nutrient Regime:	rich – very rich

	Structural Stage	2	
Rushes	*Eleocharis palustris*	***	common spike-rush
Grasses	*Juncus balticus*	**	baltic rush
Sedges	*Carex* spp.	**	sedges
Herbs	*Polygonom amphibium*	**	water smartweed
	Lemna minor	**	common duckweed
	Ranunculus sceleratus	**	celery-leaved buttercup

* 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

[71] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CT	Cattail Marsh	IDFxh1	Wm05

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 (Wm05) in the provincial classification[72]. 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.

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
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

[72] MacKenzie and Moran 2004

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. 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 and because of the Okanagan Mountain Park fire. Because of fire exclusion, most sites have become ingrown with higher densities of smaller stems. Grazing and ingrowth have reduced the presence of bunchgrasses which were likely historically common.

List of mapped units:

DPc	coarse-textured soils (glaciofluvial)	DPk	cool apsect, slope <25%
DPck	coarse-textured soils (glaciofluvial), cool aspect, slope >25%	DPks	cool aspect (usually NW to E), shallow soils (generally 50-100cm)
DPct	coarse-textured soils on a glaciofluvial or fluvial terrace	DPs	shallow soils (generally 50-100cm)
DPfk	fine-textured soils, cool aspect, slope >25%	DPt	occurs on a fluvial or glaciofluvial terrace

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	*Ceanothus sanguineus*	***	*				redstem ceanothus
	Mahonia aquifolium	**	*	**	**	**	tall Oregon-grape
	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		KG006 KG007	KG005				

* 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. 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.

List of mapped units:

DSc	coarse-textured soils	DSgw	warm aspect gully, slope >25%
DScg	coarse-textured soils, gully	DSk	cool aspect, slope >25%
DSct	coarse-textured soils, fluvial terrace	DSn	occurs on a fluvial fan
DSg	gully	DSs	shallow soils (generally 50-100cm)

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

* 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).

List of mapped units:

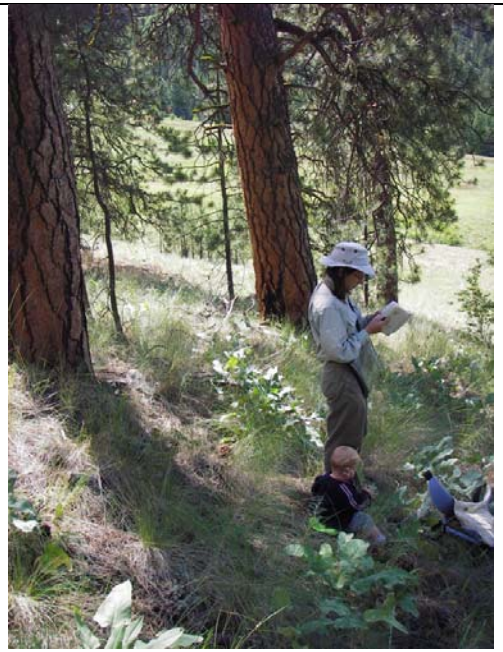
DWc	coarse-textured soils (usually glaciofluvial)	DWkv	cool aspect, very shallow soils (<20cm); exposed bedrock
DWck	coarse-textured soils, cool aspect (generally ESE or NW), slope >25%	DWr	ridge or crest
DWcr	coarse-textured soils, ridge or crest	DWs	shallow soils (20-100cm)
DWf	fine-textured soils	DWv	very shallow soils (<20cm)
DWjv	gentle slope, very shallow soils <20cm deep, exposed bedrock		

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

* 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
FC	Rough fescue - Cladina	IDFxh1	00

Typic unit occurs on cool aspects with very shallow soils (assumed modifiers are k, v)

This grassland ecosystem occurs on cool aspects of smooth, gentle to moderate cool aspects of gneiss formations. This unit is common in the South Slopes area but was not seen elsewhere. It was apparently restricted to the South Slopes area because of the distinctive nature of the gneiss rock outcrops in that area. The abundant light-yellow coloured reindeer lichen with rough fescue and some low-relief, unfractured bedrock outcrops make these sites distinctive. Many sites are relatively undisturbed but have been burned in the Okanagan Mountain Park fire.

List of mapped units:

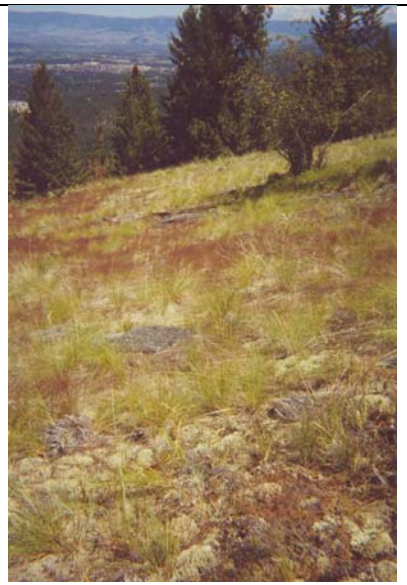
FCj gentle slopes (cool aspects, but less than 25% slope)

SITE INFORMATION

Common Terrain Types:

- very thin and thin colluvial and morainal veneers

Slope position:	middle to upper
Slope (%):	20-50%
Aspect:	all
Soil Moisture Regime:	subxeric
Soil Nutrient Regime:	poor



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FC	Rough fescue - Cladina	IDFxh1	00

	Structural Stage	2 FW	
Grasses	*Festuca campestris*	***	rough fescue
	Agrostis scabra	**	hair bentgrass
	Koeleria macrantha	**	junegrass
	Pseudoroegneria spicata	**	bluebunch wheatgrass
Herbs	*Heuchera cylindrica*	*	round-leaved alumroot
	Selaginella densa	*	compact selaginella
	Lomatium spp.	*	desert-parsley
	Fritillaria affinis	*	chocolate lily
	Galium aparine	*	cleavers
	Sedum stenopetalum	*	worm-leaved stonecrop
	Epilobium brachycarpum	*	tall annual willowherb
Lichens	*Cladina mitis*	***	lesser green reindeer
Mosses	*Dicranum* spp.	**	

* 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
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:

FOk cool aspect (>25%) 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

* 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 and 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 invasive alien plants. 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:

FWct	coarse-textures soils, terrace	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)	FWt	terrace

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:kc	2 FW:wk	
Grasses	*Festuca idahoensis*	****		*	Idaho fescue
	Festuca campestris	**			rough fescue
	Pseudoroegneria spicata	***		***	bluebunch wheatgrass
	Koeleria macrantha	**		*	junegrass
	Bromus tectorum		****	***	cheatgrass
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			KV034 KV043		

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	IDFxh1	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	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.			

