Okanagan Indian Band

December 2021

Okanagan Indian Band

Goose Lake Range

Phase 2 – Enhanced Land Use Plan

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1.0 Introduction

In 2013, the Okanagan Indian Band (OKIB) began work on a Phase 1 Land Use Plan. This Plan established a vision and guiding principles for land use on OKIB's reserve lands and fee simple properties. Through this initial land use planning process, eight development nodes were identified in which the community felt there were opportunities for future economic development and membership housing. While the Phase 1 Land Use Plan, which was updated in 2020, outlined some potential land uses and general development guidelines for these eight development nodes, the need for a more comprehensive and detailed plan for these areas was identified. This Enhanced Land Use Plan aims to provide further clarification, as well as to identify current priorities for potential land uses and direction regarding the use and management of two of these development nodes; the Goose Lake Range and Rattlesnake Point (acx̌ʷyus). This Enhanced Land Use Plan expands upon the work completed under Phase 1 and should be viewed as a subsequent phase to the original Land Use Plan.

The basic goals of this Enhanced Land Use Plan are to:

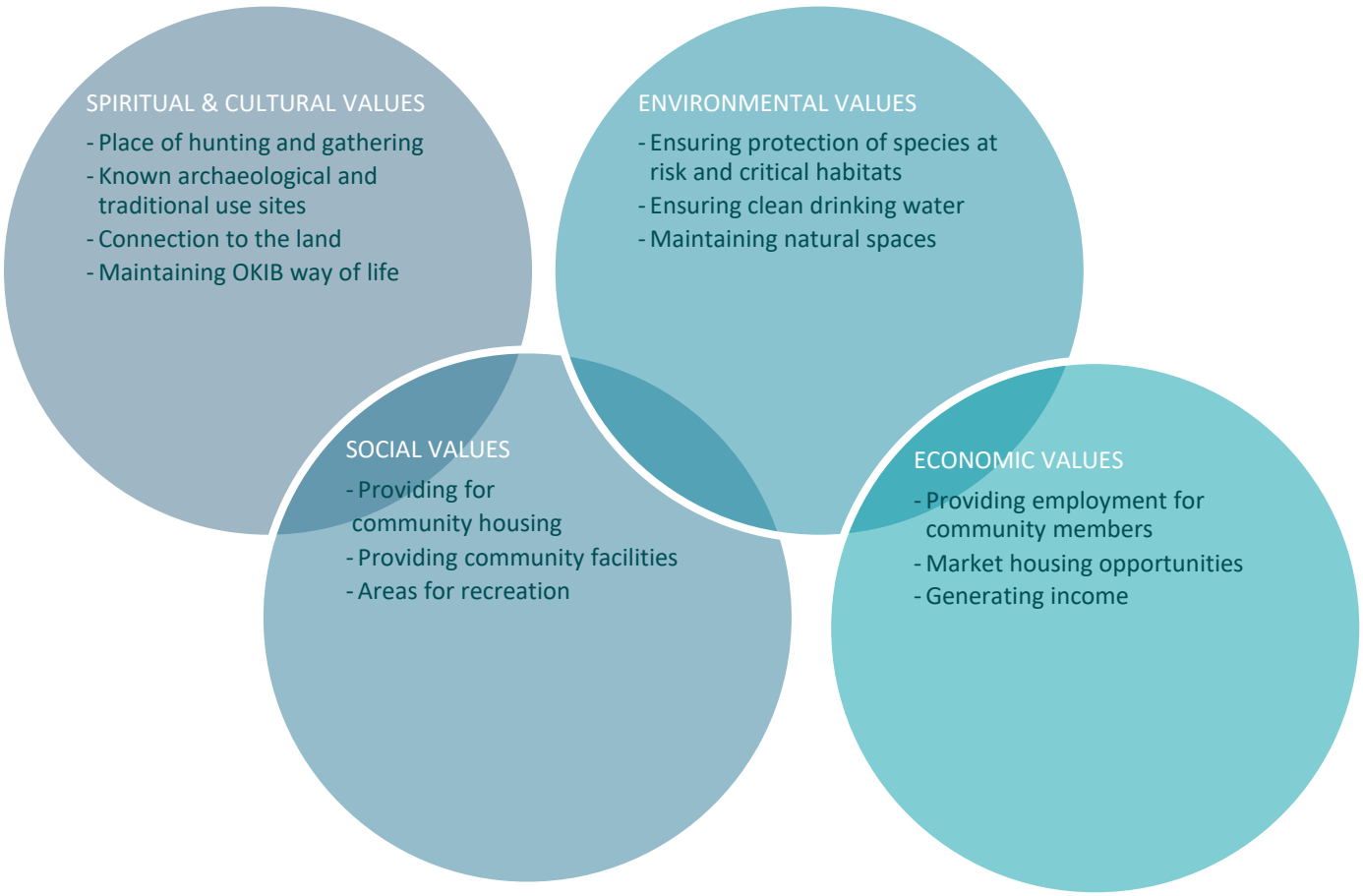
- Build upon the community vision identified in the Phase 1 Land Use Plan, with a specific focus on what current priorities are for how the Goose Lake Range should grow/develop moving forward
- Outline goals, objectives, and priorities for how that vision will be achieved
- Create an implementation plan to ensure the success of the Enhanced Land Use Plan
- Identify areas within the Goose Lake Range where more immediate development is supported by the community and outline criteria to consider before new development can occur
- Identify and assess current opportunities and constraints regarding development on the Goose Lake Range
- Document the cultural, historical, environmental, and economic development value of the Goose Lake Range to OKIB members
- Identify, through a Preliminary Highest and Best Use Assessment, the potential highest and best land use options, based on current market conditions, recognizing that this can change over time
- Create a lands inventory to help guide future land use decisions for the Goose Lake Range

How We Value These Lands

The Goose Lake Range holds many different values to OKIB members. This Enhanced Land Use Plan is an attempt to balance these community values in order to reach our vision of building a healthy, culturally vibrant, prosperous and sustainable community.

Figure 1.1 below is a summary of the values these lands hold to the community, as expressed throughout the planning process. Unfortunately, all of these values have been undermined by the presence of Unexploded Ordnances (UXOs) on the lands. As the UXO clean-up continues however, it is hoped that the community can once again utilize these lands to their full potential and begin to maximize the land's value, in all of its forms.

Figure 1.1: Summary of the Values These Lands Hold to the Community



Phase 1 Land Use Planning Principles

The following ten planning principles were developed as part of the Phase 1 OKIB Land Use Plan.

1. The OKIB will manage our land in a way that will ensure a viable mix of environmental, economic, and cultural uses for future generations.
2. The OKIB will lead by example by demonstrating effective management of natural resources on reserve lands, including the incorporation of best management practices for water, watersheds, agricultural land, rangeland, mining, forestry, fishing, and hunting and gathering grounds.
3. The OKIB will protect Band land for communal interests. We will ensure that all people in the community are included and accommodated in decision making processes.
4. The Land Use Plan will be continuously reviewed to identify future growth and development areas; and to ensure the timely construction of sustainable community infrastructure, including water, transportation and energy infrastructure.
5. The OKIB will ensure adequate access to education, housing and health care for all Band members.
6. The OKIB will continue to build strong community relationships today that will leave a legacy of trust and respect.
7. The OKIB will protect natural features and systems including ground and surface water resources, airsheds, areas of high ecological value, fish and wildlife habitats, and movement corridors.
8. The OKIB will protect our heritage, culture and places of ceremony on and off-reserve. Our traditional uses, language and values allow us to connect our past, present and future.
9. The OKIB land use plan shall promote coordinated, accountable leadership towards the fulfillment of our community goals and vision.
10. The OKIB land use plan will help create conditions that will foster greater economic development and revenue generating opportunities for our community.

Community Vision as outlined in the Phase 1 OKIB Land Use Plan:

The Okanagan Indian Band and its membership are committed to supporting each other to build a healthy, culturally vibrant and sustainable community.

As a united community, the Okanagan Indian Band will work together to create a strong and vibrant economic environment that enhances its entrepreneurial capacity while allowing the community to grow in a way that builds upon its traditions, strong relationship with the environment and valued cultural heritage.

1.1 Community Background

Located at the head of Okanagan Lake, the Okanagan Indian Band is one of eight members of the Okanagan Nation Alliance. OKIB governs over six (6) reserves, encompassing a combined area of approximately 26,285 acres. OKIB's reserve lands include Okanagan 1, Otter Lake 2, Harris 3, Swan Lake 4, Priest's Valley 6 and Duck Lake 7. In addition to these reserve lands, OKIB also owns several fee simple parcels in the areas of Beau Park, Braun and Sun Valley. OKIB's lands vary greatly in terms of use, with current land uses including residential, commercial, industrial, agricultural, community facilities and general open space.

The planning area for the Goose Lake Range Enhanced Land Use Plan is located entirely on the Okanagan 1 reserve. Okanagan 1 is the main reserve of the community and contains nearly all of OKIB's community and administrative facilities, as well as most on-reserve band housing. The reserve also contains several residential subdivisions, mobile home parks and lakeshore cabins catering to non-Band member residents. The Okanagan 1 reserve is approximately 25,456 acres in size and runs along both sides of the north arm of Okanagan Lake. The reserve shares boundaries with the several other jurisdictions including the City of Vernon, Township of Spallumcheen, Regional District of Northern Okanagan, Columbia Shuswap Regional District and the Splatsin Indian Band. Westside Road runs through the portion of the reserve on the west side of Okanagan Lake, while Highway 97 runs through the northern portion.

According to Indigenous Services Canada, OKIB has a total registered population of 2,057 individuals, 822 of which reside on one of the community's reserves, as of December 2019. **Table 1.1** provides a breakdown of the registered population of OKIB.

Table 1.1: Population Breakdown (ISC, December 2019)

Residency	# of People
Registered Males On Own Reserve	437
Registered Females On Own Reserve	385
Registered Males On Other Reserves	33
Registered Females On Other Reserves	51
Registered Males On Own Crown Land	0
Registered Females On Own Crown Land	0
Registered Males On Other Band Crown Land	0
Registered Females On Other Band Crown Land	0
Registered Males On No Band Crown Land	1
Registered Females On No Band Crown Land	2
Registered Males Off Reserve	536
Registered Females Off Reserve	612
Total Registered Population	**2,057**

1.2 Purpose of the Enhanced Land Use Plan

This Plan documents the community's vision for current priorities for land use and development of the Goose Lake Range. It also identifies particular areas within the Goose Lake Range where near term development is supported by the community and provides guidance on how new development should occur. Along with specific land uses and types of development as identified through the community engagement process, lands where the current priority is more focused on enhancing community connection and preserving options for future generations are also identified.

Due to the past use of the Goose Lake Range by the Department of National Defense for military training, including as an ordnance range, and the ongoing issues of UXOs and contamination from that use on site, OKIB members have been precluded from extensively using these lands for several decades. As the UXO clean-up process continues and the potential for development is realized, the community will again have the opportunity to utilize these lands to their full potential. This project provided an opportunity to get community members thinking about the Goose Lake Range as a potential site for community and economic growth.

This Enhanced Land Use Plan will also provide OKIB Chief and Council, staff and community members with a decision-making framework to help guide land use, development and protection of land within the Goose Lake Range.

1.3 Planning Process

Work on this plan began in June 2018. Key components in the development of the enhanced land use plan included:

- *Background research and information gathering* – information and data from a variety of sources were compiled and reviewed in order to better understand the community context and future trends. This review included:
    - Previous community plans;
    - Engineering and infrastructure servicing documents;
    - Environmental studies;
    - Legal surveys and land tenure data; and
    - Population data.
- *Site and Geographic Information Systems (GIS) Analysis* – Available and relevant GIS datasets were compiled and analyzed. This analysis helped to outline the opportunities and constraints for development on the Goose Lake Range. Areas suitable for potential development, as well as areas that should be protected from development were identified. The GIS data collected and analyzed included topographical data, parcel boundaries, land tenure, water features, infrastructure servicing, transportation networks, archaeological resources, and key environmental features.

- *Community Engagement –* Community engagement as part of the Goose Lake Range enhanced land use planning process included:
    - Site land tours of the Goose Lake Range;
    - Individual stakeholder meetings (Elders, youth, Certificate of Possession (CP) holders, OKIB staff);
    - General Band membership meetings;
    - A Community Dinner;
    - Two Community Open Houses;
    - Regular project updates through the OKIB Facebook page and Senk'lip Newsletter; and
    - A community survey.

  The community engagement component of this project is discussed in further detail in Section 4.0.

- *Preliminary Highest and Best Use Assessment–* a preliminary study of the highest and best use of potential development options was prepared in Spring 2019 and has provided guidance on the most marketable and economically beneficial uses of land at the Goose Lake Range. This built upon the work undertaken in 2017 to study marketable uses of the land as part of a 'Potential Land Development Opportunity Assessment.' It is important to note that this preliminary assessment is based on the market conditions at the time the assessment was completed. It is also important to note that the assessment is based on an economic analysis and does not necessarily capture the value of the land from cultural and environmental perspectives.

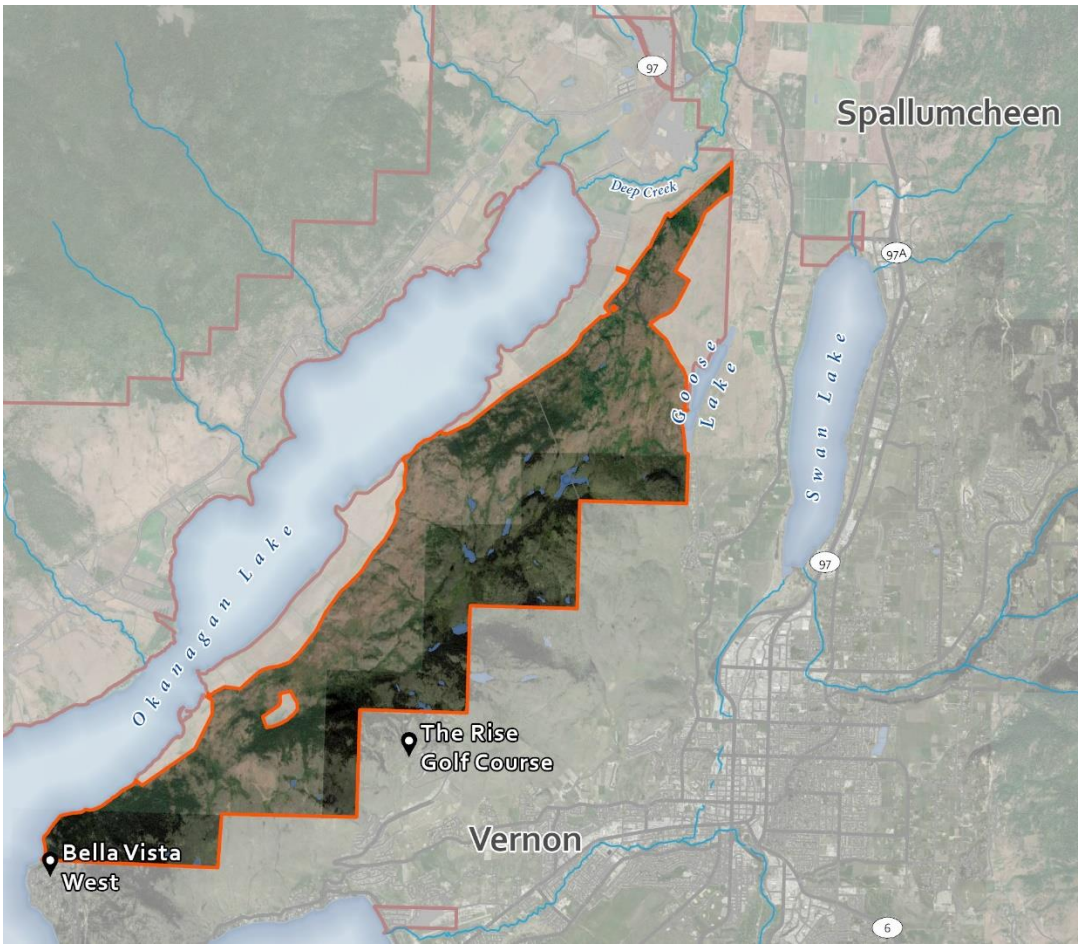
- *Preparation of the Enhanced Land Use Plan –* Based on research and community input, an Enhanced Land Use Plan was prepared for the Goose Lake Range.

2.0 Study Area Overview

2.1 Site Overview

The Goose Lake Range generally refers to the ridge of land running southwest-northeast, between the City of Vernon and the north arm of Okanagan Lake. The range takes its name from Goose Lake, a small lake located approximately 1 km west of Swan Lake, along the eastern border of the Okanagan 1 reserve. For the purpose of the Goose Lake Range Enhanced Land Use Plan, the study area was determined to be all the Okanagan 1 Band lands located along the east side of Okanagan Lake, south of Deep Creek. **Figure 2.1** outlines the study area boundaries. This represents a total area of 6,235 acres. While the study area is completely comprised of Band Land, there are CP Holdings directly adjacent in some areas.

Figure 2.1: Study of Boundaries



The majority of the eastern boundary of the study area is shared with the City of Vernon. Northern portions of the eastern boundary are also shared with the Regional District of Northern Okanagan and the Township of Spallumcheen. City of Vernon developments at The Rise Golf Course, Blue Jay Subdivision and the Bella Vista West neighbourhood abut directly with the reserve and study area boundary.

Similarly, Township of Spallumcheen developments at the Spallumcheen Golf and Country Club and in the vicinity of Stepping Stones Crescent are also directly adjacent to the Okanagan 1 reserve.

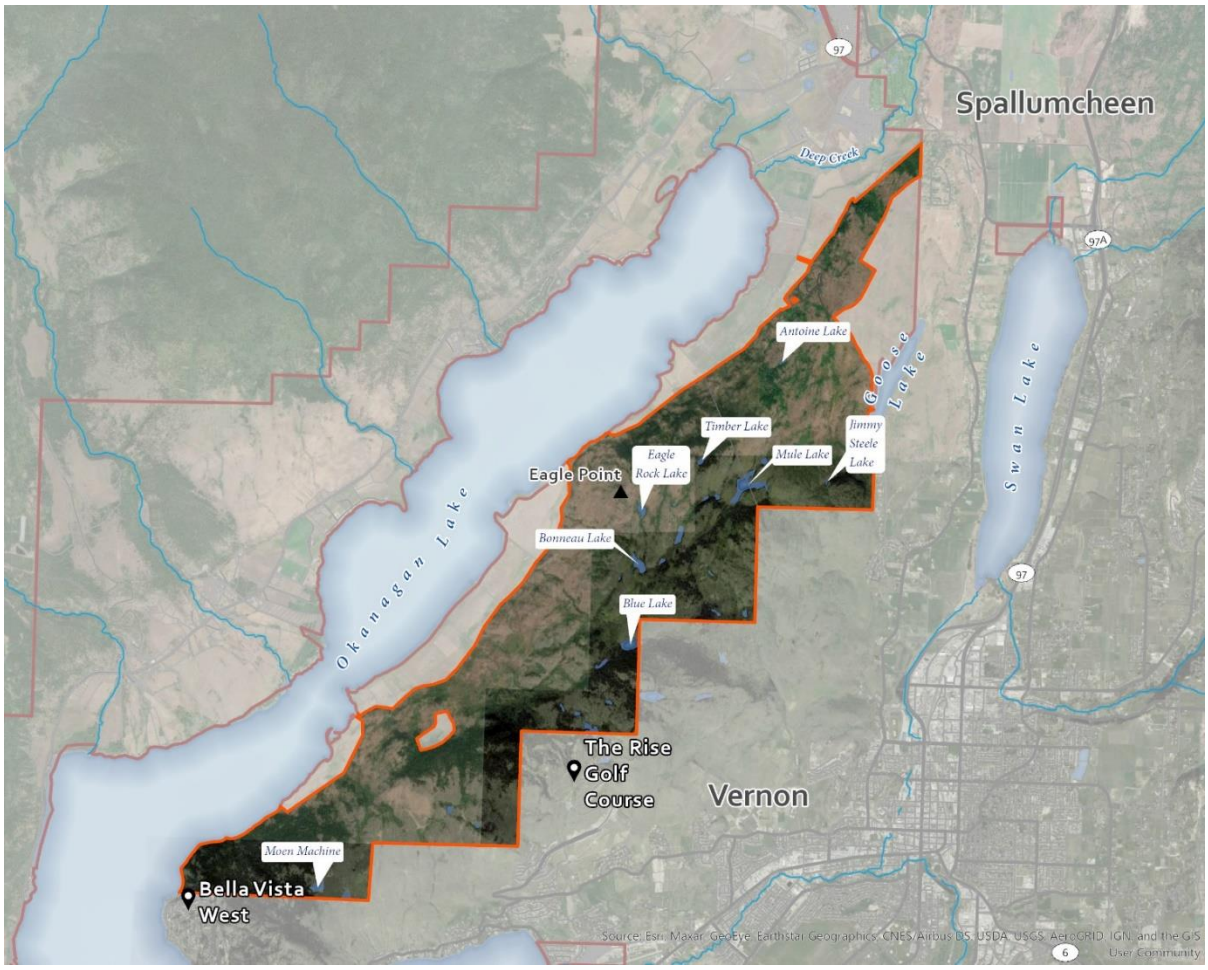
The planning area ranges in elevation from 345 metres at Okanagan Lake to 810 metres in the upper portions. The portions of the study area directly adjacent to Okanagan Lake are generally steep, as the majority of the flat, low-lying areas along the lakeshore are under a Certificate of Possession (CP) land tenure. Some CP Holders with land along Okanagan Lake have pursued economic development opportunities on their lands, primarily through lakeshore cabin developments.

Moving east from the lakeshore, the land rises sharply, forming the ridge that separates the north arm of Okanagan Lake from the City of Vernon. To OKIB members, this approximately 15 km long ridge is known as ṯ̓ḵ̓mikən. It is said that when viewed from the west side of Okanagan Lake, this ridge resembles senk'lip laying down. Senk'lip is the Okanagan word for coyote. The Okanagan word ḵ̓əḵ̓milaps refers to the base of an animal's neck, just before it rises to the head. A geographic feature representing senk'lip's ḵ̓əḵ̓milaps can be found along the southern portion of the ridge.

Figure 2.2: ***Picture of Goose Lake Range and ṯ̓ḵ̓mikən***

The upper portions of the Goose Lake Range consist of open grassland habitats interspersed with treed hillsides and rocky outcrops. A number of small lakes and wetlands are also found throughout this portion of the planning area. These lakes are of cultural importance to community members, as well as providing key habitat for wildlife species. **Figure 2.23** illustrates these lakes with their common names as referred to by the community.

Figure 2.3: Lakes of the Goose Lake Range



From approximately the late 1930s to the early 1990s, the Goose Lake Range area was used as a Department of National Defence (DND) military training ground, which at times included live ordnance test firing and the use of other artillery and ammunition. Although decades have past since the lands were actively used for military training, Unexploded Ordnances (UXOs) are still found throughout the range. The Government of Canada, in coordination with the Okanagan Indian Band, is currently in the process of surveying for and clearing UXOs from OKIB's reserve lands. At this time, it is unknown how long full clearance and remediation of the lands will take. Available information suggests that the upper portions of the Goose Lake Range were heavily used by the Department of National Defence for live ordnance training. Due to the on-going presence of UXOs on-site, these upper portions remain relatively undeveloped. Impacts of UXO and DND's use of the lands on the lower portions of the Range, close to Okanagan Lake, are not yet fully understood.

The area is of significant cultural importance to OKIB. Although use of the range has been severely impacted by the presence of UXOs, community members are still trying to utilize the area for hunting, gathering of berries and medicinal plants, as well as other cultural and recreational activities. The range is also currently being used as rangeland, with some residential housing on the periphery.

Figure 2.4: ***Goose Lake Range (looking south along Okanagan Lake)***

2.2 Site History

Prior to European contact, the main village site of the OKIB people was located at Priest's Valley, near the present-day Priest's Valley 6 reserve. Several residences and smaller village sites were also found at various locations along Okanagan Lake, including within the vicinity of the Goose Lake Range Enhanced Land Use Plan. OKIB oral history, as well as archaeological records, indicate a long presence of permanent villages in this area.

ʔ̓tkmikən, the traditional name for the ridge which makes up the Goose Lake Range, separated the main village from other village sites. Traditionally, OKIB members utilized the study area as a travel corridor between these sites. Being located directly adjacent to several villages also meant the area was an important site for hunting and gathering; uses that continue today.

During the original survey of the Okanagan 1 reserve in 1881, surveyor E. Mohun made note of cultivated fields along the lakeshore, indicating a history of agricultural use by OKIB members. In addition to the cultivated fields, the planning area and adjacent areas have also been continuously used as rangeland for horses and cattle since the late 1800s.

In addition to the traditional uses of the area for dwellings, agriculture and hunting and gathering, the Goose Lake Range also contains sites of cultural and spiritual importance. Known burial sites exist within the study area. Community Elders have also identified Eagle Point, a steep cliff located along Okanagan Lake and shown on the preceding Figure 2.2, as a likely fasting place. Fasting places were important areas for the 'spiritual training' of community members and were often found near prominent geographical features.

With the allotment of the Okanagan 1 reserve in October of 1877, OKIB members residing in Priest's Valley were relocated to the present-day community core located at the head of Okanagan Lake. Agricultural and residential uses expanded within and adjacent to the planning area, as well as along the lakeshore throughout the early 1900s.

Beginning in approximately the late 1930s, the Department of National Defense (DND) began using the range for military training purposes. This training included live-firing of explosive ordnances on the upper portions of the Goose Lake Range. Military training on the reserve ended in approximately the early 1990s, however clean-up due to DND's use, including UXOs left on the range, still continues to this day.

In the years following the DND military training the community was largely precluded from using the upper portions of the Goose Lake Range due to the health and safety risks posed by the UXOs. While hunting and gathering does occur within the area, many residents have avoided the range out of fear of the UXOs. Community members also use the Goose Lake Range for recreational purposes, including camping, hiking, and mountain biking, although members primarily limit these activities to areas of previous disturbance that are known to be cleared of UXOs.

2.3 Development Opportunities and Constraints

2.3.1 Topography

The study area ranges in elevation from approximately 345 metres at Okanagan Lake to 810 metres in the upper portions of the range. Hawhola Road roughly marks the western boundary of the study area. This road runs along the base of the ridge and marks a transition from flat, CP held lands to the west, to a steep hillside to the east. The upper portions of the range, which generally includes the top of the ridge running between Okanagan Lake and the City of Vernon, are comprised of a rolling topography, with flatter areas interspersed with rocky outcrops.

Approximately a third of the study area (2,318 acres of 6,235 total acres) is located on slopes most suitable for development, which is land with slopes less than 20%. While development can occur on slopes steeper than this, construction and development becomes more costly.

2.3.2 Floodplain

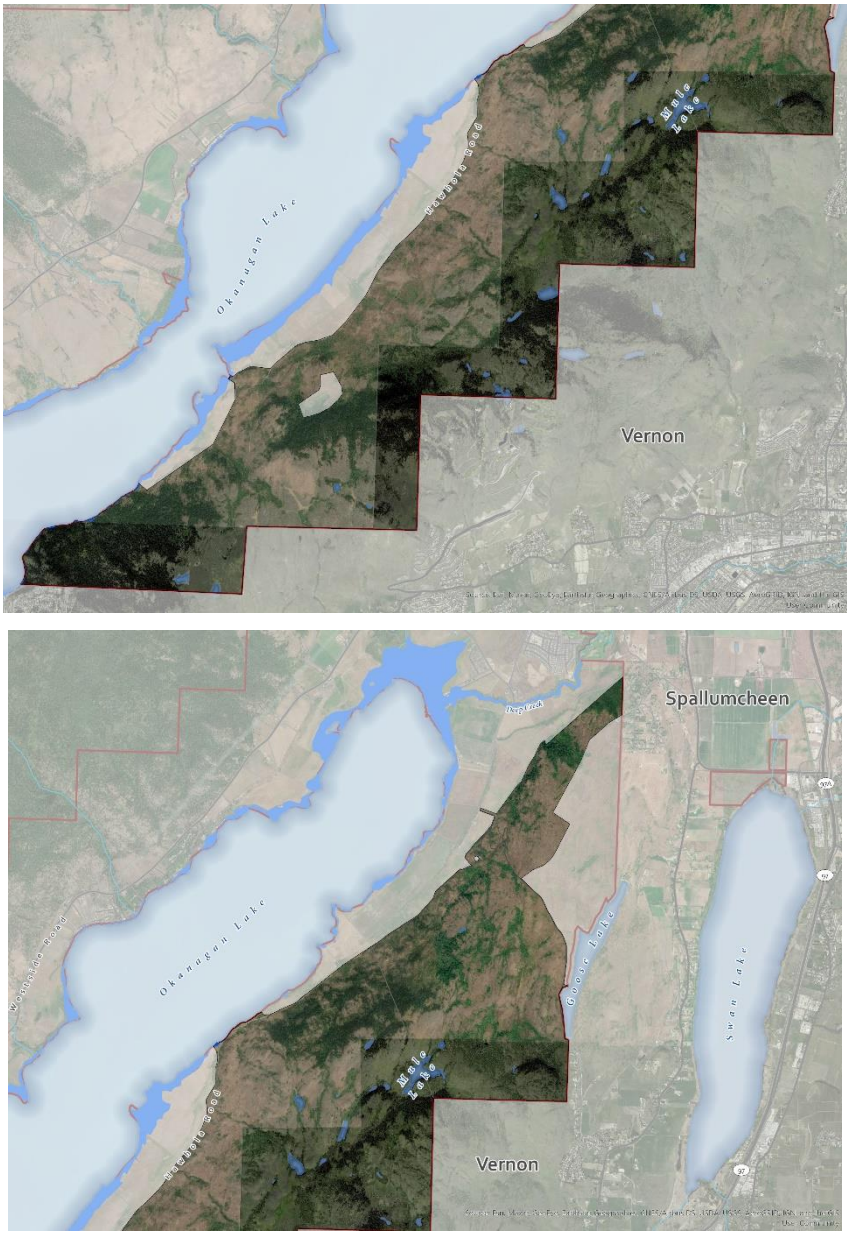
Okanagan Lake and Deep Creek are prone to flooding, with the most recent flood event taking place in Spring 2017. While there is no current mapped floodplain information available for these waterbodies, at the time of this writing, the Province of British Columbia is undertaking a project to map the floodplain of Okanagan Lake. Once complete, this floodplain information may help to guide future development guidelines within the flood prone areas on OKIB lands.

While developments along the lakeshore of Okanagan Lake and adjacent to Deep Creek may be impacted by flooding, the majority of the flood prone areas along Okanagan Lake are CP held lands, and fall outside of the study area. The Regional District of North Okanagan Zoning Bylaw No. 1888 outlines a series of regulations for developments adjacent to waterbodies. While these regulations are not directly applicable to Okanagan Indian Band lands, they can act as a reference for future development on OKIB lands.

The RDNO Zoning Bylaw states that no building construction occur below 343.66 metres for lands adjacent to Okanagan Lake. For the lands adjacent to Deep Creek, this flood construction level would be 1.5 metres above the natural boundary of the creek. **Figure 2.5** outlines what these regulation would approximately look like within the Goose Lake Range.

In addition to these flood construction levels, the RDNO Zoning Bylaw also outlines a floodplain setback from certain waterbodies where no building construction is to occur. For both Okanagan Lake and Deep Creek this would be 15 metres from their natural boundaries.

Figure 2.5: Visual of Regional District of North Okanagan Flood Construction Levels



It has also been noted by community and OKIB staff members that during some years, the water levels in Goose Lake rise to a level which covers the existing road running along the western edge of the lake. Any future development and associated access in this area would need to take this into consideration.

2.3.3 Infrastructure

Water Infrastructure

There are six (6) separate community water systems located on the Okanagan 1 reserve, with the Irish Creek/Head of the Lake (HOL) water system being the closest to the Goose Lake Range study area. Figure 2.6 outlines the current extent of the Irish Creek/HOL water system.

OKIB has recently finalized a Water Master Plan for the Okanagan 1 reserve. This plan outlines several concerns facing the Irish Creek/HOL water system, including:

- Very poor water quality for Irish Creek/HOL Community Water System.
- No treatment or disinfection is currently provided for the Irish Creek/HOL Community Water System.
- Minimal reservoir storage is provided for the Irish Creek/HOL Community Water System.
- There are a significant number of existing land parcels within Okanagan 1, including the Irish Creek/HOL area, which do not have access to a safe and reliable supply of potable drinking water from a community water system and also do not have access to sufficient water for fire protection.
- There is only one well supplying water to the Irish Creek/HOL community water system. Consequently, there is no back-up water supply should the well fail or become contaminated. This lack of capacity also hinders OKIB's ability to expand the water system for new Band housing or other developments.

The concerns as outlined above present a significant challenge for OKIB in providing safe, reliable drinking water to the existing service area, and also for future development on the Goose Lake Range. OKIB is planning to undertake upgrades to the Irish Creek/HOL water system to address a number of the concerns, however timing of these upgrades is currently unknown. Substantial investment and upgrades would be required to service potential development on the Goose Lake Range through the OKIB community water system. There are several potential viable water source options for future development. The most appropriate water source for a future development would require further assessment and would depend primarily on the scale of development (financial viability) and location. Options for specific development nodes are discussed further in the report. In general, the potential options include:

Extension of Community Water System - the Water Master Plan outlines areas where the Irish Creek/HOL community water system could be potentially expanded in the future. Since the majority of the study area is located on the upper portions of the range, the potential for an expansion of the existing community water system to facilitate development on the Goose Lake Range is limited. In addition, the overall constraints facing the community's water system means it is unlikely that the water system will be extended into this area in the near future. It may be possible for CP Holders wanting to connect to the community water system to enter into a cost sharing agreement with the Band. In order to help guide and facilitate future infrastructure planning on reserve, the Band should enter discussions with CP Holders regarding their plans for the future development of their lands. OKIB needs to gain an understanding of planned future development in order to assess long-term source, treatment, and distribution options.

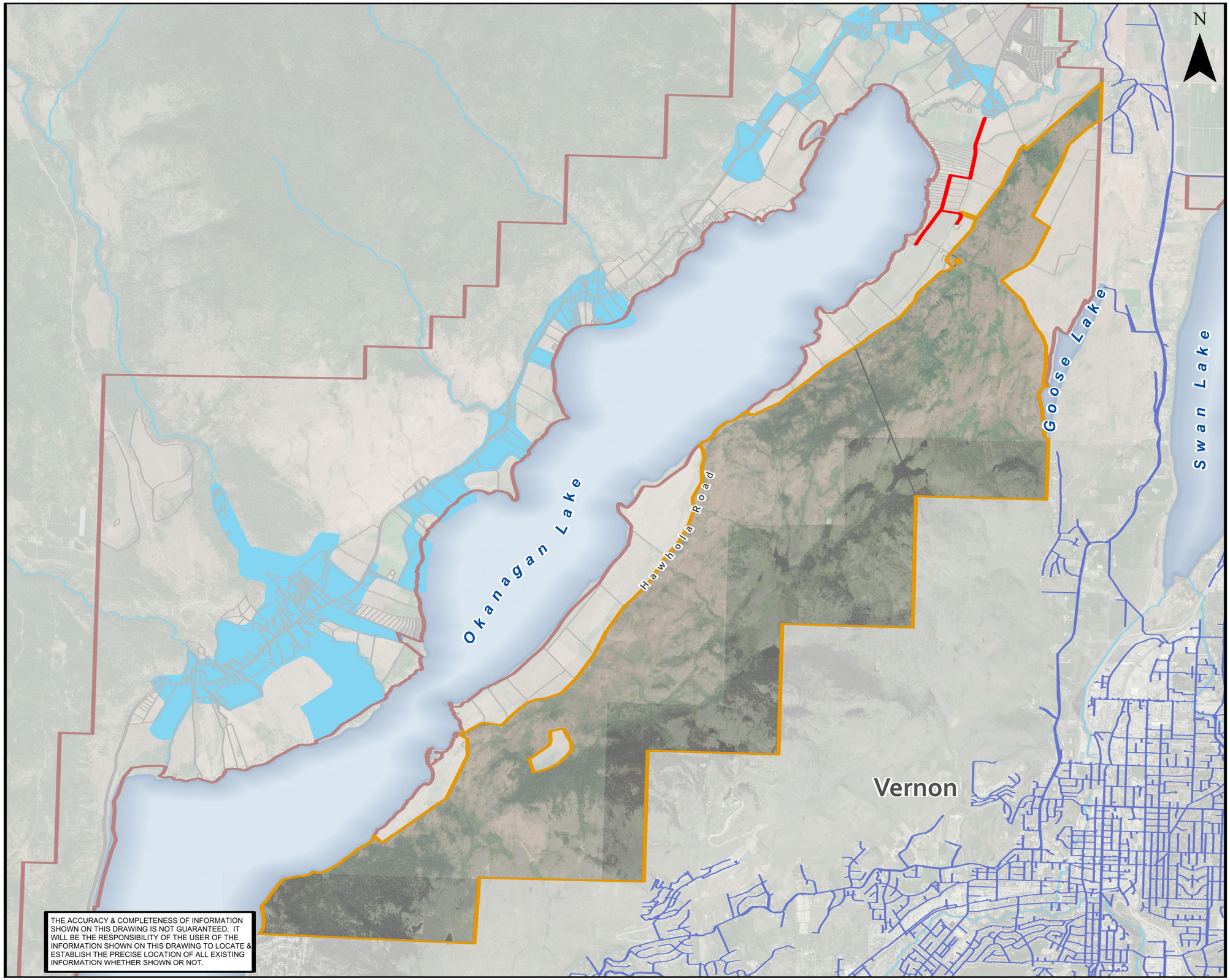
Groundwater Wells - previous studies have identified health concerns with groundwater in the vicinity of the Goose Lake Range. While it may be possible to service future developments within the planning area with groundwater, the potential exists for it to be poor quality water which would be complicated and expensive to treat.

Surface Water Sources - there are a number of communities located adjacent to Okanagan Lake which draw water from the lake for domestic supply including the District of Lake Country, Glenmore Ellison Irrigation District, City of Kelowna, Westbank First Nation and District of Peachland. Therefore, Okanagan Lake is a proven source for potable water.

In order to provide consistent water quality, a number of items should be assessed, including water quality, chemistry and turbidity; potential impacts from lake water currents to direct sources of pollutants towards the intake; existing sewage discharge pipes; potential impacts from contributing watercourses and nearby development; and potential for environmental impacts when siting intakes. Furthermore, approval requirements should be considered (i.e. water licence through the *Water Sustainability Act*).

In most cases, a surface water source requires a combination of filtration and disinfection to remove and inactivate particles and microorganisms (e.g. protozoa). However, Okanagan Lake water has very low turbidity and overall good quality. Therefore, it may be possible to treat the water for protozoa reduction using ultraviolet disinfection and sodium hypochlorite (i.e. without filtration). This can involve a lengthy testing and approval process to demonstrate that this is a sufficient level of treatment/disinfection. In the long term, it may be necessary to include filtration.

Connecting to Adjacent Water Systems - one possible solution to facilitate development within the study area would be to enter into a servicing agreement with Greater Vernon Water (GVW). GVW supplies water to the City of Vernon and other areas within the Regional District of North Okanagan, including several developments adjacent to the study area, such as the Blue Jay Subdivision, the Rise Golf Course, and the neighbourhood of Bella Vista West. **Figure 2.6** outlines the current extent of the Irish Creek/HOL and GVW water distribution systems adjacent to the Goose Lake Range. While OKIB and the City of Vernon have engaged in previous discussions regarding the possibility of extending water services for the Rattlesnake Point (acx̌ʷyus) and Eastern Bench Land areas, further investigation is required to fully assess the possibilities of GVW servicing development on the Okanagan 1 reserve.



Okanagan Indian Band

Goose Lake Enhanced Land Use Plan

Adjacent Water Distribution Systems

- Goose Lake Range Planning Area
- Okanagan Indian Band Reserve Boundary
- Existing OKIB Water System Boundary
- Greater Vernon Water Main
- Potential OKIB Watermain Extension

SOURCE:

Reserve boundary data, road and water features provided by Natural Resources Canada, 2019.
Base mapping provided by ESRI, 2019.

0 0.5 1 2 3 KM

Figure 2.6

Sanitary Infrastructure

All development on Okanagan 1 is currently serviced through septic sewerage systems. In previous discussions regarding the Rattlesnake Point (acx̌ʷyus) and Eastern Bench Land areas, the City of Vernon has indicated that it may be feasible to service future development in these areas through extending City sanitary services. The option of connecting into City services should be explored for other potential development areas within the Goose Lake Range as well.

The portions of the Goose Lake Range that are not within close proximity to City of Vernon services would likely be serviced through on-site septic systems. First Nation Health Authority (FNHA) is the approving authority for individual septic fields. FNHA states that on-site wastewater systems constructed on-reserve should be installed based on the current provincial *BC Sewerage Standard Practice Manual* (SSPM), 2014. This document provides a number of considerations regarding minimum required vertical and horizontal separation distances from various systems. As an example, the SSPM requires a minimum horizontal separation of 30m between a septic ground dispersal system and a permanent freshwater body (such as Okanagan Lake). A community septic system would require approval from ISC.

The rocky terrain found throughout much of the range may limit the feasibility of septic systems in certain areas. Septic field feasibility would need to be confirmed on a site by site basis by a Geotechnical Engineer.

