Sensitive Ecosystems Inventory: Bella Vista – Goose Lake Range 2002

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

Kristi Iverson, Iverson & MacKenzie Biological Consulting Ltd.

Jen Shypitka, Private Consultant

Okanagan Indian Band

THE REAL ESTATE FOUNDATION OF BRITISH COLUMBIA

BRITISH COLUMBIA

ALLAN BROOKS NATURE CENTRE

Acknowledgements

The Sensitive Ecosystems Inventory Steering Committee has provided project management, guidance and direction throughout the project:

Debbie Clarke	*FORECON Consulting Services*
Robert Hutton	*Okanagan Indian Band*
Keith Louis	*Okanagan Indian Band*
Susan Latimer	*Ministry of Water, Land and Air Protection*
Dale Rintoul	*City of Vernon*
Al McNiven	*Greater Vernon Services Commission*
Ken Barton	*Allan Brooks Nature Centre*
Carmen Wong	*Allan Brooks Nature Centre*
Dale Donovan	*Okanagan University College*

The project was funded by The Real Estate Foundation, the Ministry of Water, Land and Air Protection, the City of Vernon, the Ministry of Sustainable Resource Management, and the Allan Brooks Nature Centre.

Project management and extension was provided by *Debbie Clarke*. Field work was completed by ***Kristi Iverson***[1], ***Jen Shypitka***[2], and ***Mike Sarell*** and ***Allison Haney***[3]. Bioterrain, erosion potential and slope stability mapping was completed by ***Jen Shypitka*** and ecosystem mapping was completed by ***Kristi Iverson***. Field assistance was provided by ***Colleen Marchand*** and ***Keith Louis***[4] on Indian Reserve Lands. ***Terry McIntosh***[5] verified voucher plant and moss specimens. ***Bon Lee***[6] completed digital and cartography work.

Quality assurance was provided by ***Corey Erwin*** and ***Deepa Spaeth Filatow***[7].

This project has adapted material from the reports for the Central Okanagan Sensitive Ecosystem Inventory.

We would like to thank Tavistock Properties Ltd., Y-K Properties Ltd., Aspen Farms Ltd. and Jacana Enterprises Ltd. for providing access to their lands for sampling.

[1] Iverson & MacKenzie Biological Consulting Ltd.
[2] Private consultant
[3] Ophiuchus Consulting
[4] Okanagan Indian Band
[5] Biospherics Environmental Inc.
[6] Baseline Geomatics Inc.
[7] Ministry of Sustainable Resource Management

Introduction

This report presents detailed information on ecosystems in the Bella Vista – Goose Lake Range of the North Okanagan. It is the second volume in a series of three volumes.

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

This report describes the natural setting of the study area and details methods, results and recommendations for bioterrain mapping, ecosystem mapping, and slope stability and erosion potential mapping. It is intended for use by professionals that require more detailed ecological and terrain information. It is recommended for use by people interested in developing other interpretive map themes from the ecosystem or terrain mapping.

Volume 1[8] is intended for people and organizations that need information to help conserve and protect remaining sensitive and important ecosystems in the Central Okanagan and other similar areas. It is also intended to provide information and advice to landowners and developers on how to minimize and avoid possible degradation of sensitive ecosystems due to land use and development activities.

Volume 3[9] contains wildlife habitat mapping themes developed from the terrestrial ecosystem mapping (TEM) for the following ten species: great basin spadefoot (*Spea intermontana*), Western rattlesnake (*Crotalus viridis*), gopher snake (*Pituophis catenifer* ssp*. deserticola*), Western screech-owl (*Otus kennicottii* ssp*. macfarlanei*), long-billed curlew (*Numenius americanus*), yellow-breasted chat (*Icteria virens*), Brewer's sparrow (*Spizella breweri* ssp*. breweri*), grasshopper sparrow (*Ammodramus savannarum*), Swainson's hawk (*Buteo swainsonii*), and badger (*Taxidea taxus*). All of these species are considered at risk in the province of B.C. and local populations are also a concern. These species provide a cross-section of threatened or endangered reptiles, birds, and mammals that depend on a range of different sensitive and important ecosystems in the study area.

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

[8] Iverson and Cadrin 2003

[9] Sarell et al. 2003

Table of Contents

List of Figures

List of Tables

1 Study Area

The study area is located along the western edge of the City of Vernon, B.C. (Figure 1). The area is located within TRIM maps 82L.024, 82L.034, 82L.023 and covers 5728 ha.

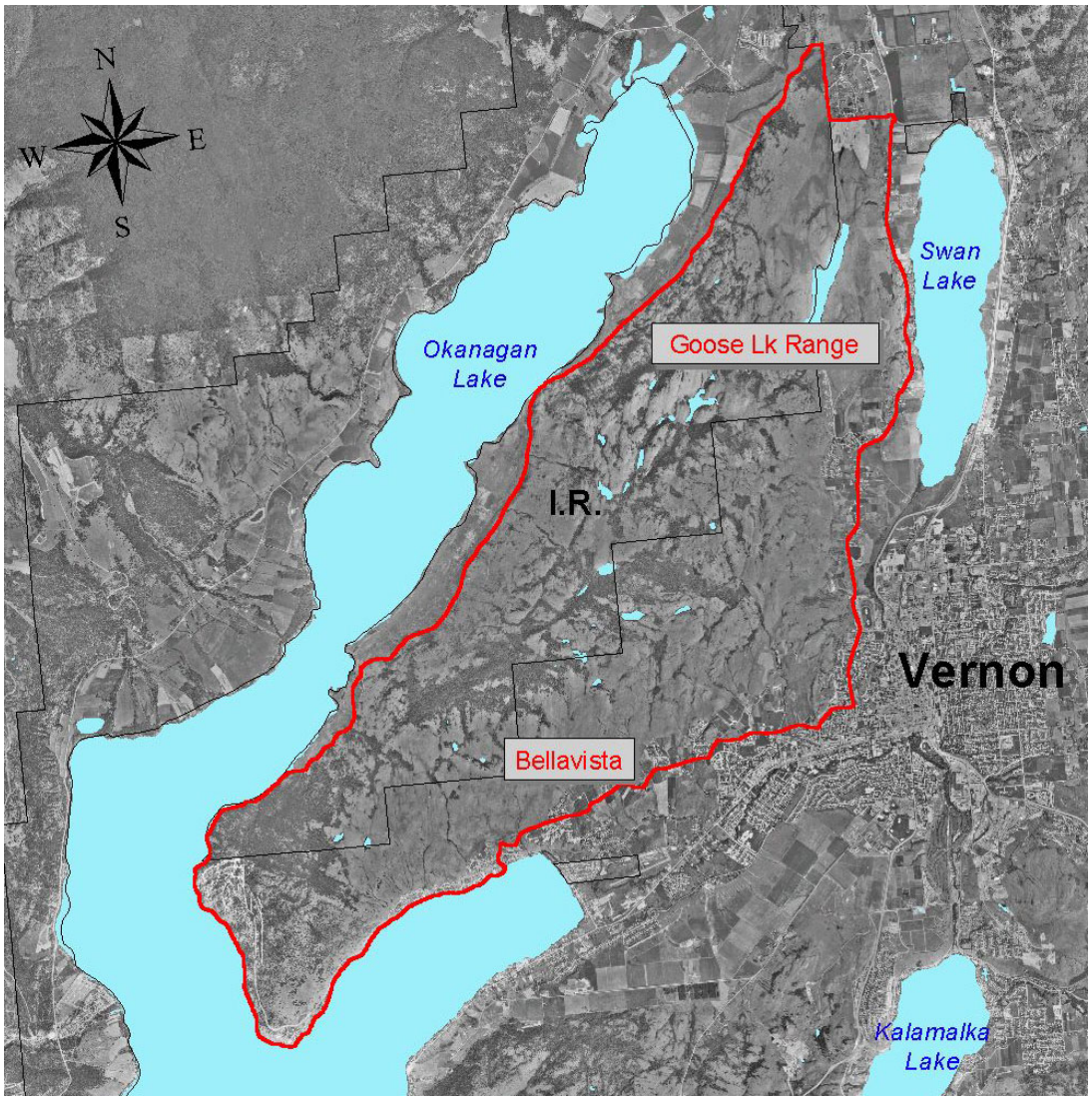


Figure 1. Study area.

1.1 Landscape Setting

The study area lies within the Interior Plateau physiographic division of British Columbia along the southerly portion of the Thompson Plateau. The Thompson Plateau is characterized by an undulating upland of low relief lying between 1220 m and 1525 m[10].

Bedrock Geology

Bedrock mapping covering the study area[11,12] indicate that it is underlain by three distinct geological assemblages; the Cache Creek Group, the Coast Intrusions, and the Kamloops Group (Figure 2).

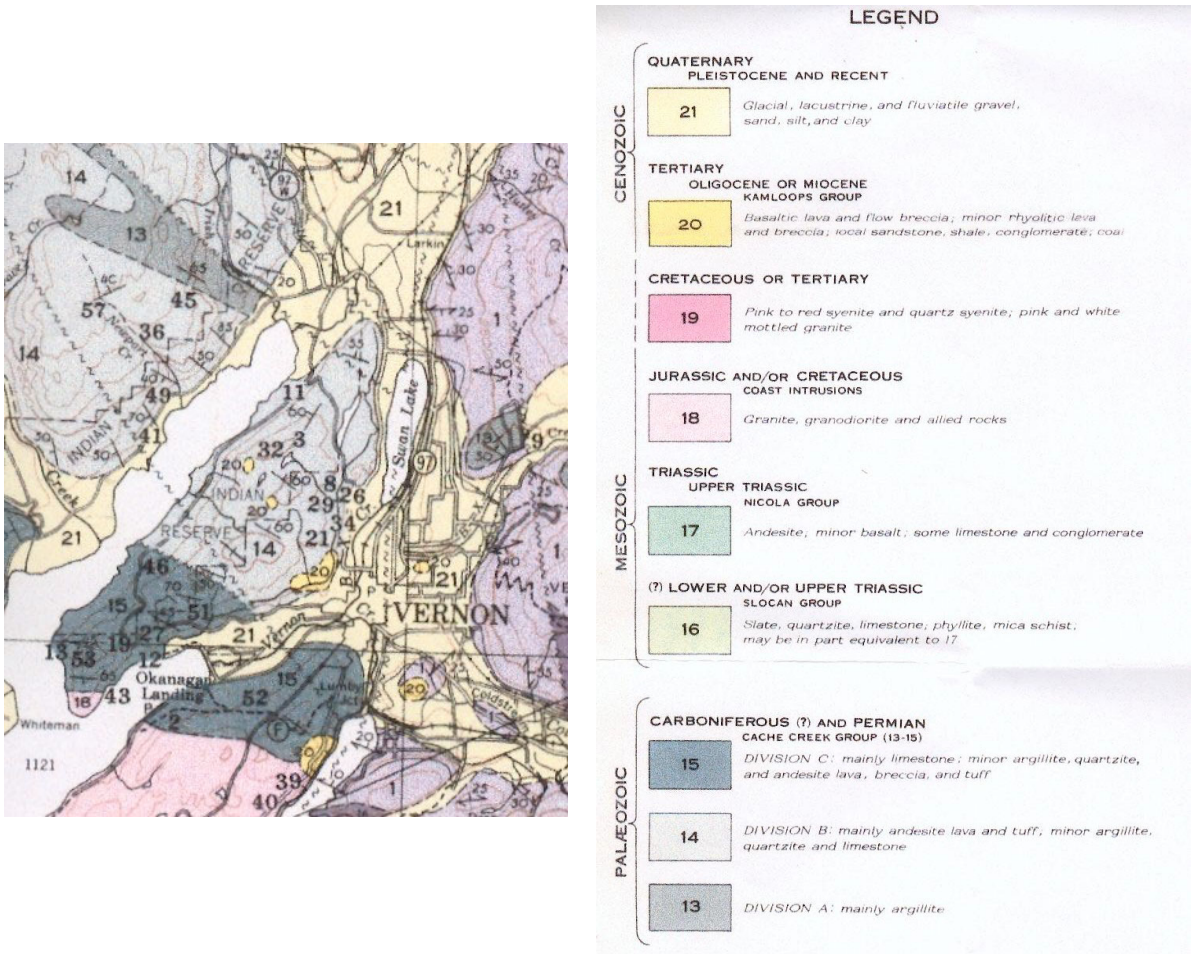


Figure 2. Bedrock geology of the study area. 1:253,440. From: Jones and Rice (1960), GSC, Map 1059A.

The Cache Creek Group of Carboniferous and Permian Age (225 to 345 million yrs old) underlie the majority of the study area. The southern third of the study area (Division C) is comprised of

[10] Holland 1976
[11] Jones and Rice 1960
[12] Wheeler and McFreely 1991

mainly limestone; minor argillite, quartzite, and andesite lava, breccia, and tuff. The northern portion (Division A) is comprised of mainly andesite lava and tuff; minor argillite, quartzite and limestone.

The Coast Intrusions of Jurassic or Cretaceous Age (65 to 190 million yrs old) are comprised of granite, granodiorite, and allied rocks. This assemblage is shown on the geology map as occurring only on the southern tip of the study area. However, in the field, granitics were also found to the north of this (e.g. plot 9901753).

The Kamloops Group of Oligocene or Miocene Age (5 to 38 million yrs old) is comprised of basaltic lava and flow breccia, local sandstone, shale, conglomerate, and coal. Little pockets of the Kamloops Group are shown scattered occasionally throughout the middle portion of the study area; we observed columnar basalt cliffs at plot BVV022.

Surficial Geology and Soils

All of British Columbia was encompassed by ice during the most recent glaciation, the Fraser glaciation. The Fraser ice was at its maximum about 15 000 years ago. Approximately 11 000 years ago, major valleys in the Thompson Plateau became ice free[13]. Within the study area, ice deposited thick blankets of till on the lower slopes, while scouring on the upper slopes and rolling uplands resulted in thinner, more discontinuous till mantles. Gradual stagnation and downwasting of the Okanagan ice lobe resulted in ice marginal meltwater channels[14], leaving behind glaciofluvial deposits at various elevations.

The irregular melting of stagnant ice also created glacial Lake Penticton; it covered the valley bottom at the west, north, and east perimeter of the study area[15]. Glacial Lake Penticton left behind glaciolacustrine deposits of silt and clay in many of the valley bottoms in the vicinity of the study area[16]. These glaciolacustrine deposits occur just west of the study area and form gently undulating terrace and plain features.

In the 10,000 years since glaciation, there have been ongoing natural modifications to the landscape. These modifications include weathering of the upper veneer of surficial deposits into soil. Soils in the study area are mapped as dominantly luvisolic soils[17]. We also observed gleysols in wetter areas, chernozems underlying grasslands, and brunisols and regosols where the soil was shallow or less developed.

Streams have eroded into drift and bedrock and deposited fluvial sands and gravels. Slope wash has removed minor amounts of material from upslope and deposited this fine textured material on gentle slopes or in depressions. Gullying has taken place on some areas of thick till. Minor weathering of rock faces and outcrops has led to the accumulation of rockfall debris and rubble.

---

[13] Valentine et al. 1978
[14] Naysmith 1962
[15] Naysmith 1962
[16] Fulton et al. 1974
[17] Valentine et al. 1978

Climate

The study area is located within the northern portion of a dry climatic system resulting in warm, dry conditions[18]. The Coast and Cascade Mountains create a rain shadow effect in the interior of B.C., reducing summer and winter precipitation. In summers, hot dry air moves in from the Great Basin to the south.

