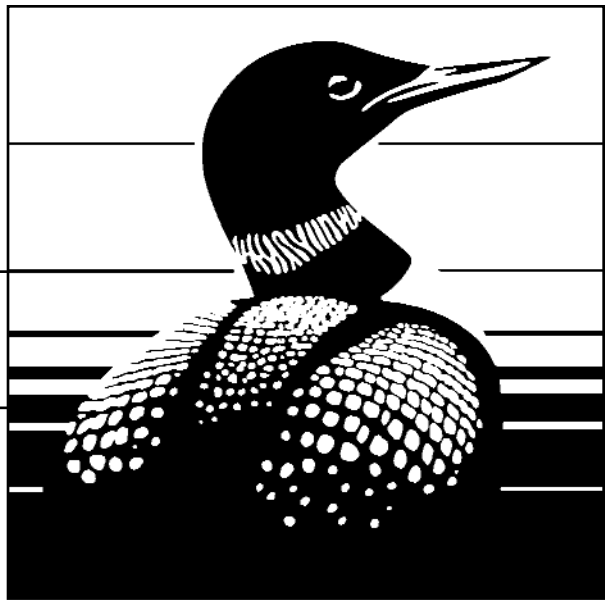
Sensitive Ecosystems Inventory: Central Okanagan 2000 - 2001

Volume 1: Methodology, Ecological Descriptions, Results and Conservation Tools

Kristi Iverson, Iverson & MacKenzie Biological Consulting Ltd.

Carmen Cadrin, Conservation Data Centre, Ministry of Sustainable Resource Management

Pacific and Yukon Region 2003
Canadian Wildlife Service
Environmental Conservation Branch



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www.regionaldistrict.com

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Project management was provided by S*teve Gormley*[1], *Carmen Cadrin*[2], and *Kristi Iverson*[3]. Field work was completed by *Kristi Iverson, Carmen Cadrin, Corey Erwin, Larry Lacelle, Ted Lea, Robert Maxwell, Sal Rasheed, Calvin Tolkamp, Deepa Spaeth Filatow* and *Debbie Webb*[4], *Mike Sarell* and *Allison Haney*[5], and *Christina Sinneman*[6]. Voucher plant specimens and mosses were identified by *Terry McIntosh*[7]. *Tim Brierley*[8], *Bruce Ganton*[9], and *Bon Lee*[10], completed digital and GIS work.

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Abstract

The central Okanagan basin of British Columbia is an area of great ecological significance within Canada. The area has very high biodiversity values, including many rare and endangered species and plant communities. The region has been subject to extensive agricultural conversion, significant changes to ecosystem structure and function through fire exclusion, and intense urban and rural human settlement pressure. The study area covers one of the most rapidly growing populations of British Columbia and development pressures are expected to increase.

The Central Okanagan Sensitive Ecosystems Inventory was initiated in 1999 in response to an urgent need for inventory information on rare and fragile ecosystems to support sound land management decisions. The project area included portions of the lower elevation ecosystems in the central Okanagan. This technical report documents the inventory, analyses the results, and provides summary descriptions of inventory findings.

The main objective of the SEI project was to provide scientific information on sensitive ecosystems to support sustainable land management decisions and encourage conservation and land stewardship. The project used Terrestrial Ecosystem Mapping (TEM) as a base to develop a Sensitive Ecosystems theme map. The inventory was compiled through survey work conducted in the years 2000 through 2001.

Twenty-five percent of the study area was in sensitive ecosystems (SE); eleven percent of the area was included in the other important ecosystem (OIE) categories. The inventory results indicated that wetlands, grasslands, broadleaf woodlands and old forests were extremely rare in the study area. Although areas of coniferous woodlands and mature forests remained, many had been altered significantly through selection logging and fire exclusion and few high quality sites remained. The study indicated that some sensitive ecosystems had already been degraded by fragmentation, human use, ingrowth, and introduced species.

Many of the sites identified by the SEI were at high risk of conversion to other land uses, or further degradation by human use and invasion by non-native plants. Sensitive ecosystems and the wildlife they support are an important part of the quality of life in the Okanagan. With so few of these rare and fragile ecosystems remaining in the study area, it is paramount that each identified site needs to be treated seriously and all possible land use options need to be fully evaluated before any changes are initiated.

Résumé

Le bassin du centre de l'Okanagan, en Colombie-Britannique, est une région très importante du point de vue écologique pour le Canada car il est riche d'une grande biodiversité. Le secteur abrite entre autres de nombreuses espèces d'animaux et de plantes rares ou en danger. Il fait cependant l'objet de grands travaux de conversion agricole, a subi des modifications considérables du point de vue de la structure et de la fonction de ses écosystèmes à cause des mesures d'exclusion des incendies et continue à subir une pression intense de la part des communautés urbaines et rurales. La présente étude portait sur un secteur qui inclut l'une des régions où la pression démographique est la plus forte en Colombie-Britannique et où cette pression devrait continuer à s'accroître.

L'inventaire des écosystèmes fragiles du centre de l'Okanagan a été lancé en 1999 pour obtenir des données scientifiques susceptibles de soutenir les prises de décisions concernant la gestion des terres et pour encourager la conservation et la gérance des terres afin de protéger les écosystèmes rares et fragiles. Le secteur concerné par le projet était constitué de portions d'écosystèmes de basse altitude du centre de l'Okanagan. La technique de cartographie des écosystèmes terrestres a été mise en œuvre pour construire une carte des écosystèmes fragiles. Des relevés sur le terrain ont été effectués entre 2000 et 2001. Le présent rapport technique fournit des détails sur l'inventaire ainsi qu'une description sommaire et une analyse des résultats.

Vingt-cinq pour cent du secteur étudié comportaient des écosystèmes fragiles; 11% des terres faisaient partie de la catégorie « autres écosystèmes importants ». Les terres humides, les prairies, les forêts caducifoliées et les forêts matures se sont révélées très rares dans le secteur étudié. Des forêts de conifères et des mature forêts exploitables étaient présentes dans le secteur mais un grand nombre d'entre elles avaient été sévèrement modifiées par des coupes sélectives et des mesures d'exclusion des incendies. Très peu de sites de bonne qualité restaient donc dans le secteur. L'étude a également montré que certains écosystèmes fragiles avaient été dégradés par la fragmentation, l'utilisation par l'homme et l'envahissement par des essences introduites.

De nombreux sites identifiés dans le cadre de l'inventaire des écosystèmes fragiles risquaient fort d'être transformés à des fins autres ou d'être dégradés par l'homme et l'invasion par des plantes non indigènes dans un proche avenir. Les écosystèmes fragiles et la faune qu'ils abritent constituent un élément important de la qualité de vie des résidants de l'Okanagan. Compte tenu du nombre décroissant de ces écosystèmes dans le secteur étudié, il est essentiel de traiter sérieusement chacun des sites identifiés et d'évaluer en profondeur tout projet d'aménagement avant d'autoriser des travaux.

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Using the Report

This report presents information on sensitive ***ecosystems***[18] in the valley of the Central Okanagan, and provides guidance regarding their conservation and management. It 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.

This report is divided into two sections. ***Section One*** describes and discusses the importance of SEI ecosystems, describes impacts of concern, and recommends how to avoid these impacts. ***Section Two*** presents conservation tools that are available to individuals and different levels of government, and describes how various legal tools can be used to implement the management recommendations in Section One.

*See **Volume 2** for details on the Terrestrial Ecosystem Mapping, Soil Erosion and Slope Stability, and Expanded Legends*[16].

*See **Volume 3** for details on the Wildlife Habitat Capability and Suitability Mapping*[17].

Section One

Chapter 1: Introduction sets the context of the SEI project by describing the importance of both biodiversity and the study area. *Chapter 2: Ecosystems of concern* outlines the importance of sensitive ecosystems, the need for concern about them. *Chapter 3: Impacts of concern* describes the types of impacts that are of concern. *Chapter 4: Methods and limitations* explains how the mapping was completed and limitations of the mapping. *Chapter 5: Inventory results* describes the current overall status of sensitive ecosystems in the study area. *Chapter 6: Planning and management* outlines the general steps involved in conservation planning and describes basic management concepts that are applicable to all sensitive and other important ecosystems.

Chapters 7 through 15 profile each of the seven sensitive ecosystems and two other important ecosystems. Each chapter provides a detailed description of the specific ecosystem, its status and importance in the study area. Impacts and management recommendations are also discussed.

Chapter 16: Future directions presents recommendations for updating the SEI products, and completing the inventory's coverage.

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[16] Iverson et al. 2003

[17] Sarell et al. 2003

[18] The first occurrence of terms found in the Glossary is high lighted in ***bold italics***.

Section Two

This section provides guidance on legal tools that are available to promote conservation and effective management of sensitive ecosystems. Each chapter in this section deals with a different level of management and planning.

Chapter 17: What local governments can do discusses many of the legal conservation tools available to local and regional governments. Official Community Plans, Development Permits, and a number of other land use bylaws are discussed with regards to incorporating the management recommendations.

Chapter 18: What landowners and other citizens can do outlines what landowners and members of the public can do to encourage and facilitate conservation through tools such as ***conservation covenants*.**

Chapter 19: What senior governments can do discusses key federal and provincial statutes that can help conserve sensitive ecosystems.

There are two companion volumes to this one for people who need or are interested in more technical information on ecosystem mapping (Volume 2) and wildlife habitat mapping (Volume 3).

Volume 2[19] 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. Appendix F of Volume 1 provides tables that can be used to cross-reference between sensitive and other important ecosystems units and ecosystem mapping units in the ecosystem mapping report.

Volume 2 contains more detailed information describing the geology, natural history and human influences in the mid- and low-elevations of the central Okanagan. It includes information on methods, results and recommendations for the ***terrain mapping*** that forms a base for the ecosystem mapping and the ***slope stability*** and ***erosion*** potential mapping and themes developed from the terrain 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 3[20] contains wildlife habitat mapping themes developed from the terrestrial ecosystem mapping (TEM) for the following nine species: Painted Turtle (*Chrysemys picta*), Western Rattlesnake (*Crotalus viridis*), Gopher Snake (*Pituophis catenifer* ssp. *deserticola*), Flammulated Owl (*Otus flammeolus*), Western Screech-Owl (*Otus kennicottii* ssp. *macfarlanei*), Lewis' Woodpecker (*Melanerpes lewis*), Townsend's Big-eared Bat (*Corynorhinus*

[19] Iverson et al. 2003.
[20] Sarell et al. 2003

townsendii), Badger (*Taxidea taxus*), and Bighorn Sheep (*Ovis canadensis*). All of these species are considered at risk in the province of B.C. These species were chosen to provide a cross-section of threatened or endangered reptiles, birds, and mammals that have a range of different ***habitat*** requirements. There are many other ***threatened and endangered species*** that likely occur in the study area. Wildlife habitat mapping portrays the potential importance of the land and its features to specific animal species through a species-habitat model. The model is used to generate a habitat map by assigning ratings to different ecosystem units from the TEM based on the needs of the species for particular life requisites. The report is intended for professionals who require more detailed information on wildlife habitat values in the study area than Volume 1 provides.

Section I: Descriptions and Management Recommendations

Ecosystems of Concern

Impacts of Concern

Planning and Management

SEI Ecosystems

Descriptions

Values

Status

Management Recommendations

1 Introduction[21]

The Regional District of the Central Okanagan (RDCO), in conjunction with the Ministry of Sustainable Resource Management, Canadian Wildlife Service and others, initiated this project as a means of identifying the remaining sensitive ecosystems in the low to mid-elevation lands of the RDCO.

This report describes inventory methods and results, rare and fragile ecosystems of the Central Okanagan, highlights their values and importance, and offers practical advice on how to best avoid or minimize damage to them. Ecosystems identified by the Sensitive Ecosystems Inventory (SEI) are the primary focus of this report.

The Central Okanagan SEI follows from the first one in British Columbia, the East Vancouver Island and Gulf Islands SEI[21a]. Many of the materials in this report have been adapted from the reports for the Vancouver Island SEI. The Central Okanagan inventory, however, differs from the Vancouver Island one in that it was built from a ***Terrestrial Ecosystem Map***[21b] base rather than a stand-alone sensitive ecosystems map and inventory.

This report is intended to be a working document that can be used to counter damaging effects of our past activities, and to encourage local governments, landowners, developers, and other citizens to become involved in protecting, conserving, and restoring ***sensitive ecosystems*** so that future generations can know, experience, and enjoy them first-hand. This is especially important since rapid population growth in the Central Okanagan has caused the loss or degradation of many sensitive ecosystems. Continued population growth places increasing pressures on the remaining sensitive ecosystems (*see* sidebar).

Sensitive ecosystems are not the only areas worth preserving. They must be considered in the context of the overall landscape, which includes other ecosystems that are important to a wide variety of flora and fauna.

Population Statistics
The population estimate for the Central Okanagan Regional District for the year 2003 is 159,750 and is projected to grow to 258,092 by the year 2031[22]. This population growth will place continuing pressure on the remaining sensitive ecosystems in the Central Okanagan.

[21] Adapated from McPhee et al. 2000.
[21a] Ward et al. 1998 and McPhee et al. 2000
[21b] The first occurrence of terms found in the Glossary is highlighted in ***bold italics***.
[22] B.C. Stats 2003

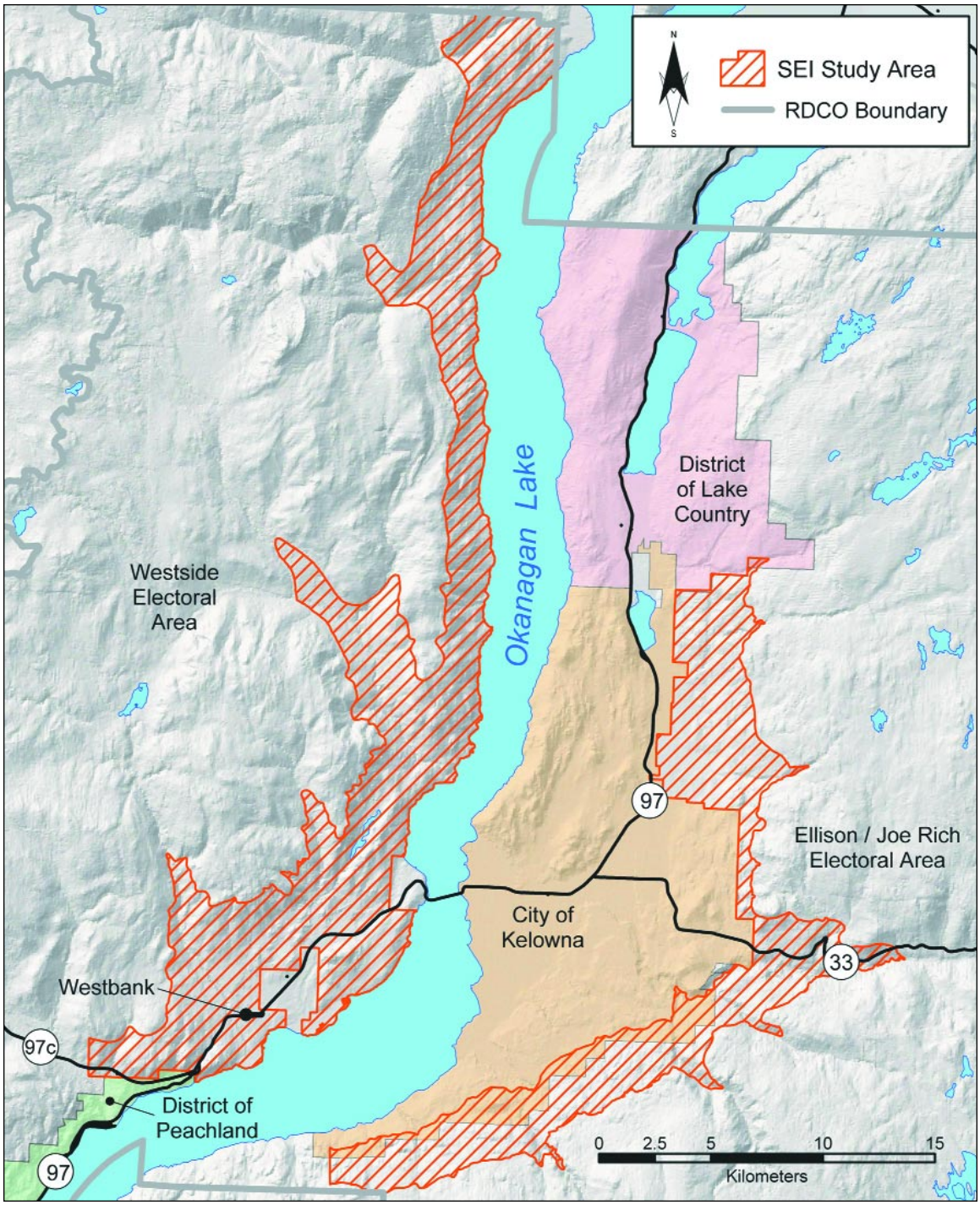

Figure 1. Study area.

Study Area

The study area (Figure 1) is located along the western and eastern flanks of Okanagan Lake in the central Okanagan Valley of south-central British Columbia. The area covers 30,908 ha, and includes private and publicly-owned lands within the Ponderosa Pine very dry, hot, Okanagan variant, and the Interior Douglas-fir very dry, hot, Okanagan variant ***biogeoclimatic subzones*** (*see* sidebar). Figure 2 shows a view of the east and west sides of the study area. The study area is located within the Southern Interior ***Ecoprovince***[23] , the northern extension of the Columbia Basin that extends south to Oregon and lies within the North Okanagan Basin ***Ecosection***, a wide trench carved out by the movement of a huge glacier.

Many government agencies and non-government organizations hope to extend coverage of sensitive ecosystems mapping to all low- and mid-elevations of the Okanagan Valley.

Most of the land within the study area was privately owned (Table 1). Protected lands covered 9.1% of the study area; of this amount 8% occurred within the PPxh1, the other 92% was within the IDFxh1.

The BC Ministry of Forests Biogeoclimatic Ecosystem Classification (BEC) is a system of classifying vegetation based on climatic and topographic patterns[24]*. Two biogeoclimatic variants are represented within the study area; the Okanagan Very Dry Hot Ponderosa Pine (PPxh1) and the Okanagan Very Dry Hot Interior Douglas-fir Variant (IDFxh1).*

Figure 2.
Views of the east side of the study area (left) and west side of the study area (right).

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

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

Table 1. Percentage of land in the study area that was crown, private, or protected.

Land Status	Percent of Study Area
Crown Land	33%
Private Land	55%
Provincial Parks	7.5%
Regional Parks	1.6%
Indian Reserve	1.9%

Most of the lands within the hot, dry, low- and mid-elevations of the valley are included in the study area because they are considered to be the more biologically diverse, and under greater pressure from urban settlement than the upper elevation lands[25]. These low- and mid-elevation lands also form a critical portion of the Okanagan corridor which is needed to maintain connectivity, and they include concentrations of rare natural plant communities.

Ecological Importance of the Study Area

This section is a summary of the information presented in Chapter 1 of ***Volume 2***[26].

The Okanagan Valley is a region of nearly unparalleled biological diversity within British Columbia and the rest of Canada. The area is characterized by a complex landscape of rugged, steep, and rocky terrain, plus gently sloping ***terraces*** that were formed by glacial lakes, and the movement of materials by melting ice during the retreat of the last glaciers 10-15,000 years ago. Since that time, erosion and ***deposition*** by wind and streams has further shaped the landscape, and the movement of material by gravity has formed some ***cones***, slide deposits, and ***talus*** slopes.

This Okanagan Valley experiences some of the warmest and driest weather conditions in the province. A rain shadow caused by the Coast and Cascade Mountains reduces precipitation in both winter and summer. In summer, hot dry air moves in from the Great Basin to the south, and very hot temperatures are common; however, the presence of Okanagan Lake (a large, glacial-relic lake), moderates these temperatures somewhat by cooling the air in summer and warming it in winter.

The complex terrain of the area, combined with a moderated semi-arid climate has resulted in a wide diversity of ecosystems and organisms. Ecosystems range from open ponderosa pine forests, to grasslands, to cliffs and talus slopes, to a wide diversity of ***riparian*** ecosystems, often within close proximity of one another. The Okanagan valley also contains a number of the province's

[25] The study area boundaries were decided upon by Regional District of the Central Okanagan staff in consultation with Andrew Harcombe and Carmen Cadrin of the Conservation Data Centre, and Mike Ladd and Orville Dyer of the Ministry of Water, Land, and Air Protection.

[26] Iverson et al. 2003

rare plant communities. Many of these are limited in distribution to the Okanagan Valley and other hot, dry valleys in the southern interior. Nearly half of the natural plant communities in the study area are on either the red- or blue-lists prepared by the B.C. Conservation Data Centre (*see* sidebar on page 11), or have not been ranked yet.

North American Context

In many places, rarity (as defined by humans) is artificially created by political boundaries. Although initially it may seem that the species, ecosystems and biological diversity of the Okanagan Valley is well represented south of the Canada-U.S. border, many conditions make the Okanagan Valley a unique place that is of vital importance to the continent and the rest of the world.

The Okanagan Valley is a north to south corridor that connects the dry interior landscapes of the Nicola, Thompson, Fraser, and Chilcotin Rivers in British Columbia to southern grassland ecosystems of the Columbia Basin in the U.S., which, in turn, connects the deserts of the south-west U.S. and Mexico. This corridor has been, and continues to be the principal entry route for southern plants and animals into B.C.'s dry interior. It also forms the main spring and fall migration route for many species of birds, and will likely play a critical role in their migration during climate changes such as global warming.

The diversity of habitat types in relatively close proximity to one another, combined with the moderating influence of relic glacial lakes on the local climate, distinguishes the Okanagan Valley from the vast Columbia Basin to the south.

The pressures from agricultural conversion and urban development that have resulted in habitat loss and threats to many species are not unique to the Okanagan Valley. Although urban development pressures are not as apparent south of the Canada-U.S. border, impacts from agriculture conversion, ***weed*** invasion, ***fire exclusion***, channelization of streams and rivers, and alteration and infilling of wetlands have caused declines in many species and plant communities that were formerly common. For example, in many areas of Canada and the U.S., only 0.1% of grasslands remain in a natural state[27].

Increasingly, scientists are finding that peripheral populations have a genetic resilience that allows them to persist in more adverse conditions, which may allow them to adapt to future changes such as global warming better than core populations[28]. Many of the species that occur in the Okanagan can be considered to comprise peripheral populations, since they are at the northern end of their range.

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[27] Henwood 1998

[28] Scudder 1991

2 Ecosystems of Concern

Why the Concern?[29]

Most people realise that they depend on biological diversity for food, medicine, and the raw materials from which industrial products such as fibres for clothing, lumber, or pulp are manufactured. Additionally, plants, animals, and the natural landscape provide aesthetic and recreational enjoyment through activities such as gardening, bird watching, and eco-tourism. All these factors serve to bolster the economy.

There is more to ***biodiversity***, however, than simply economics. Ecosystem processes regulate the climate, clean freshwater, regulate and clean soils, maintain genetic diversity, maintain the water cycle, recycle nutrients, and pollinate crops. Simply put, ecosystems provide the materials and processes that allow humans to live here on earth.

Recently, a team of ecologists and economists conservatively estimated that the annual value of the world's ecosystems, taking into account all the services they provide[30], was at least $33 trillion (U.S.) compared to a world annual gross national product (GNP) of around $18 trillion (U.S.).

Ecosystems, however, are not fully considered in the marketplace, nor are they valued along with our economic services and manufactured capital. In the past, if they were considered at all, they were given too little weight in policy decisions. It is easy to understand then, why much of the Central Okanagan has been reduced to small remnants of former ecosystems that once defined the region. People are often attracted to the most beautiful and hospitable places to live, but the impact of their presence and activities can cause degradation or loss of the integrity and beauty of these areas for both present and future generations.

What are Sensitive Ecosystems?

This sensitive ecosystems project recognises both *sensitive ecosystems* and *other important ecosystems* in the study area. Sensitive ecosystems refers to seven ecosystem types (Table 2) that are relatively unmodified, and are ecologically fragile or are recognised as being rare in the provincial landscape[32].

Sensitive ecosystems categories have been developed to reflect local ecosystems and to be as consistent as possible with the previous and other ongoing

For the SEI an ecosystem is defined as a portion of the landscape with relatively uniform vegetation and soils[31]. A sensitive ecosystem is one which is rare or ecologically fragile.

[29] Adapted from McPhee et al. 2000
[30] Costanza et al. 1997
[31] Pojar et al. 1991
[32] Ward et al. 1998

Sensitive Ecosystems Inventory projects[33]. Sensitive ecosystems categories represent generalised groupings of ecosystems that share many characteristics, particularly ecological sensitivities, ***ecological processes***, rarity, and wildlife habitat values.

Within developed landscapes, sensitive ecosystems provide ***patches*** of natural areas that have intrinsic value, and are critical to the survival of many species. They are vital in creating healthy and attractive communities for people.

The other important ecosystems are partially modified ecosystems that provide many natural values including wildlife habitat, wildlife corridors, buffers between developed areas and sensitive ecosystems, and sources of potential recruitment for some sensitive ecosystems (Table 3).

Table 2. Sensitive Ecosystems

Code	Sensitive Ecosystems	Ecosystem Description
WN	Wetlands	Non-forested ecosystems where the water table is at or near the surface; includes **marshes** (WN:ms), **swamps** (WN:sp), and **shallow open water** (WN:sw) ecosystems including ponds
RI	Riparian	Streamside ecosystems on floodplains and benches along creeks and rivers (**bench**, RI:fp), ecosystems in gullies with intermittent or permanent creeks (**gully**, RI:gu); fringe ecosystems associated with pond and lake shorelines or sites with significant seepage (**fringe**, RI:ff) and the river bed of large systems (**river**, RI:ri)
OF	Old Forest	Forest ecosystems dominated by large, old trees; excludes old riparian forests (OF:co)
GR	Grasslands	Ecosystems dominated by ***bunchgrasses*** (**grassland**; GR:gr) and **shrubland** (GR:sh) ecosystems that occur in a grassland matrix
BW	Broadleaf Woodlands	Ecosystems dominated by ***deciduous*** species including **aspen copses** (BW:ac)in grassland areas, and **aspen seepage** (BW:as)slopes; excludes old forests
WD	Coniferous Woodlands	Open stands of Douglas-fir or ponderosa pine, often on shallow soils; excludes old forests
SV	Sparsely Vegetated	Shrubby rock outcrops (**shrub**; SV:sh), grassy or unvegetated **rock outcrops** (SV:ro), **talus** (SV:ta) slopes, and **cliffs** (SV:cl)

[33] Ward et al. 1998

Table 3. Other Important Ecosystems

Code	Other Important Ecosystems	Ecosystem Description
MF	Mature Forest	Forests dominated by mature trees; includes **broadleaf** (MF:bd) forests, ***coniferous*** (MF:co) forests, and **mixed** (MF:mx) deciduous and coniferous forests; excludes mature riparian forests and mature coniferous and broadleaf woodlands
DG	Disturbed Grasslands	Disturbed grasslands are grasslands with some noxious or invasive weeds

Why are these ecosystems important?[34]

The ecological attributes and socio-economic values that are common to all SEI ecosystems are discussed below. Values and attributes unique to individual ecosystems are discussed in Chapters 7 – 15.

Ecological Attributes

- **Rarity** is a primary feature of sensitive ecosystems. It can be due to limited natural occurrence or the result of human activities over the past 140 years. Most rare species or natural plant communities in the study area are considered to be rare both because they are restricted in distribution, and because their extent and densities have been reduced.

  In each of the sensitive ecosystems chapters (Chapters 7 – 15), rare natural plant communities and vertebrate species are listed.

Conservation Data Centre
http://srmwww.gov.bc.ca/cdc/ Check this web site for the current provincial conservation status of rare plants, animals, and natural plant communities, since the status of these changes over time.

COSEWIC
http://www.cosewic.gc.ca/ Check this web site for the current national status of rare plants and animals.

[34] Adapted from McPhee et al. 2000

The Okanagan Valley provides habitat for many threatened and endangered species. Nationally rare species ranked by COSEWIC[35], as of May 2002, are noted as endangered (E), threatened (T) or of special concern (C).

Red-list: *The list of British Columbia's flora, fauna, and plant communities that are rare and endangered.*
Some red-listed animals in the study area include:
Badger *(COSEWIC-E) (Taxidea taxus)*
Western Screech-Owl *(COSEWIC-E) (Otus kennicottii* ssp. *macfarlanei)*
White-headed Woodpecker *(COSEWIC-E) (Picoides albolarvatus)*

Blue-list: *The list of British Columbia's flora, fauna and plant communities that are at risk because of low or declining numbers.*
Some blue-listed animals in the study area include:
Great Basin Spadefoot *(COSEWIC-T) (Spea intermontana)*
Lewis's Woodpecker *(COSEWIC-SC) (Melanerpes lewis)*
Townsend's Big-eared Bat *(Corynorhinus townsendii)*
Gopher Snake *(COSEWIC-T) (Pituophis catenifer* ssp. *deserticola)*
Western Rattlesnake *(Crotalus viridis)*

- **Fragility** is a measure of an ecosystem's sensitivity to a range of ***disturbance*** factors that could lead to decline or loss of ecosystem health or integrity. These factors could include direct physical impacts, introduction of ***invasive species***, or ***fragmentation***. Many of the SEI ecosystem types are fragile because they are vulnerable to invasion by weeds, they have sensitive soils, and they depend on complex ecological processes that are easily disrupted.

- **High biodiversity** is a common feature of most SEI ecosystems, largely because of the proximity of the Okanagan Valley to grasslands and deserts to the south, and because of the close proximity of many different types of ecosystems in the landscape. This creates an ensemble of species at risk not found elsewhere in Canada.

- **Specialised habitats** occur throughout the SEI ecosystems. They support many species of plants and animals. Typically, these ecosystems are critical habitats for rare, threatened or endangered species or natural plant communities. Some of these occur in only a few places in British Columbia or Canada, and their loss in the Okanagan would result in the loss of biodiversity and species at risk.

[35] *See* glossary for further discussion.

Socio-economic Values

- **Green Space** networks are provided by the various ecosystems in the study area. The diverse mix of species and ecosystems enhances the potential for human enjoyment and interaction with ***wildlife***. The networks also provide ***greenways***, such as riparian corridors or gullies, which can form the backbone of linear park systems.

- **High scenic values** are provided by rock outcrops, grasslands, and cliffs that provide excellent views of the landscape. These areas are often targeted for recreational and residential development. The scenic beauty of these and other ecosystems attracts visitors and is a source of pride and pleasure for local residents.

- **Outdoor recreation** opportunities are provided by the SEI ecosystems when they occur in public parks, and on accessible crown land where low-impact activities will not damage the habitat. Some of these sites are accessible to all income groups, particularly those who cannot afford the costs of "getting away to nature". Wildlife viewing is very important to Canadians[36], and contributes to our quality of life. Hunting, fishing, trapping and guide outfitting contribute to the economy and can occur where wildlife populations can sustain them.

- **Research and nature education** are important at all levels of the school system from early childhood through to university, plus continuing education programs. Many schools are now working with local groups on school projects (e.g., Streamkeepers and Wetlandkeepers), and most focus on creating native plant communities and restoring wildlife habitat. Children and their families are learning directly about the need and means by which to care for the environment. Some communities have nature centres (e.g., the Allan Brookes Nature Centre in Vernon) which provide opportunities for local and regional community ecosystem conservation efforts through educational programs, hands-on workshops and conservation-based recreational activities such as weed-pull days.

- **Eco-tourism** is growing in economic importance. It can also lead to increases in local commercial services such as overnight accommodation, food concessions, and ventures such as guided nature trips and bird watching. Annual events such as the Meadowlark Festival in the south Okanagan make significant contributions to the local economy as they attract visitors from well beyond the host community.

[36] Environment Canada 1999

- **Resource extraction** activities such as ranching and forestry industries have benefited generations of Okanagan residents and the remaining grasslands and forests continue to provide the economic benefits associated with domestic grazing and logging. Clean water, water retention, and groundwater infiltration are also important values provided by sensitive and other ecosystems.

- **Increased property value** is another benefit provided by green space and wild lands. The beauty of the natural landscape is often a large part of what attracts people to the Okanagan Valley. Studies show that undeveloped green space measurably increases the value of nearby property[37] by 5 to 32%[38] and thus, contributes far more in property taxes than it costs in services[39].

- **Horticultural industry** benefits can occur from the upsurge in interest in native plant gardening and backyard wildlife habitat creation. These also benefit landscape businesses in a community.

Sensitive Ecosystems Inventory (SEI)

The SEI can be used as a 'red flag' for more detailed mapping during local planning processes.

The Okanagan Valley is an area of tremendous biological and ecological significance, but it also has the highest population density in the interior of British Columbia. The study area covers one of the most rapidly growing population centers in the province. It has also been significantly altered, and many sensitive ecosystems and ***wildlife habitats*** have been lost or degraded. Land managers and private landowners need to protect biodiversity to manage for sustainable communities; populations need to be aligned with the carrying capacity of the region.

The purpose of the SEI project was to develop an inventory information base to support sound land management decisions, and promote effective stewardship of remnant rare and fragile ecosystems. The goal was to provide all levels of government with the necessary data and information for a variety of resource management issues, and to provide the RDCO and adjacent municipalities with data that could be used in developing Regional Growth Strategies, Official Community Plans, Local Area Plans, Greenspaces and Parks Plans. This product is intended to be a user-friendly information base that can be accessed by the general public, landowners, developers, professional biologists, planning staff, non-government organisations, and others. It can be used as a 'red flag' for more detailed mapping during local planning processes.

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[37] Meadows 1999
[38] U.S. National Parks Service 1990
[39] Fodor 1999

Additionally, it can be used in assessing development proposals and can provide land developers, public interest groups, and the public with scientific information needed to support conservation efforts.

The SEI will be used by the provincial Ministry of Water, Land, and Air Protection to review environmental impact assessments, assess impacts of land developments to rare species and natural plant communities, identify conservation priorities and options, identify important inventory sites, and determine availability and type of ownership of important habitats. The B.C. Conservation Data Centre will use SEI information to assess conservation status of rare natural plant communities, and conservation site planning in conjunction with known rare plant and animal occurrences.

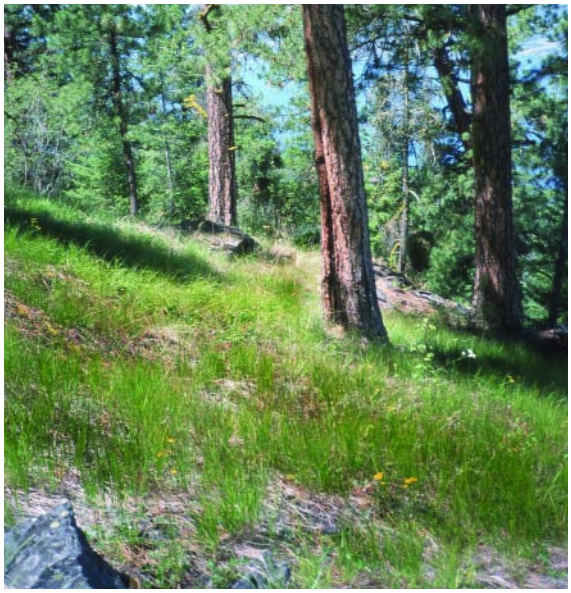
The SEI will also be used by the federal government in the *Canadian Environmental Assessment Act (CEAA)* process to identify areas of concern that CEAA must address. In addition, SEI will provide background information for site specific land uses, agency research projects, and conservation strategies.

This project focused on terrestrial ecosystems with the intention that the ***Habitat Conservation and Stewardship Program***[40] will provide more detailed analysis of the condition of aquatic habitats in the study area (*see* below).

> *The Habitat Conservation and Stewardship Program has undertaken a Sensitive Habitat Inventory Mapping (SHIM) project in the RDCO which will provide information on fish and aquatic habitats and detailed, larger scale mapping of stream riparian ecosystems than is provided by this SEI. The project will identify impacts to water quality and fish habitat and identify opportunities for policy change, restoration, and stewardship.*

[40] *See* Glossary.

In the study area, activities such as mountain biking caused erosion on some slopes and exacerbated the spread of weeds like the knapweed that covered this slope.



Historically, open grown forests like this one likely dominated the landscape. We observed such forests only on sites with shallower soils, and in the few places where logging had not occurred.

Cheatgrass, an introduced annual ***grass***, was observed as a common invasive plant species that has invaded many grasslands and open forests.

Most forests in the study area had become dense and ingrown with the exclusion of fire and the ***selection logging*** of large old veteran trees. Such forests were vulnerable to catastrophic wildfires, and much of the ***understory*** diversity and wildlife habitat value was lost when forests become closed. Forest ingrowth has caused economic losses through the loss of ***forage*** for domestic livestock, and has reduced forestry values due to decreased tree growth, and increased vulnerability to insect and disease attack.

3 Impacts of Concern

In the past 100 years, the incremental progression of human settlement, intensive agriculture, forest harvesting, ***fire suppression,*** water management, and road, railway, and power line construction has resulted in the loss of, or damage to, the natural ecosystems in the study area. In some areas, landscape fragmentation and ecosystem loss has created the situation where once widespread and common ecosystems are now considered to be rare. The species that originally inhabited these ecosystems, from minute soil biota to large mammals, are also affected. Some of these species are now considered to be threatened and endangered.

Presently, urban and rural human settlement pressures represent the greatest threat to sensitive ecosystems. Large-scale landscape concerns, which affect all ecosystems, include landscape fragmentation, disruption of ***natural disturbance*** regimes, ***edge effects,*** invasive species introductions, and climate change.

Landscape Fragmentation

Fragmentation of the landscape often affects the functioning of ecosystems by disrupting connections between different ecosystems (e.g. between uplands and wetlands, resulting in changing water movement and water table levels). In addition, disconnected islands of natural ecosystems cannot provide the necessary habitat values for wildlife species, which may require different ecosystem types for breeding, wintering, and foraging. Wildlife species require a network of corridors and habitats to maintain population levels and gene dispersal.

Urban and agricultural developments have been the primary agents of landscape fragmentation in the study area. Forestry roads and cut blocks have also caused fragmentation of the landscape.

Disruption of Natural Disturbance Regime

A major landscape level change in the study area has been the exclusion and suppression of natural fire. Ecosystems and species of the Okanagan Valley have evolved with natural fire as a major factor in ecosystem and habitat distribution. Frequent ***surface fires*** maintained open forests and grasslands, and supported the regrowth of the vegetation species that dominated the landscape

in pre-settlement times. Fire exclusion and fire suppression over a long period of time has resulted in ***forest ingrowth*** of Douglas-fir and ponderosa pine, and ***forest encroachment*** of these trees onto grasslands. Fire suppression has also resulted in extensive fuel accumulations, which combined with forest ingrowth, has altered the ***fire regime*** from low-to-moderate severity surface fires[41] to high severity, ***stand-replacing fires***[42]. Additionally, increased tree densities in forests have stressed trees making them more susceptible to diseases such as mistletoe and insect pests such as spruce budworm. These factors, together with reduced cover of bunchgrasses and shrubs, have affected both ecosystem processes and wildlife habitat values.

Another major landscape level change that has occurred in the study area has been the channelization of many riparian ecosystems to prevent flooding. The prevention of natural flooding events reduces the diversity and complexity of wetland and riparian ecosystems, and alters habitat values, resulting in loss of some functions and part of the riparian habitat.

Invasive Species

For this SEI, we define weeds as non-native plants which, in the area they occur, lack the natural enemies necessary to restrict their distribution.

Noxious weeds are aggressive invader weeds that are designated under the provincial Weed Control Act.

Both the deliberate and accidental introduction of non-native plant and animal species (*see* sidebar) has significantly altered the species composition of some ecosystems in the study area. Invasive plant species reduce diversity by displacing native plant species, and reducing vegetation structural complexity and soil stabilization. Invasion of non-native plants can also result in loss of forage for many wildlife species. Improperly managed grazing by domestic animals can exacerbate weed invasions, particularly in grasslands and wetlands where exposed soils provide excellent sites for a number of introduced and weedy native species that are capable of colonizing newly disturbed areas. Recreation vehicles such as all terrain vehicles (ATVs), bicycles, domestic animals, and people can all cause the spread of weeds. Many weeds have seeds that can survive in the soil for decades; consequently, weed control must always be considered to be a long-term process.

Grasslands, old forests, coniferous woodlands, and sparsely vegetated ecosystems are vulnerable to invasion by cheatgrass (*Bromus tectorum*) and other annual bromes (*Bromus* spp.), diffuse knapweed (*Centaurea diffusa*), or sulphur cinquefoil (*Potentilla recta*). Disturbed grasslands are very vulnerable to takeover by invasive plant species if they are disturbed further. Riparian ecosystems and broadleaf woodlands are vulnerable to invasion by common hound's-tongue (*Cynoglossum officinale*) and common burdock (*Arctium minus*). Wetland ecosystems can be completely altered if purple loosestrife (*Lythrum salicaria*) becomes established.

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[41] *See* ***fire severity*** in the glossary.

[42] Moore et al. 1999; Fule et al. 1997; Daigle 1996

Aquatic ecosystems have also been affected by the introduction of many species. Non-native fish have been introduced into many places, and now actively compete with native species. Mysid Shrimp (*Mysis relicta*) were introduced into Okanagan Lake to provide food for kokanee salmon, but instead, the kokanee population declined because the shrimp fed on the phytoplankton that the kokanee fry depended on.