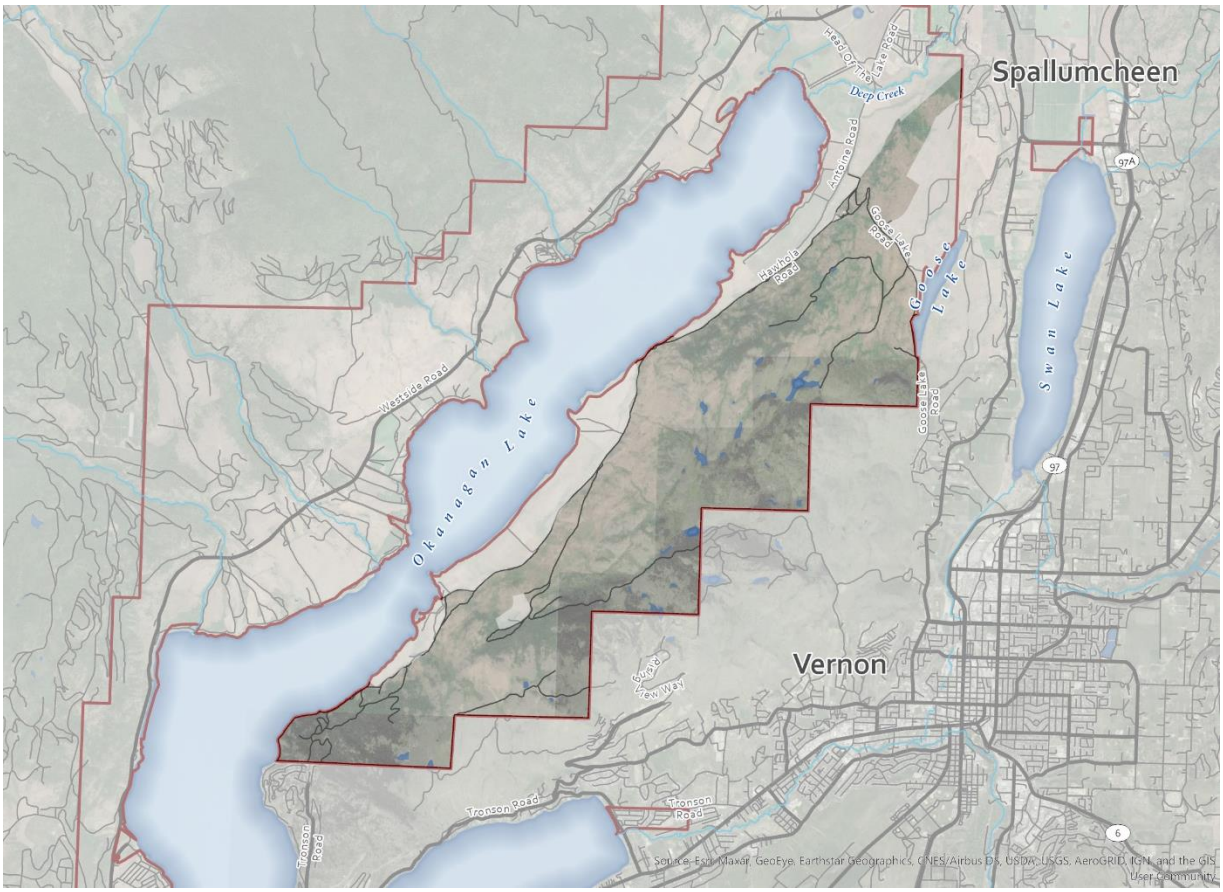
Roads

The areas along the lakeshore are accessed via two gravel roads - Antoine Road and Hawhola Road. While Antoine Road ends approximately 3.0 km south of Deep Creek, Hawhola Road extends approximately 10.0 km further south along Okanagan Lake. Antoine Road is regularly maintained by the Ministry of Transportation and Infrastructure (MoTI), whereas Hawhola Road is not under the jurisdiction of the MoTI and only receives periodic maintenance by OKIB.

The upper portions of the Goose Lake Range can be accessed via various off-shoots from Hawhola Road, all of which require vehicles with high clearance. An old road also extends off the end of the Goose Lake Road, however this access point is currently blocked by concrete barricades. A rough, gravel road extending off the end of Stepping Stones Road is also used to access the northern portions of the range. The Stepping Stones access passes through Certificate of Possession (CP) lands. Figure **2.7** outlines the current roads within the study area.

Previous studies for the Eastern Bench Lands development node has identified the extension of Rising View Boulevard as a potential access route. A similar study for Rattlesnake Point (acx̌ʷyus) initially indicated the site could be accessed via an extension of Tronson Road. However, discussions with the City of Vernon revealed that there are known safety issues associated with Tronson Road and the road will be at capacity once all approved development is constructed. Access options for future development at Rattlesnake Point (acx̌ʷyus) will have to be re-evaluated in conjunction with the City of Vernon in the future. Potential access for future development on the other development nodes also require further investigation.

Figure 2.7: Goose Lake Range Road Network



2.3.4 Environmental Considerations

The Goose Lake Range is an area of biological and ecological significance within the Okanagan Valley. A Sensitive Ecosystems Inventory was carried out on the Goose Lake Range in 2002 (see Appendix A). This report highlighted the significant biological diversity of the Goose Lake Range and noted that the area offers some of the best remaining grassland and wetland habitats within the North Okanagan Basin. Restrictions on use and development of the lands due to their prior military use likely contributed to the habitat and biological diversity that is seen today.

Guidelines for the protection of the environment and natural resources are outlined in the OKIB Phase 1 Land Use Plan. In May 2018, OKIB Chief and Council officially adopted the Okanagan Indian Band Environmental Management Framework. This framework outlines the current environmental concerns facing OKIB lands, and details specific policies and implementation strategies in order to address these concerns.

In addition to the guidelines and policies developed by OKIB, the requirements of the Federal *Species at Risk Act,* which provides protection for species at risk and their habitats, must also be considered.

The creation of this Goose Lake Range Enhanced Land Use Plan was done in consultation with OKIB's Territorial Stewardship Department (TSD), whose vision statement is: "We take care of the land, the land takes care of us." TSD staff provided background information and input regarding key environmental considerations within the range.

Key environmental considerations facing the Goose Lake Range are outlined below.

Species at Risk

Several sensitive ecosystems, as well as critical habitats for species at risk are found throughout the range. The 2002 Sensitive Ecosystems Inventory provides a comprehensive list of the potential species at risk that may occur within the Goose Lake Range. While several species have the potential to be located within the planning area, data provided through the Province of BC's open data sources indicates five (5) species at risk have been confirmed to occur in the area. One of these records is a 'masked' occurrence. Masked species at risk occurrences are not publicly available, as they represent species that may be susceptible to persecution or harm. While more detailed information for these occurrences can be obtained through the Conservation Data Centre, this information cannot be published in this Enhanced Land Use Plan.

Four (4) of the known species at risk occurrences however are publicly available and include:

- *American Badger;*
- *Baltic Rush – Common Silverweed;*
- *Common Cattail Marsh; and*
- *Painted Turtle (Rocky Mountain Population).*

As the American Badger is a mammal with a large home range, they may occur throughout the Goose Lake Range. Baltic Rush – Common Silverweed is a plant that is known to occur adjacent to three small lakes in the vicinity of The Rise Golf Course. Common Cattail Marsh, also a plant species, has been observed adjacent to a single wetland area on the upper portions of the range. The Painted Turtle has been observed in Goose Lake, which is located along the eastern border of the range. In fact, Goose Lake was traditionally referred to as "The Place of the Turtles" by OKIB members. ʔarsikʷ (turtles) are of cultural and spiritual significance to the Okanagan people.

A search of Federal and Provincial databases also indicated the presence of critical habitat for the Great Basin Spadefoot toad, Western Rattlesnake and Great Basin Gopher Snake within the Goose Lake Range. This data, as published by Environment and Climate Change Canada and downloaded through open data resources, identifies three (3) core Great Basin Spadefoot toad critical habitat areas in and around some of the wetlands and lakes located on the upper portions of the range. Connectivity habitats are also located between these core habitat areas. No specific habitat locations were identified for the two (2) snake species, rather the entire range was identified as critical habitat. While the identification of these critical habitats does not constitute an automatic "protection" designation, further environmental requirements, including an assessment by a Qualified Environmental Professional, will be required prior to any future development.

It should also be noted that the Western Rattlesnake is a species of cultural importance to the Okanagan People. Known as xaʔxʔuɬaʔxʷ, this traditional term translates to ‘sacred/powerful being on the land’. **Figure 2.8** outlines the location of the publicly available critical habitats and species at risk occurrences.

It should be emphasised that additional species at risk and critical habitats are likely to occur within the Goose Lake Range. Those species and habitats, as listed above, are simply the known and documented occurrences. An Environmental Assessment will be required prior to any development on the Goose Lake Range in order to fully assess the potential impacts any such development on species at risk and their habitats.

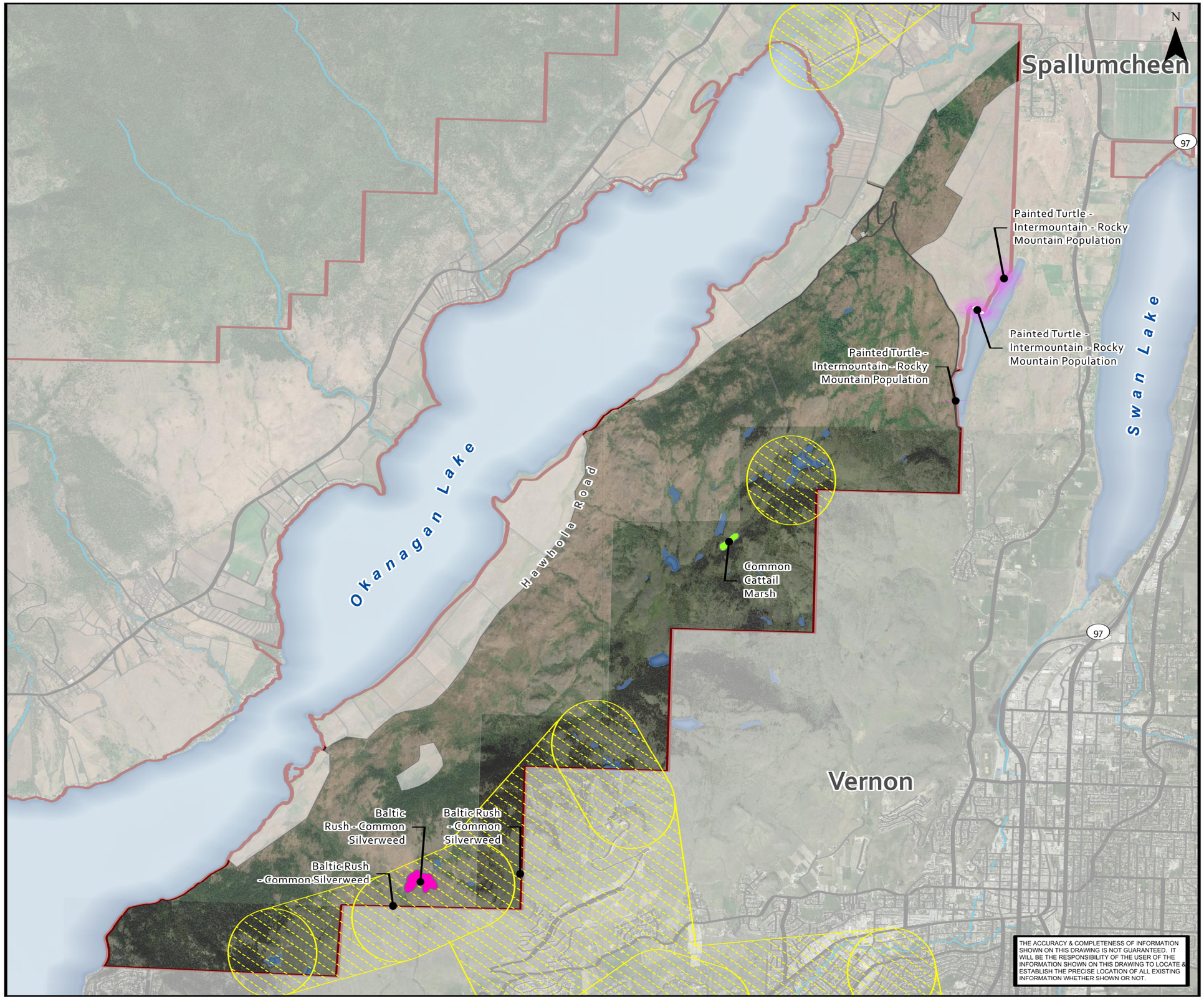
While not classified as a federally-listed species at risk, discussions with the Territorial Stewardship Department revealed that OKIB has noted a significant decrease in the number of porcupines on the range. Porcupines were a traditional food source of the Okanagan people and are of cultural significance. In fact, the OKIB community logo is a porcupine.

Contaminated Sites

A search of Provincial and Federal contaminated sites databases revealed no such sites within the study area. However, the community has expressed concerns over two potential sources of contamination:

1) UXOs – the community fears that the past use of the site for the live-firing of explosive ordnances, as well as the large quantity of UXO and munitions scrap remaining on site, may cause environmental contamination. The community is currently undertaking environmental monitoring and reporting in order to assess this potential and further study may be required.

2) Mining Activity – while no large-scale mining has occurred within the planning area, exploratory work associated with known mineral deposits has occurred in the past. Evidence of this exploratory work, which included several open-cuts and trenching at various locations throughout the range, is still visible today. Further study may be required in order to assess potential environmental impacts from these works. Information on this past mining activity can be found in Appendix B.



Okanagan Indian Band

Goose Lake Enhanced Land Use Plan

Publicly Available Critical Habitats and Species at Risk Occurrences

SARA Identified Critical Habitat Area

- Great Basin Spadefoot Toad*

Species and Ecosystems at Risk Occurrences**

- Baltic Rush - Common Silverweed
- Common Cattail Marsh
- Painted Turtle - Intermountain - Rocky Mountain Population

*The entire Planning Area is a known critical habitat for Western Rattle Snake and Great Basin Gopher Snake

**The American Badger is known to occur throughout the entire Planning Area

SOURCE:

Reserve boundary data, road and water features provided by Natural Resources Canada, 2019.
Critical Habitat and Species at Risk areas provided by DataBC, 2019.
Base mapping provided by ESRI, 2019.

0 0.5 1 2 3 Kilometers

Figure 2.8

2.3.5 Land Tenure

There are a number of different types of land tenure and legal instruments that impact access and use within the Goose Lake Range study area, including:

Band Land: this refers to land that is occupied and possessed by the Okanagan Indian Band.

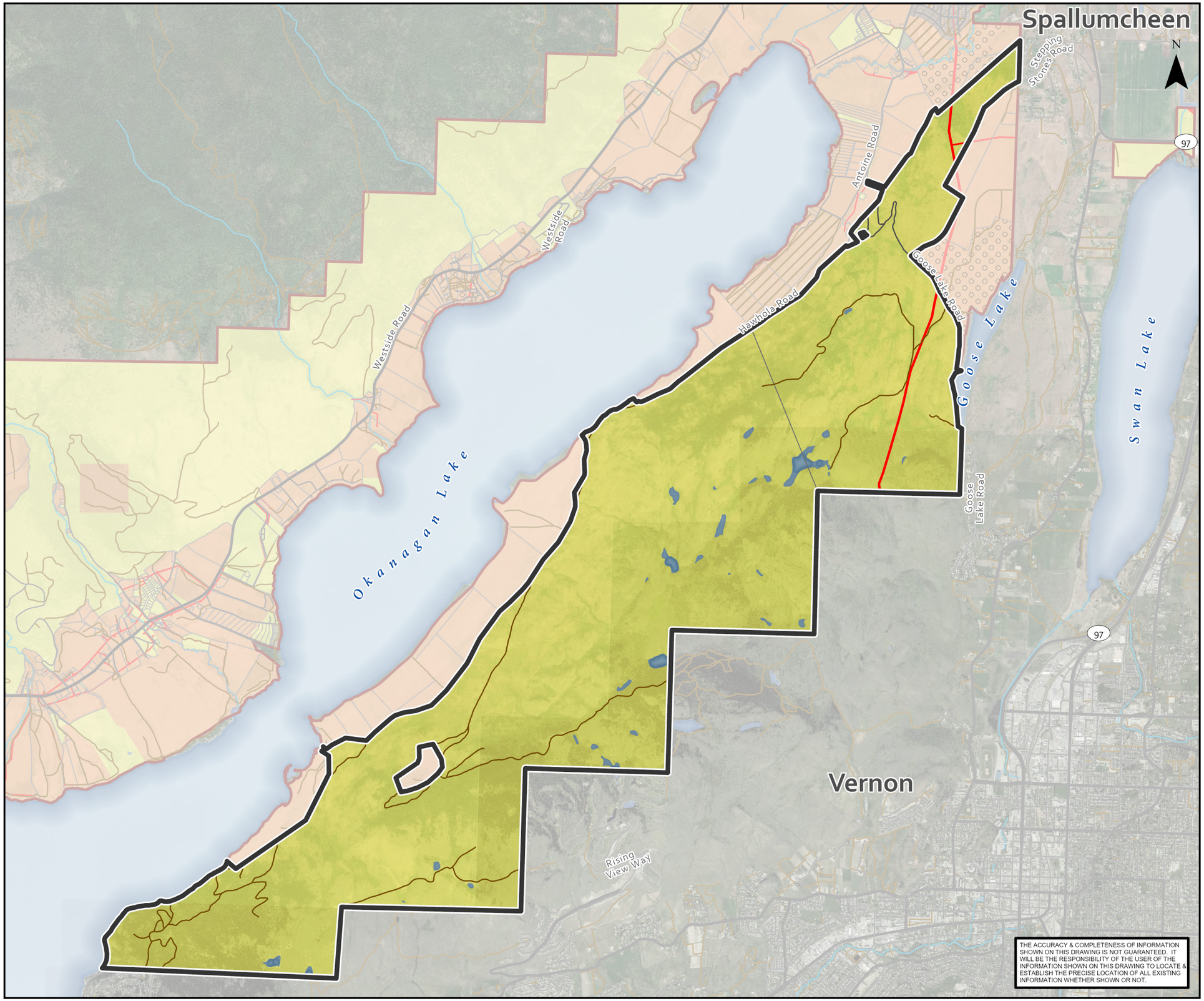
Certificate of Possession (CP): land held by community members (also known as 'locatee') with rights to access, lease and inheritance. One of the key elements of Certificate of Possession is that Indigenous Services Canada (ISC) will not provide capital funding for any construction of land held by CP, including homes and community buildings. While the study area does not include CP lands, there are such lands directly adjacent.

Leased Lands: a lease grants an interest in and exclusive possession of reserve land. It is granted for a specific period of time, often for a long term. The leased lands adjacent to the study area include three contiguous CP lots (Lots 26-1, 26-2 and 26-3) located along the lakeshore.

Surface Permits: permits allow non-members to use reserve lands in a limited way for a specific period of time. According to mapping available through Government of Canada online resources, two CP parcels (Lot 5, Block A, Fry sketch 319-37 and Lot 31, Block 3) adjacent to the planning area are identified as having surface permits. Both appear to be associated with the Inland Natural Gas Co. Ltd. pipeline right of way.

Easement: refers to a right of use over the property of another. The easement within the Goose Lake Range is related to a gas pipeline which runs along the eastern portion of the study area. The easement is granted to Inland Natural Gas Co. Ltd and came into affect in 1959.

Figure 2.9 outlines the land tenure within and adjacent to the Goose Lake Range.



Okanagan Indian Band

Goose Lake Enhanced Land Use Plan

Land Tenure

- Okanagan Indian Band Reserve Boundary
- Easement

Roads

- Paved Road
- Unpaved Road

Land Tenure

- Band Land
- Lawful Possession
- Lawful Possession - Leased
- Lawful Possession - Surface Permit
- Lawful Possession - Lease and Surface Permit
- BCR 18 (2)

Note: The entire planning area is comprised of Band Land.
Land tenure information as shown is as accessed through the Government of Canada's electronic Register Index Plan (eRIP) online mapping system. This information is shown for information purposes only and should be confirmed with the Okanagan Indian Band.

SOURCE:

Reserve boundary data, road and water features provided by Natural Resources Canada, 2019.
Land Tenure was digitized from eRIP and should be used for reference only.
Base mapping provided by ESRI, 2019.

0 0.5 1 2 3 Kilometers

Figure 2.9

2.3.6 Unexploded Ordnances (UXOs)

Between approximately the late 1930s to the 1990s, the Department of National Defence (DND) conducted military training activity on the Goose Lake Range that included live-firing of explosive ordnance (such as artillery and mortars). Unexploded Ordnances (UXOs) remain on site. Permits issued by OKIB in respect of DND's use of the reserve included clauses ensuring the lands would be cleaned-up after the training was completed. Currently, an unknown quantity of UXOs and munitions scrap remains on the reserve.

UXOs pose a serious risk of injury and/or death as they can explode if disturbed. In certain circumstances, UXO and munitions scrap may also cause environmental contamination.

The on-going presence of UXOs throughout the range presents a significant barrier to the development, enjoyment and use of these lands. While clean-up is on-going, the progress is slow, and it may take several years before the range is cleaned-up to a level that will permit the types of residential and commercial developments as proposed within the Enhanced Land Use Plan.

It is equally important that UXO clean-up is completed within the proposed Cultural Lands and Passive Development Area. Even though this area is intended for more passive developments in the near term, such as cultural uses and eco-tourism, the presence of UXOs still pose a threat and risk to community members and potential clients, and restricts options for land use.

2.3.7 Cultural/Spiritual Considerations

There are five (5) registered archaeological sites located within the Goose Lake Range study area as well as two (2) additional unregistered archaeological sites acknowledged by OKIB. The Phase 1 Land Use Plan outlines guidelines for the protection of heritage sites and cultural resources. For known archaeological sites these guidelines specify that "no clearing, removal, construction, or construction-related activities should occur within 30 metres (100 feet) from a recognized heritage site of cultural area." For future or planned developments, the guidelines require that an Archaeological Impact Assessment be required prior to any construction or excavation.

In addition to these known archaeological sites, the entire Goose Lake Range has high cultural and spiritual values for OKIB members. The area has historically been and is currently being used by community members for residential and agricultural purposes, as well as for hunting and gathering. White-tailed deer and mule deer are hunted for sustenance throughout the area. Plants, such as Siya (Saskatoon Berries), sp̓iƛ̓əm (Bitter-root) and qʷl'mniɬp (Sage) are harvested for food and traditional medicinal purposes. The range also provides for a wide range of recreational uses for OKIB members including, but not limited to off-road vehicle riding, hiking, and mountain biking. Historically, Goose Lake was a popular fishing lake for OKIB members, however the lake is no longer believed to contain fish.

2.3.8 Viewsheds

When community members were asked what they thought was great about the Goose Lake Range, "the views" was often the first response. The western portions of the range look over the north arm of Okanagan Lake and across to its western shore. The traditional OKIB communities of Six Mile Creek, Bradley Creek, Newport Creek, and Irish Creek can all be seen at various viewpoints within the range. The upper portions of the Equesis, Bradley and Newport watersheds are also visible.

Areas along the eastern border of the range offer views of Swan Lake to the north, Beachcomber Bay in the south and City of Vernon throughout. Select areas along the top of the ridge provide views of the valleys to both the east and west.

3.0 Community Engagement Summary

The Goose Lake Enhanced Land Use Plan (ELUP) was informed by extensive community participation. Starting in September of 2018, the OKIB Lands Department conducted a series of general community and individual stakeholder meetings. The purpose of these initial meetings was to introduce the project to the community and solicit feedback. Participants were asked questions related to how they had used the Goose Lake Range in the past, what they valued about these lands, and what their vision is for the lands with a focus on current priorities. The dates of these meetings were as follows:

- September 27th, 2018 – Community Dinner and Participation Session
- October 25th, 2018 – Community Site Land Tour
- January 30th, 2019 – Individual stakeholder meetings; OKIB staff, Elders, CP Holders, and Traditional Stewardship Department
- February 27th, 2019 – Set-up ELUP information booth at community meeting
- April 24th, 2019 - Youth Engagement Session
- May 29th, 2019 – Community Open House
- February 27th, 2020 – Community Open House

Feedback from community members was also sought through the development of a survey, with both online and paper versions being made available. The feedback obtained from the survey and various community meetings was summarized and helped to guide the draft ELUP report. The draft report, along with a summary of community input was presented at community open houses on May 29, 2019and February 27, 2020. The draft Plan was then revised to incorporate the feedback received from the community during the open houses.

Throughout the planning process project updates were communicated to OKIB members through the creation of an ELUP project video, as well as through articles in the community newsletter, Senk'lip News. The video was produced by OKIB staff and included interviews with community Elders and staff. The video was made available through the community's Facebook and YouTube pages.

Since much of the Goose Lake area is not easily accessible, especially for community members with mobility issues, a drone was used to capture aerial images and video of the site. This footage allowed all community members, including those no longer living within the community, to get a first-hand view of the planning area. This drone footage was used throughout the engagement process and images captured during the flight are included in this report.

What We Heard

Throughout the community engagement sessions and activities several key themes became evident, including:

- Community members care deeply about, and place significant value, on these lands. It was emphasised that the value of these lands extends beyond simply economic values and opportunities, but also includes cultural and spiritual values that are essential in maintaining the OKIB way of life.
- Taking a 'balanced approach' was a common theme among community members. While the community sees the importance in conserving portions of the range for cultural and spiritual uses, members also recognized a need to pursue economic development and housing opportunities.
- The Goose Lake Range is of significant spiritual and cultural importance to community members. The range is a key area for hunting and gathering, rangeland, recreational use, and also contains several sites of historical and archaeological importance.
- The Goose Lake Range has many desirable attributes regarding future development, including amazing views, areas of flat terrain, tranquility, and the potential for acreage lots close to a major centre.
- Community members appreciate the close proximity of the Goose Lake Range to the City of Vernon. Many current Band-housing opportunities are located on the west side of Okanagan Lake, which can be a 20-30 minute drive into Vernon. Band housing located on the Goose Lake Range, within 10 minutes of Vernon, was appealing to many members.
- Many community members expressed a desire to explore eco-tourism opportunities on the Goose Lake Range.

4.0 Enhanced Land Use Plan

4.1 Land Use Overview

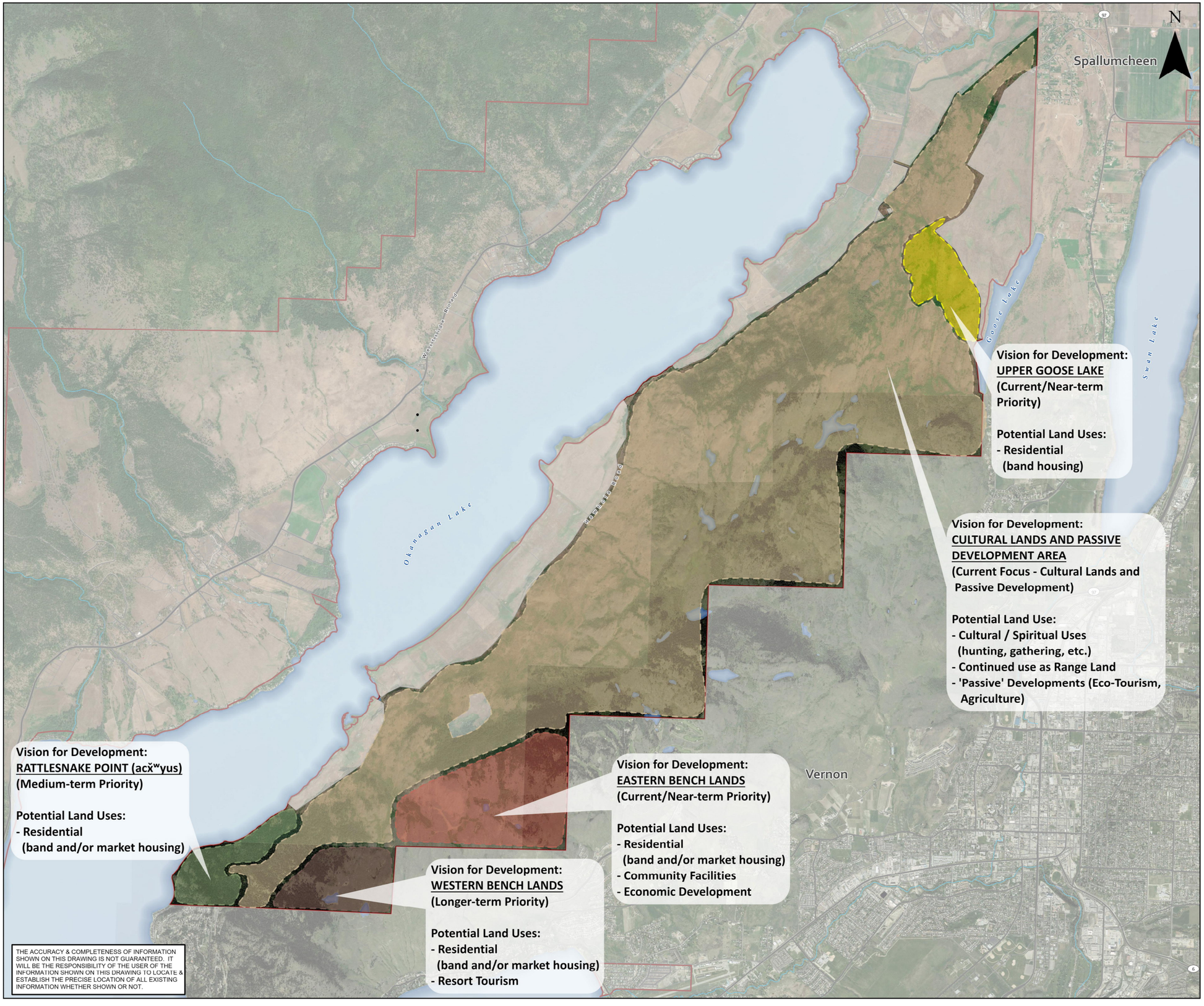
Throughout the community engagement process, OKIB members were asked to provide guidance on their visions for current priorities regarding the Goose Lake Range. A common theme among community members was the desire to take a 'balanced' approach to development on the range. While the community sees the importance in conserving portions of the range for cultural and spiritual uses, members also recognized a need to pursue economic development and housing opportunities.

The community engagement process resulted in four areas being identified for more intensive forms of development. These areas were selected based on a combination of factors including their proximity to existing development, and the overall suitability of the land for development. Areas where the current priority is community connection or where it is preferred that active development is deferred were classified as "Cultural Lands and Passive Development Area ".

As outlined on **Figure 4.1,** the development nodes identified for more intensive forms of development are located along the outside edges of the Goose Lake Range. The Cultural Lands and Passive Development Area spans the full extents of the study area, from north to south, and is primarily found within the upper portions of the range. Focussing development within specific sites along the fringes of the study area, while also conserving a large, continuous tract of land for community members to carry out their cultural and spiritual activities, for passive development and for future opportunities helps to strike the balance sought by the community.

The Enhanced Land Use planning process also identified areas within the Goose Lake Range where protection from development may be the priority. Such areas include land within 30 metres of streams, wetlands and lakes, sites of cultural significance, and significant wildlife habitats. These protected areas occur throughout the study area and guidelines for Environmental, Natural Resources, Heritage Sites and Cultural Resource Protection, as well as General Development guidelines are found in Section 4 of the Phase 1 Land Use Plan.

It should be noted that this Enhanced Land Use Plan is a living document and future generations may desire other uses for the land.



Okanagan Indian Band

Goose Lake Enhanced Land Use Plan

Development Nodes

- Okanagan Indian Band Reserve Boundary

Development Nodes

- Cultural Lands and Passive Development Area
- Eastern Bench Lands
- Upper Goose Lake
- Rattlesnake Point
- Western Bench Lands

SOURCE:

Reserve boundary data, road and water features provided by Natural Resources Canada, 2019.
Base mapping provided by ESRI, 2019.

0 0.5 1 2 3 Km

Figure 4.1

4.2 Development Nodes

The development node descriptions as outlined in the following section are summaries of existing and potential development opportunities that were explored on each site. More detailed information for each development node can be found in Appendix C.

It should be noted that, given that UXO clearance and remediation requirements and time frames for completion remain uncertain, their impacts on development could not be specifically considered.

4.2.1 The Upper Goose Lake Development Node

The Upper Goose Lake development node is located to the west of Goose Lake, on the eastern boundary of the range. Lands surrounding this development node are traditionally known as sx̌ʷaʔx̌ʷʔankiłap, or 'the place of many black berry thorns'.

The lands to the north of this site are under a Certificate of Possession land tenure held by the Gregoire family. The Gregoire family has previously applied for a lease on these lands in order to construct residential and commercial developments, including infrastructure and utility services. This proposed development is currently on hold due to the lingering issue of UXOs on site.

The development node is currently accessed via Stepping Stones Road to the north, although it should be noted that this access passes through CP held lands. The southern portion of the development node stretches along the western shore of Goose Lake and an extension of the Goose Lake Road may offer a potential alternate access route. The site offers several potential development locations and provides views of the valleys to both the east and west.

Figure 4.2 illustrates the development node while **Table 4.1** summarizes key development considerations.

Figure 4.2: Upper Goose Lake Development Node

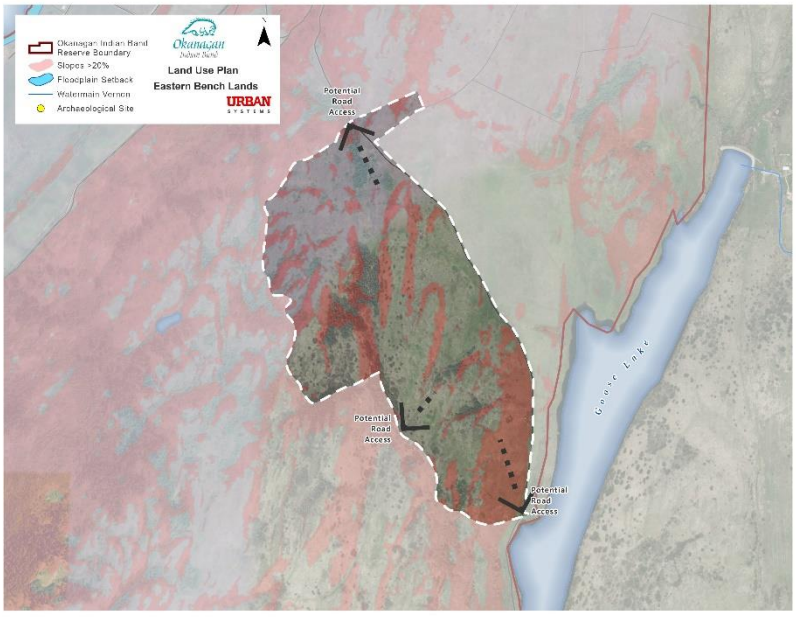


Table 4.1: Upper Goose Lake Development Summary

Development Potential	
Gross Area	184 acres
Removed from Development Area (Riparian/Protected Area, Slopes steeper than 20%)	65 acres
Infrastructure Allowance (20%)	24 acres
Net Development Area	95 acres
Known Archaeological Sites	No
Environmental Considerations	
• **Flooding Considerations**	Yes (Goose Lake)
• **Critical Habitat***	Yes (Western Rattlesnake, Great Basin Gopher Snake)
• **Known Species at Risk Occurrences***	Yes (American Badger, Painted Turtle (Rocky Mountain Population), one masked occurrence)
Existing Land Use	Rangeland, Open Space
Proposed Land Use	Residential (Band Housing)
Highest and Best Use	Residential Subdivision (medium-term potential)
Potential Infrastructure Servicing	
• **Water**	Extending existing Greater Vernon Water (GVW) services from Blue Jay Subdivisions should be explored.
• **Sanitary Sewer**	Septic
• **Roads**	Stepping Stones Road (directly north/east) Goose Lake Road (approx. 1 km south) Hawhola Road (approx. 2 km west)
• **Power**	North/East: Overhead single phase power from Steeping Stones subdivision, approx. 2.5 km north West: Overhead single phase power, approx. 1 km west South: Underground power, approx. 1 km south at Goose Lake Road

Critical habitat and known species at risk occurrence data provided through Province of BC open data sources. Additional species at risk may potentially occur within the planning area and those listed are the known and documented species and critical habitats only.

4.2.2 Eastern Bench Lands

The Eastern Bench Lands development node is located in the south-eastern portion of the range, directly west of The Rise Golf Course. The site is situated on the top of the ridge, offering views over both the north arm of Okanagan Lake and the City of Vernon. The development node borders the City of Vernon municipal boundary to the south and east. The entire site is located on Band land.

A development feasibility study was undertaken for the Eastern Bench Lands in 2018. The report indicates that a mix of single family and clustered medium density residential developments would be best suited for the site. This study also identified the site as having limited potential for commercial or industrial uses due to a variety of development constraints including distance from the downtown core of Vernon, no passing business traffic, access challenges and topography. A draft concept design created as part of the 2018 report can be found in Appendix D.

Three small lakes/wetlands, which offer critical habitat for the Great Basin Spadefoot Toad, are also located within the development node. The Great Basin Spadefoot Toad is a federally-listed species at risk and any future development within the Eastern Bench Lands may require environmental approvals. **Figure 4.3** illustrates the development node while **Table 4.2** summarizes key development considerations.

Figure 4.3: Eastern Bench Lands Development Node

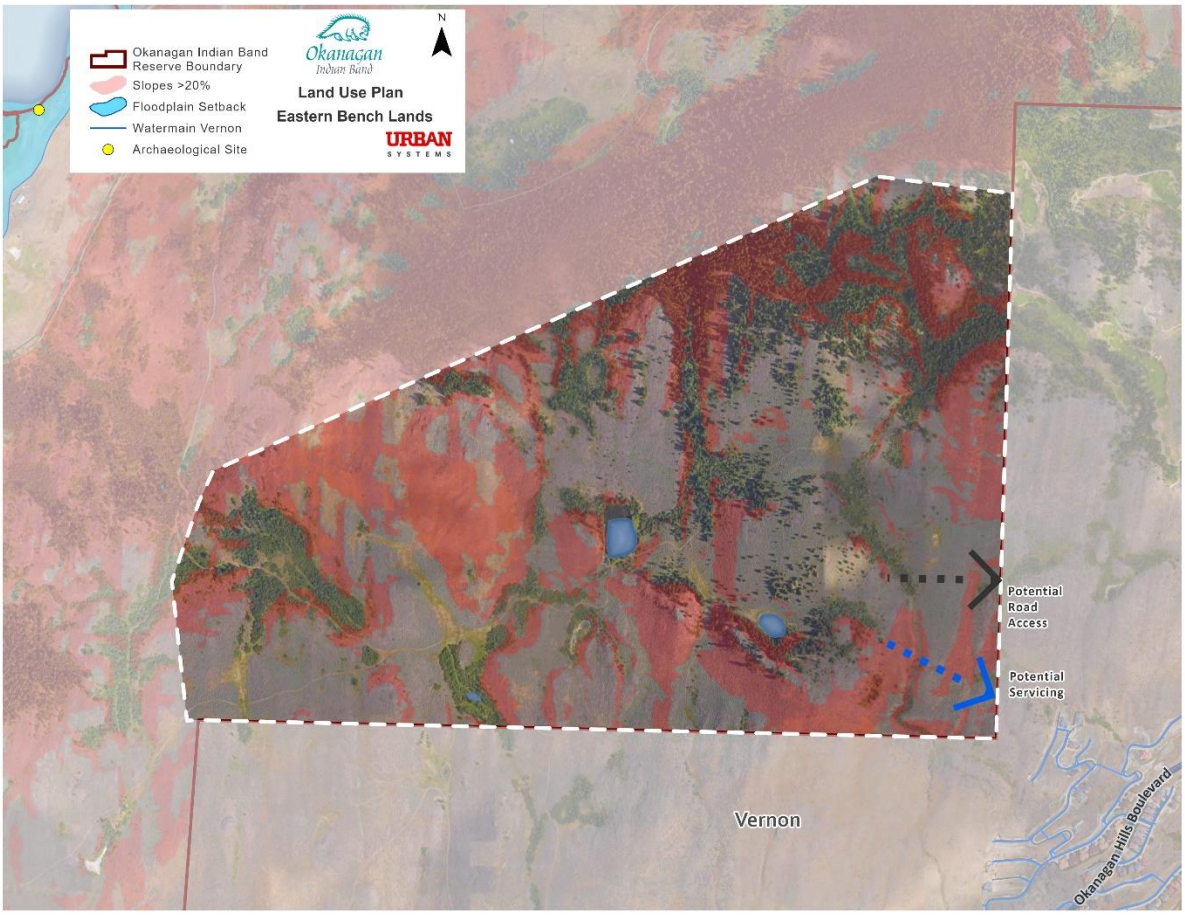


Table 4.2: Eastern Bench Lands Development Summary

Development Potential	
Gross Area	549 acres
Removed from Development Area (Riparian/Protected Area, Slopes steeper than 20%)	230 acres
Infrastructure Allowance (20%)	64 acres
Net Development Area	255 acres
Known Archaeological Sites	No
Environmental Considerations	
• **Flooding Concerns**	No
• **Critical Habitat***	Yes (Great Basin Spadefoot Toad, Western Rattlesnake, Great Basin Gopher Snake)
• **Known Species at Risk Occurrences***	Yes (American Badger, Baltic Rush – Common Silverweed, one masked occurrence)
Existing Land Use	Rangeland, Open Space
Proposed Land Use	Residential (Band Housing), Community Facilities, Economic Development
Highest and Best Use	Residential Subdivision – single family and multi-family (shorter-term potential)
Potential Infrastructure Servicing	
• **Water**	Greater Vernon Water (GVW)
• **Sanitary Sewer**	City of Vernon Sewer System
• **Roads**	Rising View Boulevard
• **Power**	Underground power, approx. 500 m southeast

**Critical habitat and known species at risk occurrence data provided through Province of BC open data sources. Additional species at risk may potentially occur within the planning area and those listed are the known and documented species and critical habitats only.*

4.2.3 Western Bench Lands

The Western Bench Lands development node is located in the southeastern portion of the range. The site borders the City of Vernon municipal boundary to the east and south. The site is comprised of an approximate 150 acre grassland bench situated on the top of the ridge. The grasslands give way to a steep forested hillside to the west and north. Given its location on the top of the ridge, the site offers views over the north arm of Okanagan Lake to the west, Beachcomber Bay to the south and the City of Vernon to the east.