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:

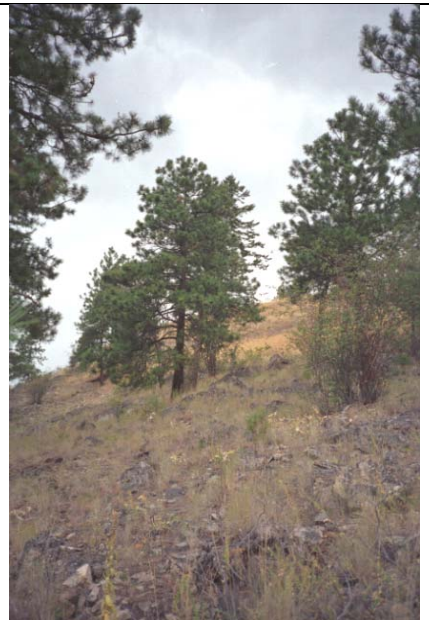
PBc	coarse-textured soils (sandy glaciofluvial), surface soils ravelling	PBrv	ridge, very shallow soils (<20cm), exposed bedrock present
PBcd	coarse-textured soils (sandy glaciofluvial), deep soils, surface soils ravelling	PBv	very shallow soils (<20cm), exposed bedrock present
PBkv	cool aspect (usually NW or ESE), slope >25%, very shallow soils (<20cm), exposed bedrock present		

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

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
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, except where excessive grazing has reduced shrub cover. Forbs and grasses are scattered in openings between shrubs. Soils are very rich black chernozems.

List of mapped units:

RFg gully

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
RI	River	IDFxh1	N/A
A watercourse with water flowing between continuous, definable banks. Used for the river bed of Mission Creek.			

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:			
ROk	cool aspect (slope >25%)	ROw	warm aspect
ROq	very steep cool aspect (slope >70%)	ROz	very steep warm aspect (slope >70%)
ROr	ridge		

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	RSg	occurs in a gully
RSac	active floodplain; coarse-textured soils		

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 redcedar
	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

* 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[73]	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:

SAvw	very shallow soils, warm aspect	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

[73] 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
Lichens	*Cladonia* spp.	**	**	**	**	**	**	clad lichens
Mosses	*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:			
SBr	ridge	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	IDFxh1	00

	Structural Stage Seral stage	2 SB	2 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
Lichens and Mosses	*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.

List of mapped units:

SDc	coarse-textured soils	SDg	gully
SDcg	coarse-textured soils ; gully		

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.	*	*	*	*	*	ragged-moss
	Mnium spp.	*	*	*	*	*	leafy 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
SO	Saskatoon – Mock orange Talus	IDFxh1	00

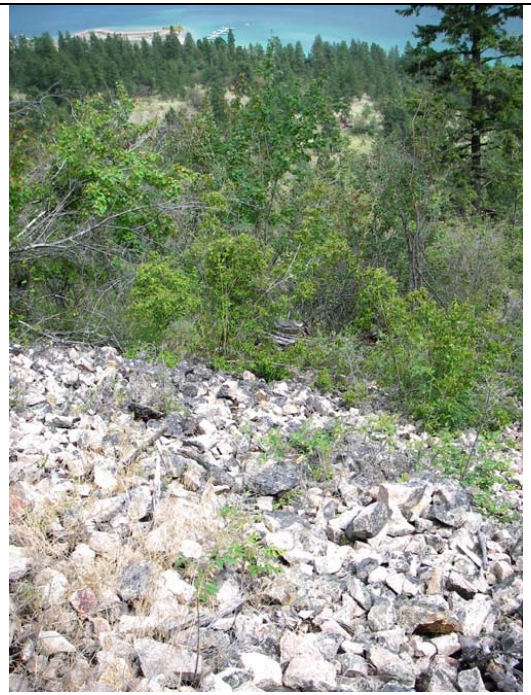
Typic unit occurs on both warm and cool steep slopes with deep, coarse textured soils (blocky) (c and d are assumed modifiers).

This ecosystem is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. This is a rare 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.

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



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
	Clematis ligusticifolia	**	*	*	*	*	white clematis
	Symphoricarpos albus	**	**	**	**	**	snowberry
	Prunus virginiana	**	**	**	**	**	choke cherry
Herbs	*Woodsia scopulorum*	*	*	*	*	*	cliff fern
	Lomatium spp.	*	*	*	*	*	desert-parsely
Plots		KG009					

* 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 rare 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 pinegrass 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)
SPcr	ridge or crest, coarse-textured soils	SPr	crest or ridge
SPct	coarse textured soils, glaciofluvial terrace	SPrs	crest or ridge, shallow soils (20-100cm deep)
SPcw	coarse-textured soils, warm aspect, slope >25%	SPs	shallow soils (20-100cm deep)
SPk	cool aspect (usually ESE or NW), 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
Lichens and Mosses	*Cladonia* spp.	**	*	*	*	*	clad lichens
	Tortula ruralis	**	*	**	**	**	sidewalk moss
	Dicranum spp.	*	*	*	*	*	heron's-bill 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

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:			
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
WA	Big sage – Bluebunch wheatgrass – Balsamroot	IDFxh1	92

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

This shrub steppe ecosystem occurs on warm aspects on glaciolacustrine slopes. It was very rare in the study area and was observed only on small, isolated sites along Mission Creek in the South Slopes area. Both big sage and rabbit-brush were common on these sites. The photo shows a degraded site infested by knapweed and affected by mountain biking.

List of mapped units:

WAf fine-textured soils

SITE INFORMATION

Common Terrain Types:

- lacustrine slopes

Slope position:	upper, crest
Slope (%):	40-60%
Aspect:	south, southwest, west
Soil Moisture Regime:	xeric
Soil Nutrient Regime:	poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WA	Big sagebrush – Bluebunch wheatgrass – Balsamroot	IDFxh1	92

	Structural Stage	3	
Shrubs	*Artemisia tridentata*	***	big sagebrush
	Ericameria nauseosus	**	*common rabbit-brush*
Grasses	*Pseudoroegneria spicata*	***	bluebunch wheatgrass
	Sporobolus cryptandrus	**	sand dropseed
	Hesperostipa comata	**	needle-and-thread grass
	Bromus tectorum	**	cheatgrass
	Aristida longiseta	*	red three-awn
Herbs	*Balsamorhiza sagittata*	*	arrowleaf balsamroot
	Erigeron spp.	*	fleabanes and daisies
	Lupinus sericeus	*	silky lupine
	Eriogonum heracleoides	*	parsnip-flowered buckwheat
	Lithospermum ruderale	*	lemonweed
Lichens	*Cladonia* spp.	*	clad lichens
Mosses	*Tortula ruralis*	*	sidewalk moss

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
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 with invasive plants 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: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)	WBs	shallow soils (20-100cm)
WBrs	ridge or crest, shallow soils (20-100cm deep)		

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:wk	
Grasses	*Pseudoroegneria spicata*	****	*	***	bluebunch wheatgrass
	Koeleria macrantha	**	*	*	junegrass
	Achnatherum nelsonii	**		*	Columbia needlegrass
	Bromus tectorum or *B. 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
Lichens	*Cladonia* spp.	**		*	clad lichens
Mosses	*Tortula ruralis*	**		*	sidewalk moss
PLOTS		KG008			

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	IDFxh1	Ws01

Typic unit occurs on level sites with deep, mineral soils (d, j and m are assumed modifiers). This is the Ws01 unit in the provincial wetland classification[74]. This is a rare unit in the study area and was only observed within the area of the Okanagan Mountain Park fire. The picture below shows an unburned ecosystem in the North Okanagan.

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

[74] MacKenzie and Moran 2004

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		KG036					

* 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.