Some invasive plant species:
Diffuse knapweed *(Centaurea diffusa)*
Sulphur cinquefoil *(Potentilla recta)*
Cheatgrass *(Bromus tectorum)* and other annual bromes *(Bromus* spp.*)*
Common hound's-tongue *(Cynoglossum officinale)*
Common burdock *(Arctium minus)*
Purple loosestrife *(Lythrum salicaria)*
Common St. John's wort *(Hypericum perforatum)*

Some invasive animal species:
European Starling *(Sturnus vulgaris)*
Dogs
Cats
Mysid Shrimp *(Mysis relicta)*
Brook Trout *(Salvelinus fontinalis)*
Bass *(Micropterus* spp.*)*
Black Crappie *(Pomoxis nigromaculatus)*
Many agricultural pests

Edge Effects

Fragmentation of ecosystems combined with adjacent development contributes to the creation of 'edges' where there is an abrupt rather than natural, gradual change from one ecosystem type to another. This edge effect can alter the habitat value of the original ecosystem by creating changes in microclimate elements such as air temperature, light level, and humidity[43]. Direct biological effects result when specific species cannot tolerate human activity nearby, or they are exposed to predation by other species. Increased non-native species invasion and competition for habitat are examples of indirect biological edge effects.

[43] Chen et al. 1995; Saunders et al. 1991

Climate Change

It is now widely accepted that global climate change is occurring[44]. This change will likely vary from region to region, and the long-term effects are unknown. Maintaining ecological functions and processes along with genetic diversity provides maximum opportunity to absorb or mitigate some of these effects. Maintaining species populations at the edges of their range is also considered to provide greatest flexibility is species survival through climate change[45]. Maintaining a corridor through the Central Okanagan is one key to maintaining the corridor that connects the interior of B.C. with drier ecosystems to the south in the U.S. With climate change, this corridor will be critical for the dispersal and conservation of many dryland species that may move to more northern latitudes or to higher elevations.

Direct Impacts

Direct impacts to ecosystems are those which occur on site, and which have the most immediate and visible effect. Vegetation removal or damage, and soil removal or compaction are examples of immediate and visible effects. Ditching, diking, draining and filling of wetlands and riparian areas are visible effects which also result in long-term indirect effects on ***hydrological*** patterns. Disturbances to wildlife species, particularly during the breeding season can directly impact their survival. Large rural lots have the potential to retain many natural values, however, many owners choose to remove native vegetation, trees, snags, logs, and rocks, and intensely manage or graze domestic animals (e.g., horses), thus reducing the natural values of these areas.

Indirect Impacts

Activities that occur adjacent to or at some distance from the ecosystem result in indirect impacts. Changes in ***hydrology*** due to physical changes to watercourses and water flow, deforestation, removal of vegetation, changes in vegetation structure (e.g., from shrub cover to ***herbaceous*** weeds), increased impervious road surfaces, soil compaction and agricultural practices can all result in reduced groundwater infiltration and summer soil moisture, increased annual ***runoff*** and flood events, disrupted drainage patterns, and reduced soil moisture holding capacity. Water pollution from both point and non-point

[44] United Nations Environment Program 1999
[45] Scudder 1991

sources contributes to reduced water quality, potential outbreaks of water-borne disease, and impacts to wildlife populations through the loss of habitat and disruption of the food chain. The use of pesticides associated with agriculture and landscaping has also caused degradation of natural ecosystems and wildlife habitat[46].

The presence of humans and their pets, even on private property can cause disturbances to wildlife. Recreational activities involving all terrain vehicles (ATVs), dirt bikes, off-road vehicles, mountain bikes, and rock climbers, if not carried out responsibly, can also disturb wildlife, and cause soil erosion and damage to plants.

[46] Cannings and Durance 1998

4 Methods and Limitations

This chapter describes the methods that were used to generate the sensitive ecosystems map. These methods were intended to provide a bridge between the wildlife habitat mapping in the South Okanagan[47] and the user-friendly methods used in the Sensitive Ecosystems Inventory project on East Vancouver Island and the Gulf Islands. The provincially recognised Terrestrial Ecosystem Mapping[48] (TEM) approach was used as a base map. Ecosystems were evaluated for sensitive ecosystems status and a sensitive ecosystems theme map was developed.

Terrestrial Ecosystem Mapping

Terrestrial Ecosystem Mapping (TEM) formed the foundation of the thematic sensitive ecosystems map that was created for this project. ***Polygons*** were delineated on 1:15,000 colour ***aerial photographs*** using a ***bioterrain*** approach. Polygons were drawn around areas of uniform vegetation, topography and terrain features. Ecosystem, terrain, and conservation evaluations were recorded in a polygon database. The polygons were digitized and compiled in a geographic information system (GIS), and linked to the polygon database.

*Details on methods, results, limitations and management recommendations for slope stability and erosion potential mapping can be found in the **Volume 2**[49].*

Sensitive Ecosystems Mapping

TEM units were evaluated for rarity and ecological sensitivity and were assigned to sensitive ecosystems and other important ecosystems categories accordingly. Criteria for ecological sensitivity included the presence of shallow soils, the susceptibility of the site to hydrological changes, erosion, and invasion by noxious weeds, and sensitivity associated with human disturbance. Rarity was based on rankings by the Conservation Data Centre (CDC), and ecosystems proposed for ranking by the CDC based on the local and provincial distribution of those ecosystems (especially in an undisturbed state) and the threats to them. If the ecosystem was determined to be ecologically fragile or rare, it was assigned to the applicable sensitive ecosystems category. In cases where a given ecosystem could be assigned to more than one Sensitive Ecosystems category, it was always assigned to the more sensitive category.

*Details on methods, results, limitations and management recommendations for wildlife capability and suitability mapping can be found in the **Volume 3**[50].*

[47] Austen et al. 1998
[48] Resources Inventory Committee 1998
[49] Iverson et al. 2003
[50] Sarell et al. 2003

For example, old riparian forests were assigned to the 'riparian' rather than the 'old forest' category.

Ecosystems were grouped into sensitive ecosystems categories using the Ecosystem-based Resource (ERM) Table Too[51]. This tool allows ratings, or in this case, SEI categories, to be assigned to each ecosystem. Detailed conversion tables can be found in Appendix F.

Field Sampling and Conservation Evaluation of Sensitive Ecosystems

Prior to initiating the fieldwork for this project, a letter was sent out to all landowners with large properties in the electoral areas of the RDCO. The letter informed the landowners of the fieldwork for the inventory, and provided them with an opportunity to notify the Regional District if they did not wish to have their property surveyed. For small properties or where no response was received, the field survey teams requested permission directly from the landowner prior to sampling on the property.

The sampling plan involved using forest cover maps to identify areas of potentially old forest, and aerial photographs to identify accessible potentially sensitive ecosystems including grasslands, wetlands, ponds, riparian areas, rock outcrops and talus slopes. Field sampling was completed over two summers: 2000 and 2001, and a total of 450 sensitive ecosystems or other important ecosystems sites were field-checked (Table 4). Teams of three scientists including a plant ecologist, terrain specialist, and wildlife biologist conducted the sampling.

Three types of sample plots were used to identify and assess ecosystems: detailed ecological plots, ground inspections, and visual inspections[52] (*see* Appendix D). Sampling procedures for detailed ecological plots and ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[53]. The *Standard for Terrestrial Ecosystem Mapping*[54] in British Columbia provides guidelines for visual inspection data collection.

Field crews used the conservation evaluation form (*see* Appendix D) to assess the conservation values of the site. Appendix G provides definitions of terms and requirements for each factor in the conservation evaluation.

Field data provided points of calibration used to photo-interpret ecosystems that were not visited.

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[51] *See* the following website for more information on the ERM tools and to download ERM tools: http://srmwww.gov.bc.ca/rib/wis/whr/sta.htm

[52] *See* Volume 2: Iverson et al. 2003.

[53] BC Ministry of Environment, Lands and Parks and BC Ministry of Forests 1998

[54] Resources Inventory Committee 1998

Table 4. Sites sampled by ecosystem type.

	Full plots	Ground Inspections	Visuals	Total Plots	Percent of Polygons Sampled
Sensitive Ecosystems					
Broadleaf Woodland	0	5	4	9	23
Grasslands	7	11	19	37	16
Old Forest	1	1	1	3	5
Riparian	8	34	53	95	20
Sparsely Vegetated	5	12	52	69	10
Coniferous Woodland	9	22	71	102	7
Wetland	6	5	16	27	29
TOTAL	**36**	**38**	**268**	**342**	**11**
Other Important Ecosystems					
Disturbed Grasslands	0	6	13	19	61
Mature Forest	1	86	2	89	14
TOTAL	**1**	**92**	**15**	**108**	**16**

Mapping Limitations

The SEI mapping does not replace the need for on-site assessments of areas where land use changes are proposed or contemplated.

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

The accuracy of polygon boundaries is limited by the scale (1:15,000) and date (1994 and 1996) of the aerial photographs on which the sites are delineated. *It is recommended that digital data not be enlarged beyond the scale of the photos as this may result in unacceptable distortion and faulty registration with other data sets*.

Given the continuing land-uses within the Central Okanagan, including human settlement and logging, some polygons may have changed since the date that the aerial photographs were taken or the field sampling was conducted. Wherever possible, polygons were updated to reflect changes that were noted during field sampling.

One of the primary limitations of aerial photograph interpretations is the ability to see specific disturbances such as invasion of noxious weeds. The mapper must apply the information from field sampling data to adjacent areas. Additionally, disturbance levels may have changed in some areas after the field sampling was completed.

Another common limitation is the ability to delineate polygons around small sensitive ecosystems. In most cases, these ecosystems are captured as a small component of a larger polygon that is dominated by another ecosystem. It is important to remember that many polygons contain a complex of ecosystems, and sensitive ecosystems may only occupy a portion of that polygon.

5 Inventory Results

This chapter provides a summary of the distribution and extent of sensitive ecosystems and other important ecosystems in the study area. Further details can be found in each of the ecosystem chapters.

SEI Summary Results

Seven types of sensitive ecosystems and two types of other important ecosystems were identified. Collectively the seven sensitive ecosystems (SE) covered 25.4% (7839 ha) of the study area (Table 5), while modified landscapes covered the remaining 74.6%. The two other important ecosystems (OIE) mapped covered 11.2% (3772 ha) of the study area.

It is important to remember that ecosystems that have not been included as sensitive ecosystems or other important ecosystems still have many important values. In particular, other ecosystems provide connectivity between SE and OIEs and some may be recruitment sites for future SEs and OIEs. Many ecosystems have wildlife habitat values and the vegetation and soils of these sites are often important for the safe capture, storage, and release of water that is critical to maintaining water quality and preventing soil erosion and siltation of streams and rivers.

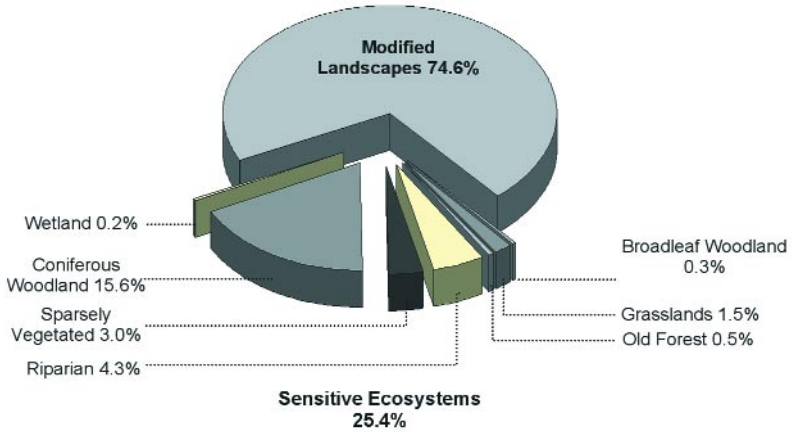

Figure 3.
Relative proportion of sensitive ecosystems and modified landscapes in the study area.

Table 5.
Area of sensitive ecosystems and other important ecosystems in the study area.

	Area (ha)	Percent of Study Area
Sensitive Ecosystems (SE)		
Broadleaf Woodland	95	0.3
Grassland	464	1.5
Old Forest	154	0.5
Riparian	1315	4.3
Sparsely Vegetated	942	3.0
Coniferous Woodland	4822	15.6
Wetland	48	0.2
Total SE	**7839**	**25.4**
Other Important Ecosystems (OIE)		
Disturbed Grassland	697	2.3
Mature Forest	3075	9.9
Total OIE	3772	11.2
TOTAL SEI and OIE	**11,610**	**37.6**

6 Planning and Management

Goals

The primary goals of the guidelines presented throughout this report reflect the differences between the two types of SEI ecosystems:

Sensitive ecosystem guidelines seek to conserve the seven sensitive ecosystems in a relatively natural state.

Other important ecosystem guidelines seek to maintain the resource values of the two other important ecosystems and minimise the loss of ecosystem functions.

Setting Priorities

Use SEI and Wildlife Maps to Prioritize Sites

SEI maps and wildlife maps[55] can be used to set priorities for conservation and management. Concentrations of high quality ecosystems and habitat for rare species should be prioritized for conservation. Quality and viability ratings of SEI units can be used to identify higher quality SEI units. Buffers should be included to protect core conservation areas, and these areas should be linked through corridors. Often, riparian areas, which are sensitive ecosystems, form natural corridors.

On-site visits are needed to assess the site and develop site-specific management recommendations.

Other SEI areas should be considered in all levels of planning and protection, and mitigation strategies should be developed in areas where development will occur. SEI maps are intended to be used for broad-level planning, however, on-site visits are needed to assess the site and develop site-specific management recommendations.

Develop a Conservation Strategy[56]

Most sensitive ecosystems are on private property, so the cooperation of landowners is essential in the long-term conservation of these ecosystems. Various tools and mechanisms are available for ecosystem protection depending on the ownership and the management policies and practices of the existing land managers. Once land status is determined, appropriate measures may be taken including:

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[55] *See* Volume 3 (Sarell et al. 2003) for more information on wildlife maps.

[56] Significant portions of this section have been adapted from McPhee et al. 2000.

- **Designation as Environmentally Sensitive Areas** (ESA) – In the identification of local government ESAs, the seven sensitive ecosystems should receive a priority designation. In some cases, site boundaries should reflect the dynamic nature of the ecosystem (*see* **Delineate Buffers around Sensitive Ecosystems** below).

- **Designation as nature or ecological reserve or other similar protected status** – The most undisturbed, publicly owned of these remaining ecosystem fragments should be designated as conservation areas and permit only activities that do not impact the ecosystem. Grassland, wetland, old forest, and broadleaf woodland together with the highest quality riparian, coniferous woodland (especially older structural stages), and sparsely vegetated sites should all be priorities for receiving protected status. Sites where different sensitive ecosystems occur adjacent to, or in close proximity to one another should also be given priority with regards to protection.

- **Acquisition of privately owned lands** containing sensitive ecosystems should be pursued by both government and non-government organisations. Priorities should reflect those stated above for protected areas and should accommodate opportunities that arise as properties come up for sale.

- **Stewardship** – Private landowners with Sensitive Ecosystems who wish to retain ownership could become involved in voluntary stewardship initiatives such as registering conservation covenants on their property to protect ecosystem values. Protection of grasslands, managing invasive weeds, and managing forest ingrowth should all be priorities for stewardship programs.

- **Use other protection techniques** such as cluster development, Development Permit Areas, restrictive covenants, and incentives.

Reducing Wildfire Threat across the Landscape

Most forests within the study area were historically maintained in open park-like conditions by frequent surface fires. Fire exclusion, however, has resulted in structural changes to forests including increased stand densities, multiple layering in stands (providing ladder fuels for surface fires to become stand-replacing fires) and increased fuel loadings. Consequently, high severity stand-replacing fires that likely would result in a loss of biodiversity, site

productivity, and create weed infestation areas with minimal biological values are more likely to occur than they did historically.

A landscape level assessment of wildfire risk can document the areas that are at greatest risk. The "Wildfire Threat Rating System" (WTRS) is the best planning tool available for assessing wildfire risk[57]. It is a GIS-based model that spatially quantifies the primary factors that affect wildfire risk, and it allows managers to examine the implications of different management activities with respect to wildfire threat. WTRS determines wildfire threat by incorporating four key components:

- fire risk;
- suppression capability;
- fire behaviour; and
- values at risk.

The components are compiled from a number of relevant contributing factors each represented by a sub-component in a Geographic Information System. A total of 13 contributing factors form the foundation for this model. To calculate the wildfire threat rating of a given component, the relevant contributing sub-components are overlaid in GIS. This process is repeated for each of the four components, which are then, in turn, overlaid to produce the final wildfire threat-rating theme.

Once Wildfire Threat or some surrogate risk and hazard assessment has been completed, a fuel break strategy can be incorporated to identify areas that can be treated as fuel breaks in the event of a large fire. Fuel management strategies for private and public landowners can also be developed to help avoid the effects of severe fires and protect such things as biodiversity values and private land values (e.g., houses).

General Management Recommendations[58]

This section provides general recommendations to avoid negative impacts to sensitive ecosystems. These recommendations reflect the principles of biodiversity conservation, which apply to all sensitive ecosystems identified in the study area. For other important ecosystems (disturbed grasslands and mature forests), broader conservation-oriented management practices are discussed.

[57] Hawkes et al. 1997

[58] Many of the management recommendations have been adapted from McPhee et al. 2000.

Delineate Buffers and Corridors around Sensitive Ecosystems

In order to achieve adequate protection, sensitive ecosystems must be buffered from potentially adverse effects of land use practices in adjacent areas. For this reason, it is recommended that the protected area for a sensitive ecosystem consist of the sensitive core surrounded by a vegetated buffer zone. These zones can absorb and avoid negative edge effects that result from such things as increased human access (on foot or by vehicle), increased animal access, and colonization by invasive species. Buffers also play a role in maintaining microclimate conditions, particularly for wetlands and riparian areas. The size of the buffer zone varies by ecosystem type, and by constraints of the surrounding landscape. This is particularly critical within urban and rural environments. Fencing may be necessary along some buffers where further adjacent development and activity is anticipated. In planning for protection of a particular site, assessments and recommendations should be made by a qualified professional to ensure that conservation options are maximized.

In addition to buffering core high priority areas, corridors are needed to connect conservation areas. Many streams and their associated riparian areas provide natural corridors in the study area.

Avoid Direct and Indirect Impacts

Minimizing negative impacts to sensitive ecosystems can be achieved through the following principles:

- **Discourage settlement and other development within or adjacent to sensitive ecosystems** unless negative impacts are expected to be insignificant. This is particularly critical within rural environments and new urban developments;

- **Manage access to both land and water:** Seasonal use-restrictions, fencing, designated trails, signage and carefully managed livestock access represent a variety of management tools that can be used to control or avoid the negative effects of access to sensitive areas;

- **Maintain water quality:** Clean and sufficient water supplies are critical to the survival of species, ecological processes, and the maintenance of agricultural systems in the study area;

- **Prevent disturbance of nesting or breeding areas:** Known and potential breeding sites, especially for vulnerable, threatened or endangered species should be protected from disturbance or any activity that would disturb breeding adults;

- **Control invasive species:** In many cases, a broad species management program may be required to deal with perennial weeds such as diffuse knapweed (*Centaurea diffusa*) and annual grasses such as cheatgrass (*Bromus tectorum*). Using native species to reclaim disturbed sites can reduce the potential for weed invasion. Vehicle use should be avoided in all areas with invasive species; and

- **Restore natural disturbances regimes wherever possible.** While it is neither desirable nor feasible to end fire suppression, it is possible to consider some planned thinning and prescribed burning to restore some areas, reduce ingrowth of Douglas-fir and ponderosa pine, and restore some grassland habitat in high-priority conservation areas. Many sensitive ecosystems and structures that are important to wildlife (e.g., large old trees) are seriously at risk of loss to catastrophic wildlife. Landscape level fuel breaks implemented in appropriate areas determined through a wildfire risk assessment can help protect these structures. Returning riparian and wetland areas to natural water flows might be recommended for specific sites.

Plan Land Development Carefully

Where it is not possible to limit settlement or other developments within or immediately adjacent to a sensitive ecosystem, activities should be carefully planned to minimize adverse effects to the ecosystem. A qualified professional biologist should conduct a detailed inventory of the area in question, ideally over an entire year, to determine the full species complement and ecological functions of the area. Surveys done at the wrong time may fail to uncover the presence of rare species or some critical habitat component for other species.

Inventories of vegetation, including wildlife trees and the extent of tree root systems, terrain features such as cliffs and talus; adjacent water bodies; and other important microhabitats are necessary to determine the full impact of development on biodiversity at the site. In addition, the occurrence of nationally vulnerable, threatened, or endangered species, and rare natural plant communities identified by the Conservation Data Centre should be given high priority for conservation management. Each sensitive ecosystem chapter has a list of the rare vertebrates and natural plant communities that could occur in that ecosystem in the central Okanagan. If the assessment is not conducted at the optimal time to detect species at risk, then it should be assumed these species are present in suitable habitats, unless some evidence demonstrates otherwise. Qualified professionals should work with the planning team to ensure that the sensitive ecosystem and potential wildlife habitat is protected as much as possible.

Incorporating SEI Information into Environmental Impact Assessments

These are guidelines for people planning land developments according to local government regulations. This information can be helpful in developing an Environmental Impact Assessment under provincial or federal guidelines, which are specified under the following acts:

Canadian Environmental Assessment Act (see page 157 for further information)

BC Environmental Assessment Act (see page 167 for further information)

Environmental Impact Assessments (EIAs) may by necessary where rezoning, subdivision, or other land development occurs within a Development Permit Area or areas where development approval information is required.

EIAs should be conducted early in the development process to allow for more flexibility in creating a development proposal that conserves sensitive ecosystems and wildlife habitat, while meeting the needs of the proponent. The process may be iterative – the consultant(s) conducting the assessment will be given information about the development layout, and then will provide specific suggestions on how to alter the layout to promote the protection of environmental values. Depending on the zoning of the site, the proponent should contact the Regional District or Municipality about the possibility of cluster development and density bonuses (*see* the section on Zoning on page 135).

Sensitive ecosystems mapping can provide information about the environmental impacts of housing and other developments on these ecosystems. The following procedure provides a guide to incorporating SEI information into EIAs.

1. The EIA must be prepared by a registered professional biologist together with other professionals[59] of different expertise, as the project warrants. Hydrologists and hydrogeologists should be consulted where wetlands, riparian areas, and broadleaf woodlands exist within the development area to ensure that proper hydrological function is maintained within these ecosystems. A professional geoscientist should be consulted where there are erosion potential or slope stability hazards. The consultant or team of consultants must have an understanding of wildlife biology, especially for species at risk, geomorphology, environmental assessment, and development planning in British Columbia. Specific expertise in Okanagan Valley wildlife species, wildlife habitat, and ecosystems is highly preferred.

2. Digital Sensitive Ecosystems and Wildlife Habitat mapping files should be used to generate a sensitive ecosystems map and wildlife habitat maps for the proposed development area plus a surrounding adjacent area that is at least equal in width to the development area. The soil erosion and slope stability maps should be used to determine if any risks exist in the development area.

[59] A collaborative team of consultants often provides the best combination of experience and expertise in the broad range of fields necessary to complete an effective Environmental Impact Assessment.

3. A field assessment should be conducted:

    a. For those SEI polygons where field data has not been collected, ground-truthing, including an assessment of the quality and condition of the ecosystems, should be conducted. For complex polygons, sensitive ecosystems should be mapped at a larger scale than used in the SEI to show specific locations;

    b. Where potential significant wildlife habitat is indicated by wildlife habitat maps, verify the presence of wildlife or their habitats by completing a detailed species inventory. The inventory should take place during the time(s) of year when wildlife species of interest are expected to be present. It will be difficult to verify the presence of some species. It may be necessary to assume the presence of these species based on habitat suitability and forgo expensive inventories efforts. Each sensitive ecosystem chapter has a list of the potential red- and blue-listed wildlife that could occur in that ecosystem in the central Okanagan. All of these species should be addressed in the assessment; and

    c. Verify any potential soil erosion (ratings of Moderate, High, or Very High) or slope stability (Class III and up) problems in the field assessment.

4. The sensitive ecosystems and wildlife habitat mapping will need to be revised to reflect the field verification work.

5. Adverse long and short-term effects that the proposed development is likely to have on sensitive ecosystems and wildlife habitat (direct and indirect impacts) should then be identified.

6. A site plan that incorporates the management recommendations found below for each sensitive ecosystems category and which optimizes conservation of sensitive ecosystems and wildlife habitat, maintains connectivity and buffers around them and corridors between them, and avoids erosion potential or slope stability risks should be generated. The plan should seek to maintain connectivity with sensitive ecosystems and important wildlife habitats in adjacent areas, wherever possible.

7. The construction schedule and type of equipment that will minimize or avoid adverse environmental effects should be determined.

8. Opportunities for restoration or enhancement of sensitive ecosystems and wildlife habitat should be identified and the criteria used to prioritize these opportunities should be documented.

9. The assessment should identify how the proposed development will affect sensitive ecosystems and wildlife habitat, and should provide recommendations to reduce negative impacts and mitigate unavoidable impacts (e.g. restoration or enhancement).

A sedge (yellow-green) and bulrush (dark green) marsh surrounded by a riparian fringe.

A juvenile painted turtle found in a marsh and shallow open water ecosystem.

A cattail marsh with shallow open water surrounded by a riparian fringe.

7 Wetland

What are wetland ecosystems?

Wetlands occur on sites where the water table is at, near, or above the soil surface for a sufficient period of time to influence soil and vegetation development[60]. Wetland ecosystems characteristically have plants that are adapted to growing on saturated soils with low oxygen levels. Soils are typically ***gleysols*** or ***organic***. Within British Columbia, approximately 6% of the total land area is covered by wetlands[61].

Wetlands were divided into distinct classes according to their environmental and vegetation characteristics. These classes included swamps, marshes, and shallow water ecosystems; they are described below.

Marsh wetland ecosystems

Marsh wetland ecosystems occurred at the edge of shallow open water, ponds, and lakes, on the edges of larger wetlands, and in depressions where the water table was above or near the soil surface. Rushes, cattails, or sedges usually dominated marshes, and some floating aquatics such as duckweed and water smartweed were often present. Soils were typically fine-textured, gleysol mineral soils.

Swamp wetland ecosystems

In this study area, swamp wetland ecosystems occurred at the edges of ponds and wetlands, forming a shrubby fringe around them. Willows dominated these sites, and sometimes sedges were present where the swamp occurred at the edge of a wetland. Although many swamps have subsurface water flow associated with them (subirrigation), those observed in the study area only had subsurface water with minimal flow. ***Soil textures*** were variable and ***mottles*** were common.

Shallow water ecosystems

Shallow water ecosystems were either areas of open water that were intermittently or permanently flooded up to 2 m in depth at midsummer[62], or were ponds that were greater than 2m in depth, but were less than 50 ha in area. Vegetation was limited to submerged or floating aquatic plants with less than 10% cover of ***emergent vegetation***. Shallow water ecosystems often occurred in association with marshes.

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[60] MacKenzie and Banner 1999
[61] Voller 1998
[62] Voller 1998

Wildlife

Amphibians & Reptiles: *Amphibians, such as the Great Basin Spadefoot, require wetlands for breeding. Painted Turtles tend to use ponds more than amphibians as they must overwinter in them. Many snakes forage in and around wetlands.*

Birds: *Wetlands provide foraging or nesting habitat for many birds, including the Great Blue Heron, American Avocet, American Bittern, Red-necked Phalarope, and waterfowl such as Western Grebe, and Trumpeter Swan.*

Mammals: *Wetland edges are extremely productive sites for small mammals and fur-bearers. These insect-rich sites also provide important foraging habitat for many species of bats, including Townsend's Big-eared Bat, Fringed Myotis, Western Small-footed Myotis, and Spotted Bat.*

Vegetation[63]

	Marsh	Swamp	Shallow Water	
Shrubs				
plane-leaved willow		**		*Salix planifolia*
red-osier dogwood		**		*Cornus stolonifera*
Grasses, Sedges & Rushes				
sedges	**	*		*Carex* spp.
rushes	**			*Schoenoplectus* spp.
Forbs				
cattail	**			*Typhus latifolia*
duckweed	**		**	*Lemna minor*
water smartweed	*		**	*Polygonum amphibium*
pondweeds			*	*Potamogeton* spp.

[63] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of wetland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **Rarity:** Most wetland plant communities have been recommended for rare status (*see* sidebar).

Natural plant communities are recommended for the red- or blue- list *Baltic rush (Juncus balticus), Great bulrush (Schoenoplectus acutus), Common spike-rush (Eleocharis palustris).*

Rare*[64] *vertebrates of wetlands
Northern Leopard Frog (R, COSEWIC-E) (Rana pipiens)
Peregrine Falcon (R, COSEWIC-T) (Falco peregrinus ssp. *anatum)*
American Avocet (R) (Recurvirostra americana)
Great Basin Spadefoot (B, COSEWIC-T) (Spea intermontana)
Painted Turtle (B) (Chrysemys picta)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
American Bittern (B) (Botaurus lentiginosus)
Great Blue Heron (B) (Ardea herodias)
Sandhill Crane (B) (Grus canadensis)
California Gull (B) (Larus californicus)
Short-eared Owl (B, COSEWIC-SC) (Asio flammeus)
Bobolink (B) (Dolichonyx oryzivorus)
Western Small-footed Myotis (B) (Myotis ciliolabrum)

- **High biodiversity:** Within the dry climates of the IDFxh1 and PPxh1, small ponds, marshes, and even man-made wetlands are focal points for wildlife because of their infrequent occurrence in this landscape. Wetlands provide wildlife and biodiversity values that are disproportionate to the area they occupy on the land base. Wetland vegetation provides food, shelter, breeding habitat, and cover for many species of amphibians, reptiles, mammals, birds, and insects. Wetland vegetation provides food for many aquatic organisms. Ponds and shallow open water bodies are important watering sites for many species and provide painted turtle habitat, especially if floating logs are present. Wetlands are also sources of insects that provide food to birds and bats.

- **Fragility:** Wetlands are vulnerable to a range of human disturbances such as vegetation removal, dredging, diking, or filling. Small changes in hydrology such as reduced flows or lowered water tables, and urban run-off and other sources of nutrients including fertilizers and livestock manure can change and reduce the diversity of wetland communities.

[64] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

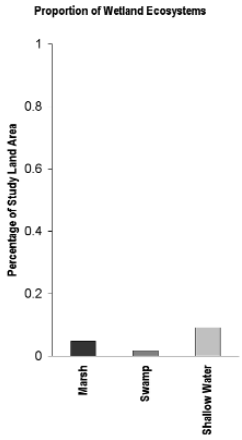
Intensive recreational activities in wetland edges can reduce plant cover, compact soil, and disturb nesting birds.

Additionally, wetlands are vulnerable to overuse by livestock. Wetlands that have been overused by livestock are still extremely valuable and many of these sites recover vegetation quickly with improved livestock management.

- **Maintenance of water quality:** Properly functioning wetlands store and filter water, and maintain water quality. They reduce the levels of sediment, nutrients, and toxic chemicals in outflow water.

- **Social values:** Wetlands provide opportunities for education, bird watching, and aesthetic enjoyment. The green space that wetlands provide can add to real estate values in adjacent areas and can draw tourists into the area.

Status



We found that wetland ecosystems were extremely rare in the study area; they occupied 48 ha or 0.2% of the land base. Historically, generally steep topography limited the occurrence of wetlands; however, further reductions have occurred because many have been filled in, or their hydrology has been altered through changes in land use in the surrounding area. For example, in the area between Penticton and Osoyoos, 85-90% of large marshes have been lost[65]. Presumably the Central Okanagan has suffered similar losses of wetlands. Agriculture, urban and suburban settlement and development, forestry, and flood control have all affected wetlands in the study area.

Shallow water (28 ha) was the most common wetland type in the study area, however, all three types of wetlands were extremely uncommon (swamps 5 ha, marshes 14ha). Only 94 wetlands were mapped in the study area; the average wetland size was 0.5 ha.

[65] Voller 1998

Management Recommendations[66]

The ecological functions that wetlands provide, specifically water storage and maintenance of water quality, are provided free of charge. Yet, when these functions are removed from an area through the loss or degradation of local wetlands, the costs to replace them through technological means can be exorbitant. The ecological functions and rarity of wetlands requires conservation of all remaining wetlands, including the maintenance of buffers to preserve the hydrologic regime, wetland functions, and connectivity to other ecosystems. Community leaders and local governments should be diligent in promoting the protection of every wetland in their area whether the wetland is on private or public lands.

The ecological functions and rarity of wetlands requires conservation of all remaining wetlands. Community leaders and local governments should be diligent in promoting the protection of every wetland in their area whether the wetland is on private or public lands.

When developing a management plan for wetland ecosystems, it is assumed that a local conservation strategy has been developed (*see* page 29). The following recommendations will aid in the site management of wetland ecosystems.

Delineate Buffers around Wetland Ecosystems

Wetlands can be negatively affected by adjacent land use that alters wetland hydrology. Vegetated buffers should be established to reduce edge effects and protect points of water inflow and outflow locations around the wetland. All vegetation should be maintained in the wetland and the associated riparian ecosystem around the wetland.

Wetland ecologists should be consulted when delineating vegetation buffers around wetlands. To select an appropriate buffer zone, the ecologists should use the presence of ***hydrophytic vegetation*** and gleysols or mottled soils in order to determine the edge of the wetland and the boundaries of the hydrological system that influence the wetland.

Avoid Direct and Indirect Impacts

- **Discourage human settlement and other land developments within, or adjacent to, wetland areas.** It is strongly recommended that such activities in and around wetlands be avoided. Roads should not be built near wetlands as they can alter hydrology and lead to extensive mortality of wildlife species that use wetlands.

[66] Many of the recommendations have been adapted from McPhee et al. 2000.

- **Maintain wetland hydrology.** Draining or ditching in or around wetlands, the filling in of wetlands, and the discharge of stormwater into such sites should be avoided. Vegetation cover should not be removed as this increases surface runoff and reduces the amount of groundwater infiltration, thus reducing available summer moisture. Additionally, areas of impervious ground surfacing (i.e., pavement) should be minimized. Wetland hydrologists may need to be consulted to determine how to protect wetland hydrology.

- **Maintain water quality.** Wetlands store and filter water, and maintain water quality; therefore, the addition of urban storm drainage, agricultural runoff, and sediment from road building into wetlands should be prevented. Wetlands that have artificially high nutrient levels may experience algal blooms, and vegetation in some marshes may convert from sedges or rushes to cattails.

- **Restrict recreational access.** Intensive recreational use of shoreline areas can reduce plant cover, compact soil, and disturb wildlife. Roots of trees and shrubs can be easily damaged by trampling and trail development in the moist soils of wetlands. Trails often become wide in wet, muddy areas, and sediments from trail damage may affect amphibians and insects. Motorized recreation, mountain biking, and horseback riding should be excluded from wetlands. Many recreational activities can potentially introduce or spread invasive species. In areas where trails to viewpoints in wetlands are desired, raised boardwalks should be used (avoid using rock or bark mulch on trails).

- **Manage livestock access.** Livestock use of many wetlands and ponds for water has significantly altered these sites. Overuse of wetlands by livestock can lead to soil compaction, damage and loss of vegetation cover and structure, and introductions of invasive plant species. Shrub and ***graminoid*** vegetation on many sites quickly recovers, however, when cattle use is reduced. Alternative watering sites, and fencing to allow a single access point to the water source can be used to maintain wetland functions and values while allowing some cattle use.

- **Prevent disturbance of nesting or breeding areas.** Recreational activities along wetland edges and canoeing in wetlands can impact amphibians, nesting waterfowl, and other birds, and thus, should be avoided during the breeding season (May through August). Disturbance of soils around wetlands, especially sandy soils that might be used by painted turtles for egg-laying, should also be avoided.

- **Prevent the introduction or spread of invasive plants.** Common burdock (*Arctium minus*) and common hound's-tongue (*Cynoglossum officinale*) are common invasive plants that are associated with wetland areas. These weeds can be cleared through hand pulling, mowing, and re-vegetating with appropriate native species. The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine appropriate treatment methods, and the best timing for treatment.

- **Restrain pets near wetlands during spring and summer.** Pets should be controlled to avoid disturbances to amphibians, waterfowl, and other birds during the breeding season (May through August).

- **Allow natural wetland processes to maintain wetland functions and values.** Beaver activity, flooding, seasonal drawdown, and groundwater recharge and discharge should be maintained. Inflow or outflow streams should not be diked or channelized.

- **Avoid use of pesticides in or near wetlands.**

Plan Land Development Carefully

If settlement or other development is allowed to occur adjacent to wetland ecosystems, then a qualified professional should be hired to conduct an ecological inventory of the site prior to development. This individual should also provide input into the design and implementation of land development activities so that wetland vegetation and structure; endangered, threatened, or vulnerable species and plant communities; and wildlife habitat, including nesting and breeding sites, are maintained.

A streamside riparian site showing a typical floodplain riparian ecosystem. In the study area, large cottonwood trees like those shown in the background were very important for many wildlife species.

A lakeshore fringe riparian site dominated by a wide variety of shrubs and trees with complex, multi-layered structure.

8 Riparian

What are riparian ecosystems?

'Riparian' is a general term derived from the Latin word for bank or shore, and simply refers to areas adjacent to water bodies such as lakes, rivers, streams, and ponds[67]. In this study, riparian ecosystems were defined as ecosystems that are adjacent to, and significantly influenced by a water body. That is, these sites are moister than, and have a ***plant community*** that is distinct from the surrounding upland. Riparian ecosystems are typically linear in nature. In the study area, soils were typically gleysols, although ***regosols*** occurred on recently deposited materials in floodplains. Wetlands are riparian in nature but were treated separately here because of their distinct ecological nature.

Riparian ecosystem vs. Riparian zone
'Riparian ecosystems' vary in width and are delineated by site-specific vegetation, soil, and topographic features. The term 'riparian zone' is often used to describe a fixed width management area surrounding streams and wetlands.

For this SEI, riparian ecosystems were classified into structural stages (Table 6) in order to identify different habitat values.

Table 6. Structural stages of riparian ecosystems

Code	Name	Definition
RI:1	Unvegetated or sparsely vegetated	Less than 10% cover of vegetation
RI:2	Herb	Herb dominated, shrub cover <20%, tree cover less than 10%
RI:3	Shrub/herb	Shrub cover 20% or greater, tree cover less than 10%
RI:4	Pole sapling	Trees are >10m tall and have 10% or greater cover, dense stands, generally 10-40 years old
RI:5	Young forest	Trees are >10m tall and have 10% or greater cover, dominated by young trees about 40-80 years old
RI:6	Mature forest	Trees are >10m tall and have 10% or greater cover, dominated by mature trees about 80-250 years old
RI:7	Older forest	Trees are >10m tall and have 10% or greater cover, many tree ages, many trees are 250 years or older

[67] MacKenzie and Banner 1999; Voller 1998

For this study, riparian ecosystems were also divided into distinct classes (bench, gully, fringe, and river) according to their environmental and vegetation characteristics; these are described below.

Bench riparian ecosystems

Bench riparian ecosystems are flood or ***fluvial*** ecosystems. They have distinct characteristics that are associated with moving water such as creeks, streams and rivers.

Bench riparian ecosystems are influenced by flooding, deposition of sediments, erosion and, often, subterranean irrigation. Such sites include active floodplains, where seasonal flooding adds inputs of organic matter and fine soil materials, and river and stream terraces that are occasionally flooded. Bench riparian ecosystems are rich in nutrients and species. Generally, these sites are productive and develop more quickly after disturbance than adjacent upland sites. Soils are only saturated for only part of the growing season, but this still has a strong influence on plant composition[68].

Typically, these ecosystems occurred as a band on either side of a creek and often formed natural corridors through the landscape. Soils of this ecosystem type were typically sandy and gravely, and were poorly developed. These ecosystems had high vegetation structural diversity. They usually had a mix of coniferous and deciduous trees in the ***overstory,*** with shrubby understories.

Gully riparian ecosystems

Gully riparian ecosystems occurred at the base and lower slopes of moderate to steep-sided linear sites (small valleys or ravines) with significant moisture. These ecosystems had either permanent or intermittent surface water flow, or significant subsurface flow, but were usually not subject to flooding. These were also rich and productive sites, and they formed natural corridors through the study area, providing habitat that is distinctly different from the surrounding landscape. These ecosystems usually had a mixed coniferous and deciduous overstory with shrubby understories. Slopes were often steep, and soils were variable.

Fringe riparian ecosystems

Lakes and ponds typically had fringe riparian ecosystems associated with their shorelines. Sandy, gravely soils were common in these ecosystems and soils were often gleysols or mottled. This class also includes sites on ***fluvial fans***, and sites with significant seepage that are sensitive to soil and hydrological disturbances; soils were typically medium-textured on these sites. Within

[68] MacKenzie and Banner 1999

the study area, fringe riparian ecosystems were commonly associated with the Okanagan Lake foreshore, pond fringes, and moist seepage slopes. These ecosystems usually had mixed coniferous and deciduous overstories with shrubby understories.

River riparian ecosystems

These are river ecosystems that include the flowing water and unvegetated sandbars, gravel bars and banks of the river. These ecosystems were mapped but were not field verified.

Wildlife

Amphibians & Reptiles: *Riparian ecosystems provide foraging habitat, especially during hot summers, for many snakes including Racers, Western Rattlesnakes and Gopher Snakes. They are also used as summer retreats. Amphibians may breed in these ecosystems, especially where surface water is retained throughout the spring.*

Birds: *Shrubby sites provide good nesting habitat for a wide variety of perching birds. Sites with large trees with cavities can be important nesting habitats for Western Screech-Owls, Lewis's Woodpeckers, other woodpeckers, and cavity nesting ducks. Great Blue Herons and Bald Eagles often nest in riparian areas with large trees or snags.*

Mammals: *These ecosystems provide good habitats for many small mammals, which in turn, are food items for other vertebrates. They also provide cover and browse for* ***ungulates****. Long, linear riparian ecosystems provide travel corridors for white-tailed and mule deer. These sites are often important fly ways and foraging habitats for many bat species. The extremely rare Western Red Bat roosts in riparian thickets.*

Vegetation[69]

	Bench	Gully	Fringe	
Trees				
black cottonwood	**		**	*Populus balsamifera* ssp. *trichocarpa*
Douglas-fir	**	**	**	*Pseudotsuga menziesii*
paper birch	**	**	**	*Betula papyrifera*
western redcedar	**	**		*Thuja plicata*
trembling aspen	**	**	**	*Populus tremuloides*
Shrubs				
common snowberry	**	**	**	*Symphoricarpos albus*
red-osier dogwood	**	**	**	*Cornus stolonifera*
thimbleberry	*	**		*Rubus parviflorus*
Douglas maple	**	**	**	*Acer glabrum*
water birch	**	**	**	*Betula occidentalis*
Nootka rose	**	**	**	*Rosa nutkana*
mock orange	**	**		*Philadelphus lewisii*
black gooseberry	**	*		*Ribes lacustre*
Grasses				
blue wildrye	*	*	**	*Elymus glaucus*
Forbs				
star-flowered false Solomon's seal	**	**	**	*Maianthemum racemosum*
horsetail	**	*		*Equisetum* spp.