A search of Provincial databases indicates that nearly the entire development node is comprised of critical habitat for the Great Basin Spadefoot toad. While this critical habitat is focused around the small wetlands/waterbodies found within the development node, it also includes connectivity corridors in between the adjacent wetlands. Given that this is a federally-listed species at risk, environmentally approvals may be required prior to any future development on the site.

The community has identified the Western Bench Lands for potential residential housing (Band housing and/or market housing) and/or resort tourism development. However, the development node is rather isolated, making infrastructure servicing and access cost prohibitive. Given these infrastructure and species at-risk constraints, development of the Western Bench Lands may be a longer-term initiative.**Figure 4.4** illustrates the development node while **Table 4.3** summarizes key development considerations.

Figure 4.4: Western Bench Lands Development Node

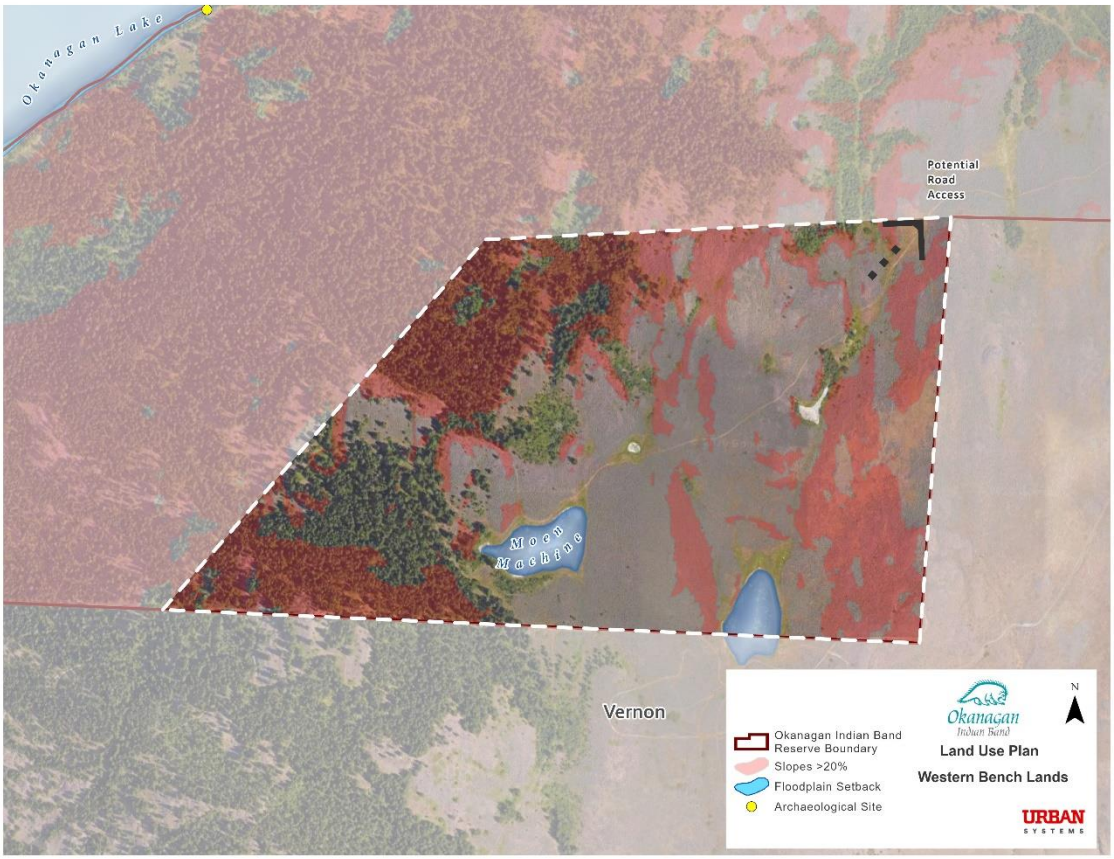


Table 4.3: Western Bench Lands Development Summary

Development Potential	
Gross Area	216 acres
Removed from Development Area (Riparian/Protected Area, Slopes steeper than 20%)	104 acres
Infrastructure Allowance (20%)	22 acres
Net Development Area	90 acres
Known Archaeological Sites	No
Environmental Considerations	
• **Flooding Concerns**	No
• **Critical Habitat***	Yes (Great Basin Spadefoot Toad, Western Rattlesnake, Great Basin Gopher Snake)
• **Known Species at Risk Occurrences***	Yes (American Badger, one masked occurrence)
Existing Land Use	Rangeland, Open Space
Proposed Land Use	Residential (Band Housing), Resort Tourism
Highest and Best Use	Uncertain due to current development constraints (eg species at risk, infrastructure, clearance)
Potential Infrastructure Servicing	
• **Water**	TBD
• **Sanitary Sewer**	TBD
• **Roads**	TBD
• **Power**	TBD

**Critical habitat and known species at risk occurrence data provided through Province of BC open data sources. Additional species at risk may potentially occur within the planning area and those listed are the known and documented species and critical habitats only*.

4.2.4 Rattlesnake Point (acx̌ʷyus)

The Rattlesnake Point (or acx̌ʷyus as traditionally known) development node is located along the southern border of the range, along the shores of Okanagan Lake. The City of Vernon neighbourhood of Bella Vista West is located directly adjacent to the development node to the south.

Rattlesnake Point (acx̌ʷyus) has long been identified as a potential development site by the community. This was again emphasised during the community engagement for the Phase 1 Land Use Plan and the area was included as one of eight potential development areas within the Land Use Plan. In 2017 OKIB applied for, and received, ISC's Lands and Economic Development Servicing Program (LEDSP) funding in order to undertake a Development Feasibility Study for Rattlesnake Point (acx̌ʷyus). As part of the background work for this project, an initial meeting was held with City of Vernon staff in order to discuss potential development and servicing at Rattlesnake Point (acx̌ʷyus). Based on the feedback received from the City related to access and infrastructure servicing concerns, it was decided that development at the Eastern Bench Lands would be given priority over Rattlesnake Point (acx̌ʷyus) **Figure 4.5** illustrates the development node while **Table 4.4** summarizes key development considerations.

Figure 4.5: Rattlesnake Point (acx̌ʷyus) Development Node

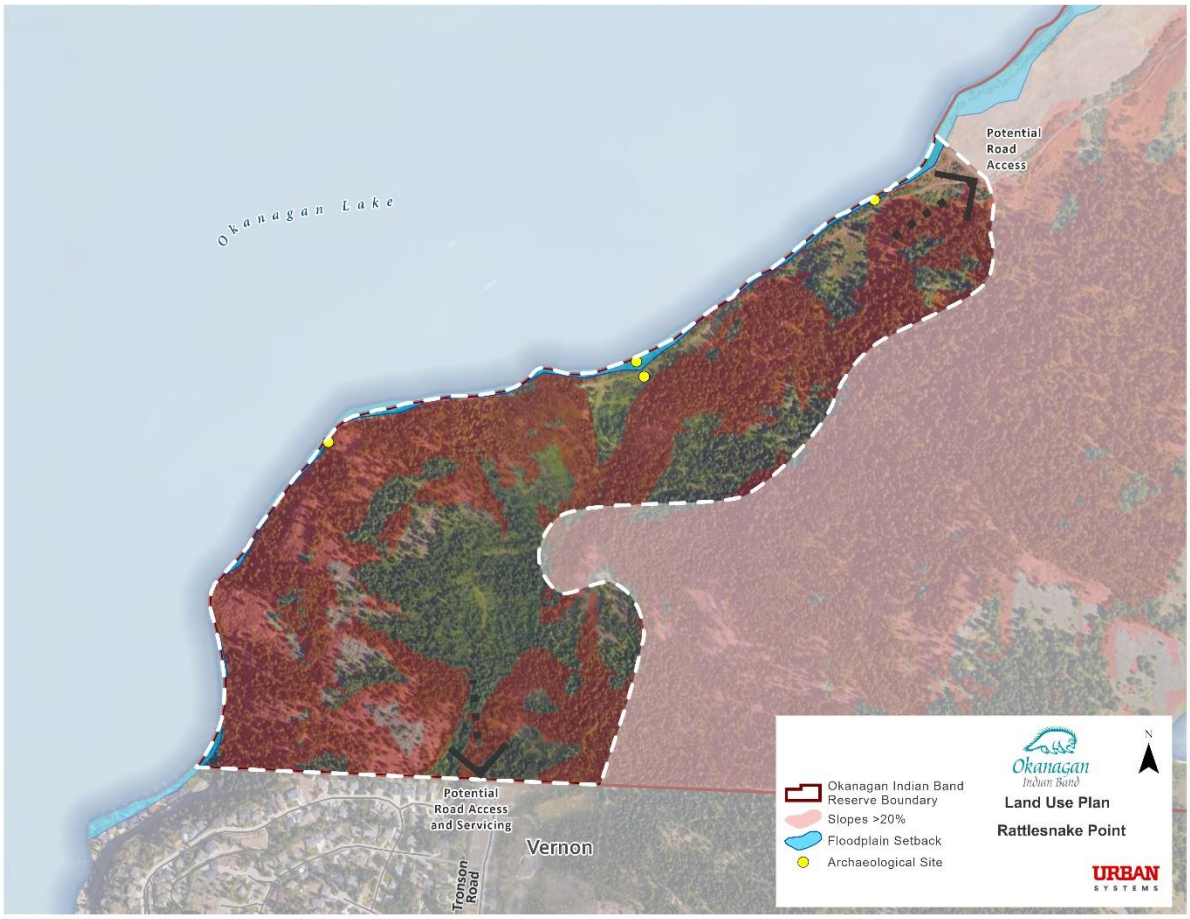


Table 4.4: Rattlesnake Point (acx̌ʷyus) Development Summary

Development Potential	
Gross Area	180 acres
Removed from Development Area (Riparian/Protected Area, Slopes steeper than 20%)	117 acres
Infrastructure Allowance (20%)	13 acres
Net Development Area	50 acres
Known Archaeological Sites	Yes
Environmental Considerations	
• **Flooding Concerns**	Yes (Okanagan Lake)
• **Critical Habitat***	Yes (Western Rattlesnake, Great Basin Gopher Snake)
• **Known Species at Risk Occurrences***	Yes (American Badger, one masked occurrence)
Existing Land Use	Rangeland, Open Space
Proposed Land Use	Residential (Band Housing)
Highest and Best Use	Residential Subdivision (medium-term potential)
Potential Infrastructure Servicing	
• **Water**	Greater Vernon Water
• **Sanitary Sewer**	City of Vernon Sewer System
• **Roads**	Tronson Road
• **Power**	Underground power south at Bella vista West

**Critical habitat and known species at risk occurrence data provided through Province of BC open data sources. Additional species at risk may potentially occur within the planning area and those listed are the known and documented species and critical habitats only.*

4.3 Cultural Lands & Passive Development Area

The Cultural Lands and Passive Development Area include lands where the cultural, spiritual, historical and/or recreational importance is the current priority for community members or where there is a desire to defer active development and leave future options open. Throughout the engagement process community members emphasised the significant value these lands have in the community. The need to preserve spaces within the range to ensure that the OKIB way of life is maintained was also emphasised.

The establishment of the Cultural Lands and Passive Development Area helps to address several community objectives and concerns related to land use planning on the Goose Lake Range, including:

- Ensuring the opportunity for community members to connect with culturally significant areas
- Ensuring that development is balanced with protection of critical habitats and sensitive ecosystems
- Prioritizing the celebration of OKIB's cultural and spiritual connection to the land
- Ensuring the protection, preservation, and sustainable use and harvesting of traditional resources on the Goose Lake Range
- Continuing use of lands as rangeland
- Maintaining open spaces adjacent to the main community for various recreational uses
- Providing for economic opportunities through 'passive' forms of development, such as eco-tourism
- Ensuring that future options and opportunities are left open

It should also be noted that while current plans for the Goose Lake Range do not prioritize near-term intensive forms of development in the Cultural Lands and Passive Development Area at present, this Enhanced Land Use Plan should be viewed as a living document. This Plan is intended to be reviewed and maintained on an on-going basis. Future OKIB generations may place different values on the Cultural Lands and Passive Development Area, allowing for different forms of development. **Figure 4.6** outlines the Cultural Lands and Passive Development Area and **Table 4.5** provides a summary of the key development considerations..

Figure 4.6: Cultural Lands and Passive Development Area

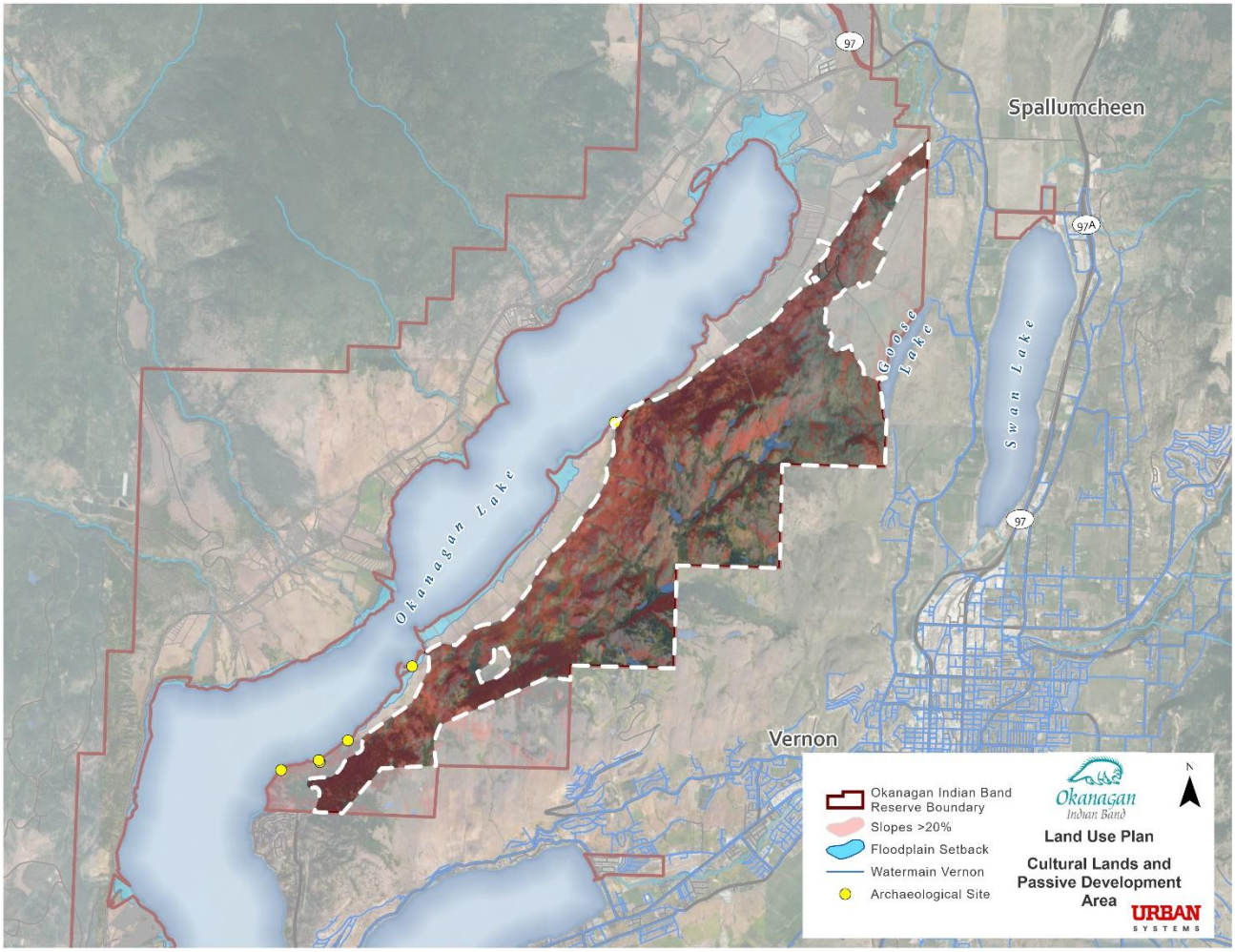


Table 4.5:Cultural Lands and Passive Development Area Development Summary

Development Potential	
Gross Area	5104 acres
Removed from Development Area (Riparian/Protected Area, Slopes steeper than 20%)	3543 acres
Infrastructure Allowance (20%)	312 acres
Net Development Area	1249 acres
Known Archaeological Sites	Yes
Environmental Considerations	
• **Flooding Concerns**	Yes (Okanagan Lake and Goose Lake)
• **Critical Habitat***	Yes (Great Basin Spadefoot toad, Western Rattlesnake, Great Basin Gopher Snake)
• **Known Species at Risk Occurrences***	Yes (American Badger, Common Cattail Marsh, Painted Turtle (Rocky Mountain Populations), one masked occurrence)
Existing Land Use	Cultural/Spiritual Uses, Recreation, Rangeland, Open Space
Proposed Land Use	Cultural/Spiritual Uses, Recreation, Rangeland, Open Space, 'Passive' Developments (Eco-Tourism, Agriculture/Rangeland), Set Aside for Future Opportunities

**Critical habitat and known species at risk occurrence data provided through Province of BC open data sources. Additional species at risk may potentially occur within the planning area and those listed are the known and documented species and critical habitats only.*

4.4 Development Guidelines

Section 4 of the Phase 1 Land Use Plan outlines several Land Use Management guidelines for the protection of key lands and resources on OKIB lands. These guidelines include:

- Environmental Protection Guidelines
- Heritage Sites and Cultural Resource Protection Guidelines
- Natural Resource Protection Guideline
- General Development Guidelines

During the Phase 1 Land Use Planning process, community members also identified areas in which they felt extra precautions should be taken when considering development. This information was used to generate a 'Level of Community Concern with Development' ranking system for all of the lands addressed in the Phase 1 Plan. Examples of issues that concerned community members regarding potential development included:

- Physical Concerns (e.g. steep slopes, floodplain, UXOs, proximity to infrastructure servicing, etc.)
- Cultural Concerns (e.g. known archaeological sites, cultural sites, etc.)
- Environmental Concerns (e.g. sensitive ecological areas, critical habitats, etc.)

This ranking is intended to be a general guide to help support land use management, including the identification of lands and resources that may require special protections. It should be noted that development on all OKIB lands, including those assigned a 'Low Level of Community Concern' ranking, will need to follow the processes and guidelines as outlined in the Phase 1 Land Use Plan, as well as adhere to any other regulations outlined by the Okanagan Indian Band or other outside agencies. Specifically, the guidelines outlined in Section 3.0 and the Protection Guidelines found in Sections 4.2 – 4.6 of the Phase 1 Land Use Plan apply to all future development on OKIB lands. Also, a "High Level of Community Concern" ranking would not preclude development, however development in such areas should be undertaken with caution.

The Land Use Management guidelines developed under the Phase 1 Land Use Plan are intended to support sustainable development on OKIB lands and to ensure the protection of important natural areas, historical sites and cultural areas from development impacts. It is important to ensure that any future development within the Goose Lake Range consider these guidelines in order to protect these important lands and resources for future generations.

5.0 Implementation and Action Items

5.1 Consistency with Other Plans

This Enhanced Land Use Plan expands upon the work undertaken during the Phase 1 Community Land Use Plan and the action items listed below build upon those as outlined in Section 5.2 of the Phase 1 Land Use Plan. Future planning and works associated with the Goose Lake Range should reference both documents.

As OKIB continues to create more plans and documents, develop more policies, bylaws and proposals, and undertakes future studies on these lands, it will be important to ensure both the Phase 1 Land Use Plan and Goose Lake Range Enhanced Land Use Plans are referenced. As these land use planning projects were community driven processes, the proposed direction, vision and current priorities presented in these documents directly reflect the desires of the community.

5.2 Reviewing the Plan

This Enhanced Land Use Plan is a living document that will need to be monitored and reviewed on a regular basis. Given this Plan is a subsequent phase of the Phase 1 Land Use Plan, it is recommended that the regular review of these documents is undertaken by Council in conjunction with one another, similar to the scheduling as outlined in the Phase 1 Land Use Plan:

1. Council shall schedule a review of the Goose Lake Range Enhanced Land Use Plan and Phase 1 Land Use Plan at the first regular meeting in the month of October in each year and proceed to amend them as deemed advisable at that time.
2. Council shall publicly adopt a methodology and schedule for a comprehensive review of the Goose Lake Range Enhanced Land Use Plan at the first regular meeting in October 2025.

5.3 Action Items

The action items outlined below identify proactive actions OKIB can take in the short, medium and long-term to move towards fulfilling the Community Vision established during the Phase 1 Land Use Plan.

General

- ☐ Implement the Action Items as outlined in Section 5.2 of the Phase 1 Land Use Plan.
- ☐ Establish a Land Use and Development Approvals Framework to help guide OKIB staff and Chief and Council in future land use decisions.
- ☐ Continue to develop key planning documents to guide land use planning and management in the community, including, but not limited to a Subdivision and Development Servicing Standards Bylaw.
- ☐ Implement the next steps as outlined in the 2018 'Potential Land Development Opportunity Assessment" report, specifically as they relate to the Eastern Bench Lands and Rattlesnake Point (acx̌ʷyus) development nodes.

Infrastructure Servicing

- ☐ Continue to engage the City of Vernon and Greater Vernon Water in regards to the extension of their existing infrastructure services to support development on OKIB lands.
- ☐ Implement the Water Master Plan for Okanagan 1.
- ☐ Where possible, ensure future infrastructure planning on the Okanagan 1 reserve takes future residential and economic development, as outlined in this Plan into account.
- ☐ Continue to engage with CP Holders regarding the future development of their lands in order to help facilitate a unified and coordinated approach to development on OKIB lands, as well as to identify potential cost sharing opportunities for future infrastructure servicing.
- ☐ Undertake a Wastewater Master Plan to assess current constraints, as well as outline recommendations and potential improvements related to the community's wastewater infrastructure

UXOs

- ☐ Continue to seek and work towards full clearance and remediation of the Goose Lake Range.
- ☐ Continue with environmental assessment and monitoring in order to fully assess any potential environmental impacts associated with the site's past military use.

Economic Development

- ☐ Ensure the Community Economic Development Plan currently being undertaken incorporates and considers this Plan, as well as the feedback and direction identified by the community throughout the engagement process.
- ☐ Finalize and implement the above-mentioned Community Economic Development Plan.

Natural Environmental and Cultural Heritage Management

- ☐ Implement the Environmental Guidelines, Heritage Sites and Cultural Resource Protection Guidelines, Natural Resource Protection Guidelines and General Development Guidelines as outlined in the Phase 1 Land Use Plan.

- ☐ Engage the Territorial Stewardship Department in future land use decisions on the Goose Lake Range.

- ☐ Follow the recommendations for on-reserve planning as outlined in the 2002 Sensitive Ecosystems Inventory: Bella Vista – Goose Lake Range report.

- ☐ Obtain the floodplain mapping currently being undertaken for Okanagan Lake by the Province of BC once it is completed and incorporate into future mapping and decision-making processes.

- ☐ Establish and/or adopt Floodplain Development Guidelines to help minimize the negative impacts of flooding in future developments adjacent to flood prone areas.

- ☐ Finalize and implement the OKIB Range Management Policy.

- ☐ Engage a Qualified Environmental Professional during the planning phases of any future development on the Goose Lake Range.

- ☐ Ensure known, unregistered OKIB heritage sites are registered with the Archaeology Branch of BC to help ensure future protection.

APPENDIX A

Bella Vista SEI Report

Sensitive Ecosystems Inventory: Bella Vista – Goose Lake Range 2002

Volume 1: Methods, Ecological Descriptions, Results and Management Recommendations

Kristi Iverson, Iverson & MacKenzie Biological Consulting Ltd.

Okanagan Indian Band

THE REAL ESTATE FOUNDATION OF BRITISH COLUMBIA

BRITISH COLUMBIA

ALLAN BROOKS NATURE CENTRE

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The Steering Committee for the Bella Vista – Goose Lake Range Sensitive Ecosystems Inventory has provided project management, guidance and direction throughout the project:

Debbie Clarke	*FORECON Consulting Services*
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Carmen Wong	*Allan Brooks Nature Centre*
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The project was funded by The Real Estate Foundation, the Ministry of Water, Land and Air Protection, the City of Vernon, the Ministry of Sustainable Resource Management, and the Allan Brooks Nature Centre.

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

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

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

Marnie and Paul Williamson and ***Debbie and Bob Clarke*** kindly provided accommodation for field crews. ***Barend Donker***[8] provided study area maps and digital coverages for the portion of the study area within the City of Vernon.

Debbie Clarke, ***Malcolm Martin***, ***Carmen Wong***, ***Mike Sarell***, and ***Susan Latimer*** reviewed the draft version of this report.

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

---

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

Abstract

The Okanagan Basin of British Columbia has very high biodiversity values, including many rare and endangered species and plant communities and a high diversity of ecosystems in close proximity. The region has been subject to extensive agricultural conversion, intense human settlement pressure, noxious weed invasion, uncontrolled motorized recreation, and forest ingrowth associated with fire exclusion. The Okanagan – Shuswap Local Resources Management Plan identified conservation issues on publicly owned lands and advised local governments to "encourage the adoption of wildlife habitat needs in Official Community Plans (OCP)" and to "participate in Sensitive Ecosystems Inventory".

The Bella Vista – Goose Lake Range area was identified in the Vernon Natural Features Inventory as one of the most significant relatively intact remnants of sensitive ecosystems in the North Okanagan, and, for the portion within the City of Vernon, has been designated for future urban growth in the OCP. The area supports ecosystems similar to other potential areas of urban growth around Vernon. For these reasons, the area was selected for a pilot Sensitive Ecosystem Inventory (SEI).

The Bella Vista – Goose Lake Range SEI was initiated in 2002 to provide inventory information on rare and fragile ecosystems that can be used for ecologically sustainable land use and development planning. The project area covers private land, Indian Reserve land, and a small area of crown land along the Bella Vista and Goose Lake Range west of the City of Vernon. This technical report documents inventory methods and results, and provides management recommendations.

The project followed methods used in the Central Okanagan SEI; we used Terrestrial Ecosystem Mapping (TEM) as a base to develop a Sensitive Ecosystems theme map. The inventory was compiled through aerial photograph interpretation and field survey work conducted in the summer of 2002.

Thirty-three percent of the study area is comprised of sensitive ecosystems (SE); twenty-seven percent of the area was included in the other important ecosystem (OIE) categories. The high proportion of SEs and OIEs in the study area reflects the choice of a study area known to have high ecological values. Wetlands, old forests, riparian ecosystems, and coniferous woodlands were extremely rare in the study area. Although areas of intact grasslands, broadleaf woodlands, and sparsely vegetated ecosystems remained, much of the area was covered by altered ecosystems and disturbed grasslands. Remaining grasslands are at risk to invasive plant species introduction or spread.

Many of the sensitive ecosystems are at high risk from human settlement, including loss, fragmentation, or further degradation by human use and invasion by non-native plants. These areas provide many social values including a scenic backdrop for the city and increased property values. With the study area supporting so much of remaining rare and fragile ecosystems, it is paramount that a comprehensive planning exercise be undertaken for the study area to balance the retention and ecological sustainability of sensitive ecosystems with sustainable land development.

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Using the Report

This report presents information on sensitive ecosystems in the Bella Vista – Goose Lake Range of the North Okanagan Valley, and provides guidance regarding their conservation and management.

> See **Volume 2** for details on the Terrestrial Ecosystem Mapping and Soil Erosion and Slope Stability.[9]
>
> See **Volume 3** for details on the Wildlife Habitat Capability and Suitability Mapping.[10]

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, and the need for concern about them.

Chapter 3: Impacts of concern describes the types of impacts that threaten sensitive ecosystems.

Chapter 4: Methods and limitations explains how the mapping was completed and limitations of the mapping.

Chapter 5: Inventory results describes and shows a map of the status of sensitive ecosystems in the study area.

Chapter 6: Planning and management outlines conservation and land management planning and provides recommendations for Vernon's Official Community Plan. It provides management recommendations for First Nations and landowners.

> The Central Okanagan Sensitive Ecosystems Inventory report[11] provides detailed information on conservation tools that are directly applicable to ecosystems in the North Okanagan.

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

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

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).

---

[9] Iverson and Shypitka 2003
[10] Sarell and Haney 2003
[11] Iverson and Cadrin 2003. Contact Ken Arcuri at the Regional District of the Central Okanagan for more information.

Volume 2[12] 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 B of Volume 1 provides tables that can be used to cross-reference between sensitive and other important ecosystems units and ecosystem mapping units in the ecosystem mapping report.

Volume 2 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. 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[13] contains wildlife habitat mapping themes developed from the terrestrial ecosystem mapping (TEM) for the following ten species: Great Basin Spadefoot (*Spea intermontana*), Northern Pacific Rattlesnake (*Crotalus oreganus*), Gopher Snake (*Pituophis catenifer* ssp*. deserticola*), Western Screech-owl (*Otus kennicottii* ssp*. macfarlanei*), Long-billed Curlew (*Numenius americanus*), Yellow-breasted Chat (*Icteria virens*), Brewer's Sparrow (*Spizella breweri* ssp*. breweri*), Grasshopper Sparrow (*Ammodramus savannarum*), Swainson's Hawk (*Buteo swainsonii*), and Badger (*Taxidea taxus*). All of these species are considered at risk in the province of B.C. and local populations are also a concern. These species provide a cross-section of threatened or endangered amphibians, reptiles, birds, and mammals that depend on a range of different sensitive and important ecosystems in the study area. There are many other threatened and endangered species that likely occur in the study area and are listed in each ecosystem chapter of Volume 1.

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

---

[12] Iverson and Shypitka 2003.
[13] Sarell and Haney 2003

1 Introduction

The Okanagan Valley is an area of tremendous biological and ecological significance, but ecosystems have been significantly modified and fragmented, and are increasingly threatened by urban and agricultural development. The valley provides a vital corridor connecting the Great Basin to the south with other dry interior landscapes of British Columbia. The Bella Vista – Goose Lake Range is a significant portion of the valley with a diverse assemblage of relatively intact ecosystems that support many endangered and other species.

The Allan Brooks Nature Centre, Okanagan Indian Band, City of Vernon, Ministry of Water, Land and Air Protection, Ministry of Sustainable Resource Management, and others, initiated this project to identify and provide a management tool for sensitive ecosystems in the Bella Vista – Goose Lake Range of the North Okanagan.

The purpose of the SEI project was to develop an inventory information base to support sound land management decisions, and promote effective stewardship of sensitive ecosystems. The goal was to provide the City of Vernon with data that could be used in revising its Official Community Plan, and providing input to Neighbourhood and Parks Plans and to provide the Okanagan Indian Band with information for land management planning. This product contributes to the tools required to develop and assess broad conservation and development options for the study area.

This report describes inventory methods and results, rare and fragile ecosystems of the Bella Vista – Goose Lake Range, highlights their values and importance, and offers practical advice on how to best avoid or minimize damage to them. It is intended as a pilot project for the North Okanagan with the goal to inventory other significant natural areas in the future.

The Bella Vista – Goose Lake Range SEI follows from the Central Okanagan SEI and Vancouver Island SEI. Many of the materials in this report have been adapted from the reports for the Central Okanagan and Vancouver Island SEI. Other SEIs are ongoing on the Sunshine Coast and in the South Okanagan.

1.1 Study Area

The study area (Figure 1) is located on a peninsula extending into the north end of Okanagan Lake in the north Okanagan Valley of south-central British Columbia. The area covers 5,728 ha, and includes private land, Indian Reserve lands, and a small area of Crown land within the Interior Douglas-fir very dry, hot, Okanagan variant biogeoclimatic subzone[14]. The study area is located within the Southern Interior ***Ecoprovince***[15], the northern extension of the Columbia Basin that

[14] The BC Ministry of Forests ***Biogeoclimatic Ecosystem Classification*** (BEC) is a system of classifying vegetation based on climatic and topographic patterns. BEC was developed by the Ministry of Forests to provide a basis for natural resource management, particularly forest and range management. See Pojar et al. 1987 for further information.

[15] 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. An ***Ecoprovince*** is an area of consistent climate or oceanography, and physiography, of a size useful for provincial overview-planning. See Demarchi 1996 for further information. An ***Ecosection***

extends south to Oregon and lies within the North Okanagan Basin ***Ecosection***, a wide trench formed by parallel fault lines and further carved out by multiple glaciations.

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 results in low 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.

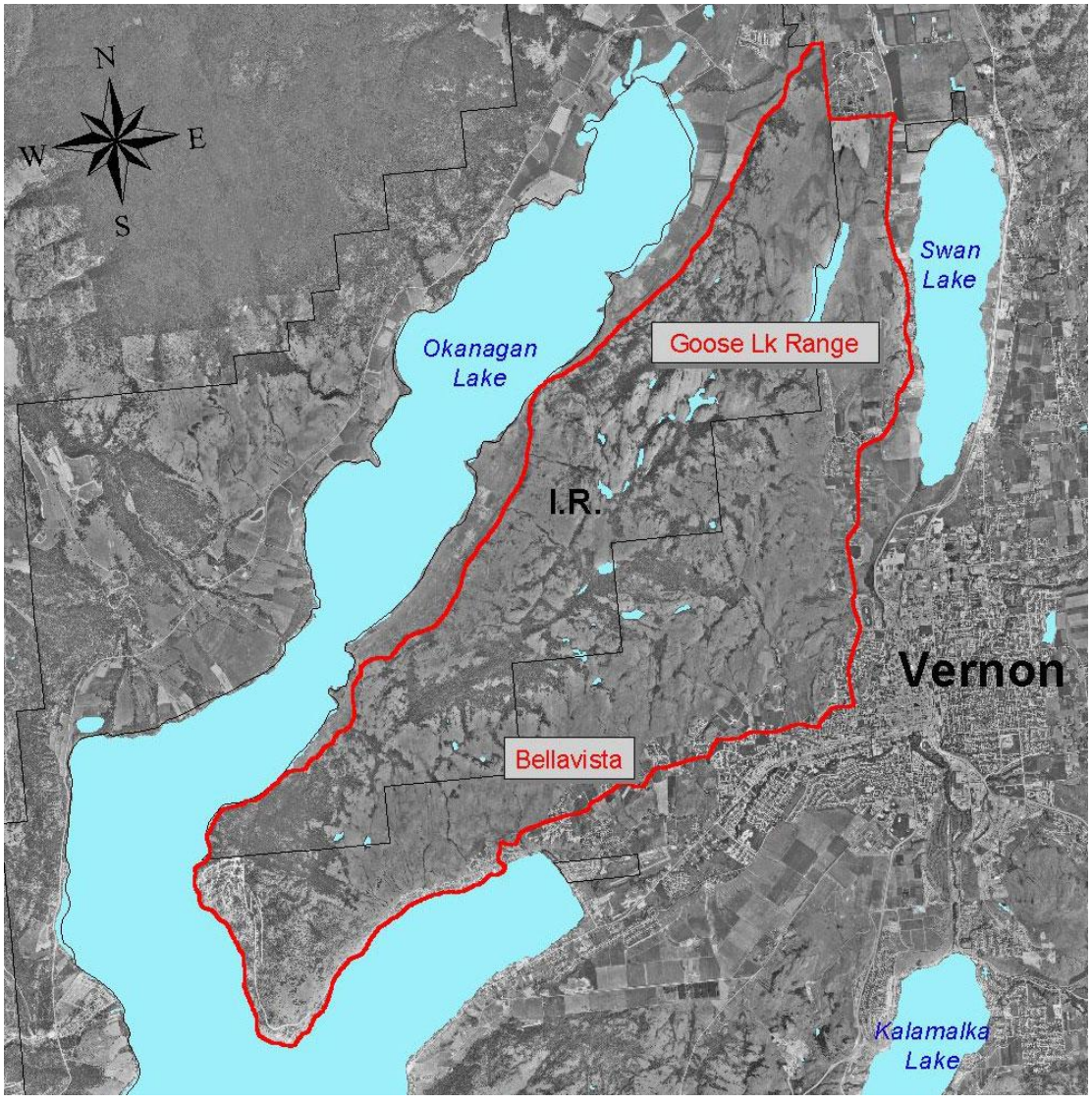

Figure 1. Bella Vista – Goose Lake Range SEI study area.

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is a subdivision of an Ecoprovince and is an area with minor physiographic and macroclimatic or oceanographic differences.

1.2 Ecological Importance of the Study Area

The Okanagan Valley is a region of nearly unparalleled biological diversity within British Columbia and North America. The complex terrain of the area, combined with a semi-arid climate moderated by the influence of Lake Okanagan has resulted in a wide diversity of ecosystems and organisms in relatively close proximity to one another, and distinguishes the Okanagan Valley from the vast Columbia Basin to the south. Increasingly, scientists are finding that populations at the edge of their range, such as those in the Okanagan, are likely to persist longer than core populations during population declines, which also may allow them to adapt to future changes such as global warming[16].

The Okanagan Valley is a north to south corridor that connects the dry interior valleys of British Columbia to southern grassland ecosystems of the Columbia Basin in the U.S. The valley is a corridor for migrating birds and a point of entry for southern plants and animals into B.C.'s dry interior.

The Bella Vista – Goose Lake Range was identified in the Vernon Natural Features Inventory[17] as an exceptional area with the best quality grasslands remaining in the North Okanagan Basin. The ponds, lakes, and wetlands found on the upper portions of the range also provide some of the best remaining wetland habitats. Additionally, the area is relatively large and natural, mostly unfragmented by roads and development, and has a great diversity of ecosystems, species, landforms, and bedrock geology. In the Natural Features Inventory, the area received a very high importance ranking for rarity, including at least four rare plants and 14 vertebrate species, and has potential for many other rare species. With proper planning and management, the natural features of the study area provide the potential for long-term viability of endangered species and sensitive ecosystems. Finally, the area provides a scenic and natural backdrop for the City of Vernon, and community values including aesthetics, hiking, and observing wildlife and nature.

Figure 2. Overview of study area looking south from Reed Lake.

[16] Scudder 1991
[17] Clarke et al. 1993

2 Ecosystems of Concern

2.1 What are Sensitive Ecosystems?

This sensitive ecosystems project recognises both ***sensitive ecosystems*** and ***other important ecosystems*** in the study area. *Sensitive ecosystems* refer to seven ecosystem types (Table 1) that are ecologically fragile or are rare in the provincial landscape and are relatively unmodified by human influences[18]. These sensitive ecosystems are generalised groupings of ecosystems that share many characteristics, particularly ecological sensitivities, ecological processes, rarity, and wildlife habitat values. These categories were adopted from the Central Okanagan SEI.

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 2).

Within developed landscapes, sensitive and other important ecosystems provide natural areas with intrinsic value and critical habitat for many species. They provide ecological functions that regulate the climate, clean freshwater, regulate and clean soils, maintain genetic diversity, maintain the water cycle, recycle nutrients, and pollinate crops. They are vital in creating healthy and attractive communities for people.

Table 1. Sensitive ecosystems.

Code	Sensitive Ecosystems	Ecosystem Description
WN	Wetlands	Non-forested ecosystems where the water table is at or near the surface; includes **wet meadows** (WN:md), **marshes** (WN:ms), and **shallow open water** (WN:sw) ecosystems including ponds
RI	Riparian	Streamside ecosystems in gullies with intermittent or permanent creeks (**gully**, RI:gu); and fringe ecosystems associated with pond and lake shorelines (**fringe**, RI:ff).
OF	Old Forest	Forest ecosystems dominated by large, old trees; excludes old riparian forests (OF:co); includes old Coniferous Woodlands and old Broadleaf Woodlands.
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 trembling aspen (BW:ac) occurring in depressions and moist areas in grasslands; old Broadleaf Woodlands are part of the Old Forest category.
WD	Coniferous Woodlands	Open stands of Douglas-fir or ponderosa pine, often on shallow soils, with typically grassy understories; old Coniferous Woodlands are part of the Old Forest category.
SV	Sparsely Vegetated	Shrubby rock outcrops (**shrub**; SV:sh), grassy or unvegetated **rock outcrops** (SV:ro), **talus** (SV:ta) slopes, and **cliffs** (SV:cl)

[18] Ward et al. 1998

Table 2. 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 (20 to 50% of the vegetation cover in the plant community)

2.2 Why are these ecosystems important?[19]

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. Rarity 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 or abundance, and because their extent and densities have been reduced.

Rare natural plant communities and vertebrate species are listed for each sensitive ecosystem (Chapters 7 – 15).

The Okanagan Valley provides habitat for many threatened and endangered species. Nationally rare species ranked by COSEWIC[20], 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*** vertebrate animals in the study area include[21]:

Badger (COSEWIC-E) (*Taxidea taxus*)
Swainson's Hawk (*Buteo swainsoni*)

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[19] Adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.
[20] **COSEWIC,** the Committee on the Status of Endangered Wildlife in Canada, determines the national status of wild Canadian species, subspecies and separate populations suspected of being at risk. 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.
[21] See Appendix D for a full list of known and potential threatened and endangered vertebrates in the study area.

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:

Lewis's Woodpecker (COSEWIC-SC) (*Melanerpes lewis*)
Western Harvest Mouse (COSEWIC-SC) (*Reinthrodontomys megalotis*)
Townsend's Big-eared Bat (*Corynorhinus townsendii*)
Great Basin Gopher Snake (COSEWIC-T) (*Pituophis catenifer* ssp*. deserticola*)
Racer (*Coluber constrictor*)
Northern Pacific Rattlesnake (*Crotalus oreganus*)
Painted Turtle (*Chrysemis picta*)

Conservation Data Centre

web site: 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

web site: http://www.cosewic.gc.ca/

Check this web site for the current national status of rare plants and animals.