KELOWNA EXPANDED LEGEND – PPxh1

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AK	Alkaline Pond	PPxh1	N/A

A body of fresh water with a pH greater than 7 and a depth less than 2 m. Often have a white salt crust around the edge of the pond and is associated with the wetland ecosystems Gs01, Gs02 and Gs03.
AKx – ponds that may be dry by late summer leaving only a white crust of salts.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AS	Trembling aspen – Snowberry – Kentucky bluegrass	PPxh1	00

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

This 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. This site unit was observed on the south-east side of the study area.

List of mapped units:			
ASg	gully	ASw	warm aspect, slope >25%
ASk	cool aspect, slope >25%		

SITE INFORMATION	
Common Terrain Types:	
• aeolian or slopewash (C1) veneer over morainal or glaciofluvial blankets	
Slope position:	toe, depression
Slope (%):	0-15
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	PPxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Populus tremuloides*	***	****	****	****	****	trembling aspen
Shrubs	*Symphoricarpos albus*	*****	****	****	****	****	common snowberry
	Rosa nutkana	***	**	**	**	**	Nootka rose
	Prunus virginiana	***	**	**	**	**	choke cherry
	Amelanchier alnifolia	**	*	*	*	*	saskatoon
	Mahonia aquifolium	**	*	*	*	*	tall Oregon-grape
Grasses	*Elymus glaucus*	*	*	*	*	*	blue wildrye
	Poa pratensis	*	*	*	*	*	Kentucky bluegrass
	Elymus repens	*	*	*	*	*	quackgrass
Herbs	*Maianthemum stellata*	*	*	*	*	*	star-flowered false Solomon's-seal
Mosses	*Brachythecium* sp.	*	*	*	*	*	ragged moss
PLOTS				KV061	KV145		

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
BE	Beach	PPxh1	N/A
The area that expresses sorted sediments reworked in recent time by wave action. Occurs at lake edges (Okanagan Lake).			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BM	Bulrush Marsh	PPxh1	Wm06

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[75]. 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. These sites are most commonly dominated by hard-stemmed bulrush, but are sometimes dominated by Nevada bulrush. Vegetation species diversity is typically low on these sites. Soils are typically mineral, sometimes with a thin organic veneer.

List of mapped units:

BMx drier than typical, water table has dropped in recent years and flooding is very temporary.

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 *S. tabernaemontani*	****	hard-stemmed or soft-stemmed bulrush
	Amphiscirpus nevadensis	**	Nevada bulrush
Herbs	*Lemna minor*	**	common duckweed
PLOTS		KG004, KG012, KV009, KV102, KV103, KV104	

* 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

[75] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
BR	Baltic Rush Marsh	PPxh1	Wm07

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[76]. 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. Occurred on fine-textured mineral soils.

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	2	
Rushes	*Juncus balticus*	***	baltic rush
Sedges	*Carex praegracilis*	**	field sedge
Grasses	*Poa pratensis*	**	Kentucky bluegrass
	Elymus repens	*	quackgrass
Forbs	*Potentilla anserina*	**	common silverweed
PLOTS		KV011	

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

[76] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CB	Cutbank	PPxh1	N/A
Edge of a road cut that is upslope or down slope of a road and was created by the excavation of a hillside. CBk – cool aspect, CBw – warm aspect.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CD	Ponderosa pine / Black cottonwood – Snowberry Riparian	PPxh1	00

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

This forest type is commonly associated with floodplains and fluvial terraces with subsurface water. This unit is also found as a fringe along the Okanagan and Duck Lake foreshore and in some large gullies in the South Slopes area. Forests are often multi-layered with a mixture of black cottonwood, Douglas-fir, and Ponderosa pine. The understory is typically rich and shrubby

List of mapped units:

CDg	gully	CDt	fluvial terrace

SITE INFORMATION

Common Terrain Types:

- gentle and level fluvial sites and active floodplains
- lacustrine lake shores

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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CD	Ponderosa pine / Black cottonwood – Snowberry Riparian	PPxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Populus balsamifera* ssp. *trichocarpa*	**	****	***	***	***	black cottonwood
	Betula papyrifera	*	**	**	**	**	paper birch
	Pinus ponderosa			*	**	**	ponderosa pine
	Pseudotsuga menziesii var. *glauca*			*	*	*	Douglas-fir
Shrubs	*Symphoricarpos albus*	*****	****	****	****	****	common snowberry
	Acer glabrum var. *douglasii*	****	***	***	***	***	Douglas maple
	Amelanchier alnifolia	***	**	**	**	**	saskatoon
	Mahonia aquifolium	***	**	**	**	**	tall Oregon-grape
	Prunus virginiana	***	**	**	**	**	choke cherry
	Rosa nutkana	***	**	**	**	**	Nootka rose
	Cornus stolonifera	**	**	**	**	**	red-osier dogwood
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
Mosses	*Brachythecium* sp.			*	*	*	ragged moss
PLOTS					KG011	KV144 KV146	

* 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	PPxh1	N/A

These are agricultural fields with tilled soils and planted crops or ground cover.

List of mapped units:

CFg	gully	CFx	dry, not recently cultivated, retains some grassland habitat values
CFgy	gully, seasonally flooded	CFy	formerly or presently seasonally flooded

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 was rare in the study area and is not included in the provincial wetland classification. 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		KV093	
		KV130	
		KV142	

* 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	PPxh1	N/A
These are steep, vertical or overhanging rock faces. Typically there are scattered plants such as cliff ferns occurring in pockets.			
List of mapped units:			
CLz	very steep (>100%) warm aspect		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CN	Canal	PPxh1	N/A
An artificial watercourse created for transport, drainage, and/or irrigation purposes. Often used to be a natural waterway within the city.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CO	Cultivated Orchard	PPxh1	N/A
Agricultural areas for growing fruit trees.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CT	Cattail Marsh	PPxh1	Wm05

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 (Wm05)[77].

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 gully

CTx drier than typical

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
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

[77] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CV	Cultivated Vineyard	PPxh1	N/A
Agricultural areas for growing grapes.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CW	Choke cherry – Bluebunch wheatgrass rocky bluff	PPxh1	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%
CWr	ridge	CWz	very steep warm aspect; slope >70%

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	PPxh1	00

	Structural Stage	3	
Shrubs	*Amelanchier alnifolia*	**	saskatoon
	Symphoricarpos albus	**	common snowberry
	Philadelphus lewisii	**	mock-orange
	Prunus virginiana	**	choke cherry
Grasses	*Pseudoroegneria spicata*	**	bluebunch wheatgrass
Herbs	*Woodsia scopulina*	*	mountain cliff fern
	Selaginella densa	*	compact selaginella
	Balsamorhiza sagittata	*	arrowleaf balsamroot
Mosses	*Tortula ruralis*	*	sidewalk 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
DM	Douglas-fir – Water birch - Douglas maple	PPxh1	08

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

This forest type is commonly associated with gullies with intermittent or permanent streams or subsurface water flow. These are diverse, rich sites with mixed coniferous (Douglas-fir) and deciduous (paper birch and aspen) overstories. The understories are dominated by a diverse mixture of shrubs.