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

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[19]. 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[20]. The Okanagan Very Dry Hot Interior Douglas-fir Variant (IDFxh1) is the only biogeoclimatic variants in 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 is predominantly grasslands.

1.2 Ecology and Disturbance Processes

Historically, frequent low-intensity surface fires maintained grasslands and open Douglas-fir and ponderosa pine forests. Both lightning and First Nations peoples likely started fires. First Nations people used fire to improve wildlife habitat, root crops (for example, mariposa lily and balsamroot) and likely to fireproof their villages[21]. 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[22]. Big sagebrush was probably less abundant on the landscape as it cannot resprout after fire[23].

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

---

[18] Demarchi 1996

[19] 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.

[20] 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.

[21] Turner 1994; Pokotylo and Foese 1983; Daubenmire 1968

[22] Daubenmire 1968

[23] Bradley 1986

likely often died[24]. Historically, forests were mostly very open with grassy, shrubby understories. Moister sites were more productive and likely more closed and shrubby. Fires also contribute to nutrient cycling, releasing nutrients that are otherwise very slowly released through decay processes.

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[25].

Historically, the principal grazing animals were likely deer and elk[26]. Domestic cattle grazing began in the late 1800's and many of the grasslands in the study area have reduced cover of the more grazing-sensitive species such as bluebunch wheatgrass and rough fescue and have more grazing resistant native grasses such as Columbian needlegrass, junegrass and Sandberg's bluegrass and forbs such as pussytoes[27]. Some grasslands have been overtaken by knapweed and introduced annual brome grasses such as cheatgrass. Grasslands in the northern tip of the study area and many of the lower slopes are now dominated by invasive plants.

1.3 Human History

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

Following the discovery of gold in British Columbia, ranchers from western Oregon came and settled in the dry interior valleys of B.C. This included O'Keefe and Greenhow who each took up 160 acres in 1867 and established the O'Keefe Ranch; the largest ranch in the study area which grew to 12,000 acres at its peak[29]. By the 1870's and 1880's most grasslands had deteriorated due to overgrazing. In 1907, O'Keefe Ranch, typical of most in the Okanagan, sold off much of its land for orchards.

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

---

[24] Agee 1993
[25] Brayshaw 1970
[26] Tisdale 1947
[27] Dormaar et al.1989; McLean and Wikeen 1985; Daubenmire 1940
[28] Cannings and Durance 1998; Thomson 2000
[29] Mather 1996
[30] Cannings and Durance 1998

2 Methods and Limitations

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

2.1 Terrestrial Ecosystem Mapping

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

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

- stand composition modifiers (e.g. coniferous, mixed or broadleaf stand),
- percent canopy closure,
- percent shrub closure (for non-forested units), and
- quality and condition of the ecosystem.

Terrain Mapping

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

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

Terrain maps are the basis for many kinds of land use planning, including slope 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

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

classification[34], mapping methods[35], slope stability mapping[36] (five-class system) and bioterrain mapping methodology[37].

Project terrain mapping was more detailed than is typical as criteria for both bioterrain and slope 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 315-90°, moderate: 270-315° and 90-135, and warm from135-270°;
- geomorphological processes;
- surface expression and slope morphology (e.g., concave or convex);
- slope stability class;
- erosion potential class;
- vegetation changes;
- riparian zones and corridors;
- any other ecologically significant areas such as cliffs, talus slopes, and ponds

Preliminary terrain mapping was completed by Jen Shypitka, P.Geo. on colour aerial photographs at a scale of approximately 1: 15 000 (Table 1). Appendix C provides a terrain legend and describing all materials and geological processes mapped. Figure 3 shows an example of a terrain map label.

Table 1. Mapsheet and aerial photograph list.

TRIM Mapsheets	82L.023 82L.024 82L.034
Flight Line and Air Photo Numbers	30BCC 94048: No. 49-51, and 127-133 30BCC 94043: No. 41-45, 95-101, and 173-179 30BCC 94044: No. 31-37 30BCC 94052: No. 199-121

During preliminary terrain mapping prior to field work, polygons were delineated, and given a terrain and drainage for each polygon. Slope gradient range, slope stability, and erosion potential interpretations were added after field work. A sample of these photos covering approximately 25% of the study area were reviewed and approved by Deepa Spaeth Filatow[38], P.Geo. for review.

[34] Howes and Kenk 1997
[35] Ryder 1994
[36] Ministry of Forests 1999
[37] Resources Inventory Committee 1998
[38] Ministry of Sustainable Resource Management

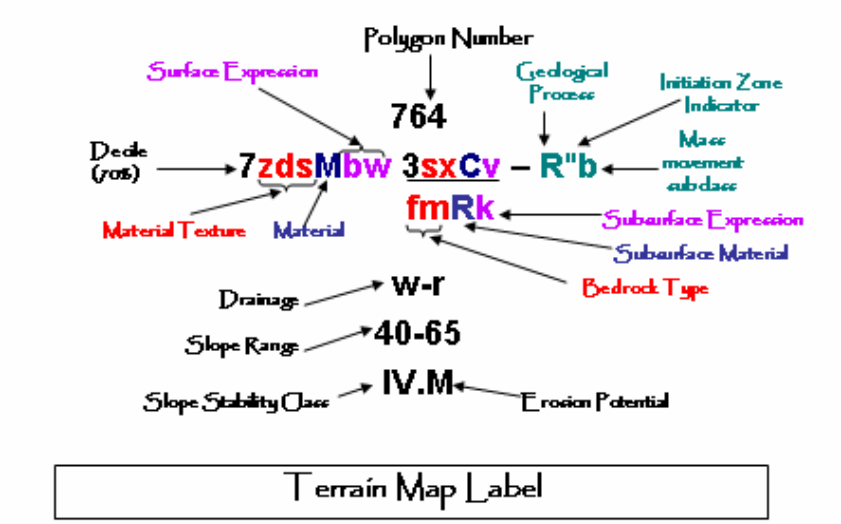


Figure 3. Sample terrain map label.

After field work, the terrain mapping was updated to reflect field observations. Slope gradient ranges were added based on field measurements and on 1:20,000 and 1:10,000 scale topographic maps. Comparison with field measurements suggests that the topographic maps are generally reliable, although some small, locally steep or gentle areas are not clearly represented by the contours.

Field Sampling

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

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

Landowners were contacted prior to fieldwork and four landowners granted us access to sample on their lands. Field sampling took place between July and August of 2002. A team of three scientists conducted field sampling: a plant ecologist (Kristi Iverson, R.P.Bio.), a terrain and soil specialist (Jen Shypitka, P.Geo.), and a wildlife habitat ecologist (Mike Sarell, R.P.Bio. or Allison Haney). Colleen Marchand and Keith Louis from the Okanagan Indian Band provided us with technical assistance when we were sampling on Indian Reserve Lands.

Three types of sample plots were used to identify and assess ecosystems and terrain: detailed ecological plots (FS882), ground inspections, and visual inspections (Appendix A). Field sampling procedures for detailed ecological plots and ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[39]. We followed guidelines from the *Standard for Terrestrial Ecosystem Mapping* in British Columbia[40] for visual inspection data collection. Additionally, we

[39] B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests 1998
[40] Resources Inventory Committee 1998

filled out a site conservation evaluation form to evaluate the quality and condition of all sensitive ecosystems.

Additional information regarding slope stability and erosion potential was collected by Jen Shypitka, P.Geo. including slope stability and erosion potential classes, signs of instability or erosion, diagrams of the local topography and material types at sites, and any other pertinent information regarding stability and erosion potential classes. On Aug. 7, 2002, Jen Shypitka, P.Geo spent a day in the field with Deepa Spaeth Filatow, P.Geo. and R.T. Robertson, GIT, accompanied by Colleen Marchand from the Okanagan Indian Band, to focus on terrain and refine slope stability and erosion potential criteria.

The location of all detailed ecological plots, ground inspection plots, and visual inspections were marked on project aerial photographs. These site locations were also digitally captured and are shown on the terrestrial ecosystem map.

Forested ecosystems were identified using existing site series described in *A Field Guide for Site Identification and Interpretation for the Kamloops Forest Region*[41]. Non-forested units such as wetlands and rock outcrops were described based on the field data and units were developed in conjunction with Dennis Lloyd, the Ministry of Forest's Regional Ecologist in Kamloops.

Approximately 6% of the plots were detailed ecological plots, 26% were ground inspections, and 68% were visual inspections. We checked a total of 18% of the polygons (TEM Survey Intensity IV, TSIL C). Detailed ecological field plots were used to sample representative sensitive ecosystems, unclassified ecosystems, and representative examples of each site series. Ground inspections were used to sample sensitive ecosystems and representative examples of site series. Visuals were primarily used to verify ecosystem units, structural stages, or terrain.

Table 2. Sites visited

FS882	Ground Inspections	Visuals	TOTAL
12	60	168	240

Expanded Legend Development

The expanded legend describes the terrain, soils, and vegetation of each ecosystem mapped in the study area. The vegetation and terrain descriptions in the expanded provided information for the wildlife biologists to develop wildlife habitat ratings (Volume 3; Sarell and Haney 2003).

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

Site Series and Site Unit Mapping

Ecosystem units were mapped according to the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[42]. Site series were identified according to Lloyd et al. (1990). Two-letter codes have been assigned to all site series in a the master list available at

[41] Lloyd et al. 1990

[42] Resources Inventory Committee 1998

ftp://ftp.env.gov.bc.ca/dist/wis/tem/mapcodes_jan2003.xls[43]. For ecosystems not included in current site series classifications, new ecosystem units were proposed and approved by the Ministry of Forests Regional Ecologist. Sparsely vegetated, non-vegetated and anthropogenic units follow the two-letter codes and descriptions in Table 3.1 of the *Standard for Terrestrial Ecosystem Mapping in British Columbia*[44].

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

The site series code and site modifier(s) are followed by a structural stage designation, one through seven. Structural stage modifiers were used to subdivide shrub and herb structural stages. Stand composition modifiers indicate the dominant stand composition and were mapped for all forested ecosystems. Crown closure was estimated for forested units and shrub cover was estimated for non-forested units. 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*[45].

Up to three ecosystems units were noted for each polygon. The percentage of each ecosystem unit present is indicated by deciles ranging from 1 to 10 (1=10%; 10=100%; Figure 4).

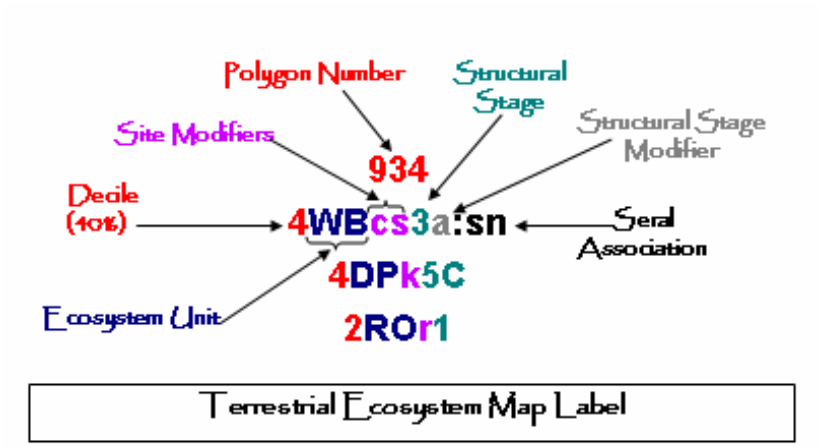


Figure 4. Example of a terrestrial ecosystem map label.

[43] Resources Inventory Committee 2000a
[44] Resources Inventory Committee 1998
[45] Resources Inventory Committee 1998

Table 3. Core polygon attributes

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

Data Management

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

Field Plot Data

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

Non-spatial Data

We captured core set of polygon attributes required to meet the provincially accepted *Standard for Terrestrial Ecosystem Mapping (TEM) - Digital Data Capture in British Columbia*[46] (Table 3).Table 4 lists the optional attributes we also applied in this project. In addition, we elected to apply "user-defined" polygon attributes. Quality/condition and viability were recorded for all occurrences of sensitive ecosystems. Slope range, erosion potential class, and terrain stability class, were also mapped as user-defined attributes. We ran quality assurance error checking routines to ensure the attribute databases were clean.

Table 4. List of Optional Attributes

Attribute
Structural stage modifiers
Stand Appearance
Seral Stage
Tree crown closure or Shrub crown closure
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[47]. The Terrain Resource Information Management (TRIM) was used as the mapping base. The linework mapped by the bioterrain and ecosystem specialists was captured through monorestitution. Monorestitution is the digital transfer of features by digitising directly from aerial photos using TRIM control points to georeference the data, and TRIM digital elevation models to correct for slope. The process allows for adjustments in polygon shape and size related to the third dimension. Standard quality assurance routines were applied to ensure accurate mapping.

2.2 Slope Stability

Slope stability refers to the susceptibility of a given slope to gravitationally-induced mass movement. Rotational slumps, debris slides, debris flows and earthflows are some examples of mass movement. Slope stability mapping provides a polygon based rating system that indicates the potential for instabilities to exist or develop as a result of anthropogenic slope modifications (eg. tree harvesting, road building, etc). This rating is based on surficial material type and texture, slope gradient range, drainage, as well as the presence and type of geomorphological processes.

A terrain stability map can be used as a planning tool for forest development, road building, or urban development. These maps identify areas that need further assessment prior to development and as such should not be considered an on-site assessment, but a tool for flagging areas needing further assessment. Terrain stability maps also help planners anticipate and/or avoid areas that may cause environmental damage[48].

---

[46] Resources Inventory Committee 2000b
[47] Resources Inventory Committee 2000
[48] Ministry of Forests 1999

Slope Stability Criteria

Criteria used to assess slope stability are shown in Table 5. Definitions for slope stability are shown in Table 5. Slope stability is defined as the resistance of a slope to failure by landsliding[49] and the classes indicate the likelihood of instability resulting from conventional harvesting and/or road building practices. Terrain stability ratings have a range of five classes for detailed terrain stability mapping, from Class **I** (stable), to Class **V** (unstable).

Table 5. Guidelines for assessment of slope stability classes.

Dominant texture	Typical surficial material	TERRAIN STABILITY CLASS				
		I	**II**	**III**	**IV**	**V**
fine s, z, zs, sz, c, m	LG, C1	<10 %	10-25 %	25-40 %	>30 % if dissected slopes (-V) >40 % if uniform slopes	all materials and landforms that are unstable; single gullies; gullies incised through very thick sediments; polygons with -F", -R"s, -R"r, -R"d
s, dsz, sdz,	LG, M	<15 %	15-30 %	30-55 %	>45 % if dissected slopes (-V) >55 % if uniform slopes	
dzs, zds, g, sd, sr, sx	M, F, FG, C	<20 %	20-40 %	40-60 %	>50 % if dissected slopes (-V) >60 % if uniform slopes	
a, b, resistant bedrock	C, R	<25 %	25-50 %	50-70 %	>65 %	

Numerical ranges in the table refer to the dominant range of slopes in percent. See Appendix C for definitions of texture and surficial material type. Table is modified from P. Uunila[50]

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. 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.

[49] Bates and Jackson 1984
[50] Uunila 2001

- ***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 slope stability class higher than a similar slope that is located in a shedding slope position.

Each slope stability class has defined management implications that are described below in Table 6.