- **Fragility** is a measure of an ecosystem's sensitivity to a range of disturbance factors that can cause decline or loss of ecosystem health or integrity. Disturbances include direct physical impacts, introduction of invasive species, and 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.

Socio-economic Values

- **Ecosystem Services** including air and water filtration and purification, nutrient cycling, and crop pollination. Clean water, water retention, and groundwater infiltration are important values provided by natural areas.

- **Green Space** networks comprised of diverse ecosystems and species of the area will provide for human enjoyment and interaction with wildlife amidst development. The area provides an attractive and aesthetic backdrop for the City.
- **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 community's natural landscape attracts visitors and new residents, and contributes towards opportunities for nature-based tourism and the unique 'sense of place', and a is source of pride and pleasure for local residents.
- **Outdoor recreation** opportunities are provided by ecosystems in public parks, and on accessible crown land where low-impact activities will not damage the habitat. Wildlife viewing is very important to Canadians[22], and contributes to our quality of life. Bird watching is among the fastest growing leisure pursuits. Hunting, fishing, trapping and guide outfitting contribute to the economy and can occur where wildlife populations can sustain them. The study area is also a source of many traditional use plants including food plants such as balsamroot and mariposa lily.
- **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. The Allan Brooks Nature Centre provides opportunities for local and regional community ecosystem conservation efforts through displays, educational programs, hands-on workshops, and conservation-based volunteer activities.
- **Nature based tourism** is growing in economic importance, and can be very important in rural communities. Economic spin-offs can include benefits to 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.
- **Natural resource use** such as grazing and selection harvesting of forests have supported generations of Okanagan residents and continue to be important activities in the study area.
- **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 North Okanagan. Studies show that undeveloped green space measurably increases the value of nearby property[23] by 5 to 32%[24] and thus, contributes far more in property taxes than it costs in services[25].

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[22] Environment Canada 1999
[23] Meadows 1999
[24] U.S. National Parks Service 1990
[25] Fodor 1999

3 Impacts of Concern[26]

The Bella Vista – Goose Lake Range is one of the few remaining areas in the North Okanagan with relatively intact natural ecosystems that are largely unfragmented. Human settlement pressures represent the greatest threat to sensitive ecosystems in the study area. Large-scale landscape concerns, which affect all ecosystems, include landscape fragmentation, disruption of natural disturbance regimes, edge effects, and invasive species introductions.

3.1 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 often cannot provide the necessary habitat values for wildlife species, which may require a number of different ecosystems for breeding, wintering, and foraging. A network of corridors that connect habitats will help to maintain habitat access, gene dispersal, and the potential distribution for wildlife species.

Although the Bella Vista – Goose Lake Range is largely unfragmented, urban and agricultural developments have affected the edges and surroundings, resulting in a somewhat isolated core natural area.

3.2 Disruption of Natural Disturbance Regime

The exclusion and suppression of natural fire has changed grassland and forest ecosystems in the study area. Ecosystems and species of the Okanagan Valley have evolved with natural fire as a major factor in ecosystem and habitat distribution. Frequent ***surface fires***[27] maintained open forests with largely grassy and shrubby understories. Fires likely limited the amount of sagebrush in grassland ecosystems. Fire exclusion has resulted in dense forests ingrown with Douglas-fir and ponderosa pine, and encroachment of these trees onto grasslands. Fire exclusion has affected both ecosystem processes and wildlife habitat values.

3.3 Invasive Species

Both the deliberate and accidental introduction of invasive non-native plant species (see below) has significantly altered the species composition of some ecosystems in the study area. The northern and lower slope portions of the study area are the areas that have been most altered by invasive plants. Some invasive animal species such as European starlings have altered wildlife populations by displacing native cavity nesting birds.

Invasive plant species reduce diversity by displacing native plant species, and reducing vegetation diversity and soil stabilization. Invasion of non-native plants can also result in loss of forage for

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[26] Adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

[27] Surface fires are fires that burn primarily through the understory or grass and herbaceous vegetation in an ecosystem and do not burn in the overstory trees.

domestic livestock and wildlife. Recreation vehicles such as all terrain vehicles (ATVs), bicycles, domestic animals, and people can all spread 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.

For this SEI, we define **invasive plant species** 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***.

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.

Some invasive plant species:

Diffuse knapweed (*Centaurea diffusa*)
Sulphur cinquefoil (*Potentilla recta*)
Cheatgrass (*Bromus tectorum*) and other annual bromes (*Bromus* spp.)
Dalmation toadflax (*Linaria genistifolia*)
Common hound's-tongue (*Cynoglossum officinale*)
Purple loosestrife (*Lythrum salicaria*)

Figure 3. Cheatgrass (left) and knapweed plant in its first year (right).

3.4 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[28]. 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.

The study area is influenced by edge effects primarily along the lower slopes, especially on the eastern side of the study area in the City of Vernon. Urban growth, linear development (e.g. roads), and other land development within the study area has the potential to increase edge effects.

3.5 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 water movement and water levels. Disturbances to wildlife species, particularly during the breeding season can directly impact their survival. Although it may seem like large rural lots have the potential to retain many natural values, many owners choose to remove native vegetation and natural features, and intensely graze domestic animals (e.g., horses). Fragmentation associated with these lots also leaves them more vulnerable to weed invasion. All of these possible changes reduce the ecological integrity and natural values of these areas.

3.6 Indirect Impacts

Activities that occur adjacent to or at some distance from the ecosystem result in indirect impacts. Hydrological[29] changes due to roads, buildings, deforestation, removal of vegetation, invasive plant species, increased impervious road surfaces, soil compaction and agricultural practices can all result in reduced groundwater infiltration and summer soil moisture, increased annual runoff, disrupted drainage patterns, and reduced soil moisture holding capacity. These hydrological changes can change the water quality and function, structure, and wildlife habitat values of adjacent wetlands and riparian areas.

Water pollution from both point and non-point 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[30].

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, and mountain bikes, create soil disturbances that allow rapid invasion and spread of invasive plant species. They can also disturb wildlife, and cause soil erosion and damage to plants.

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

[29] Water-related features and processes.

[30] Cannings and Durance 1998

4 Methods and Limitations[31]

This chapter describes the methods that were used to generate the sensitive ecosystems map. These methods follow those used in the Central Okanagan. The provincially recognised Terrestrial Ecosystem Mapping[32] (TEM) approach was used to create a base map. Ecosystems were evaluated for rarity and ecological sensitivity, and a sensitive ecosystems theme map was developed.

4.1 Terrestrial Ecosystem Mapping

Terrestrial Ecosystem Mapping (TEM) formed the foundation of the thematic sensitive ecosystems map that was created for this project. Polygons were drawn on 1:15,000 aerial photographs 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 **Volume 2**[33].

Details on methods, results, limitations and management recommendations for wildlife capability and suitability mapping can be found in **Volume 3**[34].

4.2 Sensitive Ecosystems Mapping

For the Central Okanagan SEI, TEM units were evaluated for rarity and ecological sensitivity and were assigned to sensitive ecosystems and other important ecosystems categories accordingly. For this project, TEM units were assigned to the same sensitive ecosystems as in the Central Okanagan SEI and any new TEM units were evaluated for rarity and ecological sensitivity. The Central Okanagan 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 and proposed rankings by the Conservation Data Centre (CDC), 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. 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 Tool[35]. This tool allows ratings, or in this case, SEI categories, to be assigned to each ecosystem. Detailed conversion tables can be found in Appendix B.

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[31] Adapted from Iverson and Cadrin 2003.
[32] Resources Inventory Committee 1998
[33] Iverson and Shypitka 2003
[34] Sarell and Haney 2003

Field Sampling and Conservation Evaluation of Sensitive Ecosystems

Prior to initiating the fieldwork for this project, landowners within the study were contacted by letter and phone to request permission to sample their lands. Four landowners and the Okanagan Indian Band agreed to have their lands sampled.

I developed a sampling plan 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 in the summer of 2002, and a total of 158 sensitive ecosystems or other important ecosystems sites were field-checked (Table 3). A team 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[36] (see Appendix A in Volume 2). Sample plots were subjectively located within polygons to best represent the ecosystem(s) in that polygon. Samples sites were distributed to maximize sampling of sensitive ecosystems; other ecosystems were sampled along access routes to sensitive ecosystems. Sampling of private lands we did not have permission to access was limited to visual inspections with binoculars from accessible locations in adjacent properties. Sampling procedures for detailed ecological plots and ground inspections are outlined in *Field Manual for Describing Terrestrial Ecosystems*[37]. The *Standard for Terrestrial Ecosystem Mapping*[38] in British Columbia provides guidelines for visual inspection data collection.

Field crews used the conservation evaluation form (see Appendix A in Volume 2) to assess the conservation values of the site.

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

Table 3. Sites sampled by ecosystem type.

Sensitive Ecosystems	Full plots	Ground Inspections	Visuals	Total Plots
Broadleaf Woodland	2	5	11	18
Grasslands	3	10	10	23
Old Forest		1		1
Riparian	1	6	2	9
Sparsely Vegetated	3	9	19	31
Coniferous Woodland	1	3	2	6
Wetland	1	7	23	31
TOTAL	**11**	**41**	**67**	**119**
Other Important Ecosystems				
Disturbed Grasslands		5	27	32
Mature Forest		3	4	7
TOTAL		**8**	**31**	**39**

[35] 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

[36] See Volume 2: Iverson and Shypitka 2003

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

[38] Resources Inventory Committee 1998

4.3 Mapping Limitations

The SEI information is intended to provide a broad planning base and to alert local and regional decision-makers, landowners, and development or planning consultants 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) 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.

On-going land uses may have changed some polygons after the date that the aerial photographs were taken or the field sampling was conducted. Wherever possible, polygons reflect conditions that were noted during field sampling, rather than when the aerial photographs were taken.

One of the primary limitations of aerial photograph interpretations is the ability to see disturbances such as cover of invasive plants. The mapper must apply the information from field sampling data to adjacent areas. Disturbance levels may have changed in some areas after the field sampling was completed.

Small sensitive ecosystems are captured as a small component of a larger polygon that is dominated by one or two other ecosystems. Many polygons contain a complex of up to three ecosystems, and sensitive ecosystems may only occupy a portion of a given 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 33.2% (1901 ha) of the study area (Table 4), while modified landscapes covered the remaining 66.8%. The two other important ecosystems (OIE) mapped covered 26.8% (1536 ha) of the study area. The high proportion of SEs and OIEs in the study area reflects the choice of a study area known to have high ecological values. Figure 5 shows the distribution of sensitive ecosystems in the study area.

Ecosystems that have not been included as sensitive ecosystems or other important ecosystems still have many important values, especially to provide connectivity and buffers between and around SE and OIEs. Some ecosystems such as younger forests may be recruitment sites for future SEs or OIEs. Many ecosystems provide important wildlife habitat. Also, the vegetation and soils help provide the safe capture, storage, and release of water that is critical to maintaining water quality, preventing soil erosion, and maintaining the hydrological function of wetland, riparian and other ecosystems.

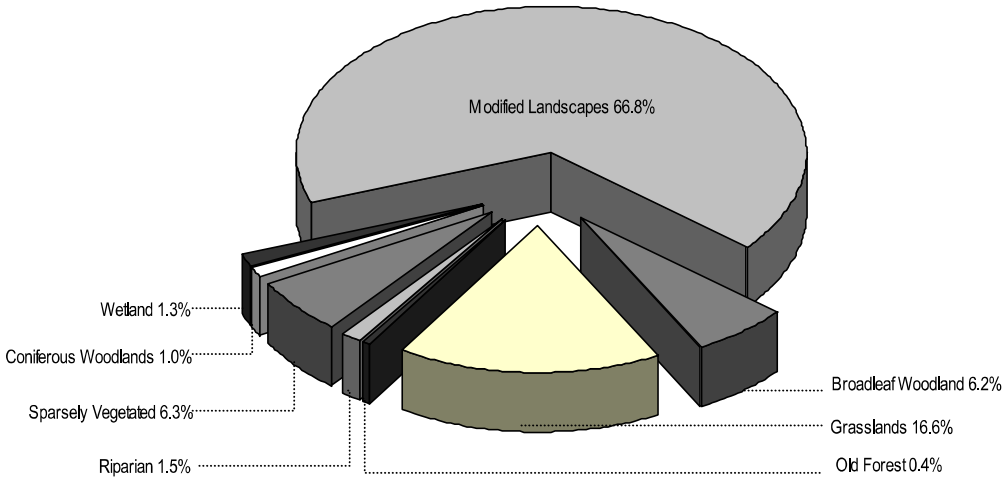

Figure 4. Relative proportion of sensitive ecosystems and modified landscapes in the study area.

Table 4. Area of sensitive ecosystems and other important ecosystems in the study area.

	Area (ha)	Percent of Study Area
Sensitive Ecosystems (SE)		
Broadleaf Woodland	353	6.2
Grassland	952	16.6
Old Forest	24	0.4
Riparian	87	1.5
Sparsely Vegetated	358	6.3
Coniferous Woodland	56	1.0
Wetland	72	1.3
Total SE	**1901**	**33.2**
Other Important Ecosystems (OIE)		
Disturbed Grassland	1350	23.6
Mature Forest	187	3.3
Total OIE	**1536**	**26.8**
TOTAL SEI and OIE	**3347**	**60.0**

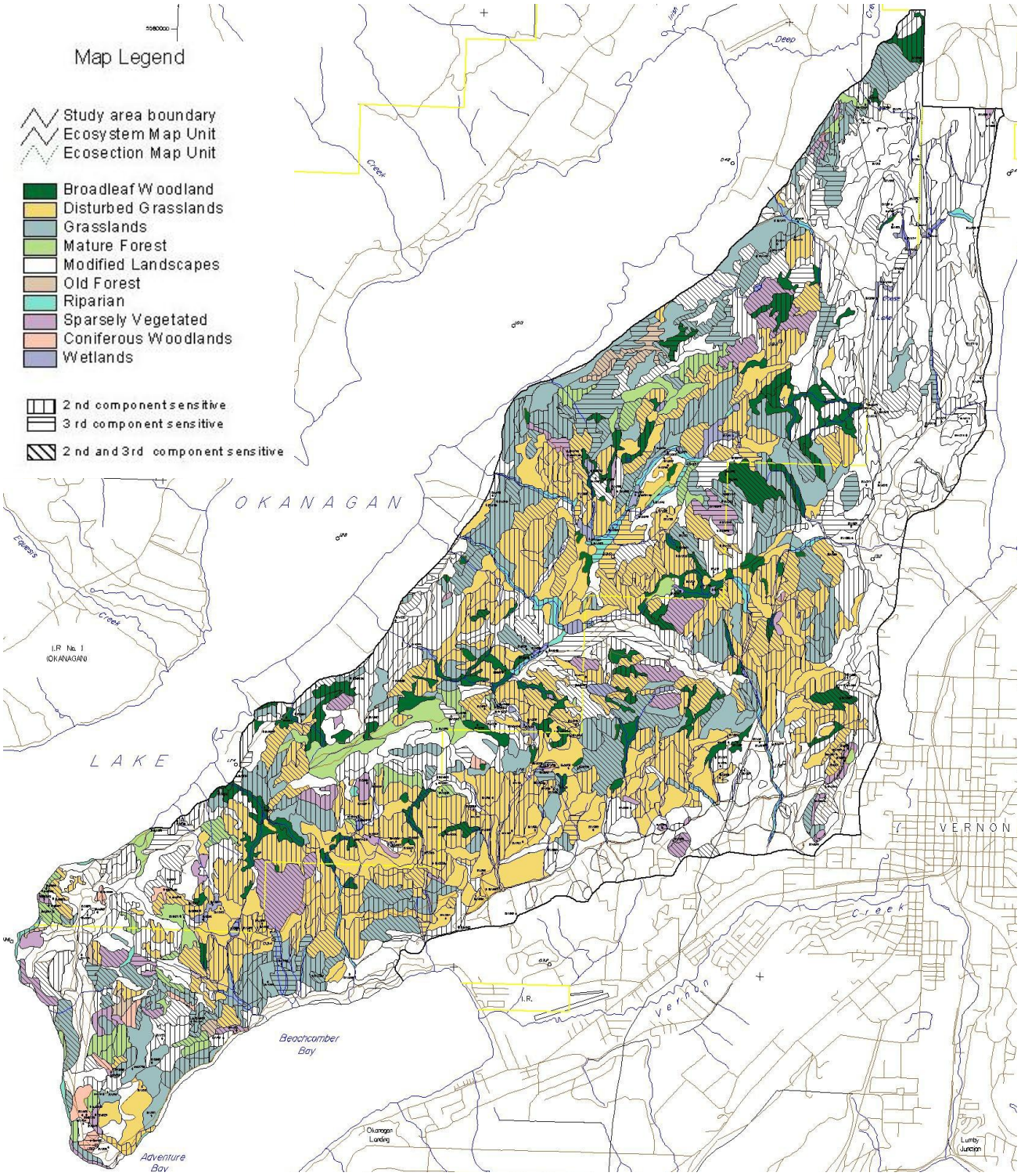

Figure 5. Sensitive Ecosystems map for the study area.

6 Planning and Management

6.1 Goals

The goals of the management guidelines differ between sensitive ecosystems and other important ecosystems:

- Sensitive ecosystem guidelines seek to conserve the seven sensitive ecosystems in a relatively natural state.
- Guidelines for other important ecosystems seek to maintain the resource values and minimise the loss of ecosystem functions.

6.2 City Planning

Develop a 'Local Ecosystems Plan'[39]

A systematic plan for prioritization and protection, and stewardship of local sensitive ecosystems should be developed. SEI mapping, terrestrial ecosystem mapping, wildlife habitat mapping, and soil erosion and slope stability terrain mapping can be used to set priorities for conservation and management. The local ecosystems plan should consider known gaps in the system of provincial and regional protected areas, and be integrated across the study area , within the City and Indian Reserve to ensure landscape level connectivity.

Recognizing and protecting environmentally sensitive areas early in the community planning process provides the best chance of protecting environmental values.

- Concentrations of high quality ecosystems and habitat for rare species should be prioritized for establishing core conservation areas.
    - Quality/condition and viability ratings of SEI units can be used to identify higher quality SEI units[40].
    - Wildlife habitat mapping can be used to determine key core areas for mapped species.
    - Core areas could be managed as natural parks, biodiversity ranches, or other forms of conservation areas.

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[39] Refer to the Conservation Tools Section of Iverson and Cadrin 2003 for more detailed information.

[40] **Quality/condition** measures how well the specific site represents the biological and ecological functions of the ecosystem, degree of fragmentation, and the degree of alteration of the site by human influences and presence of introduced species. **Viability** measures the likelihood that the ecosystem will retain its biological and ecological functions based on current conditions, and surrounding land uses and management practices. There are four possible rankings for quality/condition and viability: Excellent (1), Good (2), Marginal (3), and Poor (4). Ecosystems with Excellent and Good rankings for quality/condition and viability are the highest conservation priorities.

- In consultation with a qualified professional, establish ecologically appropriate buffers to protect core conservation areas.
- Link core areas with corridors. The habitat needs of important wildlife species must be considered in this process. A professional biologist should design habitat linkages that consider the needs of a full spectrum of species.
- Design roads and utilities at a landscape scale to minimize impacts to sensitive and other important ecosystems.
- Integrate ecosystem retention and conservation with other land use planning considerations (such as parks and recreation) that are consistent with the preservation of sensitive ecosystems.
- Develop a weed management strategy to minimize the spread and introduction of invasive plant species.

For demonstration purposes, the project team developed three preliminary modelling scenarios to illustrate the implications of three levels of ecosystem retention in the study area. These scenarios are outlined in Appendix C.

Aside from the ecosystems prioritized for protection in the ecosystem plan, other sensitive and other important ecosystems, and natural 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.

On-site visits are needed to assess and develop site-specific management recommendations for neighbourhood plans and individual developments.

Develop a Conservation Strategy[41]

Most sensitive ecosystems are on private property, so voluntary stewardship by 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:

- **Designation as Environmentally Sensitive Areas** (ESA) **–** The seven sensitive ecosystems should be a priority in the identification and designation of local government ESAs. In some cases, site boundaries should reflect the dynamic nature of the ecosystem (see **Retain Natural Vegetated Buffers around Sensitive Ecosystems** below). These ESAs should be identified in the Official Community Plan.
- **Acquisition of privately owned lands for conservation and protected status –** The most undisturbed of these remaining ecosystem fragments should be considered for purchase as conservation areas where only activities that do not impact the ecosystem would be permitted. Grassland, wetland, old forest, riparian and broadleaf woodland together with the highest quality coniferous woodland and sparsely vegetated sites should all be priorities for receiving protected

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

status. ***Sites where different sensitive ecosystems occur adjacent or in close proximity to one another should also be given priority with regards to protection***.

- **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 and managing invasive weeds should all be priorities for stewardship programs.
- **Use other protection techniques** such as cluster development, Development Permit Areas, restrictive covenants, purchase of development rights, and incentives to leave sensitive sites intact.

Official Community Plan

*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. Below, we provide specific recommendations for integrating this SEI into the City of Vernon's OCP.

- Designate sensitive and other important ecosystems as ***Development Permit Areas***[42] (DPAs) in the OCP. DPA boundaries may go beyond ESA boundaries.
    - Ensure that every effort shall be made to maintain or enhance the ecological integrity of these areas.
    - Ensure that the vegetation, wildlife, and ecological functions of these areas are maintained or enhanced.
    - Ensure that water balance and hydrologic functions are maintained and stormwater planning is integrated with other ecological planning.
    - Limit landscaping to restoration of removed or altered native vegetation or habitat. Use native plants adapted to on-site conditions. Control invasive plant species.
    - Adopt the recommendations for Environmental Impact Assessments in this report.
- Designate sensitive and other important ecosystem DPAs as areas for which ***Development Approval Information*** is required.
- Use the local ecosystems plan to ***determine areas for natural open space*** and develop conservation strategies for those areas. Create a natural open space designation for such areas.
- ***Ensure that only developments and other activities*** compatible with the preservation, protection, restoration, and enhancement of sensitive ecosystems occur in DPAs.
- Ensure ***neighbourhood plans are consistent with the local ecosystems plan*** and conservation strategies. At the development scale, maintain appropriate buffers, determined by

[42] Development Permits can be used by local governments to establish special requirements for developments including the protection, restoration or enhancement of natural ecosystems and biological diversity. Development Permit guidelines can be specified in the OCP or in the zoning bylaw, as provided in Section 919.1(1)(a) of the Local Government Act (Iverson and Cadrin 2003).

qualified professionals, around sensitive ecosystem areas and provide connectivity between sensitive and other important ecosystems.

- Provide for ***greater incentives for density bonuses*** in developments in exchange for the retention of sensitive ecosystems:
    - Ecosystems identified for conservation in the local ecosystems plan should be the highest priority for retention.
    - Ecosystems must be retained in such a way that natural values are maintained or enhanced.
    - Provide buffers and connectivity to other natural ecosystems within and beyond the development (See Retain Natural Vegetated Buffers around and Corridors Between Sensitive Ecosystems page 24).
    - Do not limit the maximum density bonus to 20% in cases where density bonuses are granted in exchange for the conservation of sensitive ecosystems.
    - Retained natural ecosystems should be covenanted to ensure that future uses are compatible with the protection, restoration, and enhancement of sensitive ecosystems.
- ***Eliminate large lot zoning designations*** in favour of cluster development zones where the net number of housing units remains the same. ***Consider the development of cluster housing as a zoning designation***.
- ***Plan and manage recreational access*** to minimize impacts to sensitive ecosystems, especially during wildlife breeding and nesting seasons. Uncontrolled motorized recreation is of particular concern.
- Add a goal into the OCP to ***acquire high priority sensitive ecosystems*** to add to protected natural areas.
- Add a goal into the OCP to ensure that ***trail and other recreation development*** is consistent with broader level conservation priorities and ecological integrity of sensitive ecosystems.
- Policy Section G[43] – ensure that subdivision plans along Lake Okanagan have provisions for maintaining all foreshore vegetation and ecosystems and provide connectivity to upland ecosystems for wildlife.
- Policy Section K – Development Phasing. Revise this section to reflect conservation priorities and conservation plans once they are developed.
    - Avoid approval of any developments in the study area until conservation priorities have been established.
- Policy Section M – Special Areas. Re-designate O'Keefe Range Lands to be consistent with conservation priorities once they are developed.

Additional Policies for Wetland and Riparian Ecosystems

- Protect water quality from pollutants, sediments, and changed nutrient loads

[43] Refers to Policy Sections in Vernon's OCP.

- Determine and consider the overall water balance affecting wetland and riparian ecology and protect from disturbance.
    - Maintain natural surface, groundwater and nutrient regimes.

Other Local Government Policies and Plans

Use the Regional Growth Strategy and Parks and Recreation Master Plan to establish community goals and policies for ecosystem protection and to establish urban containment boundaries. Revise other policies and zoning bylaws[44] as direction is established for ecosystem protection.

6.3 Indian Reserve Planning

Develop a Local Ecosystems Plan[45]

SEI mapping, terrestrial ecosystem mapping, wildlife habitat mapping, and soil erosion and slope stability terrain mapping can be used to help set priorities for conservation and management. A local ecosystems plan should be developed cooperatively to ensure connectivity to sensitive ecosystems in the City of Vernon and elsewhere. The local ecosystems plan can provide a logical framework to determine where development could occur while conserving sensitive ecosystems and cultural use values. Ecosystem planning should include traditional ecological knowledge, and be a component of overall community planning.

- Concentrations of high quality ecosystems, habitat for rare species, and high quality sites for cultural uses should be prioritized for establishing core conservation areas.
    - Quality and viability ratings of SEI units can be used to identify higher quality SEI units[46].
    - Wildlife habitat mapping can be used to determine key core areas for mapped species.
    - Integrate local knowledge of traditional uses and values.
- Establish ecologically appropriate buffers to protect core conservation areas.
- Link core areas with corridors. The habitat needs of important wildlife species must be considered in this process.
- Design road access at a landscape scale to minimize impacts to sensitive and other important ecosystems.

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[44] Refer to Sensitive Ecosystems Inventory: Central Okanagan Volume 1 (Iverson and Cadrin 2003) pp 135-143 for additional suggestions on zoning and bylaws.

[45] Refer to the Conservation Tools Section of Iverson and Cadrin 2003 for more detailed information.

[46] **Quality/condition** measures how well the specific site represents the biological and ecological functions of the ecosystem, degree of fragmentation, and the degree of alteration of the site by human influences and presence of introduced species. **Viability** measures the likelihood that the ecosystem will retain its biological and ecological functions based on current conditions, and surrounding land uses and management practices. There are four possible rankings for quality/condition and viability: Excellent (1), Good (2), Marginal (3), and Poor (4). Ecosystems with Excellent and Good rankings for quality/condition and viability are the highest conservation priorities.

- If needed, develop a recreation management plan that is consistent with the preservation of sensitive ecosystems.
- Develop a weed management strategy to minimize the spread and introduction of invasive plant species.
- Develop a strategy to return forests to their historically open conditions and to remove encroaching trees from grasslands. Ensure that the strategy is consistent with maintaining sensitive and important ecosystems, and species at risk.

Develop a Range Management Plan

The current primary disturbance within the Indian Reserve is domestic cattle grazing and trampling. Many riparian and grassland ecosystems have altered structure or vegetation species that has changed the value of these sites for wildlife. The shrub cover and structural diversity has been reduced in many riparian ecosystems. The foreshore of most ponds and marshes has been extensively trampled. Most level and gently sloping grasslands are dominated by grasses more tolerant of disturbance such as needlegrasses, Sandberg's bluegrass, and higher covers of big sagebrush. Without domestic livestock, these grasslands would be dominated by large clumpes of bluebunch wheatgrass, rough fescue and Idaho fescue.

Domestic livestock grazing can be compatible with conservation of sensitive ecosystems. A Range Management Plan will be of great value, and should:

- Determine the appropriate grazing levels in different ecosystems;
- Determine fencing needs, specifically pasture and riparian fencing;
- Determine needs and locations for alternate watering sites;
- Establish appropriate timing, location, and intensity of grazing, including ungrazed benchmark areas;
- Determine needs for on-site management and movement of cattle; and
- Develop a monitoring plan to ensure management objectives are met.

6.4 Landowners

Plan Land Development Carefully

Landowners who wish to develop their land can use various tools outlined below to protect sensitive ecosystems. Landowners who do not wish to develop their land can use many of these same tools to provide long-term protection of the ecosystems on their property.

Tools for the Protection of Sensitive Ecosystems

- Have a qualified professional conduct an environmental impact assessment[47] to provide wildlife inventory information and verify and map sensitive ecosystems at an appropriate scale for development planning. Work collaboratively with professional biologists in designing the development.

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[47] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

- Consider using cluster style developments to provide opportunities for development while retaining sensitive ecosystems. Work with city planners to obtain density bonuses in exchange for retention of sensitive ecosystems.
- Where golf courses are a desired component of a development, consider a links style golf course where retention of natural areas within the course is maximized.
- Where a development has been designed to ensure the long-term retention and function of sensitive ecosystems, consider an alternate niche marketing strategy to promote it as a 'ecosystem friendly' development.
- Consider conservation covenants on sensitive lands:
    - They can protect certain values while allowing other uses.
    - They are registered in the Land Title Office.
    - They can provide a tax advantage if they have reduced the property value through restrictions on its use. The covenanting organization can provide a charitable receipt for the difference in land value.
    - They can reduce property taxes if the market value of the land is reduced by the restrictions of the covenant.
- Consider donating land:
    - Lands can be donated to a land trust, stewardship organization or government.
    - Owners may want to establish conservation covenants prior to donating to ensure the donated land is protected.
    - Land donations can provide tax benefits.
    - Owners may want to donate the portions of their land designated for retention of sensitive ecosystems.
    - Owners may want to consider providing for the donation of their land in their will.

Further Information:

Stewardship Options for Private Landowners in British Columbia[48]

Here Today, Here Tomorrow: Legal Tools for the Voluntary Protection of Private Land in British Columbia[49]

North Okanagan Parks and Natural Areas Trust
c/o North Okanagan Regional District

The Land Conservancy of British Columbia
www.conservancy.bc.ca (250) 479-8053

The Nature Trust of B.C.
info@natureturst.bc.ca (250) 924-9771

The Canadian Ecological Gifts Program, Environment Canada
www.cws-scf.ec.gc.ca/ecogifts 1-800-668-6767

[48] Ministry of Environment, Lands and Parks 1996

6.5 General Management Recommendations[50]

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.

Retain Natural Vegetated Buffers around and Corridors Between Sensitive Ecosystems

In order to achieve adequate protection, sensitive ecosystems must be buffered from potentially adverse effects of land use practices in adjacent areas. A natural vegetated buffer zone can absorb and avoid negative edge effects that result from animal and human access and disturbance. Buffers also play a role in maintaining microclimate conditions such as temperature and humidity, particularly for wetlands and riparian areas. A vegetated buffer is established by retaining or restoring natural ecosystems that surround sensitive or other important ecosystems. The size of the buffer zone varies by ecosystem type, and by constraints of the surrounding landscape. 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[51] to ensure that conservation options are effective.

In addition to buffering core high priority areas, corridors are needed to connect conservation areas. As with buffers, corridors are vegetated zones established by retaining or restoring natural ecosystems to connect sensitive or other important ecosystems. They are usually longer and narrow than buffers and must be designed to provide sufficient width and natural vegetation cover for the species that use them.

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 only insignificant negative impacts can be demonstrated;
- ***Manage access to land and water***: Seasonal use-restrictions (e.g. during wildlife breeding seasons), fencing, designated trails, and signage can be used to help avoid the negative effects of access to sensitive areas. Designating trails and areas for limited used (e.g. restricting motorized recreation or mountain bikes) are another access management tool;
- ***Prevent disturbance of nesting or breeding areas*****:** Known and potential breeding sites, (especially for threatened or endangered species) should be protected from any activity that would disturb breeding wildlife;

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[49] Findlay and Hillyer 1994

[50] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

[51] See: Incorporating SEI Information into Environmental Impact Assessments, page 25, step 1 for guidelines on qualified professionals.

- ***Control invasive species*:** A broad weed management plan may be necessary to control and limit the spread of perennial weeds such as diffuse knapweed (*Centaurea diffusa*), sulphur cinquefoil (*Potentilla recta*) and invasive annual grasses such as cheatgrass (*Bromus tectorum*). Reclaim disturbed sites using native vegetation species adapted to the site to reduce the potential for weed invasion; and
- ***Restore natural disturbance regimes*** wherever possible. Consider some planned thinning and prescribed burning to restore open forests, and restore some encroached grassland habitat. Consult a qualified professional to develop and implement a restoration and prescribed burning plan

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. An environmental impact assessment should be completed (see below) and inventories of wildlife, 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 and minimize the full impact of development on biodiversity at the site.

6.6 Incorporating SEI Information into Environmental Impact Assessments[52]

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

BC Environment Assessment Act

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 proposed or conceptual development layout, and then will provide specific suggestions on how to make the development to reduce impacts to environmental values (e.g. changes in siting, onsite practices or design). Depending on the zoning of the site, the proponent should contact the City of Vernon about the possibility of cluster development and density bonuses.

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.

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[52] This section comes directly from Iverson and Cadrin (2003).

1. The EIA must be prepared by a registered professional biologist together with other professionals[53] 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.
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 detailed species inventories. The inventories 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 North 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 and cumulative effects that the proposed development is likely to have on sensitive ecosystems and wildlife habitat (direct and indirect impacts) should then be identified[54].

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[53] 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.

[54] 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.

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).

7 Wetland

7.1 What are wetland ecosystems?[55]

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[56]. Wetland ecosystems have plants that are adapted to growing on saturated soils with low oxygen levels.

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 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 occasionally sedges usually dominated marshes, and some floating aquatics such as duckweed were often present.

Meadow ecosystems

Meadow wetland ecosystems occurred as a fringe at the edges of ponds and marshes, especially alkaline sites indicated by a white soil crust. Meadows occur where the water table is at or above the soil surface for only a short portion of the growing season. Meadows are dominated by baltic rush, alkaligrass, foxtail barley, or saltgrass.

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[57], 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 vegetation that emerged above the water surface. Shallow water ecosystems often occurred in association with marshes.

[55] Adapted from Iverson and Cadrin 2003.
[56] MacKenzie and Banner 1999
[57] Voller 1998

Vegetation

	Marsh	Meadow	Shallow Water	
Grasses, Sedges & Rushes				
sedges	*			*Carex* spp.
rushes	***			*Schoenoplectus* spp.
Baltic rush		**		*Juncus balticus*
alkaligrass		**		*Puccinellia sp.*
foxtail barley		**		*Hordeum jubatum*
seashore saltgrass		**		*Distichlis spicata*
Forbs				
cattail	**			*Typhus latifolia*
duckweed	**		**	*Lemna minor*
water smartweed	*		**	*Polygonum amphibium*
pondweeds			*	*Potamogeton* spp.

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

7.2 Why are they important?[58]

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

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

Rare[59] 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*)
Fringed Myotis (B, COSEWIC-SC) (*Myotis thysanodes*)
Townsend's Big-eared Bat (B)(*Corynorhinus townsendii*)

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

[58] Adapted from Iverson and Cadrin 2003.
[59] 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).

- **High biodiversity**: Ponds and marshes 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 are important watering sites for many species, and in the study area provides Painted Turtle and spadefoot habitat. Wetlands are also sources of insects that provide food to many different species of birds and bats.
- **Fragility**: Wetlands are vulnerable to a range of human disturbances such as vegetation removal, dredging, diking, filling, and trampling by livestock. Small changes in hydrology such as reduced flows or lowered water tables, and urban run-off (including stormwater drainage) and other sources of nutrients including fertilizers and livestock manure can change and reduce the diversity of wetland communities. Such changes may occur away from the wetland, but can still influence it. Intensive recreational activities in and near wetlands can reduce plant cover, compact soil, and disturb nesting birds.

  Wetlands are vulnerable to overuse by livestock, but can still be extremely valuable and may recover 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 water storage and filtration and opportunities for wildlife viewing, education, and aesthetic enjoyment. They are focal points in the arid landscape of the Okanagan. They can add to real estate values in adjacent areas and can provide a tourist attraction.

7.3 Status

We found that wetland ecosystems were rare in the study area; they occupied 72 ha or 1.3% of the study area land base. However, generally steep topography naturally limits the occurrence of wetlands; but many wetlands in the Okanagan Valley 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[60]. The study area has an unusually high proportion of wetlands remaining relative to other parts of the Okanagan Valley. Wetlands have been influenced by domestic cattle grazing in the study area, reducing plant cover and changing species on many sites. Such sites are still extremely valuable for wildlife and can recover quickly with effective range management. However, these sites often attract off-road vehicles for 'mud-bogging'. Future housing and other developments in the study area may alter, isolate, or cause losses of wetlands.

Shallow water (42 ha) was the most common wetland type in the study area, however, all three types of wetlands were extremely uncommon (meadows 5 ha, marshes 25 ha).

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[60] Voller 1998

7.4 Management Recommendations[61]

The ecological functions that wetlands provide, specifically water storage and maintenance of water quality, are provided free of charge. When these functions are removed through the loss or degradation of wetlands, it can be an exorbitant cost to replace them through technological means or re-create wetlands. 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.

Retain Natural Vegetated Buffers around Wetland Ecosystems

Wetlands can be negatively affected by adjacent land use that alters wetland hydrology. Natural vegetated buffers should be retained or established with native vegetation to reduce edge effects and protect points of water inflow and outflow locations around the wetland. All native 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.

Avoid Direct and Indirect Impacts

- **Prevent 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. Roads should never encircle wetlands and should be set back as far as possible (more than 50m; distance depends on local conditions).
- **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. Hydrologists familiar with wetland function should 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. In areas where trails to viewpoints in wetlands are desired, raised boardwalks should be used (avoid using rock or bark mulch on trails).

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[61] Many of the recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

- **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. Vegetation on many sites can quickly recover, 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 or spadefoots for burrowing, should also be avoided.
- **Restrain pets near wetlands during spring and summer**. Pets should be controlled to avoid disturbances to turtles, 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 and fertilizers in or near wetlands**.

8 Riparian

8.1 What are riparian ecosystems?[62]

Riparian simply refers to areas adjacent to water bodies such as lakes, rivers, streams, and ponds[63]. 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. Wetlands are riparian in nature but were described separately 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 5) in order to identify different habitat values.

Table 5. 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; trees may be younger in broadleaf forests.
RI:7	Older forest	Trees are >10m tall and have 10% or greater cover, many tree ages, many trees are 250 years or older; trees may be younger in broadleaf forests.

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

[62] Adapted from Iverson and Cadrin 2003.
[63] MacKenzie and Banner 1999; Voller 1998

Gully riparian

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, providing habitat that is distinctly different from the surrounding landscape. These ecosystems usually had a mixed coniferous and deciduous overstory with shrubby understories.

Fringe riparian ecosystems

Ponds, marshes, and Okanagan Lake typically had fringe riparian ecosystems associated with their shorelines. This class also includes sites with significant seepage that are sensitive to soil and hydrological disturbances. These ecosystems usually had trembling aspen overstories with shrubby understories.

Vegetation

	Gully	Fringe	
Trees			
black cottonwood		*	*Populus balsamifera* ssp. *trichocarpa*
Douglas-fir	**	*	*Pseudotsuga menziesii*
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*
Forbs			
Star-flowered false Solomon's seal	**	**	*Maianthemum stellatum*
Horsetail	*		*Equisetum* spp.

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

8.2 Why are they important?[64]

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

Rare[65] riparian 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 - paper birch / Douglas maple (B) (*Pseudotsuga menziesii - Betula papyrifera / Acer glabrum*)

Rare vertebrates of riparian ecosystems
Western Screech-Owl (R, COSEWIC-E) (*Otus kennicottii* ssp. *macfarlanei*)
Yellow-breasted Chat (R, COSEWIC-E) (*Icteria virens*)
Brewer's Sparrow (R) (*Spizella breweri* ssp. *breweri*)

Great Basin Spadefoot (B, COSEWIC-T) (*Spea intermontana*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
Great Blue Heron (B) (*Ardea herodias*)
Lewis's Woodpecker (B, COSEWIC-SC) (*Melanerpes lewis*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

- **Rarity**: Their conservation status (B.C. Conservation Data Centre) lists most riparian natural plant communities as rare (see above).
- **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. Gullies generally lack surface water flow but often have lush, productive vegetation that provides significant cover and food for wildlife.
- **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 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). 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

[64] Adapted from Iverson and Cadrin 2003.
[65] 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.

inputs to the water. Riparian vegetation plays a key role in controlling water temperatures by reducing incoming radiation.

- **Wildlife corridors**: Within the study area, gullies form natural wildlife corridors connecting lower and upper slopes of the study area and connect different types of ecosystems.
- **Social values**: Riparian areas provide water retention and filtration, prevent erosion, and provide green space, and opportunities for education, bird watching, wildlife viewing, and walking and hiking. They are cooler places to enjoy nature on hot summer days. Retention of riparian corridors can enhance and maintain property values and attract tourists by retaining the natural beauty that many people seek out.

8.3 Status

Riparian ecosystems are naturally rare in the study area and occupied only 1.5% (87 ha) of the study area – predominantly gully (60 ha) ecosystems with some fringe (27 ha) ecosystems. Only a small section of the Okanagan Lake foreshore was included in the study area.

Only 2% of riparian ecosystems in the study area were in the old forest structural stage. Another 17% was mature forest and 40% was 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.

Preservation of all riparian ecosystems should be a 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 values.