List of mapped units:

DMg	gullies, usually associated with a creek	DMt	fluvial terraces
DMgk	gully, cool aspect, slope >25%	DMw	warm aspect, slope >25%
DMn	fluvial fan		

SITE INFORMATION

Common Terrain Types:

- gentle fluvial and morainal sites

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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DM	Douglas-fir – Water birch - Douglas maple	PPxh1	08

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	**	**	**	**	Douglas-fir
	Populus tremuloides	**	***	***	***	*	trembling aspen
	Betula paperifera	****	***	***	***	**	paper birch
Shrubs	*Symphoricarpos albus*	***	***	***	***	***	common snowberry
	Acer glabrum var. *douglasii*	****	***	***	***	***	Douglas maple
	Cornus stolonifera	**	**	**	**	**	red-osier dogwood
	Mahonia aquifolium	**	**	**	**	**	tall oregon-grape
	Toxicodendron rydbergii	**	**	**	**	**	poison-ivy
	Rosa nutkana	**	*	*	*	*	Nootka rose
	Betula occidentalis	**	*	*	*	*	water birch
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
Herbs	*Osmorhiza berteroi*	**	*	*	*	*	mountain sweet-cicely
	Galium triflorum	*	*	*	*	*	sweet-scented bedstraw
	Maianthemum stellatum	*	*	*	*	*	star-flowered false Solomon's-seal
Mosses	*Brachythecium* sp.	*	*	*	*	*	ragged moss
	Mnium sp.	*	*	*	*	*	leafy moss
PLOTS			KG026				

* 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	PPxh1	07

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

This forest type is commonly associated with gently sloping sites that are receiving some moisture. It is also found on receiving sites where there is some sub-surface moisture. These forests are typically have moderately closed Douglas-fir overstories with very shrubby understories dominated by snowberry with some Oregon-grape, birch-leaved spirea, and saskatoon. Often there is scattered pinegrass or Kentucky bluegrass with some heart-leaved arnica and other scattered forbs. There is a minimal moss layer with patches of ragged mosses.

List of mapped units:

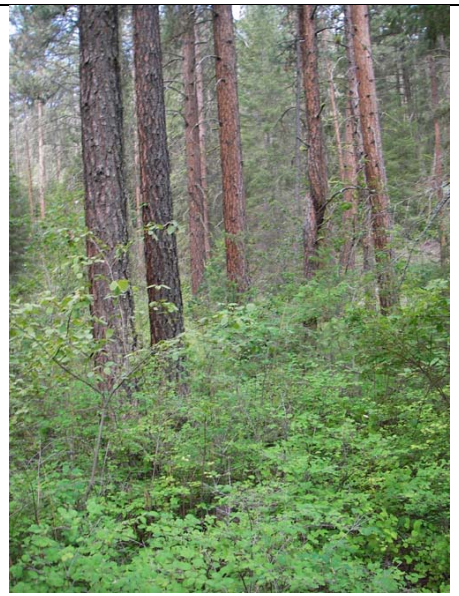
DSg	gully	DSn	fluvial fan
DSgk	gully; cool aspect (slope >25%)	DSt	fluvial terrace
DSgw	gully, warm aspect (slope >25%)	DSw	warm aspect (slope >25%)
DSk	cool aspect (slope >25%)		

SITE INFORMATION

Common Terrain Types:

- gentle morainal and glaciofluvial slopes, sites with slopewash (C1)

Slope position:	lower, toe
Slope (%):	0-15% (and sometimes up to 60%)
Aspect:	none
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	PPxh1	07

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	**	***	****	***	Douglas-fir
	Populus tremuloides	***	***	***	**		trembling aspen
Shrubs	*Symphoricarpos albus*	****	***	***	***	***	common snowberry
	Amelanchier alnifolia	**	**	**	**	**	saskatoon
	Mahonia aquifolium	**	**	**	**	**	tall oregon-grape
	Spirea betulifolia	***	**	**	**	**	birch-leaved spirea
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
Herbs	*Maianthemum stellatum*	*	*	*	*	*	star-flowered false Solomon's-seal
	Vicia Americana	**	*	*	*	*	American vetch
	Prosartes trachycarpa	**	*	*	*	*	rough-fruited fairy bells
Mosses	*Rhytidiadelphus triquetrus*	*	**	**	**	**	electrified cat's-tail moss
	Brachythecium sp.	**	**	**	**	**	ragged moss
PLOTS				KG010 KG030			

* 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
ES	Exposed Soil	PPxh1	N/A

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

List of mapped units:

ESk	cool aspect, slope >25%	ESz	very steep warm aspect, slope >25%
ESw	warm aspect, slope >25%		

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FB	Fescue – Bluebunch wheatgrass	PPxh1	00

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

This ecosystem commonly occurs on gentle and level sites and cool aspects. A mixture of Idaho fescue and bluebunch wheatgrass with balsamroot and other forbs dominate late seral sites. Unfortunately, most of these sites are highly disturbed and have a significant component of invasive alien plants. Sites with more than 10% weeds are mapped as seral associations.

FB: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.

FB:wk $*Bluebunch wheatgrass – Knapweed seral association*
This is a mid-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:

FBck	coarse-textured soils (glaciofluvial), cool aspect, slope >25%	FBs	shallow soils (generally 50-100cm)
FBk	cool aspects, slope >25%	FBt	glaciofluvial terrace
FBks	cool aspects, shallow soils (generally 50-100cm)		

SITE INFORMATION

Common Terrain Types:

- aeolian veneers overlying morainal or glaciofluvial blankets

Slope position:	middle to upper
Slope (%):	0-35%
Aspect:	none or cool
Soil Moisture Regime:	submesic – mesic
Soil Nutrient Regime:	medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FB	Rough fescue – Bluebunch wheatgrass	PPxh1	00

	Structural Stage Seral Association	2 FB	2 FB:kc	2 FB:wk	
Shrubs	*Artemisia tridentata*				big sagebrush
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		KG003 KG023 KG025			

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
FO	Douglas-fir / Ponderosa pine –Saskatoon – Mock orange	PPxh1	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 and 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:

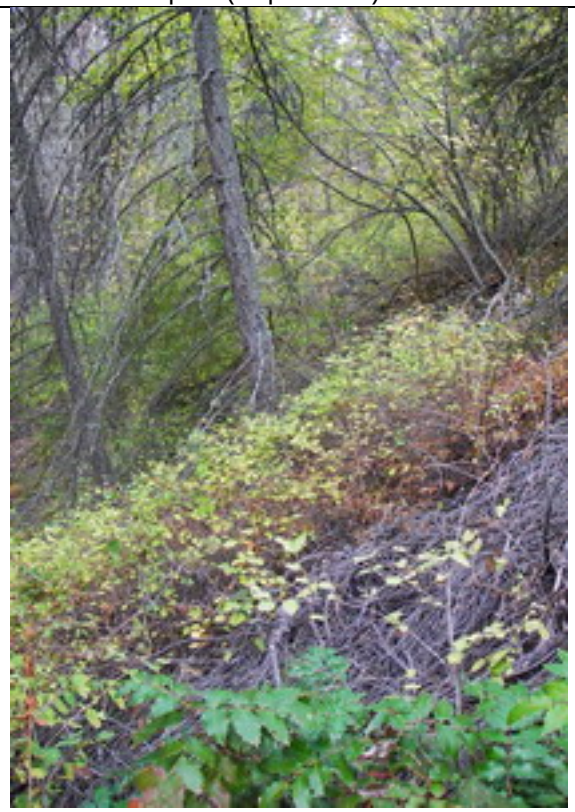
FOk	cool aspect (slope >25%)	FOsw	shallow soils (generally 50-100 cm); warm aspect (slope >25%)
FOks	cool aspect (slope >25%); shallow soils (generally 50-100cm)	FOw	warm aspect (slope >25%)

