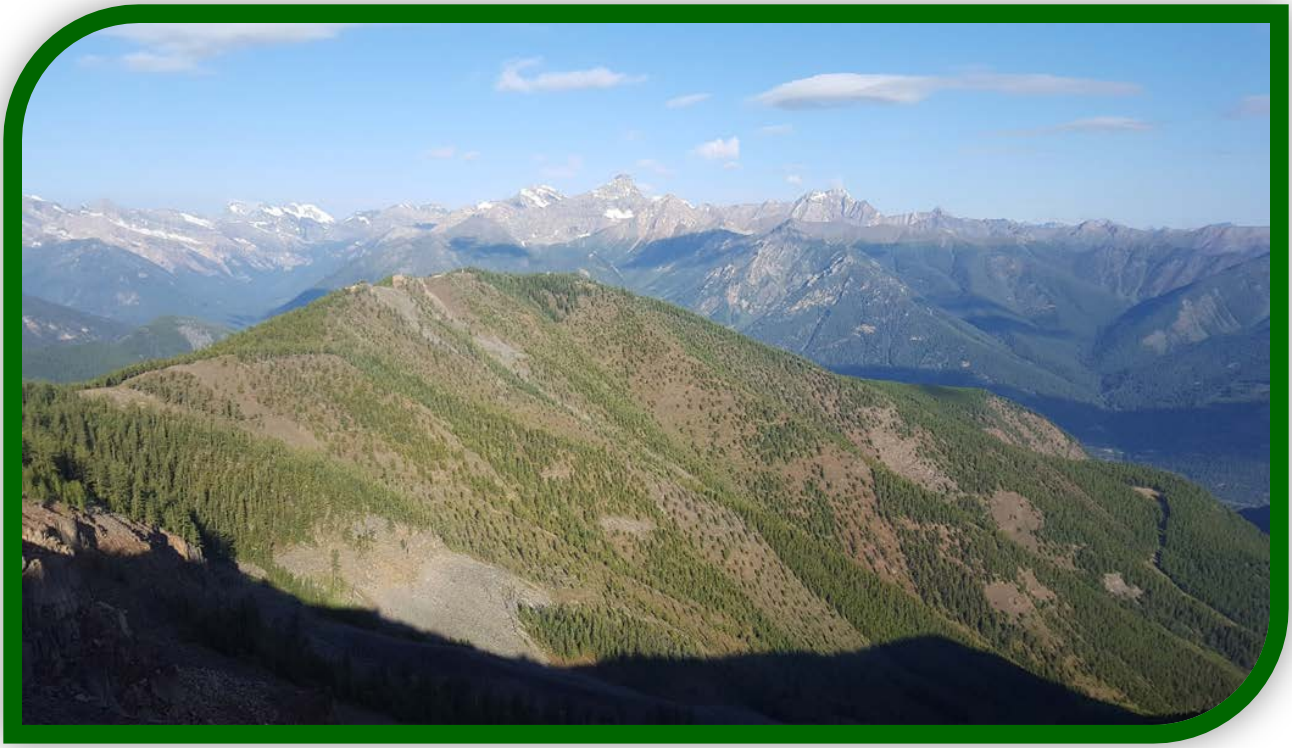
CASCADE ENVIRONMENTAL
RESOURCE GROUP LTD

Environmental Review

Taynton Bowl



Prepared for:

PANORAMA
PURE CANADA

Panorama Mountain Village
Panorama, B.C.
V0A 1T0

Prepared by:
Cascade Environmental Resource Ltd.
Unit 3 – 1005 Alpha Lake Road
Whistler, BC
V0N 1B1

Project No.: 764-01-01
Date: September 7, 2016

STATEMENT OF LIMITATIONS

This document was prepared by **Cascade Environmental Resource Group Ltd.** for the account of **Panorama Mountain Village.**

Should this report contain an error or omission then the liability, if any, of Cascade Environmental Resource Group Ltd. should be limited to the fee received by Cascade Environmental Resource Group Ltd. for the preparation of this document. Recommendations contained in this report reflect Cascade Environmental Resource Group Ltd.'s judgment in light of information available at the time of study. The accuracy of information provided to Cascade Environmental Resource Group Ltd. is not guaranteed.