8.4 Management Recommendations[66,67]

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.

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

The following recommendations will aid in the site management of riparian ecosystems.

Retain Natural Vegetated Buffers around Riparian Ecosystems

Wherever possible, natural vegetated buffers should be retained or established with native vegetation around riparian ecosystems. Buffers help maintain the integrity of riparian areas. Buffers need to be large enough to protect the core ecosystem from edge effects such as increased invasive plant species, increased temperature, decreased humidity, and increased noise and disturbance to wildlife.

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[66] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

[67] There are no fish-bearing streams in the study area. Additional management recommendations for riparian ecosystems where fish may be present can be found in Iverson and Cadrin 2003.

Maintain wildlife corridors and connectivity between riparian areas and adjacent habitats by retaining both riparian and adjacent habitats.

Avoid Direct and Indirect Impacts

- **Prevent 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 banks and 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.
- **Plan for controlled recreational access** to some areas , and access restrictions (e.g. with fencing and railings) to sensitive areas in order to manage 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, and bottom wires should be 45cm (18") above ground level (this height is for cattle, lower bottom wires are needed for sheep and other livestock).
- **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, and logs provide critical nesting habitat for many species of birds and animals. Large, old trees and snags are especially important for birds, bats and other animals. Maintain structures such as rocks and logs within streams. They provide important habitat and prevent erosion.
- **Avoid use of insecticides in or near water and important foraging areas for wildlife**. Insecticide use near foraging habitat for animals that feed on insects (e.g., Western Screech-Owl, spadefoots, Townsend's Big-eared Bat and amphibians) should be avoided.
- **Allow natural disturbances to occur**. Flooding, windthrow, and channel changes are recognised as important factors in the creation and maintenance of high diversity riparian habitats and provide important habitat attributes for fish. Leave sufficient buffers to allow these events and processes to occur wherever possible.

Plan Land Development Carefully

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

- **Require an environmental impact assessment conducted by a qualified professional**[68].
- **Plan, design, and implement land development activities to avoid adversely affecting or disturbing:**

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[68] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

- riparian vegetation;
- large old trees;
- threatened or endangered species or natural plant communities;
- natural processes such as stream flow, flooding, and stream channel movement;
- wildlife 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 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 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
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk rather than removing the whole tree.
- **Prevent disturbance of nesting and breeding areas**. Avoid development activities around features including dens, raptor nest or perch trees, woodpecker cavities, and bat roosts from May through August.
- **Ensure adequate sediment and erosion control measures** are implemented.

9 Old Forest

9.1 What are old forest ecosystems?[69]

Old forest ecosystems are forests that are dominated by large, old trees. Old forests historically would have dominated the forested patches in the study area. 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 Forest category.

Historically, most forests had frequent surface fires that killed most regeneration and allowed few new 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.

Vegetation

Trees			
	ponderosa pine	**	*Pinus ponderosa*
	Douglas-fir	**	*Pseudotsuga menziesii*
Shrubs			
	common snowberry	**	*Symphoricarpos albus*
	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*

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

[69] Adapted from Iverson and Cadrin 2003.

9.2 Why are they important?[70]

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

Rare[71] natural plant communities of old forests

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*)

Douglas-fir - ponderosa pine / snowbrush (B) (*Pseudotsuga menziesii - Pinus ponderosa / Ceanothus velutinus*)

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*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
Ferruginous Hawk (B, COSEWIC-SC) (*Buteo regalis*)
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*)
Townsend's Big-eared Bat (B) (*Corynorhinus townsendii*)

- **Rarity**: Old forest natural plant communities are rare (see above).
- **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 and small mammal 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.
- **Social values**: Old forests provide opportunities for education, and wildlife viewing. Large old trees provide attractive and aesthetic views that can raise real estate values in adjacent areas, and can draw tourists into the area.

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[70] Adapted from Iverson and Cadrin 2003.

[71] 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.

9.3 Status

Historically, old forests likely dominated the majority of the forested portion of the landscape (about 20% of the study area) but now there are only small remnants. Most old forests had been lost to selection logging. The inventory showed that only 0.4% (24 ha) of the study area was old forests; these occurred in very small and fragmented patches. Thus, there is a need to conserve all remaining old forests, and retain some mature forests for recruitment to old forests.

9.4 Management Recommendations[72]

Loss of old forest ecosystems and forest ingrowth in remaining old forest areas has resulted in the loss of many habitat features (e.g., grassy understory vegetation) and increased fire hazard.

The following recommendations will aid in the site management of old forest ecosystems.

Retain Natural Vegetated Buffers around Old Forest Ecosystems

Wherever possible, natural vegetated buffers should be retained or established with native vegetation around each old forest ecosystem. Buffers help prevent edge effects such as invasive weed colonisation and reduce indirect disturbances. When they are present, mature forests form excellent buffers around old forest ecosystems. Many species that are reliant on old forests also use other habitats; it is important to maintain connectivity with other ecosystems.

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.
- **Protect large old trees and snags**. Old trees and snags provide critical nesting habitat for many species of birds, bats, and other wildlife.
- **Reduce ingrowth.** Cut down and, if possible, remove small ingrowth trees.
- **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 control can include hand-pulling, and native species can be planted to help prevent the establishment of more 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. Herbicides and biological control agents are other possible treatments.

[72] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

- **Avoid use of insecticides in, or near, important foraging areas for wildlife**. Insecticide use near foraging habitat for animals that feed on insects (e.g., Flammulated Owl and Lewis's Woodpecker) should be avoided.
- **Recruit new old forests.** Given that old forests are extremely limited within the study area, new old forests should be encouraged by proper management of mature forests (see Management Recommendations for mature forests on page 65).

Plan Land Development Carefully

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

- **Require an environmental impact assessment conducted by a qualified professional**[73].
- **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 native species from nurseries, or plant native species 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 vehicles (e.g. ATVs), 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 to avoid spreading them.
- **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
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk 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 environmental impact assessment**. Such features include dens, cavities, and perch trees.

[73] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

10 Grasslands

10.1 What are grassland ecosystems?[74]

Grasslands in the study area were dominated by bunchgrasses with scattered forbs and a microbiotic crust. The grasslands of the North Okanagan represent a portion of the Pacific Northwest bunchgrass grasslands that are centred in south-east Washington, north-east Oregon and Idaho[75].

Areas where grasslands occurred are generally too hot and dry for forests to establish. Often, grasslands occurred on medium and finer textured soils. Moisture is effectively funnelled by the conical shape of bunchgrasses and captured by extensive grass roots in the upper horizons of the soil (generally the top 30cm), 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.

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 vehicles, people, mountain bikes, and livestock.[76]

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

Bluebunch wheatgrass is a common bunchgrass in warm and dry grasslands and open forests.

[74] Adapted from Iverson and Cadrin 2003.
[75] Tisdale 1947
[76] Williston 1999

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

Grassland ecosystems

Bunchgrasses, most commonly bluebunch wheatgrass, rough fescue, and Idaho 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. (Big sagebrush dominated ecosystems are included in 'Disturbed Grassland Ecosystems'). Grassland soils are usually fine- or medium-textured, and soils are 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.

Vegetation

	Grassland	Shrubland	
Shrubs			
common snowberry		***	*Symphoricarpos albus*
roses		***	*Rosa* spp.
Grasses			
bluebunch wheatgrass	**		*Pseudoroegneria spicata*
rough fescue	**		*Festuca campestris*
Idaho fescue	**		*Festuca idahoensis*
Forbs			
arrowleaf balsamroot	**	*	*Balsamorhiza sagittata*
parsnip-flowered buckwheat	**		*Eriogonum heracleoides*
daisies or fleabanes	**	*	*Erigeron* spp.
silky lupine	**	*	*Lupinus sericeus*
lemonweed	**	*	*Lithospermum ruderale*
Mosses and Lichens			
sidewalk moss	**		*Tortula ruralis*
clad lichens	**		*Cladonia* spp.

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

10.2 Why are they important?[77]

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 (*Balsamorhiza sagittata*) and mariposa lily (*Calochortus* spp.) were important food sources for aboriginal peoples.

Rare[78] natural plant communities of grasslands:

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

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

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

Rare vertebrates of grasslands
Swainson's Hawk (R) (*Buteo swainsonii*)
Prairie Falcon (R) (*Falco mexicanus*)
Upland Sandpiper (R) (*Bartramia longicauda*)
Burrowing Owl (R, COSEWIC-E) (*Athene cunicularia*)
Grasshopper Sparrow (R) (*Ammodramus savannarum*)
Preble's Shrew (R) (*Sorex preblei*)
Merriam's Shrew (R) (*Sorex merriami*)
Badger (R, COSEWIC-E) (*Taxidea taxus*)
Pallid Bat (R, COSEWIC-T) (*Antrozous pallidus*)

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*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
Sharp-tailed Grouse[79] (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*)
Nuttall's Cottontail (B, COSEWIC-SC) (*Sylvilagus nuttallii* ssp. *nuttallii*)

- **Highly threatened**: Grasslands commonly occur on sites that are very amenable to development – both for agriculture and housing – and many grasslands have already been lost to development. Overuse by domestic livestock and invasion of noxious weeds also threatens

[77] Adapted from Iverson and Cadrin 2003.
[78] 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.
[79] Thought to be extirpated from the area.

remaining grasslands. Grasslands are recognised as one of British Columbia's most threatened ecosystems[80]. Only 8% of provincial grasslands are protected[81].

- **Rarity**: All grassland native plant communities are listed by the B.C. Conservation Data Centre (see above).
- **High biodiversity**: Grasslands and shrublands support a unique assemblage of species that includes a high proportion of endangered species. Grasslands, in combination with other ecosystems, are used by many species.
- **Sensitivity to disturbance**: Grasslands are very sensitive to disturbances including 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, wide open spaces for walking and hiking, wildlife viewing, and aesthetic enjoyment. Grasslands are particularly attractive in spring with their vibrant display of wildflowers. The open, natural spaces that grasslands provide can add to real estate values in adjacent areas, and can draw tourists into the area.

10.3 Status

We found that grassland ecosystems covered 17% (952 hectares) of the study area. The majority of these were grasslands (72%), but a large proportion was shrublands (28%). The relatively high proportion of grasslands in the study area reflects the importance of the study area to the conservation of grasslands.

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

10.4 Management Recommendations[82]

The following recommendations will aid in the site management of grassland ecosystems.

Retain Natural Vegetated Buffers around Grassland Ecosystems

Site assessments should be conducted to delineate natural vegetated buffers that should be retained or established with native vegetation such that the buffer 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

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[80] Canadian Parks and Wilderness Society 1996
[81] Grasslands Conservation Council of B.C. 2002
[82] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

- **Discourage human settlements or other developments** within or adjacent to all grassland ecosystems.
- **Manage access**. All motorized vehicles should be restricted to existing roads. Mountain bikes should be restricted to existing or carefully planned trails that are weed free, and not subject to erosion; otherwise, these trails should be closed until weed problems have been controlled. Trails can create erosion problems, disturb fragile vegetation, and spread or introduce invasive weed species. Existing trails with erosion problems need to be rehabilitated and restored.
- **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. Bunchgrasses are damaged by season-long grazing. 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 of grassland ecosystems. Weeds can be sprayed or hand-pulled, and native species can be planted to help prevent the establishment of more 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. It is important that the right treatment method is used to ensure it is effective. Herbicides and biological control agents are other possible treatments.
- **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 other mechanical means. Prescribed fire can also be used to remove encroachment, but it must be planned and conducted by a qualified professional and requires careful management of invasive plant species to prevent their spread.
- **Avoid use of insecticides in, or near, important foraging areas for wildlife**. Insecticide 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 environmental impact assessment conducted by a qualified professional[83].**
- **Plan, design and implement land development activities** (including trails and recreation access) **to minimize impacts to grassland ecosystems** by addressing the following recommendations:
  - protect native grasses, microbiotic crusts, and other native vegetation;

[83] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

- 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 native species 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
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk 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 environmental impact assessment. Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

11 Broadleaf Woodlands

11.1 What are broadleaf woodland ecosystems?[84]

Broadleaf woodland ecosystems occurred on sites where conditions resulted in a broadleaf overstory in the climax stage of succession. Because these ecosystems are moister than surrounding areas, they have many similarities to riparian ecosystems, but are generally not found near standing or running water.

In the study area broadleaf woodland ecosystems include only 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 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. The aspen copse is shown in the lower center part of the photo.

Vegetation

Trees		
trembling aspen	**	*Populus tremuloides*
Shrubs		
common snowberry	**	*Symphoricarpos albus*
Nootka rose	**	*Rosa nutkana*
saskatoon	*	*Amelanchier alnifolia*
tall oregon-grape	*	*Mahonia aquifolium*
Grasses		
blue wildrye	*	*Elymus glaucus*
Forbs		
star-flowered false Solomon's-seal	*	*Maianthemum stellatum*

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

[84] Adapted from Iverson and Cadrin 2003.

11.2 Why are they important?[85]

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

Rare[86] natural plant communities of broadleaf woodlands

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

Rare vertebrates of broadleaf woodlands:
Ferruginous Hawk (R, COSEWIC-SC) (*Buteo regalis*)
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*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
Western Harvest Mouse (B, COSEWIC-SC) (*Reithrodontomys megalotis*)

- **Rarity**: Broadleaf woodland native plant communities are listed as rare by the B.C. Conservation Data Centre (see above).
- **High biodiversity**: Broadleaf woodland ecosystems have diverse plant communities that support a rich assemblage of species. Deciduous litter fall results in an organically enriched upper layer of soil.
- **Specialised habitats**: Aspen copse ecosystems are structurally diverse, and provide cover, food, and nesting habitat for many species. Aspen trees are very important for cavity nesting birds and animals. Many species that feed in adjacent grasslands require aspen trees for nesting and denning.
- **Social values**: Broadleaf woodland ecosystems provide opportunities for education, wildlife viewing, cover from the heat and sun, walking and hiking, and aesthetic enjoyment. They provide water filtration, soil stability and can add to real estate values in adjacent areas and draw tourists into the area.
- **Fragility**: These ecosystems are sensitive to soil disturbances because of their moist soils.

11.3 Status

Broadleaf woodland ecosystems were scattered throughout the upper elevations of the study area; they covered 6% of the study area (353 ha). All broadleaf woodland ecosystems are a high priority for conservation.

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[85] Adapted from Iverson and Cadrin 2003.
[86] 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.

11.4 Management Recommendations[87]

The following recommendations will aid in the site management of broadleaf woodland ecosystems.

Retain Natural Vegetated Buffers around Broadleaf Woodland Ecosystems

Wherever possible, natural vegetated buffers should be retained or established with native vegetation 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 ecosystems likely occurred as small to medium-sized patch sizes with a high level of interconnectedness with grassland and other ecosystems. 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.
- **Plan for controlled recreational access** to some areas, and access restrictions (e.g. with fencing and railings) to sensitive areas in order to manage 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. Herbicides and biological control agents are other possible treatments. Plant native shrubs on disturbed sites to establish a healthy, weed-resistant natural plant community.
- **Avoid use of insecticides in or near important foraging areas for wildlife**. Insecticide 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 environmental impact assessment conducted by a qualified professional**[88].

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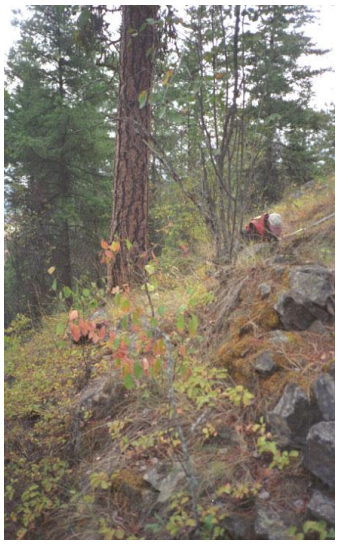
[87] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

[88] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

- **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 standing dead and declining trees, downed trees and logs, 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 native species from nurseries, or plant native species have been rescued from other development sites. Make sure any native plant material used is weed-free.
- **Design roads carefully**. Roads should be narrow and set back from the ecosystem to ensure that vegetation is maintained. Where roads encroach upon broadleaf woodland ecosystems, narrow the width of the road and avoid sidecasting material into the ecosystem.
- **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 control 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
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk rather than removing the whole tree. Large diameter 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 environmental impact assessment. 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. Trails, roads, and housing developments must be designed to maintain hydrology of these ecosystems.
- **Ensure adequate sediment and erosion control measures** are implemented.

12 Coniferous Woodlands

12.1 What are coniferous woodland ecosystems?[89]



Coniferous woodland ecosystems in the study area had open coniferous tree canopies. They occurred on rocky knolls and shallow soils where limited moisture or shallow soil limited tree establishment. 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 6). 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 6. 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

Vegetation

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.

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

[89] Adapted from Iverson and Cadrin 2003.

12.2 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.

Rare[90] natural plant communities of coniferous woodlands

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

Rare vertebrates of coniferous woodlands
Swainson's Hawk (R) (*Buteo swainsoni*)
Ferriginous Hawk (R, COSEWIC-SC) (*Buteo regalis*)

Racer (B) (*Coluber constrictor*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
Western Skink (B, COSEWIC-SC) (*Eumeces skiltonianus*)
Lewis' Woodpecker (B, COSEWIC-SC) (Melanerpes lewis)
Flammulated Owl (B, COSEWIC-SC) (*Otus flammeolus*)

- **Rarity**: Coniferous woodland native plant communities have rare status (see above).
- **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.
- **Fragility**: Coniferous woodland ecosystems commonly have shallow 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. They can add to real estate values in adjacent areas and draw tourists into the area.

12.3 Status

The types of coniferous woodland ecosystems found in the study area have a limited distribution in British Columbia. Historically, these ecosystems likely occurred as patches in areas with shallow soils in the study area. Most coniferous woodland ecosystems have been altered by disturbances such as logging, forest ingrowth, and weed invasion. Coniferous woodland ecosystems were rare in the study area (1% of study area; 56 ha).

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

[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.

Most coniferous woodland ecosystems were young or mature forests (93%). Mature woodlands (46%) should be a higher priority for conservation.

12.4 Management Recommendations[91]

The following recommendations will aid in the site management of coniferous woodland ecosystems.

Retain Natural Vegetated Buffers around Coniferous Woodland Ecosystems

Wherever possible, natural vegetated buffers should be retained or established with native vegetation 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 to further ensure connectivity to other ecosystems. Many of the wildlife values associated with coniferous woodland ecosystems are reliant on their connections with other 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. Herbicides and biological control agents are other possible treatments.
- **Prevent soil disturbances**. Coniferous woodlands typically have shallow soils 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.
- **Reduce ingrowth.** Cut down and, if possible, remove small ingrowth trees.

Plan Land Development Carefully

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

- **Require an environmental impact assessment conducted by a qualified professional[92].**

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[91] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

[92] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

- **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 large diameter (>30cm) dead and declining trees;
  - 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 native species from nurseries, or plant native species 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 vehicles (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 to reduce spread.
- **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
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk 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 and small mammals.
- **Protect nesting and denning sites** that were identified in the environmental impact assessment. 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.

13 Sparsely Vegetated

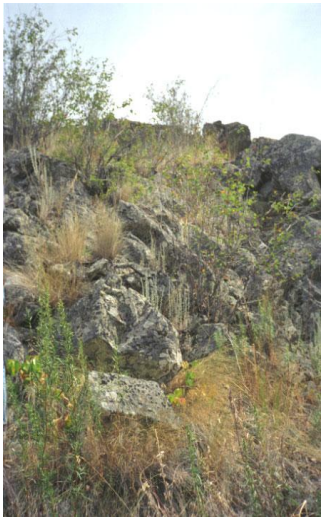
13.1 What are sparsely vegetated ecosystems?

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.

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

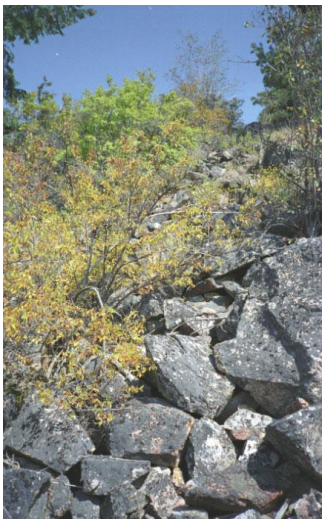
Shrub

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



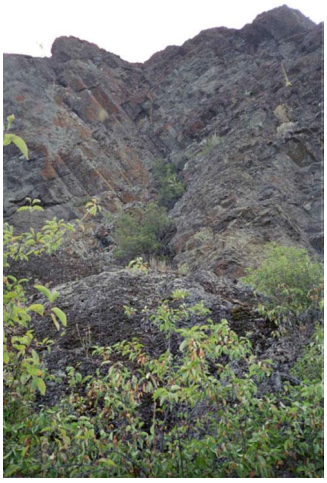
Talus

Talus ecosystems occurred on steep slopes covered with angular rock fragments. They usually occurred below rock outcrops or cliffs. Vegetation usually included scattered trees, shrubs, and cliff ferns.



Cliff

In the study area, sparsely vegetated cliff ecosystems were steep, vertical cliffs. Cliffs had minimal vegetation that was restricted to cracks and crevices, narrow ledges and small soils pockets.



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.

Vegetation

	Shrub	Talus	Cliff	Rock outcrop	
Trees					
ponderosa pine		*			*Pinus ponderosa*
Douglas-fir		*			*Pseudotsuga menziesii*
Shrubs					
saskatoon	*	*	*	*	*Amelanchier alnifolia*
choke cherry	*	*	*		*Prunus virginiana*
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*

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

13.2 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.

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

Antelope-brush – selaginella (*Purshia tridentata*)[93]

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

Saskatoon – mock orange (*Amelanchier alnifolia – Philadelphus lewisii*)

Selaginella – bluebunch wheatgrass (*Selaginella - Pseudoroegneria spicata*)

[93] Although Antelope-brush does not occur in the North Okanagan, this plant community is still considered to occur here. Some plant communities have a broad range of vegetation species and plant community names do not always reflect the dominant species at a particular site.

Rare*[94] *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*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
Western Skink (B, COSEWIC-SC) (*Eumeces skiltonianus*)
Lewis's Woodpecker (B, COSEWIC-SC) (*Melanerpes lewis*)
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*)

- **Rarity**: Most sparsely vegetated natural plant communities have been recommended for rare status (see sidebar).
- **Specialised habitats**: A variety of specialised habitats are found in sparsely vegetated ecosystems. A number of species, including many 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 Northern Pacific 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. Isolated trees provide important roosting or nesting sites for Lewis' woodpeckers and raptors.
- **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 often provide focal points in the landscape for scenic viewpoints, wildlife viewing, and aesthetic enjoyment. They can add to real estate values in adjacent areas, and can draw tourists into the area.

13.3 Status

These ecosystems covered 6% (358 ha) of the study area land base. In the study area, rock outcrops and shrub ecosystems were the most common ecosystem type (227 ha and 101 ha); cliffs and talus sites were extremely uncommon (9 ha and 21 ha).

13.4 Management Recommendations[95]

[94] 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.

The following recommendations will aid in the site management of sparsely vegetated ecosystems.

Retain Natural Vegetated Buffers around Sparsely Vegetated Ecosystems

Wherever possible, natural vegetated buffers should be retained or established with native vegetation 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. Use snake fences around higher density developments.
- **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. Herbicides and biological control agents are other possible treatments.
- **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.

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[95] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

Plan Land Development Carefully

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

- **Require an environmental impact assessment conducted by a qualified professional**[96].
- **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 and protect the steep faces of rock outcrops and cliffs;
  - protect mature and old trees and all native vegetation;
  - protect large diameter (>30cm) standing dead and declining trees and downed logs;
  - protect soil conditions and hydrologic regimes; and
  - restore native vegetation where it has been disturbed. Seed or plant native species 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 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 denning, 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,
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk 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 underpasses or snake fences may be required to prevent snake mortality.
- **Protect nesting and denning sites that were identified in the environmental impact assessment**. Such features include dens, hibernacula, raptor nest or perch trees, woodpecker cavities, and bat roosts.
- **Ensure adequate sediment and erosion control measures** are implemented.

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[96] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

14 Mature Forest

14.1 What are mature forest ecosystems?

Mature forest ecosystems were mapped where polygons included structural stage 6 forests[97] (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.

Coniferous mature forest ecosystems

Coniferous mature forests in the study area were dominated by ponderosa pine and Douglas-fir. These forests occurred on sites with a wide range of ecological conditions. Most sites had a Douglas-fir overstory, with scattered grasses, forbs, and shrubs in the understory.

Mixed mature forest ecosystems

In the study area, mixed mature forests had both Douglas-fir 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.

[97] Refer to Volume 2 (Iverson and Shypitka 2003) for details on structural stage 6.

Vegetation

	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*
blue wildrye		*	**	*Elymus glaucus*
Forbs				
arrowleaf balsamroot	*			*Balsamorhiza sagittata*
heart-leaved arnica	*	**	**	*Arnica cordifolia*

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

14.2 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[98] vertebrates of mature forests
Swainson's Hawk (R) (*Buteo swainsonii*)
Ferruginous Hawk (R, COSEWIC-SC) (*Buteo regalis*)
Badger (R, COSEWIC-E) (*Taxidea taxus*)
Racer (B) (*Coluber constrictor*)
Gopher Snake (B, COSEWIC-T) (*Pituophis catenifer* ssp. *deserticola*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
Great Blue Heron (B) (*Ardea herodias*)
Flammulated Owl (B) (*Otus flammeolus*)
Lewis's Woodpecker (B) (*Melanerpes lewis*)

- **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 is 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.

[98] 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.

- **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 in adjacent areas. Mature forests provide opportunities for selective logging.

14.3 Status

Mature forest ecosystems covered 3.2% (186 ha) of the study area. Most mature forest ecosystems in the study area were ingrown and required thinning to restore them to high quality sites that could become old forests.

Coniferous mature forests were the most common type (160 ha); only 21 ha were mixed and a mere 5 ha were broadleaf.

14.4 Management Recommendations[99]

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**. Restoration requires understanding of historical disturbance regimes (particularly fire), and of the structure of these forests prior to fire exclusion and logging. A qualified professional should develop a detailed restoration plan.

  Restoration should include the retention of larger trees, plus thinning and removal of other trees to restore forest densities to the low tree densities of the late 1800's. Following thinning, initial prescribed burns should be conducted to consume unnaturally heavy fuels. Prescribed burning should be planned and conducted by qualified professionals.

  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 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 and den sites for mammals.

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[99] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

- **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. Herbicides and biological control agents are other possible treatments.
- **Avoid use of insecticides in, or near, important foraging areas for wildlife**. Insecticide 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 environmental impact assessment conducted by a qualified professional**[100].
- **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 native species from nurseries or transplant native species 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 to prevent spread.
- **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
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk rather than removing the whole tree.
- **Prevent disturbance of nesting and breeding areas**. Avoid development activities from May through August.

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[100] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

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

15 Disturbed Grasslands

15.1 What are disturbed grassland ecosystems?

Disturbed grasslands, once intact grasslands, had a mixture of native bunchgrasses and forbs, and 20-50% invasive plant species including cheatgrass (*Bromus tectorum;* see photo), diffuse knapweed (*Centaurea diffusa*) and sulphur cinquefoil (*Potentilla recta*). Grasslands now dominated by big sagebrush are also included as disturbed grasslands.

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.

Vegetation

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*

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

15.2 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[101] 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*)
Grasshopper Sparrow (R) (*Ammodramus savannarum*)
Brewer's Sparrow (R) (*Spizella breweri* ssp. *breweri*)
Lark Sparrow (R) (*Chondestes grammacus*)
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*)
Northern Pacific Rattlesnake (B) (*Crotalus oreganus*)
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*)

15.3 Status

Grassland ecosystems cover only 0.8% of British Columbia's land area and many of these grasslands have been lost or disturbed[102]. The study showed that disturbed grasslands covered 24% (1350 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.

15.4 Management Recommendations[103]

Although 17% of the study area is covered by undisturbed grassland; disturbed grasslands covered a greater proportion. These disturbed grassland ecosystems need to be restored to replace invasive weeds with native vegetation. Where disturbed grasslands occur in association with other sensitive ecosystems, they have a higher preservation value and should be a higher priority for

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[101] 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.
[102] Grasslands Conservation Council of B.C. 2002
[103] Management recommendations have been adapted from McPhee et al. 2000 and Iverson and Cadrin 2003.

restoration. Disturbed grasslands can also form buffers, corridors, and provide wildlife habitat, but require 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 that are required for wildlife habitats or are identified as environmentally sensitive areas (ESAs).
- **Minimise vehicular access**. Vehicles are very effective at spreading invasive weeds. Ensure roads are weed-free.
- **Carefully plan 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.
- **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. Herbicides and biological control agents are other possible treatments.
- **Remove encroaching trees**. Young trees should be removed by cutting. All large old trees should be retained on the sites.
- **Avoid use of insecticides in, or near, important foraging areas for wildlife**. Insecticide 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 environmental impact assessment conducted by a qualified professional**[104].
- **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 native 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 native species from nurseries, or plant native species that have been rescued from other development sites. Ensure that any native plant material used is weed-free or contaminated with the same weeds present on site.
- **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
  - where it is absolutely necessary to cut danger trees, cut them to a level where they are safe and retain the trunk 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 environmental impact assessment**. Such features include dens, raptor nest or perch trees, owl roosts, woodpecker cavities, and bat roosts.

[104] See: Incorporating SEI Information into Environmental Impact Assessments, page 25.

Future Directions

The Bella Vista – Goose Lake Range SEI provides an essential planning tool for the study area, and an important source of information for other similar ecosystems that occur elsewhere in the North Okanagan.

For the study area, this information should be used to develop a landscape level 'local ecosystems plan' and conservation strategy, which could tie into a broader 'ecosystem plan' for the North Okanagan and the Protected Areas Strategy on crown lands.

While it may not be possible to define specific areas for conservation in the absence of other planning information, and input from the community and landowners, it should be possible to identify and assess some options. Similar to the demonstration scenarios described in Appendix 3 it should be possible to incorporate wildlife habitat information (Volume 3), and other preliminary planning information to develop scenarios for ecosystem retention. With a target established for future conservation, a property acquisition strategy can be formulated, including fundraising by conservation organizations.

As development proceeds within the study area, this inventory should be used as the basis for more detailed information gathering (at a smaller scale) for development of neighbourhood area plans and Environmental Impact Assessments. Another demonstration product could be an illustration of the use of this SEI in producing an "ecosystem-friendly" neighbourhood plan.

This SEI and the landscape level ecosystem plan for this area should be used to modify Vernon's Official Community Plan, and to provide input to a Growth Management Strategy. The 'local ecosystem plan' could be a component of the Parks and Recreation Master Plan, and this SEI can be used to provide specific input regarding the Bella Vista – Goose Lake Range, and a more general extrapolation to other important natural areas. The SEI should eventually be extended to cover other important natural areas within the North Okanagan.

This SEI also provides an important planning tool for the Okanagan Indian Band. It provides a planning base for developing a community plan , range management plan and future development proposals. It also provides a base for quantifying cultural use resources and extending traditional use and natural history information. Extending coverage of the inventory to cover the entire Indian Reserve would improve the scope of the SEI as an inventory and planning tool. Wildlife habitat mapping can be used to direct specific wildlife inventory work.

Existing mapping can provide a baseline to monitor changes in sensitive and other important ecosystems in the study area. As new housing and land developments, disturbances, and ecological succession occur in the study area, they will change components of the sensitive ecosystems map. The mapping should be updated every ten years to reflect and measure such changes.

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Appendix A: SEI Data

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.

The following are available:

- project metadata
- Non-Spatial Polygon Attributes
- TEM Map Legend Files
- TEM report with expanded legend (Volume 2)[105]
- Wildlife Species Accounts
- Wildlife Ratings Tables
- Wildlife Report (Volume 3)[106]
- Arc/Info *.E00 Export Files includes two spatial coverages: ECI field sampling points and a ECP TEM polygon coverage

[105] Iverson and Shypitka 2003
[106] Sarell and Haney 2003

Appendix B: Sensitive Ecosystems (SEI) Units[107] and related Terrestrial Ecosystem Mapping (TEM) units.

Sensitive Ecosystems

SEI Unit	Code	TEM Unit	Code[108]	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
		Sedge marsh	SM	IDFxh1 /00
Wetland, meadow	WN:md	Nuttall's alkaligrass – Foxtail barley graminoid meadow	AB	IDFxh1 /00
Wetland, shallow open water	WN:sw	Shallow open water	OW	IDFxh1 /00
		Pond	PD	IDFxh1 /00
Riparian, gully	RI:gu	Trembling aspen – Snowberry – Kentucky bluegrass	ASg, ASgk, ASgw	IDFxh1 /00
		Douglas-fir – Ponderosa pine – Snowberry – Spirea	DSg, DSgs, DSgw	IDFxh1 /07
Riparian, fringe	RI:ff	Black cottonwood – Douglas-fir – Common snowberry – Red-osier dogwood riparian	CD, CDk	IDFxh1 /00
		Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	SD	IDFxh1 /08
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 'g' modifiers)	IDFxh1 /07
		Douglas-fir – Ponderosa pine – Bluebunch wheatgrass – Pinegrass	DW 7C	IDFxh1 /03
		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	Idaho fescue – Bluebunch wheatgrass	FW, FW:$wf	IDFxh1 /91
		Bluebunch wheatgrass – Balsamroot	WB (no seral association)	IDFxh1 /93
Grassland, shrubland	GR:sh	Prairie Rose – Idaho fescue	RF	IDFxh1 /97
Broadleaf woodland, aspen copse	BW:ac	Trembling aspen – Snowberry – Kentucky bluegrass	AS (structural stage 2-6; except those with 'g' modifiers)	IDFxh1 /00 PPxh1 /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 – Bluebunch wheatgrass – Balsamroot	PB (structural stage 2-6)	IDFxh1 /02
Sparsely Vegetated, rock outcrop	SV:ro	Selaginella – Bluebunch wheatgrass rocky bluff	SB (no seral association)	IDFxh1 /00
		Rock outcrop	ROr, ROw	IDFxh1 /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
		Talus	TAw	IDFxh1 /00

[107] See page 4 for SEI unit descriptions.

[108] 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 and Shypitka 2003) for descriptions of site modifiers, structural stages, seral associations, and TEM units.

SEI Unit	Code	TEM Unit	Code[108]	Subzone / Site Series
Sparsely Vegetated, cliff	SV:cl	Cliff	CL	IDFxh1 /00

Other Important Ecosystems

SEI Unit	Code	TEM Unit	Code[109]	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 'g' modifiers)	IDFxh1 /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
Mature Forest, mixed	MF:mx	Douglas-fir – Ponderosa pine – Snowberry – Spirea	DS 6M (except those with 'g' modifiers)	IDFxh1 /07
Disturbed Grassland	DG	Idaho fescue – Bluebunch wheatgrass	FW:$sb, $sn, $sw, $wk	IDFxh1 /91
		Bluebunch wheatgrass – Balsamroot	WB:$sb, $sn, $sw, and $wk	IDFxh1 /93

[109] All site modifier combinations, structural stages, and seral associations are included unless otherwise noted.

Appendix C. Preliminary planning scenarios

Preliminary modelling used the inputs outlined below for three scenarios for setting conservation priorities. This preliminary work did not integrate wildlife habitat mapping, nor did it provide for determining core areas, buffers, and corridors. Future modelling work will integrate these additional considerations with planning and development considerations such as road placement, infrastructure, and engineering.

Scenario 1: Rudimentary environmental protection

Guidelines for 'no development' were taken from the City of Vernon's Official Community Plan (OCP) in this scenario. This scenario is not intended to identify conservation priorities. It is intended to show which parts of the landscape would not be developed under current guidelines. The lack of development on 'no-development' sites is unlikely to conserve many natural values associated with them under this scenario.

Areas for no-development:

- polygons with high slope instability ratings (V);
- TRIM[110] creeks that ran through polygons mapped with fluvial materials with a 15m buffer on either side;
- ponds, lakes, and wetlands plus a 15m buffer around them;
- polygons where riparian gullies were mapped (identified as RI:gu in the SEI mapping); this is meant to pick up areas referred to as 'vegetated ravines' in the OCP
- polygons where all slopes in the polygon are >30%

Areas for possible development with further investigation required:

- areas with slopes >30% from TRIM (this is likely a substantial overestimate of slopes >30% because contour intervals are 20m apart)

Scenario 2: Basic sensitive ecosystem retention

This scenario is intended to provide a basic level of retention for the highest priority sensitive ecosystems. Under this scenario, many natural values associated with retained ecosystems are likely to be lost in a highly fragmented landscape.

Areas for no-development:

- all polygons included in Scenario 1 as no-development
- all polygons with excellent quality sensitive ecosystems in them (qualcond=1)

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[110] Terrain Resources Inventory Mapping provides standardized provincial mapping of waterbodies, creeks and rivers, and 20m contour interval mapping.

- all polygons with Old Forests (OF) in them
- all polygons with Riparian (RI) ecosystems as the first component
- all polygons with cliffs (SV:cl) in them

Areas for possible development in portions of them with further investigation required:

- polygons with good quality sensitive ecosystems as the dominant component (qualcond=2)
- polygons with Broadleaf Woodlands (BW) in them
- polygons with Riparian (RI) ecosystems in them as the 2nd or 3rd component
- polygons with Mature Forests (MF) in them
- polygons with moderate slope stability ratings (IV)

Scenario 3: Sensitive Ecosystem Retention

This scenario is intended to capture all ecosystems likely required to provide for retaining important values associated with sensitive ecosystems. The scenario needs to be updated to model the placement of buffers and corridors needed to achieve this objective.

Areas for no-development:

- all no-development areas from Scenario 2
- polygons with Broadleaf Woodlands (BW) in them
- polygons with Riparian (RI) ecosystems in them

Areas for possible development in portions of them with further investigation required:

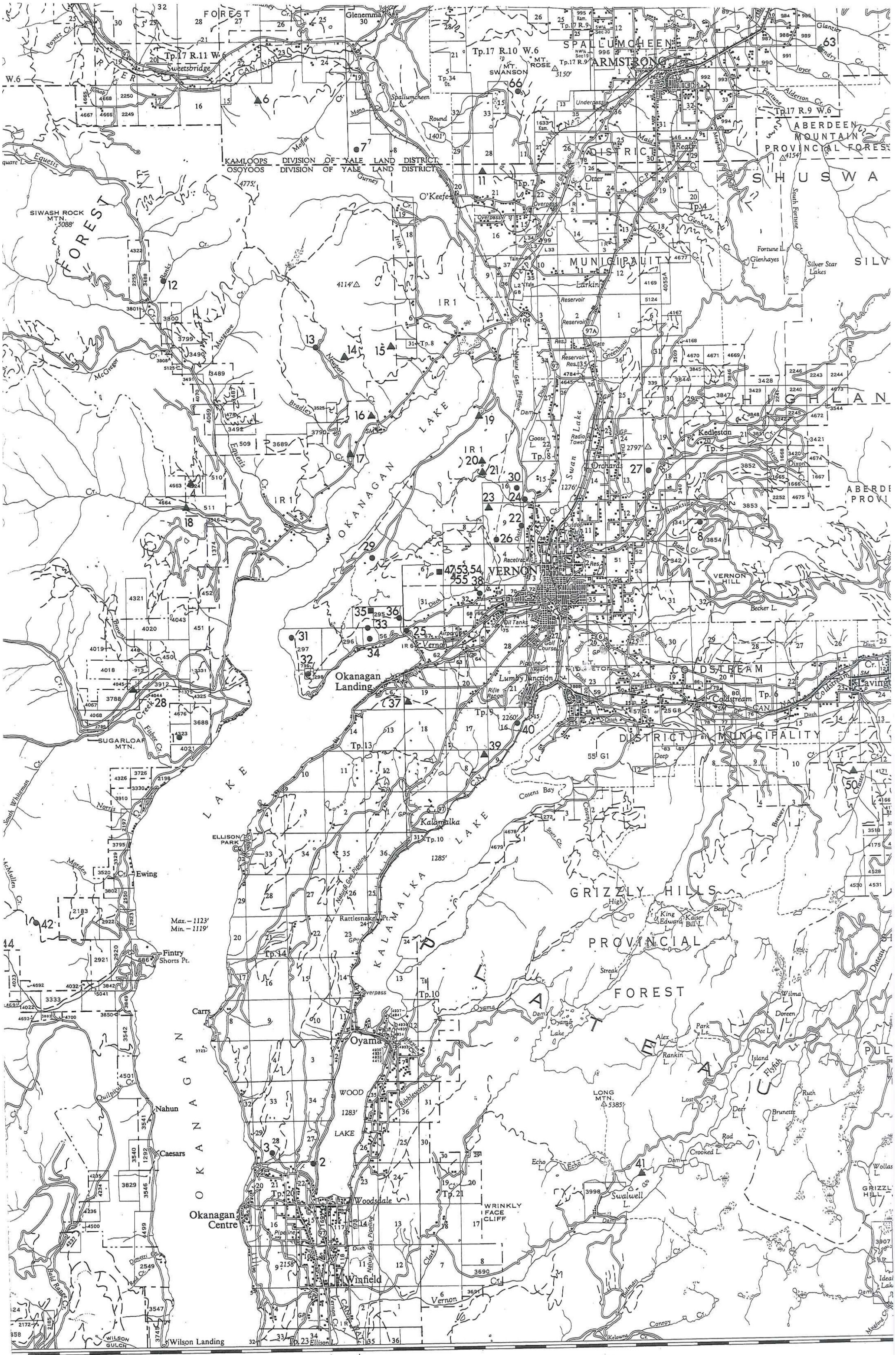
- all polygons with good and marginal quality sensitive ecosystems in them (qualcond=2 or 3)
- polygons with Mature Forests (MF) in them
- polygons with moderate slope stability ratings (IV)

Appendix D. Known and potential threatened and endangered vertebrate animals in the study area.