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	PPxh1	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
	Prunus virginiana	***	*	*	**	**	choke cherry
	Amelanchier alnifolia	****	**	**	***	***	saskatoon
Grasses	*Pseudoroegneria spicata*	**	*	**	**	**	bluebunch wheatgrass
	Calamagrostis rubescens	**	*	**	**	**	pinegrass
Herbs	*Lomatium dissectum*	*	*	*	*	*	fern-leaved desert parsley
Mosses	*Tortula ruralis*	*		*	*	*	sidewalk moss
PLOTS				KG020			

* 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	PPxh1	N/A
Areas set aside for playing golf including grass-covered areas, and patches of trees or shrubs.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GP	Gravel Pit	PPxh1	N/A
An area of exposed soil formed through the removal of sand and gravel			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Gs01	Alkali saltgrass	PPxh1	Gs01

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

This meadow ecosystem occurs at the fringes of alkaline ponds. It is equivalent to the unit of the same name and number in the provincial wetland classification[78]. These sites often have a white crust of salts on the soil surface. Vegetation is limited to species like saltgrass and foxtail barley that can tolerate alkaline conditions. These are dynamic ecosystems and their location and vegetation composition can change over the years with changing water levels. Foxtail barley tends to increase on drier sites This unit was uncommon and was found associated with several ponds in the Glenmore Highlands.

SITE INFORMATION	
Common Terrain Types: • lacustrine veneers	
Slope position:	depression, level
Slope (%):	0 – 5
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	very rich

	Structural Stage	2	
Grasses	*Distichlis spicata*	****	seashore saltgrass
	Hordeum jubatum	**	foxtail barley
Herbs	*Aster ericoides*	*	tufted white prairie aster
PLOTS		KV007 KV081 KV165	

* 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

[78] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Gs02	Nuttall's alkaligrass – Foxtail barley	PPxh1	Gs02

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

This meadow ecosystem occurs at the fringes of alkaline ponds. It is equivalent to the unit of the same name and number in the provincial wetland classification[79]. These sites often have a white crust of salts on the soil surface. Vegetation is limited to species like foxtail barley that can tolerate alkaline conditions. These sites were disturbed and mostly dominated by foxtail barley. These are dynamic ecosystems and their location and vegetation composition can change over the years with changing water levels. This unit was uncommon and was found associated with several ponds in the Glenmore Highlands.

SITE INFORMATION	
Common Terrain Types: • lacustrine veneers	
Slope position:	depression, level
Slope (%):	0 – 2
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	rich – very rich

	Structural Stage	2	
Grasses	*Distichlis spicata*	**	seashore saltgrass
	Hordeum jubatum	***	foxtail barley
Herbs	*Potentilla anserina*	**	common silverweed
	Aster ericoides	*	tufted white prairie aster
PLOTS		KV008 KV039 KV082	

* 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

[79] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Gs03	Field sedge	PPxh1	Gs03

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

This meadow ecosystem occurs on moderately alkaline sites. It is equivalent to the unit of the same name and number in the provincial wetland classification[80]. Vegetation is limited dominated by field sedge on undisturbed sites. These sites were disturbed and mostly dominated by quackgrass. These are dynamic ecosystems and their location and vegetation composition can change over the years with changing water levels.

SITE INFORMATION	
Common Terrain Types: • lacustrine veneers	
Slope position:	depression, level
Slope (%):	0 – 2
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	rich

	Structural Stage	2	
Sedges and Grasses	*Carex praegracilis*	****	field sedge
	Elymus repens	***	quackgrass
	Agrostis gigantea	**	redtop
Herbs	*Aster ericoides*	**	tufted white prairie aster
	Mentha arvensis	*	field mint
PLOTS		KG014 KV060 KV075	

* 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

[80] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
GW	Giant Wildrye	PPxh1	00

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

This ecosystem occurs on slopes sites that are alkaline. These sites are generally quite small and are dominated by large clumps of giant wildrye. This is ecosystem was only observed once in the study area.

SITE INFORMATION	
Common Terrain Types: • aeolian veneer over morainal or glaciofluvial blanket	
Slope position:	lower, level, toe slopes
Slope (%):	0
Aspect:	None
Soil Moisture Regime:	subhygric
Soil Nutrient Regime:	rich

	Structural Stage	2b	
Grasses and Sedges	*Leymus cinereus*	***	giant wildrye
	Poa pratensis	**	Kentucky bluegrass
	Carex praegracilis	**	field sedge
PLOTS		KV010	

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
LA	Lake	PPxh1	N/A
These are areas of permanent open water that are greater than 2m deep and greater than 50ha. Duck Lake.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
MI	Mine	PPxh1	N/A
An unvegetated area used for the extraction of mineral ore and other materials. MIz – very steep warm slope of a mine			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
OW	Shallow Open Water	PPxh1	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 may be present. OWx – drier than typical, may only have water in spring and is usually dry during summer.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PC	Ponderosa pine – Bluebunch wheatgrass – Cheatgrass	PPxh1	04

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

This forest type is most common on moderate to steep warm aspects. It sometimes occurs on cooler aspects where soils are shallow. Occasionally found on ridges and crests where soils are not shallow enough to be the PPxh1 /02 (PT). Forests are open and dominated by bunchgrasses, particularly bluebunch wheatgrass with scattered forbs. Mosses and lichens are scattered and uncommon.

List of mapped units:

PCc	coarse-textured soils	PCrs	ridge, crest, shallow soils
PCck	coarse-textured soils, cool aspect (>25% slopes, typically southeast)	PCs	shallow soils (20-100cm deep)
PCcs	coarse-textured soils, shallow soils (20-100cm deep)	PCsw	shallow soils, warm aspect (25-50% slopes)
PCcw	coarse-textured soils, warm aspect (25-50% slopes)	PCw	warm aspect (25-50% slopes)
PCks	cool aspect (>25% slopes, typically southeast), shallow soils	PCz	very steep warm aspect (>70% slope)
PCr	ridge, crest		

SITE INFORMATION

Common Terrain Types:

- colluvial and morainal blankets and veneers
- moderate glaciofluvial slopes

Slope position:	middle and upper
Slope (%):	(30) 40 – 60%
Aspect:	south, southwest, west (also southeast on glaciofluvial slopes and shallow soils)
Soil Moisture Regime:	subxeric – submesic
Soil Nutrient Regime:	medium - poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PC	Ponderosa pine – Bluebunch wheatgrass - Cheatgrass	PPxh1	04

	Structural Stage	3	4	5	6	7	
Trees	*Pinus ponderosa*	**	****	***	***	***	ponderosa pine
Shrubs	*Amelanchier alnifolia*	***	**	**	**	**	saskatoon
	Ceanothus velutinus	***					snowbrush
Grasses	*Pseudoroegneria spicata*	***	**	***	***	****	bluebunch wheatgrass
	Koeleria macrantha	*	*	*	*	*	junegrass
Herbs	*Balsamorhiza sagittata*	**	**	**	**	**	arrowleaf balsamroot
	Antennaria spp.	**	*	*	*	*	pussytoes
	Achillea millefolium	**	*	*	*	*	yarrow
Mosses and Lichens	*Cladonia* spp.	**	**	**	**	**	clad lichens
	Tortula ruralis	**	**	**	**	**	sidewalk moss
	Brachythecium sp.	*	*	*	*	*	ragged moss
PLOTS				KG013 KG019 KG021 KG031 KG038			