Why are they important?

Ecological attributes and socio-economic values of riparian ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **Rarity:** Their conservation status (B.C. Conservation Data Centre) lists most riparian natural plant communities as rare (*see* below).

[69] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Rare*[70] *natural plant communities of riparian ecosystems
Black cottonwood – Douglas-fir – common snowberry – red-osier dogwood (R) (Populus balsamifera ssp. *trichocarpa - Pseudotsuga menziesii - Symphoricarpos albus - Cornus stolonifera)*

Douglas-fir / common snowberry – birch-leaved spirea (B) (Pseudotsuga menziesii / Symphoricarpos albus - Spiraea betulifolia)

Douglas-fir / water birch – Douglas maple (R) (Pseudotsuga menziesii / Betula occidentalis - Acer glabrum)

Ponderosa pine – black cottonwood / snowberry (R) (Pinus ponderosa - Populus balsamifera ssp. *trichocarpa / Symphoricarpos albus)*

Trembling aspen – mock-orange (R) (Populus tremuloides - Philadelphus lewisii)

Western redcedar – Douglas-fir – false Solomon's seal (R) (Thuja plicata - Pseudotsuga menziesii - Maianthemum racemosum)

Rare vertebrates of riparian ecosystems
Western Screech-Owl (R, COSEWIC-E) (Otus kennicottii ssp. *macfarlanei)*
Yellow-breasted Chat (R, COSEWIC-E) (Icteria virens)
Great Basin Spadefoot (B, COSEWIC-T) (Spea intermontana)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
Western Rattlesnake (B) (Crotalus viridis)
Great Blue Heron (B) (Ardea herodias)
California Gull (B) (Larus californicus)
Lewis's Woodpecker (B, COSEWIC-SC) (Melanerpes lewis)
Townsend's Big-eared Bat (B) (Corynorhinus townsendii)
Fisher (B) (Martes pennanti).

- **High biodiversity:** Riparian ecosystems support disproportionately high numbers of species relative to the area they occupy on the land base. They provide wildlife with water, cover, breeding habitat, and food. The wide diversity of plants, invertebrate organisms, and structural complexity of these ecosystems provide many habitat niches. Riparian vegetation provides food for many aquatic organisms. Many gullies, particularly in the western side of the study area, generally lack surface water flow but often have lush, productive vegetation that provides significant cover and food for wildlife.

[70] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

- **Fragility:** Riparian ecosystems are strongly influenced by adjacent water bodies and, thus, they are sensitive to disturbance and changes in hydrology.

- **Aquatic habitat protection and water quality:** Riparian vegetation supplies most of the organic matter (70-80% of the food energy needed by aquatic communities) in small- and medium-sized streams, and plays a large role in determining the composition of the aquatic invertebrate community. Riparian vegetation also provides a source of large organic debris (e.g., logs). This debris reduces stream velocity, and is important in creating and maintaining stream channels, and aquatic habitat, and in controlling sediment deposition[71]. Riparian areas are important for trapping sediments and maintaining water quality. The root systems of riparian vegetation stabilize stream banks, thus reducing erosion and sediment inputs to the water.

  Riparian vegetation plays a key role in controlling water temperatures of small and medium-sized streams. Canopies can reduce incoming radiation by up to 85% in smaller streams. This function is extremely important because the amount of dissolved oxygen and the metabolic processes of many stream organisms are dependent on temperature. With increased water temperatures, many native trout species become more susceptible to disease and are out-competed by warmer-water species[72].

- **Wildlife corridors:** Within the study area, larger streams with steep-sided canyons form natural wildlife corridors connecting grasslands with rim rock areas and the areas above the Okanagan Valley. Additionally, many gullies, either with or without streams, also form natural east-west corridors that connect forested areas with other habitats.

- **Flood protection and erosion reduction:** Like wetlands, riparian ecosystems can reduce peak flows by slowing or storing runoff. Installation of diking and rip-rapping to prevent flooding reduces water storage capacity and increases water velocity and scouring. Dense root growth of vegetation in riparian ecosystems helps slow water and provides bank stability. Unvegetated banks are prone to erosion, undercutting, and slumping. However, even within these ecosystems, dynamic channel changes can lead to tree fall and bank slumping, threatening properties. Riparian areas can buffer these effects if development is not allowed too close.

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[71] Voller 1998
[72] Voller 1998

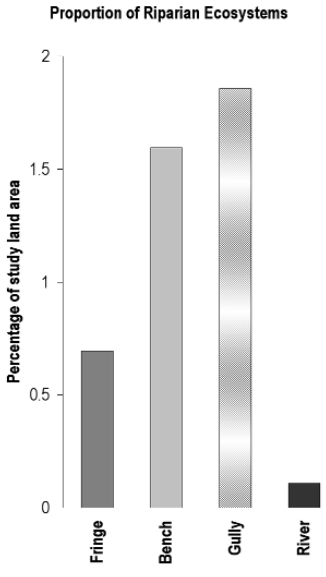
- **Social values:** Riparian areas provide green space, and opportunities for education, bird watching, wildlife viewing, walking and hiking, and aesthetic enjoyment. Retention of riparian corridors can enhance and maintain property values and attract tourists by retaining the natural beauty that many people seek out.

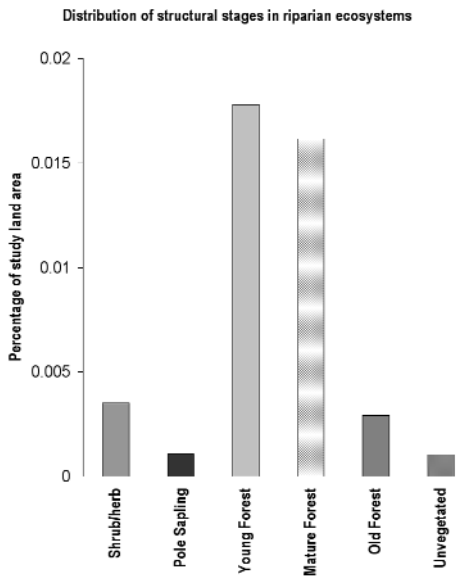
Status

Riparian ecosystems occupied 4.3% (1315 ha) of the study area. They were predominantly bench (493 ha) and gully (574 ha) ecosystems with some fringe (215 ha) ecosystems and occasional river ecosystems (33 ha).

Only 7% of riparian ecosystems in the study area was in the old forest structural stage. Another 39% was mature forest and 43% young forest, indicating that many riparian ecosystems had been altered by human disturbance. Historically, riparian ecosystems would have been predominantly old and mature structural stages, with some earlier structural stages where flooding and changes in watercourses had occurred relatively recently. Unvegetated riparian structural stages corresponded to river riparian ecosystems.

Preservation of all riparian ecosystems should be a priority; however, retention of old structural stages should be given the highest priority. In all structural stages, it is important to retain all riparian vegetation to preserve stream bank stability, water temperature and quality, and wildlife habitat.





Management Recommendations[73]

Riparian ecosystems have attracted considerable attention in the last decade because of increased awareness of their value in stream and river protection. Most protection has focussed on fisheries or wildlife values, with less emphasis on the diversity and ecology of riparian plant communities.

Well-managed riparian areas have the ability to buffer the destructive impacts of floods and droughts. In both the past and present, people have channelized and straightened many streams and rivers to prevent spring flooding and protect buildings. Channelization has the effect of increasing the velocity and power of the stream, often increasing the flooding and erosion effects downstream. Once a stream is channelized and isolated from its floodplain, most of the riparian values are lost with the loss of nutrient inputs to riparian vegetation. Sites downstream may also have reduced riparian productivity due to increased water velocity caused by the upstream channelization.

Efforts should be made to maintain connections with adjacent upland ecosystems and to reduce fragmentation in order to preserve wildlife migration and dispersal functions. Where possible, vegetation and ecological functions of altered riparian ecosystems should be restored.

When developing a management plan for riparian ecosystems, it is assumed that a local conservation strategy has been developed (*see* page 29). The following recommendations will aid in the site management of riparian ecosystems.

Delineate Buffers around Riparian Ecosystems

Wherever possible, delineate vegetated buffers around riparian ecosystems. Buffers help maintain the integrity of riparian areas, and reduce their susceptibility to invasive species colonization. Buffers need to be large enough to protect the core ecosystem from edge effects such as increased temperature, decreased humidity, and increased noise levels.

Maintain wildlife corridors and connectivity between riparian areas and adjacent habitats by retaining riparian corridors and adjacent habitats. Larger streams with steep-sided canyons are natural areas for preservation because they tend to be difficult to build on and are frequently associated with unstable slopes. Seepage associated with these sites makes it difficult to find a place for a septic field.

[73] Many of the management recommendations have been adapted from McPhee et al. 2000.

Avoid Direct and Indirect Impacts

- **Discourage human settlement or other development** within or adjacent to riparian areas.

- **Riparian vegetation should be maintained where it is present, and restored where it has been lost.** Vegetation maintains the cohesive nature of the stream bank, and reduces the power of the stream. During flood events, riparian vegetation catches fine nutrient-rich sediment, thus maintaining the productivity of the site. Without this vegetation, streams become wide and shallow, and sediment can accumulate in the stream channel where it may harm fish and reduce water quality. It can take many decades to stabilize denuded stream banks and restore narrow, deep stream channels. Riparian vegetation also provides inputs of organic matter into soils, which increases their capacity to adsorb and store water. Additionally, riparian vegetation moderates water temperatures, provides an important source of food for many aquatic organisms, and provides important wildlife cover for nesting and feeding.

- **Manage access** actively (e.g. with fencing and railings) to minimise the effects of recreation and other human uses.

- Where practical or necessary, **restrict livestock access** by using fencing. To allow safe wildlife access, fences should be top-railed, page-wire should not be used, and bottom wires should be 45cm above ground level.

- **Control invasive species.** Managing human and livestock access will help prevent the spread of weeds. Invasive species should be managed in a broad area around the riparian area to control their spread. The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food should be consulted to determine the best techniques and appropriate timing for controlling specific invasive plant species on a particular site.

- **Control pets.** Pets should be restrained and hunting dogs should be trained away from riparian areas during the spring and summer. Other disturbances to waterfowl during the nesting season should also be avoided.

- **Protect structural features:** Large trees, snags, logs provide critical nesting habitat for many species of birds and animals. Large, old cottonwood trees and snags are especially important for birds, bats and other animals.

- **Avoid use of pesticides in or near water and important foraging areas for wildlife.** Pesticide use near foraging habitat for animals that feed on insects (e.g., Western Screech-Owl and Townsend's Big-eared Bat) should be avoided.

- **Allow natural disturbances to occur.** Flooding, windthrow, channel changes, slope failures and debris flows are recognised as important factors in the creation and maintenance of high diversity riparian habitats. These events and processes should be maintained as follows unless they pose a threat to safety or property.
  - Minimise bank or flood protection. Human changes such as channel stabilisation, deposition of rip-rap, and vegetation removal reduce riparian diversity and habitats.
  - Maintain natural flow regimes. Deforestation, removal of vegetation, or increased impervious surfacing can result in significant increases in the size, duration, and frequency of floods. Bank erosion can also worsen.

Plan Land Development Carefully

Where human settlement or other development is permitted in or adjacent to a riparian area, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Plan, design, and implement land development activities to avoid adversely affecting or disturbing:**
  - riparian vegetation;
  - large cottonwood trees;
  - threatened or endangered species or natural plant communities;
  - natural processes such as stream flow, flooding, and stream channel movement;
  - nesting or denning sites;
  - standing dead trees, and downed trees and logs; and
  - riparian corridors, and connectivity with upland communities.

- **Design roads carefully.** Roads should be narrow and placed perpendicular to the riparian ecosystem. Roads should be set back from the riparian ecosystem to ensure that both the riparian vegetation and bank stability are maintained. If roads must cross riparian ecosystems, bridges are recommended to minimize disturbance of soil and vegetation

and to provide a wildlife corridor below. Where roads encroach upon riparian ecosystems, narrow the width of the road and construct retaining supports on the down-slope side to avoid sidecasting material into the riparian area.

- **Design trails carefully.** Trails should provide a direct route to a viewing area or crossing, and should avoid sensitive vegetation, seepage areas and wetlands, and erodable stream banks or gully side walls.

- **Protect endangered, threatened, or vulnerable species or plant communities** by addressing the following recommendations:
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as trees with cavities, large old trees, and snags; and
  - cut danger trees to a level where they are safe rather than removing the whole tree.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Protect nesting and denning sites that were identified in the ecological inventory.** Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

- **Ensure adequate sediment and erosion control measures** are implemented.

A typical old forest ecosystem with scattered large old trees and an open understory.

9 Old Forest

What are old forest ecosystems?

Old forest ecosystems are forests that are dominated by large, old trees. Old forests historically would have occupied a large proportion of the landscape, forming the matrix for other smaller ecosystem types. Throughout the study area, historical harvesting of large, old ponderosa pine and Douglas-fir has greatly reduced the area of old forest ecosystems. Old forests were mapped where polygons included old structural stage ecosystems except for old riparian forests, which were included in the Riparian category.

Historically, most forests had frequent surface fires that killed most regeneration and allowed few trees into the overstory. Overstories were generally multi-aged with a largely single-layered canopy, and understories were open and dominated by grasses and shrubs. Frequent fire also limited the occurrence of dead wood to scattered large snags and large, downed wood.

The exclusion of fires has caused formerly open, park-like forests to infill with waves of smaller trees (this is referred to as forest ingrowth; historically, most of these small trees would have been killed by periodic fires). Old forests still occur where large, old trees have not been selectively harvested. In most cases these stands have undergone some forest ingrowth and, thus, are not fully representative of the historical forests. Old trees, however, are structurally very important for wildlife, and old forest sites have the best potential for restoration to historical stand structure. Presently, many stands are at risk from catastrophic wildfire due to fuel build-up, and to forest ingrowth internally, and in adjacent forests.

On wetter sites, forest development occurs more quickly than on drier sites. Historically, these wetter sites did not burn as frequently and multi-layered forests were able to develop. Moist forests are also at an increased risk of loss to catastrophic wildfire relative to historical levels. Increased forest densities places stress on older trees and makes them more susceptible to attack by insects such as spruce budworm. Moist forests are, by nature, denser, more multi-layered and less affected by forest ingrowth.

Wildlife

Amphibians & Reptiles: *The Rubber Boa is the most common snake found in old forests, however, Gopher Snakes and Western Rattlesnakes may also be present.*

Birds: *Many species of woodpeckers and owls, including White-headed Woodpecker and Flammulated Owl, rely on old forests and the large trees and snags they contain. Lewis's Woodpeckers prefer snags in open forests. Old forests are home to many birds and cavity nesters.*

Mammals: *As well as providing cover and forage to a number of large mammals, old forests, particularly on warm aspects, provide critical winter range for Mule Deer. Tree cavities and loose bark provide important roosting sites for bats. Many small mammals depend on tree cavities.*

Vegetation[74]

Trees		
ponderosa pine	**	*Pinus ponderosa*
Douglas-fir	**	*Pseudotsuga menziesii*
Shrubs		
common snowberry	**	*Symphoricarpos albus*
redstem ceanothus	**	*Ceanothus sanguineus*
tall oregon-grape	**	*Mahonia aquifolium*
saskatoon	**	*Amelanchier alnifolia*
Grasses		
bluebunch wheatgrass	**	*Pseudoroegneria spicata*
rough fescue	**	*Festuca campestris*
pinegrass	**	*Calamagrostis rubescens*
blue wildrye	*	*Elymus glaucus*
Forbs		
arrowleaf balsamroot	**	*Balsamorhiza sagittata*
heart-leaved arnica	*	*Arnica cordifolia*

[74] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of old forest ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **Rarity:** Most old forest natural plant communities are rare (*see* below).

Rare*[75] *natural plant communities of old forests
Douglas-fir / common snowberry – birch-leaved spirea (B) (Pseudotsuga menziesii / Symphoricarpos albus - Spiraea betulifolia)

Douglas-fir – ponderosa pine / bluebunch wheatgrass (B) (Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata)

Douglas-fir – ponderosa pine / pinegrass (B) (Pseudotsuga menziesii - Pinus ponderosa / Calamagrostis rubescens)

Rare vertebrates of old forests
Swainson's Hawk (R) (Buteo swainsonii)
White-headed Woodpecker (R, COSEWIC-E) (Picoides albolarvatus)
Badger (R, COSEWIC-E) (Taxidea taxus)
Racer (B) (Coluber constrictor)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
Western Rattlesnake (B) (Crotalus viridis)
Great Blue Heron (B) (Ardea herodias) Flammulated Owl (B, COSEWIC-SC) (Otus flammeolus)
Lewis's Woodpecker (B, COSEWIC-SC) (Melanerpes lewis)
Williamson's Sapsucker (B) (Sphyrapicus thyroideus)

- **High biodiversity:** Old forests provide habitat for a wide variety of wildlife, plant, and invertebrate species. Old forest ecosystems have many unique and important structural attributes. Typically these forests are open, and, thus, provide good visibility from predators for ungulates. Large old trees provide good snow interception.

- **Specialised habitats:** Many species depend on features found only in old forests. The large, old trees in these forests provide cavities for many bird species. Additionally, these ecosystems usually have scattered large snags and large woody debris which provide critical habitats for many species, including some species at risk.

[75] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

- **Social values:** Old forests provide opportunities for education, wildlife viewing, walking and hiking, and aesthetic enjoyment. The green space that old forests provide can add to real estate values in adjacent areas, and can draw tourists into the area.

Status

Historically, old forests likely dominated the majority of the study area landscape, as old trees were retained and maintained by frequent low- to moderate-severity surface fires. We found only small remnants of old forest. Most old forests had been lost to selection logging or forest ingrowth due to fire exclusion. The inventory showed that only 0.5% (154 ha) of the study area was old forests; these occured in small and fragmented patches averaging less than 3 ha in size. Thus, there is a need to conserve all remaining old forests, and to ensure they are not lost through human settlement, forest harvesting, or forest ingrowth. Large buffer areas of younger and mature forests around old forest polygons are needed to provide recruitment and ecological integrity for existing old forests.

Management Recommendations[76]

Loss of old forest ecosystems, forest ingrowth, and increased fuel loads in remaining old forest areas has resulted in the loss of many habitat features (e.g., grassy understory vegetation), and has placed these ecosystems at increasing risk of loss to catastrophic wildfire.

When developing a management plan for old forest ecosystems, it is assumed that a local conservation strategy has been developed (*see* page 29). The following recommendations will aid in the site management of old forest ecosystems.

Delineate Buffers around Old Forest Ecosystems

Wherever possible, vegetated buffers should be delineated around each old forest ecosystem. Buffers help prevent edge effects such as invasive weed colonisation and reduce indirect disturbances. Mature forests form important buffers. Many species that are reliant on old forests also use other habitats; it is important to maintain connectivity with other ecosystems.

[76] Many of the management recommendations have been adapted from McPhee et al. 2000.

Avoid Direct and Indirect Impacts

- **Discourage human settlement or other development** within or adjacent to old forest ecosystems.

- **Manage access** to minimise vehicular and livestock access. Where trails can be safely established, the appropriate recommendations listed below under "Plan Land Development Carefully" should be followed.

- **Restore and maintain ecological structures and functions.** Restoration requires understanding of historical disturbance regimes (particularly fire), and of the structure of these forests prior to fire exclusion. Historical photographs and accounts, early forest or land surveys, and results from researchers in other similar ecosystems can be used to determine what historical old forest ecosystems looked like[62]. A qualified professional should develop a detailed restoration plan.

  Restoration should include the retention of large, old trees and thinning of other trees. After thinning, initial prescribed burns should be conducted to consume unnaturally heavy fuels. Prescribed burning should be planned and conducted by qualified professionals. Large old trees need to be protected from cambial girdling and root mortality by raking accumulated forest floor fuels away from tree bases prior to burning. Noxious weeds need to be controlled, and native plants may need to be seeded if there are inadequate native grasses and shrubs present on-site. Grazing should be deferred until the plant community has had an opportunity to recover[63].

  It may be too dangerous to conduct a prescribed burn on small, private lots. Landowners can reduce the risk of wildfire and maintain some of the ecological functions of old forest ecosystems on their land by retaining large old trees, raking and removing fuels from beneath trees, and by cutting and removing most small ponderosa pine and Douglas-fir trees.

- **Protect large old trees and snags.** Old trees and snags provide critical nesting habitat for many species of birds.

- **Prevent disturbance of nesting sites and breeding areas** (e.g., cavities in large trees).

- **Control invasive species.** Managing human and livestock access, and treating existing invasive plant species will help maintain the ecological integrity of old forest sites. Weeds can be hand-pulled, and native species can be planted to help prevent the establishment of more weeds.

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[62] Swetman et al. 1999
[63] Moore et al. 1999

The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine the appropriate method and timing of treatment for invasive plant species.

- **Avoid use of pesticides in, or near, important foraging areas for wildlife.** Pesticide use near foraging habitat for animals that feed on insects (e.g., Flammulated Owl and Lewis's Woodpecker) should be avoided.

Plan Land Development Carefully

Where development is allowed near old forest ecosystems, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Plan, design and implement land development activities** (including trails and recreation access) **to minimize impacts to old forest ecosystems** by addressing the following recommendations:
  - protect large, old trees and snags, and understory vegetation;
  - locate settlements and other developments away from existing large, old trees and snags;
  - design linear corridors to be as narrow as possible, and configure them to allow wildlife crossing; and
  - restore native vegetation where it has been disturbed. Seed or plant natives from nurseries, or plant natives that have been rescued from other development sites. Ensure that any native plant material used is weed-free.

- **Design trails carefully.** Ensure that trails do not affect the root systems of trees, and will not create soil erosion problems. Trails should be designed to discourage use by vehicular traffic (ATV's), horses, and mountain bikes. Fences may be necessary in some places to prevent access. Trails should be closely monitored for noxious and invasive weeds. If weeds are present, trails should be closed until the weeds have been treated and are under control.

- **Protect endangered, threatened, or vulnerable species or plant communities** by addressing the following recommendations:
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as large old trees and snags; and
  - cut danger trees to a level where they are safe rather than removing the whole tree.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Protect nesting and denning sites that were identified in the ecological inventory.** Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

A typical grassland ecosystem. We found that most remaining grasslands occurred at the higher elevations of the study area on sloping sites.

Arrowleaf balsamroot was a common grassland and open forest plant we observed. The underground parts of the plant were an important food for First Nations.

Bluebunch wheatgrass was a common bunchgrass we observed in grasslands and open forests, especially on hotter, drier sites.

A shrubland ecosystem. We found that these ecosystems usually occurred as patches in grassland areas, and had deep, rich soils.

10 Grasslands

What are grassland ecosystems?

Grasslands in the study area were dominated by bunchgrasses, but scattered ***forbs*** occurred throughout these sites. The grasslands of the Central Okanagan represent a portion of the Pacific Northwest bunchgrass grasslands that are centred in south-east Washington, north-east Oregon and Idaho[77].

Areas where grasslands occurred are generally too hot and dry for forests to establish. Often, grasslands occurred on medium and finer textured soils (typically ***chernozems***). Moisture is effectively funnelled by the conical shape of bunchgrasses and captured by extensive grass roots in the upper horizons of the soil, thus leaving little moisture available for tree seedlings. In comparison, trees are usually able to establish on moist sites, and on coarse soils (sandy, gravely) where moisture is available at depth. Additionally, grasslands are favoured in environments where frequent, low-severity fires historically occurred.

For this SEI, grassland ecosystems were divided into distinct classes (grassland and shrubland) according to their environmental and vegetation characteristics; these are described below.

What is a bunchgrass? *Bunchgrasses are grasses where several or many stems grow in a close tuft; they have a characteristic growth habit of forming a bunch.*

Common bunchgrasses in the study area: *bluebunch wheatgrass (Pseudoroegneria spicata), rough fescue (Festuca campestris), Idaho fescue (Festuca idahoensis), junegrass (Koeleria macrantha).*

Much of the diversity within grasslands is found in the microbiotic crust that covers the soil surface between plants. The microbiotic crust is composed of lichens, mosses, algae, bacteria and cyanobacteria. Crusts slow evaporation, prevent wind and water erosion, and contribute nutrients through nitrogen fixation. The microbiotic crust is, however, sensitive to disturbance by livestock and people.[78]

Grassland ecosystems

Bunchgrasses, most commonly bluebunch wheatgrass and rough fescue, dominated healthy grassland ecosystems in the study area. Bunchgrasses are designed to funnel moisture to the center of the plant, and have extensive fine roots to capture moisture in the upper horizons of the soil. Grassland soils were usually fine- or medium-textured, and soils were topped by a thick, dark-coloured horizon enriched by organic matter from the decomposition of grass roots.

Shrubland ecosystems

Shrubs, most commonly snowberry and roses, dominated shrubland ecosystems in the study area. Shrublands occurred in grassland areas, but were moister than the surrounding grasslands as they occurred in depressions and moist pockets that tended to collect snow and some run-off. Soils were dark (organic rich), typically medium-textured, and very rich.

[77] Tisdale 1947
[78] Williston 1999

Wildlife

Amphibians & Reptiles: *The desert-adapted Great Basin Spadefoot forages and over winters in grasslands in the study area. Grasslands provide foraging habitat for many species of snakes, including the Gopher Snake, Racer, and Western Rattlesnake. Gopher Snakes are particularly attracted to these areas for foraging on subterranean rodents, and they may also den and lay eggs here.*

Birds: *Grasslands provide nesting and foraging for Short-eared Owls, Long-billed Curlews, Grasshopper Sparrows, and the extirpated Sharp-tailed Grouse and Burrowing Owl. They also provide foraging habitat for Swainson's Hawks and other birds of prey. Lewis's Woodpeckers use grasslands for foraging, and they use them for nesting if snags are available.*

Mammals: *Grasslands provide foraging and denning habitat for Badgers and small mammals, including the Great Basin Pocket Mouse and Harvest Mouse. Some bats such as the Fringed Myotis and Pallid Bat rely on grasslands for foraging.*

Vegetation[79]

	Grassland	Shrubland	
Shrubs			
common snowberry		**	*Symphoricarpos albus*
roses		**	*Rosa* spp.
Grasses			
bluebunch wheatgrass	**		*Pseudoroegneria spicata*
rough fescue	**		*Festuca campestris*
junegrass	**		*Koeleria macrantha*
Columbia needlegrass	**		*Achnatherum nelsonii*
Forbs			
arrowleaf balsamroot	**		*Balsamorhiza sagittata*
parsnip-flowered buckwheat	**		*Eriogonum heracleoides*
daisies or fleabanes	**		*Erigeron* spp.
silky lupine	**		*Lupinus sericeus*
lemonweed	**		*Lithospermum ruderale*
western groundsel		**	*Senecio integerrimus*
mountain sweet-cicely		*	*Osmorhiza berteroi*
star-flowered false Solomon's seal		*	*Maianthemum stellatum*
Mosses and Lichens			
sidewalk moss	**		*Tortula ruralis*
clad lichens	**		*Cladonia* spp.

[79] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of grassland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Many of the forbs that grow in grasslands, including arrowleaf balsamroot (Pseudoroegneria spicata), bitterroot (Lewisia redivida), and mariposa lily (Calochortus spp.*) were important food sources for aboriginal peoples.*

- **Highly threatened:** Grasslands most commonly occurred on sites that were very amenable to development – both for agriculture and housing. Overuse by domestic livestock and invasion of noxious weeds also threatens remaining grasslands. Only 0.69% of the world's temperate grasslands are currently protected[82]. Grasslands are recognised as one of British Columbia's most threatened ecosystems[83]. Only 8% of provincial grasslands are protected[84].

- **Rarity:** All grassland native plant communities are listed by the B.C. Conservation Data Centre (*see* below).

Rare*[80] *natural plant communities of grasslands:
Big sage / bluebunch wheatgrass – balsamroot (R) (Artemisia tridentata / Pseudoroegneria spicata - Balsamorhiza sagittata)

Bluebunch wheatgrass – balsamroot (R) (Pseudoroegneria spicata - Balsamorhiza sagittata)

Idaho fescue – bluebunch wheatgrass (R) (Festuca idahoensis - Pseudoroegneria spicata)

Giant wildrye (R) (Leymus cinereus)

Prairie rose – Idaho fescue (R) (Rosa woodsii / Festuca idahoensis)

The following natural plant communities are recommended for the red- (R) or blue- (B) list:
Rough fescue – Cladina (Festuca campestris – Cladina)
Saskatoon – common snowberry (Amelanchier alnifolia – Symphoricarpos albus)
Snowberry – rose – Kentucky bluegrass (Symphoricarpos albus – Rosa – Poa pratensis)

[80] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.
[82] IUNC 1994
[83] Canadian Parks and Wilderness Society 1996
[84] Grasslands Conservation Council of B.C. 2002

Rare vertebrates of grasslands
Swainson's Hawk (R) (Buteo swainsonii)
Ferruginous Hawk (R, COSEWIC-SC) (Buteo regalis)
Prairie Falcon (R) (Falco mexicanus)
Upland Sandpiper (R) (Bartramia longicauda)
Burrowing Owl (R, COSEWIC-E) (Athene cunicularia)
Brewer's Sparrow (R) (Spizella breweri ssp. *breweri)*
Lark Sparrow (R) (Chondestes grammacus)
Grasshopper Sparrow (R) (Ammodramus savannarum)
Preble's Shrew (R) (Sorex preblei)
Merriam's Shrew (R) (Sorex merriami)
Badger (R, COSEWIC-E) (Taxidea taxus)
Great Basin Spadefoot (B, COSEWIC-T) (Spea intermontana)
Painted Turtle (B) (Chrysemys picta)
Racer (B) (Coluber constrictor)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
Western Rattlesnake (B) (Crotalus viridis)
Sharp-tailed Grouse[81] (B) (Tympanuchus phasianellus ssp. *columbianus)*
Long-billed Curlew (B, COSEWIC-SC) (Numenius americanus)
Short-eared Owl (B, COSEWIC-SC) (Asio flammeus)
Lewis's Woodpecker (B, COSEWIC-SC) (Melanerpes lewis)
Fringed Myotis (B, COSEWIC-SC) (Myotis thysanodes)
Great Basin Pocket Mouse (B) (Perognathus parvus)
Western Harvest Mouse (B, COSEWIC-SC) (Reithrodontomys megalotis)

- **High biodiversity:** Grasslands and shrublands support a unique assemblage of species that includes a high proportion endangered species. Grasslands, in combination with other ecosystems, are used by many species.

- **Sensitivity to disturbance:** Grasslands are very sensitive to disturbances from such things as off-road vehicle use and mountain biking, and recovery can take many decades. Disturbance to grassland soils can damage the fragile microbiotic crust, and can allow noxious weed invasions, which can slow or limit recovery.

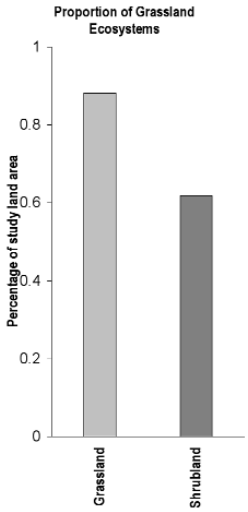
- **Social values:** Grasslands provide opportunities for education, walking and hiking, wildlife viewing, and aesthetic enjoyment. The green space that grasslands provide can add to real estate values in adjacent areas, and can draw tourists into the area.

[81] Thought to be extirpated from the area.

Status

We found that grassland ecosystems covered 1.5% (464 hectares) of the study area. The majority of these were grasslands, but a large proportion was shrublands. Many of these undisturbed grassland ecosystems were restricted to rocky sites with poor access for cattle, and to higher elevations where more moisture and higher productivity enabled these sites to recover more quickly than lower elevation sites.

All grassland ecosystems are a high priority for conservation considering that many have been lost to agricultural and urban settlement, and many sites had been invaded by non-native plants. Grasslands with 20-50% non-native vegetation were included in the Disturbed Grasslands category.



Management Recommendations[85]

When developing a management plan for grassland ecosystems, it is assumed that a local conservation strategy has been developed (*see* page 29). The following recommendations will aid in the site management of grassland ecosystems.

Delineate Buffers around Grassland Ecosystems

Site assessments should be conducted to delineate buffers that will maintain continuity with adjacent sensitive ecosystems and wildlife habitat and protect the grassland ecosystem from edge effects. Buffers are particularly important around grassland ecosystems because of their vulnerability to disturbance and susceptibility to weed invasions.

Avoid Direct and Indirect Impacts

- **Discourage human settlements or other developments** within or adjacent to grassland ecosystems.

- **Manage access** to minimize vehicular access and manage livestock access. All motorized vehicles should be restricted to existing roads. Mountain bikes should be restricted to existing trails that are weed free, and not subject to erosion; otherwise, these trails should be closed. Trails that have weeds but no erosion problems can be re-opened once the weed problems have been controlled. Do not develop new trails on

[85] Many of the management recommendations have been adapted from McPhee et al. 2000.

grassland ecosystems. Trails can create erosion problems, disturb fragile vegetation, and spread or introduce invasive weed species.

- **Prevent disturbance of nesting sites and breeding areas.** Many grassland birds are ground-nesters.

- **Protect large old trees and snags.** Scattered trees or snags are extremely important for wildlife in grassland areas. These trees can be isolated structures in grassland areas.

- **Manage livestock use.** Livestock grazing needs to be carefully managed to ensure that ecological values associated with grassland ecosystems are maintained. Careful monitoring should be implemented to ensure that grazing levels and timing meet management objectives for the site.

- **Control invasive species.** Managing human and livestock access and treating existing invasive species will help maintain the ecological integrity grassland ecosystems. Weeds can be sprayed or hand-pulled, and native species can be planted to help prevent the establishment of more weeds. Retention of a healthy natural plant community will also help prevent weed invasions. The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine the appropriate method and timing of treatment for invasive plant species. It is important that the right treatment method is used to ensure it is effective.

- **Remove encroaching trees.** Large old trees are important habitat features that should be protected where they occur in grassland areas, but young trees should be removed by cutting or prescribed fire. Prescribed burns should always be planned, properly scheduled, and conducted by a qualified professional.

- **Avoid use of pesticides in, or near, important foraging areas for wildlife.** Pesticide use near foraging habitat for animals that feed on insects (e.g., Lewis's woodpecker) should be avoided.

Plan Land Development Carefully

Where development is allowed near grassland ecosystems, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Plan, design and implement land development activities** (including trails and recreation access) **to minimize impacts to grassland ecosystems** by addressing the following recommendations:
  - protect natives grasses, microbiotic crusts, and other native vegetation;
  - protect large old trees, and snags;
  - protect soils, and other terrain features such as bedrock; and
  - restore native vegetation where it has been disturbed. Seed or plant natives from nurseries, or plant native species that have been rescued from other development sites. Ensure that any native plant material used is weed-free.

- **Maintain native grassland ecosystems and their wildflowers** by encouraging landowners and developers to maintain natural sites, and landscape with native species adapted to local conditions. Native plant gardening can help create wildlife habitat, and minimize the need to water or irrigate.

- **Protect endangered, threatened, or vulnerable species or plant communities, and habitat features** that were identified during the planning and inventory stages by addressing the following recommendations:
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as large old trees and snags; and
  - cut danger trees to a level where they are safe rather than removing the whole tree.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Protect nesting and denning sites** that were identified in the ecological inventory. Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

We found that aspen copses typically occurred in depressions in a mosaic with grasslands and shrublands.

We observed aspen seepage ecosystems as large patches on slopes, usually within forested areas. Note the diverse, shrubby understory.

11 Broadleaf Woodlands

What are broadleaf woodland ecosystems?

Broadleaf woodland ecosystems occurred on sites where ***succession*** resulted in a broadleaf overstory in the ***climax stage*** of succession.

Broadleaf woodland ecosystems were divided into distinct classes (aspen copse and aspen seepage) according to their environmental and vegetation characteristics; these are described below.

Aspen copse ecosystems

Aspen copse ecosystems occurred in broad, moist depressions in grassland areas. They were typically small ecosystems with trembling aspen overstories and shrubby understories dominated by common snowberry and roses. Soils were typically and medium-textured. These sites were rich as the yearly input of leaf ***litter*** is quickly decomposed and mixed into the upper soil horizon by soil organisms.

Aspen seepage ecosystems

Aspen seepage ecosystems occurred on slopes with subsurface seepage in a matrix of coniferous forests. These ecosystems were moist and rich as a result of nutrient inputs from seepage and the annual input of leaf litter. They had trembling aspen overstories and diverse, shrubby understories. Soils were typically medium-textured.

Wildlife

Amphibians & Reptiles: *Snakes forage in these ecosystems. Amphibians tend to use these environments as they have more moderate temperatures and higher humidity than much of the surrounding uplands.*

Birds: *Broadleaf woodland ecosystems provide foraging and nesting habitat for a variety of perching birds, raptors and woodpeckers. Western Screech-Owls are dependent on cavities in broad-leaved trees for nesting. The shrubby understory is used for nesting by many species of songbirds.*

Mammals: *Broadleaf woodland ecosystems provide important summer habitat for Mule Deer. Bats often use these areas for foraging and some, like the very rare Western Red Bat, roost in the foliage, unlike most other bats that roost under the bark or in tree cavities.*

Vegetation[86]

	Aspen copse	Aspen seepage	
Trees			
trembling aspen	**	**	*Populus tremuloides*
Shrubs			
common snowberry	**	**	*Symphoricarpos albus*
Nootka rose	**	**	*Rosa nutkana*
saskatoon	*	**	*Amelanchier alnifolia*
tall oregon-grape		**	*Mahonia aquifolium*
Douglas maple		**	*Acer glabrum*
choke cherry		**	*Prunus virginiana*
Grasses			
blue wildrye	*	*	*Elymus glaucus*
Forbs			
star-flowered false Solomon's-seal	*	**	*Maianthemum stellatum*
mountain sweet-cicely		**	*Osmorhiza berteroi*

Why are they important?

Ecological attributes and socio-economic values of broadleaf woodland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **Rarity:** All broadleaf woodland native plant communities are listed as rare by the B.C. Conservation Data Centre (*see* below).

Rare*[87] *natural plant ommunities of broadleaf woodlands
Trembling aspen – common snowberry – mountain sweet-cicely (R) (Populus tremuloides - Symphoricarpos albus - Osmorhiza berteroi)

Trembling aspen / snowberry / Kentucky bluegrass (R) (Populus tremuloides / Symphoricarpos albus / Poa pratensis)

Rare vertebrates of broadleaf woodlands:
Western Screech-Owl (R, COSEWIC-E) (Otus kennicottii ssp. *macfarlanei)*
Yellow-breasted Chat (R, COSEWIC-E) (Icteria virens)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
Western Rattlesnake (B) (Crotalus viridis)
Western Harvest Mouse (B, COSEWIC-SC) (Reithrodontomys megalotis)

[86] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

[87] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

- **High biodiversity:** Broadleaf woodland ecosystems have diverse plant communities that support a rich assemblage of species. Deciduous litter fall results in organically enriched in the upper layer of soil.

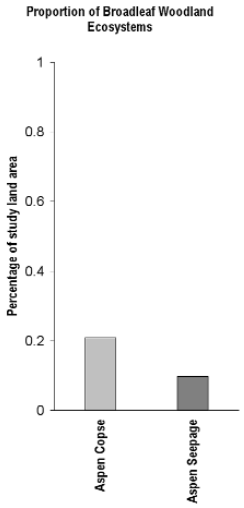
- **Specialised habitats:** Aspen copse and aspen seepage ecosystems are structurally diverse, and provide cover, food, and nesting habitat for many species. Aspen trees are very important for cavity nesters.

- **Social values:** Broadleaf woodland ecosystems provide opportunities for education, wildlife viewing, landscape viewpoints, walking and hiking, and aesthetic enjoyment. The green space that woodlands provide can add to real estate values in adjacent areas and can draw tourists into the area.

- **Fragility:** These ecosystems sensitive to soil disturbances because of the seepage associated with them.

Status

Broadleaf woodland ecosystems were isolated and uncommon; they covered only 0.3% of the study area (95 ha). All broadleaf woodland ecosystems are a high priority for conservation.



Management Recommendations[88]

When developing a management plan for broadleaf woodland ecosystems, it is assumed that a local conservation strategy has been developed (*see* page 29). The following recommendations will aid in the site management of broadleaf woodland ecosystems.

Delineate Buffers around Broadleaf Woodland Ecosystems

Wherever possible, vegetated buffers should be delineated around each broadleaf woodland ecosystem to maintain ecological viability and prevent the introduction and spread of invasive weed species. Connectivity should be maintained with surrounding ecosystems. Historically, broadleaf woodland

[88] Many of the management recommendations have been adapted from McPhee et al. 2000.

ecosystems likely occurred as small to medium-sized patch sizes with a high level of interconnectedness with grassland, old forest, and other ecosystems. Presently, many of these connections are lost and most of the larger patches of woodlands have been reduced in size. Many wildlife values associated with these ecosystems are reliant on their connections with other ecosystems.

Avoid Direct and Indirect Impacts

- **Discourage human settlement or other development** within or adjacent to broadleaf woodland ecosystems.

- **Manage access** actively (e.g., with fencing and railings) to minimize the effects of recreation and other human uses. Avoid road access wherever possible.

- **Prevent disturbance or nesting of breeding areas.** Avoid development activities from May through August.