Common Name	Scientific Name	Occurrence in Study Area	Prov. Status	COSEWIC Status
Amphibians				
Great Basin Spadefoot	*Spea intermontana*	unknown but likely	Blue	Threatened
Western Toad	*Bufo boreus*	unknown but likely	-	Special Concern
Reptiles				
Painted Turtle	*Chrysemis picta*	throughout	Blue	-
Western Skink	*Eumeces skiltonianus*	unknown but likely	Blue	Special Concern
Northern Pacific Rattlesnake	*Crotalus oreganus*	southern portion	Blue	(pending)
Great Basin Gopher Snake	*Pituophis catenifer*	throughout	Blue	Threatened
Racer	*Coluber contrictor*	throughout	Blue	-
Rubber Boa	*Charina bottae*	unknown but likely	-	Special Concern
Birds				
Great Blue Heron	*Ardea herodias* ssp. *herodias*	occasional	Blue	-
California Gull	*Larus californicus*	seasonal transients	Blue	-
American Avocet	*Recurvirostre americana*	unknown but likely	Red	-
Long-billed Curlew	*Numenius americanus*	at least one breeding area	Blue	Special Concern
Upland Sandpiper	*Bartramia longicauda*	unknown but possible	Red	-
Swainson's Hawk	*Buteo swainsoni*	provincial benchmark	Red	-
Ferruginous Hawk	*Buteo regalis*	unknown but possible	Red	Special Concern
Interior Western Screech-owl	*Otus kennicotti* ssp. *macfarlanei*	unknown but likely	Red	Endangered
Flammulated Owl	*Otus flammeolus*	unknown but likely	Blue	Special Concern
Short-eared Owl	*Asio flammeus*	unknown but likely	Blue	Special Concern
Lewis' Woodpecker	*Melanerpes lewis*	known but uncommon	Blue	Special Concern
Yellow-breasted Chat	*Icteria virens*	unknown but possible	Red	Endangered
Brewer's Sparrow	*Spizella breweri breweri*	known from one location	Red	-
Grasshopper Sparrow	*Ammodramus savannarum*	at least 1 breeding colony	Red	-
Lark Sparrow	*Chondestes grammacus*	likely (OK Landing)	Red	-
Mammals				
Merriam's Shrew	*Sorex merriami*	unknown but possible	Red	-
Preble's Shrew	*Sorex prebeii*	unknown but possible	Red	-
Townsend's Big-eared Bat	*Corynorhinus townsendii*	known from one location	Blue	-
Pallid Bat	*Antrozous pallidus*	unknown but possible	Red	Threatened
Fringed Myotis	*Myotis thysanodes*	unknown (OK Landing)	Blue	Special Concern
Western Small-footed Myotis	*Myostis ciliolabrum*	unknown but likely	Blue	-
Western Harvet Mouse	*Reinthrodontomys megalotis*	known from several areas	Blue	Special Concern
Great Basin Pocket Mouse	*Perognathus parvus*	unknown but likely	Blue	-
Nuttall's Cottontail	*Sylvilagus nuttallii* ssp. *nuttallii*	not currently	Blue	Special Concern
Badger	*Taxidea taxus*	throughout	Red	Endangered

APPENDIX B

Mining Information



ARMSTRONG
SPALLUMCHEEN
VERNON
COLDSTREAM
DISTRICT MUNICIPALITY
Okanagan Landing
Lumby Junction
Kalamalka
OKANAGAN LAKE
KALAMALKA LAKE
WOOD LAKE
Oyama
Winfield
Woodsdale
Okanagan Centre
Carrs
Ewing
Fintry
Shorts Pt.
Nahun
Caesars
Wilson Landing
ELLISON PARK
SUGARLOAF MTN.
SIWASH ROCK MTN. 5088'
GRIZZLY HILLS
PROVINCIAL FOREST
PLATEAU
LONG MTN. 5385'
WRINKLY FACE CLIFF
Swalwell L.
Swan Lake
Sweetsbridge
KAMLOOPS DIVISION OF YALE LAND DISTRICT
OSOYOOS DIVISION OF YALE LAND DISTRICT
ABERDEEN MOUNTAIN PROVINCIAL FOREST
SHUSWAP HIGHLAND
Max. – 1123'
Min. – 1119'

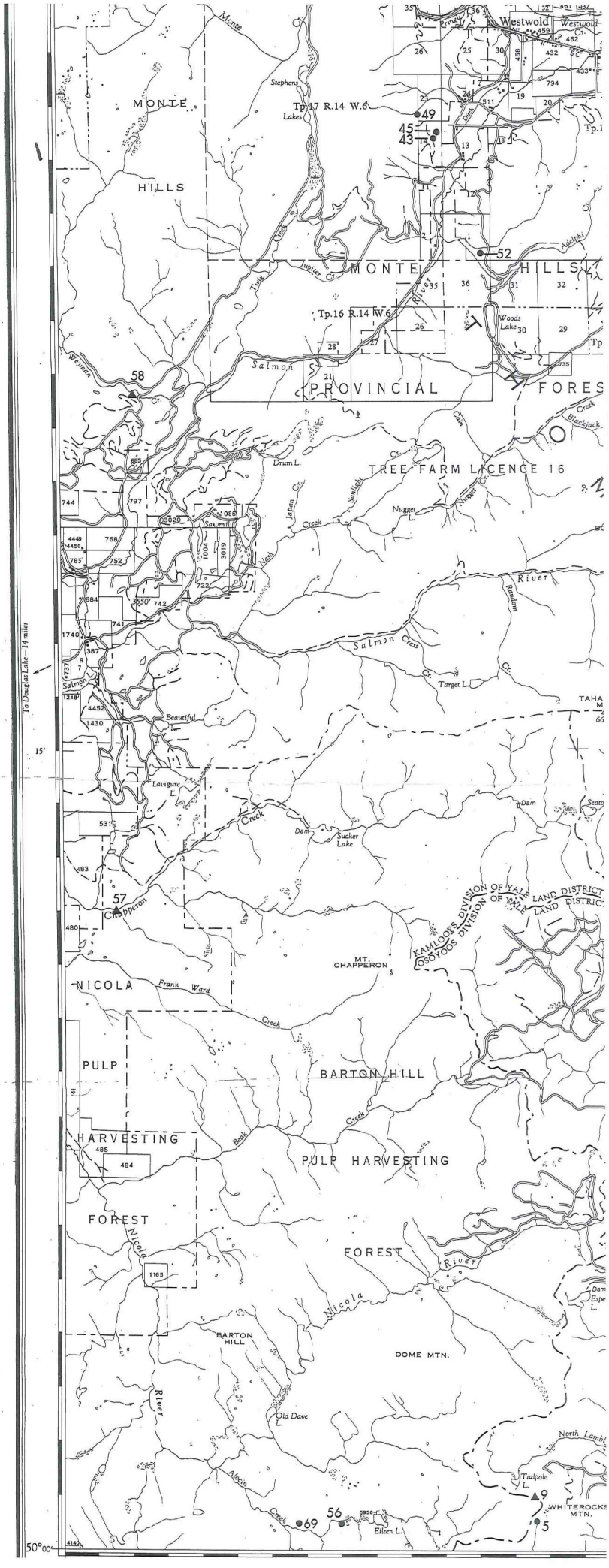
incomplete.

Copies of this map may be obtained for $1.00 per sheet. Orders for maps should specify the map sheet number and letter. Orders should be addressed, with prepayment, to the

Department of Mines and Petroleum Resources,
Victoria, B. C. V8X 1S4

Mineral Inventory cards containing specific information on each of the following mineral occurrences are available for viewing on open file according to the map number. Contact the Resource Data Section, Geological Division, Victoria.

NO. 82L/SW-	NAME	PRODUCT (S)
1	GREEN GABLES (VIEW; LAKEVIEW)	Fluorite
2	NOVA	Mo
3	TICK	Mo
4	GOODENOUGH (HUGAL; QUEEN; DAWSON)	Cu
5	ALFY (BEAR)	Cu
6	EIN (SWEETBRIDGE)	Cu
7	BLACK HAWK (PEOITCH; BJ)	Au, Ag, Cu, Pb, Zn
8	MOUNT VERNON (SILVER STREAK; DCK)	Au, Ag, Pb, Zn, Mo, Cu
9	NIGHT OWL (BARD)	Cu, Mo
10	SILVER QUEEN (SILVER STAR)	Ag, Pb, Zn, Au, Mo, Cu
11	MAY	Au, Ag, Pb
12	GRAND TIMES, HIDDEN TREASURE	Au
13	SKOOKUM (ONA)	Ag, Au, Cu, Pb
14	MAY (OCTAGON ?)	Ag, Pb, Zn, Cu
15	OCTAGON (MAY)	Ag, Cu, Pb, Zn, Sb
16	PAY ROLL	Ag, Pb, Au
17	MITCHELL, COCHRANE	Ag, Pb, Cu, Zn
18	IOU, GEM (BLUE SHALE ?)	Au, Cu
19	BRENT	Cu, Pb, Ag, Au
20	BEVERLEY, MARIE, EDITH	Au, Ag, Pb, Cu, Sb
21	KEYSTONE	Cu, Zn, Pb
22	BLUE JAY	Au, As, Pb, Sb
23	IXL	Au ?
24	JUMBO	Au, Ag
25	REX (THREE TRAMPS)	Au, Cu
26	FALCON	Au, Cu, Pb, As
27	BON DIABLE	Au, Ag
28	KLONDYKE	Cu, Au
29	OPHIR	Cu, Ag, Pb, Zn, Au
30	ROYAL (CARTWRIGHT)	Ag, Pb, Zn
31	RUBY GOLD	Au
32	MORNING GLORY	Au, Cu
33	DENSY	Au, Cu
34	BRITISH EMPIRE	Au, Ag
35	IRON CAP	Cu
36	THREE TRAMPS (REX)	Cu
37	BACHELOR	Au, Cu
38	RITA (RETA)	Ag, Cu, Au
39	MISSION HILL (BABY ?)	Ag, Au, Cu, Pb
40	MILLIGAN (SALLY BROWN ?)	Au
41	COPPER KING (KIK)	Cu
42	WHITE ELEPHANT	Au, Ag, W, Bi, Te
43	KENNALLAN (YOKAHAMA; CHIP; BUM 2)	Mo, Cu
44	ZION (HOMESTAKE)	Au
45	BUM 1 (KENNALLAN; YOKAHAMA)	Mo, Cu
46	EAGLE	Mo
47	PEERLESS	Ag, Pb
48	PAT	Cu
49	ANNIS INDUSTRIES	Limestone
50	KALAMALKA (CHANCE)	Au, Ag, Cu, Pb, Zn
51	AT (DUN)	Cu, Mo
52	JIM	Mo, Cu
53	ADMIRAL	Ag, Pb, Zn
54	FAITH	Ag, Pb, Zn
55	LOST TREASURE	Ag, Pb, Zn
56	CHROME VANADIUM (HORNE)	Cr, Fe, Asbestos
57	LONE STAR	Asbestos
58	PILOT (PILOT LODE; ROYAL)	Au, Ag, Cu
59	MYSTERY	Au, Ag, Pb
60	PRINCE OF WALES	Au, Ag, Pb, Mo
61	GOLD MOUNTAIN, WOODLAND BELL	Au, Cu
62	SHORTS CREEK	Coal
63	BARBARA ANN — SONNY	Talc
64	BRETT — BIRD	Mica
65	RUBY	Cu
67	AB 9	Cu
68		
69	JOHN, GROUSE	Cu



RESERVE: OKANAGAN NO. 1

BAND: OKANAGAN #7390

IANC DISTRICT: Central

BRITISH COLUMBIA MINING DIVISION: Vernon

LOCATION: Osoyoos District - at the north end of Okanagan Lake, northwest of Vernon (Figure 1).

MINERALS SURRENDER: No

NTS: 82L

AREA (Approx.): 10 310 ha

COORDINATES: Lat. - 50°16'N
Long. - 119°25'W

GROUPING POTENTIAL:

Priest's Valley No. 6	35 ha
Total	10 345 ha

PHYSIOGRAPHIC SETTING:

The reserve occupies flat to rolling and hilly terrain north of and bordering the North Arm of Okanagan Lake (Figure 1). Vertical relief is in the order of 400 m. The reserve area exhibits considerable bedrock exposure in addition to an abundant surficial cover of Pleistocene glaciolacustrine, till and kettle terrace deposits which, in places, are overlain by postglacial and Recent floodplain, channel fan, delta and shoreline deposits of silt, sand and gravel (Figure 2). Numerous creeks including Whiteman (Siwash), Equesis and Newport (Deep) Creeks cross the reserve to enter Okanagan Lake which constitutes the base level of drainage.

GEOLOGIC SETTING:

The bedrock geology of the reserve may be divided into two distinct areas (Figure 5A). The southern part of the reserve is underlain by the Carboniferous/Permian Thompson Assemblage which consists of argillaceous sediments, volcaniclastics and limestone pods. The northern part of the reserve is underlain by two units: one, the Upper Triassic Sicamous Formation, a belt of argillite and shale containing limestone lenses and conglomerate beds lies to the northeast of the Thompson Assemblage; the second unit consists of a belt of andesitic and basaltic volcanic rocks in flows as well as brecciated tuffaceous horizons.

Though the age of the second unit is uncertain it is likely a part of the Upper Triassic/Lower Jurassic Nicola Group which appears to conformably overlie the conglomerates and shales of the Sicamous Formation with a narrow gradational contact. A few outliers of Tertiary Kamloops Group lavas and small stocks of Lower Jurassic granodiorite also are present within the reserve boundary.

AEROMAGNETIC GEOPHYSICS:

The southern part of the reserve shows a number of magnetic anomalies (Figure 3), having a west-northwest trend, which reflect the underlying linear pattern of the bedrock (Figure 3). In the northern part of the reserve, the magnetic profile is broad reflecting the thick surficial cover.

MINERAL SHOWINGS ON RESERVE:

There are a number of mineral occurrences known on the reserve (Figures 6 and 6A).

1. SAND AND GRAVEL

A recent study of sand and gravel potential was completed by Indian Minerals (West). The report found that significant sand and gravel deposits are associated with stream terraces, kame terraces, kettle terraces and ancient deltas (Figure 2) on the reserve. These landforms were identified along Equesis Creek, Whiteman Creek and the O'Keefe Valley.

The old deltas are not only a source of sand and gravel but they also indicate the level of standing water during various stages of Glacial Lake Penticton. The actual areas for potential sand and gravel development are shown in Figure 4.

Area 1B has the highest potential for sand and gravel development on the reserve. One million m^3 of accessible, commercially useable material has been estimated. More material may be available in this area but more detailed testing is necessary.

Area 1C appears to contain approximately 2,500,000 m^3 of gravelly sand. The high quality of the deposit shows great potential for fine aggregate used in highway construction in fine concrete manufacture and as pipe bedding sand.

Area 1A is not as promising for commercial development as it contains a smaller amount of material and is farther away from potential markets. An off-reserve housing development nearby and a well used logging road may offer some demand for material from this source, however, the best use of this material would probably be as an aggregate supply for the band.

Area 1E contains a lower quality and smaller quantity of granular material. The main constraint to further investigation or development in this area is its previous use as a military target range.

The last area, 1D, has such a low quality and quantity of sand and gravel that it would not be feasible to develop.

At present none of the recommended areas are under development.

1. RAFUSE, I.N. 1983. Sand and Gravel Potential of the Okanagan Indian Reserve No. 1, Indian Minerals (West) British Columba Indian Reserve 119 - 83.

2. Ophir - COPPER, SILVER, LEAD, ZINC AND GOLD (082LSW029)

Considerable interest has been shown by various mining companies in this prospect over the years; the property is on the east side of the northwest arm of Okanagan Lake about 10 km from the head of lake and 24 km by road from Vernon (Figure 4). The initial discovery was made in 1923 on the side of the hill nearly 90 m above the lake shore. At this location, some high-grade copper ore was discovered in a shear zone striking northwest and dipping 60 degrees to the northeast. This shear zone has a maximum width of about 4.5 to 6 m and conforms with the structure of the enclosing formations. The latter are chiefly dark grey, argillaceous, more or less slaty or schistose rocks, but include, along the course of the shear zone, a narrow but persistent band of quartz-sericite schist. The latter is a white or cream coloured, lustrous, highly micaceous rock which has been involved in most of the deformation affecting the associated argillaceous beds and may be a highly altered quartz porphyry dyke or sill.

Exploratory work, including several open-cuts and trenches, has established continuity of the shear zone for 240 m to a vertical depth of over 60 m. Mineralization is not equally distributed along or across this zone but is confined to widths of, at most, a few metres.

The minerals present include chalcopyrite, malachite, pyrite, sphalerite, and galena approximately in order of abundance. Zinc silicate (calamine) has also been reported and a number of secondary minerals have formed in small quantities from the iron and copper sulphides. Pyrite occurs disseminated through both the rich and lean portions of the shear zone irrespective of other minerals. Chalcopyrite is more restricted and is most conspicuous in the lowest open-cut where it occurs in two settings: firstly, as bands or lenses a few cm wide of solid or nearly solid sulphide and secondly, as disseminated blebs through the adjoining quartz-sericite schist wall rock across a 120 cm wide mineralized zone. A sample taken by the Resident Engineer in 1925 across 0.6 m of such material assayed: gold - trace; silver - 0.2 oz./ton; copper - 4.3 per cent. Subsequent development work opened up about 1.2 m of higher grade copper ore.

Sphalerite is abundant in the upper main open-cut situated 47 m above and 120 m southeast of the lower workings. At this location, a trench 25 m long follows a well mineralized band about 1 m wide in the shear zone from which a carload of ore had

been extracted and was reported (1929) to assay $43.00 per ton in combined gold, silver and zinc values. A sample across the trench was obtained in 1928 by the Resident Engineer and assayed: gold - 0.06 oz./ton; silver - 2.4 oz./ton; copper - 1.6 per cent; lead - 2 per cent; zinc - 21 per cent. The sphalerite is partly massive and partly disseminated and is associated with galena, pyrite and chalcopyrite in replacing the schistose country rock. At the southeast end of the trench, the mineralized width pinches to a few cm and attempts to pick it up again in a couple of trenches farther southeast have not been successful, although the shear zone itself is persistent. Similarly, a long trench intermediate between the upper and lower main showings does not show any appreciable concentraton of sulphide minerals. However, this latter trench may not have extended far enough to the northeast.

Chip samples collected by Cominco Ltd. in 1976 assayed: silver - 1.8 oz./ton; zinc - 16.4 per cent; lead - 2.9 per cent; and copper - 0.29 per cent across 1 m. Grab samples gave values up to: gold - 0.33 oz./ton; silver - 12.4 oz./ton; zinc - 32.39 per cent; lead - 5.30 per cent and copper - 2.98 per cent. Some preliminary mapping and sampling of the property was done by R. Young of Indian Minerals (West) in 1980. A full mapping and drilling program was undertaken by Indian Minerals (West) in 1981. A series of six holes were drilled on the property in an attempt to determine the lateral continuity and width of the showing. All the holes intersected and passed through a zone of disseminated to massive sulphides. However, although some encouraging assays were encountered the mineralization appeared to be too erratic in grade and thickness for the deposit to be of any economic interest. The assayed values are gold - trace to 0.05 oz./ton; silver - 0.02 to 6.25 oz./ton, zinc - 0.02 to 16.0 per cent, lead - trace to 1.50 per cent, and copper - 0.01 to 0.89 per cent.

This work demonstrates the continuity of the shear zone, but indicates that any significant mineralization if present must be confined to ore shoots, of as yet unproven dimensions, containing quite different proportions of sulphide minerals. The deposit is therefore considered to have a low potential as a future producer of base and precious metals.

The mineralization may be related in origin to the granitic rocks exposed in the immediate vicinity of the Ophir property; a number of porphyritic, grey to somewhat pinkish, intrusive bodies outcrop in the area.

1. EMPR AR 1923-161, 1925-184, 1926-200, 1927-213, 1928-220.
2. GSC SUM RPT 1931A-92.
3. GSC MEM 296-148.
4. GSC MAP 1059A 48-4A.

5. DINA E-5853-07390-G
6. EMPR INDEX 3-208.
7. GSC OF 637, 1505A, 1565, 1989-5.

3. Brent - COPPER, LEAD, GOLD AND SILVER (082LSW019)

This property is located on the west side of Okanagan Lake, about 1.6 km to the south of its extreme north end (Figure 6). The prevailing bedrock is schist with a northwest strike and a dip of about 70 degrees to the northeast. The exposed vein has a width of about 90 to 120 cm and conforms to the underlying formation. The vein filling is quartz with malachite and chalcopyrite. The following samples were taken (1923):

(1) Across 1 metre on the footwall (quartzose material): gold - trace; silver - 4 oz./ton; copper - 2 per cent; lead - 1 per cent.
(2) Across 1.2 metre on the hangingwall, at the same point as sample (1) (yellowish schistose material); gold - trace; silver - 0.6 oz./ton.
(3) General sample along the footwall (across a metre) for about 7.5 m gold - trace; silver - 4.6 oz./ton, copper - 3.6 per cent; lead - nil.
(4) A picked sample with very little visible copper; gold - trace; silver - 5.6 oz./ton.

Samples (1), (2) and (3) were all from the same open-cut, which has stripped the vein for about 7.5 m along its strike. Sample (4) is from a cut about 120 m to the northwest and is apparently on the same vein, although an intervening wash prevents tracing the vein through. The vein is narrow at this location.

On the hangingwall of the zone, which dips towards the northeast, there is a seam of disintegrated siliceous material, from which a sample was taken in 1925 across a width of 40 cm. It assayed: gold - trace; silver - 2.8 oz./ton. Towards the middle of the zone, a seam of rusty copper stained rock with some quartz had been exposed in the bottom of the cut. A sample taken across 0.6 m assayed: gold - trace; silver - 0.2 oz./ton; copper - 4.3 per cent.

Sinking on this seam subsequent to the date of the examination, when the above samples were taken, is reported to have opened up a better grade of ore, in which there were bands of solid chalcopyrite.

It would appear that, if a similar type of ore to that shown in the 7.5 m cut could be exposed along the surface for an economic distance, that the deposit would merit some additional exploration and some underground development.

1. EMPR AR 1923-161, 1925-184, 1926-200.

2. GSC MAP 1059.
3. GSC MEM 296-142.
4. DINA E-5853-07390-G.
5. EMPR INDEX 1874-1936, P. 56.
6. GSC OF 637, 1505A, 1565, 1989-5.

4. Pay Roll - SILVER, LEAD AND GOLD (082LSW016)

This group of six claims is located on Newport (Deep) Creek, a stream which flows into the North Arm of Okanagan Lake from the west, a few km above Siwash Creek (Figure 4). The occurrence is a quartz vein in an argillite formation intruded by dykes of feldspar porphyry. The vein is exposed on the southwest bank of the creek and occupies an east-west fissure about 120 m above Okanagan Lake. A notable feature is the continuity of the vein as exposed at surface. The vein has been stripped at regular intervals for a horizontal distance of over 400 m and a vertical range of nearly 30 m. The vein has a uniform exposed width of between 60 and 90 cm and dips of 40-45 degrees to the south. Galena is fairly well distributed throughout the whole width of the quartz although the better samples are found nearer the upper hangingwall side of the vein. On the hangingwall side there is a seam of lead carbonate (calamine). The quartz appears to have been fractured but the mineralization does not appear to be secondary to the quartz deposition. Ribbon structure is present and, in general, appearance of the vein provides encouragement in the belief that economic amounts of lead, gold and silver may be fairly evenly distributed.

A sample taken in 1929 across a width of 76 cm in an open-cut at the highest elevation at which the outcrop has been exposed assayed: gold - trace; silver - 6 oz./ton; lead - 1.6 per cent. A sample taken across a width of 60 cm at the lowest point assayed: gold - trace; silver - trace; lead - trace. A sample of selected ore from the hangingwall assayed: gold - 0.04 oz./ton; silver - 35.5 oz./ton; lead - 40.4 per cent.

In 1981, Indian Minerals (West) mapped and sampled the main showing. Assays from samples collected gave values of: gold - trace to 0.18 oz./ton; silver - trace to 20.57 oz./ton; zinc - trace; lead - trace to 9.56 per cent; copper - trace to 0.06 per cent and manganese - trace to 1.1 per cent. The enclosing rocks vary from rather schistose, argillaceous sediments to more massive, quartzitic, limy and possibly tuffaceous types. The sediments are intersected by dykes of grey feldspar porphyry mainly of post-mineral age. The vein is composed of banded white quartz carrying appreciable sulphide mineralization, chiefly galena, with chalcopyrite towards the west. Other exposures of mineralized quartz veins occur on the property near the summit of the ridge on the north side of the creek at an elevation of about 930 m.

This vein has an exposed width of about 30 m and strikes northwesterly parallel with the bedding of the enclosing sedimentary rocks. This vein consists mostly of massive quartz sparingly mineralized with galena, sphalerite, and pyrite. A little native sulphur is also present. The vein probably carries a little free gold. Where present, the galena carries approximately an ounce of silver to one per cent lead.

Another exposure of vein quartz, possibly a continuation of the last-mentioned vein, is reported in the left side of the creek near the bottom of the valley. The vein is exposed for a width of several metres and, in places, is well mineralized with galena, and carries considerable sphalerite and a little pyrite and chalcopyrite. Drusy cavities in the quartz contain a conspicuous amount of native sulphur, a feature that also is present in the veins on the Jumbo claim near Swan Lake.

Although further work on this showing might be warranted, present indications are that the mineralization and the higher assays are concentrated in a narrow band of massive galena 20 cm thick. The entire vein structure does not appear to have either the size or grade necessary to permit development of this deposit.

1. GSC MAP 1059A, 48-4A.
2. GSC MEM 296-148.
3. GSC SUM RPT 1931A-85.
4. EMPR AR 1929-247, 1930-208.
5. DINA E-5853-07390-G.
6. GSC ASS RPT 12313.
7. GSC OF 1505A, 1563, 637, 1989-5.

5. Mitchell and Cochrane Group - SILVER, LEAD, COPPER AND ZINC (082LSW017)

Two parallel quartz veins, 180 to 240 cm wide and 60 cm apart occur in argillites above the road along the west side of Okanagan Lake (Figure 4). The veins strike nearly east, dip steeply to the south and intersect argillaceous sediments which, in this vicinity, strike about north 65 degrees west and dip at low angles to the southwest. The veins have been traced for 120 m or more. They carry disseminated sulphides including pyrite, galena, chalcopyrite and sphalerite. One of the veins showing a little galena has been opened up on the surface. According to the Resident Engineer (1922) a sample of some of the sorted ore from the smaller of the two veins ran: silver - 9 oz./ton; lead - 15 per cent. Samples taken from the larger vein, consisting of quartz impregnated with iron pyrites yielded no appreciable values in gold and silver. In the vicinity of these workings, several other small quartz veins are present. Both veins and adjoining wall rocks carry pyrite, lesser chalcopyrite and traces of other sulphides.

1. EMPR AR 1922-145.
2. GSC SUM RPT 1931A-84A.
3. GSC MEM 296-147.
4. GSC MAP 1059A, 48A-4A.
5. EMPR INDEX 1874-1936, P. 95.
6. GSC OF 1505A, 1565, 637, 1989-5.

6. Beverly, Peggy, Marle and Edith - GOLD, SILVER, LEAD, COPPER AND ANTIMONY
(082LSW020)

These former groups of 32 claims are located southwest of Goose Lake, and about 11 km by road from Vernon (Figure 4), between elevations of 400 and 800 m. The quartz veins, which form an extensive network, differ to a great extent from those found elsewhere in the area, in that the continuity and mineralization of the veins appear to be much more persistent. The country rocks, where exposed, are Mesozoic sediments and volcanics occasionally intruded by tongues of granite. The veins strike anywhere from north-south to east-west, dip from 54 degrees to perpendicular and generally conform to the schistosity of the enclosing rocks.

Exploration in 1934 consisted of trenching, open-cutting and sinking on the different mineralized exposures in an endeavour to locate ore-shoots upon which deeper development could be done. The veins vary from 25 cm to 9 m in width between free walls, and are generally mineralized with pyrite and galena and occasionally with chalcopyrite and tetrahedrite. Many samples were taken (1934) across the vein. They assayed from a trace in gold and silver to: gold - 0.80 oz./ton; silver - 32 oz./ton; lead - 31 per cent. The latter gold and silver values were obtained from across 120 cm of quartz in a shallow shaft on the Beverley No. 2 claim. Vein continuity and widths have been proven for over 240 m in several instances and, in spite of many low value assays, further exploration appears to be warranted.

1. EMPR AR 1934-D32.
2. GSC MEM 296-141.
3. GSC MAP 1059.
4. EMPR INDEX 1874-1936, P. 38.
5. GSC OF 1505A, 1565, 637, 1989-5.

7. Keystone - COPPER, LEAD, ZINC AND GOLD (082LSW021)

On this former claim group, situated about midway between Swan and Okanagan Lakes (Figure 4) several exposures of vein quartz have been found and little work has been done on some of them. At a point near the northeast end of Mule Lake, an open-cut exposes some copper-stained vein quartz carrying a little chalcopyrite. This vein strikes a few degrees north of west and dips vertical. About 430 m to the northeast, another vein, 1 m

wide, is heavily mineralized with pyrite and carries a little sphalerite. It is exposed for only a few metres but may join, about 100 m to the northwest, a large exposure of sparsely mineralized vein quartz having a width of between 15 and 30 m. About 150 m in a northeasterly direction from the heavily mineralized vein showing, an open-cut and short incline have been made on a quartz vein up to 1 m wide, striking about north 35 degrees east and dipping 30 degrees northwest. This vein carries a little pyrite and galena.

No attempt has been made to correlate the various vein exposures or to trace them for any considerable distance. They mainly intersect sedimentary members of the Sicamous Formation including dark argillites and grey to greenish grey tuffaceous beds; the whole assemblage striking west to northwesterly and dipping principally to the northeast. Locally, the veins show encouraging mineralization and include at least one unusually large exposure. Assay values are not known.

1. GSC MEM 296-146.
2. GSC SUM REPT. 1931-83.
3. GSC MAP 1059A, 48-4A.

8. Whiteman Creek - GEMSTONES (082LSW103)

This showing is located on Whiteman Creek upstream from where the road crosses the Creek about 1 km from Okanagan Lake. Jasper has been found.

1. WESTERN HOMES AND LIVING OCT. 1961.
2. EMPR INDUST MIN FILE.

MINERAL SHOWINGS OFF RESERVE:

There are over thirty mineral occurrences in the area of the reserve (Figures 6 and 6A).

1. Green Gables, View Group - FLUORITE (082LSW001)

This is a long known fluorite occurrence on Bursary Mountain, 3 km southwest of the mouth of Whiteman Creek. The creek flows east through the extreme southwest part of the reserve into Okanagan Lake.

The mountain is a circular mass about 900 m in diameter. Small isolated showings of fluorite occur scattered over the entire mountain. The main exploration work done to date has been concentrated in an area 0.8 km long and 0.4 km wide, situated between 550 and 640 m elevation, in the southwest quarter of lot 4323 at the southeast corner of the mountain.

Most of the mountain is underlain by late Jurassic quartz monzonite. This has been intruded by numerous dykes of various types and sizes. A north-trending fault and fracture zone cuts all the rocks. It is within elements of this zone that the fluorite occurs.

Mineralization on the property occurs as fracture fillings. In some cases the fractures are completely filled to form solid veins, but in other cases the fractures are only partly filled so that, the resulting veins are vuggy or drusy. Most veins are short and narrow, the widest measured being 80 cm. Rapid pinching and swelling are characteristic of the veins and frequently small lenses or pods of mineralized material are all that can be seen. Most vein fillings consist of milky quartz. Fluorite occurs as lenses and irregular masses scattered in quartz veins, as veins by itself and as films on fracture faces. Lenses of fluorite 20 cm in diameter and 1.2 cm thick occur in several places and solid veins between 0.6 and 5 cm thick and 0.3 to 0.6 m long are present in scattered locations. The fluorite is usually coarsely crystalline and is mostly pale green or white and rarely purple. Occasionally, black manganese oxide is present with the fluorite mineralization. Except for scattered grains of pyrite, no sulphides are present.

1. EMPR AR 1966-265, 1967-303, 1968-299.
2. EMPR ASS RPT 3393.
3. EMPR PF.
4. GSC MEM 296.
5. EMPR GEM 1971-461.

2. Whiteman Creek, Twelve-Mile Creek - GOLD (082LSW086)

This placer gold occurrence is located on Whiteman Creek, 0.75 km downstream from the confluence of Bouleau and Whiteman Creeks.

1. GSC OPEN FILE MAP 637.
2. EMPR AR 1915-253, 1920-187, 1921-196.
3. EMPR BULL 28-62.

3. Bouleau Creek, Bolean Creek - GOLD (082LSW085)

This showing is on Bouleau Creek approximately 0.5 km upstream from the confluence of Bouleau and Whiteman Creeks.

1. GSC OPEN FILE MAP 637.

4. Klondyke - COPPER AND GOLD (082LSW028)

This mineral occurrence is located on the west side of Okanagan Lake near Whiteman Creek about 3 km west of the reserve. The pyrite and chalcopyrite mineralization is found in small

irregular quartz veins. The veins occur in fractured area at the contact between granitic rocks and dykes with older sediments.

1. EMPR AR 1898-1130, 1899-746, 1905-255, 1934-D33.
2. GSC MEM 296-146.
3. GSC MAP 1059, 48-4A.
4. GSC SUM RPT 1931 A-77.

5. Morning Glory - GOLD AND COPPER (082LSW032)

This property is 10 km from Vernon on the peninsula of land between the two arms of Okanagan Lake. Pyrite, arsenopyrite, free gold, chalcopyrite and galena mineralization occur in a quartz vein which may be as wide as 180 cm.

1. EMPR AR 1896-579, 1897-608, 1902-189.
2. GSC SUM RPT 1931A-77.
3. GSC MEM 296-147.
4. GSC MAP 1959A, 48-4A.

6. Ruby Gold - GOLD (082LSW031)

The showing is located 9 km southwest of Vernon and close to the east shore of Okanagan Lake (Figure 4). A vein of milky white quartz, 3 to 3.65 m wide, contains pyrite and free gold. The vein is not continuous and may be found as stringers.

1. EMPR AR 1897-608, 1904-300.
2. GSC SUM RPT 1931A-78.
3. GSC MEM 296-149.
4. GSC MAP 1059A, 48-4A.

7. British Empire - GOLD, SILVER AND COPPER (082LSW034)

This property is 8 km southwest of Vernon and is one of many located on the peninsula between the two arms of north Okanagan Lake (Figure 4). Considerable work has been done on this property and a small tonnage of ore has been extracted and milled.

The workings on the British Empire Group lie between 75 and 150 m and not far from the shore of Okanagan Lake, opposite Okanagan Landing. The country rocks are chiefly dark grey or black argillites and slate containing a number of narrow brownish weathering bands of a fine grained carbonate rock. The vein quartz carries sparsely disseminated pyrite and chalcopyrite; the adjoining wallrocks are abundantly impregnated with well formed cubes and octahedra of iron sulphide. Values are chiefly in gold which is largely free-milling, but also partly carried in the sulphides.

A stamp mill was erected on the lake shore in 1903. A small tonnage of ore was treated and is reported to have given 27 dollars a ton in gold on the plates. Concentrates were stated, in 1905, to carry about 50 dollars a ton in gold. The mill was closed down in 1906 after a 120 day run. No further work is reported until 1925 and the years immediately following, when further attempts at production were made with only limited success. The geologic environment of the deposits of the British Empire Group is similar to that on several other nearby properties. The showings do not, individually, warrant large expenditures, as gold values, though locally spectacular, are spotty and average values over any considerable body of vein material appear to be too low to warrant extensive development work. The quartz veins though numerous are mostly small and scattered, and individually are faulted or split into a number of small, unworkable stringers. The character of the veins at depth has received little investigation, but the available evidence does not suggest that there is any change in either continuity or concentration.

1. EMPR AR 1901-1125; 1902-189,303, 1903-178, 1905-192, 1906-172, 1913-194, 1925-184, 1927-213.
2. GSC SUM 296-142.
3. GSC MAP 1059.
4. EMPR INDEX 3-90.
5. GSC SUM RPT 1931A-81.

8. Densy - GOLD AND COPPER (082LSW033)

This property, which is located 8 km southwest of Vernon, is one of several deposits which contains free gold and some copper in milky white quartz veins. There are three veins on this property which are up to 180 cm wide.

1. EMPR AR 1897-609, 1898-1195, 1899-746.
2. GSC SUM RPT 1931A-76.
3. GSC MEM 296-144.
4. GSC MAP 1059, 48-4A.

9. Iron Cap - COPPER (082LSW035)

The occurrence is about 8 km southwest of Vernon near the shore of Okanagan Lake. A 3 m hole exposes two narrow veins of sugary white quartz with a little chalcopyrite, however, the veins are not traceable for any distance.

1. EMPR AR 1897-609.
2. GSC SUM RPT 1931A-76.
3. GSC MEM 296-145.
4. GSC MAP 1059.

10. Three Tramps, Rex - COPPER AND GOLD (082LSW036)

This prospect is situated immediately north of the east arm of Okanagan Lake and approximately 1.6 km northwest of the reserve. On the property, narrow quartz veins containing pyrite and chalcopyrite occur in a dark green coarse grained hornblende rich diorite of early Jurassic age. No production is reported.

1. EMPR AR 1897-609, 1899-746, 1901-1125, 1902-182, 1903-248, 1904-300, 1905-192.
2. GSC SUM RPT 1931A-78.
3. GSC MEM 296-149.
4. GSC MAP 1059A, 48-4A.

11. Rex, Three Tramps (082LSW025)

This property is on the east arm of Okanagan Lake at the north end about 7 km southwest of Vernon. The vein, which is 30 to 45 cm wide, occurs in a crushed zone in an igneous hornblende dyke which strikes E-W and dips N. The quartz vein contains chalcopyrite, pyrite and free gold.

1. EMPR AR 1897-609, 1899-746, 1901-1125, 1902-189, 1903-248, 1904-300, 1905-192.
2. GSC MAP 1059A.
3. GSC MEM 296-149.
4. GSC SUM RPT 1931A-78.

12. Vernon Limestone - LIMESTONE (082LSW097)

The deposit occurs beside the road, 2.5 km west of 32 Street. At this location, the limestone forms humps and bare patches on a grassy open sidehill over an area roughly 0.8 km in diameter. The stone is medium to dark grey medium grained limestone containing white quartz and calcite veinlets and lenses. The City of Vernon once burned lime from this location for use in the sewage-treatment plant, but stopped due to the poor quality of the stone. Analysis of a sample consisting of random chips collected from the top of the largest hummock shows: - Insol. - 5.14 per cent; R_2O_3 - 1.00 per cent (R is an unknown trivalent ion); Fe_2O_3 - 0.62 per cent; MnO - 0.07 per cent; MgO - 2.16 per cent; CaO - 49.92 per cent; P_2O_5 - 0.05 per cent; S - 0.01 per cent; Ig. Loss - 41.68 per cent; H_2O - 0.07 per cent.

A second body of limestone borders the road for 300 m about 1.6 km west of the old kiln and extends as a 0.4 km wide band curving up over the hill to the northwest for nearly 3 km. The rock consists of dark grey, medium to fine grained limestone with interbedded ribbons of chert and veins of white quartz.

1. EMPR AR 1961-147.
2. GSC MAP 1960 - 1059A.

3. BUREAU OF MINES CANADA, PUBL. NO. 811, 1944-204.

13. Rita, Reta - SILVER, COPPER AND GOLD (082LSW038)

This showing is located immediately south of the town of Vernon. Exploratory work consists of one open-cut of 15 m and another of 6 m. One sample of ore (1914) assayed: Copper - 1.4 per cent; silver - 73.3 oz./ton; gold - 0.1 oz./ton.

1. EMPR AR 1914-360.
2. GSC MEM 296-149.
3. GSC MAP 1059A.

14. Peerless Silver, Lead, Zinc (082LSW047)
Admiral Silver, Lead, Zinc (082LSW053)
Faith Silver, Lead, Zinc (082LSW054)
Lost Treasure Gold, Silver, Lead, Zinc (082LSW055)

These properties are all located in the same area about 4 km west of Vernon. A few tonnes of material have been mined from each property, the most production reported being from the Admiral claim.

Peerless	1. EMPR AR 1942-A26.
	2. EMPR INDEX 3-208.
Admiral	3. EMPR AR 1946-36.
	4. EMPR INDEX 3-187.
Faith	5. EMPR AR 1935-A24.
	6. EMPR INDEX 3-196.
Lost Treasure	7. EMPR AR 1935-A24.
	8. EMPR INDEX 3-203.

15. Falcon - GOLD, COPPER, LEAD AND ARSENIC (082LSW026)

This former claim is situated 3 km northwest of Vernon (Figure 4). It was discovered about 1899 on the south slope of the open rounded glacial hills which encompass the area. A shaft was sunk 20 m on a 5 to 50 cm wide quartz vein showing segregations of arsenical iron, chiefly near the collar of the shaft. The vein strikes north-south and dips 41 degrees westerly, with numerous fractures branching from it.

A sample taken in 1921 across the vein 5.5 m below the collar of the shaft gave a trace of gold and silver to the ton. Another sample of white quartz, slightly oxidized in the fractures gave 0.12 oz./ton gold and 0.08 oz./ton silver. The arsenical iron with little quartz present gave: gold - 0.82 oz./ton and silver - 0.70 oz./ton. This suggests that the values are in arsenides.

Samples taken in 1934 of the shaft-vein returned no value to trace values in gold and silver.