* 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
Snowbrush may only occur on sites that have been burned.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PD	Pond	PPxh1	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
PF	Ponderosa pine – Bluebunch wheatgrass – Rough fescue	PPxh1	05

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

This forest type is commonly associated with moderate to steep slopes on cool aspects. It is also found on gently sloping sites with shallow soils. Occasionally it is found on warm aspects, but generally these are moderately sloping (25-35%) or on 'neutral' aspects (northwest, southeast). The overstory is moderately closed, although historically frequent surface fires would have kept these stands very open. Understories are usually a mixture of rough fescue and pinegrass with scattered shrubs, forbs and mosses.

List of mapped units:

PFck	coarse-textured soils, cool aspect (30-70% slopes)	PFks	cool aspect (30-70% slopes), shallow soils (50-100cm deep)
PFk	cool aspect (30-70% slopes)		

SITE INFORMATION

Common Terrain Types:

- colluvial and morainal blankets and veneers
- moderate to steep glaciofluvial slopes

Slope position:	middle and upper
Slope (%):	30 – 75%
Aspect:	(northwest) north, northwest, east
Soil Moisture Regime:	mesic - submesic
Soil Nutrient Regime:	medium - poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PF	Ponderosa pine – Bluebunch wheatgrass – Rough fescue	PPxh1	05

	Structural Stage	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	*Festuca campestris*	**	**	***	***	***	rough fescue
	Pseudoroegneria spicata	**	*	**	**	**	bluebunch wheatgrass
	Koeleria macrantha	*	*	*	*	*	junegrass
Herbs	*Balsamorhiza sagittata*	**	*	**	**	**	arrowleaf balsamroot
	Achillea millefolium	**	*	*	*	*	yarrow
	Antennaria spp.	**	*	*	*	*	pussytoes
	Hieracium scouleri	*	*	*	*	*	Scouler's hawkweed
Mosses and Lichens	*Cladonia* spp.	**	*	*	**	**	clad lichens
	Tortula ruralis	*	*	*	**	**	rusty steppe moss
	Brachythecium albicans	*	*	*	*	*	lawn moss
PLOTS				KG018 KG022			

* 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
PT	Ponderosa pine – Red three-awn	PPxh1	02

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

This forest type most commonly occurs on moderate to steep warm aspects, with shallow or very shallow soils (PTv). It is also commonly found on moderate to steep slopes of all aspects and ridge crests where the soils are extremely shallow. 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 (bluebunch wheatgrass and rough fescue) dominate the understory. A lichen and moss crust may be present on undisturbed sites. This ecosystem also occurs on steep glaciofluvial slopes with ravelling, sandy surface soils (PT). Trees and other vegetation is usually widely spaced and scattered on these slopes.

List of mapped units:

PTjv	gentle slopes, very shallow soils, exposed bedrock present	PTrv	ridge, very shallow soils, exposed bedrock present
PTkv	cool aspect, very shallow soils, exposed bedrock present	PTv	very shallow soils, exposed bedrock present
PTqv	very steep cool aspect, very shallow soils, exposed bedrock present	PTvz	very shallow soils, exposed bedrock present , very steep warm aspect

SITE INFORMATION

Common Terrain Types:

- thin and very thin colluvial, morainal and weathered bedrock veneers over bedrock
- steep glaciofluvial slopes

Slope position:	upper and crest (and middle slopes on steep glaciofluvial sites)
Slope (%):	0-70%
Aspect:	none (crest), south, southwest
Soil Moisture Regime:	very xeric to subxeric
Soil Nutrient Regime:	poor (very poor, medium)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PT	Ponderosa pine – Red three-awn	PPxh1	02

	Structural Stage	3	4	5	6	7	
Trees	*Pinus ponderosa*	**	***	***	***	***	ponderosa pine
	Pseudotsuga menziesii var. *glauca*			*	**	**	Douglas-fir
Shrubs	*Amelanchier alnifolia*	**	**	**	**	**	saskatoon
	Symphoricarpos albus	**	*	*	*	*	common snowberry
Grasses and Sedges	*Pseudoroegneria spicata*	***	***	***	***	***	bluebunch wheatgrass
	Bromus japonicus or tectorum	*	*	*	*	*	Japanese brome or cheatgrass
	Festuca campestris		*	*	**	**	rough fescue
Herbs	*Selaginella densa*	***	**	**	**	**	compact selaginella
	Balsamorhiza sagittata	**	**	**	**	**	arrowleaf balsamroot
	Penstemon fruiticosa	**	**	**	**	**	shrubby penstemon
Lichens	*Cladonia* spp.	**	**	**	**	**	clad lichens
Mosses	*Polytrichum piliferum*	**	**	**	**	**	awned haircap moss
PLOTS			KG001				

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: cover of Japanese brome or cheatgrass will usually increase with disturbance, spreading dogbane is often present on steep glaciofluvial sites

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PW	Ponderosa pine – Bluebunch wheatgrass – Idaho fescue	PPxh1	01

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

This forest type is commonly associated with gentle slopes. The overstory is generally open and dominated by ponderosa pine. Historically these sites would have been kept extremely open by frequent low-severity surface fires. Saskatoon, bluebunch wheatgrass, rough fescue and arrow-leaved balsamroot are most common in the understory. This ecosystem type been altered extensively by selection logging and ingrowth of small trees into formerly open forests (as shown in picture below).

List of mapped units:

PWc	coarse-textured soils (typically glaciofluvial materials)	PWks	cool aspect (NW or SE, 25-35% slopes, usually mid-upper slopes), shallow soils (generally 50-100cm deep)
PWf	fine-textured soils (glaciolacustrine)	PWs	shallow soils (50-100cm deep)
PWk	cool aspect (NW or SE, 25-35% slopes, usually mid-upper slopes),	PWw	warm aspect (usually WNW or SE, 25-35% slopes)

SITE INFORMATION

Common Terrain Types:

- Gently sloping glaciofluvial and morainal slopes and terraces

Slope position:	Level, mid to upper
Slope (%):	0-15 (25)%
Aspect:	none
Soil Moisture Regime:	submesic – mesic
Soil Nutrient Regime:	poor – medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PW	Ponderosa pine – Bluebunch wheatgrass – Idaho fescue	PPxh1	01

	Structural Stage	3	4	5	6	7	
Trees	*Pinus ponderosa*		**	***	**	**	ponderosa pine
Shrubs	*Amelanchier alnifolia*	**	**	*	*	*	saskatoon
	Mahonia aquifolium	**	*	*	*	*	tall Oregon-grape
	Ceanothus sanguineus or *C. velutinus*	***	*				redstem ceanothus or snowbrush
Grasses	*Festuca campestris*	*	**	***	***	**	rough fescue
	Pseudoroegneria spicata	**	*	**	**	***	bluebunch wheatgrass
	Bromus tectorum	*	*	*	*	*	cheatgrass
Herbs	*Balsamorhiza sagittata*	***	**	**	**	**	arrow-leaved balsamroot
	Antennaria spp.	**	**	**	**	**	pussytoes
	Achillea millefolium	*	*	*	*	*	yarrow
	Hieracium scouleri	*	*	*	*	*	Scouler's hawkweed
Mosses and Lichens	*Brachythecium* sp.	*	*	*	*	*	ragged moss
	Cladonia spp.	*		*	**	**	clad lichens
	Tortula ruralis	*	*	*	**	**	sidewalk moss
PLOTS		KV172	KV002	KG037	KG029		

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
RE	Reservoir	PPxh1	N/A
A man-made body of water created by impounding water behind a dam, berm, dyke, or wall. Older reservoirs may have wetland ecosystems associated with them.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RI	River	PPxh1	N/A
A watercourse with water flowing between continuous, definable banks. Used for the river bed of Mission Creek.			