Neither all nor part of the contents of this report should be used by any party, other than the client, without the express written consent of Cascade Environmental Resource Group Ltd. This report was prepared for the client for the client's own information and for presentation to the approving government agencies. The report may not be used or relied upon by any other person unless that person is specifically named by Cascade Environmental Resource Group Ltd. as a beneficiary of the report, in which case the report may be used by the additional beneficiary Cascade Environmental Resource Group Ltd. has named. If such consent is granted, a surcharge may be rendered. The client agrees to maintain the confidentiality of the report and reasonably protect the report from distribution to any other person. If the client directly or indirectly causes the report to be distributed to any other person, the client shall indemnify, defend and hold Cascade Environmental Resource Group Ltd. harmless if any third party brings a claim against Cascade Environmental Resource Group Ltd. relating to the report.

This document should not be construed to be:

- A Phase 1 - Environmental Site Assessment;
- A Stage 1 – Preliminary Site Investigation (as per the Contaminated Sites Regulations of the Waste Mgt. Act);

EXECUTIVE SUMMARY

Cascade Environmental Resource Group Ltd's parent company, GeoAlpine Environmental Consulting Ltd. was retained by Panorama Mountain Village to conduct an Environment Assessment of Taynton Bowl in 1997 in support of a boundary expansion of the Controlled Recreation Area (GeoAlpine, 1999). Panorama wishes to make a minor amendment to the CRA to more adequately manage the area of the bowl currently being accessed by skiers from Panorama. In support of this amendment, Cascade conducted an update of the original 1999 report.

Due to the remote nature and limited development in Taynton Bowl, very little has changed in the intervening years with the exception of:

1. Glading efforts on two slopes to facilitate skiing
2. Clearing and trail building of Stumbock's ski trail to facilitate access and egress from Taynton Bowl.
3. Construction of an egress ski trail and summer access road.

The condition of Taynton Creek remains largely unaffected and riparian buffers are largely unaffected.

The ecosystem mapping was updated to include the new amendment area as well as the updated biogeoclimatic subzone classifications carried out by BC Forest Service in 2012.

BC Conservation Data Centre Red and Blue listed species were updated to reflect the current lists.

Panorama experiences approximately 985 mm of annual precipitation based on records at the Village.

The geological and geomorphological conditions of Taynton Bowl consist of exposed fractured bedrock on steep slopes prone to colluvial activity, slope failures and avalanches. All development should consider geotechnical constraints.

Taynton Creek flows out of Taynton Bowl, into Toby Creek and then into the Columbia River. The water quality is good and protection of riparian areas will ensure water quality is protected into the future.

Soils of Taynton Bowl are thin veneers covering bedrock and consist of young brunisols and regosols.

Vegetation of Taynton Bowl is characterized by coniferous forest with shrublands and grasslands in avalanche affected areas. There is evidence of a large wildfire throughout the lower portions of the Bowl resulting in an average estimated age of approximately 80 years. The upper elevations were spared the effects of fire and old growth forest can be found.

Analysis of ecological conditions using Terrestrial Ecosystem Mapping (TEM) protocols reveals the site to be typical of the region. Five different ecological subzones occur within the study area. At the lower elevations Montane Spruce Dry Cool (MSdk) subzone occurs, followed by the Engelmann Spruce / Sub-alpine Fir Columbia Dry Cool (ESSFdk2) subzone, the Dry Cool Woodland Engelmann Spruce Subalpine Fir (ESSFdkw) subzone, the Dry Cool Parkland Engelmann Spruce Subalpine Fir (ESSFdkp) subzone, and the Woodland, Parkland Alpine (IMAun) subzone; as one move moves upslope toward the peak of Mt. Goldie.

Young lodgepole pine dominated forests tend to dominate the lower elevations of the ESSFdk2 subzone in the study area, while old growth whitebark pine and alpine larch forests occur at higher elevations in the ESSFdkw and ESSFdkp subzones. A considerable portion of the study area contains edaphic ecosystems modified by avalanches, rockfall and landslides.