Table 6. Definitions and management implications for slope stability classes.[51]

Stability Class	Interpretation
I	• No significant stability problems exist.
II	• There is a low likelihood of landslides following disturbance or development. • Minor slumping is expected along road cuts and excavations.
III	• Stability problems can develop. • Follow BMP to reduce the likelihood of causing slope failure. • Minor slumping is expected along road cuts and excavations. There is a low likelihood of landslide initiation following 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.

When using these ratings, it is essential to bear in mind that conditions are locally variable. The ratings (and information on the terrain map) indicate the mappers impression of typical conditions for each terrain polygon, but locally steeper slopes, wetter soils, and emergence of water from seepage zones give rise to areas that are potentially more unstable and/or more erodible than their surroundings. Consequently, persons using these maps for development should recognize and take account of these local conditions.

In some cases, a polygon may contain more than one stability class, or be able to fit into two stability classes. In these cases, the higher of the two stability classes was used for a conservative rating.

[51] Table is from Iverson et al. 2003

2.3 Erosion Potential

For this study, erosion refers to the particle by particle removal of material from bare soil by running water. Erosion potential refers to the susceptibility of a bare surface (that is without vegetation, humus, or other protective layers) to erosion by water.

Most fine sediment production from soil erosion is from the ground surface being exposed by roads or trails. Other causes of exposure of bare soil to rain are construction sites, excavation sites, landslide scars, active gullying, excessive cattle use, or a fire in which the vegetation and humus is destroyed. Sediment generated by erosion is generally transported from a source area to a depositional area.

Soil erosion potential ratings are based on surficial material type and texture, surficial material thickness, slope, drainage, slope morphology (eg, concave vs. convex), and upslope catchment area.

Erosion is a natural process, but it may be accelerated by human activity. Each polygon is assigned an erosion potential rating which gives the degree of soil erosion potential expected if the vegetation and humus is removed. Erosion potential mapping can be used as a planning tool to anticipate or avoid development in areas that may cause environmental damage.

Erosion Potential Criteria

Erosion potential is based on a five-class rating scheme ranging from very low (VL) where no problems of erosion are expected to very high (VH) where there already exists the natural movement of sediments into adjacent creeks (Table 8). Ratings were assigned to each polygon through aerial photographic interpretation.

Criteria for assessing erosion potential are based on drainage, soil texture, material thickness and slope gradient (Table 7).

Table 7. Guidelines for assessment of surface erosion potential.

Soil Drainage	*Soil Texture*[52]	*Material Thickness (m)*	Surface Erosion Potential for given slope gradient ranges			
			0 – 10%	10 – 35%	35 – 55%	>55%
v - p	fine	>1	H	VH	VH	VH
	fine	<1	H,M	H,VH	VH	VH
	medium	>1	M,H	H	VH,H	VH
	medium	<1	M,H	H	H	VH
	coarse	>1	M	H	H	H
	coarse	<1	M	M	H	H
	organic	>1	VL	L	-	-
	organic	<1	L,VL	L	-	-
i	fine	>1	M	H,VH	VH	VH
	fine	<1	M	H	VH	VH
	medium	>1	M,L	H,M	H	VH
	medium	<1	L,M	M,H	H,M	VH,H
	coarse	>1	L,VL	L,M	M	M,H
	coarse	<1	VL,L	L	M	M
m - w	fine	>1	M	H,M	H	VH
	fine	<1	M	H,M	H	H
	medium	>1	M,L	M	M	H
	medium	<1	L,M	M	M	M
	coarse	>1	VL	L	L	L
	coarse	<1	VL	VL	L	L
r - x	fine	>1	M	M,H	H	VH
	fine	<1	M,L	H,M	H	H
	medium	>1	L	M	M	M
	medium	<1	L	L,M	L,M	M
	coarse	>1	VL	VL	L	L
	coarse	<1	VL	VL	VL,L	L
	resistant bedrock	-	VL	VL	VL	VL
	less resistant bedrock	-	VL	VL,L	L	L,M

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

[52] See site modifiers in Resources Inventory Committee 1998. These definitions of fine, medium, and coarse were used as a general guideline; sandy materials were classified as either fine- or medium-textured depending upon the coarse fragment content by volume because sandy material is generally not very cohesive and is fairly erodible (Jordan 2000).

- ***Slope position***: Lower slopes and concavities tend to be more erodible because they generally receive more moisture compared to a middle slope. As a result a polygon may be rated one class higher if it is a receiving site.

  In contrast, upper slopes are generally less erodible 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 erodible than a smooth slope. A polygon may be rated one class lower if a slope is irregular enough to inhibit some erosion potential; and

- ***Geomorphic Processes***: If a polygon contains an active geomorphic process that is deemed to increase the erosion, such as gullying or slope failure, the erosion potential class may be rated one class higher.

Each soil erosion potential class has defined management implications that are shown below in Table 8.

Table 8. Definitions and management implications of soil erosion potential classes.

Class	Rating	Definition and 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.
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 these sites.

When using these ratings, it is essential to bear in mind that conditions are locally variable. The ratings indicate the mappers impression of typical conditions for each terrain polygon, but locally steeper slopes, wetter soils, and emergence of water from seepage zones give rise to areas that are potentially more erodible than their surroundings.

2.4 Mapping Limitations

TEM Mapping Limitations

Terrain Mapping Limitations

The accuracy terrain mapping and the reliability of the air photo interpretations are dependant on a number of factors. These factors include;

- skill and experience of the mapper;
- scale and quality of the air photos;

- terrain survey intensity level;
- detail and quality of field work;
- type and complexity of terrain and surficial materials;
- type and density of vegetation;
- accuracy of the base maps;
- transfer of linework and terrain symbols into digital format; and
- quality control.

The terrain mapping was completed by an experienced terrain mapper who has completed many projects throughout B.C. The terrain mapper has also had previous experience with projects in the Okanagan and other dry interior areas. The air photos used were of good quality with few shadows. The scale used is larger than the scale of final presentation, which is desirable.

The terrain survey intensity level (TSIL) represents the extent of field-checking done during mapping. It is expressed as a scale ranging from TSIL A (most checks) to TSIL E (least checks). For this project, the TSIL was level C was used.

In general, the terrain in the study area was not very complex and the vegetation was not very dense which allowed the mapper a good view of landform features while mapping.

Some locally steeper or gentler areas were not represented by the topographic maps used for estimating slope. Measurements of slope during field work helped in identifying these areas.

The transfer of line work to a digital format was checked twice. J. Shypitka (the mapper) entered all terrain data and standard quality assurance routines were used to ensure the data entry was clean. Quality control was completed by Deepa Spaeth Filatow, P.Geo from the Ministry of Sustainable Resource Management who is familiar with the terrain in this area.

The terrain mapping was based on observations of land-surface conditions and current understanding of terrain and erosion. The following factors have not been taken into account by this study: subsurface conditions not detectable by air photo interpretation or field observations, events whose time of occurrence and severity cannot be predicted (e.g., storm events), management practices, and land-use.

Slope Stability and Erosion Potential Mapping Limitations

The same limitations of terrain mapping also apply to slope stability and erosion potential mapping. None of these previously listed limitations were found to be significant, however, slope stability mapping and erosion potential mapping are also subject to additional limitations. These limitations include:

- ***Polygon based interpretations***: Both slope stability and erosion potential classes have been assigned on a polygon basis. Even with small, fairly homogeneous polygons, these classes are not always continuous across the polygon. When assigning a slope stability or erosion potential class, generally the most dominant class represented in the polygon is used. If there is a significant portion of a higher class in the polygon, then the higher class will be used for the most conservative rating.

Sometimes within a polygon, a small portion of a higher class rating will be present, but deemed not significant enough in size to increase the rating.

- ***Field verification***: Slope stability and erosion potential classes are assigned based on air photo interpretations and field verification. During field work, soil pits, root wads and road cuts are used to interpret the subsurface conditions. No deeper subsurface investigations are carried out. Groundwater flow influences both slope stability and erosion potential and can be adequately interpreted from the surface, but not as accurately as when subsurface investigations are carried out.
- ***Timing of fieldwork***: Failures and erosion are commonly associated with wet periods. Observing a wet period such as spring runoff can provide additional insight into these interpretations. Field work for this project was carried out during a dry time of the year and little precipitation occurred during this time. Therefore a wet period was not observed in the field.
- ***Interpretations based on standard practices***: Interpretations are applied based on the use of standard forestry practices from the Forest Practices Code[53]. Failure to comply with the Forest Practices Code may change the stability of a polygon. For example, if inadequate culvert placing redirected drainage to an area that previously did not receive as much water, this area will be more susceptible to failure and erosion that it is rated. Extensive irrigation is another unnatural source of water that may increase erosion potential and the likelihood of a landslide.

[53] Ministry of Forests 1999

3 Results

3.1 Terrestrial Ecosystem Mapping

Table 9 lists the ecosystems mapped in the study area, the area they covered and the percentage of the study area landbase. Appendix C provides a list of all plant species encountered during field sampling. Appendix D (Expanded Legend) provides a complete description of each ecosystem.

Table 9. Ecosystem Units mapped, their area, and their percent of the study area.

Code/ Number	Ecosystem Unit Name	Area (hectares)	% of study area
AB /00	Nuttall's alkaligrass[54] – Foxtail barley	4.9	0.09
AS /98	At – Snowberry – Kentucky bluegrass	374	6.5
BM /00	Bulrush Marsh	6.2	0.1
BN /96	Kentucky bluegrass – Stiff needlegrass	61	1.1
BR /00	Baltic Rush Marsh-Meadow	17	0.3
CD /00	ActFd –Common Snowberry – Red-osier Dogwood Riparian	5.1	0.1
CF /00	Cultivated Field	228	4.0
CL /00	Cliff	8.9	0.2
CO /00	Cultivated Orchard	130	2.3
CS /00	Common Spikerush Marsh	0.1	0.001
CT /00	Cattail Marsh	0.8	0.01
CW /00	Choke cherry – Bluebunch wheatgrass rocky bluff	55	1.0
DP /01	FdPy – Pinegrass	314	5.5
DS /07	FdPy – Snowberry – Spirea	308	5.4
DW /03	FdPy – Bluebunch wheatgrass – Pinegrass	140	2.4
ES /00	Exposed Soil	1.1	0.02
FW /91	Idaho fescue – Bluebunch wheatgrass	1241	22
LA /00	Lake	25	0.4
OW /00	Shallow Open Water	36	0.6
PB /02	FdPy – Bluebunch wheatgrass – Balsamroot	35	0.6
PD /00	Pond	5.9	0.1
RF /97	Prairie Rose – Idaho fescue	268	4.7
RO /00	Rock Outcrop	5.0	0.1
RW /00	Rural	182	3.2
RZ /00	Road Surface	28	0.5
SA/00	Antelope brush – Selaginella[55]	46	0.8
SB /00	Selaginella – Bluebunch wheatgrass rock outcrop	241	4.2
SD /08	SxwFd – Douglas maple – Dogwood	48	0.8
SM /00	Sedge Marsh	1.1	0.02
SO /00	Saskatoon – Mock orange Talus	20	0.3
SP /04	FdPy – Snowbrush – Pinegrass	88	1.5
TA /00	Talus	1.5	0.03
UR /00	Urban/Suburban	154	2.7
WB /93	Bluebunch wheatgrass – Balsamroot	1649	29
TOTAL		**5,728**	**100**

[54] Althought the plant association name includes Nuttall's Alkaligrass in the name, it is actually Weeping Alkaligrass in the study area.

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

3.2 Terrain Results

In general, the terrain in the study area was not very complex. It generally consisted of thinner soils overlying bedrock with thicker materials in the depressions on the rolling uplands, thin material and some bedrock outcrops on the steeper valley sides grading to thicker till on the lower, gentler slopes. Some glaciolacustrine material was seen on the lower slopes in very typical terrace and plain landforms. Some glaciofluvial was mapped in places as well. The glaciofluvial deposits in the upland areas were generally difficult to identify by air photo interpretation as they did not follow typical glaciofluvial landforms.

In general, the study area can be divided in to three distinct regions: the rock controlled rolling uplands, the steeper sided valley walls dropping down from the rolling uplands to the lake, and the gently sloping to flat valley bottom.

The rolling upland area is generally gently sloping with locally steeper areas, and as such, most of this area is mapped as stable. The valley sides below the uplands contain the steepest areas and have a range of material from thin and rocky to less commonly thick exposures of till. The valley bottom is flat to gently sloping, and mainly stable.

The main areas of concern with regard to slope stability and erosion potential are located on the valley sides. Most polygons with slope stability class **IV** and **V** are located here. The only access to the gentle uplands is through theses steeper valley side slopes. Careful planning and appropriate assessments are necessary prior to considering development in these areas.

Existing roads within the study area showed no significant signs of current instabilities or excessive active erosion, largely as a result of self armouring of the road surface. Erosion rates were likely significantly higher within the first few years following construction.

Soil degradation through disturbance from livestock was observed surrounding many of the ponds in the study area.

Depending upon what type of development may be planned for the study area in the future, an additional tool that may be useful is sediment delivery to stream interpretations. When determining the risk of erosion and sedimentation to an area, the downstream connection to resources such as water supply and fish habitat should be considered. This type of interpretation is known as 'risk of sediment delivery to streams'. It is a qualitative rating to assess the potential for sediment from soil erosion sources of reaching a watercourse or lake by surface run-off. This interpretation is made for polygons that contain high or very high surface erosion potential.

Terrain Recommendations

The following recommendations are standard for avoidance of problems during development in areas that are prone to erosion or instability:

- 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 gentle 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.
- Where slope stability class **IV** terrain occurs within areas where development is planned, on-site inspections by a qualified slope stability specialist should be carried out in order to determine more precisely the nature of the instability and the extent of the unstable areas.
- Class **V** terrain is unstable and should be avoided.

The information and analyses contained in this report are based on observations of land-surface conditions and current understanding of slope processes. However, because slope stability is strongly influenced by subsurface conditions that are not apparent from surface observations or air photo interpretation (e.g., subsurface hydrologic conditions, characteristics of subsurface materials), by events whose time of occurrence cannot be predicted (e.g., extreme storms, earthquakes), and by land management practices, the results and recommendations provided in the report cannot guarantee that no landslides will occur in areas affected by land clearing and development. Appropriate use of terrain information and implementation of recommendations will, however, reduce the risk of landslides and erosion.

References

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

Bates, R.L. and Jackson, J.A. 1984. Dictionary of Geological Terms (third edition). American Geological Institute. Bantam Doubleday Dell Publishing Group, Inc., New York, New York.

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

Bradley, A. 1986. Artemisia tridentata ssp. tridenata. In: Fischer, William C., compiler. The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory. Magnetic tape reels; 9 track; 1600 bpi, ASCII with Common LISP present.

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

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

Daubenmire, R. 1968. Ecology of fire in grasslands. Adv. Ecol. Res. 5:209-266.

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

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

Eicher, D.L. 1976. Geologic Time (second edition). Prentice-Hall, Inc., Englewood Cilffs, New Jersey.

Fulton, R.J., Berti, A.A., and Smith, G.W. 1974. Surficial Geology of Vernon, West of Sixth Meridian, British Columbia, Geological Survey of Cananda, Map 1392A, scale 1: 126, 720.

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

Howes, D.E. and E. Kenk (ed.). 1988. Terrain classification system for British Columbia. Revised edition. MOE Manual 10. B.C. Min. Environ. and B.C. Min. Crown Lands. Victoria, B.C.

Jones, A.G. and Rice, H.M.A. 1960. Geology of Vernon - Kamloops, Osoyoos, and Kootenay Districts of British Columbia; Geological Survey of Canada, Map 1059A, scale 1: 253 440.