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RN	Railway Surface	PPxh1	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	PPxh1	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. Generally rock outcrops on the east side of the study area had more fractures than those on the west side of the study area.			
List of mapped units:			
ROw	warm aspect, slope >25%	ROz	very steep warm aspect, slope >70%

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
RS	Western redcedar / Douglas-fir – False Solomon's Seal	PPxh1	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:

RSg occurs in a gully

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	PPxh1	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

* 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	PPxh1	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	PPxh1	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[81]	PPxh1	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.

List of mapped units:

SAkv	cool aspect, very shallow soils	SAvw	very shallow soils, warm aspect
SAqv	very steep cool aspect (>100% slope), very shallow soils	SAvz	very shallow soils, very steep warm aspect (>100% slope)
SArv	ridge, very shallow soils		

SITE INFORMATION

Common Terrain Types:

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

Slope position:	crest, upper
Slope (%):	40 – 70
Aspect:	variable
Soil Moisture Regime:	very xeric – xeric
Soil Nutrient Regime:	very poor – poor

[81] 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	PPxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	**	**	**	**	Douglas-fir
	Pinus ponderosa	*	***	***	***	***	ponderosa pine
Shrubs	*Amelanchier alnifolia*	**	**	**	**	**	saskatoon
	Philidelphus lewisii	*	*	*	*	*	mock orange
Grasses	*Pseudoroegneria spicata*	***	***	***	***	***	bluebunch wheatgrass
Herbs	*Selaginella densa*	**	**	**	**	**	compact selaginella
	Penstemon fruticosa	*	*	*	*	*	shrubby penstemon
	Woodsia scopulina	*	*	*	*	*	mountain cliff fern
Lichens	*Cladonia* spp.	**	**	**	**	**	clad lichens
Mosses	*Polytrichum piliferum*	**	**	**	**	**	awned haircap moss
PLOTS		KG002					

* 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. Rather 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	PPxh1	00

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

This ecosystem commonly occurs on bedrock outcrops with low relief, generally unfractured bedrock. Selaginella and rusty steppe moss with some grasses and forbs dominate these sites. Shrubs are sometimes present but are quite uncommon due to the lack of fractures in the bedrock.

SB:cg *Cheatgrass seral association*
This seral association is dominated by cheatgrass.

List of mapped units:

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

SITE INFORMATION

Common Terrain Types:

- Very thin morainal, glaciofluvial, weathered bedrock and colluvial veneers

Slope position:	crest
Slope (%):	0-20
Aspect:	all
Soil Moisture Regime:	very xeric
Soil Nutrient Regime:	poor, medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SB	Selaginella – Bluebunch wheatgrass rock outcrop	PPxh1	00

	Structural Stage Seral stage	2 SB	2 SB:cg	
Shrubs	*Amelanchier alnifolia*	*	*	saskatoon
Grasses	*Pseudoroegneria spicata*	**	*	bluebunch wheatgrass
	Bromus tectorum	*	***	cheatgrass
	Poa secunda	*	*	Sandberg's bluegrass
Herbs	*Selaginella densa*	***	***	compact selaginella
	Eriogonum heracleoides	**	*	parsnip-flowered buckwheat
	Achillea millefolium	*	*	yarrow
Lichens and Mosses	*Cladonia* spp.	**	*	clad lichens
	Tortula ruralis	**	*	sidewalk moss
	Polytrichum piliferum	**	*	awned haircap moss
PLOTS		KG017 KG027 KV200		

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
SO	Saskatoon – Mock orange Talus	PPxh1	00

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

This forest type is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. Scattered trees (Douglas-fir, ponderosa pine and/or aspen) and scattered shrubs (mock orange, snowberry, ocean spray) 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 development, typically a mixture of both angular rocks and sandy, silty material. Cool aspects more commonly have trees on them. Sites that are dominated by shrubs will not necessarily succeed into a forested structural stage. Historically, these sites would not have enough fuel to burn. Thus they would be have been a seed source for some dry refugia species that are fire intolerant such as Rocky Mountain juniper.

List of mapped units:

SOk	cool aspect	SOsw	shallow soils, warm aspect
SOks	cool aspect, shallow soils	SOw	warm aspect

SITE INFORMATION

Common Terrain Types:

- rubbly colluvium

Slope position:	Lower to upper
Slope (%):	60-75%
Aspect:	All
Soil Moisture Regime:	subxeric to very xeric
Soil Nutrient Regime:	poor to medium

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SO	Saskatoon – Mock orange Talus	PPxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	**	**	**	**	Douglas-fir
	Pinus ponderosa	*	**	**	**	**	ponderosa pine
Shrubs	*Philadelphus lewisii*	***	**	**	**	**	mock-orange
	Amelanchier alnifolia	**	**	**	**	**	saskatoon
	Symphoricarpos albus	**	**	**	**	**	common snowberry
	Prunus virginiana	**	*	**	**	**	choke cherry
Grasses	*Pseudoroegneria spicata*	*	*	*	*	*	bluebunch wheatgrass
Herbs	*Woodsia* sp.	*	*	*	*	*	cliff fern
	Heuchera cylindrical	*	*	*	*	*	round-leaved alumroot
PLOTS		KG035		KG033			

* 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 – Snowberry - Pinegrass	PPxh1	06

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

This forest type is commonly associated with gentle lower slopes and moderate to steep cool aspects that are receiving some subsurface moisture. Common on the lower slopes of gullies, adjacent to the wetter /08 (DM) unit mapped along the creeks and streams. Forests are moderately closed with mixed Douglas-fir and ponderosa pine overstories, although historically they would have been quite open, as fire would have been a frequent disturbance. The understory is dominated by snowberry and pinegrass. Mosses are prominent in the moss and lichen layer, especially on the cool aspects. Forbs are more abundant on the open sites that have been less subject to ingrowth (or have been thinned). This ecosystem also occurs on gentle glaciofluvial slopes or terraces where ponderosa pine is often more abundant than Douglas-fir but understories are very similar. 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.