- **Control invasive species.** Managing human and livestock access will help prevent the spread of weeds. Treat existing invasive species to maintain ecological integrity of the site. The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine the appropriate method and timing of treatment. Plant native shrubs on disturbed sites to establish a healthy, weed-resistant natural plant community.

- **Avoid use of pesticides in or near important foraging areas for wildlife.** Pesticide use near foraging habitat for animals that feed on insects (e.g. Western Screech-Owl and Townsend's Big-eared Bat) should be avoided.

Plan Land Development Carefully

Where development is allowed near broadleaf woodland ecosystems, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Plan, design and implement land development activities** (including trails and recreation access) **to minimise impacts** to broadleaf woodland ecosystems by addressing the following recommendations:

- protect mature and old trees and understory vegetation (especially shrubs);
- protect live and dead trees with cavities;
- protect dead and declining trees, downed trees, logs, snags, and leaf litter;
- protect the root systems of trees;
- protect soil conditions and hydrologic regimes; and
- restore native vegetation where it has been disturbed. Plant cuttings of shrubs, or plant natives from nurseries, or plant natives have been rescued from other development sites. Make sure any native plant material used is weed-free.

- **Design trails carefully.** Ensure that trails do not affect the root systems of trees, and will not create soil erosion problems. Trails should be designed to discourage use by vehicular traffic (ATV's), horses, and mountain bikes. Fences may be necessary in some places to prevent access.

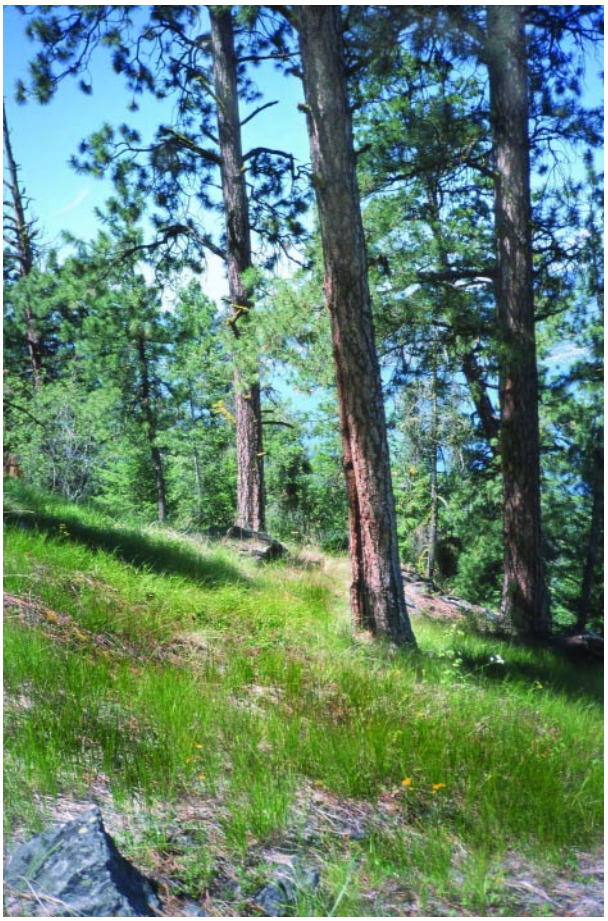
- **Protect endangered, threatened, or vulnerable species or plant communities, and habitat features** that were identified during the planning and inventory stages, by including the following recommendations:
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as trees with cavities, large old trees, and snags, and limbs, leaf litter and soil; and
  - cut danger trees to a level where they are safe rather than removing the whole tree. Felled trees should be left on the ground.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Protect nesting and denning sites** that were identified in the ecological inventory. Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

- **Maintain hydrologic regimes.** Changes to surface and ground water flow can negatively impact broadleaf woodland ecosystems. These ecosystems tend to be difficult to build on and are frequently associated with unstable slopes. Seepage associated with these sites makes it difficult to find a place for a septic field. Trails, roads, and housing developments must be designed to maintain hydrology of these ecosystems.

- **Ensure adequate sediment and erosion control measures are implemented.**



We found that coniferous woodland ecosystems had scattered trees and grassy understories, usually with scattered shrubs.

12 Coniferous Woodlands

What are coniferous woodland ecosystems?

Coniferous woodland ecosystems in the study area had open coniferous tree canopies. They occurred in drier climates, on rocky knolls, and on steep south-facing slopes where limited moisture or shallow soil limited tree establishment. Historically, these ecosystems would have burned frequently, except on sites with minimal vegetation and lots of exposed rock. Fire exclusion has resulted in forest ingrowth on some sites. These ecosystems had scattered ponderosa pine and Douglas-fir trees, and saskatoon growing in rock fractures with patches of grasses and forbs in shallow soil pockets.

Coniferous woodland ecosystems were classified into five structural stages for this SEI. Structural stages are important to identify different habitat values and the quality of the site (Table 7). Generally, older structural stages are higher conservation priority younger structural stages. Younger sites are important for buffers, and they provide recruitment for older structural stages.

Table 7. Structural stages of coniferous woodland ecosystems

Code	Name	Definition
WD:3	Shrub/herb	Shrub cover 20% or greater, tree cover less than 10%
WD:4	Pole sapling	Trees are >10m tall and have 10% or greater cover, dense stands, generally 10-40 years old
WD:5	Young forest	Trees are >10m tall and have 10% or greater cover, dominated by young trees about 40-80 years old
WD:6	Mature forest	Trees are >10m tall and have 10% or greater cover, dominated by mature trees about 80-250 years old

Wildlife

Amphibians & Reptiles: *Snakes forage and bask in coniferous woodland ecosystems; they also den in shallow soil and bedrock areas.*

Birds: *A variety of perching birds, and raptors and woodpeckers, including Lewis's Woodpeckers, forage and nest in these ecosystems. Old coniferous woodland ecosystems provide the greatest habitat values for rare birds.*

Mammals: *Warm aspect coniferous woodland ecosystems provide important winter habitat for deer.*

Vegetation[89]

Trees		
ponderosa pine	*	*Pinus ponderosa*
Douglas-fir	*	*Pseudotsuga menziesii*
Shrubs		
saskatoon	**	*Amelanchier alnifolia*
Grasses		
bluebunch wheatgrass	**	*Pseudoroegneria spicata*
rough fescue	**	*Festuca campestris*
Forbs		
arrowleaf balsamroot	**	*Balsamorhiza sagittata*
selaginella	*	*Selaginella* spp.

[89] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of coniferous woodland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **Rarity:** Most coniderous woodland native plant communities are, or are recommended for, rare status (*see* below).

Rare*[90] *natural plant communities of coniferous woodlands

Douglas-fir – ponderosa pine / bluebunch wheatgrass (B) (Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata)

Ponderosa pine / bluebunch wheatgrass – Idaho fescue (B) (Pinus ponderosa / Pseudoroegneria spicata - Festuca idahoensis)

Ponderosa pine / bluebunch wheatgrass – rough fescue (B) (Pinus ponderosa / Pseudoroegneria spicata - Festuca campestris)

Ponderosa pine / red three-awn (B) (Pinus ponderosa / Aristida purpurea var. longiseta)

Natural plant communities recommended for the red- (R) or blue- (B) list
Douglas-fir – ponderosa pine – saskatoon – mock orange (Pseudotsuga menziesii - Pinus ponderosa – Amelanchier alnifolia – Philadelphus lewisii)

Rare vertebrates of coniferous woodlands
Racer (B) (Coluber constrictor)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. deserticola)
Western Rattlesnake (B) (Crotalus viridis)
Flammulated Owl (B, COSEWIC-SC) (Otus flammeolus)
Williamson's Sapsucker (B) (Sphyrapicus thyroideus)
Gray Flycatcher (B) (Empidonax virescens)

- **High biodiversity:** Coniferous woodland ecosystems are diverse and support a rich assemblage of species. Coniferous woodland ecosystems on shallow soil sites with exposed bedrock often provide habitat for snakes.

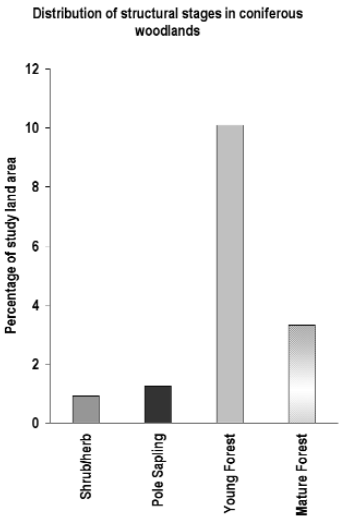
- **Specialised habitats:** Scattered large, old trees and cracks and crevices in ecosystems with exposed bedrock provide a range of habitat niches.

[90] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

- **Fragility:** Coniferous woodland ecosystems commonly have shallow soils and steep sandy soils that are very sensitive to disturbance.

- **Social values:** Coniferous woodland ecosystems provide opportunities for education, wildlife viewing, landscape viewpoints, walking and hiking, and aesthetic enjoyment. The green space that woodlands provide can add to real estate values in adjacent areas and draw tourists into the area.

Status



Old coniferous woodland ecosystems are included within the old forest category because of their extreme rarity.

Coniferous woodland ecosystems have a limited distribution in British Columbia. Historically, these ecosystems likely occurred as the matrix ecosystem in the lowest elevations of the study area and as large patches in other areas. In the study area, most coniferous woodland ecosystems had been fragmented and altered by disturbances such as logging, forest ingrowth, and weed invasion. We found that relatively large portions of the study area were coniferous woodland ecosystems (15.6% of study area; 4821 ha); they comprised the largest sensitive ecosystems category.

Most coniferous woodland ecosystems were young forests (3122 ha) and only 1028 ha were mature forests. Mature woodlands should be higher priorities for conservation and preservation; younger structural stages can be important in forming buffers and providing recruitment for older structural stages.

Management Recommendations[91]

When developing a management plan for coniferous woodland ecosystems, it is assumed that a local conservation strategy has been developed (*see* page 29). The following recommendations will aid in the site management of coniferous woodland ecosystems.

Delineate Buffers around Coniferous Woodland Ecosystems

Buffers help to reduce the spread and introduction of invasive weed species, and help to maintain ecological viability and connectivity to other ecosystems. It is also important to maintain corridors and

[91] Many of the management recommendations have been adapted from McPhee et al. 2000.

connectivity to other ecosystems. Many of the wildlife values associated with coniferous woodland ecosystems are reliant on their connections with other ecosystems. Maintaining landscape patterns with inclusions of other ecosystems in coniferous woodland matrices should be a priority for managing and conserving these ecosystems.

Avoid Direct and Indirect Impacts

- **Discourage human settlement or other developments** within or adjacent to coniferous woodland ecosystems.

- **Manage access** to minimize vehicular and livestock access. Where trails can be safely established, follow the appropriate recommendations listed below under "Plan Land Development Carefully".

- **Control invasive species.** Managing human and livestock access, and treating existing invasive species will help maintain the ecological integrity of coniferous woodland sites. Retaining a healthy natural plant community and avoiding soil disturbance will help prevent weed invasions. The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine the appropriate method and timing of treatment for invasive plant species.

- **Prevent soil disturbances.** Coniferous woodlands often have shallow soils, sandy soils, or occur on steep slopes that are sensitive to disturbance. Soil disturbance can allow invasive weeds to establish and spread and can make it difficult for native plants to re-establish.

Plan Land Development Carefully

Where development is allowed in or near coniferous woodland ecosystems, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Design and implement land development activities** (including trails and recreation access) **to minimise impacts** to coniferous woodland ecosystems by addressing the following recommendations:
  - protect mature and old trees, and native vegetation;
  - protect dead and declining trees, snags;
  - protect the root systems of trees;
  - protect soils by avoiding activities that cause erosion or compaction; and

- restore native vegetation where it has been disturbed. Seed or plant natives from nurseries, or plant natives that have been rescued from other development sites. Ensure that any native plant material used is weed-free.

- **Design trails carefully.** Ensure that trails do not affect the root systems of trees, and will not create soil erosion problems. Trails should be designed to discourage use by vehicular traffic (ATV's), horses, and mountain bikes. Fences may be necessary in some places to prevent access. Trails should be closely monitored for noxious and invasive weeds. If weeds are present, trails should be closed until the weeds have been treated and are under control.

- **Protect endangered, threatened, or vulnerable species or plant communities, and habitat features** that were identified during the planning and inventory stages by addressing the following recommendations:
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as trees with cavities, large old trees, and snags; and
  - cut danger trees to a level where they are safe rather than removing the whole tree.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Protect large old trees, and snags.** Old trees and snags provide critical nesting habitat for many species of birds.

- **Protect nesting and denning sites** that were identified in the ecological inventory. Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

- **Ensure adequate sediment and erosion control measures** are implemented.

We found that sparsely vegetated shrub ecosystems usually occurred on rocky sites in grassland areas.

Talus ecosystems were observed below rock outcrops or cliffs. The amount of vegetation on them depended on the amount of soil between the angular rocks.

We observed cliff ecosystems scattered throughout the study area. Shrubs often grew in cracks in the rock.

13 Sparsely Vegetated

What are sparsely vegetated ecosystems?

Sparsely vegetated ecosystems in the study area occurred on sites where rock or talus limited vegetation establishment. Vegetation cover was discontinuous, and was interspersed with bedrock or blocks of rock.

We subdivided sparsely vegetated ecosystems into four subtypes: shrub, talus, cliff, and rock outcrop ecosystems; these are described below.

Shrub

In the study area, shrub ecosystems occurred on small rock outcrops with cracks and crevices. They most commonly occurred in a grassland matrix. These ecosystems were often steep; soils were restricted to small pockets. Scattered shrubs grew in cracks and cliff ferns often grew in small crevices.

Talus

Talus ecosystems occurred on steep slopes covered with angular rock fragments. They usually occurred below rock outcrops or cliffs. Soil was restricted to small pockets between rock fragments. Vegetation usually included scattered trees, shrubs, and cliff ferns. Occasional grasses and forbs were found growing in soil pockets between rock fragments. Vegetation cover was higher on sites with smaller rock fragments; there was more soil.

Cliff

In the study area, sparsely vegetated cliff ecosystems were steep, vertical cliffs. Often they occurred above talus ecosystems. Cliffs had minimal vegetation that was restricted to cracks and crevices, narrow ledges and small soils pockets. Shrubs typically occurred in crevices and grasses and forbs occurred in small soil pockets on ledges.

Rock Outcrops

Rock outcrop ecosystems occurred on areas of exposed rock that had very little soil development and sparse vegetation cover. Vegetation cover typically consisted of bunchgrasses, selaginella and scattered shrubs that were typically restricted to crevices and pockets of soil. These ecosystems were gently to steeply sloping but were neither vertical (these were cliff ecosystems), nor were they dominated by shrubs (these were shrub ecosystems).

Wildlife

Amphibians & Reptiles: *Snakes and skinks use sparsely vegetated ecosystems extensively. Ecosystems on warm aspects and ecosystems with lots of cracks and crevices are used the most frequently; snake hibernacula are found here.*

Birds: *Birds of prey, including Peregrine and Prairie Falcons, eagles, and hawks, nest on rocky ledges found in sparsely vegetated ecosystems. White-throated Swifts nest in cliffs.*

Mammals: *Many bat species such as Townsend's Big-eared Bat, Spotted Bat, Pallid Bat, Fringed Myotis, and Small-footed Myotis roost in rock crevices found in sparsely vegetated ecosystems.*

Vegetation[92]

	Shrub	Talus	Cliff	Rock outcrop	
Trees					
trembling aspen		*			*Populus tremuloides*
ponderosa pine		*			*Pinus ponderosa*
Douglas-fir		*			*Pseudotsuga menziesii*
Shrubs					
saskatoon	*	*	*	*	*Amelanchier alnifolia*
choke cherry	*	*	*		*Prunus virginiana*
Nootka rose		*			*Rosa nutkana*
redstem ceanothus		**			*Ceanothus sanguineus*
mock orange		**	*		*Philadelphus lewisii*
Grasses					
bluebunch wheatgrass	*	*	*	*	*Pseudoroegneria spicata*
Forbs					
arrowleaf balsamroot	*			*	*Balsamorhiza sagittata*
selaginella				**	*Selaginella* spp.
cliff fern		*	*		*Woodsia* spp.
shrubby penstemon		*			*Penstemon fruticosus*

[92] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of sparsely vegetated ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **Rarity:** Most sparsely vegetated natural plant communities have been recommended for rare status (*see* below).

Natural plant communities recommended for the red- or blue- list

Antelope-brush – selaginella (Purshia tridentata)

Choke cherry – bluebunch wheatgrass (Prunus virginiana – Pseudoroegneria spicata)

Saskatoon – mock orange (Amelanchier alnifolia – Philadelphus lewisii)

Selaginella – bluebunch wheatgrass (Selaginella - Pseudoroegneria spicata)

Rare*[93] *vertebrates of sparsely vegetated ecosystems

Swainson's Hawk (R) (Buteo swainsonii), Ferruginous Hawk (R, COSEWIC-SC) (Buteo regalis)
Peregrine Falcon (R, COSEWIC-SC) (Falco peregrinus ssp. *anatum)*
Prairie Falcon (R) (Falco mexicanus)
Pallid Bat (R, COSEWIC-T) (Antrozous pallidus)
Racer (B) (Coluber constrictor)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
Western Rattlesnake (B) (Crotalus viridis)
White-throated Swift (B) (Aeronautes saxatilis)
Lewis's Woodpecker (B, COSEWIC-SC) (Melanerpes lewis)
Canyon Wren (B) (Catherpes mexicanus)
Fringed Myotis (B, COSEWIC-SC) (Myotis thysanodes)
Western Small-footed Myotis (B) (Myotis ciliolabrum)
Spotted Bat (B, COSEWIC-SC) (Euderma maculatum)
Townsend's Big-eared Bat (B) (Corynorhinus townsendii)
Nuttall's Cottontail (B, COSEWIC-SC) (Sylvilagus nuttallii ssp. *nuttallii)*
Fisher (B) (Martes pennanti)
Bighorn Sheep (B) (Ovis canadensis)

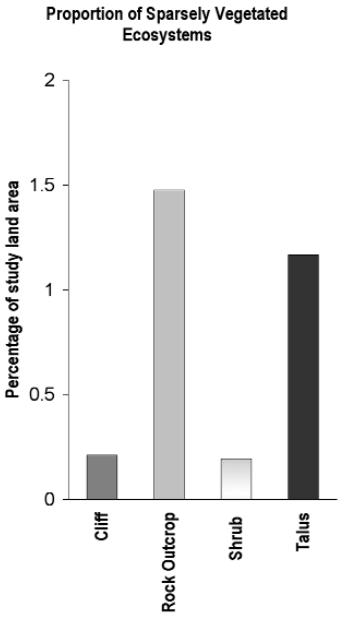
[93] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

- **Specialised habitats:** A variety of specialised habitats are found in sparsely vegetated ecosystems. A number of species, including some threatened- or endangered-species are dependant on these habitats. Deep crevices and some talus slopes are used for shelter and hibernacula for over-wintering snakes such as Western Rattlesnakes, Gopher Snakes, and Racers. Some shrub, rock outcrop and cliff ecosystems with deep crevices provide roosting or hibernacula sites for a variety of bat species.

- **Fragility:** Sparsely vegetated sites are sensitive to disturbance. They can take very long periods of time to recover, or never if soil is removed or eroded.

- **Social values:** Sparsely vegetated ecosystems provide opportunities for scenic viewpoints, wildlife viewing, education, and aesthetic enjoyment. The green space that sparsely vegetated ecosystems provide can add to real estate values in adjacent areas, and can draw tourists into the area.

Status



These ecosystems have not been well documented in the past, and they covered only 3% (942 ha) of the study area land base. In the study area, rock outcrops and talus ecosystems were the most common ecosystem type (456 ha and 361 ha); cliffs and shrub sites were extremely uncommon (65 ha and 59 ha).

Management Recommendations[94]

When developing a management plan for sparsely vegetated ecosystems, it is assumed that a local conservation strategy has been developed (*see* page 29). The following recommendations will aid in the site management of sparsely vegetated ecosystems.

[94] Many of the management recommendations have been adapted from McPhee et al. 2000.

Delineate Buffers around Sparsely Vegetated Ecosystems

Wherever possible, vegetated buffers should be delineated around each sparsely vegetated ecosystem and connectivity should be maintained between sparsely vegetated ecosystems and adjacent habitats. Many of the species that use sparsely vegetated ecosystems are also reliant on other types of ecosystems.

Avoid Direct and Indirect Impacts

- **Discourage human settlement and other land development** within or adjacent to sparsely vegetated ecosystems.

- **Manage access** to minimise vehicular and livestock access on and near sparsely vegetated ecosystems. Vehicle traffic, including bicycles, causes mortality to wildlife species that rely on these ecosystems. Road access should be avoided and rock climbing should be carefully managed on cliffs. Do not develop trails on sparsely vegetated ecosystems. Trails can create erosion problems, disturb fragile vegetation, and spread or introduce invasive weed species.

- **Prevent disturbance** of snake hibernacula. If snake hibernacula are found, they should not be disturbed and should not be made known to the public unless they occur in an area where public use may disturb snakes.

- **Control invasive species.** Managing human and livestock access, and treating existing invasive species will help maintain ecological integrity of the site. Weeds can be hand-pulled, and native species can be planted to help prevent the establishment of more weeds. Retention of a healthy natural plant community will also help prevent weed invasions. Sparsely vegetated ecosystems are very sensitive and it is important not to cause further disturbance when treating weeds. The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine the appropriate method and timing of treatment for invasive plant species.

- **Prevent soil disturbances.** Sparsely vegetated have sensitive pockets of shallow soils, and they frequently occur on steep slopes. Soil disturbance can allow invasive weeds to establish or spread and can make it difficult or impossible for native plants to re-establish. Disturbance of talus or bedrock may destabilize remaining rocks.

Plan Land Development Carefully

Where development is allowed in or near sparsely vegetated ecosystems, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Plan, design and implement land development activities** (including trails and recreation access) **to minimise impacts** to sparsely vegetated ecosystems by addressing the following recommendations:
  - protect talus that occurs at the base of rock outcroppings;
  - protect the steep faces of rock outcrops and cliffs;
  - protect mature and old trees and vegetation;
  - protect dead and declining trees, and snags;
  - protect the root systems of trees;
  - protect soil conditions and hydrologic regimes; and
  - restore native vegetation where it has been disturbed. Seed or plant natives from nurseries, or plant natives that have been rescued from other development sites. Ensure that any native plant material used is weed-free.

- **Protect endangered, threatened, or vulnerable species or plant communities, and habitat features** that were identified during the planning and inventory stages by addressing the following recommendations:
  - avoid disturbance of rock debris;
  - do no permit rock climbing without determining which areas must be avoided to protect nesting and roosting habitats;
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as trees with cavities, large old trees, and snags; and,
  - cut danger trees to a level where they are safe rather than removing the whole tree.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Avoid roads near hibernacula.** Determine locations of snake hibernacula prior to planning site layouts, including roads. Roads should not be located within 750m of a hibernaculum and barriers and under-passes may be required to prevent snake mortality.

- **Protect nesting and denning sites** that were identified in the ecological inventory. Such features include dens, hibernacula, raptor nest or perch trees, woodpecker cavities, and bat roosts.

- **Ensure adequate sediment and erosion control measures** are implemented.

A typical coniferous mature forest with an open, grassy understory.

In the study area, mixed and broadleaf mature forests usually had shrubby understories.

14 Mature Forest

What are mature forest ecosystems?

Mature forest ecosystems were mapped where polygons included structural stage 6 forests[95] (mature forest), except for mature riparian, broadleaf woodland, and coniferous woodland forests, which were included in the riparian, broadleaf woodland, and coniferous woodland categories respectively.

Historically, most forests had frequent surface fires that killed most regeneration and allowed few trees into the overstory. Overstories were generally multi-aged with a largely single-layered canopy of mostly large, old trees, and understories were open and dominated by grasses and shrubs. Frequent fire also limited the occurrence of dead wood to scattered large snags and large, downed wood.

The exclusion of fires has caused formerly open, park-like forests to infill with waves of smaller trees (this is referred to as forest ingrowth; historically, most of these small trees would have been killed by periodic fires). Mature forests occurred where there are mature trees and a few large old trees. These stands typically had a history of selection logging and had forest ingrowth, but the mature and old trees they contained are structurally important for wildlife.

Mature forest sites provide excellent buffers for old forests and have good potential for restoration to historical stand structure. In the study area, many stands were at risk from catastrophic wildfire due to fuel build-up, and to forest ingrowth internally, and in adjacent forests.

On wetter sites, forest development occurs more quickly than on drier sites. Historically, these wetter sites did not burn as frequently and multi-layered forests were able to develop. Moist forests in the study area were also at an increased risk of loss to catastrophic wildfire relative to historical levels. Moist forests were, by nature, denser, more multi-layered and less affected by forest ingrowth.

[95] Refer to Volume 2 (Iverson et al. 2003) for details on structural stage 6.

Coniferous mature forest ecosystems

Coniferous mature forests in the study area were dominated by ponderosa pine and Douglas-fir. Coniferous mature forests were the most common type of the mature forest ecosystem that we observed. These forests occurred on sites with a wide range of ecological conditions. Typically, drier sites had ponderosa pine with some Douglas-fir in the overstory, and bunchgrasses and scattered shrubs in the understory. Slightly moister sites often had a mixed Douglas-fir and ponderosa pine overstory, and pinegrass with some bunchgrasses and shrubs in the understory.

Mixed mature forest ecosystems

In the study area, mixed mature forests had a mixture of both coniferous tree species, including Douglas-fir and ponderosa pine, and broadleaf tree species, including trembling aspen and paper birch. These ecosystems occurred on moister sites than coniferous mature forest ecosystems and had shrubby understories with scattered grasses and forbs.

Broadleaf mature forest ecosystems

In the study area, broadleaf mature forest ecosystems had broadleaf tree species in the overstory including trembling aspen and paper birch. These ecosystems occurred on moister sites than coniferous mature forest ecosystems and had shrubby understories.

Wildlife

Amphibians & Reptiles: *The Rubber Boa is the most common snake found in mature forests, however, Gopher Snakes and Western Rattlesnakes can also be present.*

Birds: *Many species of woodpeckers and owls, including White-headed Woodpecker and Flammulated Owl, rely on mature forests that have large trees and snags. Lewis's Woodpeckers prefer snags in open forests.*

Mammals: *As well as providing cover and forage to a number of large mammals, mature forests, particularly on warm aspects, provide winter range for Mule Deer. Tree cavities and loose bark provide important roosting sites for bats. Many small mammals depend on the cavities available.*

Vegetation[96]

	Coniferous	Mixed	Broadleaf	
Trees				
ponderosa pine	**	**		*Pinus ponderosa*
Douglas-fir	**	**		*Pseudotsuga menziesii*
paper birch		**	**	*Betula papyrifera*
trembling aspen		**	**	*Populus tremuloides*
Shrubs				
common snowberry	**	***	***	*Symphoricarpos albus*
tall oregon-grape	**	**	**	*Mahonia aquifolium*
saskatoon	**	**	**	*Amelanchier alnifolia*
Nootka rose	*	**	**	*Rosa nutkana*
Douglas maple		**	**	*Acer glabrum*
mock orange			**	*Philadelphus lewisii*
Grasses				
bluebunch wheatgrass	**			*Pseudoroegneria spicata*
rough fescue	**			*Festuca campestris*
pinegrass	**	**	**	*Calamagrostis rubescens*
blue wildrye		*	**	*Elymus glaucus*
Forbs				
arrowleaf balsamroot	**	*		*Balsamorhiza sagittata*
heart-leaved arnica	*	**	**	*Arnica cordifolia*

[96] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of mature forest ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

Rare*[97] *vertebrates of mature forests
Swainson's Hawk (R) (Buteo swainsonii)
Ferruginous Hawk (R, COSEWIC-SC) (Buteo regalis)
White-headed Woodpecker (R, COSEWIC-E) (Picoides albolarvatus)
Badger (R, COSEWIC-E) (Taxidea taxus)
Racer (B) (Coluber constrictor),
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
Western Rattlesnake (B) (Crotalus viridis)
Great Blue Heron (B) (Ardea herodias)
Flammulated Owl (B) (Otus flammeolus)
Lewis's Woodpecker (B) (Melanerpes lewis)
Williamson's Sapsucker (B) (Sphyrapicus thyroideus)

- **Future old forest ecosystems:** The extent of old forest ecosystems was extremely limited. With proper restoration, mature forests can, over time, become old forest ecosystems. However, removal of forest ingrowth and treatment of fuels are required to develop old forest ecosystems.

- **Biodiversity:** Mature forest ecosystems have many important structural attributes, including some remaining large, old trees. They provide habitat for many species, and, where they occur, broadleaf trees are important for many cavity-nesting species.

- **Landscape connectivity:** Mature forests provide buffers, and connectivity between other ecosystems.

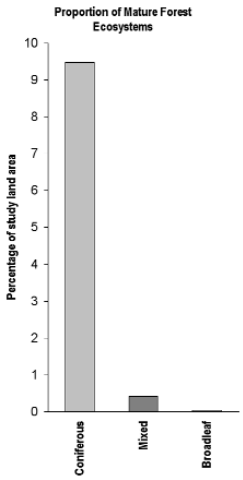
- **Social values:** Mature forests provide opportunities for education, recreation, wildlife viewing, and aesthetic enjoyment. The green space that mature forests provide can add to real estate values higher in adjacent areas. Mature forests provide opportunities for selective logging.

[97] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

Status

We found that mature forest ecosystems covered 9.9% of the study area; they should be preserved as large patches to provide recruitment for old forests. Most mature forest ecosystems in the study area were ingrown and required thinning and prescribed burning to restore them to high quality sites that could become old forests.

Coniferous mature forests (2930 ha) were the most common type; only 131 ha were mixed and a mere 14 ha were broadleaf.



Management Recommendations[98]

Avoid Direct and Indirect Impacts

- **Discourage human settlement or other developments** within or adjacent to mature forest ecosystems.

- **Manage access** to minimize vehicular and livestock access. Where trails can be safely established, the appropriate recommendations listed below under "Plan Land Development Carefully" should be followed.

- **Restore and maintain ecological structures and functions, and reduce the risk of catastrophic wildfires.** Restoration requires understanding of historical disturbance regimes (particularly fire), and of the structure of these forests prior to fire exclusion and logging. Historical photographs and accounts, early forest or land surveys, and results from researchers in other similar ecosystems can be used to determine what historical old forest ecosystems looked like[62]. A qualified professional should develop a detailed restoration plan.

  Restoration should include the retention of larger trees, plus thinning of other trees. Following thinning, initial prescribed burns should be conducted to consume unnaturally heavy fuels. Prescribed burning should be planned and conducted by qualified professionals. Large old trees need to be protected from cambial girdling and root mortality by raking accumulated forest floor fuels away from tree bases prior to burning. Noxious weeds need to be controlled, and native plants may need to be seeded if there are inadequate native grasses and shrubs present on-site. Grazing should be deferred until the plant community has had an opportunity to recover[63].

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[98] Many of the management recommendations have been adapted from McPhee et al. 2000.
[62] Swetman et al. 1999
[63] Moore et al. 1999

Prescribed fire may be too dangerous to conduct a prescribed burn on small, private lots. Landowners can reduce the risk of wildfire and maintain some of the ecological functioning of mature forest ecosystems on their land by raking and removing fuels from beneath trees, and by cutting and removing most small ponderosa pine and Douglas-fir trees.

- **Prevent disturbance of nesting sites and breeding areas** (e.g., cavities in large trees).

- **Protect large old trees, and snags.** Old trees and snags provide critical nesting habitat for many species of birds.

- **Control invasive species.** Managing human and livestock access, and treating existing invasive species (e.g., cheatgrass, knapweed, sulphur cinquefoil) will help maintain the ecological integrity of old forest sites. Retention or restoration of a healthy natural plant community will also help prevent weed invasions The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine the appropriate method and timing of treatment for invasive plant species.

- **Avoid use of pesticides in, or near, important foraging areas for wildlife.** Pesticide use near foraging habitat for animals that feed on insects (e.g., Flammulated Owl and Lewis's Woodpecker) should be avoided.

Plan Land Development Carefully

Where development is allowed in mature forest ecosystems, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Design and implement land development activities** (including trails and recreation access) to minimise impacts to the mature forest ecosystems by addressing the following recommendations:

  - protect large, old trees, and understory vegetation;
  - locate the development away from existing large, old trees and snags; and

- restore native vegetation where it has been disturbed. Seed in or plant natives from nurseries or plant natives that have been rescued from other development sites. Ensure that any native plant material used is weed-free.

- **Design trails carefully.** Ensure that trails do not affect the root systems of trees, and will not create soil erosion problems. Trails should be designed to discourage use by vehicular traffic (ATV's), horses, and mountain bikes. Fences may be necessary in some places to prevent access. Trails should be closely monitored for noxious and invasive weeds. If weeds are present, trails should be closed until the weeds have been treated and are under control.

- **Protect endangered, threatened, or vulnerable species and habitat features** that were identified during the planning and inventory stages by addressing the following recommendations:
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as large old trees and snags; and
  - cut danger trees to a level where they are safe rather than removing the whole tree.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Protect nesting and denning sites** that were identified in the ecological inventory. Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

In the study area, disturbed grasslands were a mixture of native bunchgrasses and forbs with 20-50% cover of invasive plants.

Cheatgrass is an introduced (non-native) annual grass that we commonly observed in disturbed grasslands.

15 Disturbed Grasslands

What are disturbed grassland ecosystems?

Disturbed grasslands, once intact grasslands, had a mixture of native bunchgrasses and forbs, and 20-50% invasive weeds including diffuse knapweed (*Centaurea diffusa*) and sulphur cinquefoil (*Potentilla recta*). In the study area, some grassland ecosystems had been invaded by noxious weeds that covered more than 50% of the plant community. These ecosystems would be extremely challenging to restore and were excluded from the disturbed grasslands category.

Wildlife

Amphibians & Reptiles: *The desert-adapted Great Basin Spadefoot forages and over winters in grasslands in the study area. Although prey populations may be lower than in grasslands, disturbed grasslands provide foraging habitat for many species of snakes, including the Gopher Snake, Western Yellow-bellied Racer, and Western Rattlesnake. Gopher Snakes are particularly attracted to these areas for foraging on subterranean rodents, and they may also den and lay eggs here.*

Birds: *Some disturbed grasslands may still provide nesting and foraging for Short-eared Owls, Long-billed Curlews, and Grasshopper Sparrows. They may also provide foraging habitat for Swainson's Hawks and other birds of prey. Lewis's Woodpeckers use disturbed grasslands for foraging, and for nesting if snags are available.*

Mammals: *With less native seed and insect food, disturbed grasslands have fewer small mammals. They can provide forage and denning habitat for Badgers if there are enough small mammals.*

Vegetation[99]

Grasses		
bluebunch wheatgrass	**	*Pseudoroegneria spicata*
junegrass	*	*Koeleria macrantha*
Columbia needlegrass	**	*Achnatherum nelsonii*
Forbs		
arrowleaf balsamroot	*	*Balsamorhiza sagittata*
parsnip-flowered buckwheat	*	*Eriogonum heracleoides*
daisies or fleabanes	*	*Erigeron* spp.
silky lupine	*	*Lupinus sericeus*
Non-native Plants		
cheatgrass or Japanese brome	**	*Bromus tectorum* or *B. japonicus*
diffuse knapweed	**	*Centaurea diffusa*
sulphur cinquefoil	**	*Potentilla recta*

[99] This broadly shows what vegetation occurred in these ecosystems. Abundance of different species is indicated by: * uncommon species, ** common species, *** abundant species.

Why are they important?

Ecological attributes and socio-economic values of disturbed grassland ecosystems are listed below. Values common to most SEI ecosystems are discussed in Chapter 2.

- **Rarity:** Disturbed grasslands represent the best potential to recover part of the extent of rare grassland natural plant communities.

- **Biodiversity:** Disturbed grasslands provide important habitat for many species, including many red- and blue-listed species (*see* below).

Rare*[100] *vertebrates of disturbed grasslands
Swainson's Hawk (R) (Buteo swainsonii),
Ferruginous Hawk (R, COSEWIC-SC) (Buteo regalis),
Prairie Falcon (R) (Falco mexicanus),

Upland Sandpiper (R) (Bartramia longicauda)
Burrowing Owl (R, COSEWIC-E) (Athene cunicularia)
Preble's Shrew (R) (Sorex preblei)
Merriam's Shrew (R) (Sorex merriami)
Badger (R, COSEWIC-E) (Taxidea taxus)
Great Basin Spadefoot (B, COSEWIC-T) (Spea intermontana)
Painted Turtle (B) (Chrysemys picta)
Racer (B) (Coluber constrictor)
Gopher Snake (B, COSEWIC-T) (Pituophis catenifer ssp. *deserticola)*
Western Rattlesnake (B) (Crotalus viridis)
Long-billed Curlew (B, COSEWIC-SC) (Numenius americanus)
Lewis's Woodpecker (B, COSEWIC-SC) (Melanerpes lewis)
Fringed Myotis (B, COSEWIC-SC) (Myotis thysanodes)
Western Small-footed Myotis (B) (Myotis ciliolabrum)
Great Basin Pocket Mouse (B) (Perognathus parvus)
Western Harvest Mouse (B, COSEWIC-SC) (Reithrodontomys megalotis)

[100] Provincially endangered or threatened (R-red-listed) or vulnerable (B-blue-listed) vertebrate species and natural plant communities as of August 2002 are noted. Nationally rare vertebrate species ranked by COSEWIC, as of May 2002, are noted as endangered (E), threatened (T), or of special concern (SC). *See* Glossary for further discussion.

Status

Grassland ecosystems cover only 0.8% of British Columbia's land area and many of these grasslands have been lost or disturbed[101]. The study showed that disturbed grasslands covered 2.3% (697 ha) of the study area. Although these sites had up to 50% non-native plants, they could provide a source of grassland ecosystems through restoration. In particular, disturbed grassland ecosystems that occur in association with other sensitive and important ecosystems are higher priorities for preservation and restoration.

Management Recommendations[102]

Grasslands most commonly occur on sites that are very amenable to development – both for agriculture and housing. Overuse by domestic livestock and invasion of noxious weeds also threatens remaining grasslands. Very few relatively undisturbed grassland ecosystems remained in the study area. A few larger areas of disturbed grasslands were still present. These disturbed grassland ecosystems need to be restored to replace invasive weeds with native vegetation. Disturbed grasslands can form buffers, particularly around grassland ecosystems, but need a plan to control invasive weeds.

Avoid Direct and Indirect Impacts

- **Discourage human settlement or other land developments** within or adjacent to disturbed grassland ecosystems.

- **Minimise vehicular access.** Vehicles are very effective at spreading invasive weeds. Ensure roads are weed-free.

- **Do not develop new trails on disturbed grassland ecosystems.** Trails can create erosion problems, disturb fragile vegetation, and spread invasive weed species. All motorised vehicles should be restricted to existing roads. Mountain bikes should be restricted to existing trails where such trails are weed-free, sustainable, and are not subject to erosion; otherwise these trails should be closed. Trails with weeds (and no erosion problems) can be reopened once weed problems have been controlled.

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[101] Grasslands Conservation Council of B.C. 2002

[102] Many of the management recommendations have been adapted from McPhee et al. 2000.

- **Prevent disturbance of nesting sites and breeding areas.** Many grassland birds are ground-nesters.

- **Manage livestock use.** Livestock grazing needs to be carefully managed to ensure that ecological values associated with grassland ecosystems can be maintained and to avoid spreading invasive plant species. Careful monitoring should to be implemented to ensure that grazing levels and timing meet management objectives for the site. Grazing levels may need to be reduced to effectively restore these sites.

- **Protect large old trees and snags**. Scattered trees or snags are extremely important for wildlife in grassland areas. These trees can be isolated structures in grassland areas.

- **Control invasive species.** Managing human and livestock access and treating existing invasive plant species will help restore the ecological integrity of disturbed grassland ecosystems. Weeds can be sprayed or hand-pulled, and native species can be planted to help prevent the establishment of more weeds. Restoring a healthy natural plant community will also help prevent future weed invasions. The BC Ministry of Forests or BC Ministry of Agriculture, Fish and Food can be consulted to determine the appropriate method and timing of treatment for invasive plant species. It is important that the right treatment method is used to ensure it is effective.

- **Remove encroaching trees.** Young trees should be removed by cutting or prescribed fire. Prescribed burns should always be planned, properly scheduled, and conducted by a qualified professional. Prescribed fires should only be conducted after invasive weeds have been controlled.

- **Avoid use of pesticides in, or near, important foraging areas for wildlife.** Pesticide use near foraging habitat for animals that feed on insects (e.g., Lewis's woodpecker) should be avoided.

Plan Land Development Carefully

Where development is allowed in or near disturbed grassland ecosystems, the following guidelines apply:

- **Require an ecological inventory conducted by a qualified professional.**

- **Plan, design and implement land development activities** (including trails and recreation access) **to minimise impacts** to disturbed grassland ecosystems by addressing the following recommendations:
  - protect natives grasses, microbiotic crusts, and other native vegetation,
  - protect large, old trees;
  - protect soils and other terrain features such as bedrock;
  - do not create trails unless invasive weeds have been controlled; and
  - restore native vegetation where it has been disturbed. Seed or plant natives from nurseries, or plant native species that have been rescued from other development sites. Ensure that any native plant material used is weed-free.

- **Protect endangered, threatened, or vulnerable species, and habitat features** that were identified during the planning and inventory stages by addressing the following recommendations:
  - avoid disturbance to sites where rare plants are growing and where rare natural plant communities occur;
  - maintain habitat structures such as large old trees and snags; and
  - cut danger trees to a level where they are safe rather than removing the whole tree.

- **Prevent disturbance of nesting and breeding areas.** Avoid development activities from May through August.