Jordan, P. 2000. Soil erosion hazard criteria for watershed assessments in the Southern Interior. B.C, Ministry of Forests, Nelson Forest Region, Nelson, B.C.

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

Mather, K. 1996. Bunchgrass and beef: bunchgrass ecosystems and the early cattle industry in the Thompson Okanagan. http://royal.okanagan.bc/cthomson/living_landscapes/articles/bunchgrass/

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

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

Naysmith, H. 1962. Late Glacial History and Surficial Deposits of the Okanagan Valley, British Columbia, Bulletin no. 46, British Columbia Ministry of Energy, Mines and Petroleum Resources, Queen's Printer, Victoria, British Columbia.

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

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

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

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

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

Ryder, J.M. 1994. Specifications and Guidelines for Terrain Mapping in British Columbia. Surficial Geology Task Group, Earth Science Task Force, Resource Inventory Committee, British Columbia.

Thomson, Duane. 2000. The response of Okanagan Indians to European settlement. http://royal.okanagan.bc.ca/cthomson/living_landscapes/articles/ddt.html

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

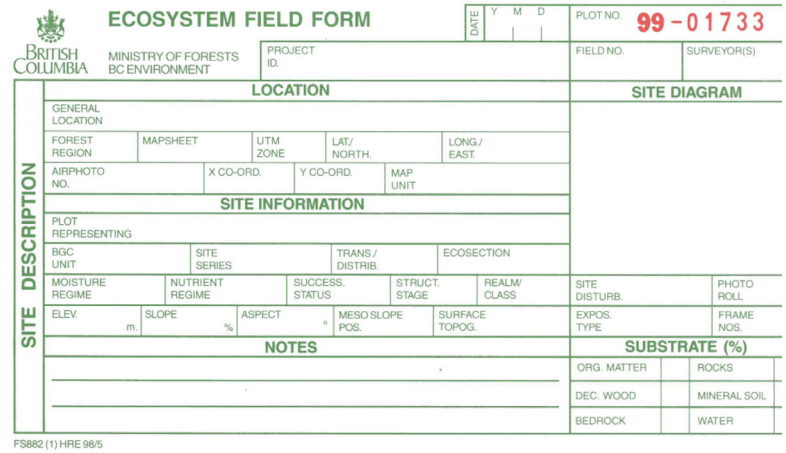
Turner, N.J. 1994. Burning mountain sides for better crops: aboriginal landscape burning in British Columbia. Int. J. Ecofor. 10:116-122.

Uunila, P. 2001. Detailed Terrain Stability Mapping (TSIL C), Chase Creek, Salmon Arm Forest District, by EBA Engineering Consultants Ltd., for Riverside Forest Products Limited, Armstrong Division, Kelowna, B.C., Unpublished.

Valentine, K.W.G., Sprout, P.N., Baker, T.E., and Lavkulich, L.M. 1978. The Soil Landscapes of British Columbia, British Columbia Ministry of Environment Resource Analysis Branch.

Wheeler, J.O. and McFreely, P. (comp), 1991. Tectonic Assemblage Map of the Canadian Cordillera and Adjacent Parts of the United States of America; Geological Survey of Canada, Map 1712A, scale 1: 2 000 000.

Appendix A: Plot forms



ECOSYSTEM FIELD FORM

BRITISH COLUMBIA — MINISTRY OF FORESTS / BC ENVIRONMENT

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

SITE DESCRIPTION

LOCATION | SITE DIAGRAM

GENERAL LOCATION

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

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

SITE INFORMATION

PLOT REPRESENTING

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

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

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

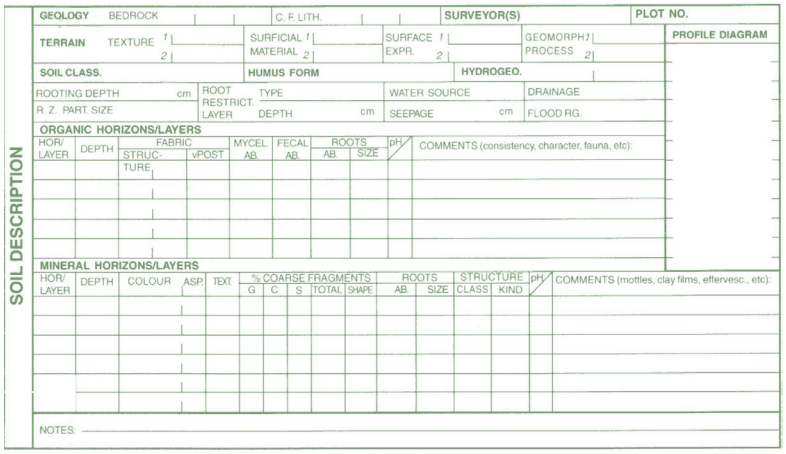
NOTES | SUBSTRATE (%)

ORG. MATTER | ROCKS

DEC. WOOD | MINERAL SOIL

BEDROCK | WATER

FS882 (1) HRE 98/5



SOIL DESCRIPTION

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

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

SOIL CLASS. | HUMUS FORM | HYDROGEO.

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

R. Z. PART. SIZE

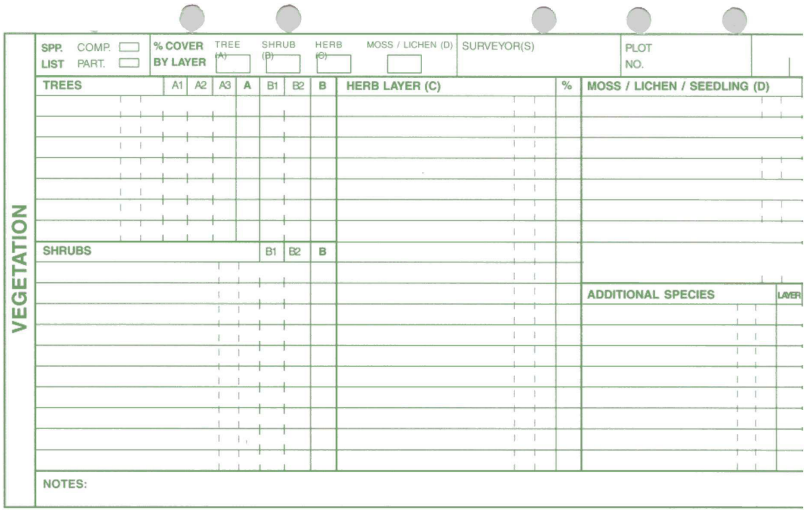
ORGANIC HORIZONS/LAYERS

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

MINERAL HORIZONS/LAYERS

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

NOTES:



VEGETATION

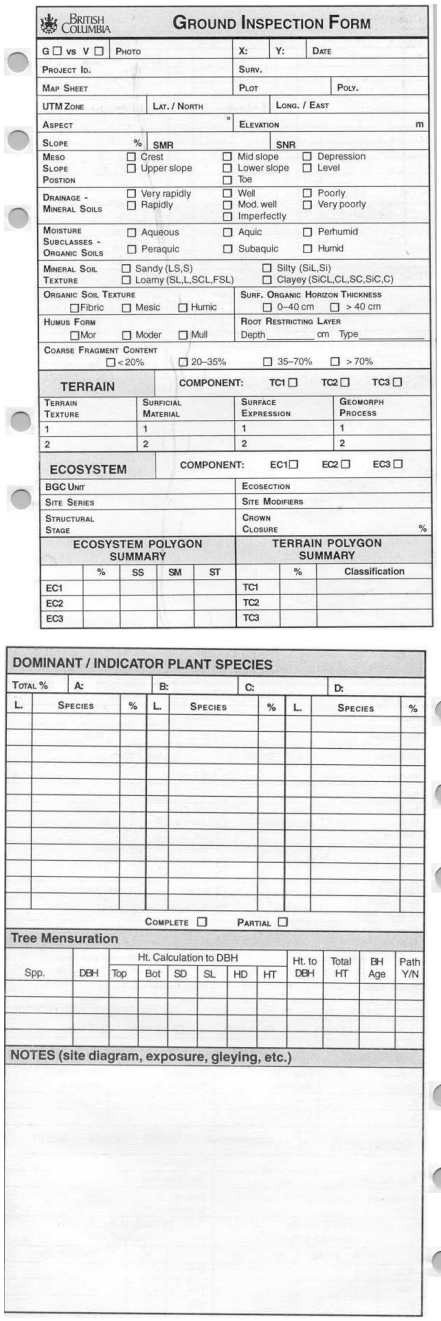
SPP. LIST COMP. PART. | % COVER BY LAYER TREE (A) SHRUB (B) HERB (C) MOSS / LICHEN (D) | SURVEYOR(S) | PLOT NO.

TREES	A1	A2	A3	A	B1	B2	B	HERB LAYER (C)	%	MOSS / LICHEN / SEEDLING (D)

SHRUBS	B1	B2	B

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 POSTION	☐ 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	☐ Aquic	☐ Perhumid	
	☐ Peraquic	☐ Subaquic	☐ Humid	

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

ORGANIC SOIL TEXTURE ☐ Fibric ☐ Mesic ☐ Humic

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

HUMUS FORM ☐ Mor ☐ Moder ☐ Mull

ROOT RESTRICTING LAYER Depth_____ cm Type_____

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

TERRAIN

COMPONENT: TC1 ☐ TC2 ☐ TC3 ☐

TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1	1	1	1
2	2	2	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						Ht. to DBH	Total HT	BH Age	Path Y/N
		Top	Bot	SD	SL	HD	HT				

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

CONSERVATION EVALUATION & VISUAL INSPECTION FORM

PROJ. ID.	**SURV.**

POLY	**AIR PHOTO #**	**DATE**

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

PLOT #	**GR. PHOTO #.**	MAPSHEET
UTM ZONE	LAT./NORTH	LONG./EAST
ASPECT °	ELEVATION m	SLOPE %
MESO SLOPE	SOIL DRAINAGE	SOIL TEXTURE

ECOSYSTEM COMPONENT 1:	
TERRAIN COMPONENT 1	

DOMINANT / INDICATOR VEGETATION SPECIES

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

SPECIES	L	%	SPECIES	L	%	SPECIES	L	%

COMPLETE ❒ PARTIAL ❒

% Fragmentation (Plant Association)				
❑ UNFRAGMENTED (< 5% of polygon) ❑ PARTLY FRAGMENTED (5 - 25 % of polygon) ❑ HIGHLY FRAGMENTED (> 25% of polygon)				
SITE DISTURBANCE (e.g., L.c/F.l.b.b)				
ADJACENT LAND USE:				
KNOWN THREATS:				
OTHER FACTORS:				
EVALUATION SUMMARY:				
QUALITY	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
CONDITION	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
VIABILITY	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
DEFENSIBILITY	❑ EXCELLENT	❑ GOOD	❑ MARGINAL	❑ POOR
NOTES (site diagram, exposure, gleying, etc.)				

Appendix B: Vegetation Species List

Note: This is not a complete list of all plant species in the study area. It is a list of species that were encountered during field sampling and includes all species mentioned in this report.

*denotes introduced species; ~denotes rare plants. Please check the BC Conservation Data Centre web site for current provincial status of plant species (http://srmwww.gov.bc.ca/cdc/), and the COSEWIC web site (http://www.cosewic.gc.ca/) for national status of plant species. The sampling methodology did not include searches for rare plants and it is probable that many other rare plants occur in the study area. Known rare plants from previous inventories in the study area include *Botrychium hesperium* (western moonwort; blue-listed), *Crassula aquatica* (pigmyweed; blue-listed), and *Cyperus squarrosus* (awned cyperus; blue-listed).

Common Name	Latin Name
alfalfa*	*Medicago sativa*
alkali muhly	*Muhlenbergia asperifolia*
American bulrush	*Schoenoplectus pungens*
American bush-cranberry	*Viburnum opulus*
American vetch	*Vicia americana*
annual hawksbeard	*Crepis tectorum*
apple pelt	*Peltigera malacea*
arnica	*Arnica* sp.
arrowleaf balsamroot	*Balsamorhiza sagittata*
awned haircap moss	*Polytrichum piliferum*
baldhip rose	*Rosa gymnocarpa*
balsam poplar	*Populus balsamifera*
Baltic rush	*Juncus balticus*
Bebb's willow	*Salix bebbiana*
big sagebrush	*Artemisia tridentata*
birch-leaved spirea	*Spiraea betulifolia*
black bindweed	*Polygonum convolvulus*
black gooseberry	*Ribes lacustre*
black hawthorn	*Crataegus douglasii*
black medic*	*Medicago lupulina*
black raspberry	*Rubus leucodermis*
blue elderberry	*Sambucus caerulea*
blue forget-me-not	*Myosotis stricta*
blue wildrye	*Elymus glaucus*
bluebunch wheatgrass	*Pseudoroegneria spicata*
bluegrass	*Poa* sp.
boreal pixie-cup	*Cladonia borealis*
brain scale	*Psora cerebriformis*
bristle-moss	*Orthotrichum* sp.
brittle prickly-pear cactus	*Opuntia fragilis*
brome	*Bromus* sp.
broom-moss	*Dicranum scoparium*

Common Name	Latin Name
brown-eyed Susan	*Gaillardia aristata*
bull thistle*	*Cirsium vulgare*
butterfly pelt	*Peltigera lepidophora*
Canada bluegrass	*Poa compressa*
Canada thistle*	*Cirsium arvense*
Canada violet	*Viola canadensis*
catnip*	*Nepeta cataria*
cheatgrass*	*Bromus tectorum*
chocolate lily	*Fritillaria affinis*
choke cherry	*Prunus virginiana*
clad lichens	*Cladonia* sp.
claw-moss	*Hypnum* sp.
cleavers	*Galium aparine*
clover	*Trifolium* sp.
Columbia bower	*Clematis occidentalis*
Columbia needlegrass	*Achnatherum nelsonii*
common barberry*	*Berberis vulgaris*
common beard-moss	*Schistidium apocarpum*
common burdock*	*Arctium minus*
common cattail	*Typha latifolia*
common chickweed*	*Stellaria media*
common cocklebur*	*Xanthium strumarium*
common dandelion*	*Taraxacum officinale*
common duckweed	*Lemna minor*
common hook-moss	*Drepanocladus aduncus*
common horsetail	*Equisetum arvense*
common hound's-tongue*	*Cynoglossum officinale*
common juniper	*Juniperus communis*
common mare's-tail	*Hippuris vulgaris*
common plantain	*Plantago major*
common rabbit-brush	*Ericameria nauseosus*
common silverweed	*Potentilla anserina*
common snowberry	*Symphoricarpos albus*
common spike-rush	*Eleocharis palustris*
common stork's-bill*	*Erodium cicutarium*
common timothy*	*Phleum pratense*
compact selaginella	*Selaginella densa*
concentric pelt	*Peltigera horizontalis*
corn gromwell	*Lithospermum arvense*
cow pie	*Diploschistes muscorum*
creamy peavine	*Lathyrus ochroleucus*
cutleaf evergreen blackberry	*Rubus laciniatus*
cut-leaved daisy	*Erigeron compositus*
Dalmatian toadflax*	*Linaria genistifolia* ssp. *dalmatica*
desert alyssum*	*Alyssum desertorum*
diffuse fleabane	*Erigeron divergens*
diffuse knapweed*	*Centaurea diffusa*