List of mapped units:

SPck	coarse-textured soils, cool aspect, slope >25%	SPk	cool aspect, slope >25%
SPg	gully	SPw	warm aspect (lower slopes, often south, southeast)
SPgw	gully, warm aspect, slope >25%		

SITE INFORMATION

Common Terrain Types:

- gentle morainal and glaciofluvial slopes
- moderate to steep morainal and glaciofluvial slopes
- glaciofluvial terraces

Slope position:	lower or toe
Slope (%):	0-30%; up to 70% on cool aspects
Aspect:	All
Soil Moisture Regime:	Mesic – subhygric
Soil Nutrient Regime:	Medium – rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SP	Douglas-fir / Ponderosa pine – Snowberry - Pinegrass	PPxh1	06

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	****	***	***	***	Douglas-fir
	Pinus ponderosa	*	**	**	**	**	ponderosa pine
Shrubs	*Symphoricarpos albus*	***	***	***	***	***	common snowberry
	Mahonia aquifolium	**	**	**	**	**	tall oregon-grape
	Spirea betulifolia	**	**	**	**	**	birch-leaved spirea
	Ceanothus sanguineus or *velutinus*	****					redstem ceanothus or snowbrush
Grasses	*Calamagrostis rubescens*	***	***	****	****	****	pinegrass
	Festuca campestris	**	**	**	**	**	rough fescue
	Elymus glaucus	*	*	*	*	*	blue wildrye
Herbs	*Arnica cordifolia*	***	**	**	**	**	heart-leaved arnica
	Aster conspicuus	**	*	*	*	*	showy aster
Mosses	*Dicranum* sp.		*	*	*	*	
PLOTS		KV201		KG032			

* 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: Fireweed seems to be common only after burning (as opposed to logging)

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SR	Snowberry – Rose – Kentucky Bluegrass	PPxh1	00

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

Typically moist shrub dominated depressions in grassland mosaics (equivalent to the IDFxh1 RF /97 unit). Sites are dominated by snowberry and Nootka rose, with some Kentucky bluegrass in openings between the shrubs. These depressions are typically much smaller and shallower than those sites with trembling aspen.

List of mapped units:

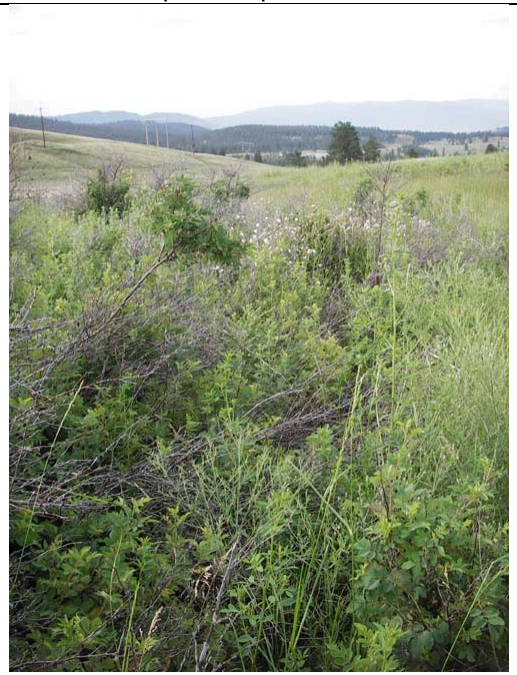
SRgw	gully, warm aspect , slope >25%	SRw	warm aspect, slope >25%

SITE INFORMATION

Common Terrain Types:

- gentle and level slopewash sites (C1) or eolian veneers over till or glaciofluvial

Slope position:	level, 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
SR	Snowberry – Rose - Kentucky bluegrass	PPxh1	00

	Structural Stage	3	
Shrubs	*Symphoricarpos albus*	*****	common snowberry
	Amelanchier alnifolia	**	saskatoon
	Rosa nutkana or *gymnorcarpa* or *acicularis*	****	roses
Grasses	*Poa pratensis*	**	Kentucky bluegrass

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
TA	Talus	PPxh1	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		TAw warm aspect	

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
UR	Urban/Suburban	PPxh1	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	PPxh1	00

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

This ecosystem commonly occurs on moderately steep to steep warm slopes. Often surface soils are actively ravelling. Bluebunch wheatgrass and balsamroot dominate these sites. Bunchgrasses are more widely spaced than on more gentle slopes. Many of these sites have been disturbed by grazing and have been invaded by weeds (see seral association descriptions 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. Invasive weeds including knapweed, cheatgrass and sulphur cinquefoil dominate 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:

WBc	coarse-textured soils	WBk	cool aspect (usually NW or ESE), slope >25%
WBck	coarse-textured soils, cool aspect (NW or ESE)	WBks	cool aspect (usually NW or ESE), shallow soils (20-100cm)
WBcs	coarse-textured, shallow soils (20-200cm)	WBkv	cool aspect (NW, ESE), very shallow soils (<20cm)
WBf	fine-textured soils	WBrs	ridge or crest, shallow soils (20-100cm)
WBjs	gentle slope (<25%), shallow soils (20 -100cm)	WBs	shallow soils (20-100cm)
WBjv	gentle slope (<25%), very shallow soils (<20cm)	WBz	very steep warm aspect (slope >70%)

cool aspect

SITE INFORMATION

Common Terrain Types:

- morainal and glaciofluvial blankets and veneers

Slope position:	middle, upper
Slope (%):	30-65%
Aspect:	south, southwest, west
Soil Moisture Regime:	subxeric
Soil Nutrient Regime:	medium – poor

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
WB	Bluebunch wheatgrass – Balsamroot	PPxh1	00

	Structural Stage Seral Association	2 WB	2 WB:kc	2 WB:wk	
Grasses	*Pseudoroegneria spicata*	****	*	**	bluebunch wheatgrass
	Bromus tectorum	*	****	***	cheatgrass
	Koeleria macrantha	*	*	*	junegrass
	Poa secunda	*	*	**	Sandberg's bluegrass
Herbs	*Balsamorhiza sagittata*	**	*	*	arrowleaf balsamroot
	Lupinus sericeus	**	*	**	silky lupine
	Artemisia frigida	*	*	*	pasture sage
	Eriogonum heracleoides	*	*	*	parsnip-flowered buckwheat
	Lithospermum ruderale	*	*	*	lemonweed
	Centaurea diffusa	*	***	**	diffuse knapweed
	Potentilla recta		***	**	sulphur cinquefoil
Mosses	*Cladonia* spp.	**			clad lichens
Lichens	*Tortula ruralis*	**		*	sidewalk moss
PLOTS		KG016 KG028			

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
WS	Willow – Sedge Wetland	PPxh1	00

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 associations in the provincial classification[82].

This swamp wetland ecosystem occurs at the edges of ponds and wetlands, forming a shrubby fringe on mineral soils. This is a very rare unit in the study area. It is dominated by willows, usually with sedges where it occurs at the edge of a wetland. Willow species likely vary from site to site.

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

	Structural Stage	3	
Shrubs	*Salix amygdaloides*	*****	peach-leaf willow
Sedges	*Carex* spp.	**	sedges
Forbs	*Polygonum amphibium*	**	water smartweed
PLOTS		KV143	

* 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

[82] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Ws01	Mountain Alder – Skunk Cabbage – Lady Fern Swamp	PPxh1	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[83]. This is a rare unit in the study area. The picture below shows an ecosystem in the North Okanagan.

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

[83] MacKenzie and Moran 2004

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
Ws01	Mountain Alder – Skunk Cabbage – Lady Fern Swamp	PPxh1	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

* 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