The area is well utilized by wildlife and series of studies by Cascade regarding wildlife management in the Toby Creek Valley suggest that the upper Taynton Bowl may function as a wildlife habitat patch.

Since the intended level of use in Taynton Bowl is likely to be fairly low and backcountry oriented, the potential impacts to wildlife in the area should be low as well. A number of federally listed Species at Risk (Table 10) may utilize the area as well, but their presence or absence is not verified at this time. Grizzly

bears are known to utilize the area, along with deer and moose. A list of observed species and species that are likely to occur is provided in the report.

Identified potential constraints to development include the following:

1. Steep, unstable slopes and avalanche prone areas
2. Wildlife movement corridors
3. Wetlands, riparian and old growth forest habitat

Recommendations and Conclusions

The following recommendations of the 1999 and 2016 update study are presented herein.

General

1. Geotechnical data suggests that wide spread instabilities exist in the surficial deposits as well as the upper bedrock units. Rock and slope instabilities are not uncommon in ski resorts, particularly those occupying the tops of mountains; however, these factors warrant further study prior to proceeding with lift and run design.
2. The integrity of the water quality, habitat values and downstream fisheries values of all water bodies should be protected by the establishment of riparian buffer zones. In general, buffers should be as specified in the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al., 1992), the Forest Practices Code Riparian Management Area Guidebook (MOF, 1995b), or the Riparian Area Regulation of the *BC Fish Protection Act*, whichever is more stringent.
3. The oldest and most significant forest vegetation in the study area is associated with the ESSFdkp and IMAun subzones near the summit ridge of Panorama Mountain. These subzones contain an abundance of whitebark pines. Any proposed development in this area should maximize preservation opportunities by avoiding destruction of plant communities and minimizing ground disturbance.
4. An attempt should be made to preserve all wetlands within the study area. In order to protect the functional values associated with the wetlands preservation buffers should be incorporated into the plans. Any wetlands potentially impacted by future developments should be subjected to detailed assessment to identify all plant species prior to development approval.
5. Retain an on-site environmental monitor to be present during all development activity.

Wildlife and Wildlife Habitat

Construction Windows

1. The study area may be used by moose, elk and deer during the fall rut. In the absence of further study, development activity and future use of the site should be restricted between October 15th and December 15th.
2. To avoid contravention of the Wildlife Act, land clearing activity should not be undertaken between May 1st and August 31st, the sensitive nesting period for breeding birds and other wildlife without specific permission from FLNRO or MOE. Under Section 34 of the *BC Wildlife Act*, it is an offense to destroy nests occupied by a bird, its eggs or its young.
3. The subject property maintains the high to moderately high habitat value in summer and fall. Construction should be sensitive to disturbance of all types of wildlife by reducing length of day worked and where possible, noise levels.

Habitat Protection

1. Areas with high densities of snags should be retained. A minimum 15 m vegetated buffer on either sides of creeks and wetlands should be retained. In areas where windthrow is a risk, wider buffer zones to 30 m should be set aside. Protection of these areas will retain wildlife trees, breeding and

foraging areas for wildlife and provide corridors for wildlife moving or migrating through the site.
2. Large snags in upland areas should be retained within the development plan wherever possible. Widespread clearing of the subject property should not be permitted. Ski runs should be developed to utilize existing forest openings as much as possible to maintain closed second growth forest and alpine old growth forest.
3. Wetlands should be retained intact and undisturbed. Disturbances such as infilling or redirection of runoff into wetlands should not occur. A 30 m vegetated set-back should be established adjacent to wetlands to protect the unique plant and wildlife values of the wetland and adjacent riparian areas. Often wildlife trees important to bats and other wildlife species will are located within the 30 m setback area.
4. Wildlife movement corridors will be provided if retention zones along streams are designated as recommended above. Road and trail crossings of these ephemeral streams should be designed so that wildlife movement is not impeded or discouraged. The number of stream crossings should be minimized. Bridges rather than culverts or fords are preferred. Planting of additional native, riparian shrubs and trees may be necessary.
5. Nests of raptors such as northern goshawk and great horned owl found during land clearing activity must be adequately protected by forested buffer while the nest is occupied.
6. All areas protected for wildlife habitat, should be flagged and enclosed by temporary fence or continuous 2" flagging along the protection boundary prior to initiation of work on the site. Panorama should take necessary steps to ensure that skiers and staff do not enter protected areas.
7. To protect the sub-nivian habitat from destruction by compacting of snow, skiers should be restricted to using the designated runs.
8. Recreational and ski operation maintenance should be greatly restricted during summer and fall when the subject property has the most significant habitat value to many wildlife species.
9. The recommendations of the Wildlife Management Plan for establishing a local wildlife patch in upper Taynton Bowl should be considered (Cascade, 2001).