Common Name	Latin Name
dog pelt	*Peltigera canina*
dog rose*	*Rosa canina*
Douglas' knotweed	*Polygonum douglasii*
Douglas maple	*Acer glabrum*
Douglas-fir	*Pseudotsuga menziesii*
early blue violet	*Viola adunca*
electrified cat's-tail moss	*Rhytidiadelphus triquetrus*
European bittersweet*	*Solanum dulcamara*
European mountain-ash*	*Sorbus aucuparia*
false Solomon's-seal	*Maianthemum racemosum*
felt pelt	*Peltigera ponojensis*
felt pelt	*Peltigera rufescens*
fern-leaved desert-parsley	*Lomatium dissectum*
field bindweed*	*Convolvulus arvensis*
field dodder	*Cuscuta pentagona*
field filago*	*Filago arvensis*
field mint	*Mentha arvensis*
fire-moss	*Ceratodon purpureus*
foxtail barley	*Hordeum jubatum*
freckle plet	*Peltigera leucophlebia*
garden asparagus*	*Asparagus officinalis*
Geyer's desert-parsley	*Lomatium geyeri*
giant wildrye	*Leymus cinereus*
glaucous bluegrass	*Poa glauca*
golden curl-moss	*Homalothecium aeneum*
golden dock	*Rumex maritimus*
golden-aster	*Heterotheca villosa*
great duckweed	*Spirodela polyrhiza*
great mullein*	*Verbascum thapsus*
greater bladderwort	*Utricularia macrorhiza*
greater celandine*	*Chelidonium majus*
green needlegrass	*Nassella viridula*
grimmia	*Grimmia* sp.
hair bentgrass	*Agrostis scabra*
hairy vetch*	*Vicia villosa*
hairy water-clover~	*Marsilea vestita*
hard-stemmed bulrush	*Schoenoplectus acutus*
heart-leaved arnica	*Arnica cordifolia*
heron's-bill moss	*Dicranum* sp.
hillside milk-vetch	*Astragalus collinus*
Holboell's rockcress	*Arabis holboellii*
honeysuckle	*Lonicera* sp.
hybrid white willow*	*Salix x rubens*
Idaho fescue	*Festuca idahoensis*
interrupted apera*	*Apera interrupta*
Japanese brome*	*Bromus japonicus*
junegrass	*Koeleria macrantha*

Common Name	Latin Name
juniper haircap moss	*Polytrichum juniperinum*
Kentucky bluegrass	*Poa pratensis*
lamb's-quarters*	*Chenopodium album*
large-fruited desert-parsley	*Lomatium macrocarpum*
large-leaved avens	*Geum macrophyllum*
lawn moss	*Brachythecium albicans*
leafy moss	*Mnium* sp.
lemonweed	*Lithospermum ruderale*
lesser green reindeer	*Cladina mitis*
lesser powderhorn	*Cladonia coniocraea*
Lindley's aster	*Aster ciliolatus*
little meadow-foxtail	*Alopecurus aequalis*
Loesel's tumble-mustard*	*Sisymbrium loeselii*
long-spurred plectritis	*Plectritis macrocera*
low pussytoes	*Antennaria dimorpha*
Lyall's goldenweed	*Tonestus lyallii*
meadow aster	*Aster campestris*
meadow brome*	*Bromus commutatus*
meadow death-camas	*Zigadenus venenosus*
meadow sedge	*Carex praticola*
mealy pixie-cup	*Cladonia chlorophaea*
Menzies' campion	*Silene menziesii*
Michaux's mugwort	*Artemisia michauxiana*
mock-orange	*Philadelphus lewisii*
mountain cliff fern	*Woodsia scopulina*
mountain sweet-cicely	*Osmorhiza berteroi*
mouse-ear chickweed*	*Cerastium fontanum*
mutton grass	*Poa fendleriana*
n/a (lichen)	*Cladina arbuscula*
n/a (lichen)	*Cladonia cornuta*
n/a (lichen)	*Cladonia gracilis*
n/a (liverwort)	*Lophozia* sp.
n/a (liverwort)	*Riccia* sp.
n/a (moss)	*Orthotrichum laevigatum f. macounii*
n/a (moss)	*Pterygoneurum ovatum*
n/a (vascular plant)	*Arabis* sp.
n/a (vascular plant)	*Aster* sp.
n/a (vascular plant)	*Astragalus* sp.
n/a (vascular plant)	*Lithospermum* sp.
n/a (vascular plant)	*Lomatium* sp.
n/a (vascular plant)	*Myriophyllum* sp.
n/a (vascular plant)	*Rumex* sp.
n/a (vascular plant)	*Schoenocrambe* sp.
n/a (vascular plant)	*Senecio* sp.
n/a (vascular plant)	*Woodsia* sp.
narrow-leaved collomia	*Collomia linearis*
needle-and-thread grass	*Hesperostipa comata*

Common Name	Latin Name
nine-leaved desert-parsley	*Lomatium triternatum*
nodding brome	*Bromus anomalus*
Nootka rose	*Rosa nutkana*
northern bedstraw	*Galium boreale*
northern fairy-candelabra	*Androsace septentrionalis*
northern gooseberry	*Ribes oxyacanthoides*
northern wormwood	*Artemisia campestris*
Nuttall's pussytoes	*Antennaria parvifolia*
oak-leaved goosefoot*	*Chenopodium glaucum*
old man's whiskers	*Geum triflorum*
Olney's bulrush	*Schoenoplectus americanus*
one-sided wintergreen	*Orthilia secunda*
orange arnica	*Arnica fulgens*
orchard-grass*	*Dactylis glomerata*
Pacific alkaligrass	*Puccinellia nutkaensis*
pale alyssum*	*Alyssum alyssoides*
pale comandra	*Comandra umbellata*
paper birch	*Betula papyrifera*
parsnip-flowered buckwheat	*Eriogonum heracleoides*
pasture sedge	*Carex petasata*
pebbled pixie-cup	*Cladonia pyxidata*
peg-leg soldiers	*Cladonia cariosa*
perennial sow-thistle*	*Sonchus arvensis*
pinegrass	*Calamagrostis rubescens*
pink twink	*Phlox gracilis*
pink wintergreen	*Pyrola asarifolia*
poison ivy	*Toxicodendron rydbergii*
ponderosa pine	*Pinus ponderosa*
powdered trumpet	*Cladonia fimbriata*
prairie pepper-grass*	*Lepidium densiflorum*
prairie rose	*Rosa woodsii*
prairie sagewort	*Artemisia frigida*
prickly rose	*Rosa acicularis*
prince's pine	*Chimaphila umbellata*
pulse milk-vetch	*Astragalus tenellus*
purple sweet-cicely	*Osmorhiza purpurea*
pussytoes	*Antennaria* sp.
quackgrass*	*Elymus repens*
ragged-moss	*Brachythecium* sp.
rattlesnake-plantain	*Goodyera oblongifolia*
red clover*	*Trifolium pratense*
red goosefoot*	*Chenopodium rubrum*
red hawthorn	*Crataegus columbiana*
red raspberry	*Rubus idaeus*
red-mouthed leafy moss	*Mnium spinulosum*
red-osier dogwood	*Cornus stolonifera*
red-stemmed feathermoss	*Pleurozium schreberi*

Common Name	Latin Name
redtop*	*Agrostis gigantea*
reed canarygrass	*Phalaris arundinacea*
ribbed extinguisher-moss	*Encalypta rhaptocarpa*
Rocky Mountain juniper	*Juniperus scopulorum*
rose	*Rosa* sp.
Ross' sedge	*Carex rossii*
rough fescue	*Festuca campestris*
rough-fruited fairybells	*Prosartes trachycarpa*
rough-leaved ricegrass	*Oryzopsis asperifolia*
round-leaved alumroot	*Heuchera cylindrica*
sagebrush mariposa lily	*Calochortus macrocarpus*
sand dropseed	*Sporobolus cryptandrus*
Sandberg's bluegrass	*Poa secunda*
saskatoon	*Amelanchier alnifolia*
Scotch thistle*	*Onopordum acanthium*
Scouler's willow	*Salix scouleriana*
Scouler's hawkweed	*Hieracium scouleri*
scouring-rush	*Equisetum hyemale*
seacoast bulrush	*Bolboschoenus maritimus*
seashore saltgrass	*Distichlis spicata*
sedge	*Carex* sp.
shining starwort	*Stellaria nitens*
shore buttercup	*Ranunculus cymbalaria*
showy daisy	*Erigeron speciosus*
showy pussytoes	*Antennaria pulcherrima*
shrubby penstemon	*Penstemon fruticosus*
sidewalk moss	*Tortula ruralis*
silky lupine	*Lupinus sericeus*
silverleaf phacelia	*Phacelia hastata*
silver-moss	*Bryum argenteum*
Sitka mountain-ash	*Sorbus sitchensis*
six-weeks grass	*Vulpia octoflora*
slender hawksbeard	*Crepis atribarba*
slender wheatgrass	*Elymus trachycaulus*
small-flowered blue-eyed Mary	*Collinsia parviflora*
small-flowered forget-me-not	*Myosotis laxa*
small-flowered fringecup	*Lithophragma parviflorum*
smooth brome*	*Bromus inermis*
smooth sumac	*Rhus glabra*
snow buckwheat	*Eriogonum niveum*
soft brome*	*Bromus hordeaceus*
soft-stemmed bulrush	*Schoenoplectus tabernaemontani*
soopolallie	*Shepherdia canadensis*
spike trisetum	*Trisetum spicatum*
spotted knapweed*	*Centaurea biebersteinii*
spring speedwell*	*Veronica verna*
squaw currant	*Ribes cereum*

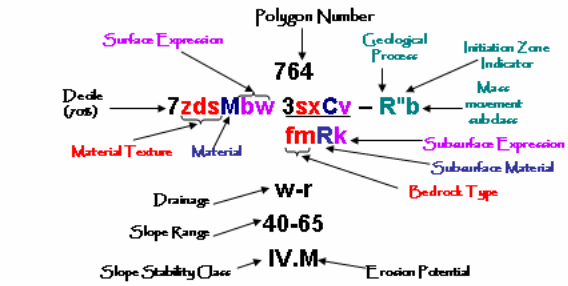
Common Name	Latin Name
star-flowered false Solomon's-seal	*Maianthemum stellatum*
starwort	*Stellaria* sp.
step moss	*Hylocomium splendens*
stepladdered pixie-cup	*Cladonia macrophyllodes*
steppe mouse-moss	*Coscinodon calyptratus*
sticky cinquefoil	*Potentilla glandulosa*
sticky purple geranium	*Geranium viscosissimum*
stinging nettle	*Urtica dioica*
sulphur cinquefoil	*Potentilla recta*
swale desert-parsley	*Lomatium ambiguum*
sweetbrier*	*Rosa eglanteria*
sweet-scented bedstraw	*Galium triflorum*
tall annual willowherb	*Epilobium brachycarpum*
tall Oregon-grape	*Mahonia aquifolium*
tamarisk-moss	*Thuidium* sp.
tarpaper lichens	*Collema* sp.
tarragon	*Artemisia dracunculus*
temporary pelt	*Peltigera didactyla*
thatch soldiers	*Cladonia symphycarpia*
thick-leaved thelypody~[56]	*Thelypodium laciniatum*
thimbleberry	*Rubus parviflorus*
Thompson's paintbrush	*Castilleja thompsonii*
thorn clad	*Cladonia uncialis*
thread-leaved fleabane	*Erigeron filifolius*
thread-leaved phacelia	*Phacelia linearis*
thread-moss	*Bryum* sp.
thyme-leaved sandwort*	*Arenaria serpyllifolia*
timber milk-vetch	*Astragalus miser*
toad rush	*Juncus bufonius*
tower mustard	*Arabis glabra*
trailing fleabane	*Erigeron flagellaris*
trembling aspen	*Populus tremuloides*
tufted thread-moss	*Bryum caespiticium*
twinflower	*Linnaea borealis*
upland larkspur	*Delphinium nuttallianum*
violet	*Viola* sp.
Wallace's selaginella	*Selaginella wallacei*
water birch	*Betula occidentalis*
water smartweed	*Polygonum amphibium*
wavy-leaved moss	*Dicranum polysetum*
weeping alkaligrass	*Puccinellia distans*
western dock	*Rumex aquaticus*
western fescue	*Festuca occidentalis*
western hawksbeard	*Crepis occidentalis*

[56] No voucher specimen was collected to confirm this blue-listed plants, as only two plants were present on the site.

Common Name	Latin Name
western meadowrue	*Thalictrum occidentale*
western mountain-ash	*Sorbus scopulina*
western stickseed	*Lappula occidentalis*
western trumpet	*Lonicera ciliosa*
Wheeler's bluegrass	*Poa wheeleri*
white clover*	*Trifolium repens*
white pussytoes	*Antennaria microphylla*
white sweet-clover*	*Melilotus alba*
wild bergamot	*Monarda fistulosa*
wild strawberry	*Fragaria virginiana*
willow	*Salix* sp.
wood strawberry	*Fragaria vesca*
woody-branched rockcress	*Arabis lignifera*
worm-leaved stonecrop	*Sedum stenopetalum*
yarrow	*Achillea millefolium*
yellow bell	*Fritillaria pudica*
yellow gromwell	*Lithospermum incisum*
yellow salsify*	*Tragopogon dubius*

Appendix C: Terrain Legend

Terrain Polygon Symbols



Note: Two or three 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**
C	Colluvium
C1	Slope wash
D	Weathered bedrock
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 Materials

Till (M)

Till is material deposited directly by glacier ice. It typically consists of a fine-grained matrix (particles < 2 mm) that surrounds and supports clasts (particles >2 mm) of a variety of sizes, shapes and rock types.

Most till in the study area was moderately consolidated basal (subglacial) till. Hand texturing indicated that the matrix texture is generally sand loam (SL) to silt loam (SiL). A sample was sent to a lab for particle size distribution analysis which confirmed field findings. Clast content ranged from 10 to 40 % by volume. The pebbles (2-64 mm), cobbles (64-256 mm) and boulders (< than 256) were predominantly subangular to subrounded of mixed lithology. The till appeared to contain higher coarse fragment content as it became shallower.

Till was widespread throughout the study area on all but the steepest slopes. It was generally between 0.5 and 1.5 m thick, and thicknesses sometimes varied abruptly over short distances (Mw). Till less than 1 m thick (Mv) was present on convex slopes and the crests of small hills, and up to a few metres in thickness (Mb) in concavities and depressions. In the rock controlled rolling uplands of the study area, the bedrock mounds and hummocks were overridden by glacial ice, resulting in thin till that is occasionally absent on rises and thicker in depressions.

There were a few small areas of very thick till (Mka) located on the lower slopes in the western part of the study area adjacent to Okanagan Lake (eg, BVV148, BVV150). A failure in the thick till deposit was observed at BVV148.

Colluvium (C)

Colluvial materials accumulate during post-glacial time as a result of gravity-induced movements such as soil creep, rock fall and landslides, and slope wash by running water (C1). The physical characteristics of colluvium and colluvial landforms are closely related to its source material (bedrock or glacial drift) and the process whereby it was moved. The texture and other characteristics of colluvium may vary widely.

In the study area, there were two primary sources of colluvium. Shattered or disintegrated bedrock was the most common source for colluvium, and slope wash was the other, lesser common source. Because these two types of colluvium are so different, they have been differentiated during mapping. The more typical colluvium derived from soil creep, landslides, rockfall etc, is given ‘C’ for material type and will be discussed in this section. For slope wash, ‘C1’ has been used and is described in the next section.