The extension of the vein can be traced for about 90 m to the north where it splits and disappears in tuffaceous rocks. About 60 m to the northwest, another quartz vein, 0.3 km wide, containing oxidized pyrite has been uncovered in a 1.2 m shaft. This vein may strike southeast and may intersect the shaft vein. The ore minerals consist of pyrite and arsenopyrite, with lesser amounts of galena and free gold. A sample (1932) from the shaft assayed gold: 0.24 oz./ton. A picked sample of pyrite assayed gold: 1.0 oz./ton.

Some stripping was also done on what appears to be a 0.6 m branch vein, 15 m higher and 45 m west of the shaft. In 1934, a sample across 40 cm of this vein assayed: gold - 0.04 oz./ton; silver - trace per ton. A few hundred metres farther west a similar vein was previously uncovered.

An open-cut and a couple of shafts on this claim have developed a quartz vein, about 0.3 m wide, striking a few degrees east of north and dipping 30 degrees west. This vein intersects argillaceous and tuffaceous sediments and is of interest partly because of the high gold values that have been obtained from selected samples and partly because of the considerable amount of disseminated arsenopyrite both in the vein and in the adjoining wall rock. Other minerals include chalcopyrite, pyrite, a little galena and free gold. Average values do not appear to have been sufficient to encourage further development of so small a vein.

1. EMPR AR 1899-747, 1902-304, 1921-191, 1932-143, 1934-D30.
2. GSC SUM RPT 1931A-82.
3. GSC MEM 296-144.
4. GSC MAP 1059, 48-4A.

16. Blue Jay - GOLD, ARSENIC, LEAD ANTIMONY (082LSW022)

This showing is situated about 2.5 km northwest of Vernon and immediately south of the reserve (Figure 6). The property was first reported in 1897 and lay dormant for many years. In February, 1974, Laura Industries and Resources Limited acquired an option to purchase the Blue Jay and ML claims from M.P. Stadnyk for a commitment to spend $10,000 on exploration by December 31, 1974 and other considerations.

The showing consists of a 120 cm wide vein of sugary, yellow-white quartz carrying pyrite, arsenopyrite, tetrahedrite and galena in volcanic breccia. An inclined shaft has been sunk on the vein to a depth of 13 m. About 30 m below and to the east, a 50 m crosscut adit has been driven with a drift from it to the northwest 10.7 m in length. In the shaft, the quartz vein, which strikes northwesterly and dips 56 degrees northeast, has definite walls with heavy gouge. In 1973, C.A.R. Lammle (P. Eng.), examined mapped and sampled the old prospect workings and

studied the surrounding country rock types. He reported that a 23 cm section on the north wall of the Blue Jay shaft "contains decidedly interesting gold-silver values but that the extent of this rich gouge appears to be extremely limited". He adds "visible indications are that the gouge is not continuous either along strike or down-dip.

Similar gouge, however, might well be found along the shear zone particularly where it is intersected by other structures, or where it is refracted as it passes through rock types of different competence, if they are present, or perhaps where there are normal rolls in the plane of the shear zone. In a structural environment such as this, one could expect appreciable gouge development. Accordingly, these would constitute exploration targets for deposits amenable to a small highgrading type operation".

1. EMPR AR 1897-609, 1998-1195, 1899-747, 1934-D34.
2. EMPR GEM 1974-89.
3. EMPR ASS RPT 4960.
4. GSC SUM RPT 1931A-75.
5. GSC MEM 296-142.
6. GSC MAP 1059, 48-4A.
7. GCNL NO. 36, 1974-1, No. 46. 1974-3.

17. I x 1 - GOLD (082LSW023)

This property is at an elevation of about 670 m and is situated about 275 m above and 2.5 km west of the south end of Swan Lake (Figure 4). A 6 m inclined shaft follows a 15 cm quartz vein striking north 75 degrees east and dipping 45 degrees northwest. A smaller quartz vein joins it on the hangingwall side. The veins intersect platy argillaceous sediments which strike nearly east and dip 50 degrees north. The veins are composed of brownish-stained vitereous quartz carrying a sparse dissemination of iron sulphides. Assay values are not known.

1. GSC SUM RPT 1931A-82.
2. GSC MEM 296-145.
3. GSC MAP 1059, 48-4A.

18. Jumbo - GOLD AND SILVER (082LSW024)

This former claim is located in a field a few hundred metres west of the Vernon-Kamloops road and about 3 km north of Vernon (Figure 6). On the property, a number of narrow quartz veins are exposed by the workings (1928) which include two shallow shafts, two short inclined adits and 75 m or more of surface trenching. The veins follow two principal directions; one group striking about east and dipping south at approximately 65 degrees, and the other trending north and standing nearly vertical. In one open-cut, a series of north-south quartz veins and stringers are

intersected by an east-west vein. Gold values have been found mainly in the latter. The veins intersect sedimentary members of the Upper Triassic Sicamous Formation represented by black platy argillite or slate and a more massive grey or greenish grey rock of tuffaceous appearance carrying numerous small fragments of argillite. The rocks have a general north-westerly strike but their structure is complicated by faulting. A body of the black slaty rocks immediately north of the workings apparently has been thrust southerly at a small angle over more massive tuffaceous beds in which the vein deposits occur.

The veins appear to distinctly favour the more massive rocks and either pinch out or are faulted off where they encounter the slaty types. They vary in width from a fraction of a cm to about 120 cm. Individually they show great irregularity and as exposed would not average more than 30 cm in width.

Though mineralization of an attractive nature has been found on this property the veins are small and discontinuous. Mineralization is erractic. A 5 cm seam in 1928 assayed: gold - 2.70 oz./ton; silver - 0.3 oz./ton. A sample taken across 50 cm assayed; gold - 0.03 oz./ton; silver - 1 oz./ton. A third sample across 60 cm gave a trace in gold and silver. The veins are, doubtless, of the same age as many other veins occurring in a belt that extends westerly to and across the northwest arm of Okanagan Lake in the vicinity of Newport (Deep) Creek.

1. EMPR AR 1897-608; 1928-220, 520; 1929-248; 1930-208; 1931-116; 1934-D34.
2. EMPR GEM 1974-89.
3. EMPR BULL 1-78.
4. EMPR ASS RPT 4960.
5. GSC SUM RPT 1931A-82.
6. GSC MEM 296-145.
7. GSC MAP 1059, 48-4A.
8. EMPR INDEX 3-201.

19. Royal Cartwright - GOLD, LEAD AND ZINC (082LSW030)

This property is located on the east shore of the north arm of Okanagan Lake, immediately south of the reserve boundary (Figure 6). The showing consists of a white, barren-looking, quartz vein several metres in width which is visible over a considerable strike distance. The vein occurs in the Sicamous Formation. There are no reported assays from the showing.

1. EMPR AR 1896-563, 1897-609, 1952-41.
2. EMPR GEM 1974-89.
3. EMPR ASS RPT 4960.
4. EMPR MINES INDEX 3-144, 211.

20. Goodenough, Hud, Hugal - COPPER (082LSW004)

The property is situated north of Naswhito (Siwash) Creek, on the west side of the north arm of Okanagan Lake (Figure 6). Most of the workings lie between 400 and 550 m above lake level. The property has had a long history, having been staked and restaked a number of times under different names and explored by various individuals and organizations. Interest has been maintained by the extent and variety of mineral deposition rather than by assay values. Exploratory work has been largely devoted to attempts to delineate the area of mineralization.
The mineralization has been produced at the contact of a body of grey granite with overlying sedimentary and volcanic rocks. It is a light grey, medium grained, massive granite in which the original dark constituents, chiefly biotite, have been completely altered to secondary minerals, principally chlorite. The pre-granitic rocks are greenstones, limestone and some argillaceous sediments. The limestone is highly altered at the granite contact, but elsewhere forms conspicuous outcrops of nearly pure grey limestone.

Workings include six or more shallow shafts, three or more adits, many open-cuts and several hundred metres of surface trenching. They are scattered over an area about 365 m long and 245 m wide in which occur many exposures of iron and copper stained rocks.

The principal metalliferous constituents are chalcopyrite, chalcocite, pyrrhotite, pyrite and magnetite in order of relative abundance. Of these the copper sulphide is the most important economically. It occurs, in part, as tiny veinlets intersecting the other minerals and in part as disseminations, irregular streaks, and small masses associated in varying proportions with the other minerals. Copper carbonate stains and soot-like decomposition products are common wherever chalcopyrite is present; minor galena is also present. The mineralization appears to be related to, and occurs mainly within, a zone along the contact of this granitic intrusive. The mineralization is principally confined to the overlying older rocks, although, in places, the granite is sparingly mineralized.

In spite of the amount of surface or near surface work and the great number of showings, the property is difficult to evaluate. Many samples taken at different times and by different persons indicate values in copper of rarely less than 1 per cent, more commonly ranging from 1 to 8 per cent, and, for selected material, much higher values. Assays also generally show values in gold and silver averaging about 0.03 oz.and 0.05 oz. per ton respectively.

In 1969, an I.P. survey was carried out on the property; chargeability and resistivity were plotted in profile form.

The results of the I.P. survey indicate that almost any portion on the grid which exhibits a chargeability in excess of 10.0 milliseconds could contain a disseminated sulphide deposit of 1.0 per cent by volume sulphide. It is possible, however, that at least part of the increased chargeability response is caused by magnetite, sericite, carbonaceous material or some other polarizable mineral inherent in the rocks.

1. EMPR AR 1900-896; 1902-189;1904-228; 1921-191; 1924-140; 1929-247C; 1930-208; 1962-66; 1964-104.
2. EMPR GEM 1969-299.
3. EMPR ASS RPT 2042, 6404, 6947.
4. EMPR PF.
5. EMPR EXPL IN B.C. 1977-E80, 1978-E95.
6. GSC SUM RPT 1931A-91.
7. GSC MEM 296-144.
8. GSC MAP 1059A.

21. I.O.U., Gem, Blueshale, Buckthorn - GOLD AND COPPER (082LSW018)

This property on Naswhito (Siwash) Creek on the west side of Okanagan Lake, 1.5 km from the reserve is a continuation of the Goodenough, Hud and Hugal claims and consequently the geology is similar. Gold and copper values have been obtained from a quartz vein 180 cm wide.

1. EMPR AR 1899-746.
2. EMPR ASS RPT 2042, 6404, 6947.
3. EMPR EXPL IN B.C. 1977-E80, 1978-E95.
4. GSC MEM 296-145.
5. GSC MAP 1059.

22. Naswhito Creek, Siwash Creek, (082LSW080)

This property is on the north shore of Naswhito (Siwash) Creek approximately 2 km west of the reserve. Very little is known concerning this property other than the fact that gold has been found.

1. GSC OPEN FILE 637.
2. EMPR AR 1904-228, 1915-252, 1916-263, 1924-140, 1926-200, 1929-247, 1930-208, 1931-116, 1934-D34, 1935-D15.
3. EMPR BULL 1-41 (1933), 28-62.

23. Skookum - SILVER, GOLD, COPPER AND LEAD (082LSW013)

This prospect is situated near the head of Newport Creek at an elevation of about 1175 m (Figure 6). The main workings consist of deep open-cuts from 3 to 7.5 m long in disintegrated rock. In one of the cuts, a 33 degree inclined shaft has been sunk 15 m and a 3 m drift and a crosscut from it, 6.5 m long, have been

driven. The quartz vein is highly fractured and varies in width in the workings from 0.6 to 2 m. The vein flattens and passes into the hangingwall 10.5 m down the shaft. The vein has been traced about 305 m along strike to the northeast. The ore minerals comprise pyrite, tetrahedrite, chalcopyrite, galena and free gold. A sample of well mineralized quartz from an old shaft-dump near the incline assayed (1933): gold - 0.10 oz./ton; silver - 12.0 oz./ton.

On the property, several additional parallel or nearly parallel veins have been discovered. These veins vary from 0.6 to 2 m in width, but are of unknown length. The veins strike a few degrees north of west, stand almost vertically and conform closely in attitude to the wall rocks, which in the vicinity of the main showings, are principally argillaceous sediments varying from black slaty types to more massive, chiefly grey, fragmental beds possibly of volcanic origin. These sediments are in contact, a little to the northwest of the showings, with a body of volcanic breccia which appears to rest unconformably on the sedimentary formations.

The high silver values are apparently associated with some form of copper, probably argentiferous grey copper or freibergite. Gold can be panned from each of the veins and some very spectacular specimens of gold bearing quartz have been obtained from them.

In 1951, twelve tons of crude ore shipped from the property were refined to give: gold - 8 oz.; silver - 430 oz.; copper - 40 lbs.; lead - 219 lbs.

1. GSC SUM RPT 1931A-86.
2. EMPR AR 1931-116, 1932-143, 1933-A196, 1934-D34, 1937-A35, 1941-60, 1951-43.
3. EMPR BULL 1-78.
4. GSC MEM 296-150.
5. GSC MAP 1059A, 48-4A.
6. EMPR INDEX 3-213.
7. EMPR GEM 1969-429.

24. May Octogon - SILVER, LEAD, ZINC AND COPPER

This property is located on a ridge northeast of Newport Creek, approximately 4 km west of the north end of Okanagan Lake and adjacent to the west boundary of the reserve (Figure 4).

The property is underlain by highly metamporphosed rocks of the Sicamous Formation. The rocks mainly consist of argillites and quartzites with some andesitic lava, tuff and limestone. Two major northwest-striking fault systems occur at the boundaries of the property. These faults have secondary fractures which host mineralized quartz veins. An irregular quartz vein 150 to 180 cm

wide contains galena, argentite, sphalerite and minor chalcopyrite. The vein strikes WNW and dips gently to the north.

Float material containing malachite, azurite and argentite has been found in a few places on th property. The float is of angular quartz-rich argillite. Chemical analyses of the float material gave the following results:

Silver	Lead	Zinc	Copper
185.1 oz./ton	0.87%	0.18%	2.01%
370.0 oz./ton	1.09%	0.51%	3.67%

The exact origin of the float is not known, however, it is reasonable to assume that it comes from outcrops northwest of where it was collected.

In 1970, geochemical and ground magnetometer surveys were carried out on the property. A geochemical survey was completed with soil samples taken from the B horizon and analysed for total copper content. Samples were taken at 30 m intervals on lines spaced 120 m apart. The results showed a few linear geochemical anomalies with readings of up to 300 ppm copper.

A magnetometer survey was run over the same grid lines using a Scintrex MF-1 vertical force fluxgate magnetometer. The results outlined a few northwest trending linear anomalies with readings of up to three to four times background value.

1. EMPR GEM 1970-407.
2. EMPR AR 1901-1230.
3. EMPR ASS RPT 2552.
4. GSC SUM RPT 1931A.
5. GSC MEM 296.
6. GSC MAP 1059A.

25. Little Duncan - SILVER, GOLD COPPER AND LEAD (082LSW079)

This claim is located 3.5 km west of the north end of Okanagan Lake. Though little is known about it, it appears the mineralization is in a quartz vein in Sicamous Formation argillites.

1. GSC OPEN FILE MAP 637.
2. EMPR AR 1899-746, 1901-1230.

26. Octagon - SILVER, COPPER, ANTIMONY, LEAD, ZINC AND GOLD (082LSW015)

The workings on this prospect are about 610 m above Okanagan Lake on the southwest slope of the valley of Irish Creek, approximately 1.5 km west of the extreme north end of Okanagan

lake (Figure 6). An open-cut and a short adit have opened up a quartz vein, 1.8 to 2.1 m wide, striking northeasterly and dipping at an angle of about 30 to 35 degrees. The vein is sparingly mineralized with argentiferous tetrahedrite, sphalerite and pyrite. Copper staining occurs at the surface and along fractures in the quartz. The vein intersects a massive grey dyke of feldspar-quartz porphyry.

1. EMPR AR 1923-3, 83, 161, 383, 1933-161.
2. EMPR ASS RPT 2552.
3. GSC SUM RPT 1931A-85.
4. GSC MEM 296-148.
5. GSC MAP 1059A, 48-4A.
6. EMPR INDEX 3-207.

27. May - GOLD, SILVER AND LEAD (082LSW011)

This property is 8 km southwest of Armstrong and 3.5 km west of Otter Lake. The gold, silver and lead mineralization are found in a quartz vein. No other information is known.

1. EMPR AR 1899-747.
2. GSC MEM 296-146.
3. GSC MAP 1059A.
4. EMPR GEM 1970-407.
5. EMPR ASS RPT 2552.

28. Black Hawk - GOLD, SILVER, COPPER LEAD AND ZINC (082LSW007)

The principal exposures on the property lie nearly 610 m above, and less than 1.5 km west of the Canadian National Railway, and about 1.5 km southeast of Moffat Creek (Figure 6). A strong highly oxidized shear zone containing quartz strikes north to northwest and intersects Jurassic/Triassic greenish volcanics and minor slaty sediments. The zone can be traced for several hundred metres. It is visibly mineralized with pyrite, chalcopyrite, sphalerite and galena and in places carries much calcite. Samples taken by the Resident Engineer (1919) at a number of points indicated gold values varying from 0.20 to 0.56 oz./ton and silver values from 0.20 to 1.5 oz./ton. Five samples taken along 30 m of the quartz vein in 1922 gave assays for gold from a trace to 0.42 oz./ton and for silver from a trace to 0.20 oz./ton.

In 1970, a geochemical soil survey was carried out on the property. A total of 349 soil samples were taken at 30 m intervals on a control grid and were analysed for zinc using an Atomic Absorption Spectrometer.

The contoured survey results indicate a strong northwesterly-trending zinc anomaly that varies from 60 to 120 m in width and can be traced for 1460 m. This anomalous zone is

related to the strong shear zone that contains the sulphide mineralizaton.

1. EMPR PF (RPT - G. GUTRATH 1976).
2. EMPR AR 1899-747, 1900-887, 1902-189, 1919-184, 1922-144, 1934-D34.
3. EMPR GEM 1969-239, 1973-100, 1976-E55, 1977-E81.
4. EMPR ASS RPT 2516, 4796, 6197, 6732.
5. GSC SUM RPT 1931A-80.
6. GSC MEM 296-141.
7. GSC MAP 1059, 48-4A.
8. EMPR EXPL 1979-104.
9. EMPR ASS RPT 5863, 7837.
10. EMPR ASS RPT 12237.

29. Moffat Creek - GOLD (082LSW076)

A placer deposit is located on Moffat Creek which is a small valley emptying into an area of several small lakes that eventually discharge northwesterly into Salmon River. Cairnes (1932) reported:

At Moffat Creek, on the other hand, encouraging values are reported to have been obtained from the entire deposit of unconsolidated bench materials accumulated near its mouth on either side of the Canadian National Railway. Considerable exploratory work including attempts at hydraulic operations was done on this property many years ago by Ross Mahon and others, and some coarse gold is reported to have been obtained. The chief practical difficulties relate to disposition of waste and to securing an adequate supply of water. At one time it was proposed, and negotiations were in fact put under way, to tap Pinaus Lake, in the valley of Equisis Creek, by a rock tunnel, to be driven from the Upper, southern slope of Salmon River Valley, and flume the water from thence to the diggings.
Generally, the placer deposits of the area have never produced important amounts of gold, but have been of local interest over a long period of time. Most activity has been concentrated near the north end of Okanagan Lake. Gold has been found in a number of streams particularly those draining the western slopes of the northern part of the Okanagan Valley. There are no reports of gold in streams draining the eastern side of the Okanagan Valley.

1. GSC SUM RPT 1931A.
2. GSC OPEN FILE RPT 637.
3. EMPR AR 1932-144.

30. Sweetbridge (Ein) - COPPER (082LSW006)

This property is located south of the Salmon River at Sweetbridge, approximately 3 km due west of the northern part of the reserve (Figure 6). In 1968, electromagnetic and magetometer

surveys were carried out on the property. The area covered by the geophysical surveys is underlain mainly by low-grade metamorphic rocks of the Sicamous Formation consisting of horblende-talc-schist, phyllite argillite and andesite. A few basaltic dykes also are present in the area.

The magnetometer survey was carried out using a Sharpe Magnetometer Model Es-180. Readings were taken at 30 m intervals on a cut grid and corrections were made for magnetic variation. The results of the survey show that the magnetic relief over the surveyed area is less than 700 gammas. This relief is restricted to small isolated "highs" and "lows" with no significant magnetic pattern.

The electromagnetic survey indicated two moderate to strong conductive zones; one (Zone A) having a strike length exceeding 240 m and a width of 120 to 150 m and the other (Zone B) with a length exceeding 365 m and a width of 90 to 180 m. A third area, (Zone C) is of smaller dimensions but indicated good conductivity.

1. EMPR GEM 1969-239.
2. EMPR ASS RPT 1572.
3. GSC MEM 296.
4. GSC MAP 1059A.

31. Ivan, Mount Rose - SILICA (082LSW066)

This property is situated 6.5 km due west of Armstrong, at 800 m asl, on the south side near the centre of Mount Rose (Figure 6).

The deposit consists of a quartz vein in a quartz-diorite intrusion into Sicamous Formation phyllite. It forms a 12 m high knob that projects through the surficial overburden. The vein strikes north 70 degrees east and dips 55 degrees northwest and is exposed for 76 m along strike and for 30 m in average plan width. To the northeast, the vein terminates at a fault. To the southwest, it plunges under overburden.

The quartz is massive and milky white and contains a few small scattered pockets of galena, chalcopyrite, pyrite, pyrrhotite and limonite. These minerals occur chiefly along the hangingwall, near the fault, at the northeast end of the exposure. Fractures are numerous in the quartz and many fracture faces, especially near the fault, are iron stained.

Quartz has been mined from a 1.5 to 4.5 m high face across the southwest end of the quartz outcrop. After crushing and screening the end product was sold as chips for stucco dash, exposed aggregate, and similar uses.

A sample consisting of equal sized chips picked at random from loose muck in the quarry area has the following per cent chemical composition:
SiO_2, 99.56; total Fe, 0.076; Al_2O_3, 0.27; CaO, 0.056.

1. EMPR MONTHLY RPT. SMITH D. SEPT. 1975.
2. EMPR AR 1968-331.
3. EMPR GEM 1969-406, 1973-564.
4. EMPR OF 1987-15.

32. Ebring - CLAY (082LSW083)

This deposit is 2 km southeast of Vernon. It is a light grey very calcareous clay which fires to a dark salmon or brownish-red colour suitable for common brick and tile.

1. GSC SUM RPT 1931A-99.
2. GSC OPEN FILE MAP 637.

33. Lakeside - CLAY (082LSW089)

In 1920, Lakeside Clay Products Company Limited was formed to work a clay deposit near Okanagan Landing (Figure 6). During the summer, a plant was installed for production of brick and some kilns fired. It was the intention of the company to manufacture drain and hollow tile as soon as developments warranted. Some good tile was made from samples of the clay, but so far no production is recorded.

1. EMPR AR 1920-169.
2. GSC SUM RPT 1931A-99.
3. GSC MEM 296-158.
4. GSC OPEN FILE 637.

34. SAND AND GRAVEL

Gravel and sand suitable for road material and possible use as concrete aggregate are readily available in moderate quantities in most parts of the area. They are mostly of fluvioglacial origin and generally occur in benches above the level of the present streams and lakes.

Approximately 1.5 km west of the reserve, on Naswhito Creek, a gravel pit is located in terrace deposits of Cenozoic age. Similar terraces are also present on the reserve adjacent to this location (Figure 2).

Other gravel pits are reported between Deep Creek and the east boundary of the reserve area near Glenemma. All of these pits occur in terrace deposits.

A gravel pit in pre-Fraser surficial fan deposits is located along the Kelowna-Vernon Highway, approximately 4 km southwest of Vernon.

1. GSC TOPOGRAPHIC MAP 82L/3 1978, 82L/6 1978.

35. Milligan, Sally Brown - GOLD (082LSW040)

This property is located on shore of Kalamalka Lake, 6 km south of Vernon. The exposure on the lake is 60 m wide and 150 m high. Free gold is found in a limestone and quartz conglomerate mixture. A second exposure 45 m high and 150m long is located in a ravine 1067 m from the lakeshore. The overburden is 6 m thick at this site.

1. EMPR AR 1902-188.
2. GSC MEM 296-147.
3. GSC MAP 1059A.

36. Sweetsbridge - GYPSUM (082LSW074)

This showing is located 300 m north of the Sweetsbridge Station on Highway 97 south of Vernon. The white grey and brown gypsum can be seen in a 12 m wide band which runs for 280 m along the hillside.

1. EMPR INDUST MIN. FILE.

37. Bachelor - GOLD, COPPER (082LSW037)

The claim is located 1 km east of Okanagan Landing. Pyrite and chalcopyrite with some free gold were reported in a 1 to 2.4 m quartz vein intruded into granite.

1. EMPR AR 1896-579, 1899-747.
2. GSC SUM RPT 1931A-75, 84.
3. GSC MEM 296-141.
4. GSC MAP 1059, 48-4A.

38. Equesis Creek - GOLD (082LSW081)

This placer gold occurrence is located on Equesis Creek approximately 6 km west of the north arm of Okanagan Lake. The occurrence is within 1 km of the Okanagan No. 1 Reserve.

1. EMPR AR 1904-228.
2. GSC MAP 637.

39. Grand Times (L1173) - GOLD, SILVER, LEAD, COPPER, ZINC (082LSW012)

The Grand Times occurrence is situated on Banks Creek approximately 11 km west of the centre of the Okanagan Reserve No. 1 reserve.

Mineralization on the northwest portion of the property is associated with quartz veins, within a west-northwest trending shear zone hosted by feldspar porphyry tuff. The quartz veins pinch and swell ranging up to 4.5 metres in width. Mineralization includes minor limonite, chalcopyrite, sphalerite, galena, pyrite and visisble gold. Development on the property consists of 2 short adits.

1. EMPR ASS RPT 2552, 10031, 14305, 12313, 15535.
2. EMPR AR 1896-1129, 1899-747, 1905-192.
3. GSC MEM 296-144.
4. GSC MAP 1059, 48-4A.
5. GSC OF 1505A, 1565, 637, 1989-5.

40. Vernon - CLAY (082LSW072)

Light grey calcareous clay is located 3 km southeast of Okanagan Landing.

1. EMPR BULL 30-51.

41. Mission Hill - SILVER, GOLD, COPPER, LEAD (082LSW039)

The Mission Hill occurrence is located 4.5 km southeast of Okanagan Landing.

Mineralization on the property is within a series of quartz veins ranging from a few centimetres to 1.8 metres wide, hosted by diabase and granite. Mineralization is characterized by disseminated pyrite, chalcopyrite, and galena. Carbonate alteration is also reported. A grab sample taken in 1928, returned values of 0.68 grams per tonne gold and 175 grams per tonne silver.

Development on the property consists of one adit driven to a depth of 24.4 metres.

1. EMPR AR 1900-989, 1928-221.
2. GSC SUM RPT 1931A-84.
3. GSC MEM 296-147.
4. GSC MAP 1059A, 48-4A.
5. GSC OF 637, 1505A, 1565, 1989-5.

REGIONAL GEOCHEMICAL SURVEY:

Several samples were collected from the reserve proper (Figure 4) but most of these reflect off-reserve provenance. Several of these samples, notably #3038, #3034 and #3032 are anomalous in gold at 28, 33 and 23 ppb respectively. Antimony and Arsenic in these samples is also correspondingly high. Sample #3034 has 59 ppm Cu and sample #3038 has 14 ppm Pb and 180 ppm Zn to create. The sample (#3037) upstream from #3034 returned 10 ppm to create a multi-element base and precious metal anomaly. The values are consistent with the base and precious metal mineralization described previously on the reserve and above the reserve on the slopes to the west.

1. Matysek, P.F., Jackaman, W., Gravel, J.L., Sibbick, S.J., Feulgen, S., 1990; British Columbia Regional Geochemical Survey, Vernon (NTS 82L). Stream Sediment and Water Geochemical Data and Maps, MEMPR BC RGS 32. GSC Open File 2357.

PROPERTY EXPLORATION ACTIVITY

1. Equesis Creek Claims

The Equesis Creek Claims consist of the Peak I-IV, Tiki I & II and Irish 1 & 2 claims located west of the north end of the reserve operated by QPX Minerals. This company did extensive soil geochemistry, geophysics, trenching in 1987 and 1988. The work outlined a number of soil geochemical anomalies associated with carbonate-altered ultramafics and quartz veins. The veins tend to be barren although one 1 metre sample returned 1,550 ppb gold and a grab sample from another vein returned 1,470 ppb gold. The area is underlain by Cache Creek Formation and the target is mesothermal quartz veins.

1. BCMEMPR ASS RPT 17176, 18717.

2. Skookum Property

The Skookum property consists of the Brit 1-32, Jep 2, Tick, Toct and Ona claims at the headwaters of Newport Creek west of the reserve. Property owners Conova Resources and Epiditor Resources did diamond and reverse circulation drilling on the Skookum showing to follow up geology, geochemistry, geophysics and trenching in 1988. Diamond drilling entailed 240 m in 3 holes and the rotary drilling involved 516 m in 6 holes. Although abundant veining up to 3 m wide was found the highest silver value was 105 ppm and the highest gold value was 363 ppb. This contrasted to surface sampling from the vein which returned 320 opt silver and 0.117 opt gold.

1. BCEMPR ASS RPT 17664, 18860.

3. Vera Property

The Vera Property consists of the Golden Zone 1-3, Gloria 1 and Vera 1-6 claims, the latter of which seem to have been replaced with the Golden Zone #1. This property is also owned by Conova Resources. The property hosts the Vera Showing which is a polymetallic quartz vein. Trenching on the vein in 1988 revealed galena and tetrahedrite in the main vein but better mineralization consisting of malachite, azurite, tetrahedrite and galena was found in stringer zones at the contacts of the vein. The best assay returned 148 opt silver and 0.146 opt gold.

1. BCMEMPR ASS RPT 1766, 17928.

4. YH Group

The YH Group consists of the YH1-13 on Newport Creek immediately west of the reserve. Exploration on the properties outlined a number of VLF-EM conductors and multi-element geochemical anomalies.

1. BCMEMPR ASS RPT 20448.

5. Au Property

The Au 400 and 500 claims located adjacent to the north edge of the reserve constitute the remains of the Au property. Work on the property in 1986 outlined a number of multi element geochemical anomalies and several VLF-EM conductors.

1. BCMEMPR ASS RPT 15093.

6. Goodenough Property

The Goodenough Property consists of the Goodenough claim located on Naswhito Creek just west of the reserve. Most recent work here consisted of a diamond drill hole by Brican Resources in 1988 to test a preexisting skarn zone. The hole returned 6.71 m grading 188 ppb Au and 5879 ppm Cu with a 1.2 m section grading 660 ppb Au and 8566 ppm Cu. The skarn occurs in an andesite tuff with quartz-carbonate fracture filling abundant magnetite and some pyrite and chalcopyrite.

1. BCMEMPR ASS RPT 18179.

7. Nash Property

The Nash Property consists of the various Nash claims and Save on, Bingo claims, etc., located along Naswhito Creek just west of the south end of the reserve. Work on this property by Prosperity Gold Corp. in 1990 consisted of mapping geochemical sampling and geophysics over a 3.0 km by 0.75 m area of felsic

fragmentals. Silver and gold geochemical anomalies and several VLF-EM conductors were outlined. Target on the property is epithermal veins in Tertiary volcanics. No further work appears to have been done to follow up the results possibly because of the difficulty of raising exploration funds.

1. BCMEMPR ASS RPT 15093.

MINERAL RESOURCES AND ECONOMIC POSSIBILITIES:

The economic minerals potential of the reserve is considered to be good. Seven base and/or precious metal showings have been reported on the reserve and numerous other metalliferous prospects are known in proximity to the reserve boundary. To date, all of the occurrences have been high-grade, low tonnage, vein type deposits related to structural dislocations within the Sicamous Formation. In view of the amount of information available on the various mineral showings in the general area, it is possible that additional mineralization may occur on the reserve. More exploration in order to delineate additional deposits as well as determining extensions to the present base and precious metal deposits on the reserve is definitely warranted. Economic possibilities also appear to be good for limestone, silica, gypsum, fluorite, placer gold, sand, gravel and clay. Sand and gravel in particular offer an important and easily accessible potential for economic development on the reserve.

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BCEMPR MIN FILE, 1988, 082LSW001 to 082LSW110

Aeromagnetic Maps:

BCEMPR - Geol. Surv., Canada, Map 8512G, Oyama British Columbia,
82L/3, 1973 ..... 1:63,360
BCEMPR - Geol. Surv., Canada, Map 8513G, Vernon, British Columbia,
82L/6, 1973 ..... 1:63,360

Mineral Claim Map:

BCEMPR - M82L/6W, 1992 ..... 1:50,000
BCEMPR - M82L/3W, 1992 ..... 1:50,000

Revised Mineral Inventory Map:

BCEMPR - Vernon, British Columbia,
82L/SW, (M1), 1983 ..... 1:126,720

Topographic Map(s):

Vernon, British Columbia,
82L, Edition 1, 1966 ..... 1:250,000

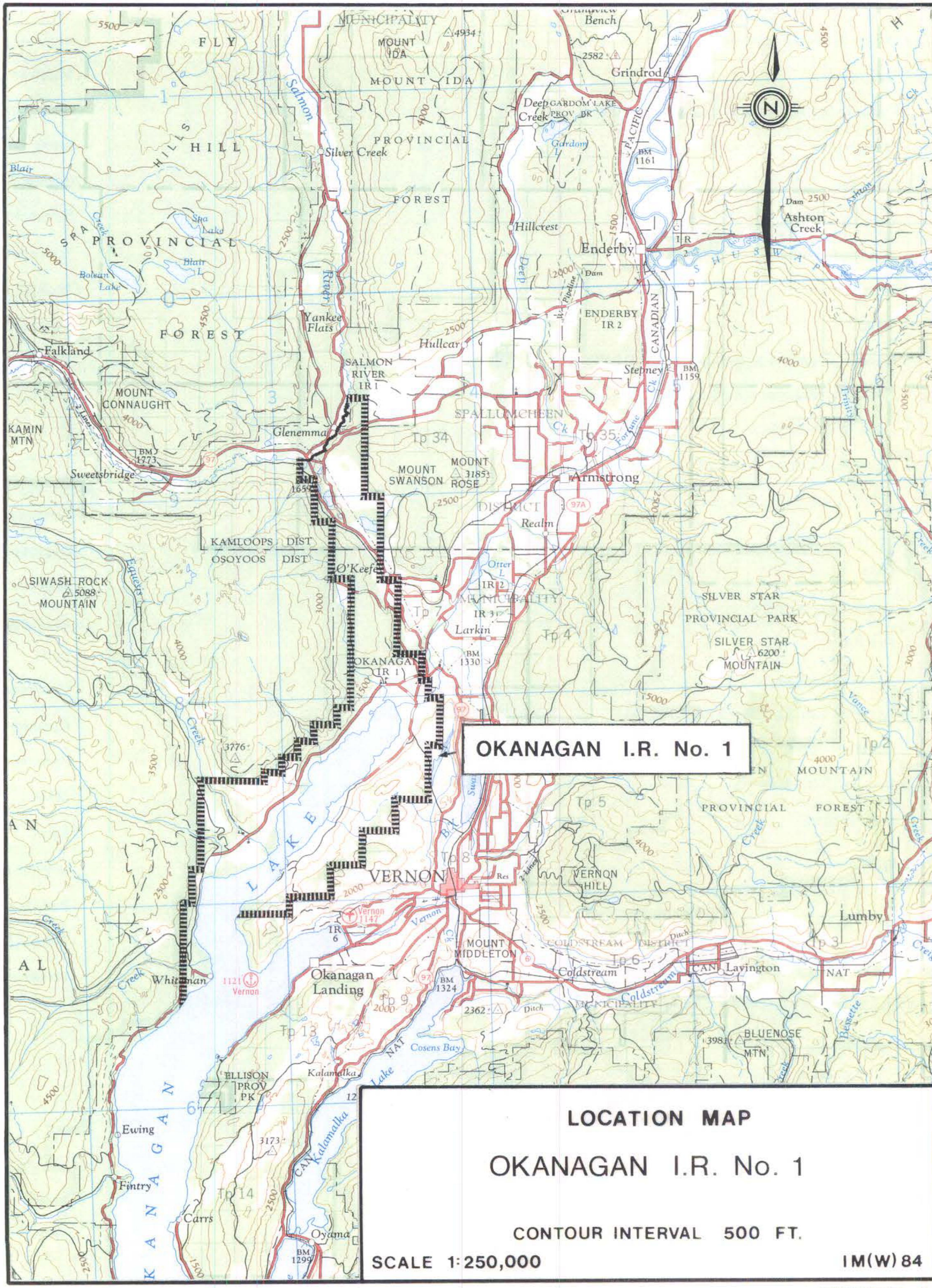

OKANAGAN I.R. No. 1
LOCATION MAP
OKANAGAN I.R. No. 1
CONTOUR INTERVAL 500 FT.
SCALE 1: 250,000
IM(W) 84
VERNON
Enderby
Armstrong
Grindrod
Lumby
Lavington
Coldstream
Okanagan Landing
Falkland
Glenemma
Sweetsbridge
O'Keefe
Larkin
Hullcar
Silver Creek
Yankee Flats
Hillcrest
Stepney
Realm
Ashton Creek
Whitman
Ewing
Fintry
Carrs
Oyama
KAMLOOPS DIST
OSOYOOS DIST
SILVER STAR PROVINCIAL PARK
SILVER STAR MOUNTAIN
MOUNT SWANSON
MOUNT ROSE
MOUNT MIDDLETON
BLUENOSE MTN
SIWASH ROCK MOUNTAIN
MOUNT CONNAUGHT
SALMON RIVER IR 1
ENDERBY IR 2
ELLISON PROV PK
OKANAGAN LAKE
Kalamalka Lake

FIGURE 1.

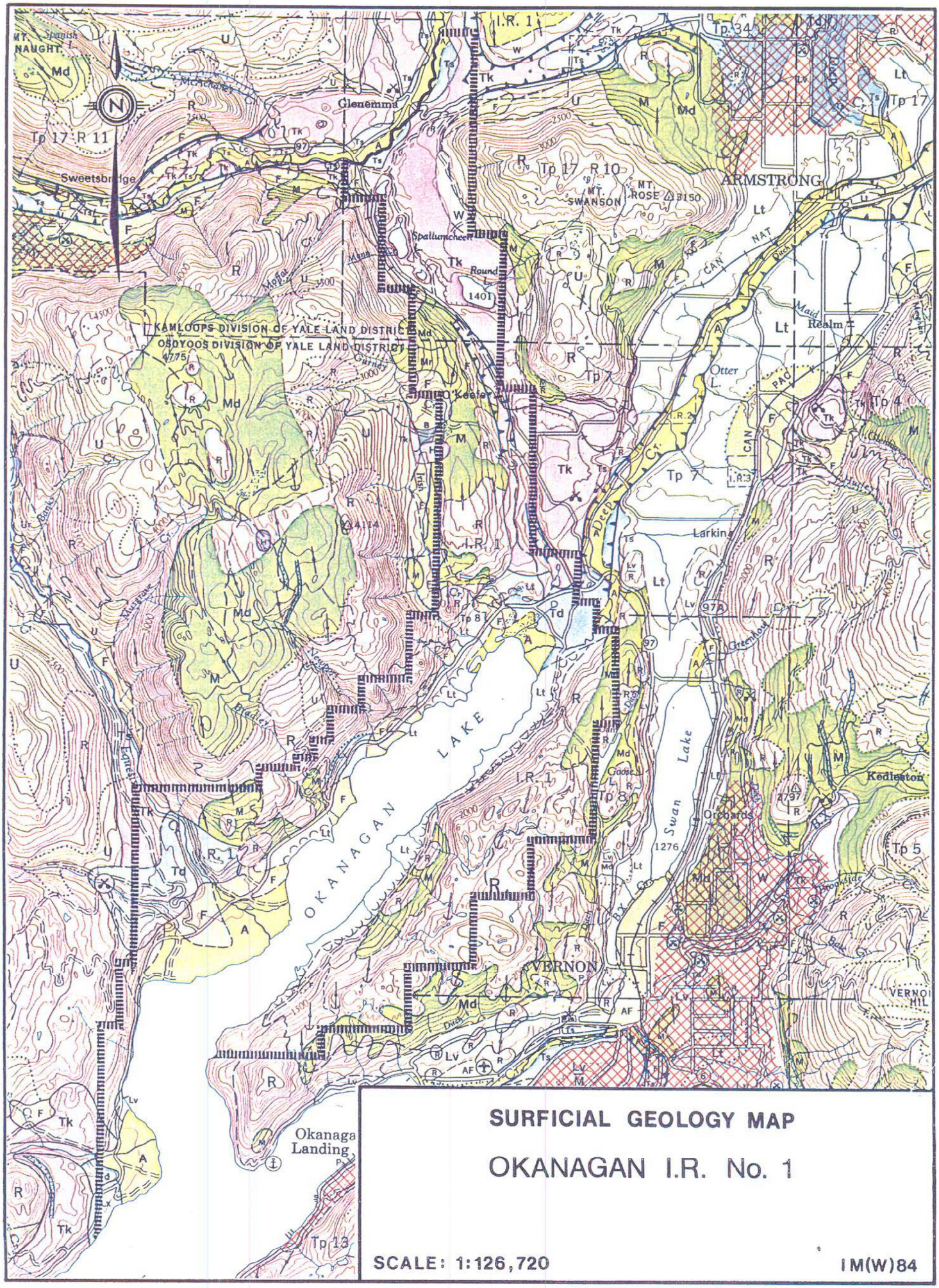

SURFICIAL GEOLOGY MAP
OKANAGAN I.R. No. 1
SCALE: 1:126,720
IM(W)84
KAMLOOPS DIVISION OF YALE LAND DISTRICT
OSOYOOS DIVISION OF YALE LAND DISTRICT
OKANAGAN LAKE
Swan Lake
ARMSTRONG
VERNON
Kedleston
Larkin
Okanaga Landing
Sweetsbridge
Glenemma
Spallumcheen
Round L.
Otter L.
Realm
Orchards
Tp 17 R 11
Tp 17 R 10
Tp 34
Tp 17
Tp 4
Tp 5
Tp 7
Tp 8
Tp 13
I.R. 1
I.R. 2
I.R. 3
MT. SPANISH NAUGHT
MT. SWANSON
MT. ROSE △3150
CAN NAT
PAC

FIGURE 2.