- **Protect nesting and denning sites** that were identified in the ecological inventory. Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

16 Future Directions

Updating SEI Products

New housing developments and other land developments, ecological succession, natural disturbances, and other disturbances will change components of the sensitive ecosystems map. Existing mapping can provide a baseline to changes in sensitive and important ecosystems in the study area. The mapping should be updated every ten years to reflect new housing developments, other land developments, and other disturbances. Structural stages of riparian, forest, and woodland ecosystems should be updated every 10 years.

Completing SEI Coverages

SEI mapping should be completed to provide full coverage from the South Okanagan Biophysical Mapping to the Bella Vista – Goose Lake Range SEI in the North Okanagan. Lake Country, Peachland, the City of Kelowna, and other gaps in coverage should be filled to provide a SEI base for Okanagan-wide planning and conservation strategies.

Section II: Conservation Tools

Conservation Tools for:

Local Governments

Landowners and other Citizens

Senior Governments

By:
Larry D.S. Wolfe, Quadra Planning Consultants Ltd.
Michael W. McPhee, Quadra Planning Consultants Ltd.

Modified by Kristi Iverson to reflect
ecosystem conditions in the study area

17 What Local Governments Can Do

This section of the report provides general guidance to local governments, landowners and other citizens and senior governments for conserving and protecting ecosystems. Although the focus of the report is on the seven sensitive ecosystems and two other important ecosystems (*see* sidebar), the tools can also be used for conserving other environmentally sensitive areas (ESAs).

Planning

Local governments have numerous planning tools available to assist them in protecting and conserving sensitive and other important ecosystems. Various considerations enter into decisions as to which tools to use in a particular situation. In many cases, innovative development plans can allow compatible development to take place, while conserving sensitive ecosystems and respecting the legal rights of landowners. In some cases, existing environmental problems may have resulted from ongoing land uses that conflict with environmental objectives or do not conform to bylaws.

Sensitive ecosystems
Wetlands
Riparian
Old Forest
Grasslands
Broadleaf Woodlands
Coniferous Woodlands
Sparsely Vegetated

Other important ecosystems
Mature Forest
Disturbed Grasslands

The constitutional authority for planning and land use regulation rests with the Province. The Province, through various pieces of legislation, has delegated much of its authority to local governments – to regional districts and municipalities. These powers include, for example, authority to adopt regional growth strategies, official community plans, zoning bylaws, subdivision bylaws, and other bylaws that affect development and conservation. Regional districts develop regional growth strategies and related bylaws in consultation with provincial agencies and municipalities within their territory. Municipalities have broad planning and land use control powers within their borders.

The tools below provide many options for developing environmentally compatible development plans within the local government's jurisdiction.

Primary Goals

The primary goals of the policies and regulations described in this chapter reflect the differences between the seven sensitive ecosystems and the two other important ecosystems.

- **Sensitive ecosystems**—the policies and regulations suggested below seek to conserve these areas in a relatively natural state.

- **Other important ecosystems**—the policies and regulations suggested below seek to maintain the resource use values of the two other important ecosystems while minimizing the loss of ecosystem functions.

Information Requirements

Other Sources of Information
Canadian Wildlife Service
Environment Canada
Ministry of Sustainable Resource Management
Ministry of Water, Land and Air Protection
BC Conservation Data
Local naturalists
Environmental groups
Universities
First Nations

Sound information is needed to establish a policy and legal basis for protecting sensitive and other important ecosystems. Three types of information are considered in this chapter:

- **SEI ecosystems** are the nine ecosystems defined by the Sensitive Ecosystems Inventory (SEI). Information gathered by the SEI project is at an overview level. Site-specific development proposals will require further refinement and confirmation by detailed inventories, field studies, and ground-truthing to ensure that all habitat patches have been identified.

  SEI information can be used by local governments to 'red flag' areas for designation as Environmentally Sensitive Areas and Development Permit Areas. The detailed ecological information that was collected during the SEI field checking of selected sites, and the management recommendations in this report can be used for Development Approval Information. Developers can also use the report's information to incorporate conservation objectives into initial development design to streamline approvals.

- **Development Approval Information (DAI)** may be required from developers to provide more detailed information as part of the development approval process. Local governments can, in an Official Community Plan, specify areas or circumstances within which development approval information may be required. Areas can include development permit areas or other areas. Information requirements must be specified in advance in a bylaw along with procedures for requiring the information.

*See **Local Government Act** sections 920.01 and 920.1 for more information.*

- **Environmentally Sensitive Areas (ESA)** are areas formally identified as environmentally sensitive by the local government. ESAs are usually identified spatially on a map. Local governments may, in co-operation with other government agencies, assemble databases for identifying and managing ESAs within their boundaries. Sensitivity may be due to ecological concerns or existence of natural hazards. ESAs may be mapped either at an overview scale or in considerable detail, depending on the local government jurisdiction. Identification alone does not protect an ESA. Once identified, however, ESAs must be protected by regulations such as zoning provisions or development permit conditions.

The 'Environmentally Sensitive Area Management Plan' [103] documents current management recommendations for Environmentally Sensitive Areas identified as part of the Regional District of the Central Okanagan's Natural Features Inventory predating this Sensitive Ecosystems Inventory. Environmentally Sensitive Areas were identified on a map and management recommendations in the report were intended to encourage voluntary conservation of ESAs and did not impose any legal restrictions. Identified natural features have been recognized as Environmentally Sensitive Areas in many Official Community Plans.

Information Verification

Local governments may do the following to ensure adequate information for managing sensitive ecosystems.

- **Establish procedures for verification and ground-truthing** of candidate
  areas for inclusion in ESAs, as part of planning updates and development approvals, in co-operation with other government agencies.

- **Review, refine, and confirm** areas identified by the Sensitive Ecosystems Inventory Project as candidates for inclusion in ESA inventories or maps.

- **Enact appropriate bylaws** to require Development Approval Information for all Sensitive Ecosystem ESAs pursuant to the *Local Government Act,* sections 920.01 and 920.1.
  - Establish procedures and policies for provision of such information. In co-operation with other government agencies, provide criteria for the types of information to be provided, and its sources, quality, and reliability.
  - Use the Sensitive Ecosystems Inventory and information in this report as a basis for defining the circumstances and rationale for this designation.

- **Involve the public, non-government organizations; environmental, fish, and wildlife agencies; and qualified professional consultants** in co-operative efforts to assemble and evaluate ESA studies and review Development Approval Information. This can involve workshops, open houses, advisory groups, or other participation approaches to gather local knowledge and information.

[103] Deagle 1995

Regional Growth Strategies

*See **Local Government Act** Part 25 for more information*

Regional growth strategies are a regional planning mechanism available to regional districts. A regional growth strategy is a regional vision and broad policy statement that commits affected municipalities and regional districts to a course of action "to promote human settlement that is socially, economically and environmentally healthy and that makes efficient use of public facilities, land and other resources" (section 849, *Local Government Act*). It must contain social, economic, and environmental objectives in relation to the regional district, and can propose actions to meet the needs of projected populations for a variety of subjects, including parks and natural areas. The strategy must have a time horizon of 20 years.

A regional growth strategy is not mandatory. The strategy is initiated by a regional district and prepared through a broad consultative process specified in legislation. Prior to its enactment, it is referred to all affected local governments for acceptance.

Once a regional growth strategy has been enacted, municipalities must include a 'context statement' in their Official Community Plan (OCP) that describes the relationship of OCP policies to the strategy and identifies how they would be made consistent over time. The statement is prepared by the municipality and referred to the regional district for acceptance.

An implementation agreement is a partnership agreement between the regional district and the municipality and other orders of governments and their agencies and other bodies. These agreements detail how certain aspects of the strategy will be put into practice. For example, an implementation agreement may address the construction and funding of new or upgraded highways, sewers, regional parks or hospitals.

Where regional district enacts an OCP for electoral areas within their boundaries, the OCP must be consistent with the regional growth strategy.

Through the regional growth strategy process, regional districts can establish a leadership role in conservation of sensitive ecosystems by identifying and establishing conservation policies for them.

Official Community Plans

*See **Local Government Act** sections 875-884 for more information.*

The Official Community Plan (OCP) provides overall policy direction for the local government and establishes the basis for its regulations and development approvals. OCPs may include goals and policies that define the local government's intention to protect and conserve sensitive ecosystems.

*See **Local Government Act**, section 876(3).*

Local governments are required to consider any applicable policy guidelines when developing an OCP. Such guidelines could address sensitive ecosystems.

Municipalities are expected to include regional context statements that identify the relationship between the OCP and the mandatory content of the regional growth strategy of the regional district in which the municipality is located. The statement must also indicate how the OCP will be made consistent with the regional growth strategy over time. Regional growth strategies may include policies related to sensitive ecosystems.

See ***Local Government Act,*** *Part 25.*

For local governments who intend to conserve and protect sensitive ecosystems, the following policies are suggested as models (*see* sidebar) that could be incorporated in OCPs. The common policies suggested below are relevant to all sensitive ecosystems unless otherwise noted. Additional policies specific to individual ecosystems are also presented.

Using suggested policies in developing Official Community Plans

Actual legal documents would need to be customized to reflect local practices and conditions. Readers should seek legal advice when preparing new legal documents or bylaws, or when interpreting existing ones.

Suggested Policies for all Sensitive Ecosystems

- Recognize the importance of sensitive ecosystems as a part of the natural environment and biological diversity of the community, and an important component of the open green space and natural features of the community.

- Promote preservation of sensitive ecosystem areas and their living resources in a natural condition and maintain these areas free of development and human activity to the maximum extent possible.

- Promote priority acquisition and preservation of sensitive ecosystem sites as protected areas, where possible, with strict 'no access' and 'no disturbance' bylaws for especially sensitive zones.

- Develop a local government-led ecosystems plan, with the assistance of government, non-government environmental agencies and the public, that considers the following recommendations:
  - uses ecosystem, habitat, and environmental inventories developed by environmental agencies such as the Ministry of Sustainable Resource Management, Ministry of Water, Land and Air Protection, Canadian Wildlife Service, Fisheries and Oceans Canada, and any inventories collected by other groups using approved government inventory standards.
  - identifies a network of ecosystems that exist within the larger landscape;
  - identifies isolated ecosystems and establishes or enhances corridors, connections, and linkages with larger ecosystem networks; and

- promotes connectivity between, and discourages fragmentation of, contiguous ecosystems and ecosystem components to preserve landscape diversity, and allow wildlife use, movement, and dispersal.

*See **Local Government Act,** section 878.*

- Establish goals, objectives, and policies related to the preservation, protection, restoration, and enhancement of sensitive ecosystems and their natural environments and biological diversity.

- Develop policies, bylaws, plans, and procedures for preserving, protecting, restoring, and enhancing these ecosystems, while not rendering private parcels as unusable and subject to compensation.

*See **Local Government Act,** sections 919.1 and 920.*

- Designate ESAs identified for sensitive ecosystems as Development Permit Areas (DPAs) in the OCP using information in this report and provide guidelines for development or land use changes in these areas.

- Discourage development and other activities that are not compatible with the preservation, protection, restoration, and enhancement of sensitive ecosystems in DPAs, including land uses and the location of roads and utility corridors.

- Design roads and utilities with environmental sensitivity and at a landscape scale to minimize impacts to ESAs.

*See **Local Government Act,** section 920.01.*

- Designate sensitive and other important ecosystem DPAs as areas for which Development Approval Information may be required. Provide technical advice and staff assistance to landowners to become involved in stewardship initiatives such as appropriate restoration and enhancement, and registering conservation covenants.

See Environmental Objectives, Best Management Practices and Requirements for Land Development[104].

- Maintain appropriate buffers, determined by suitably qualified professionals, around sensitive ecosystem areas that take into account processes of natural erosion, deposition and movement of natural boundaries (*see* sidebar).

- Protect SEI ecosystems from invasion of introduced species.

- Manage recreational access into ecosystems to minimize impacts especially during wildlife nesting seasons.

[104] Ministry of Environment, Lands and Parks 2000

Additional Policy Suggestions for Wetland Ecosystems

- Investigate and consider the overall hydrology affecting the ecology of wetland ecosystems, and ensure local government land use plans maintain natural surface, groundwater and nutrient regimes to support existing wetland hydrology and ecological processes.

- Protect water quality from pollutants, sedimentation or altered nutrient loading.

- Seek to acquire and conserve important wetland ecosystems as open green space and parkland.

Additional Policy Suggestions for Riparian Ecosystems

- Protect water quality from pollutants, sedimentation or altered nutrient loading.

- Maintain continuous riparian corridors of sufficient width to protect fish and wildlife habitat and accommodate the dynamic nature of the hydrologic system, and reduce the need for channel stabilization and flood controls.

- Avoid locating road and utility corridors along, parallel to, or across riparian ecosystems in order to maintain unconstrained natural connections for wildlife to surrounding upland ecosystems. Where crossings are necessary, bridges are recommended to minimize disturbance of soil and vegetation and to provide a wildlife corridor below. Roads should be narrow and placed perpendicular to the riparian ecosystem. Roads should be set back from the riparian ecosystem to ensure that both the riparian vegetation and bank stability are maintained.

Additional Policy Suggestions for Old Forest Ecosystems

- Work with private forest landowners to encourage the development of appropriate forest management plans for logging activities which identify, where possible, approaches that reduce forest ingrowth and fuels and sustain the structure and composition of old forest ecosystems. This suggestion and the following suggestions are not applicable to Managed

Forest Land identified under the *Assessment Act* subject to the *Private Land Forest Practices Regulation*.

- Work with private forest landowners to provide adequate buffers between old forests and developed areas to avoid demands to remove or top "hazard" trees.

- Work with private forest landowners to discourage site clearing, urban development, and road and utility construction within old forest ecosystem areas, especially where such development fragments forest areas into smaller patches.

- Seek to acquire and conserve important old forest ecosystems as open green space and parkland.

Additional Policy Suggestions for Grassland Ecosystems

- Recognize the extremely sensitive and vulnerable nature of this ecosystem to almost any human disturbance.

- Work with private grassland landowners to discourage site clearing, urban development, and road and utility construction within grassland ecosystem areas, especially where such development fragments grassland areas into smaller patches.

- Manage recreational access into ecosystems to minimize impacts.

- Seek to acquire and conserve important grassland ecosystems as open green space and parkland.

Additional Policy Suggestions for Broadleaf Woodland Ecosystems

- Work with private forest landowners to discourage site clearing, urban development, and road and utility construction within broadleaf woodland ecosystem areas, especially where such development fragments broadleaf woodland areas into smaller patches.

- Investigate and consider the overall hydrology affecting the ecology of broadleaf woodland ecosystems, and ensure local government land use plans maintain natural surface and groundwater regimes.

- Seek to acquire and conserve important broadleaf woodland ecosystems as open green space and parkland.

Additional Policy Suggestions for Coniferous Woodland Ecosystems

- Work with landowners to retain patches of natural forest in addition to open meadow areas with isolated trees.

- Work with private forest landowners to discourage site clearing, urban development, and road and utility construction within coniferous woodland ecosystem areas, especially where such development fragments coniferous woodland areas into smaller patches.

Additional Policy Suggestions for Sparsely Vegetated Ecosystems

- Recognize the extremely sensitive and vulnerable nature of this ecosystem to almost any human disturbance.

- Manage recreational access into ecosystems to minimize impacts especially during wildlife nesting seasons for cliff-dwelling species.

Development Permits

Local governments may use Development Permits to establish special requirements that apply to development or redevelopment, including the preservation, protection, restoration and enhancement of the natural environment, its ecosystems, and biological diversity. Development Permits are one of the most important tools available to a local government for protecting sensitive ecosystems.

*See **Local Government Act,** sections 919.1 and 920 for more information.*

The following guidelines are suggested as models (*see* sidebar) for inclusion in Development Permits and, unless noted, apply to most sensitive ecosystem categories. Additional provisions are suggested for specific ecosystems.

Development Permits are not generally developed for application to, nor are applicable to, Managed Forest Land as identified under the *Assessment Act* and subject to the Private Land Forest Practices Regulation or to lands within the Agricultural Land Reserve. Therefore ecosystems such as grasslands within the Agricultural Land Reserve and old forest, and mature forest within Managed Forest Land are not managed or protected using development permits. Development Permit guidelines may be specified in the OCP or in the zoning bylaw, as provided in section 919.1 of the *Local Government Act*.

Using suggested guidelines in creating Development Permits
Actual legal documents would need to be customized to reflect local practices and conditions. Readers should seek legal advice when preparing new legal documents or bylaws, or when interpreting existing ones.

Suggested Guidelines for all Sensitive Ecosystems

*See **Local Government Act,** section 919.1.*

- Designate sensitive ecosystems as Development Permit Areas as provided in section 919.1(1)(a) of the *Local Government Act*. Include sufficient contiguous developable land areas within Development Permit Areas to enable sensitive planning of development that might impact on sensitive ecosystems.

- Designate portions of sensitive ecosystems prone to hazardous conditions as Development Permit Areas as provided in section 919.1(1) (b) of the *Local Government Act*.

- Identify evidence that the sensitive ecosystems require protection as required in section 919.1(2) of the *Local Government Act*. This report provides at least partial information related to special conditions and objectives justifying the designation of sensitive ecosystems.

- Require that a Development Permit be required prior to subdivision; start of construction of, addition to or alteration of a building or structure; or alteration of land including disturbance of vegetation, soil deposit or removal, or any other development or activity that would disturb sensitive ecosystems within DPAs.

- Require that development in less sensitive portions of the DPA be planned, designed, and implemented in a manner that will not adversely affect or disturb the sensitive ecosystems. This should be tailored to site-specific conditions, including:
  - vegetation, trees, snags, and root systems;
  - rare and uncommon species and natural plant communities;
  - soils and soil conditions;
  - terrain features such as rock; and
  - birds and other wildlife and their habitats, such as nesting and breeding areas.

- Avoid creating access such as trails to sensitive ecosystems that could be adversely impacted by human activity.

- Encourage application of density bonusing, cluster housing, relaxation of servicing requirements (such as street widths), density transfers, or other innovative planning tools to achieve attractive development designs while protecting sensitive ecosystems.

- Require that Development Approval Information be prepared by qualified environmental professionals, to include as a minimum:
  - a topographic survey with an appropriate contour interval;
  - an inventory of natural biophysical features including soils, trees, vegetation, water bodies, watercourses, wetlands, wildlife species, ecological processes, and other ecosystem components (*see* sidebar);
  - identification of populations, habitats, or natural features supporting rare, threatened, and endangered species. Information from wildlife habitat maps can be used to help guide inventories[105];
  - identification and confirmation of the boundaries of sensitive and other important ecosystem ESAs;
  - description of site development plans and operations; and
  - assessment of the potential environmental effects of activities and developments proposed for the site on sensitive and important ecosystems and watercourses.

The Ministry of Water, Land and Air Protection prepared general terms of reference for these types of studies (see Appendix B). See also Environmental Impact Assessment guidelines on page 34.

- Require that an environmental site plan be prepared by qualified environmental professionals[106], as an integral part of a Development Permit for any Development Permit Area that includes or abuts a sensitive ecosystem, to ensure that the development does not create offsite effects that adversely affect that ecosystem. The site plan should:
  - include details of specific provisions that will be implemented to pre serve, protect, restore, and enhance the natural environment, ecosystems, and biological diversity of sensitive ecosystems within the DPA. This should include provisions to maintain connectivity between adjacent SEI ecosystems and other important habitats;
  - include provisions to maintain connectivity between adjacent SEI ecosystems and other important habitats, and be consistent with landscape level initiatives where these are available;
  - specify terms and conditions regulating any activities that may potentially adversely affect or disturb species, vegetation, soils, watercourses, natural features, or ecological processes of sensitive ecosystems within the DPA, where such disturbance is unavoidable;
  - define measures for professional environmental supervision, inspection, and monitoring of development activities and related environmental effects on sensitive ecosystems occurring during and after development, including the environmental consequences of any contravention of a condition of the Development Permit and proposed measures for mitigation of these consequences; and
  - conform to all municipal bylaws, federal and provincial legislation, regulations, and standards.

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[105] *See* Volume 3 (Sarell et al. 2003)

[106] Qualified professional personnel should include, at minimum, a Registered Professional Biologist with extensive experience with the ecosystems and wildlife species of the Okanagan.

- Require that all areas within sensitive ecosystems DPAs remain free of development, except for areas identified as suitable for development in an approved Development Permit and associated environmental site plan.

- Require that sensitive ecosystems be preserved, protected, restored, or enhanced in accordance with conditions in the development permit.

- Require that sensitive ecosystems that have been disturbed prior to an application for a development permit be restored or enhanced to a natural condition as a requirement of a development permit.

- Include provisions in development permits requiring that any works for preserving, protecting, restoring, or enhancing sensitive ecosystems be maintained and repaired as necessary to continue to perform their intended function over time.

See Environmental Objectives, Best Management Practices and Requirements for Land Development[107]

- Promote and maintain natural buffers adjacent to sensitive ecosystem areas, where possible, that:
  - recognize natural processes and changing natural boundaries;
  - insulate the ecosystem from uses that would cause adverse effects;
  - avoid disturbance and removal of native vegetation by people;
  - emphasize native vegetation species compatible with the ecosystem;
  - deter spreading invasive species into the ecosystem;
  - deter grazing by livestock in sensitive ecosystem areas;
  - deter predation and disturbance of wildlife by pets and domestic animals in sensitive and other important ecosystem areas; and
  - maintain wildlife corridors and other corridors between the sensitive ecosystem and nearby wildlife habitat patches.

- Maintain connectivity and linkages with adjacent sensitive ecosystems and other habitat areas through the use of corridors and greenways to minimize fragmentation.

- Where the development site contains or is adjacent to a natural water course, require that the developer do the following:
  - dedicate, where possible, the watercourse and continuous riparian corridors of sufficient width to protect fish and wildlife habitat and accommodate the dynamic nature of the hydrologic system, to reduce the need for channel stabilization and flood controls;
  - prevent access to the watercourse by construction activities, except as approved by appropriate government agencies;

[107] Ministry of Environment, Lands and Parks 2000

- ensure that the flow of the watercourse is not polluted by sediment or toxic materials, or obstructed or impeded, whether or not the watercourse is located on private property;
- preserve and restore the watercourse to natural condition, including the planting and retaining of vegetation and trees, in order to preserve, protect, restore, or enhance fish habitat or riparian areas, control drainage, or control erosion or protect banks; and
- comply with provisions of the *BC Water Act, Canada Fisheries Act* and *BC Fish Protection Act*.

- Design and implement appropriate sediment and erosion control measures to protect sensitive ecosystems from silt smothering low plant growth where land disturbance is planned or likely to occur.

- Where utilities, servicing, and infrastructure are required near sensitive ecosystems, the following recommendations apply:
  - avoid locating these works within ESAs and associated buffers;
  - permit their location within ESAs and associated buffers only where the installation is necessary, such as essential public roads, utilities, public works, pathways and creek or ecosystem restoration or protection measures or there is no other physical alternative, in the determination of the local government, except to locate within an ESA;
  - require construction to be managed to avoid adverse effects on sensitive and important ecosystem functions and condition;
  - require installations to be located and designed so that sensitive and important ecosystems can be maintained when adjacent lands are developed; and
  - require that any disturbed sensitive ecosystems be restored and enhanced to maintain, at minimum, the previously existing natural conditions and functions of the sensitive ecosystem.

- Encourage the use of only native plant species where development occurs within or adjacent to a sensitive ecosystem and discourage use of invasive plant species that could supplant native species.

- Create and implement a plan, where necessary, to control the introduction or spread of invasive plant species. Disturbed sites should be planted with appropriate native species. Consult qualified professionals, the BC Ministry of Agriculture, Fish and Food, or the BC Ministry of Forests for recommendations on controlling invasive plant species.

- Require that development activities not be implemented in areas that would disturb wildlife during spring nesting and breeding seasons. Ensure that wildlife agencies are consulted as necessary to determine the best times and practices for development. Avoid activities adjacent to ESAs and areas where endangered species or nesting sites are known to occur.

- Minimize human activities within sensitive and important ecosystems that disturb wildlife, compact or expose soils, or damage native vegetation, such as intensive recreation and intensive livestock grazing. Where such activities are unavoidable favour designs that minimize road and other public access to sensitive and important ecosystems, and do the following:
  - develop and implement Best Management Practices or guidelines to avoid impacts, including prescriptions for managing human activities and uses;
  - provide information to landowners on the sensitivity of the ecosystems and the types of activities that adversely affect these ecosystems;
  - develop and provide opportunities for public education; and
  - install appropriately-designed fencing, rails, pathways, elevated board walks, signage, and access controls, where necessary and ensure that they do not impede wildlife access between the sensitive ecosystem and adjacent habitat areas.

- Trails and other crossings are not recommended within ESAs or sensitive ecosystems. Where appropriate, they should be designed and constructed consistent with the *Access near Aquatic Areas Stewardship Guidebook*[108]. Any access intrusions should be designed using environmentally sensitive approaches and aligned to do the following:
  - provide the least intrusive and disruptive route to viewing areas;
  - avoid areas with high soil compaction or erosion potential;
  - avoid rare natural plant communities or rare plant species; and
  - prevent intrusion into wet areas including seepage sites and wetlands.

[108] *See* Appendix A: Stewardship Series

Additional Guideline Suggestions for Wetland Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect, disturb, or fragment wetland ecosystems including the following:
  - wetland vegetation and structure;
  - rare or uncommon animals, wetland plants or plant communities;
  - wildlife habitats such as breeding and nesting sites; and
  - soils, and soil conditions.

- Require proponents to enlist the assistance of suitably qualified professionals to calculate baseline flow regimes, where possible, as part of an integrated stormwater management strategy at a watershed level to determine optimum water levels.

- Avoid trail, fencing, or landscape materials that would adversely affect wetlands, such as limestone, bark mulch, and preserved wood.

- Maintain the natural groundwater and surface water hydrologic systems that supports the wetland's ecological processes by doing the following:
  - retain professional biological and hydrologic services to advise on treatment of hydrology in the environmental site plan;
  - maintain existing volumes, flows, and timing of stormwater drainage, except where alterations restore or enhance natural regimes;
  - maintain existing volumes, timing, and rates of stormwater i filtration or recharge to groundwater systems, except where alterations restore or enhance natural regimes;
  - minimize the extent of impervious area covering groundwater infiltration areas and storm runoff associated with the wetland, and use effective porous pavements such as "grasscrete", exfiltration galleries, or other techniques to compensate for loss of pervious surfaces;
  - maintain natural ecological processes that support the wetlands including winter flooding, seasonal drawdown, beaver activity, sediment accretion, and groundwater recharge and discharge;
  - protect water quality from pollutants and sedimentation, including nutrient rich urban stormwater which includes heavy metals, pesticides, and fecal coloforms etc., agricultural runoff, and septic field drainage; and
  - avoid ditching and drainage works within the hydrologic zone of the wetland.

Additional Guideline Suggestions for Riparian Ecosystems

Identify and establish streamside protection and enhancement areas according to criteria established in the Streamside Protection Regulation.

Where there is potential to provide greater riparian and watercourse protection than with standard setbacks, consider development permit provisions by doing the following:

- averaging the width of setbacks across the lot or lots to achieve the required area of protection; and
- requiring protection, restoration, or enhancement of watercourse environments on the development site if possible, or if this is not possible, elsewhere within the catchment area of the watercourse.

Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb riparian ecosystems, including the following:

- natural processes related to disturbance events and ecological succession, such as natural flow regimes of streams, seasonal flooding, stream channel movement, senescence of seral species, windthrow or blow-down of trees, and natural slope failures;
- trees, understory plants, and other vegetation within the riparian ecosystem area;
- nesting and denning sites;
- standing dead and dying trees, snags, fallen trees, downed logs, and similar forest features within riparian ecosystem area; and
- natural corridors and connectivity of riparian species and habitats with upland ecosystems.

- Require protection measures where necessary, including planting or retention of trees and shrubs, in order to preserve, protect, restore or enhance fish habitat or riparian areas; control drainage; or control erosion or protect banks in accordance with the terms of a development permit.

- Minimize windthrow, susceptibility to invasive species, and loss of interior, non-edge habitats by maintaining the following:
  - riparian corridors as wide as practical with buffers of trees well rooted in deep soil; and
  - wildlife corridors between the riparian and nearby upland ecosystem patches.

- Ensure that trees in the buffer areas are given stabilization treatments as necessary, under the supervision of a suitably qualified professional, to ensure a windfirm edge, such as feathering, sail pruning, topping, and removal of unsound trees. Ensure that trees in windward edge are located in deep soils and well-rooted, where possible. Use an ISA certified arborist to assess trees before topping or pruning. Plant restored areas adjacent to urban areas with windfirm species.

- Avoid removal of snags and downed logs for fire wood or any other purpose.

Additional Guideline Suggestions for Grassland Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb grassland ecosystems including the following:
  - grasses, forbs, shrubs, bryophytes, trees, snags, and root systems;
  - rare and uncommon species and communities;
  - terrain features such as rock and especially soils and soil conditions; and
  - birds and other wildlife and their habitats, such as nesting and breeding areas, microhabitats and habitat niches characteristic of this ecosystem.

Additional Guideline Suggestions for Broadleaf Woodland Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb broadhleaf woodland ecosystems, including the following:
  - the root systems of large old trees;
  - the removal of small diameter trees;
  - shrub, herb, grass, moss, and lichen understory species;
  - standing dead and dying trees and snags;
  - soil conditions;
  - ground or surface water drainage regimes; and
  - nesting and denning sites.

- Require that a tree management plan be prepared by a suitably qualified professional as part of the environmental site plan that would locate and design windward edges of forest stands to minimize windthrow potential

including the following recommendations:

- cut unsound trees only where these are a hazard to the public and leave the downed tree onsite;
- replace trees or other significant vegetation that are unavoidably or accidentally lost as part of land development with plants appropriate to the ecosystem, with preference for replacement by plants salvaged from disturbed areas of the site; and
- provide for appropriate management to sustain these ecosystems and deter invasive species in consultation with biologists or environmental management agencies.

- Encourage site plans that locate buildings, infrastructure, other development an adequate distance away from core deciduous woodland areas in order to maintain tree and forest health.

Additional Guideline Suggestions for Coniferous Woodland Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb coniferous woodland ecosystems, including the following:
  - the root systems of large-diameter trees;
  - the removal of small diameter trees;
  - shrub, herb, grass, moss, and lichen understory species;
  - standing dead and dying trees, and snags;
  - soil conditions; and
  - hibernacula, nesting, and denning sites.

- Require that a tree management plan be prepared by a suitably qualified professional as part of the environmental site plan that would reduce and minimize forest ingrowth with the following considerations:
  - remove large, old, unsound trees only where these are a hazard to the public;
  - replace significant vegetation that are unavoidably or accidentally lost as part of land development with native plants appropriate to the ecosystem, with preference for replacement by plants salvaged from disturbed areas of the site;
  - provide for appropriate management to sustain these ecosystems and deter invasive species in consultation with biologists or environmental management agencies; and
  - consider approaches for maintaining natural disturbance regimes, and implement such approaches where feasible and appropriate.

- Encourage site plans that locate buildings, infrastructure, other development an adequate distance away from core coniferous woodland areas in order to maintain tree and forest health.

Additional Guideline Suggestions for Sparsely Vegetated Ecosystems

- Require that land development activities be planned, designed, and implemented in a manner that will not adversely affect or disturb sparsely vegetated ecosystems, including the following:
  - the root systems of trees, tree density, tree canopy, tree health, or stand age structure;
  - shrub, herb, grass, moss, and lichen understory species;
  - standing dead and dying trees, fallen trees, snags and downed logs;
  - soil conditions;
  - ground or surface water drainage regimes; and
  - hibernacula, nesting, and denning sites.

- Require that a tree management plan be prepared by a suitably qualified professional as part of the environmental site plan that would locate and design windward edges of forest stands to minimize windthrow potential and includes the following recommendations:
  - remove unsound trees only where these are a hazard to the public;
  - replace trees or other significant vegetation that are unavoidably or accidentally lost as part of land development with native plants appropriate to the ecosystem, with preference for replacement by plants salvaged from disturbed areas of the site; and
  - provide for appropriate management to sustain these ecosystems and deter invasive species in consultation with biologists or environmental management agencies.

- Encourage site plans that locate buildings, infrastructure, other development an adequate distance away from core sparsely vegetated ecosystems.

Recommendations for Other Important Ecosystems

Mature Forest Ecosystems

Mature forest ecosystems are most effective as buffers around sensitive ecosystems. They also provide green space and wildlife habitat in urban areas, contribute to biodiversity and provide recruitment for old forests. Local governments who intend to conserve and protect this ecosystem on land within their authority and on non-Managed Forest Land subject to the Private Land Forest Practices Regulation should, where practical, and in co-operation with landowners:

- Encourage the maintenance of mature forests at historical densities with reduced fuels and forest ingrowth.

- Promote the retention of mature forests as buffers around sensitive ecosystems.

- Encourage measures to minimize fragmentation of mature forests by large-scale developments, roads, and other linear developments, and clearcutting.

- Require where practical, Development Approval Information that does the following:
  - provides an evaluation of the forest condition and forestry and wildlife habitat potential of mature forest ecosystem areas;
  - identifies rare, threatened, and endangered species and their populations; and
  - identifies the habitats and natural features supporting rare, threatened, and endangered species and their populations, such as patches of rare plants, nesting trees or snags.

- Require, where practical, as a component of the environmental site plan, development of a forestry management plan that does the following:
  - sustains the mature forest ecosystem through appropriate conservation-oriented forest management practices after development, where feasible;
  - protects rare, threatened, and endangered species and their populations, including their supporting species, habitats, or natural features;
  - conserves large-diameter live, standing dead, dying trees, and snags; and

- reduces fuels and forest ingrowth including the removal of small-diameter trees.

Disturbed Grassland Ecosystems

With the historical loss of grassland ecosystems, disturbed grassland ecosystems provide many of the habitat values associated with grasslands for wildlife and provide potential to recruit more grasslands through restoration or changed management regimes. Local governments who intend to conserve and protect these disturbed grasslands should, where practical, and in co-operation with landowners:

- Support the retention of grasslands in the Agricultural Land Reserve, emphasized through agricultural zoning, and by restricting urban encroachment.

- Encourage, where practical and in co-operation with the landowner, as a component of the environmental site plan, a management plan that would achieve the following after development, where possible:
  - conserves the use of these disturbed grasslands as well-managed grazing areas;
  - maintains associated wildlife habitat;
  - encourages innovative conservation range management practices and voluntary stewardship programs for maintaining productive ranchland while conserving valuable bird and wildlife habitat;
  - conserves adjacent supporting habitats, such as adjacent riparian areas, woodlands, grasslands, and other habitats;
  - maintains connectivity between disturbed grasslands and adjacent supporting habitats; and
  - minimises intrusion of people into ranch and wildlife habitat areas.

Zoning

Zoning bylaws[109] regulate how land is developed and used (*see* sidebar). Innovative zoning provisions can provide significant protection to environmentally sensitive resources. Where appropriate, local governments can:

See ***Local Government Act,*** *sections 903-904*

- Review boundaries for zones established under section 903(1)(a) of the *Local Government Act*. Ensure that zoning boundaries recognize sensitive ecosystems where possible.

[109] Stream stewardship guides are an excellent resource for language that can be used in regulatory bylaws, particularly zoning bylaws.

- Define sensitive ecosystems as a "siting circumstance" as contemplated in the *Local Government Act,* section 903(3)(e). This provision can be applied where the location of sensitive ecosystems may not be precisely defined but can be described in relation to the characteristics of the resources on site[110]. This is particularly useful for imprecise, evolving, and ambulatory resources such as a stream corridor or ecosystem. The siting circumstance provision would allow zoning regulations to be defined and applied for parcels near sensitive ecosystems. Caution should be exercised to avoid vagueness or uncertainty in defining 'siting circumstance'. Development permit provisions may provide more flexibility.

- Review permitted uses in zones near locations and boundaries of sensitive ecosystems. Amend bylaws to prohibit or regulate uses that would have adverse impacts on sensitive ecosystems.

- Review regulations for density, lot size, and site coverage for zones near locations and boundaries of sensitive ecosystems. Amend bylaws to ensure that these regulations are compatible with conservation requirements for sensitive ecosystems.

- Review regulations for siting, size, and dimensions of uses and buildings for zones near locations and boundaries of sensitive ecosystems. Amend bylaws to ensure that these regulations are compatible with conservation requirements for sensitive ecosystems. Establish setback provisions for siting buildings, structures and other development to protect sensitive ecosystems from development. Note that setbacks under section 903 of *Local Government Act* are subject to variance by the Board of Variance under sections 899 to 902.

- Ensure that zoning categories allow parcel sizes and dimensions that will enable the establishment of appropriate setbacks and leave areas in the event of future rezoning or subdivision. This should ensure that, after subdivision, uses permitted under existing zoning can be accommodated in the lot area of each lot exclusive of any portion of the parcel that are deemed environmentally sensitive.

- Create density bonusing zones for residential areas adjacent to ESAs to allow developers to apply for an increase in density in exchange for the conservation of a specified amenity, such as the preservation of substantial area of a development site as a protected ESA. This allows developers to preserve sensitive ecosystems in return for designs that increase

[110] Buhlozer 2001

density in nonsensitive portions of the site. Density bonusing often requires complex, site-specific planning analyses. Municipalities frequently use development agreements and zoning amendments to effect density bonuses[111].

*See **Local Government Act,** section 904.*

Cluster developments provide opportunities to maintain housing densities while allowing opportunities to protect sensitive ecosystems. Density bonuses can provide an incentive to promote cluster developments and protect sensitive ecosystems.

- Create cluster housing zones for residential areas adjacent to ESAs to allow a tighter grouping of houses or multiple-unit buildings on the most buildable portions of a building site in exchange for retaining a large portion of the land, such as an ESA, in a natural state. Lot averaging provisions within zoning categories can permit subdivision to a variety of lot sizes, thus allowing development to be concentrated in non-environmentally sensitive areas. Including sensitive areas in density calculations can provide an additional incentive to cluster development.

- Encourage the use of bare land strata subdivisions for residential areas adjacent to ESAs to promote cluster housing with protection of sensitive site areas as common open space.

*See **Strata Property Act.***

- Ensure sensitive areas (including those in common land portions of bare land strata subdivisions) are protected from future development by conservation covenants in the name of the regional district, municipality, and/or non-government environmental or conservation organizations (*see* sidebar).

See Conservation Covenants, page 149 for more information.

- Use comprehensive development zones for complex sites in urban development areas to enable careful site planning for conservation of sensitive ecosystems.

- Continue to implement the flood plain setbacks and regulations under Section 910 of the *Local Government Act*.

Subdivision Approvals

Subdivisions are examined under the *Land Title Act* by a *subdivision approving officer,* appointed by the Attorney General. Approving officers within municipalities are municipal employees. Outside municipalities, approving officers may be employees of a regional district, or of the Ministry of Transportation where regional districts have not been granted subdivision approval authority. Subdivision approval provisions require an approving officer to ensure that subdivisions conform to local government bylaws such as zoning and subdivision servicing bylaws. However, approving officers have substantial independent authority to determine the public interest and specify

[111] Buhlozer 2001

requirements for subdivisions. The *Land Title Act* enables the approving officer to:

- Use the "protecting the public interest" provisions in the *Land Title Act* to conserve sensitive and important ecosystems within the subdivision approval process. In this situation, a subdivision approving officer may refuse to approve a subdivision if s/he considers it to be against the public interest. Case law is extensive with regard to 'public interests', which helps define the scope of this authority. Provincial agencies may review subdivision referrals and develop general or site specific environmental or conservation recommendations to subdivision approving authorities.

- Make provision, where possible, for retention of sensitive ecosystems in public ownership as part of neighbourhood and subdivision designs.
  - Seek a dedication during subdivision for park or public open space in order to acquire lands within ESAs, where possible, and in accordance with section 941 of the *Local Government Act*.
  - Consider, where appropriate, the use of road and water body access dedication requirements for provision of stream and wildlife corridors.

- Where acquisition or dedication is not appropriate or possible, seek the registration of a covenant on land titles to preserve ESAs. Covenants can be used to require environmental protection measures such as retaining vegetation, keeping sensitive areas free of development and in a natural condition, and installing fencing to restrict access. Covenants can be in favour of the local government, senior government agency, land trust and/or a conservation organization. Covenants must be enforced to be effective.

Subdivision Servicing Bylaws

Subdivision servicing bylaws are established under sections 938-946 of the *Local Government Act*. These bylaws set standards and make requirements for the provision of services, such as access (roads, sidewalks, trails, transit stops), water, sewer, and storm drainage systems. To protect sensitive and other important ecosystems, subdivision servicing bylaws may:

- Develop Best Management Practices and guidelines, and incorporate these into engineering, servicing, construction standards and requirements, as well as operational procedures to ensure these are compatible

with the preservation, protection, restoration, and enhancement of sensitive and important ecosystems. Important functions include stormwater management, stream protection, vegetation management, and erosion and sedimentation control.

- Require that all public works, including road, utility and park construction be conducted in a manner that is consistent with environmental protection of ESAs.

Stream and Drainage Policies and Bylaws

The *Local Government Act* provides significant powers to local governments to enact stream and drainage policies and bylaws that may assist in the protection of environmentally sensitive and important ecosystems. A liquid waste management plan under the *Waste Management Act* may also be used to implement some stormwater management policies and proposed management practices. Some of these drainage system powers may require additional authority within electoral areas of regional districts. Some proposals are subject to the *BC Water Act* and *Canada Fisheries Act* regulations. Local governments can and are encouraged to

- Establish integrated stormwater drainage policies for drainage facilities and land development activities that do the following:
  - maintain the natural hydrology and natural environment of watersheds, groundwater, streams, and other water bodies, including provisions that would help ensure maintenance of minimum base stream flows; and
  - regulate development work within stream corridors.

- Enact or amend a watercourse protection bylaw pursuant to section 725.1 of the *Local Government Act* that restricts anyone from polluting or obstructing or impeding the flow of a stream, creek, waterway, watercourse, waterworks, ditch, drain, or sewer, and imposes penalties for contravention of the prohibition.

- Adopt an open streams policy that will limit the crossing, confinement, covering, or piping of watercourses.