On slopes that are moderately steep to steep and down slope from bedrock outcrops, bedrock and till were commonly overlain by a thin covering of colluvium (Cv and Cvb). This material typically consisted of loosely packed rubble or angular fragments with interstitial silty sand. It resulted from disintegration of local bedrock due to weathering, and slow down slope creep of the detached material. Colluvium of this type is non-cohesive, highly porous and permeable.

Talus slopes (Ck) often form below bluffs from accumulated rockfall. Talus is typically loosely packed rubble or blocks with little interstitial silt and sand near the surface. It is typically rapidly or very rapidly drained. Talus was observed at site BVG013, where material had accumulated below

the columnar basalt cliffs as a result of rockfall. Talus was mapped in a few other places, but was relatively uncommon in the study area.

Colluvial fans (Cf) and gentle colluvial slopes (Cj) are formed at the foot of gullies by the accumulation of materials moved by small steep creeks. In the study area, these types of colluvial deposits commonly rested upon lacustrine deposits or gently sloping till. This type of colluvium generally included some imperfect drainage as they were receiving sites for moisture.

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. This material 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 or lacustrine deposits. The typical texure was silty sand or sandy silt with generally less than 5 % coarse fragments. It commonly includes some imperfect drainage as it accumulates in receiving sites.

Fluvial Materials (F,F^{A})

Fluvial materials have been 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 were present mainly as small portions of a polygon that included a stream. Fluvial materials were generally been mapped as plains (Fp, FAp) or gentle fluvial areas (Fj) with imperfect to poor drainage. There were no large areas of fluvial material mapped in the study area.

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 (FGa).

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. In general, glaciofluvial materials created well-drained and relatively dry sites due to the highly porous and permeable sands and gravels. The material was 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.

Lacustrine (L)

Lacustrine materials have been deposited by 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 were seen in shallow ponds that are periodically inundated (szLp and szLv). Sediments can also be deposited at the margins of the lake by wave action. These materials generally consist of sand and gravel and are found along the shoreline of lakes. This type of lacustrine material (spLp) was observed along the shoreline of Okanagan Lake at site BVG022.

Glaciolacustrine (L^G)

Glaciolacustrine materials have been 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 and/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, glaciolacustrine materials resulting from glacial Lake Penticton were found along the northwestern perimeter of the study area bordering Okanagan Lake (LGt and LGp) and along the north-eastern edge of the study area bordering Swan Lake (LGpu).

Organics (O)

Organic materials form where decaying plant material accumulates in poorly or very poorly drained areas. In the study area, organic materials were uncommon. They were only mapped in two polygons as a veneer overlying till and lacustrine materials (Ov).

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, undifferentiated material were mapped in the southern tip of the study area where moderate or moderately steep slopes exposed layers of sediments (Ua, Uk). Exposures of material revealed colluvium, glaciofluvial sediments, glaciolacustrine sediments, and till.

Weathered Bedrock (D)

Weathered bedrock has been modified *in situ* by mechanical and chemical weathering. In the study area, weathered bedrock was found as a discontinuous veneer (Dv) or very thin veneer (Dx) overlying gently sloping or undulating bedrock outcrops. It typically contained a high proportion of angular coarse fragments with varying amounts of interstitial silty sand. It is non-cohesive and well to very rapidly drained.

Bedrock (R)

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

Geological Processes	
Code	**Name**
-E	Glacial meltwater channels
-F	Slow mass movement (failing, slumps)
-F"	Slow mass movement initiation zone
-Fu	Slump in surficial material
-R	Rapid mass movement (slides and falls)
-R"	Rapid mass movement initiation zone
-Rb	Rockfall
-Rs	Debris slide
-V	Gullying

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.

Geological Processes

Channeled by Meltwater (-E, -EV)

Meltwater channels form alongside, beneath, or in front of a glacier or ice sheet. Glacial meltwater channels are typically sinuous in plan, flat-floored, and steep-sided in cross-section. The floors of the meltwater channel may contain glaciofluvial sediments, indicative of the water flow that once took place here. Meltwater channels were found occasionally in the study area, sometimes in association with gullies that formed from meltwater (-EV).

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

Slow mass movement refers to slope failures where movement occurs slowly and/or where the displaced material moves only a short distance downslope. The double prime symbol (") indicates the initiation zone of slow mass movement. In the study area, failure occurred in thick surficial materials; this is indicated by the subclass 'u' (e.g. -Fu).

Slow mass movement was only mapped in two polygons. These polygons are located on the western edge of the study area near sites BVV148 and BVV150. At these locations, failure occurred where thick deposits of till were exposed in an erosional scarp. The erosional scarp was likely created by glacial Lake Penticton. Both polygons containing slow mass movement were designated as slope stability class **V** and erosion potential **VH** (very high). The failures were too small to be seen on the air photos, but were observed during fieldwork.

Rapid Mass Movement (-R, -R"s, -Rs, -R"b, -Rb)

Rapid mass movement refers to downslope movement by falling, rolling or sliding of debris derived from surficial material and/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.

Debris slides (-R"s, -Rs) are a type of landslide. They occur when a mass of surficial material slides rapidly downslope often as a result of the loss of soil strength due to high pore water

pressure. Debris slides 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 slides can be triggered from excessive moisture as a result of weather or as a result of redirected drainage (e.g. poorly placed culverts). During wet conditions, they can also be triggered by tree throw, rock fall, or vibrations due to earthquakes or human activity.

In the study area, debris slides were relatively rare and were mapped in only a few polygons.

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 creates talus slopes, colluvial veneers and blankets. Polygons with rockfall were scattered throughout the study area in association with local bedrock outcrops or cliffs. While these areas may not be mapped as unstable, they represent a hazard from above and should be treated with caution.

Gully Erosion (-V)

Gullies are small ravines with a V-shaped cross section formed in surficial material or bedrock. The symbol is usually applied to terrain polygons where more than one gully is present, or to gullies large enough to delineate as a polygon. Gullies are formed by the erosive effects of debris slides, meltwater channels, small streams and rockfall. Their presence is an indicator of former or present-day erosion, and the symbol '-V' identifies potentially erodible and presently eroding materials. Gullied terrain is commonly rated as potentially unstable or unstable because gully side slopes and headwalls are prone to instability, especially if disturbed.

In the study area, gully erosion was mapped in polygons scattered throughout the study area.

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

Slope Stability Classes[57]	
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.

Erosion Potential Classes[58]		
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.
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 these sites.

[57] From Iverson et al. 2003

[58] From BC Ministry of Forests 1999

Appendix D: Expanded Legend

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AB	**Nuttall's alkaligrass – Foxtail barley graminoid meadow**	**IDFxh1**	**00**

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

This meadow ecosystem commonly occurs at the fringes of alkaline ponds and lakes. These sites often have a white crust of salts on the soil surface. Vegetation is limited to species like Nuttall's alkaligrass, saltgrass, and foxtail barley that can tolerate alkaline conditions. This unit was uncommon and was found associated with several ponds on the top of the range.

SITE INFORMATION	
Common Terrain Types: • lacustrine and morainal blankets	
Slope position:	depression, lower, toe
Slope (%):	0 – 5
Aspect:	none
Soil Moisture Regime:	hygric
Soil Nutrient Regime:	rich – very rich

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AB	Nuttall's alkaligrass – Foxtail barley graminoid meadow	IDFxh1	00

	Structural Stage	2b	
Grasses	*Puccinellia nuttalliana*	****	Nuttall's alkaligrass
	Hordeum jubatum	***	foxtail barley
	Distichlis spicata	**	seashore saltgrass
Herbs	*Ranunculus cymbalaria*	**	shore buttercup
	Chenopodium spp.	*	lamb's quarters / goosefoot
PLOTS		BVG016 BVG021 BVV042	

Highlighted species – indicate important forage plants for ungulates
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

Notes: 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.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
AS	**At – 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	gully	ASgk	gully, cool aspect; slope >25%
ASgw	gully; warm aspect; slope >25%	ASk	cool aspect; slope >25%
ASks	cool aspect; shallow soil (50-100cm); slope >25%	ASs	shallow soil (50-100cm)
ASsw	shallow soil (50-100cm); warm aspect; slope >25%	ASw	warm aspect; slope >25%

SITE INFORMATION

Common Terrain Types:

- morainal blankets, colluvial slopewash and sometimes glaciofluvial blankets

Slope position:	lower, toe, depression, mid
Slope (%):	0 – 10 (40)
Aspect:	none
Soil Moisture Regime:	subhygric (mesic)
Soil Nutrient Regime:	rich (medium)

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

	Structural Stage	3	4	5	6	7	
Trees	*Populus tremuloides*	*	***	***	***	***	trembling aspen
Shrubs	*Crataegus douglasii*	****	***			**	black hawthorn
	Amelanchier alnifolia	**	*	*	*	*	saskatoon
	Symphoricarpos albus	*****	****	*****	*****	*****	common snowberry
	Rosa nutkana		**	**	**	**	Nootka rose
Grasses	*Poa pratensis*	**	*	**	**	**	Kentucky bluegrass
	Elymus glaucus		*	*	*	*	blue wildrye
Herbs	*Osmorhiza berteroi*	*	*	*	**	**	mountain sweet-cicely
	Thalictrum occidentalis	**	*	*	*	*	western meadowrue
Mosses	*Brachythecium* sp.		*	*	*	*	ragged moss
PLOTS		BVG004 BVG040 BVV006 BVV019 BVV112 BVV125	9901751 BVG015 BVV023	BVG010	9901747 BVV133	BVG047	

Highlighted species – indicate important forage plants for ungulates
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
BM	**Bulrush Marsh**	**IDFxh1**	**00**

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

This unit is equivalent to the *Great bulrush marsh* association in the provincial classification (MacKenzie and Shaw 2000).

This marsh wetland ecosystem commonly occurs on small ponds adjacent to shallow open water as a fringe along the shoreline. This unit is very uncommon in the study area. It sometimes occurs as a complex with cattail marshes (CT) and 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 soft-stemmed bulrush, with some floating aquatic plants (duckweed, bladderwort and water smartweed) and occasionally with a minor component of cattail. 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

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

	Structural Stage	**2b**	
Rushes	*Schoenoplectus tabernaemontani*	***	soft-stemmed bulrush
	Schoenoplectus acutus	*	hard-stemmed bulrush
Herbs	*Lemna minor*	**	common duckweed
	Utricularia macrorhiza	*	greater bladderwort
Liverworts	*Ricciocarpos natans*	*	
PLOTS	9901745, BVG032, BVG038, BVV021		

* 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: sites are usually only dominated by one bulrush species; soft-stemmed bulrush was more common in the study area

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

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

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

List of mapped units:

BNct	coarse-textured soils; terrace	BNf	fine-textured soils
BNg	occurs in a gully	BNw	warm-aspect; slope >25%

SITE INFORMATION

Common Terrain Types:

- thick morainal blankets

Slope position:	toe, depression
Slope (%):	0 – 15
Aspect:	none
Soil Moisture Regime:	subhygric (mesic)
Soil Nutrient Regime:	medium – rich

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

	Stuctural Stage	2b	3a	
Shrubs	*Artemisia tridentata*		***	big sagebrush
Grasses	*Poa pratensis*	****	***	Kentucky bluegrass
	Achnatherum occidentalis	**	**	Columbia needlegrass
Herbs	*Taraxacum officinale*	**	**	dandelion
	Geranium viscosissimum	**	**	sticky purple geranium
	Achillea millefolium	**		yarrow
PLOTS		BVV040	BVV043	

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 know what climax vegetation is but may be dominated by Columbia needlegrass and forbs.

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

Typic unit occurs on level sites with deep, fine-textured soils (assumed modifiers are d, f, and j).
This unit is equivalent to the *Baltic rush – Field sedge marsh* association in the provincial classification (MacKenzie and Shaw 2000).
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 rushes or other rushes. Field sedge may also occur in slightly drier situations. Soils are typically 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

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

	Structural Stage	2b	
Rushes	*Juncus balticus*	***	baltic rush
Herbs	*Potentilla anserina*	**	common silverweed
	Ranunculus cymbalaria	*	shore buttercup
PLOTS	BVG043, BVV024, BVV055, BVV108, BVV115, BVV135		

* 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: We mostly observed disturbed sites.
These sites were frequently dominated by quackgrass or Kentucky bluegrass (BVV024, BVV108, and BVV115).
It is unknown if these sites will recover climax vegetation with improved range management.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CD	**ActFd –Common Snowberry – Red-osier Dogwood Riparian**	**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 very uncommon but was found on the foreshore of Okanagan Lake and Goose Lake. Forests are often mixed black cottonwood with Douglas-fir, and paper birch. The understory is typically rich and shrubby, often dominated by Nootka rose, mock orange, snowberry and red-osier dogwood. Forbs are uncommon and scattered.

List of mapped units:

CDk cool aspect; slope >25%

SITE INFORMATION

Common Terrain Types:

- glaciofluvial 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	ActFd –Common Snowberry – Red-osier Dogwood Riparian	IDFxh1	00

	Structural Stage	3	4	5	6	7	
Trees	*Populus balsamifera* ssp. *trichocarpa*	**	***	***	***	***	black cottonwood
	Betula papyrifera		**	**	**	**	paper birch
	Pseudotsuga menziesii var. *glauca*			*	**	**	Douglas-fir
Shrubs	*Symphoricarpos albus*	*****	****	****	****	****	common snowberry
	Philadelphus lewisii	***	**	***	***	***	mock orange
	Amelanchier alnifolia	**	**	**	**	**	saskatoon
	Mahonia aquifolium	**	*	**	**	**	tall oregon-grape
	Rosa nutkana	***	*	**	**	***	Nootka rose
	Cornus stolonifera	***	**	**	**	**	red-osier dogwood
Grasses	*Elymus glaucus*	**	*	*	*	*	blue wildrye
	Poa pratensis	**	*	*	*	*	Kentucky bluegrass
Herbs	*Equisetum arvense*	**	*	*	*	**	common horsetail
Mosses	*Brachythecium* sp.				*	*	ragged moss
PLOTS				BVV110	BVG022		

Highlighted species – indicate important forage plants for ungulates
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
CF	**Cultivated Field**	**IDFxh1**	**N/A**
These are agricultural fields with tilled soils and planted crops or ground cover. Mapped units: CFcn – coarse-textured soils, fan; CFk – cool aspect, slope >25%			

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	
Plots: BVV020, BVV157			

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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
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 (MacKenzie and Shaw 2000).

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 usually have shallower water than Bulrush marshes or Cattail marshes. They have a variable mixture of common spikerush 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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
CS	Common Spikerush Marsh	IDFxh1	00

	Structural Stage	2b	
Rushes	*Eleocharis palustris*	***	common spike-rush
Grasses	*Hordeum jubatum*	*	foxtail barley
Herbs	*Chenopodium glaucum*	*	oak-leaved goosefoot
	Rumex maritimus	*	golden dock
PLOTS		BVG056	

Highlighted species – indicate important forage plants for ungulates
* 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: Vegetation may have more foxtail barley, oak-leaved goosefoot, and golden dock in drier years.

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

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

This unit is equivalent to the *Cattail marsh* association in the provincial classification (MacKenzie and Shaw 2000).