Additional Studies

1. Grizzly bear is a blue listed species in the East Kootenay region of British Columbia. Further study into actual use and importance of Taynton Bowl for grizzly bear may be warranted.
2. A live trapping program should be conducted to determine if the species of chipmunk found on site is *T. minimus selkerki*.
3. In light of the fact that Taynton Bowl is an important part of a larger ecosystem, and that wildlife migration occurs from Taynton to adjacent high habitat capability drainages, further wildlife studies to assess the overall impact of the proposed development on wildlife movement studies on a larger area would be beneficial.
4. Further geotechnical studies are required to determine the feasibility of building a lift station in an area with such geologic hazards. These studies should incorporate an evaluation of the initiation zones of landslides and snow avalanches, the deposition zones from such events, the potential of deeper seated bedrock instabilities, and their association with the site hydrology.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF MAPS

LIST OF PHOTOS

1 INTRODUCTION

Panorama Mountain Village operates a four season resort featuring downhill and cross-country ski facilities in the winter season, with golf, hiking and mountain biking facilities in the summer months; all within a Controlled Recreation Area (CRA) that is located on Crown leased lands under a Master Development Agreement (MDA) with the All Season Resort Branch of the BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO). The resort plans to expand its terrain in the high alpine to increase skiing opportunities and protect skier safety through active avalanche management. These plans include the development of additional lands within the area identified as Taynton Bowl. The proposed development would require a minor ammendment to the ski area boundary to include the remaining portion of the southerly portion of Taynton Creek drainage, hereafter referred to as Taynton Bowl. As part of the planning process for possible boundary adjustment and recreational development, Panorama Mountain Village retained Cascade Environmental Resource Group Ltd., (Cascade, re-branded from GeoAlpine Environmental Consulting Ltd.) to conduct an update of Environmental Review initially completed in 1999. This report presents the results of field assessments conducted in August, 2016, incorporated into the baseline inventory work conducted in 1997 (GeoAlpine, 1999).

1.1 Study Area Location

The study area, referred to as Taynton Bowl, is located on the west side of Taynton Creek and is immediately adjacent to the existing eastern boundary of Panorama Mountain Village lands. Panorama is approximately 20 km southwest of Invermere, BC. Map 1 contains a location map of Panorama Mountain Resort and the study area.

1.2 Project Team

The 2016 study team included Dave Williamson, B.E.S., ASc.T. and Mike Nelson, R.P.Bio. The 1999 study team included Dave Williamson and Mike Nelson, as well as Mike Cole, M.Sc., P.Eng. and Shelagh Wrazej, B.Sc. Mapping was provided by GIS specialists Todd Hellinga, B.Sc., GIS AS and Nicola Church, M.Sc., B.A. (GIS). All project team members have extensive experience in conducting environmental inventories, reviews and assessments.