- Identify and establish a program to remove obstacles impeding movement of fish such as inappropriately designed culverts and stream crossings.

- Identify "lost streams" that have been covered by culverts or other covers, and consider "day-lighting" these lost streams where practical and feasible.

- Enact or amend a runoff control bylaw for areas abutting or adjacent to ESAs, pursuant to section 907 of the *Local Government Act,* to do the following:
  - establish a maximum percentage of area that can be covered by impermeable material; and
  - establish standards for drainage works for the ongoing disposal of surface runoff and stormwater from paved areas and roof areas during and after construction to maintain natural runoff volumes and water quality[112].

- Enact or amend a parking bylaw to discourage location of parking areas in ESAs, and regulate surface treatments to avoid runoff impacts on sensitive and important ecosystems.

Tree and Landscaping Policies and Bylaws

The *Local Government Act* provides significant powers to local governments to enact tree and landscaping policies and bylaws that may assist in the protection of environmentally sensitive ecosystems. Local governments can and are encouraged to

See ***Local Government Act,*** *section 906.*

- Enact or amend a Tree Bylaw, pursuant to sections 708 to 715 of the *Local Government Act* (municipalities only), in order to do the following:
  - designate ESAs as areas for special tree cutting regulations, as contemplated in section 708;
  - define appropriate trees within ESAs as Significant Trees under the meaning of section 710, and require tree cutting permits for removal or pruning of these trees; and
  - where removal of a hazardous tree (*see Local Government Act,* section 711) is essential within an ESA, require special care to be exercised to minimize disturbance to surrounding vegetation, fish, and wildlife and their habitat.

[112] Stormwater Planning: A Guidebook for British Columbia. May 2002. BC Ministry of Water, Land and Air Protection. Nanaimo, B.C. available at: http://wlapwww.gov.bc.ca/epd/epdpa/mpp/stormwater/stormwater.pdf

- Enact or amend a landscaping bylaw under section 909 of the *Local Government Act* in order to do the following:
  - set standards for screening and landscaping for preserving, protecting, restoring, and enhancing the natural environment of sensitive and important ecosystems including reducing forest ingrowth and wildfire threat;
  - regulate the provision of landscaping including the planting of vegetation where necessary to conserve sensitive and important ecosystems; and
  - enforce regulations to ensure ongoing maintenance of landscaping for protecting sensitive and important ecosystems.

Soils Bylaws

The *Local Government Act* provides significant powers to local governments to enact soils policies and bylaws that may assist in the protection of environmentally sensitive ecosystems. Local governments can and are encouraged to:

- Enact or amend a soils bylaw pursuant to section 723 of the *Local Government Act* that does the following:
  - regulates soil removal and deposition, including site grading, in order to ensure that ESAs are protected and conserved during and after landdevelopment and redevelopment;
  - ensures that development plans near ESAs include and implement appropriate designs and procedures for control of erosion and sedimentation; and
  - where soil movement is approved within or near an ESA, require special care to be exercised to minimize disturbance to surrounding vegetation, wildlife and wildlife habitat.

This report provides guidance on screening and landscaping standards. The desired standard is the maintenance of the natural environments of sensitive and important ecosystems, including buffers to insulate them from human activities where applicable. (This bylaw may be a substitute for a tree bylaw in areas outside of municipalities where tree bylaws cannot be established except in relation to hazardous conditions.)

Animal Control Bylaws

Sections 703 to 707.1 of the *Local Government Act* empower local governments to enact bylaws for the regulation of animals. These bylaws may be used to control pets and livestock that could endanger wildlife or damage vegetation in ESAs and sensitive ecosystems. The local government may:

- Regulate or restrict the keeping of dogs, horses, cattle, sheep, goats, swine, rabbits, or other animals and define areas where they may or may not be kept. Defined areas could include ESAs and DPAs.

- Require dog owners to keep dogs on leash or under the control of a competent person while on a highway or public place (public place could include publicly owned ESAs and sensitive areas of public parks, stream corridors, and roadsides).

- Regulate or restrict the running of cattle on a highway or public place, the straying of or trespassing by cattle on a highway or public place or private property, or grazing of cattle on unfenced land, unless securely tethered. Private property could include sensitive areas such as ESAs and stream corridors.

Partnerships

Stewardship of the environment is everyone's responsibility. Local governments can build partnerships with other governments, nongovernment organizations, and the public by:

- Providing leadership for the development of a long term strategy to acquire priority ESAs, including the following:
  - acquiring and preserving ESAs as part of local parks programs;
  - identifying acquisition priorities in co-operation with nongovernment and government conservation organizations;
  - identifying priorities for protection through development permit, rezoning, subdivision, and other regulations; and
  - acquiring additional lands that focus and limit the spatial growth of communities and provide a natural landscape setting for a community.

- Establish intergovernmental partnerships with senior governments to facilitate a 'one-window" approach to planning and approvals. Coordination of regulations among the various levels of government would allow owners, developers and the public to deal with one contact point in government. This would speed approvals, reduce confusion and provide more effective enforcement.

- Adopt a bylaw under section 343.1 to 344 of the *Local Government Act* to exempt eligible riparian property from property taxes where a property is subject to a conservation covenant under section 219 of the *Land Title Act*. Providing information on property tax incentives for protecting riparian land through conservation covenants where this bylaw has been adopted.

- Direct landowners to sources of advice about federal tax benefits for ecological gifts.

- Implement stewardship awareness programs, in cooperation with senior governments, local conservation organizations, and schools, to increase public awareness and support for conservation of sensitive and important ecosystems and existing ESAs, and to promote active stewardship and restoration activities.

- Encourage individuals and community organizations to be involved in managing sensitive ecosystems, restoring and enhancing native habitats, planting native vegetation and appropriate trees and grasses, preventing erosion, establishing conservation covenants, promoting proper use and disposal of polluting chemicals, installing signs to inform and educate the public, monitoring misuse of sensitive ecosystems, and advocating conservation and protection of sensitive ecosystems. Initiating a landowner contact program, in concert with conservation organizations, can be an effective way of educating property owners about the ecological functions and sensitivity of their land.

- Encourage land developers to use environmentally sensitive site designs, construction procedures, and landscaping methods that avoid or minimize impacts on the functions and conditions of sensitive and important ecosystems.

- Endorse and support the efforts of community organizations, landowners, and others to identify, acquire, and protect sensitive and important ecosystems. Encouraging restoration and enhancement measures that are carried out under appropriate authority and guidelines.

- Encourage and educate pet owners to control pets that prey on or disturb birds, small mammals, or other species.

- Co-operate with provincial and federal government programs to protect sensitive and important ecosystems, and fish and wildlife habitat. Consider supplementing municipal environmental policies with environmental and sustainable development guidelines of federal, provincial, and regional government agencies.

18 What Landowners and Citizens Can Do

The real substance of conservation lies not in the physical projects of government, but in the mental processes of its citizens.

– Aldo Leopold

Local and senior government policies, legislation and their enforcement are just part of the equation when conserving sensitive ecosystems in the Central Okanagan. Implementing all the measures necessary to secure environmentally sensitive areas (ESA) protection is limited by the availability of public financial assistance and concerns by private property owners over regulation of their land. The voluntary efforts of landowners and citizens are therefore essential to the conservation and enhancement of sensitive and other important ecosystems. Described below are several conservation related initiatives that landowners and other citizens can undertake.

Learn about the Natural Environment

The value of education about environmentally sensitive areas cannot be emphasized strongly enough, as it is the foundation of all private land protection tools. For some sensitive ecosystems, education about its importance and conservation methods may be the only available means to secure some measure of its protection. Education also helps generate a constituency of concerned citizens and landowners who may then be motivated to secure the protection of a sensitive ecosystem through purchase or other legal mechanisms. Finally, education about the ESA is necessary for its successful long-term protection, as protection through a legal mechanism is only useful if it is respected. If it is not respected, then the legal tool may only be useful in determining the liability and damages to be awarded for the destruction of the ESA.

At the end of this report there are a number of references, such as the publications in the Stewardship Series, which are useful for expanding the understanding of ESAs.

Join or Create a Stewardship Organization, Land Trust or Advocacy Group

People may first learn about sensitive ecosystems or through the activities of a stewardship organization in their neighbourhood. Generally, stewardship organizations and land trusts are non-profit and frequently non-political organizations dedicated to protecting specific sites, specific species or habitat types,

or sensitive environmental areas in general. Advocacy groups are non-profit organizations generally established to raise awareness within government, industry and the public on conservation issues. All of these types of groups may range from very loose-knit "Friends of...." clubs to formal, registered charitable organizations.

Stewardship Organizations

Appendix B provides a list of government and non-government organizations active in the conservation of lands in the SEI study area. If there is not already a suitable organization in your area, a helpful publication from the Stewardship Series is Community Stewardship: A Guide to Establishing Your Own Group.[113]

Stewardship organizations include a broad spectrum of groups, both charitable and non-charitable, as well as formal and informal. Typically, stewardship organizations are involved in hands-on management, protection, rehabilitation or enhancement of habitat. Some stewardship organizations, such as The Land Conservancy, may also qualify as holders of conservation covenants on land. A conservation covenant is a voluntary, written legal agreement in which a landowner promises to protect his/her land in specified ways pursuant to Section 219 of the *Land Title Act*. Further discussion regarding conservation covenants is found later in this chapter.

Stewardship organizations raise public interest and awareness about significant local ESAs through a number of means: establishing festivals, e.g. the Meadow Lark Festival; distributing native plants; holding public information and educational forums; and conducting weed pulls, among other activities.

Senior governments have long recognized the important contribution of non-government stewardship organizations undertaking activities to enhance the environment. There are now federal, provincial and some local government grants to help support these organizations. Stewardship organizations are also seen as potential "eyes and ears" of government for reporting threats to habitat[114].

Land Trusts

Land Trusts are not "trusts" in the legal sense but they fulfill a form of public trust by holding an interest in land, or owning land and preserving it for future generations. Land trusts have been active in Great Britain and the United States for more than 100 years. In Canada, they are a more recent phenomenon, but have been growing rapidly, particularly in British Columbia[115].

To raise funds through charitable donations and become registered landowners, land trusts are required to meet more formal requirements than typical stewardship organizations. Nevertheless, how they achieve their objectives may vary depending on the resources, culture and experience of the land trust. The spectrum of activities of land trusts can be characterized by three active land trusts in southern interior British Columbia: The *Nature Trust of British*

[113] Fraser Basin Management Program 1995
[114] Dovetail Consultants Ltd. 1996
[115] *See* Appendix B for a list of land trusts and conservancies in the study area

Columbia, The Land Conservancy of British Columbia, and the *Central Okanagan Parks and Wildlife Trust*.

The rapidly expanding number of land trusts as well as the growing number of stewardship organizations engaged in land trust activities has prompted the establishment of an umbrella organization to share expertise and information to assist the activities of these organizations. The ***Land Trust Alliance of British Columbia*** had its formal inaugural convention in March 1998 and as part of the event provided a forum for a number of US and Canadian land trust and stewardship experts to make presentations.

- **The Nature Trust of British Columbia** was established by the federal government in 1971 as a charitable federal corporation with an endowment of $4.5 million to mark the centenary of British Columbia's entry into Confederation. Since that date, The Nature Trust has purchased or formed partnerships to purchase more than $26 million in protected land in British Columbia including a number of parcels and significant lands in the South Okanagan including the Vaseux and White Lake Biodiversity Ranches.

- **The Land Conservancy of British Columbia.** Otherwise known as TLC, The Land Conservancy of B.C. is a charitable membership-based land trust that protects natural areas. They acquire protective control of lands and waters through ownership of Title to Land, long-term leases, or conservation covenants. Presently TLC holds 40 conservation covenants and has approximately 30 more in negotiation. It also now owns over 6,000 acres and holds long term leases on an additional 76,000 acres, protecting a total of over 82,000 acres of environmentally sensitive lands throughout B.C.

The tools that land trusts use (*see* below for a discussion of tools) to protect ESAs vary according to the resources and culture of the organization. They also vary according to the following:

- the circumstances of the ESA: the type of landowner, e.g., institutional, private land or corporate ownership;

- the type of ESA values: pristine wilderness, older second growth forest;

- the location of the ESA: near high density urban development, low density agricultural land, etc.;

- the ESA land's current use (open space, farm, industrial surplus, etc.); and

- the potential for donor interest in the land.

Advocacy Groups

Stewardship organizations and land trusts are advocates for their causes but advocacy groups do not typically own land for conservation or carry out stewardship activities. Their focus is on raising awareness, raising funds and creating public opinion to encourage the protection of sensitive environmental areas.

Advocacy groups can raise concerns and argue the case for protection of environmentally sensitive areas where a senior or local government has the authority to protect the area on private land but has made a decision not to do so.

Advocacy groups fill an important niche in sensitive environmental area protection by allowing stewardship organizations and land trusts to pursue their activities, unaligned with one position or another in a contested land use debate. Traditionally, support for advocacy groups comes from a smaller spectrum of committed members and donors that support the mission and strategies adopted by the organization.

Participate in your Local Government

Making the significant commitment of running for a position in the local government may be a step very few people are willing to take. There are, however, many ways for landowners and citizens to participate in local government land use decision-making.

Speaking at Council meetings or public hearings, volunteering for appointment to a local government Environmental Advisory Committee or an Advisory Planning Commission, or offering expertise on an informal basis to these agencies, allow landowners and citizens to provide informed recommendations to Council on matters that are referred to the Committee or Commission.

Be a Good Steward of Your Own Land

Landowners can help protect ESAs by learning about the natural values of their own land, rehabilitating the landscape and protecting its natural values. Information on stewardship is available from groups and sources in Appendices A and B. A significant publication to assist landowners is the *Naturescape Series: Caring for Wildlife Habitat at Home*[116] .This publication includes ways to enhance wildlife habitat on small properties and even apartment balconies.

[116] Naturescape British Columbia 1995

Consider Legal Tools for the Long-term Protection of ESAs

Land trust or stewardship organizations may be able to help landowners establish longer term and more secure means of protecting environmentally sensitive areas on their land. Some examples of private legal tools for ESA protection include:

Land Management Agreements

Land management agreements are agreements between a primary land owner and an individual or organization that actually manages the land. They are for publicly owned land or for private lands where the landowner is prepared to allow the encouragement of wildlife and native vegetation but is not yet prepared to adopt more protective measures, such as a **conservation covenant,** that will restrict the uses of that land. A land management agreement does not necessarily have to be a contract.

Conservation Covenants

A conservation covenant is a voluntary, written agreement between a landowner and another person, or more typically, an organization, where the landowner undertakes to protect certain natural values of the land[118]. It provides stronger protection for an ESA than land management agreements because they give the organization an interest in the land that is registered in the Land Title Office and is binding on anyone who may own the land in the future.

Conservation covenants, known in other jurisdictions as conservation easements, have been used for more than a century to protect environmentally sensitive areas. Their chief advantage is that conservation objectives can be achieved, at significantly less cost, by limiting the use of land without eliminating all use of the land.

For a more detailed discussion of conservation covenants, see "Leaving a Living Legacy: Using Conservation Covenants in BC"[117].

A conservation covenant may provide tax advantages to the landowner. If it can be shown that registration of a conservation covenant has reduced the property value through the restrictions on its use (under the provisions of the *BC Assessment Act*), then the covenanting organization (if it is a registered charitable organization) may provide the landowner with a charitable receipt for the difference in the land value. The landowner has, in effect, made a

[117] Andrews and Loukidelis 1996 (*See* Appendix A: *StewardshipPublications*).

[118] *Land Title Act,* RSBC 1996 c. 250, section 219. Under the terms of the conservation covenant, the interest granted may allow public access or it may limit access to the organization for the sole purpose of monitoring of the covenant. Holders of conservation covenants must be preapproved by the Surveyor General of BC.

charitable donation that provides a tax credit to reduce the income tax payable by the landowner. This tax credit can be carried over tax years to prolong the impact of the gift[119].

Similarly, property taxes in British Columbia are based on the "actual value", typically the market value, of a parcel of land. If it can be demonstrated that the property value is reduced by the restrictions of a registered conservation covenant then the landowner will also have the benefit of reduced property taxes after the registration of the conservation covenant.

Under revisions to the *Local Government Act* adopted in 1997[120], there is also specific provision for the reduction of property taxes by councils and regional district boards for covenants established in eligible riparian areas. This, however, is at the discretion of local governments.

Conservation covenants require regular monitoring by covenant holders. A landowner that initiates a conservation covenant may dispose of the land to family members or sell to others who may have different views about the land's intended use. Threats to the ESA may require more frequent monitoring of the conservation covenant area to ensure the ESAs protection. A program of landowner contact and education is an important means of ensuring compliance with the objectives of the covenant without the organization having to resort to a costly court action for enforcement of the conservation covenant.

Land trusts and stewardship organizations (if designated by the Minister of Water, Land and Air Protection) are entitled to hold conservation covenants[121]. Holding covenants is less costly to the organizations than holding land but there are costs: surveying the land, drafting the covenant, registering it on title and monitoring the covenanted area to ensure compliance. Land trusts and stewardship organizations usually have priorities for habitats they want to protect.

Other Interests in Land

Land ownership in British Columbia is akin to owning a bundle of rights to use and occupy land. As a human invention, there are consequently many creative methods of granting rights that may also provide protection for an ESA.

Land law can be a complex area. Landowners may receive valuable information and assistance from land trusts, stewardship organizations or advocacy groups in sorting through the options available to them, but ultimately

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[119] The tax considerations and the structuring of charitable gifts of land and interests in land can be complex depending on the circumstances of the landowner and on the nature of the gift. Competent tax advice is essential in order for the landowner to see the greatest benefit from their generosity.

[120] *Local Government Act,* RSBC 1996, c.323, s.343.1 to s.344, effective October 31, 1997. The council or regional district board must also be a covenantee of the conservation covenant.

[121] *Land Title Act,* c. 250, section 219(3).

landowners must assume the responsibility for protecting their interests and realizing their wishes by seeking the advice of legal counsel. The intent in this section is therefore merely to alert the reader to the existence of other types of interests that may be granted by a landowner, short of granting land outright or providing a conservation covenant.

For example, a landowner may grant a life estate in the land to his or her children with the remainder given to a conservation organization. This means that the landowner gives the right to use and occupy the land to his or her children until their death. During their lifetime, the children are responsible for looking after the land and are restricted from diminishing the value of the land[122]. After the children's death, the conservation organization becomes the landowner.

Another illustration is the ability of a landowner to grant an interest to someone to enter the land and remove something from it. This right, called a ***profit à prendre***, was used in earlier times to provide security to someone to remove hay or harvest trees on a property. For conservation purposes, however, a landowner could grant a profit à prendre to a conservation organization so that the conservation organization has the sole right to remove the vegetation—something it will never exercise. The landowner and any subsequent landowners would nevertheless be restricted from removing the trees.

Donate Land

Landowners may take the greatest step of securing the legal protection of an ESA by donating that land to a land trust, stewardship organization or government by deed or by will. To ensure the continued protection of the land if the organization ceases to exist or the government does not honour the intent of the gift, the landowner may provide that another larger land trust or other organization hold a conservation covenant on the land or that the other organization assume ownership of the land should certain conditions occur[123].

Tax Advantages

When considering a donation of environmetally sensitive land, donors have two choices. Property can be donated as a capital gift or an Ecological Gift. Each has different tax advantages for donors. Issues such as capital gains, gifts of "ecologically significant lands" and other issues require landowners to seek

[122] It would be prudent for the grant of a life estate to explain the specific rights and obligations of the life tenant and to allow for the remainderman to monitor the land.

[123] This is also often done in the case of conservation covenants. A local land trust or stewardship organization may hold the covenant but an alternative land trust or other organization is specified should the local group fail. This often referred to as "cross-covenanting".

See Giving it Away: Tax Implications of Gifts to Protect Private Land.

the advice of a tax expert to pursue the best options for their particular circumstances (*see* sidebar)[124].

For general information on legal tools available to a landowner, a very helpful publication from the Stewardship Series[125] is *Stewardship Options For Private Landowners in British Columbia*[126]. For greater detail on the options available to landowners, *see Here Today, Here Tomorrow: Legal Tools for the Voluntary Protection of Private Land in British Columbia*[127].

Make a Charitable Donation

In addition to donating land or an interest in land such as a conservation covenant, landowners and citizens may donate cash, goods, and services or leave money in a will to an organization dedicated to protecting ESAs. Most land trusts, stewardship organizations and advocacy groups are dependent upon the support of private donations and the volunteer services of their members. From the point of view of these organizations, there is no gift too small. Every contribution makes a difference to the protection of ESAs.

Green Legacies

The Green Legacies Donor Guide is an excellent resource for conservation giving in BC. Green Legacies are gifts made by British Columbians to nature conservation organizations in the form of money, bequeaths, life insurance policies, land, and covenants. Green Legacies provide a means to supplement public funding of important services such as stewardship, habitat restoration, education, research, and much more.

This guide was developed by conservation organizations wanting to find an effective means to connect donors interested in conservation giving with organizations who need their support. This guide provides information to donors and professional advisors about different options for planned giving and the many organizations that can benefit. The guide is available in print or on their web site at: http://www.stewardshipcentre.bc.ca/green_legacies_web/index.asp

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[124] Hillier and Atkins, 2000
[125] *See* Appendix A: *Stewardship Publications*
[126] Ministry of Environment Lands and Parks 1996 (*See* Appendix A)
[127] Findlay and Hillyer 1994 (*see* Appendix A)

Ecological Gifts Program

Ecological Gifts[127b] provide enhanced tax benefits over and above those available for gifts of land that are not deemed by Environment Canada to be ecologically sensitive. An ecological gift is a donation of ecologically sensitive land or a partial interest in land that meets certain conditions in the *Income Tax Act*. The gift may include the transfer of property title or take the form of a covenant or easement. The owner making the donation can qualify for a tax credit or deduction based on the appraised value of the property as approved by Environment Canada. For the property to qualify as an ecological gift it must be:

- certified by the federal Minister of the Environment (or designate) as being ecologically sensitive land and the protection or conservation of the land is important to the preservation of Canada's environmental heritage; and

- made to Canada, a Province or Territory, a municipality, or a registered charity which has been approved by the Minister of the Environment (or designate) to receive such gifts. Most land trust organizations in BC are qualified to receive ecological gifts.

The Ecological Gifts Program is administered by Environment Canada. Anyone wishing more information can visit their web-site: http://www.cws-scf.ec.gc.ca/ecogifts. In British Columbia, the coordinator of the Ecological Gifts Program can be reached at (604) 940-4700.

[127b] Contact the Canadian Wildlife Service or a local land trust for a copy of '*The Canadian Ecological Gifts Program Handbook 2003: a legacy for tomorrow...a tax break for today*' (Environment Canada 2002)

19 What Senior Governments Can Do

Whereas this report focuses on the tools available to local governments and private landowners, the following section provides an introduction to the range of provincial and federal legislation that may be used to protect sensitive and other important ecosystems in the SEI study area. The Government of Canada and the Province of British Columbia have a responsibility to protect and manage the environment using a broad range of legislated powers. Some are directed at specific resources such as the federal *Fisheries Act* and the provincial *Fish Protection, Wildlife* and *Water Acts,* whereas others address broader environmental issues through assessment or process requirements.

In general, wetlands and riparian ecosystems are most effectively protected under federal or provincial laws (e.g., *Federal Fisheries Act, BC Water Act, BC Fish Protection Act*). Forested ecosystems on provincial Crown land are also afforded considerable management emphasis under the *Forest Practices Code of BC Act* and those on Managed Forest Lands are subject to the *Private Land Forest Practices Regulation*. However, there are few provisions aimed specifically at maintaining or protecting forested ecosystems elsewhere. Other SEI ecosystem types including grassland, broadleaf and coniferous woodland, and sparsely vegetated ecosystems have fewer legislative policies or laws available for their protection, although the *Wildlife Act* and the *Fisheries Act* can be used for some of these ecosystems in certain circumstances.

Because of the paramountcy principle under the Canadian Constitution, which gives more senior levels of government powers over lower levels of government, the Parliament of Canada has and uses powers that supersede provincial and local government powers. Provincial powers that override local powers are usually stated as such in legislation. Another principle—'occupied field'—means that where a higher order of government does not use its powers and the lower level chooses to do so under its legislation, it may do so even if primary jurisdiction rests at a higher level.

Some of the strongest legislation for environmental protection is the responsibility of the Government of Canada and Province of British Columbia. However, the provincial government has primary jurisdiction over land use decisions. As well, Fisheries and Oceans Canada, Environment Canada, BC Ministry of Water, Land and Air Protection, BC Ministry of Sustainable Resource Management; BC Ministry of Agriculture, Fish and Food, and BC Ministry of Forests have expertise, information and other resources that may be useful in identifying and conserving sensitive ecosystems.

Federal Legislation

Federal Crown Land

In general, provincial and local and use regulations do not apply to land that is within federal jurisdiction. This includes certain airports, lands of the Department of Defense, federal institutions, and other federally owned lands. It also includes land occupied by tenants, but owned by the federal government.

Wildlife Act

Canada Wildlife Act enables the federal government to do wildlife research and interpretation and to designate National Wildlife Areas (NWA) for conservation purposes. One of the five NWAs in British Columbia is near the SEI study area—the Vaseaux – Bighorn NWA.

Migratory Birds Convention Act

This Act is primarily concerned with regulating the hunting and use of migratory birds in Canada. Regulations pursuant to the Act restrict the disturbance or destruction of nests, eggs and shelters of migratory birds, except in accordance with a permit. One of the seven Migratory Bird Sanctuaries in British Columbia is located near the SEI study area: Vaseaux Lake Migratory Bird Sanctuary.

Fisheries Act

***Fish habitat** is defined as: "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend either directly or indirectly in order to carry out their life processes" Canada Fisheries Act Sec 34(1).*

The Federal government has a legislated responsibility for Canada's fisheries. A key component of this responsibility is the protection of fish and fish habitat (*see* sidebar). This definition is applied to streams, rivers, wetlands, and riparian areas. All of these habitats may be found in SEI ecosystem types. The *Fisheries Act* allows for protected or restorative management to maintain the productive capacity of fish habitat.

This entails review and authorization of development proposals that have the potential to affect fish habitat, as well as requirements for compensatory mechanisms to offset the unavoidable destruction of fish habitat. To do so requires authorization under the *Fisheries Act*.

Canadian Environmental Assessment Act

The *Canadian Environmental Assessment Act (CEAA)* is designed to ensure thorough assessment of large-scale projects that have the potential to affect the environment prior to approval. Only projects requiring certain federal approvals or authorizations, granting an interest in federal land, receiving federal funding, or proposed by a federal department or agency are addressed by *CEAA*. The Province of British Columbia has a provincially based environmental assessment act with much the same purpose, and there is currently a harmonization agreement in place to reduce overlap between the two processes. If both *CEAA* and the *BC Environmental Assessment Act (BCEAA)* are triggered, then the *BCEAA* process is used to address *CEAA* requirements with the addition of outstanding issues only addressed by *CEAA*.

The SEI is a tool that is used in the *CEAA* process to identify areas of concern that *CEAA* must address. For example, the Canadian Wildlife Service will provide expert advice to a responsible authority under *CEAA* recommending that impacts to SEI sites due to a project, be avoided or minimized.

CEAA screenings are triggered irrespective of scale. The depth of the review varies with scale, but the legislative process is the same. Not all projects under the federal mandate are subject to *CEAA*. *CEAA* uses a screening process to identify projects for which environmental impacts are likely. Routine activities such as channel dredging may not require a full assessment. Many urban fish habitat issues are encompassed by *CEAA*, but are addressed at a local or regional level under provisions of the *Fisheries Act* that allow for review and comment prior to approval.

Because of federal responsibility under the *Fisheries Act,* wetland and riparian ecosystems are the most likely ecosystem types to be affected by *CEAA*. The *Fisheries Act* will be the most significant trigger for the *CEAA* in the SEI study area. Large-scale projects on military bases would also be screened. Failure of the Department of Fisheries to use its powers under the *Fisheries Act* can trigger a challenge under *CEAA*.

Species at Risk Act

References: Douglas, Kristen. Bill C-5 the Species at Risk Act (Legislative Summaries). Law and Government Division. Revised July 2002. Available on line at:
http://www.parl.gc.ca/common/bills_ls.asp?lang=E&ls=c5&source=library_prb&Parl=37&Ses=1
Environment Canada Species at Risk web site:
http://www.speciesatrisk.gc.ca/sar/main.htm

Under the Accord for the Protection of Species at Risk the federal, provincial and territorial governments all pledged to take measures to protect species at risk under their jurisdiction. Species at Risk Act (SARA, Bill C-5) is the federal legislation for the protection of species at risk and their critical habitat on federal lands. The jurisdiction of this Act will only apply to provincial or private lands when it is felt that appropriate measures for protection of species at risk are not being taken. SARA was passed by the House of Commons on June 11, 2002 and received Royal Assent in December 2002. It will be proclaimed into law during 2003.

SARA will:

- give legal status to the Committee on the Status of Endangered Wildlife in Canada *(COSEWIC)*, the scientific body that assesses and classifies the status of species at risk;
- prohibit disturbance, destruction or removal of species listed as threatened, endangered or extirpated;
- prohibit destruction of the residences of listed species;
- give responsible ministers emergency authority to list species and protect the critical habitat of listed species;
- require recovery strategies and action plans for endangered and threatened species as well as management plans for species of special concern;
- protect critical habitat as identified by recovery plans and action strategies; and
- promote funding for conservation activities and agreements; and
- enable compensation for individuals who experience loss due to restrictions placed on critical habitat.

International Trade and Investment

The federal government has exclusive jurisdiction over trade and commerce. Under this authority, the federal government entered the North American Free Trade Agreement (NAFTA) with the United States and Mexico. Some provisions of NAFTA have significant and ominous implications for land use management and conservation. Chapter 11 of the Agreement entitles foreign investors from the US and Mexico to compensation if land use regulations are ruled as "tantamount to expropriation." In one case, a Mexican land use regulation blocking a planned hazardous waste landfill led to a large payment of compensation to a US firm. Buholzer (2001) argued that,

> *"Had this agreement been in effect in 1973 when the Agricultural Land Reserve ("ALR") was established, investors from Mexico and the U.S. who purchased agricultural land with plans to develop it for uses that are not permitted in the ALR would have been entitled to compensation, though Canadian investors would not. It seems that Canada may now have reason to discourage provincial governments, and their municipalities, from taking legislative measures that, despite their desirability domestically, might be 'tantamount to expropriation' and result in a claim against Canada for compensation."*

First Nations

First Nations Role in Conserving Sensitive Ecosystems

References: Adams, Peter. 1999. Approaches and options for treaties in urban areas. Prepared for: The Union of British Columbia Municipalities and the Ministry of Community, Aboriginal and Women's Services. Semmens and Adams. (Available on line at: http://www.landcentre.ca/lcframedoc.cfm?ID=4300

BC Treaty Commission web site:http://www.bctreaty.net

Department of Justice Canada. First Nations Land Management Act: http://laws.justice.gc.ca/en/F-11.8/

Department of Justice Canada. Indian Act: http://laws.justice.gc.ca/en/I-5/ Indian and Northern Affairs Canada web site: Backgrounder First Nations Land Management Initiative: http://www.ainc-inac.gc.ca/nr/prs/j-a2002/02125bk_e.html

Natural Resources Canada and Canadian Forest Service.1996-1997. The State of Canada's Forests Learning from History. Her Majesty the Queen in Right of Canada. 1997.

The Continuing Legal Education Society of British Columbia: http://www.cle.bc.ca

Sensitive ecosystems occur within First Nations' reserve boundaries as well as their traditional territories. The authority to manage these ecosystems derives from the *Indian Act, First Nations Land Management Act,* court cases concerning aboriginal title, treaties negotiated with federal and provincial governments, and other co-management or interim agreements between federal and provincial governments.

The *Indian Act* grants the majority of governmental power over lands and resources on reserve lands to the Minister of Indian Affairs, the Governor-in-Council and other government officers. First Nation bands have only very limited authority to make decisions regarding the use of some natural resource activities on reserve. For example, the Band may make regulations in relation to fur-bearing animals or fish on reserve. In most other cases, authority rests with the Minister or other department officials. The Minister or other official has authority to govern mining, grant timber permits, or deal with waste disposal on reserve. In addition to the *Indian Act,* the *Indian Oil and Gas Act, Fisheries Act,* and *Migratory Bird Convention and Act* also deal with natural resource issues on reserves.

In 1997 the Supreme Court of Canada decision in the Delgamuukw case confirmed that aboriginal title to land was never extinguished in BC. This decision expanded the definition of aboriginal title beyond the right to traditional use of the land to include the right to exclusive use and occupation of the land, commonly held property interests, and the right to non-traditional use of the land (BC Treaty Commission). Inherent in the definition of aboriginal title is the protection of natural values. Aboriginal title is based on First Nations relationship with the land that has evolved over time with traditional uses such as hunting, fishing and gathering. Development or any other activities that would exclude or destroy the opportunities for future generations to participate in traditional activities are not permitted[128].

First Nations involved in the treaty process can also enter into co-management agreements with federal and provincial government agencies in which they become active participants in land management decisions for the area. This allows First Nations to protect their interests until a treaty process is concluded.

There is a movement away from the *Indian Act* to self-government among First Nations. The *First Nations Land Management Act,* passed in 1999 gives Bands more local control over management of reserve land and their ecological values[129]. This Act applies to the following First Nation groups in B.C.: Squamish, Musqueam, Lheidli T'enneh, N'Quatqua, and Westbank. Under this Act, Bands have agreed to develop their own Land Code that replaces the land management sections of the *Indian Act*.

When a Land Code is adopted, environmental protection at the local level rests with each band and will be determined by the management strategies

[128] Clogg 1999
[129] Adams 1999

defined for their reserve. This is asserted through their authority to enact laws respecting the regulation, control or prohibition of land use and development including zoning and subdivision control, environmental assessment and environmental protection, management of natural resources on their land, and the enactment of laws relating to development, conservation, protection, and management[130].

First Nations also have the authority to assert environmental control at the local level over reserve lands leased from Indian and Northern Affairs Canada to a developer. When head leases are negotiated with a developer a band can assert zoning and bylaw regulations over the development process. This can ensure development will fit in with conservation priorities defined for the reserve.

Although not required to by law, First Nations and neighbouring municipalities can set up formal avenues for communication and collaboration in land management planning decisions. In this way, rather than acting as isolated bodies on a contiguous landscape when land management plans are developed, planning can be complementary between the local government and First Nation.

When First Nations have a legitimate claim to an area and are involved in the treaty negotiation process their interests and the natural values in these areas can be protected through co-management agreements between themselves and other levels of government until their claim has been resolved. Co-management agreements are also referred to as interim measurement agreements, memorandums of understanding, or park management agreements[131].

Traditional ecological knowledge developed by First Nations is another valuable tool for the conservation of sensitive ecosystems. This body of knowledge is the result of First Nations close relationship with the ecological, cultural and spiritual values of the landscape. This kind of knowledge "includes understandings of plants and animals (properties or locations), the functioning and management of ecosystems, and the reliance on species for food, medicines, fuel, or shelter" (Natural Resources Canada and Canadian Forest Service).

Provincial Legislation

Provincial Crown Land

The Province owns most of the land base of British Columbia. As such, it has a proprietary and constitutional right to manage these lands as it sees appropriate. In terms of land use regulation, local government regulation on the use and development of land are not binding on the provincial government or its agencies. Thus OCPs and zoning bylaws are not binding on the Province. This immunity of provincial agencies from local regulation extends

The Local Government Act in its own right and in relation to other statutes is a complex legal area, which cannot be addressed effectively in this report.

[130] Adams 1999
[131] Clogg 1999

to certain Crown corporations, such as BC Hydro. However, the courts have recently ruled that local regulations do apply to tenants on provincial Crown land.

Local Government Act

Under the *Local Government Act,* local governments[132] have extensive powers over the use, development, and servicing of private land as well as those provincial Crown lands that are subject to private tenures under the *BC Land Act*, for example, foreshore and water lot leases for moorage (*see* Section 4.1). However, these powers have limited application in the Agricultural or the Forest Land Reserves, and no application (except with respect to servicing under special agreements) to areas under federal legislative jurisdiction, such as National Wildlife Areas, Indian Reserves and Department of National Defence lands.

The following should be considered when looking to local governments to protect environmentally sensitive areas.

- Although local governments do not have primary mandates for natural resource management, their land use, development approval and servicing (e.g., water supply, liquid and solid waste disposal) decisions can be used to protect, restore, maintain and enhance ecosystems and resource productivity. Or, by not considering and acting on these interests, local governments can be party to their loss.

- Local governments cannot restrict the use of land to a public use without triggering compensation claims. Thus local governments cannot be expected to use their regulatory tools on behalf of provincial or federal interests to the extent that this would trigger compensation claims.

- Local governments are comprised of locally elected representatives who have, with the exceptions noted above, autonomous authority to give priority to community interests. In this regard, environmental interests are among a range of diverse and competing priorities such as housing, commercial and industrial development, and transportation. The priority each of these receives is related to a variety of factors—a primary one being community based values—in other words, the importance residents place on these values.

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[132] There are several types of local government in the study area and official community plans for some of these require provincial approval:

Municipalities - which may be cities, towns, district municipalities and villages (official community plans do not require provincial approval); *Regional Districts* - which are comprised of municipalities and unincorporated electoral areas (electoral area official community plans require provincial approval).

Proposed Community Charter

The Government of British Columbia has tabled a draft community charter that would create a new relationship between local and provincial governments. Local governments would be provided considerable autonomy for regulating local matters. The charter would give local governments stronger planning, revenue, and enforcement tools while strengthening their accountability to citizens. This legislation would give local governments autonomous authority to regulate such areas of community interest as nuisances, animals, trees, signs, and activities in a public place. Local governments will have a greater role in establishing and enforcing environmental protection regulations and standards. They would be less constrained by the detailed, specific language in previous legislation and procedures for provincial approvals for their decisions. The effect of the community charter on sensitive ecosystems will depend more strongly on the character of local government. Local governments will still be required to conform to provincial environmental legislation and standards, but may be able to impose stronger standards. On the other hand, local governments may use their new powers to favour development over environmental values.

Water Act

The *Water Act* regulates the use of surface water and for changes in and about streams. Licenses or approvals are required from Lands and Water BC Inc.

The *Water Act* provides for regulations to require Notification for many routine works constructed in or around streams.

Wildlife Act

The *Wildlife Act* is intended to address the protection and management of wildlife species in British Columbia. However, in reality it focuses on a relatively small group of designated endangered species, Wildlife Management Areas (WMA), and the management of recreational hunting. In addition, it provides a mechanism through which land acquisition can be funded and administered.

Designated endangered species under the *Wildlife Act* include the Vancouver Island marmot, burrowing owl, and white pelican; none of which reside in the SEI study area (although burrowing owls likely historically occurred in the study area). The only WMA near the SEI study is:

- South Okanagan WMA.

The *Wildlife Act* also specifies no disturbance of beaver dams and muskrat dens without approval, except where drainage is threatened. Bird nests are also protected. The nests of eagle, peregrine falcon, gyrfalcon, osprey, great blue heron and burrowing owl are protected throughout the year; all other birds' nests are protected when occupied by a bird or egg (i.e., during the spring or early summer in interior British Columbia).

Protection or management of SEI ecosystem types through the *Wildlife Act* would occur if it were in a WMA, or contained the nest of a raptor or heron. However, if there is sufficient scientific justification and public support for acquisition of a sensitive ecosystem for wildlife values, then the *Wildlife Act* should be considered as a means of acquiring and protecting important ecosystems.

Fish Protection Act

> *See BC Sensitive Streams Designation and Licensing Regulation, http://www.qp.gov.bc.ca/statreg/reg/F/FishProtect/89_2000.htm*

The *Fish Protection Act,* passed in 1997, is designed to increase the protection and management of fisheries by the Provincial Government. The legislation addresses improving water allocation policy and procedures to ensure adequate flows are maintained for fish, improving riparian protection on private land, and promoting enhanced watershed planning. The *Fish Protection Act* has several objectives:

- **To ensure adequate water for fish.** This entails better licensing of withdrawals, and allowing stewardship groups to hold water licenses for maintaining flows for fish.

- **To protect and restore fish habitat.** These provisions include developing recovery plans for sensitive streams and offering incentives for conservation covenants on private land. Several streams have been designated as "sensitive streams" within other SEI study areas.

- **Riparian protection.** The Act authorizes the Cabinet to establish by regulation "policy directives regarding the protection and enhancement of riparian areas" that are considered "subject to residential, commercial or industrial development." It does not apply to agricultural or institutional activities. Under this authority, the Cabinet has enacted the Streamside Protection Regulation, which is described in the next section.

- **Enhanced Watershed Planning.** The Act also provides for enhanced watershed planning in "sensitive stream" watersheds, which should be of assistance to the wetland and riparian ecosystems.

- **To strengthen environmental protection by local governments**. Local governments, through their management of land use and development, have a critical role to play in protecting streams, lakes, wetlands and other fish habitats. The *Fish Protection Act* amends sections in several acts including the *Local Government Act* and the *Water Act*.

Streamside Protection Regulation

In 2001, the Provincial cabinet established the *Streamside Protection Regulation* under the *Fish Protection Act*. At the time of printing, this regulation was under review by the Province of British Columbia. The regulation requires certain regional districts and their municipalities to establish and protect "streamside protection and enhancement areas" (SPEA) adjacent to streams. The SPEA's would be "no disturbance" setbacks or "leave areas" along streams with widths determined in accordance with a formula in the regulation. These areas must be established within five years of the enactment of the regulation in 2001. They would be established under existing powers under Part 26 of the *Local Government Act*. These include development permit areas, zoning, and other regulations, as well as acquiring dedications and other tenures over stream corridors. It is likely that the most commonly used approach will be the use of development permits[133]. Development permits are very powerful yet flexible tools.

Land Act

The *Land Act* enables the province to manage, regulate, or dispose of Crown lands. All lands that are sold, leased, occupied, or granted an easement for, through the Land and Water British Columbia Inc. (LWBC) may be referred to other agencies for review and comment.