This marsh wetland ecosystem commonly occurs as a fringe on pond edges or in depressions, often adjacent to shallow open water (OW). This unit is very uncommon 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:

CTp peaty materials, 40+cm of organic material overlaying mineral deposits

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

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

	Structural Stage	2a	
Herbs	*Typha latifolia*	****	common cattail
	Lemna minor	**	common duckweed
Mosses	*Drepanocladus aduncus*	***	common hook-moss
PLOTS		BVG048	

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

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

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

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

List of mapped units:			
CWk	cool aspect; slope >25%	CWks[59]	cool aspect; shallow soil
CWq	cool aspect; slope very steep (>100%)	CWr	occurs on a ridge
CWw	warm aspect; slope >25%	CWz	warm aspect; slope very steep (>100%)

SITE INFORMATION	
Common Terrain Types: • rock and very thin colluvial and morainal veneers	
Slope position:	crest, upper
Slope (%):	0 – 130
Aspect:	all
Soil Moisture Regime:	very xeric – xeric
Soil Nutrient Regime:	very poor – poor

[59] This was an unusual site – rubble over rock, also shrubbier than typic unit

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

	Structural Stage	3	
Trees	*Pinus ponderosa*	*	ponderosa pine
Shrubs	*Philadelphus lewisii*	***	mock-orange
	Amelanchier alnifolia	**	saskatoon
	Symphoricarpos albus	**	common snowberry
	Prunus virginiana	**	choke cherry
Grasses and Sedges	*Pseudoroegneria spicata*	**	bluebunch wheatgrass
	Bromus japonicus or tectorum	*	Japanese brome or cheatgrass
	Carex rossii	*	Ross' sedge
Herbs	*Woodsia scopulina*	*	mountain cliff fern
	Balsamorhiza sagittata	*	arrowleaf balsamroot
Mosses	*Tortula ruralis*	**	sidewalk moss
PLOTS		BVG012 BVG014 BVG039 BVG051	

Highlighted species – indicate important forage plants for ungulates
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
DP	**FdPy – Pinegrass**	**IDFxh1**	**01**

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

This forest ecosystem is commonly associated with mesic gently sloping sites. This is the most common forest unit in the study area. Forests are moderately closed with mixed Douglas-fir and ponderosa pine overstories, although historically they would have been quite open. The understory is relatively shrubby with snowberry, birch-leaved spirea, tall Oregon-grape and scattered grasses, herbs and mosses. Pinegrass is a very characteristic species in this site series in other areas but was almost completely absent in the study area, perhaps due to present and historical grazing regimes. This unit is also common on cool aspects (DPk) where there is usually more of a moss layer. Mature (structural stage 6) and old (structural stage 7) forests are uncommon because most of the large trees historically present on these sites have been logged. Because of fire exclusion, most sites have become ingrown with higher densities of smaller stems. Grazing and ingrowth have reduced the presence of bunchgrasses which were rarely observed but were likely historically common.

List of mapped units:

DPf	fine-textured soils	DPk	cool aspect (usually NW to E)
DPks	cool aspect (usually NW to E), shallow soils (generally 50-100cm)	DPs	shallow soils (generally 50-100cm)

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:	lower to upper
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	FdPy – Pinegrass	IDFxh1	01

	Structural Stage	3	4	5	6	7	
Trees	*Pseudotsuga menziesii* var. *glauca*	**	****	****	***	***	Douglas-fir
	Pinus ponderosa	**	***	***	**	**	ponderosa pine
	Populus tremuloides	*	*	*			
Shrubs	*Symphoricarpos albus*	****	*	**	***	***	common snowberry
	Spirea betulifolia	**	*	**	***	***	birch-leaved spirea
	Amelanchier alnifolia	***	*	*	*	*	saskatoon
	Mahonia aquifolium	**	*	*	*	*	tall oregon-grape
	Rosa spp.	**					roses
Grasses	*Calamagrostis rubescens*	*		*	*	*	pinegrass
	Festuca idahoensis	**		*	*	**	Idaho fescue
	Achnatherum nelsonii	**		*	*	**	Columbia needlegrass
	Elymus glaucus	*	*	*	*	*	blue wildrye
Herbs	*Balsamorhiza sagittata*	***	*	**	**	***	arrowleaf balsamroot
	Antennaria neglecta	**	*	*	*	*	field pussytoes
	Fragaria virginiana	***	*	*	*	*	wild strawberry
	Epilobium angustifolium	***					fireweed
Mosses and Lichens	*Tortula ruralis*	**	*	*	*	*	sidewalk moss
	Rhytidiadelphus triquetrus			*	**	**	electrified cat's tail moss
	Brachythecium albicans.	*	*	*	**	**	lawn moss
	Peltigera canina	*		*	*	**	
	Dicranum sp.	*	*	*	*	*	heron's bill moss
PLOTS		BVG026	BVG007	BVG025 BVG044 BVV002	BVG017 BVG019 BVG042	BVG057	

Highlighted species – indicate important forage plants for ungulates

* 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), mosses are more common and abundant on cool aspects and nearly absent in open forests

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	**FdPy – Snowberry – Spirea**	**IDFxh1**	**07**

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

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

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

List of mapped units:

DScw	coarse-textured soils; warm aspect; slope >25%	DSg	gully
DSgs	gully, shallow soil (50-100cm)	DSgw	gully, warm aspect, slope >25%
DSk	cool aspect	DSks	cool aspect, shallow soil (50-100cm), slope >25%
DSs	shallow soil (50-100cm)	DSsw	shallow soil (50-100cm), warm aspect, slope >25%
DSw	warm aspect (usually SE or NW, usually only on sites with some compensating moisture)		

SITE INFORMATION

Common Terrain Types:

- gentle morainal slopes

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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DS	FdPy – Snowberry – Spirea	IDFxh1	07

	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
	Amelanchier alnifolia	**	**	**	**	**	saskatoon
	Mahonia aquifolium	**	*	**	***	***	tall oregon-grape
	Paxistima myrsinites	**	**	**	**	**	falsebox
	Acer glabrum	***	**	**	**	***	Douglas maple
	Spirea betulifolia	***	**	**	**	**	birch-leaved spirea
	Rosa nutkana	***	*	**	**	***	Nootka rose
	Ceanothus sanguineus	****	*				redstem ceanothus
Grasses	*Calamagrostis rubescens*	**		*	*	**	pinegrass
	Elymus glaucus	**		*	*	**	blue wildrye
	Poa pratensis	**	*	*	*	*	Kentucky bluegrass
Herbs	*Osmorhiza berteroi*	***	*	**	**	**	mountain sweet-cicely
Mosses	*Brachythecium* sp.	*	*	*	**	**	ragged moss
PLOTS				BVG002 BVG035			

Highlighted species – indicate important forage plants for ungulates
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
DW	**FdPy – Bluebunch wheatgrass - Pinegrass**	**IDFxh1**	**03**

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

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

List of mapped units:

DWc	coarse-textured soils (usually glaciofluvial)	DWjs	gentle slope (dry upper slopes), shallow soils (20-100cm)
DWjv	gentle slope with very shallow soils (<20cm)	DWks	cool aspect (generally NW or ESE), shallow soils (20-100cm)
DWkv	cool aspect (generally NW or ESE), very shallow soils (<20cm); exposed bedrock (typically 10-20% cover) is present	DWrs	ridge, shallow soils (20-100cm)
DWrv	ridge, very shallow soils (<20cm)	DWs	shallow soils (20-100cm)

SITE INFORMATION

Common Terrain Types:

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

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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
DW	FdPy – 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
	Mahonia aquifolium	**		*	*	*	tall oregon-grape
Grasses	*Pseudoroegneria spicata*	***	**	***	***	****	bluebunch wheatgrass
	Festuca campestris	***	*	**	**	***	rough fescue
	Koeleria macrantha	***	*	**	**	**	junegrass
	Poa fendleriana	***	*	**	**	**	Fendler's bluegrass
	Bromus tectorum	**	**	**	**	**	cheatgrass
Herbs	*Balsamorhiza sagittata*	***	*	**	***	***	arrowleaf balsamroot
	Achillea millefolium	**		*	*	*	yarrow
	Antennaria microphylla or *Antennaria parviflora* or *Antennaria umbrinella*	**	*	*	*	*	white pussytoes Nuttall's pussytoes umber pussytoes
	Lithospermum ruderale	**		*	*	*	lemonweed
Mosses and Lichens	*Cladonia* spp.	**	*	**	**	**	clad lichens
	Tortula ruralis	**	*	**	**	**	sidewalk moss
	Brachythecium albicans			*	*	*	lawn moss
	Peltigera spp.	*		*	*	*	pelt lichens
PLOTS				9901748 9901756 BVG028 BVG049 BVV101	BVG024		

Highlighted species – indicate important forage plants for ungulates
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
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
FW	**Idaho fescue – Bluebunch wheatgrass**	**IDFxh1**	**91**

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

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

FW:wf *$Bluebunch wheatgrass – Idaho fescue seral association*
This is a mid- to late-seral seral association. These sites are dominated by bluebunch wheatgrass and Idaho fescue. These are the latest seral sites observed for this ecosystem in the study area.

FW:sw *$Big sagebrush – Bluebunch wheatgrass seral association*
This is a mid- to late-seral seral association. These sites are dominated by big sagebrush, bluebunch wheatgrass and Idaho fescue. These are similar to the $wf seral association but differ in having a significant shrub layer of big sagebrush.

FW:sn *$Big sagebrush – Columbia needlegrass seral association*
These are mid-seral sites with a big sagebrush shrub layer and a grass cover of Columbia needlegrass and bluebunch wheatgrass. This is a common seral association. Sometimes the layer of big sagebrush is absent.

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 either knapweed, or cheatgrass. Sometimes there is a layer of big sagebrush.

FW:sb *$Big sagebrush – Kentucky bluegrass seral association*
This are early seral sites with a big sagebrush shrub layer and a grass layer dominated by Kentucky bluegrass with Columbia needlegrass. This is a common seral association.

FW:kb *$Kentucky bluegrass seral association*
These are early seral sites dominated by Kentucky bluegrass.

FW:kc *$Knapweed - Cheatgrass seral association*
These are early and very early seral sites. There are few or no native bunchgrasses remaining on these sites. Invasive weeds including knapweed, cheatgrass and sulphur cinquefoil dominate these sites.

FW:sk *$Big sagebrush - Knapweed seral association*
These are early and very early seral sites. There are few or no native bunchgrasses remaining on these sites. Invasive weeds including knapweed, cheatgrass and sulphur cinquefoil dominate these sites along with a big sagebrush shrub layer.

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
FW	Idaho fescue – Bluebunch wheatgrass	IDFxh1	91
List of mapped units:			
FWc	coarse-textured soils	FWck	coarse-textured soils, cool aspect
FWct	coarse-textured soils, terrace (glaciofluvial)	FWf	fine-textured soils
FWk	cool aspect	FWks	cool aspect, shallow soils (20-100cm)
FWs	shallow soils (50-100cm)		

SITE INFORMATION	
Common Terrain Types: • morainal blankets	
Slope position:	lower to upper
Slope (%):	0-35%
Aspect:	all
Soil Moisture Regime:	submesic – mesic
Soil Nutrient Regime:	medium

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

	Structural Stage Seral Association	2b FW[60]	2b FW:wf	3a FW:sw	2b/3a[61] FW:sn	3a FW:sb	2b/3a[62] FW:wk	2b FW:kb	2a FW:kc	3a FW:sk	
Shrubs	*Artemisia tridentata*			***	****	****	***			***	big sagebrush
Grasses	*Festuca idahoensis*	***	***	***	*						Idaho fescue
	Festuca campestris	*****	*	*							rough fescue
	Pseudoroegneria spicata	*	****	****	***	*	**				bluebunch wheatgrass
	Koeleria macrantha	*	**	**	*						junegrass
	Stipa nelsonii				***	**	*				Columbian needlegrass
	Poa pratensis		*	*	**	***		****	***	***	Kentucky bluegrass
	Bromus tectorum or *Bromus japonicus*			*		**	**	**	***	***	cheatgrass or Japanese brome
Herbs	*Balsamorhiza sagittata*	***	***	***	***	**	**	*			arrowleaf balsamroot
	Lupinus sericeus	**	*	*	*	*	*				silky lupine
	Eriogonum heracleoides	**	**	*	*	*	*				parsnip-flowered buckwheat
	Achillea millefolium	*	*	*	*	*	*				yarrow
	Lithospermum ruderale	*	*	*	*	*	*				lemonweed
	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			BVV126 BVV129	9901754 BVG011 BVG059 BVV044	BVG031 BVG058	BVG036 BVG020 BVV004 BVV015		BVV032	BVG029 BVV116 BVV123 BVV109 BVV114	BVV013	

Highlighted species – indicate important forage plants for ungulates
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

[60] Climax grasslands were not observed. Seral development on these sites is speculative. It is unknown whether or not rough fescue may take over eventually from Idaho fescue.
[61] Seral association may be structural stage 2 or 3. Structural stage 2 does not have the big sagebrush shown in the table.
[62] Seral association may be structural stage 2 or 3. Structural stage 2 does not have the big sagebrush shown in the table.

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

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	**FdPy – 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 (PB, PBrv, PBv). This unit is rare 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 (bluebunch wheatgrass and Idaho or rough fescue) dominate the understory. A lichen and moss crust may be present on undisturbed sites.

List of mapped units:

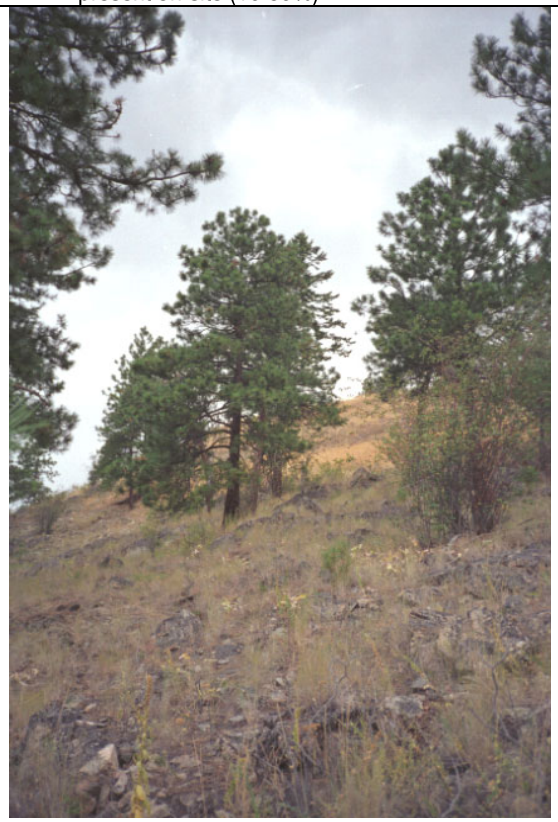
PBrv	ridge, very shallow soils, exposed pockets of bedrock are usually present on-site (10-30% cover of bedrock)	PBv	very shallow soils (<20cm), exposed pockets of bedrock are usually present on-site (10-30%)

SITE INFORMATION

Common Terrain Types:

- Thin and very thin colluvial and morainal materials over rock and patches of exposed bedrock

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



Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PB	FdPy – 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	**	*	**	**	**	common snowberry
	Mahonia aquifolium	*		*	*	*	tall oregon-grape
Grasses and Sedges	*Pseudoroegneria spicata*	****	**	***	***	****	bluebunch wheatgrass
	Festuca idahoensis	**	*	**	**	**	Idaho fescue
	Bromus japonicus or *tectorum*	**	*	*	*	*	Japanese brome or cheatgrass
Herbs	*Balsamorhiza sagittata*	***	*	**	**	**	arrowleaf balsamroot
	Selaginella densa or *Selaginella wallacei*	*	*	*	*	*	compact selaginella Wallace's selaginella
	Woodsia scopulina	*	*	*	*	*	mountain cliff fern
	Penstemon fruticosa	*	*	*	*	*	shrubby penstemon
Mosses Lichens	*Cladonia* spp.	**	**	**	**	**	clad lichens
	Polytrichum piliferum	**	**	**	**	***	awned haircap moss
PLOTS				BVG052	BVV102		

Highlighted species – indicate important forage plants for ungulates
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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
PD	**Pond**	**IDFxh1**	**N/A**
These are small bodies of permanent water greater than 2m deep but less than 50ha in size. Floating aquatic vegetation is rarely present on ponds.			