LEGEND

CENOZOIC

QUATERNARY

POST-FRASER GLACIATION
NON-GLACIAL

A — MODERN ALLUVIUM: *sand, gravel, silt, and minor muck and peat; at/or near present base-level (floodplain, channel, delta, and shoreline deposits)*

F — *FAN DEPOSITS: poorly sorted gravel, sand, silt, and clay*

B — *BOG DEPOSITS: muck, mucky peat, marl, and peat*

FRASER GLACIATION
KAMLOOPS DRIFT

LACUSTRINE ENVIRONMENT

Lt Lv — *LACUSTRINE DEPOSITS: silt with minor clay and sand;* Lt, *deposits thick enough to mask underlying topography (generally more than 10 feet thick);* Lv, *thin veneer not masking underlying topography (generally less than 10 feet thick)*

Lx — *LACUSTRINE COMPLEX: silt, sand, and gravel; complex of deep water and shoreline deposits and features*

FLUVIAL ENVIRONMENT

T — *TERRACE DEPOSITS: gravel, sandy gravel, and sand;* Ts, *stream terrace;* Td, *delta terrace*

Tk — *KETTLE TERRACE DEPOSITS; gravel sandy gravel, and sand; terrace form broken by kettle holes; includes kettled stream terrace; kame terrace; and kettled delta terrace*

W — *RILL COMPLEX: lag gravels, channel-bottom gravels, areas of unmodified till, small areas of hummocky gravel, and local pockets of backwater silt (in general morainal deposits washed and channelled by meltwater)*

H — *HUMMOCKY GRAVELS; poorly sorted gravel and sand characterized by irregular hummocks and kettles; includes kames and eskers*

GLACIAL ENVIRONMENT

M — *MORAINAL DEPOSITS: till with minor sand, gravel, and silt;* M, *undifferentiated;* Mr, *ridged (characterized by sharp ridges and kettles);* Md, *drumlinoid (characterized by streamlined forms)*

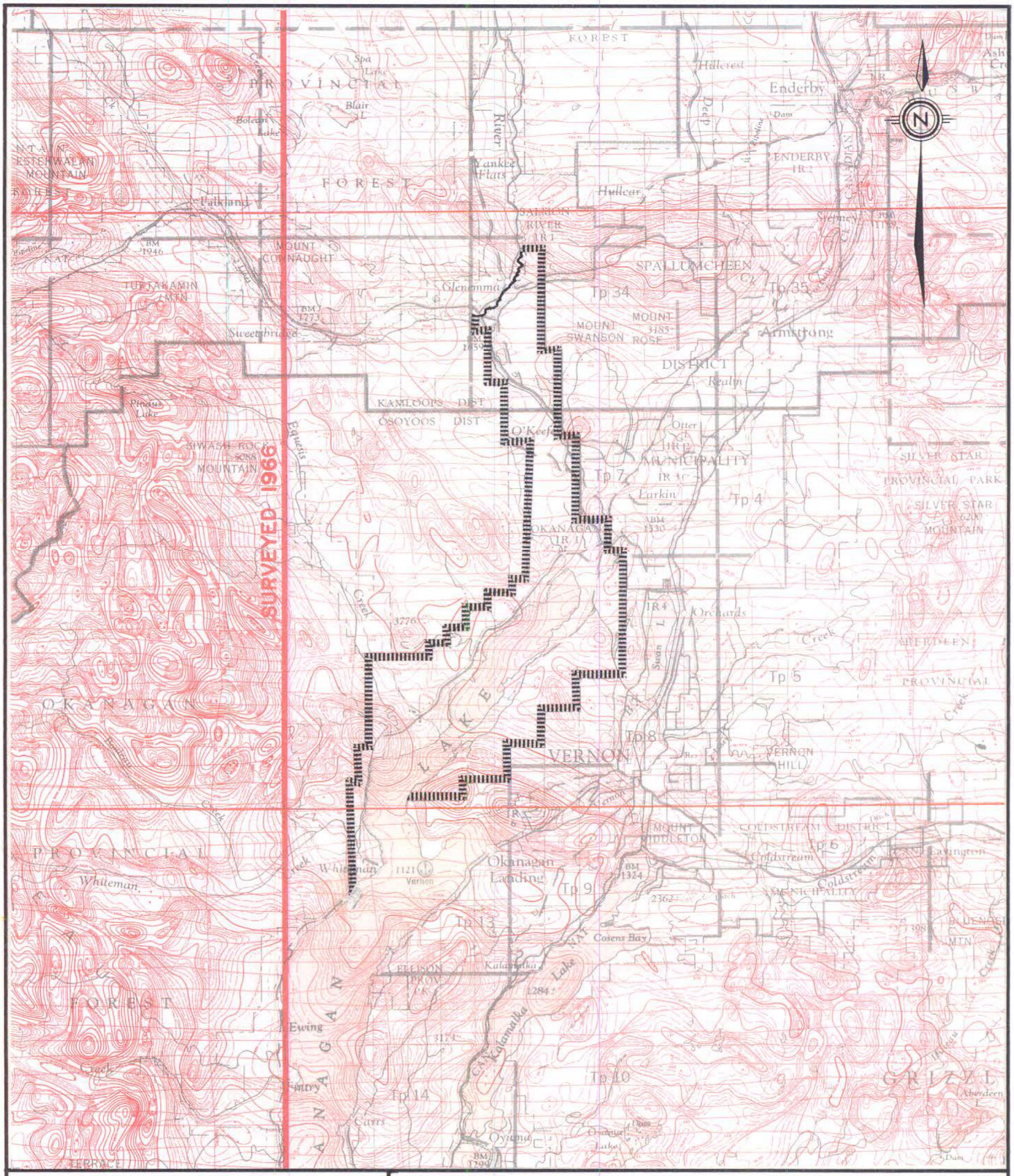
PRE-FRASER GLACIATION
GLACIAL AND NON-GLACIAL

"OLDER" UNCONSOLIDATED SEDIMENTS: sand, silt, gravel, and till deposited prior to the last ice advance (generally overlain by Fraser and younger deposits); shown only where deposits contribute to the present geomorphology

U — *UNDIVIDED DEPOSITS: (forested areas mapped largely by airphoto interpretation);* U, *mainly undifferentiated morainal deposits but may contain small areas of younger deposits;* Ur, *mainly glacial, fluvial, and lacustrine environment deposits with ridged or kettled topographic expression*

Rock outcrop and areas of near-surface rock ..... R

After Fulton (1975)



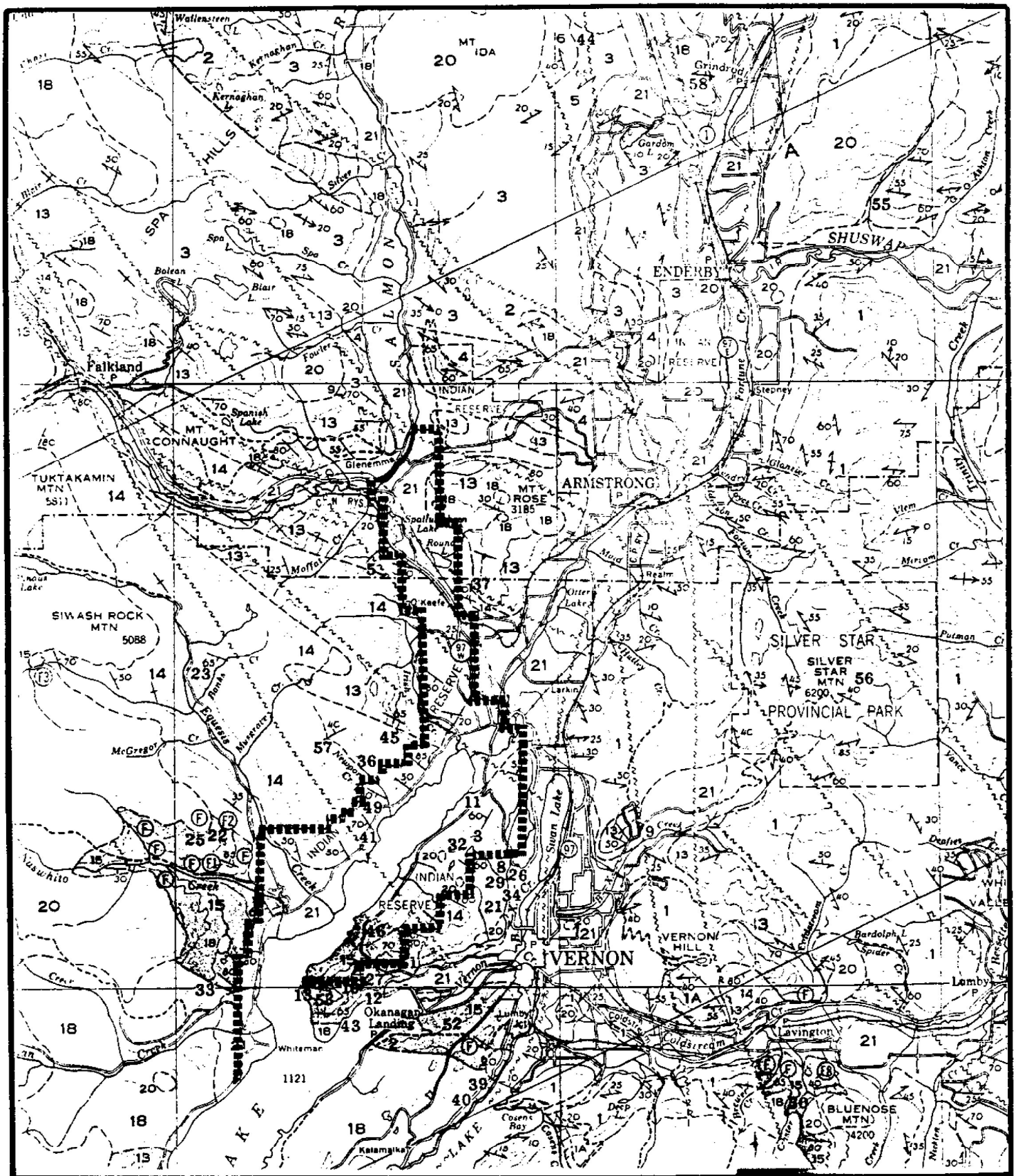
AEROMAGNETIC MAP

OKANAGAN I.R. No. 1

SCALE 1:250,000

IM(W)84

FIGURE 3.



BEDROCK GEOLOGY MAP

OKANAGAN I.R. No. 1

SCALE 1:253,440

1992

FIGURE 5A

BEDROCK GEOLOGY LEGEND
GSC MAP 1059A

CENOZOIC

QUATERNARY
PLEISTOCENE AND RECENT

21 — *Glacial, lacustrine and fluvatile gravel, sand, silt, and clay*

TERTIARY
OLIGOCENE OR MIOCENE
KAMLOOPS GROUP

20 — *Basaltic lava and flow breccia; minor rhyolitic lava and breccia, local sandstone, shale, conglomerate, coal*

MESOZOIC

CRETACEOUS OR TERTIARY

19 — *Pink to red syenite and quartz syenite, pink and white mottled granite*

JURASSIC AND/OR CRETACEOUS
COAST INTRUSIONS

18 — *Granite, granodiorite and allied rocks*

TRIASSIC
UPPER TRIASSIC
NICOLA GROUP

17 — *Andesite, minor basalt; some limestone and conglomerate*

(?) LOWER AND/OR UPPER TRIASSIC
SLOCAN GROUP

16 — *Slate, quartzite, limestone, phyllite, mica schist; may be in part equivalent to (?)*

PALÆOZOIC

CARBONIFEROUS (?) AND PERMIAN
CACHE CREEK GROUP (13-15)

15 — *DIVISION C: mainly limestone; minor argillite, quartzite, and andesite lava, breccia, and tuff*

14 — *DIVISION B: mainly andesite lava and tuff; minor argillite, quartzite and limestone*

13 — *DIVISION A: mainly argillite*

PROTEROZOIC AND/OR PALÆOZOIC

WINDERMERE (?) OR EARLY PALÆOZOIC
LARDEAU SERIES

12 — *Argillite, phyllite, schist, quartzite, limestone, conglomerate*

WINDERMERE (?) OR CAMBRIAN

11 — *BADSHOT FORMATION: limestone and marble, minor argillite*

WINDERMERE OR (?) CAMBRIAN
HAMILL SERIES

10 — *Quartzite, staurolite schist, argillite, phyllite; minor limestone*

WINDERMERE OR EARLIER

9 — *OLD DAVE INTRUSIONS: serpentinized, ultramafic dykes*

SHUSWAP TERRANE

ARCHÆAN OR LATER

MOUNT IDA GROUP (1-7)

7 / 7A — *EAGLE BAY FORMATION: chlorite and sericite schist, slate, limestone, quartzite, minor conglomerate*
7A. *Predominantly limestone*

6 — *SICAMOUS FORMATION: flaggy limestone, sericite schist, graphite schist*

5 — *MARA FORMATION: argillite slate, sericite and chlorite schist, limestone*

4 — *TSALKOM FORMATION: green andesite and agglomerate, chlorite schist, slate*

3 — *SILVER CREEK FORMATION: slate, sericite schist, garnetiferous quartz-mica schist*

2 — *CHASE FORMATION: quartzite, calcareous quartzite, garnetiferous quartz-mica schist*

8 — CHAPPERON GROUP
Argillite, chlorite schist, mica schist, quartzite, limestone. May be equivalent to Mount Ida group, in part

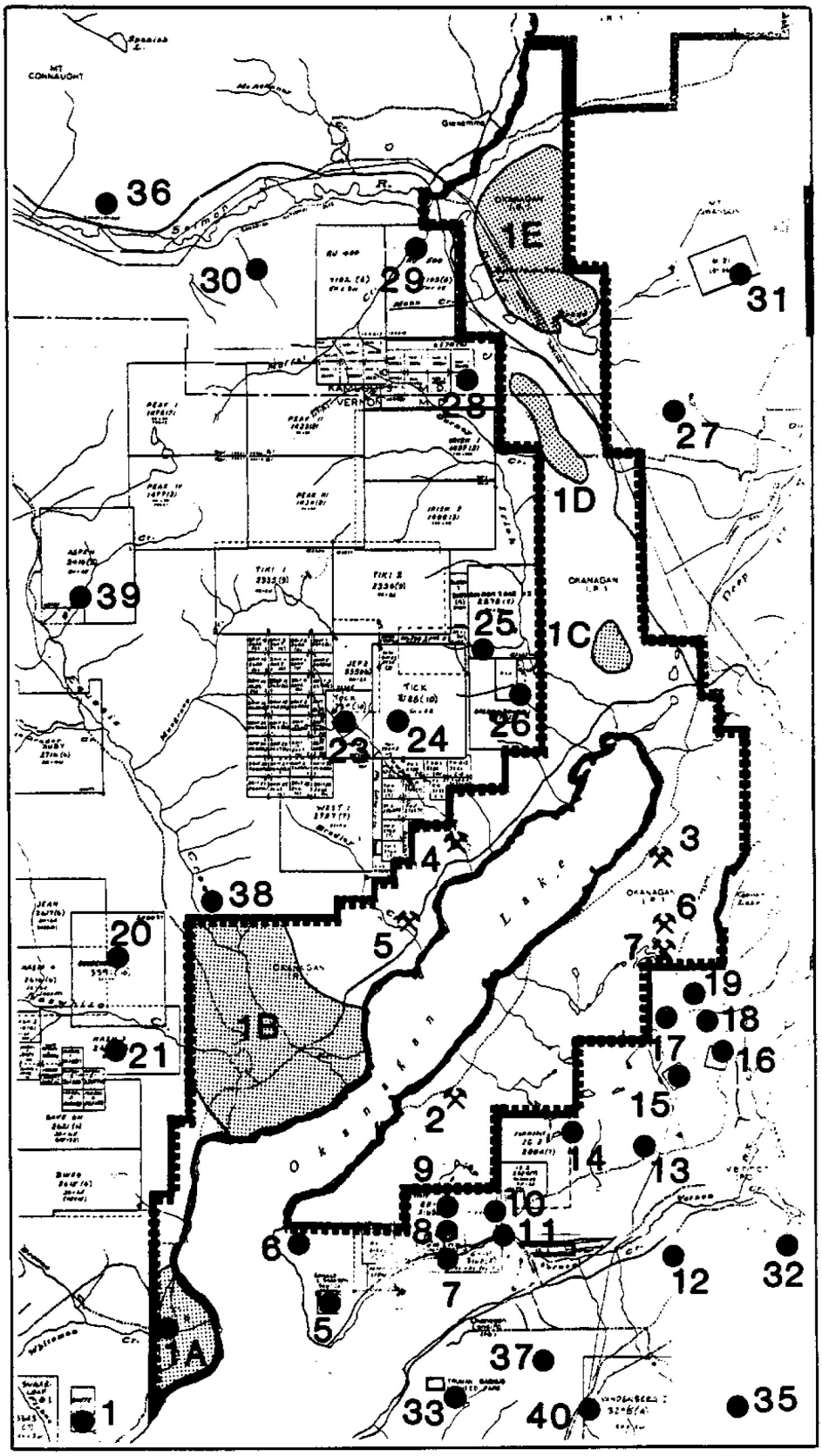
MONASHEE GROUP

1 / 1A, C — 1. *Granitoid gneiss, augen gneiss, mica-sillimanite-garnet schist, quartzite, marble, hornblende gneiss, slate, phyllite*
1A. *Limestone*
1B. *Quartzite*
1C. *Hornblende gneiss*

Bedding (inclined, vertical, horizontal)
Foliation (inclined, vertical, horizontal)
Lineation (plunging and horizontal)

BEDDING AND FOLIATION WITH LINEATION

	Bedding	Foliation
Inclined (with plunging lineation)		
Inclined (with two plunging lineations)		



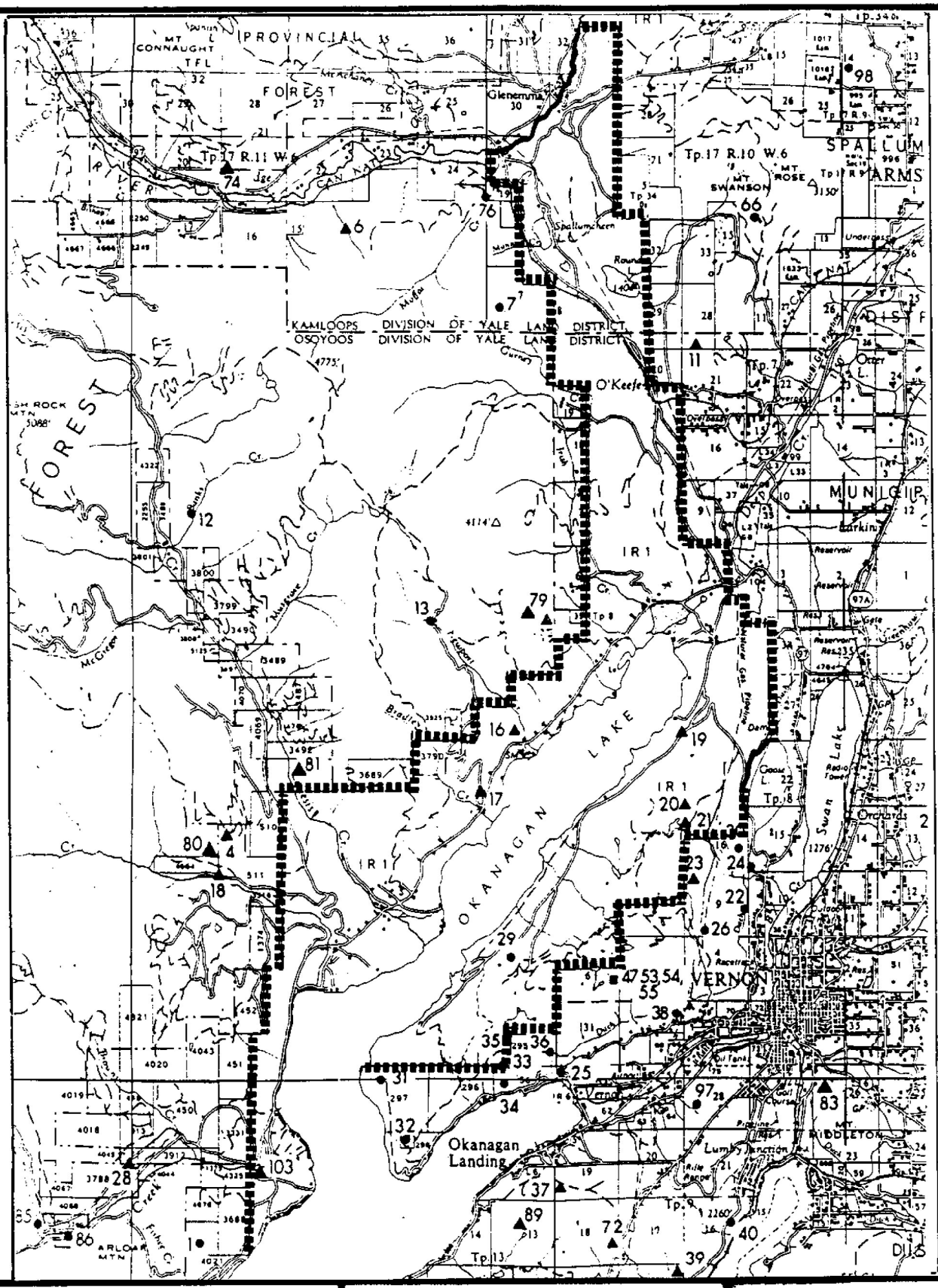
MINERAL OCCURRENCES AND CLAIMS MAP

OKANAGAN I.R. No. 1

SCALE 1:150,000

1992

FIGURE 6.



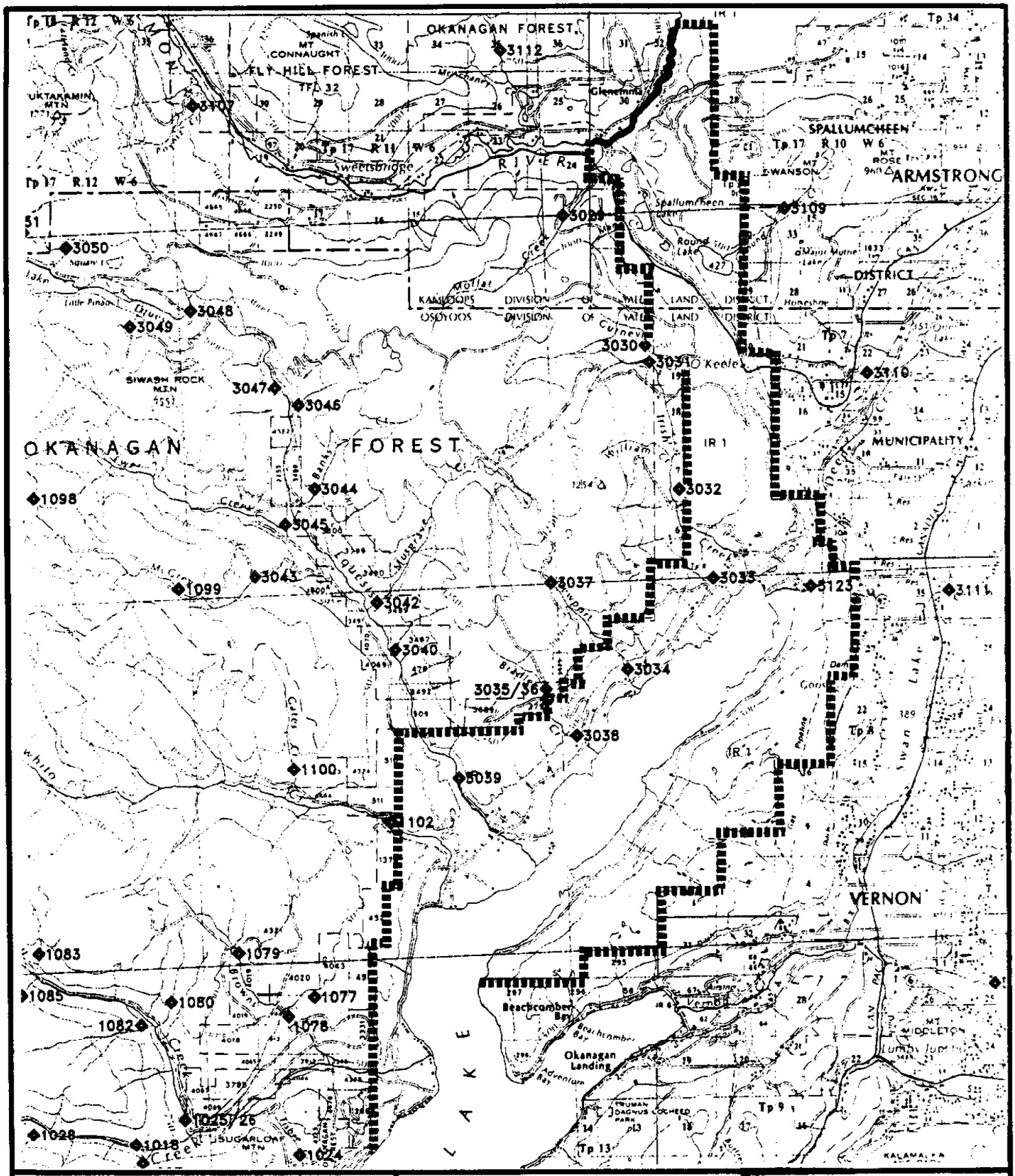
MINFILE OCCURRENCE LOCATION

OKANAGAN I.R. No. 1

SCALE 1:150,000

1992

FIGURE 6A



LEGEND

◆ Silt sample site and sample number

REGIONAL GEOCHEMICAL SURVEY

OKANAGAN I.R. No. 1

SCALE 1:150,000

1992

FIGURE 4.

APPENDIX C

Development Node Profiles

Upper Goose Lake

Site Overview

This development node is located west of Goose Lake on the eastern boundary of the planning area. This site has long been identified as a potential location for residential Band housing. As most on-reserve band housing opportunities are located on the west side of Okanagan Lake, community members have indicated that the close proximity of the Goose Lake site to the City of Vernon makes this a desirable location for future development.

Given the hilly nature of the development node, suitable building sites are scattered throughout the area.

Land Use

Existing Land Use

The development node is currently used as rangeland, with no existing buildings found on the site. OKIB community members currently use the site for various cultural and spiritual uses, such as hiking, mountain biking, and hunting and gathering.

During community engagement activities, one Elder indicated that his parents had constructed a house in the vicinity of Goose Lake in the early 1950's, but later abandoned the site.

Proposed Land Use

Community members have indicated a desire for Band housing to be located on this site.

Environmental Conditions

The areas of the site directly adjacent to Goose Lake were identified for protection in the Phase 1 Land Use Plan.

A search of known Species at Risk occurrence data as downloaded from the Provincial Government indicates that the American Badger has been known to occur throughout the development node. A Painted Turtle was also observed in Goose Lake in 2010. Both of these species are listed on Schedule 1 of the Species at Risk Act.

Archaeology and Cultural Considerations

While there are no known archaeological sites within the development node, Goose Lake, known locally as ‘The Place of the Turtles”, is a place of cultural importance to OKIB members.

Infrastructure Servicing

Water: The site is not currently serviced with water infrastructure. Greater Vernon Water (GVW) currently services the Blue Jay Subdivision located approximately 1 km to the south . If development is to occur within this area, the extension of this GVW infrastructure should be explored.

Sanitary: The site is not currently serviced with sanitary sewer infrastructure. Any future development within the Goose Lake/Blue Jay Subdivision development node would likely have to be serviced through on-site septic.

Road Access: The site is currently accessed via rough gravel roads off of Hawhola Road to the west and Stepping Stones Road to the north.

The site could potentially be accessed from the south off of the Goose Lake Road. While a rough road currently exists along the west shore of Goose Lake and extends through the development node, it is barricaded at the end of the Goose Lake Road.

Power: BC Hydro overhead single phase power currently extends south along Hawhola Road until approximately Antoine Road. This is approximately 1 kilometre west of the development node.

BC Hydro underground power is also currently supplied up to the end of the Goose Lake Road in the south, which is approximately 1.2 kilometres from the development node.

Eastern Bench Lands

Site Overview

The Eastern Bench Lands development node is located in the eastern portion of the planning area, west of The Rise Golf Course. The entire development node is located on Band Land. Given a development feasibility study was undertaken for this site in 2018, more detailed site servicing and proposed land use information is available for this development node as compared to others.

The Eastern Bench Lands is a mix of grassland flats interspersed with treed hillsides and rocky outcrops. Several small lakes and wetlands are also located within the area.

Land Use

Existing Land Use

The development node is currently being used as rangeland. OKIB community members also utilize the site for recreational and cultural uses, such as mountain biking, hiking, and hunting and gathering.

Proposed Land Use

The 2018 development feasibility study undertaken for the Eastern Bench Lands indicates that a mix of single family and clustered medium density residential developments would be best suited for the site. This study also identified the site as having limited potential for commercial or industrial uses due to a variety of development constraints, including distance from the downtown core of Vernon, no passing business traffic, access challenges and topography.

Environmental Conditions

A search of Provincial databases indicates that the development node contains critical habitat for the Great Basin Spadefoot toad. While this critical habitat is focused around the many small wetlands/waterbodies found within the development node, it also includes connectivity corridors in between the wetlands.

A search of known Species at Risk occurrence data as downloaded from the Provincial Government revealed two non-sensitive species occurrences within the development node: the American Badger and Baltic Rush – Common Silverweed. Both of these species are listed on Schedule 1 of the Species at Risk Act. In addition to these non-sensitive species, one sensitive species occurrence was identified. Sensitive species occurrences are confidential and cannot be disclosed in this report.

Archaeology and Cultural Considerations

While there are no known archaeological sites within the development node, community Elders have indicated that this area contains the only known occurrences of the bitterroot plant on reserve.

Infrastructure Servicing

The development feasibility study and concept design undertaken in 2018 included a preliminary infrastructure servicing review. This study also included initial meetings with the City of Vernon to discuss the potential of connecting future infrastructure servicing on the Eastern Bench Lands to the City's water and sewer systems. Early indications from the City of Vernon were that both the existing water and sewer systems located at The Rise likely have capacity to handle additional loading from the Eastern Bench Lands. However, it should be noted that further investigation into the feasibility of connecting to the City of Vernon's road, sewer and water infrastructure is required. The development of a servicing agreement with the City was also identified as an important next step.

Water: There are no existing OKIB water systems within close proximity to the Eastern Bench Lands development node. Previous reports and discussions with the City of Vernon indicate that it may be feasible to connect to the City's existing water system located in the vicinity of Rising View Way. Previous reports also indicate the need for a booster station and storage tank within the development node in order to meet required fire flows.

Sanitary: The development feasibility study completed in 2018 recommended that development on the Eastern Bench Lands connect to the City of Vernon sanitary sewer system located near The Rise. The report outlined the following sanitary sewer design considerations and items requiring further investigations for development at the Eastern Bench Lands:

- Sewer pipe diameter exiting the Eastern Bench Land development will require a 200 mm diameter sewer pipe which will connect with the City of Vernon system at the lower end of the Rise Development.
- Within the Eastern Bench Land development node the general drainage trend is toward Okanagan Lake. As a result, sewage lift stations and a 200 mm forced main to the high point of land adjacent to the Rise will be required followed by gravity sewer line to connect with the City system.

Road Access: Previous studies have indicated that potential access to the Eastern bench Lands is expected to be via an extension of Rising View Way.

Power: BC Hydro underground power is currently supplied to the adjacent development at The Rise. Future servicing at the Eastern Bench Lands would likely be an extension of these existing services.

Western Bench Lands

Site Overview

The Western Bench Lands development node is located on an isolated bench in the south eastern portion of the range. Given the infrastructure servicing constraints facing development on the site, as well as environmental considerations, development on the Western Bench Lands is likely a longer-term initiative. In fact, a preliminary Highest and Best Use study undertaken as part of this Enhanced Land Use Plan indicated that, from an economic perspective, development of the Western Bench Lands is “beyond any foreseeable timeline”. Development of the Eastern Bench Lands may make development at the Western Bench Land more feasible.

The eastern portion of the development node is comprised of grasslands habitat while the western portion consists of a treed hillside. A series of small wetlands and lakes are also located with the development node. Given the Western Bench Land’s location on the top of a ridge, potential development sites would provide views in all directions.

Land Use

Existing Land Use

The development node is currently being used as rangeland. OKIB community members also utilize the site for recreational and cultural uses such as mountain biking, hiking, and hunting and gathering.

Proposed Land Use

The community has identified the Western Bench Lands for potential residential housing (band housing and/or market housing) as well as Resort Tourism. As previously noted, the development node is rather isolated, making infrastructure servicing and access cost prohibitive. The development of the Western Bench Lands is likely a longer-term initiative.

Environmental Conditions

A search of Provincial databases indicates that the majority of development node is comprised of critical habitat for the Great Basin Spadefoot toad. While this critical habitat is focused around the small wetlands/waterbodies found within the development node, it also includes connectivity corridors in between the adjacent wetlands.

A search of known Species at Risk occurrence data as downloaded from the Provincial Government revealed that the American Badger is known to occur within the development node. American Badgers are listed on Schedule 1 of the Species at Risk Act. In addition to this non-sensitive species, one sensitive species occurrence

was identified. Sensitive species occurrences are confidential and cannot be disclosed in this report.

Archaeology and Cultural Considerations

While there are no known archaeological sites within the development node, community Elders have indicated that this area contains the only known occurrences of the bitterroot plant on reserve.

Infrastructure Servicing

The development node is located on an isolated bench situated on the upper elevations of the range. While the development node is within approximately 1.6 kilometres of the nearest development (Beachcomber Bay), an elevation difference of approximately 245 metres exists between the two sites. Due to these factors, access and infrastructure servicing of the development node would be cost prohibitive under current conditions. Future development of the Western Bench Lands could be re-evaluated if development of adjacent areas, in particular at the Eastern Bench Lands, is to occur.

Rattlesnake Point (acx̌ʷyus)

Site Overview

The Rattlesnake Point (acx̌ʷyus) development node is located along the southern boundary of the Goose Lake Range planning area, directly adjacent to the City of Vernon neighbourhood of Bella Vista West. The site was identified as a development node in the Phase 1 Land Use Plan, with Single Family Residential listed as a proposed land use.

Much of the development node is comprised of steep slopes and cliff areas, particularly along the lake shore. However, suitable development sites would offer stunning views over Okanagan Lake. Rattlesnake Point (acx̌ʷyus) was initially identified as a high priority area for development by the community, however servicing and access constraints outlined by the City of Vernon has resulted in the community shifting focus to the Eastern Bench Lands.

Land Use

Existing Land Use

The development node is currently being used as range land. OKIB community members also utilize the site for recreational and cultural uses, such as mountain biking, hiking, and hunting and gathering.

Proposed Land Use

The community has long identified Rattlesnake Point (acx̌ʷyus) as a potential location for residential housing (band housing and/or market housing). Rattlesnake Point (acx̌ʷyus) had previously been identified as a priority for future development, however based on feedback from the City of Vernon regarding site servicing and access, the community has decided to shift its focus to the Eastern Bench Lands development node. The development of Rattlesnake Point (acx̌ʷyus) is likely a longer-term initiative.

The Phase 1 Land Use Plan specified Single Family Residential as the proposed land use type and outlined a potential density of 1.5 units per acre, matching the nearby Bella Vista West neighbourhood.

Environmental Conditions

A search of Provincial databases indicates that no known and mapped critical habitats are found within the development node. A search of known Species at Risk occurrence data that was downloaded from the Provincial Government revealed that the American Badger is known to occur within the development node. American Badgers are listed on Schedule 1 of the Species at Risk Act. In addition to these non-sensitive species, one sensitive species occurrence was identified. Sensitive species occurrences are confidential and cannot be disclosed in this report.

Archaeology and Cultural Considerations

Four (4) known archaeological sites are found within the development node, along the lakeshore.

Infrastructure Servicing

No OKIB community water and/or sanitary sewer systems are within close proximity to the Rattlesnake Point (acx̌ʷyus)development node. Future development at Rattlesnake Point will likely be serviced through extending existing City of Vernon infrastructure services servicing at Bella Vista West. Initial discussions with the City of Vernon indicated that while there is potential to service development at Rattlesnake Point (acx̌ʷyus) through extending city services, there are more cost-effective options elsewhere on reserve (primarily the Eastern Bench Lands). Specific items identified by the City of Vernon include:

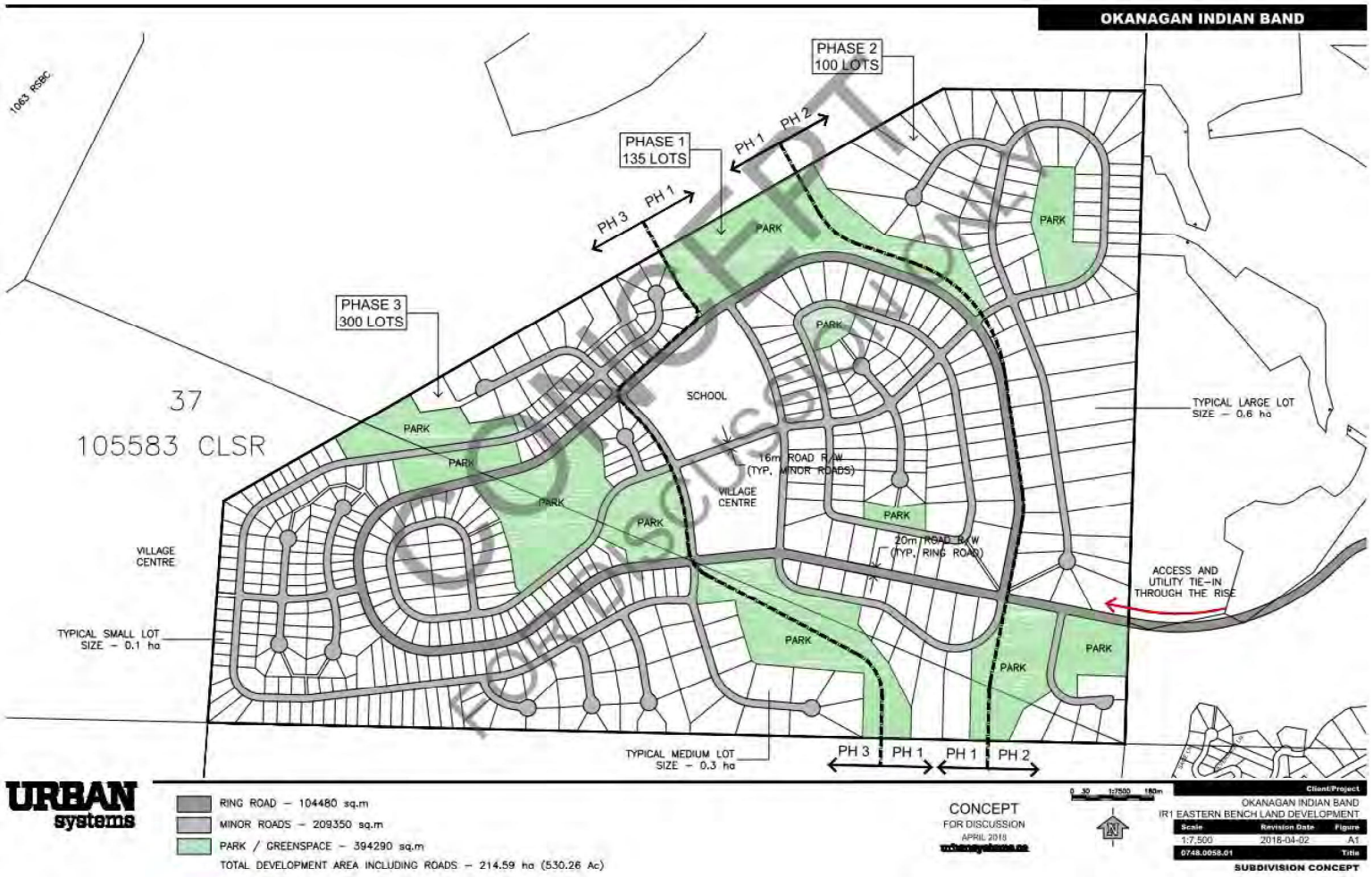
- Tronson Road has existing safety issues and will be at capacity once all currently approved development is built.
- While it is possible to service the Rattlesnake Point (acx̌ʷyus) site with sewer and water, the City indicated that the Okanagan 1 reserve lands adjacent to The Rise golf course development would have better access via Okanagan Hills Boulevard, which was recently built to modern standards with capacity for additional traffic.
- In addition, sewer and water infrastructure are currently located closer to the reserve boundary at the Eastern Bench Lands development node as compared to Rattlesnake Point (acx̌ʷyus), which will further reduce off-site upgrade costs.
- The City of Vernon did suggest there is potential to service the site adjacent to The Rise development and the road is more than adequate to provide access.
- Rattlesnake Point (acx̌ʷyus) should not be discounted as a feasible site for development in the future, but a phased approach, starting at the Eastern Bench Lands will likely provide more immediate benefits.

APPENDIX D

Eastern Benchlands Concept

SECTION 2

Appendix D - Eastern Benchlands Concept



URBAN systems