In the SEI area, land is primarily privately owned and therefore is not subject to this Act. However, water surfaces are subject to the *Land Act*. Therefore, many foreshore structures such as wharves, docks, etc. require approval by LWBC and could be subject to SEI conservation guidelines. They would also need approval under the federal *Navigable Waters Protection Act*.

[133] Bulholzer 2001

Agricultural Land Reserve Act

The *Agricultural Land Reserve (ALR) Act* protects farmland from conversion to non-agricultural use. The Land Reserve Commission regulates ALR lands.

The ALR ensures that farmland is maintained as large parcels that are economically viable for food production. The *Local Government Act* contains provisions that affect local governments' jurisdiction with respect to farm practices in the ALR.

The primary use of the *ALR Act* in terms of SEI ecosystem types is to maintain ranches and orchards by discouraging or preventing conversion to other land uses such as housing. The ALR does allow for compatible uses including wildlife habitat and nature reserves.

Forest Land Reserve Act

The *Forest Land Reserve (FLR) Act* protects privately owned "managed" or Crown forestland from conversion to non-forestry use. The original act created a Forest Land Commission, which has been merged with the Agricultural Land Commission and renamed the Land Reserve Commission.

The Forest Land Reserve consists of Crown Land and private land, other than agricultural reserve land that is classified under the *Assessment Act* as Managed Forest Land.

The objective of the legislation is to "protect the integrity of the working forest land base by minimizing the impact of urban development and rural area settlement on forest reserve land, encourage responsible forest practices on forest land and to promote conditions favourable for investment in private land forest management."

The FLR restricts the use of land to certain purposes, namely forestry, forage production, recreation, water management, fish, wildlife and biodiversity management and mineral exploration or development. The powers of local governments to enact land use regulations for Forest Land Reserves are limited, and cannot have the effect of interfering with forestry uses.

Private Land Forest Practices Regulation

The *Private Land Forest Practices Regulation (PLFPR)* was enacted April 1, 2000. The regulation is applicable to Managed Forest Land under the *Assessment Act*. The *PLFPR* prescribes a number of management requirements including soil conservation, stream and fish habitat protection, water supply protection, protection of critical wildlife habitats and reforestation.

The Ministry of Water, Land and Air Protection has staff that are designated environmental officials under the regulation and the Land Reserve Commission has staff that are designated as officers under the new regulation. These people work as team to ensure the regulation is applied to Managed Forest Lands.

Farm Practices Protection (Right to Farm) Act

This *Farm Practices Protection Act (FPPA)* legislation supports farmers who farm responsibly, establishes a process to address public concerns about farm practices and helps local governments support farming in community plans and by-laws.

The fundamental policy of the legislation is that farmers have a right to farm in British Columbia's important farming areas, particularly in the Agricultural Land Reserve, provided they use "normal farming practices" (*see* sidebar) and are in compliance with related legislation (the *Waste Management Act, Water Act, Pesticide Control Act, Health Act)*.

The legislation establishes an improved complaint resolution process for people who live near farms and have concerns about farm practices that create dust, odour, noise or other disturbances. The FPPA also amends the *Local Government Act* and *Land Title Acts* to encourage local governments to support farming by ensuring local by-laws reflect provincial standards for farming.

Definition of Normal Farming Practices
An activity that is conducted by a farm business in a manner consistent with proper and accepted customs and standards as established and followed by similar farm businesses under similar circumstances.

Environmental Assessment Act (BCEAA)

The purpose of the *BC Environmental Assessment Act* is to assess the potential environmental, economic, heritage, health, and social effects arising from a broad range of large-scale projects. *BCEAA* only addresses projects under provincial responsibility. Forestry related projects are not generally included as they are addressed by the Forest Practices Code. Where both *BCEAA* and *CEAA* interests may apply, a joint assessment process can be initiated.

BCEAA covers major projects including mines, waste disposal, energy projects such as power generation plants, pipelines, transmission lines, tourism projects, and transportation related projects (e.g., public highways). Large-scale urban developments may also be subject to *BCEAA* review. Project size or 'threshold' is an important factor; the *BCEAA* is intended to address large scale projects with significant potential to affect the environment.

BCEAA has the potential to increase protection of all SEI ecosystem types if they are threatened by a large-scale project such as a new highway. However, much of the ecosystem loss in the SEI is due to the incremental damage caused by many small developments and activities that are not encompassed by *BCEAA*.

Conclusion

Let us leave a splendid legacy for our children...let us turn to them and say, 'this you inherit: guard it well, for it is far more precious than money, and once destroyed, nature's beauty cannot be repurchased at any price.'

— Ansel Adams

It is clear that senior levels of government have a vital role to play in the conservation of sensitive ecosystems within the SEI study area. However, no one level of government or agency has overall responsibility for conservation. Although there is no explicit sensitive ecosystems legislation per se within British Columbia or at the federal level, legislation exists that can set aside sensitive areas for conservation purposes—usually as part of a Wildlife Management Area or a National Wildlife Area, Ecological Reserve, provincial or national park, etc. The majority of legislation is generally directed towards protecting specific resources (e.g. fish, wildlife or habitat) and regulating human activities that could impact on the resource.

In recent years there has been an effort to take more of an ecosystem approach to land use planning and management, with the introduction of the *Fish Protection Act* and amendments to the *Local Government Act*. There is recognition that watershed planning and management is an essential step towards conserving sensitive ecosystems. The identification, designation and mapping of ESAs by local governments, land trusts, conservancy groups, and special interest groups is an important tool in conserving sensitive ecosystems.

However, long-term conservation of biodiversity depends on public support—the development of a 'conservation ethic' that acknowledges and affirms the link between a healthy environment and human prosperity. Development of such an ethic requires education in conservation and natural values, which in turn helps to develop a love of home and place, quality of life, and an appreciation of and protective attitude toward non-human life forms everywhere. We hope that this report will assist governments, landowners, developers, and others to find ways to live productively and sustainably while conserving our rich biological heritage.

Glossary[134]

Aerial photograph[135]: A photograph showing a vertical view of the earth's surface. They are taken as a series of photographs from an aircraft flying at a specific elevation.

Anthropogenic[136]: Human influenced. Here we are referring to sites or ecosystems that have been altered by human activities such that their physical properties have been drastically altered (for example: gravel pits, housing developments, roads, orchards).

Aspect: The compass direction that a slope faces. It is often described more broadly relative to the major cardinal directions (e.g. a slope facing south has a southerly aspect).

Biodiversity: The variety of living organisms on the planet, and their ecological roles and the genetic diversity they contain[137].

Biogeoclimatic subzones[138]: These are the basic unit of the biogeoclimatic ecosystem classification system. They are a geographic area within which the same vegetation occurs on climax sites that are primarily influenced by climate.

Bioterrain[139]: Terrain map that emphasizes elements of the landscape that are relevant to ecosystem mapping and wildlife habitat such as soil moisture conditions, aspect, and vegetation characteristics. *See also* **terrain mapping.**

Blue-listed (B): Those indigenous species, subspecies or plant communities considered provincially vulnerable. *See also* **indigenous.**

Bunchgrass: Grasses where several or many stems grow in a close tuft; having a characteristic growth habit of forming a bunch; lacking stolons or rhizomes.

Capability: The greatest ability of a habitat in a natural successional stage to support the life requisites of an organism; the suitability is the current ability of the habitat to support the life requisites of an organism.

Chernozem[140]: Soils with an upper layer that is dark due to the accumulation of organic matter from grasses and forbs; these soils are characteristic of grasslands.

Climax stage: The final, self-replacing stage in plant succession that has a relatively stable species composition and persists for long periods of time in the absence of disturbance. In ecosystems with frequent low severity fire, fire results in few changes in the structure and organization of the ecosystem and it persists in a climax stage.

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[134] Terms and definitions are extracted or adapted from Dunster and Dunster (1996) unless otherwise noted.
[135] Resources Inventory Committee 1998
[136] Resources Inventory Committee 1998
[137] Wilcox 1984
[138] Pojar et al. 1991
[139] Resources Inventory Committee 1996
[140] Soil Classification Working Group 1998

Cones[141]: Mountains, hills or other landforms shaped like a cone, having relatively steep slopes and a pointed top.

Coniferous: Cone-bearing trees having needles or scale-like leaves, usually evergreen. Common conifers in the study area include Douglas-fir, ponderosa pine and western redcedar.

Conservation covenant: A conservation covenant is a voluntary, written legal agreement in which a landowner commits to protect his/her land in specified ways as outlined in the covenant. It can cover all or part of a property. Covenants offer a way of protecting land for a variety of uses such as wildlife habitat, watershed protection, scenic values and historic preservation. The agreement is between the landowner and an organization such as The Land Conservancy or any other group or government agency recognised by the Minister of Water, Land and Air Protection. Conservation covenants protect the land by giving the covenant holder the authority to assume the long-term responsibility for monitoring and enforcing the agreement. The covenant is attached to the title of the land, is registered in the Land Title Office, and binds future owners of the land to the terms established by the covenant.

COSEWIC: The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild Canadian species, subspecies and separate populations suspected of being at risk. All native mammals, birds, reptiles, amphibians, fish, molluscs, lepidopterans (butterflies and moths), vascular plants, mosses and lichens are included in its current mandate. Three categories of risk are used in this report. Endangered (E) denotes a species facing imminent extirpation or extinction. Threatened (T) denotes a species likely to become endangered if limiting factors are not reversed. (SC) denotes a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Deciduous: A term applied to trees, most commonly broadleaf trees, which shed their leaves annually (note that some conifers such as larch are also deciduous).

Deposition[142]: Accumulation of earth material resulting from naturally occurring physical, chemical or organic processes.

Disturbance: A discrete force that causes significant change in structure or composition through human caused events such as cutting trees, driving vehicles off-road, grazing of domestic animals. *For natural events such as fires and floods see:* **Natural disturbances.**

Ecological processes: The actions or events that link organisms (including humans) and their environment, such as disturbance, successional development, nutrient cycling, productivity, and decay.

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[141] Resources Inventory Committee 1996

[142] Resources Inventory Committee 1996

Ecoprovince: In the Ecoregion Classification system[143], this is an area of consistent climate or oceanography, and physiography, of a size useful for provincial overview-planning. The study area lies in the Southern Interior Ecoprovince. Ecoprovinces are subdivided into Ecosections.

Ecosection: In the Ecoregion Classification system, this is an area with minor physiographic and macroclimatic or oceanographic differences[144]. The study area lies in the North Okanagan Ecosection. Ecosections are subdivisions of Ecoprovinces.

Ecosystem: A functional unit consisting of all of the living organisms and abiotic (non-living) factors of a unit or portion of the landscape, together with the processes that link them including nutrient cycling and energy flow. An ecosystem can be any size, but here we define them as a portion of the landscape with relatively uniform vegetation and soils[145].

Edge effect: The penetration of wind, light, and humidity creating differences in microclimate (air and soil temperature, wind, light, humidity), as well as sound, predation, and visibility, beyond and into vegetation bordering a zone of disturbance. Edge effects can drastically reduce the area of a vegetated "island" that can function as "interior" forest. We are specifically referring to edge effects associated with human influences as opposed to the natural edge effects associated with the influence of one adjoining plant community upon the margin of another.

Emergent vegetation[146]: Upright plants rooted in water or exposed to seasonal flooding that emerge above the water surface. Commonly includes rushes, cattails and some sedges in the study area.

Erosion: The loosening and removal of soil by running water, wind or glaciers.

Fan: A fan-shaped accumulation of materials deposited by a stream, river (*see* fluvial fan) or gravity with a slope of less than 26%.

Fire exclusion: The exclusion of fire from ecosystems. Although fire suppression is the most widely known form of fire exclusion, the following factors also contribute to fire exclusion: cessation of First Nation's burning, reduction of fine fuels through grazing, removal of vegetation, and creation of roads and trails. *See also* **fire suppression.**

Fire regime[147]: A fire regime is a generalized description of the role fire plays in an ecosystem. Fire regime characteristics include fire frequency, extent, intensity, timing and the ecological effects of fire. A commonly used fire regime classification separates on the basis of the predominance of fires of a particular severity: low, moderate (or mixed) or high severity. *See also* **fire severity.**

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[143] Demarchi 1996
[144] Demarchi 1996
[145] Pojar et al. 1991
[146] MacKenzie 2003
[147] Agee 1993

Fire severity[148]: Fire severity refers to the effect of fire on the dominant overstory tree species in an ecosystem. Common classes of fire severity are low (few or no trees killed), moderate (many trees killed) or high (most or all trees killed).

Fire suppression: The prevention or extinguishment of natural or human-caused fires in ecosystems.

Fluvial[149]: Pertaining to streams and rivers.

Fluvial fans[150]: A fan-shaped accumulation of materials deposited by a stream or river, usually at the point where a stream emerges from a canyon onto a plain.

Forage: The portion of vegetation (shrubs, grasses, forbs) that is available and can provide food for grazing or browsing animals (includes both domestic and wild animals). Also, the act of acquiring vegetation for food.

Forbs: Herbaceous plants with broad leaves, excluding grasses, sedges and rushes.

Forest encroachment: The establishment and growth of trees onto areas formerly dominated by grasses (grasslands). This phenomenon is usually associated with **fire exclusion**.

Forest ingrowth: An abnormal increase in tree establishment in formerly open fire-adapted forests. This phenomenon is usually associated with **fire exclusion**.

Fragmentation: The breaking up of continuous areas of habitat into smaller parcels. For example grasslands becomes fragmented when roads are built in them.

Gleysols: Soils influenced by periodic or sustained water saturation as indicated by gleyed colours (dull yellowish, blue, or olive) or prominent mottles (reddish or orange spots or blotches).

Graminoid: Grasses, sedges, or rushes.

Grass: Plants in the family Gramineae, whose characteristics include stems that are jointed at nodes, are hollow, have sheathing leaves, and flowers (inflorescences) surrounded by bracts (glumes).

Greenway: a system of protected linear corridors of open space, managed for conservation and recreation purposes.

Habitat: The natural abode of a plant or animal, including all biotic, climatic, and edaphic factors affecting life.

Habitat Conservation and Stewardship Program: A program of the federal Department of Stewardship and Oceans where Habitat Stewards (including one in the office of the Regional District of the Central Okanagan) work in partnership to protect and restore fish habitat.

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[149] Agee 1993

[149] Resources Inventory Committee 1996

[150] Resources Inventory Committee 1996

Herbaceous: Plants that are herb-like and contain little permanent woody tissue. The above ground parts of the plant die back after the growing season. In annuals, the whole plant dies; in perennials the plant has organs (bulbs, corms or other structures) that survive beneath the soil in unfavourable conditions.

Hibernacula: Refuges (dens) from extreme conditions, usually during winter; generally applies to animals that undergo extended dormancy, such as reptiles and bats; these are usually specific sites and are used by countless generations (singular is hibernaculum).

Hydrological[151]: Water-related features and processes.

Hydrology[152]: The scientific study of the distribution and characteristics of water at and close to the earth's surface.

Hyrophytic vegetation[153]: Any plants that are adapted for growing on permanently saturated soils deficient in oxygen.

Indigenous: Any species growing naturally in an area or region.

Invasive species: Species that were absent in undisturbed portions of the landscape and will invade or increase, especially following disturbance.

Litter: The uppermost layer of organic debris on the soil surface.

Mottles: Reddish or orange spots or blotches in soils (typical of **gleysols**).

Natural Disturbance: An event that causes change in structure or composition through natural events such as fire, flooding, wind storms, and insect outbreaks with minimal influence from human activity.

Noxious weed: aggressive invader weeds that are designated under the provincial *Weed Control Act*. *See also* **weed**.

Organic soils[154]: Sediments formed by the accumulation of decaying vegetation matter; occur in some wetlands in the study area.

Overstory: In a forest or woodland, the overstory is the upper canopy of trees.

Patch: A habitat patch is a spatially distinct unit of a particular habitat.

Plant community: A unit of vegetation with relatively uniform species com position. Plant communities also tend to have characteristic environmental features such as soil type, topographic position, and climate.

Polygon: Delineations that represent discrete area on a map, bounded by a line. On an ecosystem map, polygons depicting ecosystem units represent areas from less than one hectare to tens of hectares depending on the uniformity or complexity of an area.

Profit à prendre: A right to take a part of the soil or produce (e.g. vegetation) of the land, or take from the soil such as by logging, grazing, or mining. The taking (profit) distinguishes this right from an easement, which is a right of use over the property of another.

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[151] Resources Inventory Committee 1996
[152] Resources Inventory Committee 1996
[153] MacKenzie 2003
[154] Resources Inventory Committee 1996

Red-listed (R): Those indigenous species or subspecies considered provincially rare.

Regosols: Poor or weakly developed soils characteristic of recently deposited materials.

Riparian: Terrestrial areas adjacent to the banks of a stream or any other water body that are influenced by that stream or water body.

Runoff: The part of precipitation and snowmelt that reaches streams, rivers, lakes, or other water bodies by flowing over or through the ground. Surface runoff flows away without penetrating the soils. Groundwater runoff enters water bodies by seeping through soils.

Selection logging: Harvesting of trees selectively where only certain trees are cut and others are left standing.

Sensitive ecosystem: Those remaining natural terrestrial ecosystems which are considered fragile or rare in the SEI study area: wetlands, riparian, old forest, grassland, broadleaf woodland, coniferous woodland, and sparsely vegetated ecosystems.

Seral: The successional stage of plant communities that succeed one another. *See also* **succession.**

Slope stability: Pertains to the susceptibility of slopes to landslides or the rupture and collapse or flow of surficial materials, soil or bedrock.

Soil texture: The relative proportion of sand, silt and clay in the fine fraction (particles <2mm in size) of the soil. Fine-textured soils are dominated by clay or silt, medium-textured soils have a mixture of sand, silt, and clay, and coarse-textured soils are dominated by sand.

Stand-replacing fire: A high severity fire that kills all or nearly all of the overstory trees.

Succession: A series of dynamic changes in ecosystem structure, function, and species composition over time as a result of which one group of organism succeeds another through stages leading to a climax stage. Primary succession occurs when organisms colonise a previously sterile area. Secondary succession occurs on sites that have been previously disturbed (for example, after a fire) in some manner or the natural replacement of a seral ecosystem with a later seral or climax ecosystem.

Suitability: The current ability of a habitat in its current natural successional stage to support the life requisites of an organism.

Surface fire: Fires that burn primarily through the understory or grass and herbaceous vegetation in an ecosystem and do not burn in the overstory.

Surficial material[155]: Non-rock sediments; usually classified according to how they were deposited (fluvial – deposited by moving water; colluvium – deposited by gravity; lacustrine – deposited by lakes).

[155] Resources Inventory Committee 1996

Talus[156]: Angular rock fragments accumulated at the foot of a steep rock slope and being the product of successive rock falls.

Terrace[157]: A step-like landform where each step-like form consists of a flat surface (tread) and a steep slope below.

Terrain mapping[158]: Mapping that shows surficial materials, their texture, sur face expression, present day geological processes and other features. *See also* **surficial material**.

Terrestrial ecosystem mapping: The stratification of a landscape into map units according to a combination of ecological features, primarily climate, physiography, surficial material, bedrock geology, soil, vegetation, and disturbance. In the Province of British Columbia, Terrestrial Ecosystem Mapping is guided by the Standard for Terrestrial Ecosystem Mapping[159].

Threatened and endangered species: An indigenous species of flora or fauna that is likely to become endangered if the factors affecting its vulnerability do not become reversed. Threatened and endangered species are referred to as "red-listed" by the B.C. Conservation Data Centre.

Understory: In a forest or woodland, the plants growing beneath the canopy of other plants (trees).

Ungulates: Hooved mammals, such as deer and sheep.

Weed: A weed can be commonly defined as a plant growing in where it is unwanted or a plant that has a negative value within a given management system. For this SEI, we define weeds as non-native plants which, in the area they occur, lack the natural enemies necessary to restrict their distribution. *See also* **noxious weed**.

Wildlife: Animals, such as invertebrates, amphibians, reptiles, birds, and mammals.

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[156] Resources Inventory Committee 1996
[157] Resources Inventory Committee 1996
[158] Resources Inventory Committee 1996
[159] Resources Inventory Committee 1998

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The Stewardship Series

The Stewardship Series is a group of publications describing stewardship activities for various audiences. The series is funded by federal and provincial governments in partnership with non-government organisations on a project by project basis. Current publications include:

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Appendix B: Organizations and Resources

Federal Government

Environment Canada
Canadian Wildlife Service
Pacific and Yukon Region
RR 1, 5421 Robertson Road, Delta, B.C. V4K 3N2
tel: (604) 940-4700 fax: (604) 946-7022

Provincial Government

Ministry of Sustainable Resource Management
Conservation Data Centre
Terrestrial Information Branch
P.O. Box 9993 Stn. Prov. Govt., Victoria, B.C. V8W 9R7
tel: (250) 387-9798 fax: (250) 387-2733
email: cdcdata@victoria1.gov.bc.ca
web site: http://srmwww.gov.bc.ca/cdc/

Ministry of Water, Land and Air Protection
Environmental Stewardship Division
Okanagan Regional Office
201-3547 Skaha Lake Road, Penticton, B.C. V2A 7K2
web site: http://www.gov.bc.ca/wlap/

Ministry of Agriculture, Food and Fisheries
Animal Industry Branch - Kamloops
162 Oriole Road, Kamloops, B.C. V2C 4N7
tel: (250) 371-6051
web site: http://www.agf.gov.bc.ca

Provincial Agricultural Land Commission
Room 133, 4940 Canada Way, Burnaby, B.C. V5G 4K6
tel: (604) 660-7000 fax: (604) 660-7033

Ministry of Community, Aboriginal and Women's Services
Local Government Structure Branch
P.O. Box 9490, Stn. Prov. Govt., 4th Floor, 800 Johnson Street, Victoria, B.C. V8W 9N7
tel: (250) 387-4054 fax: (250) 356-7972

Ministry of Forests
Penticton District Office
102 Industrial Place, Penticton, B.C. V2A 7C8
tel: (250) 490-2255 fax: (250) 490-2200

Ministry of Forests
Vernon District Office
2501 14th Avenue, Vernon, B.C. V1T 8Z1
tel: 250-558-1700

Regional & Local Government

Regional District of the Central Okanagan
1450 K.L.O Road, Kelowna, B.C. V1W 3Z4
tel: (250) 763-4928 fax: (250) 763-0606
web site: http://www.regionaldistrict.com/

City of Kelowna
1435 Water Street, Kelowna, B.C. V1Y 1J4
tel: (250) 763-6011
email: ask@city.kelowna.bc.ca
web site: http://www.city.kelowna.bc.ca

Non-Government Organizations

*Note: this list has been compiled to provide the reader with some sources of further information. This is **not** intended to be a complete listing of all conservation organizations in or near the SEI study area.*

Allan Brooke Nature Centre Society
50 Allan Brooks Way, P.O. Box 20038,Vernon, B.C. V1T 9L4
tel: (250) 260-4227 fax: (250) 558-4208
email: info@abnc.ca
website: www.abnc.ca

Central Okanagan Naturalists Club
Box 396 Stn A, Kelowna, B.C. V1Y 7N8
tel: (250) 769-6605
email: hughwest@telus.net

Central Okanagan Parks & Wildlife Trust
#217 – 1889 Springfield Road, Kelowna, B.C. V1Y 5V5
tel: (250) 861-6160
email: cof@silk.net

Ducks Unlimited Canada
954A Laval Crescent, Kamloops, B.C. V2C 5P5
tel: (250) 374-8307 fax: (250) 374-6287
email: i_barnett@ducks.ca

Federation of BC Naturalists
#425 - 1367 West Broadway, Vancouver, B.C. V6H 4A9
tel: (604) 737-3057 fax: (604) 738-7173
email: info@naturalists.bc.ca
website: www.naturalists.bc.ca/

Grasslands Conservation Council of B.C.
954A Laval Crescent, Kamloops, B.C. V2C 5P5
tel: (250) 374-5787 fax: (250) 374-6287
email: gcc@bcgrasslands.org
website: www.bcgrasslands.org

Land Trust Alliance of B.C.
204-338 Lower Ganges Road, Salt Spring Island, B.C. V8K 2V3
Email: ltabc@saltspring.com
web site: www.island.net/~ltabc/

Native Plant Society of B.C.
email: information@npsbc.org
website: http://www.npsbc.org/

North Okanagan Naturalists' Club
Box 473, Vernon, B.C. V1T 6M4
tel: (250) 542-3461
email: walsted-works@telus.net

North Okanagan Parks & Natural Area Trust
P.O. Box 265, Vernon, B.C. V1T 6N2
tel: (250) 545-7673
ptassie@telus.net

The Land Conservancy of British Columbia
5793 Old West Saanich Road, Victoria, B.C. V9E 2H2
tel: (250) 479-8053 fax: (250) 744-2251
email: admin@conservancy.bc.ca
web site: www.conservancy.bc.ca

The Living by Water Project
BC/Yukon Regional Office
P.O. Box 7 Salmon Arm, B.C. V1E 4N2
tel: (250) 832-7405 fax: (250) 832-6874
email: shorelines@jetstream.net
web site: www.livingbywater.ca

The Nature Trust of B.C.
#2600 – 1000 Roosevelt Crescent, West Vancouver, B.C. V7P 1M3
tel: (604) 924-9771 fax: (604) 924-9772
email: info@naturetrust.bc.ca

West Coast Environmental Law Association
1001 - 207 West Hastings Street, Vancouver, B.C. V6B 1H7
tel: (604) 684-7378 fax: (604) 684-1312
email: admin@wcel.org

Nature Conservancy of Canada
202-26 Bastion Square, Victoria, B. C. V8W 1H9
tel: (250) 479-3191

Wetkit: tools for working with wetlands in Canada
web site: www.wetkit.net

Appendix C:
SEI Contacts and Data

Regional District of the Central Okanagan

1450 K.L.O. Road, Kelowna, B.C. V1W 3Z4
Tel: (250) 868-5246 Contact: Ken Arcuri
web site: www.regionaldistrict.com

Contact the Regional District of the Central Okanagan for SEI maps, spatial and non-spatial map data and copies of Volumes 1, 2[160], and 3[161]

Ministry of Sustainable Resource Management
B.C. Conservation Data Centre

PO Box 9993 Stn Prov Govt, Victoria, B.C. V8W 9R7
Tel: (250) 356-0928; Fax: (250) 387-2733 Contact: Carmen Cadrin
email: cdcdata@victoria1.gov.bc.ca
web site: srmwww.gov.bc.ca/cdc/

Spatial and non-spatial data for the Terrestrial Ecosystem Mapping (TEM) component are available for download at the Ministry of Sustainable Resource Management's Terrestrial Ecosystem Mapping Data Warehouse at http://srmwww.gov.bc.ca/rib/wis/tem/dataware.htm under Region 3 - Central Okanagan.

The following are available:

- project metadata
- Non-Spatial Polygon Attributes
- TEM Map Legend Files
- TEM report with expanded legend (Volume 2)
- Wildlife Species Accounts
- Wildlife Ratings Tables
- Wildlife Report (Volume 3)[163]
- Arc/Info *.E00 Export Files includes two spatial coverages: ECI field sampling points and a ECP TEM polygon coverage

Environment Canada
Canadian Wildlife Service
Pacific and Yukon Region

RR 1, 5421 Robertson Road, Delta, B.C. V4K 3N2
Tel: (604) 940-4700 Fax: (604) 946-7022 Contact: Ken Brock
web site: pyr.ec.gc.ca/EN/Wildlife/

SEI Web Site: srmwww.gov.bc.ca/cdc/sei/seiprojects.htm#cok
OR
pyr.ec.gc.ca/EN/Wildlife/habitat/tools.shtm#SEI

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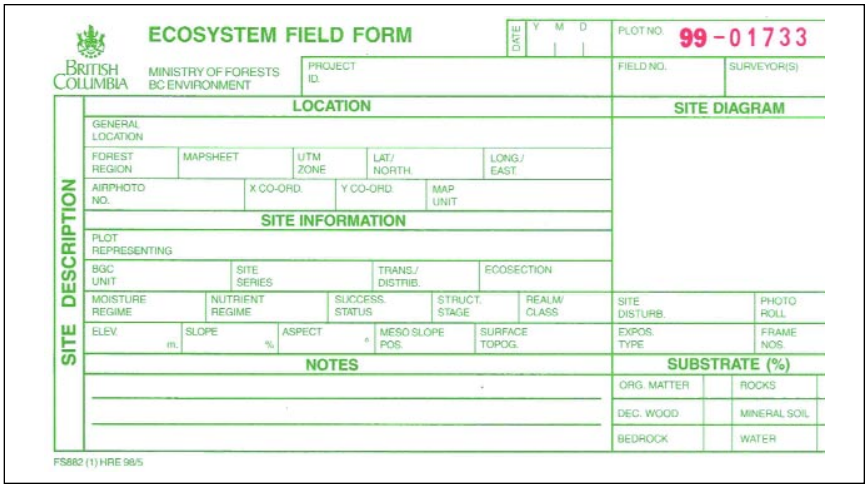
[160] Iverson et al. 2003
[161] Sarell et al. 2003
[162] Iverson et al. 2003
[163] Sarell et al. 2003

Appendix D: Plot Forms



ECOSYSTEM FIELD FORM

BRITISH COLUMBIA — MINISTRY OF FORESTS / BC ENVIRONMENT

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

SITE DESCRIPTION

LOCATION | SITE DIAGRAM

GENERAL LOCATION

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

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

SITE INFORMATION

PLOT REPRESENTING

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

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

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

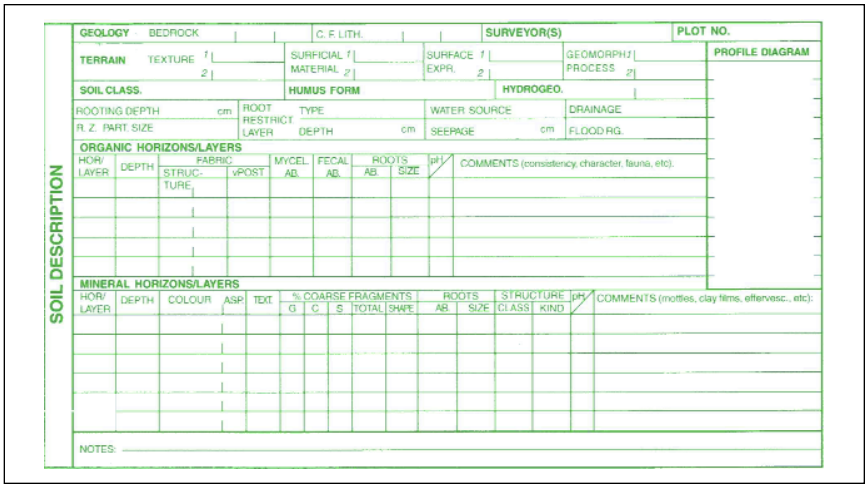
NOTES | SUBSTRATE (%)

ORG. MATTER | ROCKS

DEC. WOOD | MINERAL SOIL

BEDROCK | WATER

FS882 (1) HRE 98/5



SOIL DESCRIPTION

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

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

SOIL CLASS. | HUMUS FORM | HYDROGEO.

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

R. Z. PART. SIZE

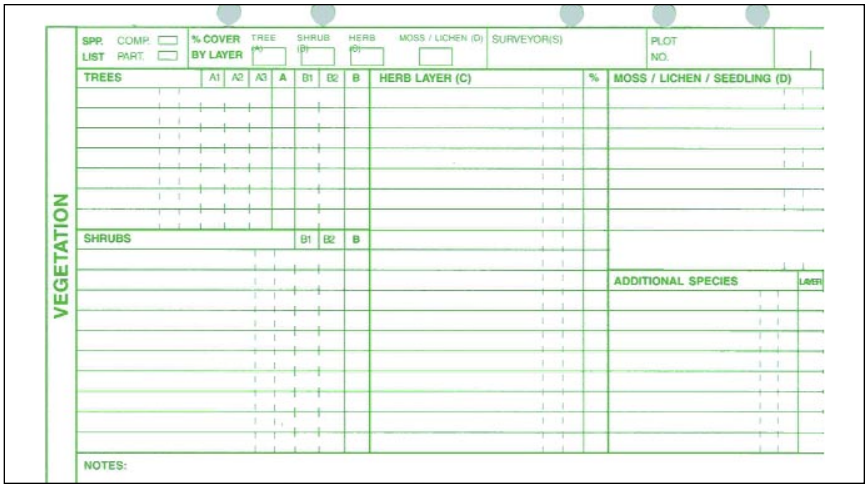
ORGANIC HORIZONS/LAYERS

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

MINERAL HORIZONS/LAYERS

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

NOTES:



VEGETATION

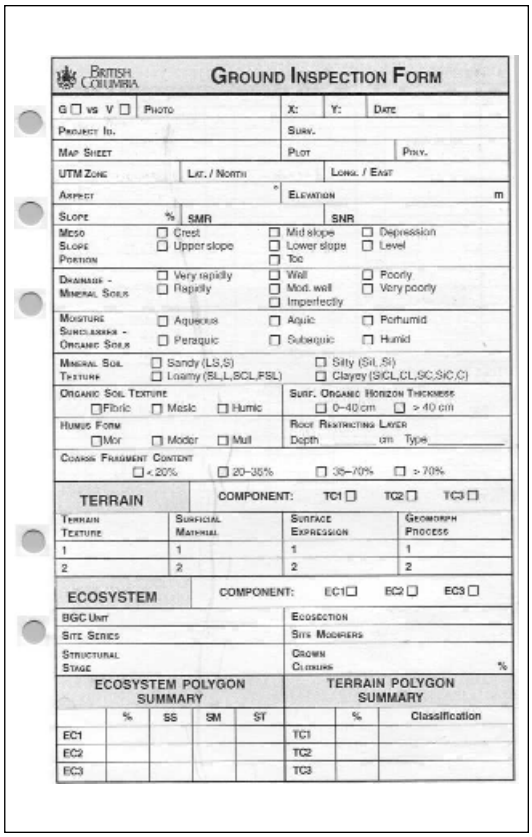
SPP. LIST COMP. PART. | % COVER BY LAYER TREE (A) SHRUB (B) HERB (C) MOSS / LICHEN (D) | SURVEYOR(S) | PLOT NO.

TREES A1 A2 A3 A | B1 B2 B | 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		PHOTO
UTM ZONE	LAT. / NORTH		LONG. / EAST	
ASPECT °		ELEVATION		m
SLOPE %	SMR		SNR	

MESO SLOPE POSITION: ☐ Crest ☐ Upper slope ☐ Mid slope ☐ Lower slope ☐ Toe ☐ Depression ☐ Level

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

MOISTURE SUBCLASSES - ORGANIC SOILS: ☐ Aqueous ☐ Peraquic ☐ Aquic ☐ Subaquic ☐ Perhumid ☐ Humid

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

ORGANIC SOIL TEXTURE: ☐ Fibric ☐ Mesic ☐ Humic

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

HUMUS FORM: ☐ Mor ☐ Moder ☐ Mull

ROOT RESTRICTING LAYER: Depth ____ cm Type ____

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

TERRAIN COMPONENT: TC1 ☐ TC2 ☐ TC3 ☐

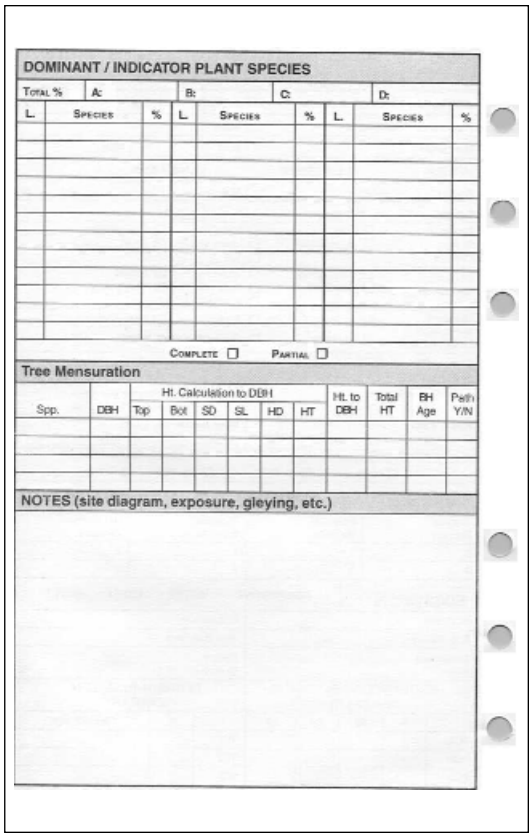
TERRAIN TEXTURE	SURFICIAL MATERIAL	SURFACE EXPRESSION	GEOMORPH PROCESS
1	1	1	1
2	2	2	2

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:

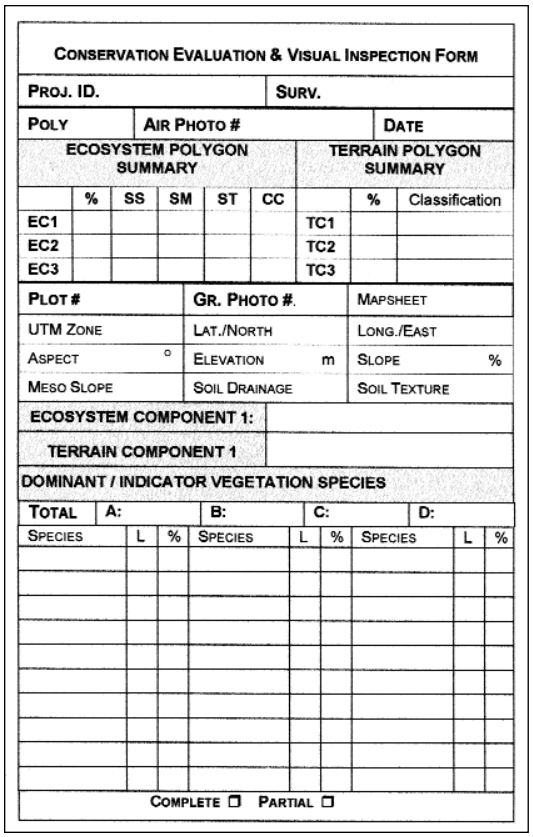
L.	SPECIES	%	L.	SPECIES	%	L.	SPECIES	%

COMPLETE ☐ PARTIAL ☐

Tree Mensuration

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

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		

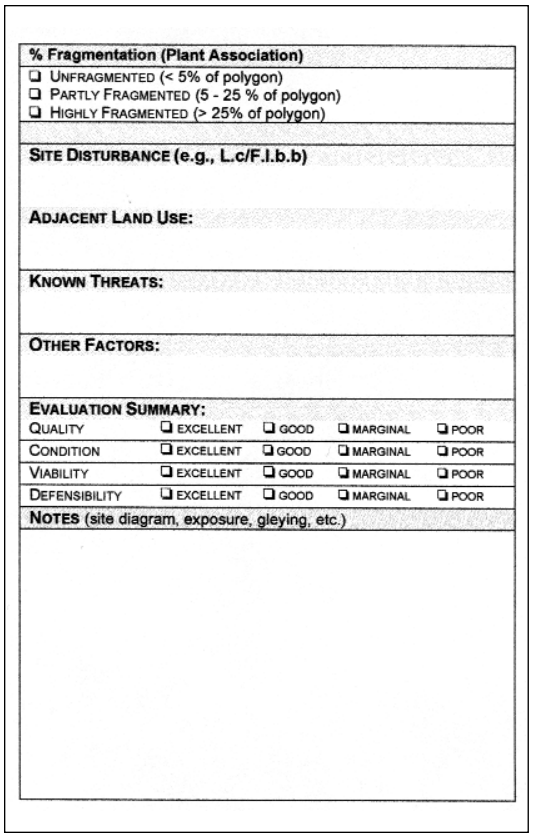
PLOT #	GR. PHOTO #.	MAPSHEET
UTM ZONE	LAT./NORTH	LONG./EAST
ASPECT °	ELEVATION m	SLOPE %
MESO SLOPE	SOIL DRAINAGE	SOIL TEXTURE

ECOSYSTEM COMPONENT 1:	
TERRAIN COMPONENT 1	

DOMINANT / INDICATOR VEGETATION SPECIES

TOTAL	A:		B:			C:			D:		
SPECIES	L	%	SPECIES	L	%	SPECIES	L	%	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 E:
Plants of the SEI Study Area

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; no rare species were encountered during field-work. 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 rare plants occur in the study area.