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 commonly occurs as patches on grassland slopes. These sites are dominated by shrubs, primarily snowberry and roses. Forbs and grasses are scattered in openings between shrubs. These sites are often less disturbed than the surrounding grasslands probably because they provide less forage for cattle. Soils are very rich black chernozems.

List of mapped units:

RFct	coarse-textured soils, terrace	RFg	occurs in a gully
RFk	cool aspect	RFks	cool aspect, shallow soils (50-100cm)
RFs	shallow soil (50-100cm)	RFsw	shallow soil (50-100cm), warm aspect
RFw	warm aspect		

SITE INFORMATION

Common Terrain Types:

- morainal blankets

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

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

	Structural stage	3a or 3b	
Shrubs	*Symphoricarpos albus*	*****	common snowberry
	Rosa woodsii	***	prairie rose
	Rosa nutkana	***	Nootka rose
Grasses	*Poa pratensis*	**	Kentucky bluegrass
Herbs	*Balsamorhiza sagittata*	*	balsamroot
	Erigeron speciosus	*	showy daisy
	Galium boreale	*	northern bedstraw
	Lupinus sericeus	*	silky lupine
	Potentilla recta	*	sulphur cinquefoil
Mosses	*Brachythecium* sp.	*	ragged moss
PLOTS		9901750 BVG045 BVV066	

Highlighted species – indicate important forage plants for ungulates
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
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:			
ROr ridge		ROw warm aspect	

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

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

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

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

However, in the study area, this unit more commonly occurs on steep south facing slopes on rock outcrops with small ledges and pockets of soil (modifiers v and w). 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, big sage 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	SAqv	very steep cool aspect (>100% slope), very shallow soils
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 (%):	40 – 70
Aspect:	southeast to west
Soil Moisture Regime:	very xeric – xeric
Soil Nutrient Regime:	very poor – poor

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

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

	Structural Stage	2b	3	
Trees	*Pseudotsuga menziesii* var. *glauca*	*	*	Douglas-fir
Shrubs	*Amelanchier alnifolia*	**	**	saskatoon
	Artemisia tridentata	**	**	big sagebrush
Grasses	*Pseudoroegneria spicata*	***	***	bluebunch wheatgrass
Herbs	*Selaginella densa*	**	**	compact selaginella
	Balsamorhiza sagittata	**	**	arrowleaf balsamroot
	Artemisia frigida	**	**	pasture sage
Mosses	*Cladonia* spp.	**	**	clad lichens
Lichens	*Polytrichum piliferum*	**	**	awned haircap moss
PLOTS		9901746 9901749 9901755 BVG054 BVV137		

Highlighted species – indicate important forage plants for ungulates
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
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. Shrubs are quite uncommon. This unit is commonly scattered as small sites in a forested matrix. Some sites are very disturbed and dominated by weeds. This seral association is described below.

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

List of mapped units:

SBk	cool aspect	SBr	ridge
SBw	warm aspect		

SITE INFORMATION

Common Terrain Types:

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

Slope position:	crest, upper
Slope (%):	0 – 50
Aspect:	southeast to northwest
Soil Moisture Regime:	xeric
Soil Nutrient Regime:	poor

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

	Structural Stage Seral stage	2a SB	2a SB:cg	3a SB	
Shrubs	*Artemisia tridenata*			***	big sagebrush
Grasses	*Pseudoroegneria spicata*	**	*		bluebunch wheatgrass
	Bromus japonicus or tectorum	*	***	*	Japanese brome or cheatgrass
Herbs	*Selaginella densa*	***	***	***	compact selaginella
	Eriogonum niveum	*	*	*	snow buckwheat
	Erigeron compositus	*	*	*	cut-leaved daisy
	Eriogonum heracleoides	*		*	parsnip-flowered buckwheat
	Balsamorhiza sagittata	*		*	arrowleaf balsamroot
	Potentilla recta		**		sulphur cinquefoil
	Centaurea diffusa				diffuse knapweed
Mosses and Lichens	*Cladonia* spp.	**	*	**	clad lichens
	Tortula ruralis	***	**	***	sidewalk moss
	Polytrichum piliferum	***	*	***	awned haircap moss
	Peltigera rufescens or *Peltigera ponojensis*	*		*	felt pelt felt pelt
PLOTS		BVV028	BVG009 BVV058 BVV117	BVG001	

Highlighted species – indicate important forage plants for ungulates
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
SD	**SxwFd – 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. Forb species are diverse but not abundant and mosses are scattered on these sites. These moist sites likely had a longer fire return interval than adjacent upland areas.

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

List of mapped units:

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

SITE INFORMATION

Common Terrain Types:

- gentle morainal sites

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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SD	SxwFd – 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
	Populus balsamifera ssp. *trichocarpa*	**	*	*	*	**	black cottonwood
Shrubs	*Symphoricarpos albus*	****	***	***	****	***	common snowberry
	Acer glabrum var. *douglasii*	****	**	***	***	***	Douglas maple
	Rosa nutkana	**	**	**	**	**	Nootka rose
	Crataegus douglasii	***	*	**	***	***	black hawthorn
	Cornus stolonifera	****	*	**	**	**	red-osier dogwood
	Betula occidentalis	***	*	**	**	**	water birch
	Amelanchier alnifolia	***	*	*	**	**	saskatoon
Grasses	*Carex* spp.	***					sedges
	Poa pratensis	**	**	**	**	**	Kentucky bluegrass
Herbs	*Osmorhiza berteroi*	**	*	*	**	**	mountain sweet-cicely
	Smilacina stellata	*	*	*	*	*	star-flowered false Solomon's-seal
	Viola canadensis	*	*	*	*	*	Canada violet
Mosses	*Brachythecium* sp.			*	*	*	raggged-moss
PLOTS		9901752 BVG033 BVG037		BVG041	BVG003 BVG030	BVV140	

Highlighted species – indicate important forage plants for ungulates
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
SM	**Sedge 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 *Woolly sedge marsh* and *Water sedge – Beaked sedge fen* units in the provincial classification (MacKenzie and Shaw 2000)

This ecosystem occurs on the edges of larger wetlands (fens) or in depressions with water tables above or near the soil surface. This is a very rare ecosystem in the study area and was only noted at the north end of Goose Lake. Soils are typically mineral, but may sometimes have a thin organic veneer on top.

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

Site Unit Symbol	Site Unit Name	BGC	Site Series Number
SM	Sedge Marsh	IDFxh1	00

	Structural Stage	2b	
Sedges	*Carex lanuginosa*	****	woolly sedge
Rushes	*Juncus balticus*	**	baltic rush
	Carex spp.	**	sedges
PLOTS	BVV111		

Highlighted species – indicate important forage plants for ungulates
* 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: This marsh was viewed from a distance: it may have been dominated by beaked sedge or water sedge

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

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

This ecosystem is commonly associated with steep, blocky talus slopes with minimal soil in pockets between blocks. This is an uncommon unit in the study area. Scattered trees (Douglas-fir, ponderosa pine 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. 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 had enough fuel to burn.

Forested structural stages may include sites with less than 10% tree cover (6-9%). These sites are included as forested structural stages because the tree cover is significant for wildlife interpretations.

List of mapped units:

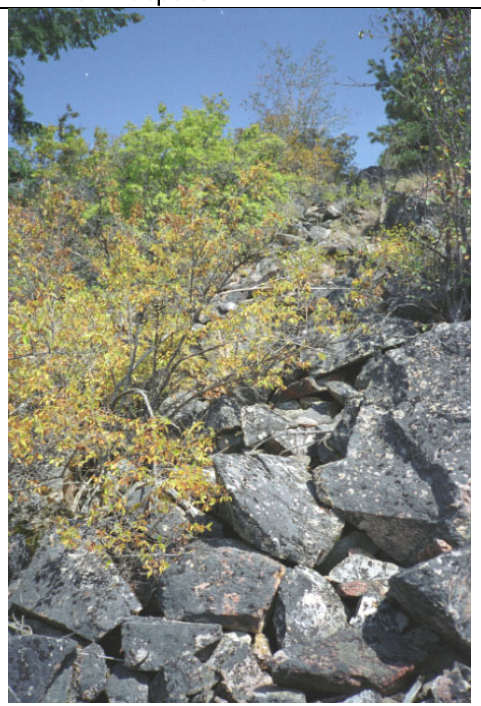
SOk	cool aspect	SOsw	shallow soils (20-100cm), warm aspect
SOks	cool aspect, shallow soils (20-100cm)	SOw	warm aspect

SITE INFORMATION

Common Terrain Types:

- rubbly colluvial slopes

Slope position:	lower to upper
Slope (%):	60 – 65%
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	*Philadelphus lewisii*	***	**	**	***	***	mock-orange
	Amelanchier alnifolia	**	**	**	**	**	saskatoon
	Symphoricarpos albus	**	**	**	**	**	common snowberry
	Spirea betulifolia	*	*	*	*	*	birch-leaved spirea
	Juniperus scopulorum	*	*	*	*	*	Rocky mountain juniper
	Prunus virginiana	*	*	*	*	*	choke cherry
Grasses	*Pseudoroegneria spicata*	**	**	**	**	**	bluebunch wheatgrass
Herbs	*Woodsia* sp.	*	*	*	*	*	cliff fem
	Lomatium sp.	*	*	*	*	*	desert-parsely
PLOTS		BVG023 BVG054					

Highlighted species – indicate important forage plants for ungulates
* 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	**FdPy – 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 slightly cool aspects (SPk; northwest and east-southeast). This is a very uncommon 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%) and/or on 'barely' warm aspects (west-northwest, southeast). It also may occur on gentle to steep cool slopes with very shallow soils (SPkv, SPv); these sites have some exposed bedrock and open forests. The overstory is moderately closed, although historically frequent surface fires would have kept these stands very open and bunchgrasses likely were more abundant. Understories are usually a mixture of bunchgrasses (bluebunch wheatgrass and rough fescue) and other grasses with scattered shrubs, forbs and mosses.

List of mapped units:

SPks	cool aspect (usually SE or WNW), shallow soils	SPrs	ridge, shallow soils (50-100cm)
SPkv	cool aspect, very shallow soils	SPs	shallow soils
SPqs	very steep cool aspect, shallow soils (50-100cm)	SPw	warm aspect (usually SE or WNW or at higher elevations)

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	FdPy – 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
	Mahonia aquifolium	**		*	*	**	tall Oregon-grape
Grasses	*Calamagrostis rubescens*	**		*	*	*	pinegrass
	Pseudoroegneria spicata	***	*	**	**	***	bluebunch wheatgrass
	Festuca campestris or idahoensis	***	*	**	**	***	rough or Idaho fescue
Herbs	*Balsamorhiza sagittata*	**	*	*	**	**	arrowleaf balsamroot
Mosses	*Cladonia* spp.	**	*	*	*	*	clad lichens
Lichens	*Rhytidiadelphus triquetrus.*			*	**	**	electrified cat's-tail moss
PLOTS				BVG027			

Highlighted species – indicate important forage plants for ungulates
* incidental cover (less than 1% cover); used as indicator species
** 1-5% cover; occurs in 60% or more of sites
*** 6-25% cover; occurs in 60% or more of sites
**** 26-50% cover; occurs in 60% or more of sites

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

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. Urban areas are shown in the lower portion of the photo.			

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

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

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

WB:sw *$Big sagebrush – Bluebunch wheatgrass seral association*
This is a late-seral seral association. These sites are dominated by big sagebrush and bluebunch wheatgrass.

WB:sn *$Big sagebrush – Columbia needlegrass seral association*
These are mid-seral sites with a big sagebrush shrub layer and a grass cover of Columbia needlegrass and bluebunch wheatgrass. This is a common seral association. Sometimes the big sagebrush layer is absent.

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 either knapweed, and/or cheatgrass. May or may not have big sagebrush.

WB:sb *$Big sagebrush – Kentucky bluegrass seral association*
This are early seral sites with a big sagebrush shrub layer and a grass layer dominated by Kentucky bluegrass with Columbia needlegrass.

WB:kb *$Kentucky bluegrass seral association*
These are early seral sites dominated by Kentucky bluegrass. This is an uncommon seral association

WB:kc *$Knapweed - Cheatgrass seral association*
These are early and very early seral sites. There are few or no native bunchgrasses remaining on these sites. Invasive weeds including knapweed, cheatgrass and sulphur cinquefoil dominate these sites. Some sites also have big sagebrush.

List of mapped units:

WBc	coarse-textured soils	WBcj	coarse-textured soils, gentle slope
WBck	coarse-textured soils, cool aspect	WBcs	coarse-textured and shallow soils (20-100cm)
WBr	ridge	WBrs	ridge, shallow (20-100cm) soils
WBs	shallow soils (20-100cm)		

SITE INFORMATION

Common Terrain Types:

- morainal blankets and veneers and colluvial veneers

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

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

	Structural Stage Seral Association	2b WB	3a WB:sw	2b/3a[64] WB:sn	2b/3a[65] WB:wk	3a WB:sb	2b WB:kb	2a/3a[66] WB:kc	
Shrubs	*Artemisia tridentata*		****	****	****	****		****	big sagebrush
Grasses	*Pseudoroegneria spicata*	***	***	*	**	**		*	bluebunch wheatgrass
	Koeleria macrantha	*	*	**	*				junegrass
	Stipa nelsonii			***	*		*		Columbia needlegrass
	Poa pratensis			**	*	***	****	**	Kentucky bluegrass
	Bromus tectorum or *Bromus japonicus*	*	***		**	**	**	***	cheatgrass or Japanese brome
Herbs	*Artemisia frigida*	*	*						pasture sage
	Balsamorhiza sagittata	***	***	***	**	**	*		arrowleaf balsamroot
	Lupinus sericeus	**	**	**	**	**	*	*	silky lupine
	Eriogonum heracleoides	*	*	*	*	*		*	parsnip-flowered buckwheat
	Lithospermum ruderale	*	*		*	*		*	lemonweed
	Centaurea diffusa		**		**	*	*	****	diffuse knapweed
	Potentilla recta		**		**			***	sulphur cinquefoil
Mosses and Lichens	*Cladonia* spp.	**	*	*					clad lichens
	Polytrichum piliferum	**							awned haircap moss
	Tortula ruralis	**	*	*	*	*	*		sidewalk moss
PLOTS		9901753 BVG013 BVG050 BVG055	BVG005 BVG046 BVV047 BVV163 BVV167	BVV026 BVG018 BVG034 BVV027 BVG006		BVG008 BVV014 BVV045	BVV051 BVV053	BVV035 BVV113	

Highlighted species – indicate important forage plants for ungulates
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: Rabbitbrush is sometimes present on glaciolactustrine materials

[64] Seral association may be structural stage 2 or 3. Structural stage 2 does not have the big sagebrush shown in the table.
[65] Seral association may be structural stage 2 or 3. Structural stage 2 does not have the big sagebrush shown in the table.
[66] Seral association may be structural stage 2 or 3. Structural stage 2 does not have the big sagebrush shown in the table.