Common Name	Latin Name
alfalfa*	*Medicago sativa*
American bulrush	*Scirpus americanus = Schoenoplectus pungens*
American speedwell	*Veronica beccabunga*
American vetch	*Vicia americana*
annual hawksbeard	*Crepis tectorum*
apple pelt	*Peltigera malacea*
arctic lupine	*Lupinus arcticus*
arnica	*Arnica sp.*
arrowleaf balsamroot	*Balsamorhiza sagittata*
awned haircap moss	*Polytrichum piliferum*
baldhip rose	*Rosa gymnocarpa*
ballhead waterleaf	*Hydrophyllum capitatum*
Baltic rush	*Juncus balticus*
baneberry	*Actaea rubra*
beaked hazelnut	*Corylus cornuta*
beaked sedge	*Carex utriculata*
Bebb's willow	*Salix bebbiana*
bent sedge	*Carex deflexa*
bentgrass	*Agrostis sp.*
big sagebrush	*Artemisia tridentata*
birch-leaved spirea	*Spiraea betulifolia*
bitterroot	*Lewisia rediviva*
bittersweet	*Solanum dulcamara*
black cottonwood	*Populus balsamifera* ssp. *trichocarpa*
black gooseberry	*Ribes lacustre*
black hawthorn	*Crataegus douglasii*
black huckleberry	*Vaccinium membranaceum*
black medic*	*Medicago lupulina*
black sanicle	*Sanicula marilandica*
black twinberry	*Lonicera involucrata*
bladder campion*	*Silene vulgaris*
blue elderberry	*Sambucus cerulea*
blue forget-me-not	*Myosotis stricta*
blue wildrye	*Elymus glaucus*
bluebunch wheatgrass	*Elymus spicatus = Pseudoroegneria spicata*
bluegrass	*Poa sp.*
bluejoint	*Calamagrostis canadensis*
boreal pixie-cup	*Cladonia borealis*
bristly-stalked sedge	*Carex leptalea* ssp. *leptalea*
brittle prickly-pear cactus	*Opuntia fragilis*

Common Name	Latin Name
broom moss	*Dicranum scoparium*
brown stipplescale	*Catapyrenium squamulosum*
brown-eyed scale	*Psora montana*
brown-eyed Susan	*Gaillardia aristata*
buckwheat	*Eriogonum sp.*
bull thistle*	*Cirsium vulgare*
bunchberry	*Cornus canadensis*
bur-reed	*Sparganium sp.*
buttercup	*Ranunculus sp.*
butterfly pelt	*Peltigera lepidophora*
California brome*	*Bromus carinatus*
California comandra	*Comandra umbellata*
Canada bluegrass*	*Poa compressa*
Canada goldenrod	*Solidago canadensis*
Canada thistle*	*Cirsium arvense*
Canada violet	*Viola canadensis*
celery-leaved buttercup	*Ranunculus sceleratus*
cheatgrass*	*Bromus tectorum*
cherry	*Prunus sp.*
chocolate lily	*Fritillaria affinis*
choke cherry	*Prunus virginiana*
clad lichens	*Cladonia sp.*
clasping twistedstalk	*Streptopus amplexifolius*
cleavers	*Galium aparine*
clover*	*Trifolium sp.*
clustered broomrape	*Orobanche fasciculata*
Columbia bower	*Clematis occidentalis*
Columbian needlegrass	*Stipa nelsonii = Achnatherum nelsonii*
common burdock	*Arctium minus*
common cattail	*Typha latifolia*
common chickweed*	*Stellaria media*
common cord-moss	*Funaria hygrometrica*
common dandelion*	*Taraxacum officinale*
common draba*	*Draba verna*
common duckweed	*Lemna minor*
common hook-moss	*Drepanocladus aduncus*
common horsetail	*Equisetum arvense*
common hound's-tongue*	*Cynoglossum officinale*
common juniper	*Juniperus communis*
common leafy moss	*Plagiomnium medium*
common mare's-tail	*Hippuris vulgaris*
common plantain	*Plantago major*
common rabbit-brush	*Ericameria nauseosus*
common snowberry	*Symphoricarpos albus*
common spike-rush	*Eleocharis palustris*
common St. John's-wort*	*Hypericum perforatum*
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*
cowherb*	*Vaccaria pyramidata*
cow-parsnip	*Heracleum maximum*
crane’s bill moss	*Atrichum selwynii*
creamy peavine	*Lathyrus ochroleucus*
creeping feathermoss	*Amblystegium serpens*

Common Name	Latin Name
crested wheatgrass	*Agropyron cristatum*
crowned pixie-cup	*Cladonia carneola*
curly heron's-bill moss	*Dicranum fuscescens*
cut-leaved anemone	*Anemone multifida*
cut-leaved daisy	*Erigeron compositus*
dalmatian toadflax*	*Linaria genistifolia*
devil's club	*Oplopanax horridus*
Dewey's sedge	*Carex deweyana*
diffuse fleabane	*Erigeron divergens*
diffuse knapweed*	*Centaurea diffusa*
dog pelt	*Peltigera canina*
dogbane	*Apocynum sp.*
Douglas' campion	*Silene douglasii*
Douglas' knotweed	*Polygonum douglasii* ssp. *douglasii*
Douglas maple	*Acer glabrum*
Douglas' water-hemlock	*Cicuta douglasii*
Douglas-fir	*Pseudotsuga menziesii*
dwarf blueberry	*Vaccinium caespitosum*
dwarf rattlesnake orchid	*Goodyera repens*
dwarf red raspberry	*Rubus pubescens*
early blue violet	*Viola adunca*
edible thistle	*Cirsium edule*
electrified cat's-tail moss	*Rhytidiadelphus triquetrus*
elegant beaked-moss	*Eurhynchium pulchellum*
enchanter's-nightshade	*Circaea alpina*
false melic	*Schizachne purpurascens*
false Solomon's-seal	*Smilacina racemosa = Maianthemum racemosum*
falsebox	*Paxistima myrsinites*
false-polytrichum	*Timmia austriaca*
felt pelt	*Peltigera ponojensis*
felt pelt	*Peltigera rufescens*
Fendler's bluegrass	*Poa fendleriana*
fern-leaved desert-parsley	*Lomatium dissectum*
few-flowered shootingstar	*Dodecatheon pulchellum*
field filago*	*Filago arvensis*
field mint	*Mentha arvensis*
field pussytoes	*Antennaria neglecta*
field sedge	*Carex praegracilis*
fire moss	*Ceratodon purpureus*
fireweed	*Epilobium angustifolium*
fleabane	*Erigeron sp.*
flixweed*	*Descurainia sophia*
forklet-moss	*Dicranella sp.*
fowl bluegrass	*Poa palustris*
foxtail barley	*Hordeum jubatum*
fragile fern	*Cystopteris fragilis*
freckle pelt	*Peltigera aphthosa*
freckle plet	*Peltigera leucophlebia*
fringecup	*Tellima grandiflora*
frost-soldiers	*Cladonia ecmocyna*
Geyer's desert-parsley	*Lomatium geyeri*
giant wildrye	*Leymus cinereus*
glow moss	*Aulacomnium palustre*
golden curl-moss	*Homalothecium aeneum*
golden-aster	*Heterotheca villosa*
graceful cinquefoil	*Potentilla gracilis*
great duckmeat	*Spirodela polyrhiza*

Common Name	Latin Name
great mullein*	*Verbascum thapsus*
great northern aster	*Aster modestus*
greater bladderwort	*Utricularia macrorhiza*
greater felt-soldiers	*Cladonia phyllophora*
green needlegrass	*Nassella viridula*
green wintergreen	*Pyrola chlorantha*
green-flowered bog orchid	*Platanthera hyperborea*
green-tongue liverwort	*Marchantia polymorpha*
grey reindeer	*Cladina rangiferina*
grey rock moss	*Racomitrium canescens*
hair bentgrass	*Agrostis scabra*
haircap moss	*Polytrichum sp.*
hairy vetch*	*Vicia villosa*
harsh paintbrush	*Castilleja hispida*
hawkweed	*Hieracium sp.*
heart-leaved arnica	*Arnica cordifolia*
hemlock water-parsnip	*Sium suave*
hemp	*Apocynum cannabinum*
heron's-bill moss	*Dicranum sp.*
Holboell's rockcress	*Arabis holboellii*
Hood's sedge	*Carex hoodii*
Hooker's fairybells	*Disporum hookeri = Prosartes hookeri*
hook-moss	*Drepanocladus sp.*
hybrid white spruce	*Picea engelmannii x glauca*
icelandmoss	*Cetraria islandica*
Idaho fescue	*Festuca idahoensis*
ivy-leaved duckweed	*Lemna trisulca*
Japanese brome*	*Bromus japonicus*
jointed rush	*Juncus articulatus*
junegrass	*Koeleria macrantha*
juniper haircap moss	*Polytrichum juniperinum*
Kentucky bluegrass	*Poa pratensis*
kinnikinnick	*Arctostaphylos uva-ursi*
knight's plume	*Ptilium crista-castrensis*
lady fern	*Athyrium filix-femina*
lamb's-quarters	*Chenopodium album*
lance-leaved stonecrop	*Sedum lanceolatum*
large-flowered blue-eyed Mary	*Collinsia grandiflora*
large-fruited desert-parsley	*Lomatium macrocarpum*
large-leaved avens	*Geum macrophyllum*
lawn moss	*Brachythecium albicans*
leafy moss	*Mnium sp.*
leafy moss	*Plagiomnium sp.*
leafy moss	*Rhizomnium sp.*
lemonweed	*Lithospermum ruderale*
lesser green reindeer	*Cladina mitis*
lesser green reindeer	*Cladina mitis*
lesser sulphur-cup	*Cladonia deformis*
lesser wintergreen	*Pyrola minor*
Lindley's aster	*Aster ciliolatus*
linear-leaved daisy	*Erigeron linearis*
little buttercup	*Ranunculus uncinatus*
little meadow-foxtail	*Alopecurus aequalis*
little tarweed	*Madia exigua*
littlebells polemonium	*Polemonium micranthum*
littlepod flax*	*Camelina microcarpa*
lodgepole pine	*Pinus contorta*

Common Name	Latin Name
Loesel's tumble-mustard*	*Sisymbrium loeselii*
long-flowered bluebells	*Mertensia longiflora*
long-leaved aster	*Aster ascendens*
long-leaved fleabane	*Erigeron corymbosus*
long-spurred plectritis	*Plectritis macrocera*
lousewort	*Pedicularis sp.*
low northern sedge	*Carex concinna*
low pussytoes	*Antennaria dimorpha*
mariposa lily	*Calochortus sp.*
meadow birds-foot trefoil	*Lotus denticulatus*
meadow brome*	*Bromus commutatus*
meadow death-camas	*Zigadenus venenosus*
meadow horsetail	*Equisetum pratense*
meadow salsify*	*Tragopogon pratensis*
meadow saxifrage	*Saxifraga nidifica*
meadow sedge	*Carex praticola*
mealy pixie-cup	*Cladonia chlorophaea*
Menzies' neckera	*Metaneckera menziesii*
miner's funnel	*Cladonia cenotea*
miner's-lettuce	*Claytonia perfoliata*
mock-orange	*Philadelphus lewisii*
Montana larkspur	*Delphinium bicolor* ssp. *bicolor*
mountain alder	*Alnus incana* ssp. *tenuifolia*
mountain cliff fern	*Woodsia scopulina*
mountain ladyslipper	*Cypripedium montanum*
mountain sweet-cicely	*Osmorhiza berteroi*
mouse-ear chickweed*	*Cerastium fontanum*
n/a (lichen)	*Acarospora schleicheri*
n/a (lichen)	*Cladina arbuscula*
n/a (lichen)	*Cladonia cornuta*
n/a (lichen)	*Cladonia crispata*
n/a (lichen)	*Cladonia gracilis*
n/a (lichen)	*Fulgensia bracteata*
n/a (lichen)	*Lepraria sp.*
n/a (lichen)	*Ochrolechia upsaliensis*
n/a (liverwort)	*Barbilophozia sp.*
n/a (liverwort)	*Lophozia sp.*
n/a (liverwort)	*Ricciocarpos natans*
n/a (moss)	*Brachydontium sp.*
n/a (moss)	*Dicranum acutifolium*
n/a (moss)	*Peltolepis sp.*
n/a (vascular plant)	*Arabis sp.*
n/a (vascular plant)	*Aster sp.*
n/a (vascular plant)	*Astragalus sp.*
n/a (vascular plant)	*Cardamine oligosperma*
n/a (vascular plant)	*Claytonia sp.*
n/a (vascular plant)	*Fritillaria sp.*
n/a (vascular plant)	*Lithospermum sp.*
n/a (vascular plant)	*Lomatium sp.*
n/a (vascular plant)	*Melilotus sp.*
n/a (vascular plant)	*Myosotis sp.*
n/a (vascular plant)	*Myriophyllum sp.*
n/a (vascular plant)	*Opuntia sp.*
n/a (vascular plant)	*Oxytropis sp.*
n/a (vascular plant)	*Polygonum sp.*
n/a (vascular plant)	*Rumex sp.*
n/a (vascular plant)	*Senecio sp.*

Common Name	Latin Name
n/a (vascular plant)	*Smilacina sp.*
narrow-leaved montia	*Montia linearis*
needle-and-thread grass	*Stipa comata = Hesperostipa comata*
Nevada bluegrass	*Poa secunda* ssp. *juncifolia*
nine-leaved desert-parsley	*Lomatium triternatum*
nodding thread-moss	*Pohlia nutans*
nodding wood-reed	*Cinna latifolia*
Nootka rose	Rosa nutkana
northern bedstraw	*Galium boreale*
northern blackcurrant	*Ribes hudsonianum*
northern gooseberry	*Ribes oxyacanthoides*
northern mannagrass	*Glyceria borealis*
northern scouring-rush	*Equisetum variegatum*
northern wormwood	*Artemisia campestris*
northwestern sedge	*Carex concinnoides*
Nuttall's pussytoes	*Antennaria parvifolia*
oak fern	*Gymnocarpium dryopteris*
oceanspray	*Holodiscus discolor*
old man's whiskers	*Geum triflorum*
one-leaved foamflower	*Tiarella trifoliata var. unifoliata*
one-sided wintergreen	*Orthilia secunda*
one-spike oatgrass	*Danthonia unispicata*
orange arnica	*Arnica fulgens*
orchardgrass*	*Dactylis glomerata*
orchid	*Platanthera sp.*
paintbrush	*Castilleja sp.*
paper birch	*Betula papyrifera*
parsley fern	*Cryptogramma acrostichoides*
parsnip-flowered buckwheat	*Eriogonum heracleoides*
pasture sedge	*Carex petasata*
pathfinder	*Adenocaulon bicolor*
pearly everlasting	*Anaphalis margaritacea*
pebbled pixie-cup	*Cladonia pyxidata*
peg-leg soldiers	*Cladonia cariosa*
pelt lichens	*Peltigera sp.*
penstemon	*Penstemon sp.*
perennial sow-thistle*	*Sonchus arvensis*
Philadelphia fleabane	*Erigeron philadelphicus*
pin cherry	*Prunus pensylvanica*
pinedrops	*Pterospora andromedea*
pinegrass	*Calamagrostis rubescens*
pink twink	*Phlox gracilis*
pink wintergreen	*Pyrola asarifolia*
plains prickly-pear cactus	*Opuntia polyacantha*
poison ivy	*Toxicodendron rydbergii*
ponderosa pine	*Pinus ponderosa*
pondweed	*Potamogeton sp.*
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*
pumpelly brome*	*Bromus inermis* ssp. *pumpellianus*
purple peavine	*Lathyrus nevadensis*
purple-leaved willowherb	*Epilobium ciliatum*
pussytoes	*Antennaria sp.*

Common Name	Latin Name
Pyrenean sedge	*Carex pyrenaica*
quackgrass*	*Elymus repens*
queen's cup	*Clintonia uniflora*
racemose pussytoes	*Antennaria racemosa*
ragged moss	*Brachythecium sp.*
rattlesnake-plantain	*Goodyera oblongifolia*
rayless mountain butterweed	*Senecio indecorus*
red raspberry	*Rubus idaeus*
red three-awn	*Aristida longiseta*
red-mouthed leafy moss	Mnium spinulosum
red-osier dogwood	*Cornus stolonifera*
redstem ceanothus	*Ceanothus sanguineus*
red-stemmed feathermoss	*Pleurozium schreberi*
reed canarygrass	*Phalaris arundinacea*
reindeer lichens	*Cladina sp.*
Richardson's sedge	*Carex richardsonii*
rock-moss	*Racomitrium sp.*
Rocky Mountain fescue	*Festuca saximontana*
Rocky Mountain juniper	*Juniperus scopulorum*
rose	*Rosa sp.*
rosetted pixie-cup	*Cladonia pocillum*
Ross' sedge	*Carex rossii*
rough fescue	*Festuca campestris*
rough-fruited fairybells	*Disporum trachycarpum = Prosartes trachycarpa*
rough-leaved ricegrass	*Oryzopsis asperifolia*
round-leaved alumroot	*Heuchera cylindrica*
sagebrush buttercup	*Ranunculus glaberrimus*
sagebrush mariposa lily	*Calochortus macrocarpus*
salsify*	*Tragopogon sp.*
sand dropseed	*Sporobolus cryptandrus*
Sandberg's bluegrass	*Poa secunda* ssp. *secunda*
saskatoon	*Amelanchier alnifolia*
scale lichens	*Psora sp.*
scarlet gilia	*Ipomopsis aggregata*
scarlet paintbrush	*Castilleja miniata*
Scouler's willow	*Salix scouleriana*
Scouler's hawkweed	*Hieracium scouleri*
scouring-rush	*Equisetum hyemale*
screw-moss	*Tortula sp.*
sedge	*Carex sp.*
self-heal	*Prunella vulgaris*
shaggy fleabane	*Erigeron pumilus*
sheep sorrel	*Rumex acetosella*
shining starwort	*Stellaria nitens*
showy aster	*Aster conspicuus*
showy daisy	*Erigeron speciosus*
showy pussytoes	*Antennaria pulcherrima*
shrubby penstemon	*Penstemon fruticosus*
sidewalk moss	*Tortula ruralis*
silky lupine	*Lupinus sericeus*
silverleaf phacelia	*Phacelia hastata*
Sitka columbine	*Aquilegia formosa*
six-weeks grass	*Vulpia octoflora*
skunk cabbage	*Lysichiton americanum*
slender hawksbeard	*Crepis atribarba*
small bedstraw	*Galium trifidum*
small bur-reed	*Sparganium nutans*

Common Name	Latin Name
small yellow water-buttercup	*Ranunculus gmelinii*
small-flowered blue-eyed Mary	*Collinsia parviflora*
small-flowered forget-me-not	*Myosotis laxa*
small-flowered penstemon	*Penstemon procerus*
small-flowered woodland star	*Lithophragma parviflorum*
small-leaved montia	*Montia parvifolia*
smooth brome*	*Bromus inermis*
smooth sumac	*Rhus glabra*
snow buckwheat	*Eriogonum niveum*
snowbrush	*Ceanothus velutinus*
soft brome*	*Bromus hordeaceus*
soft-stemmed bulrush	*Scirpus validus = Schoenoplectus tabernaemontani*
soopolallie	*Shepherdia canadensis*
speedwell	*Veronica sp.*
spotted coralroot	*Corallorhiza maculata*
spreading dogbane	*Apocynum androsaemifolium*
spreading needlegrass	*Stipa richardsonii = Achnatherum richardsonii*
squaw currant	*Ribes cereum*
star-flowered false Solomon's-seal	*Smilacina stellata = Maianthemum stellatum*
starwort	*Stellaria sp.*
step moss	*Hylocomium splendens*
stepladdered pixie-cup	*Cladonia macrophyllodes*
sticky cinquefoil	*Potentilla glandulosa*
sticky currant	*Ribes viscosissimum*
stiff needlegrass	*Stipa occidentalis = Achnatherum occidentale*
stinging nettle	*Urtica dioica*
stipplescale lichens	*Catapyrenium sp.*
stream violet	*Viola glabella*
streambank butterweed	*Senecio pseudaureus*
striped coralroot	*Corallorhiza striata*
sulphur buckwheat	*Eriogonum umbellatum*
sulphur cinquefoil*	*Potentilla recta*
swale desert-parsley	*Lomatium ambiguum*
sweet-cicely	*Osmorhiza sp.*
sweet-scented bedstraw	*Galium triflorum*
tall annual willowherb	*Epilobium brachycarpum*
tall larkspur	*Delphinium glaucum*
tall mannagrass	*Glyceria elata*
tall Oregon-grape	*Mahonia aquifolium*
tall tumble-mustard*	*Sisymbrium altissimum*
tamarisk-moss	*Thuidium sp.*
tarpaper lichens	*Collema sp.*
tarragon	*Artemisia dracunculus*
tea-leaved willow	*Salix planifolia*
thatch soldiers	*Cladonia symphycarpia*
thick-headed sedge	*Carex pachystachya*
thimbleberry	*Rubus parviflorus*
Thompson's paintbrush	*Castilleja thompsonii*
thread-leaved fleabane	*Erigeron filifolius*
thread-leaved phacelia	*Phacelia linearis*
thread-moss	*Bryum sp.*
three-spot mariposa lily	*Calochortus apiculatus*
thyme-leaved sandwort*	*Arenaria serpyllifolia*
thyme-leaved speedwell*	*Veronica serpyllifolia*
tiger lily	*Lilium columbianum*
timber milk-vetch	*Astragalus miser*
timmia	*Timmia sp.*

Common Name	Latin Name
trailing fleabane	*Erigeron flagellaris*
trembling aspen	*Populus tremuloides*
triple-nerved fleabane	*Erigeron subtrinervis*
tufted thread-moss	*Bryum caespiticium*
twinflower	*Linnaea borealis*
umber pussytoes	*Antennaria umbrinella*
upland larkspur	*Delphinium nuttallianum*
Utah honeysuckle	*Lonicera utahensis*
violet	*Viola sp.*
viper's bugloss*	*Echium vulgare*
Wallace's selaginella	*Selaginella wallacei*
wapato	*Sagittaria latifolia*
water birch	*Betula occidentalis*
water smartweed	*Polygonum amphibium*
wavy-leaved moss	*Dicranum polysetum*
wavy-leaved thistle	*Cirsium undulatum*
western fescue	*Festuca occidentalis*
western groundsel	*Senecio integerrimus*
western larch	*Larix occidentalis*
western meadowrue	*Thalictrum occidentale*
western mountain-ash	*Sorbus scopulina*
western polypody	*Polypodium hesperium*
western redcedar	*Thuja plicata*
western springbeauty	*Claytonia lanceolata*
western trumpet	*Lonicera ciliosa*
western yew	*Taxus brevifolia*
Wheeler's bluegrass	*Poa wheeleri*
white clematis	*Clematis ligusticifolia*
white hawkweed	*Hieracium albiflorum*
white pussytoes	*Antennaria microphylla*
white-veined wintergreen	*Pyrola picta*
wild sarsaparilla	*Aralia nudicaulis*
wild strawberry	*Fragaria virginiana*
wildrye	*Elymus sp.*
willow	*Salix sp.*
willowherb	*Epilobium sp.*
wintergreen	*Pyrola sp.*
wood strawberry	*Fragaria vesca*
woolly sedge	*Carex lanuginosa*
woolly willow	*Salix lanata*
worm-leaved stonecrop	*Sedum stenopetalum*
yarrow	*Achillea millefolium*
yellow bell	*Fritillaria pudica*
yellow iris*	*Iris pseudacorus*
yellow sagebrush violet	*Viola vallicola*
yellow salsify*	*Tragopogon dubius*

Appendix F:
Sensitive Ecosystems (SEI) Units[164] and related Terrestrial Ecosystem Mapping (TEM) units.

Sensitive Ecosystems

SEI Unit	Code	TEM Unit	Code[165]	Subzone / Site Series
Wetland, marsh	WN:ms	Bulrush marsh	BM	IDFxh1 /00
		Baltic rush marsh-meadow	BR	IDFxh1 /00
		Common spikerush marsh	CS	IDFxh1 /00
		Cattail marsh	CT	IDFxh1 /00 PPxh1 /00
		Sedge marsh	SM	IDFxh1 /00
Wetland, swamp	WN:sp	Willow – Sedge wetland	WS	IDFxh1 /09
Wetland, shallow open water	WN:sw	Shallow open water	OW	IDFxh1 /00 PPxh1 /00
		Pond	PD	IDFxh1 /00 PPxh1 /00
Riparian, bench	RI:fp	Trembling aspen – Mock orange – Choke cherry riparian	AOa, AOt	IDFxh1 /00
		Black cottonwood – Douglas-fir – Common snowberry – Red-osier dogwood riparian	CDa, CDac, CDct, CDt	IDFxh1 /00
		Douglas-fir – Water birch – Douglas maple	DMa, DMct, DMt	PPxh1 /08
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DSa, DSt	IDFxh1 /07
		Ponderosa pine – Black cottonwood – Snowberry riparian	PAa, PAac, PAt	PPxh1 /00
		Western red cedar – Douglas-fir – False Solomon's Seal	RSa, RSac	IDFxh1 /00
		Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	SDa, SDac, SDt	IDFxh1 /08
Riparian, gully	RI:gu	Trembling aspen – Mock orange – Choke cherry riparian	AOg	IDFxh1 /00
		Black cottonwood – Douglas-fir – Common snowberry – Red-osier dogwood riparian	CDg	IDFxh1 /00

[164] *See* page 10 for SEI unit descriptions.

[165] All site modifier combinations, structural stages, and seral associations are included unless otherwise noted. Seral stages are indicated by the two letters following a '$' (e.g., $kw). Structural stages are indicated by a number (e.g. '7'). Structural stage stand composition modifiers are indicated by a capital letter after the number (e.g., 'C' in '7C'). *See* Volume 2 (Iverson et al. 2003) for descriptions of site modifiers, structural stages, seral associations, and TEM units.

Sensitive Ecosystems

SEI Unit	Code	TEM Unit	Code	Subzone / Site Series
Riparian, gully	RI:gu	Douglas-fir – Water birch – Douglas maple	DMg	PPxh1 /08
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DScg, DSfg, DSg	IDFxh1 /07 PPxh1 /07
		Western red cedar – Douglas-fir – False Solomon's Seal	RS, RSg	IDFxh1 /00
		Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	SDcg, SDg, SDgw	IDFxh1 /08
Riparian, fringe	RI:ff	Trembling aspen – Mock orange – Choke cherry riparian	AO	IDFxh1 /00
		Black cottonwood – Douglas-fir – Common snowberry – Red-osier dogwood riparian	CD, CDc, CDcn, CDs	IDFxh1 /00
		Douglas-fir – Water birch – Douglas maple	DM	PPxh1 /08
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DSn	IDFxh1 /07
		Ponderosa pine – Black cottonwood – Snowberry riparian	PA	PPxh1
		Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	SD, SDc, SDf, SDk, SDkn, SDn	IDFxh1 /08
Riparian, river	RI:ri	River	RI	PPxh1 /00
Old Forest, coniferous	OF:co	Douglas-fir – Ponderosa pine – Pinegrass	DP 7C	IDFxh1 /01
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 7C (except those with 'a', 'g', or 't' modifiers)	IDFxh1 /07
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Pinegrass	DW 7C	IDFxh1 /03
		Douglas-fir – Ponderosa pine – Saskatoon – Mock orange	FO 7C	IDFxh1 /00
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Balsamroot	PB 7C	IDFxh1/02
		Douglas-fir – Ponderosa pine – Snowbrush – Pinegrass	SP 7C	IDFxh1 /04
Grassland, grassland	GR:gr	Rough fescue – Bluebunch wheatgrass	FB	PPxh1 /00
		Rough fescue – Cladina	FC	IDFxh1 /00
		Idaho fescue – Bluebunch wheatgrass	FW, FW:$nb	IDFxh1 /91
		Giant wildrye	GW	PPxh1 /00

Sensitive Ecosystems

SEI Unit	Code	TEM Unit	Code	Subzone / Site Series
Grassland, grassland	GR:gr	Big sagebrush – Bluebunch wheatgrass – Balsamroot	WA (no seral association)	IDFxh1 /92
		Bluebunch wheatgrass – Balsamroot	WB (no seral association)	IDFxh1 /93 PPxh1 /00
Grassland, shrubland	GR:sh	Prairie Rose – Idaho fescue	RF	IDFxh1 /97
		Snowberry – Rose – Kentucky bluegrass	SR	PPxh1 /00
		Saskatoon – Common snowberry	SS	IDFxh1 /00
Broadleaf woodland, aspen copse	BW:ac	Trembling aspen – Snowberry – Kentucky bluegrass	AS (structural stage 2-6)	IDFxh1 /00 PPxh1 /00
Broadleaf woodland, aspen seepage	BW:as	Trembling aspen – Common snowberry – Mountain sweet-cicely	AM (structural stage 2-6)	IDFxh1 /00
Coniferous Woodland	WD	Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Pinegrass	DW (only those with 'r' or 'v' modifiers; structural stage 2-6)	IDFxh1 /03
		Douglas-fir – Ponderosa pine – Saskatoon – Mock orange	FO (structural stage 2-6)	IDFxh1 /00
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Balsamroot	PB (structural stage 2-6)	IDFxh1 /02
		Ponderosa pine – Bluebunch wheatgrass – Cheatgrass	PC (structural stage 2-6)	PPxh1 /04
		Ponderosa pine – Bluebunch wheatgass – Rough fescue	PF (structural stage 2-6)	PPxh1 /05
		Ponderosa pine – Red three-awn	PT (structural stage 2-6)	PPxh1 /02
		Ponderosa pine – Bluebunch wheatgrass – Idaho fescue	PW (structural stage 2-6)	PPxh1 /01
Sparsely Vegetated, rock outcrop	SV:ro	Selaginella – Bluebunch wheatgrass rocky bluff	SB (no seral association)	IDFxh1 /00 PPxh1 /00
		Rock outcrop	ROr, ROw, ROz	IDFxh1 /00 PPxh1 /00
Sparsely Vegetated, shrub	SV:sh	Choke cherry – Bluebunch wheatgrass rocky bluff	CW	IDFxh1 /00
		Antelope brush - Selaginella	SA	IDFxh1 /00
Sparsely Vegetated, talus	SV:ta	Saskatoon – Mock orange talus	SO	IDFxh1 /00 PPxh1 /00

Sensitive Ecosystems

SEI Unit	Code	TEM Unit	Code	Subzone / Site Series
Sparsely Vegetated, talus		Talus	Taw	IDFxh1 /00 PPxh1 /00
Sparsely Vegetated, cliff	SV:cl	Cliff	CL	IDFxh1 /00 PPxh1 /00

Other Important Ecosystems

SEI Unit	Code	TEM Unit	Code[166]	Subzone / Site Series
Mature Forest, broadleaf	MF:bd	Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 6B	IDFxh1 /07
Mature Forest, coniferous	MF:co	Douglas-fir – Ponderosa pine – Pinegrass	DP 6C	IDFxh1 /01
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 6C (except those with 'a', g', or 't' modifiers)	IDFxh1 /07 PPxh1 /07
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Pinegrass	DW 6C (except those with 'r' and 'v' modifiers)	IDFxh1 /03
		Douglas-fir – Ponderosa pine – Snowbrush – Pinegrass	SP 6C	IDFxh1 /04 PPxh1 /06
Mature Forest, mixed	MF:mx	Douglas-fir – Ponderosa pine – Pinegrass	DP 6M	IDFxh1 /01
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 6M (except those with 'a', 'g', or 't' modifiers)	IDFxh1 /07 PPxh1 /07
Disturbed Grassland	DG	Kentucky bluegrass – Stiff needlegrass	BN	IDFxh1 /96
		Idaho fescue – Bluebunch wheatgrass	FW:$wk	IDFxh1 /91
		Bluebunch wheatgrass – Balsamroot	WB:$kw, $nc, and $wk	IDFxh1 /93 PPxh1 /00

[166] All site modifier combinations, structural stages, and seral associations are included unless otherwise noted.

Appendix G: Conservation Evaluation Criteria

The following conservation criteria are those used primarily for evaluating forested ecosystems (*see* Landscape section below for a definition). Other types of ecosystems have somewhat differing conservation evaluation criteria. For the purposes of this project, we evaluated quality and condition together and evaluated viability but not defensibility. Evaluations were done only for sensitive ecosystems and were primarily done from interpretation of aerial photographs, thus we were often not able to evaluate for factors such as introduced species.

CONDITION:

Condition is a combined measure of the biotic and abiotic factors, the plants, animals, soil and site characteristics and also the ecological processes that influence the ecosystem at that site. Condition can be assessed by the degree of ***anthropogenic*** impacts (fragmentation, alteration of natural disturbance regimes, presence of introduced species, etc.) and the presence of biological legacies (critical features that require generations or centuries to develop, e.g. large coarse woody debris in old growth forest). Thus, the degree of human disturbance and influence of introduced species are considered when making these assessments. The following criteria are applied to the forested ecosystem type.

Excellent (1):

Criterion 1: No anthropogenic disturbances have altered the site (this includes fire exclusion as an anthropogenic disturbance), no vegetation or soil removal has occurred.

Criterion 2: No introduced species occur at the site.

Criterion 3: No man-made structures occur at the site.

Criterion 4: There is little to no fragmentation (< 5%) of the occurrence or its surrounding landscape, by anthropogenic activities or structures.

Good (2):

Criterion 1: No soil removal or disturbance to soil surface has occurred; little or no influence of old road beds or skid tracks, no construction evidence, old selection harvesting only, minimal influence of fire exclusion.

Criterion 2: Minor cover (<5%) of introduced species occurs at the site.

Criterion 3: Some man-made structures may occur at the site (< 2% of total area of occurrence).

Criterion 4: There is minimal fragmentation (<5%) of the occurrence and moderate fragmentation (5-25%) of the surrounding landscape.

Marginal (3):

Criterion 1: Some anthropogenic disturbances have occurred on site.

Criterion 2: Significant cover of introduced species occurs at the site (5-20% in forests and riparian systems, up to 50 % in grasslands).

Criterion 3: Some man-made structures may be present (less than 10% of total area).

Criterion 4: The element occurrence has minimal fragmentation (<5%) but the surrounding landscape is fragmented (>25%) by anthropogenic development and current use, although still primarily vegetated (i.e. rural areas).

Poor (4):

Criterion 1: Significant anthropogenic disturbances have occurred, particularly removal/disturbance of soil materials and vegetation.

Criterion 2: Introduced species may dominate a vegetation layer or may total more than 20% (>50% for grasslands) cover overall.

Criterion 3: Significant man-made structures occur (>10% of total area of occurrence).

Criterion 4: The element occurrence is fragmented and also located within a matrix of heavily fragmented and urbanized landscape.

QUALITY:

Quality is a measure of how well the specified occurrence of the ecosystem represents the biological and ecological functions of the ecosystem. The presence of well-developed structure and species composition that includes characteristic species of that community is assessed. The occurrence of uncommon species also implies good habitat quality and some historical continuity. The size of the occurrence (minimum dynamic area, or use the home range of a species that is typical of that system or community) is considered. Size criteria will vary for matrix (e.g. forest) or patch (e.g. wetland) type ecosystems.

Excellent: (1)

Criterion 1: Species composition, stand structure, and site factors identify the mature climax stage of a known rare plant community.

Criterion 2: The size of the occurrence is sufficiently large to allow natural disturbance regimes to occur without completely destroying the occurrence. (Rule of thumb in theory of patch dynamics and disturbance ecology: the size of a community needs to be the size of the largest natural disturbance to that community or system over a 500-1000 yr. time frame.) Here, for forests, the most important conservation criteria is size combined with forest structure and fuel loadings that would allow wildfires to burn with fire-effects similar to those that occurred historically; i.e. it would not be a stand replacing fire and the ecosystem is 'resilient' to natural disturbance. The forests do not have to be as big as the largest natu-

ral disturbance (would have been huge) as the disturbance regime historically resulted in minimal structural, compositional, and functional rearrangement in the ecosystem – i.e. the quality and condition of the ecosystem were very similar before and after the disturbance.

Criterion 3: Natural succession is in process (i.e. not thinned or spaced: forests have not become ingrown, fire regime has been maintained within natural parameters); old trees dominate the site.

Good: (2)

Criterion 1: Species composition and site factors readily identify the younger seral stages of a known rare plant community; recognizable as the plant community although not all characteristics of old forests may be present.

Criterion 2: Sufficient size to absorb effects of a medium-scale natural disturbance.

Criterion 3: Natural succession is in process and natural disturbance regimes are within their range of natural variability (fire, windthrow, etc.)

Marginal: (3)

Criterion 1: Species composition and site factors indicate the younger stages of a known rare plant community or an older rare forested plant community that has become ingrown; identification reasonably certain.

Criterion 2: Sufficient size to absorb effects of a small-scale natural disturbance.

Criterion 3: Successional pattern has been altered by anthropogenic activities; stand has been had some forest harvesting.

Poor: (4)

Criterion 1: Species composition and site factors tentatively identify younger seral stages of a known rare plant community.

Criterion 2: Insufficient size to absorb effects of even small-scale natural disturbance.

Criterion 3: Successional pattern has been altered; stand origin from anthropogenic activities and on-going management is evident (e.g. planting, spacing, thinning, grazing, alterations to natural hydrologic regime).

DEFENSIBILITY:

This attribute is an assessment of both the present and future conditions of the Element Occurrence as to whether it can be protected from outside influences. Again the Landscape context plays an integral role in determining the extent to which the Element Occurrence can be protected from adjacent land use practices. For present effects, *see* above. Presence of a natural buffer around the plant community, which can absorb or filter out the effects of adjacent land use, is a key factor.

Excellent (1):

Criterion 1: The element is of significant size to absorb natural disturbances.

Criterion 2: The element has a natural buffer sufficiently large to reduce impact of disturbances and edge effects.

Criterion 3: The element is completely protected from anthropogenic disturbances.

Good (2):

Criterion 1: The element is large enough to absorb minor natural disturbances.

Criterion 2: The element has a natural buffer sufficiently large to reduce impact of disturbances and edge effects.

Criterion 3: The element is somewhat protected from anthropogenic disturbances.

Marginal (3):

Criterion 1: The element is not large enough to absorb minor natural disturbances.

Criterion 2: The element has a partial buffer which can somewhat reduce impact of disturbances and edge effects.

Criterion 3: The element is somewhat protected from anthropogenic disturbances

Poor (4):

Criterion 1: The element is not large enough to absorb minor natural disturbances.

Criterion 2: The element has no natural area buffer and it cannot be protected form disturbances and edge effects.

Criterion 3: The element is not protected from anthropogenic disturbances

VIABILITY:

Viability considers the long-term prospects for continued existence of the plant community occurrence by assessing the surrounding land use (Landscape Context) and management practices. Ratings are most often based on the known present conditions (Condition and Quality) but an assessment of the Defensibility of the site is made if there is additional known information. The viability assessment essentially answers the following question: If there is no change in the present circumstances, will the plant community continue to exist over the next 20+ years?

Excellent (1):

Criterion 1: The element is of significant size and has the structure and fuel loading necessary to absorb natural disturbances.

Criterion 2: The element has a natural buffer sufficiently large to reduce impact of disturbances and edge effects.

Criterion 3: The element is completely protected from anthropogenic disturbances.

Criterion 4: Surrounding landscape is not fragmented by anthropogenic influences (e.g. road or other transportation corridors, extensive harvesting, settlements or urban development, industrial activity)

Good (2):

Criterion 1: The element is large enough and has the structure and fuel loading necessary to absorb minor natural disturbances.

Criterion 2: The element has a natural buffer sufficiently large to reduce impact of disturbances and edge effects.

Criterion 3: The element is somewhat protected from anthropogenic disturbances.

Criterion 4: The surrounding landscape is partially fragmented (less than 25% of surrounding area is impacted)

Marginal (3):

Criterion 1: The element is not large enough or has become too altered to absorb minor natural disturbances.

Criterion 2: The element has a partial buffer which can somewhat reduce impact of disturbances and edge effects.

Criterion 3: The element is somewhat protected from anthropogenic disturbances.

Criterion 4: The surrounding landscape is

Poor: (4):

Criterion 1: The element is not large enough or has become too altered to absorb minor natural disturbances.

Criterion 2: The element has no natural area buffer and it cannot be protected form disturbances and edge effects.

Criterion 3: The element is not protected from anthropogenic disturbances.

LANDSCAPE CONTEXT:

In the absence of detailed site information, long term viability of some ecosystems can be assessed using size of the site under study and landscape features. These features can be determined from existing mapping information by placing the site under study within a larger "landscape context". Landscape context is a measure of two criteria, connectivity to other communities and intactness of surrounding ecological processes, and environmental regimes. Ecosystem types can be categorized according to how they are influenced by, and respond to, the surrounding landscape processes. The BC Conservation Data Centre applies the following descriptors to ecosystems when assessing Landscape context.

A ***Matrix*** ecosystem occupies a very large area with high connectivity to other community types; in the study area, forests, and lower elevation grasslands east of Kelowna, are typically matrix ecosystems. Matrix types that depend on easily disrupted ecological processes occurring at a scale larger than the individual community (e.g. fire dependent) are most at risk by what hap-

pens in surrounding landscape. With Matrix ecosystems, size of the area under study has priority over landscape context, which has priority over Condition of the site. Consequently, if there is no detailed information available on the condition of the ecosystems, a viability assessment can still be determined.

The ***Large Patch*** ecosystem occupies 'middle ground' between matrix and small patch types (some may be more similar to matrix or to small patch types). In the study area, coniferous woodlands best express these ecosystem types. For these ecosystems, condition has priority over size, which has priority over landscape context. Therefore, without detailed information on condition of the site, it is difficult to assess the viability of the area.

Small Patch ecosystems occupy small areas, tend to vary less in size than large patch and matrix communities, contain more specialised species and are sensitive to factors affecting landscape context. In the study area, wetlands and sparsely vegetated ecosystems are typical of small patch ecosystems. In this case condition has priority over landscape context which has priority over size. Again, without detailed information on the ecosystem, assessment of long term viability must lean most heavily on landscape context. If it is an ecosystem strongly affected by its hydrological regime, more emphasis should be placed on landscape context.

Linear ecosystem types have a large amount of edge and are typically dependent on currents or water flow regimes, are generally very sensitive to factors affecting landscape context and often support specialised species. Riparian ecosystems are typical linear ecosystems. Landscape Context has priority over Condition, which has priority over Size. In this case, landscape context has significant influence over long term viability.

Excellent (1): The surrounding landscape has little to no fragmentation due to anthropogenic influences (no roads, other transportation corridors, rural settlement or urban developments, no industrial activity or recent forest harvesting). The community occurs within a larger landscape that has some formal protected status (e.g. Federal or Provincial park/reserve, where no development or resource extraction is allowed). There may be some defacto protection where no future development is foreseen, e.g. access restricts use and there is no known plan to develop or disturb present conditions, or the site is protected by conservation covenants.

Good (2): The larger landscape context provides some protection from anthropogenic disturbance (e.g. provincial crown land rather than private land) but effects of natural disturbances and harvesting may influence the element occurrence (e.g. fire suppression within a landscape previously dominated by

frequent fire). There may be up to 25% fragmentation of the surrounding landscape.

Marginal (3): Current management and development of the surrounding landscape may affect the continued existence of the element occurrence, i.e. removal of vegetation, hydrological changes, invasive species, etc. More than 25% of the surrounding landscape is fragmented and affected by anthropogenic influences.

Poor (4): A management plan exists which will result in significant alteration or destruction of the element occurrence itself, e.g. development plan, harvesting plan, mining operation, anthropogenic structures.

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