1.3 Project Scope

Panorama Resort Inc. updated their Resort Development Plan in 1995. As part of that process Ecosign Resort Planners Inc. updated the Master Plan (Ecosign 1995). The Master Plan was again updated in 1998. The review identified a portion of Taynton Bowl to be potentially suitable for the development of skiing. Coincidentally, a local heli-ski operator used this same site for that purpose. In order to obtain a Crown lease for the Taynton Bowl area, Panorama Mountain Village was required by the Ministry of Environment, Lands and Parks to conduct a number of studies to prove out the viability of the proposed use of the lands. In partial response to those requirements, Panorama Mountain Village retained GeoAlpine Environmental Consulting Ltd. to conduct an environmental inventory and review of the subject site. The primary objectives of this undertaking (hereafter referred to as the Environmental Review) are to identify and delineate ecosystem units, environmentally sensitive areas, and ecologically significant habitats within the study area.

In 2016, at the behest of FLNRO, Panorama Mountain Village asked Cascade to update the Environmental Review to assess changes to the condition of the existing tenured land in Taynton Bowl, as well as the proposed area of expanded tenure. The combined study area for Taynton Bowl is approximately 680 ha.

1.4 Methodology

The study area landscape was stratified into map units based on ecological criteria such as climate, surficial geology and topography, soil, and vegetation. Recently established terrestrial ecosystem mapping principles (Resources Inventory Committee, 1995) were employed to identify and delineate distinct ecosystem units, and show their distribution within the study area. Terrestrial ecosystem mapping integrates both abiotic and biotic components to provide an ecological framework for land use and resource management. Specifically, it also serves to:

1. Identify sensitive wetlands and riparian areas;
2. Identify forest types and vegetation cover;
3. Produce wildlife capability and suitability mapping for the following species: Deer, Black Bear, Grizzly Bear, Cavity Nesters, Bats, Amphibians.

At the outset of the study, a literature review was conducted to collect pertinent data and identify information gaps. Maps and aerial photographs of the study area were analyzed to develop preliminary distinctions between ecosystem units, based on terrain and forest cover. These tentatively delineated polygons were mapped for field use and ground-truthing during site investigations.

Reconnaissance level field investigations were conducted during the week of June 22, 1997 and in September 1997. Ecosystem Field Forms [FS 882(1) HRE 96/4] were used to collect and record information to describe the site, soils, vegetation, and mensuration/wildlife in each polygon of the study area. A Global Positioning System (GPS) was employed during field investigation to provide accurate geo-referencing of sample sites. Fish habitat information was collected using the DFO/MOE Stream Survey Forms and methodology, and a program of electrofishing and trapping was undertaken to determine fish presence near the study area.

Wildlife habitat assessment field investigations were conducted on September 4, 21, and 27, 1997. Wildlife Plot locations, established with GPS survey equipment in the initial field investigations, were determined based on rough approximations using a 1:5000 trim map. A video camera was used to collect and record information to describe the wildlife capability of the given plots.

The collected field data and other information constitute a baseline environmental inventory that identifies the main ecological systems and processes that occur in the study area. In the final phase of the study, an analysis of the inventory information was performed to identify constraints to development in the study area.

In 2016, the project team de-archived the maps developed for the project in 1999 and updated the them based on the most recently available ecological information. The 1999 and 2016 map data was merged into an ArcInfo geodatabase. The Terrestrial Ecosystem Mapping (TEM) polygons were then refined using current technology.

The 2016 field team conducted a cursory assessment by carrying out hiking transects through the proposed expansion terrain and visual observation of the previously assessed area within the current CRA. Navigation and data input relied on ESRI Collector installed on Android smartphones.

Further detail on methodology is included under separate section headings.

Map 1. Location Map of Study Area

2 EXISTING CONDITIONS

2.1 Cultural Environment

No archeological or heritage features were identified in the study area during either the 1999 or the 2016 surveys. Most of the study area is densely forested and undulating in topography, with poor access. While there are no known disputes or claims concerning this area, it should be noted that land claims issues are yet to be resolved with First Nations throughout the province.

The only evident anthropogenic activities in the area relate to recreational uses and even in the 2016 survey, the visible impacts were very limited. During the site visits a number of cut trees were observed in the alpine elevations. The cutting was carried out to produce gladed skiing runs for Panorama under the direction of Summit Valley Contracting (SVC, 2014).

In addition to the gladed ski areas, a Black Diamond trail known as Stumbock's was developed to provide access to the bottom of the bowl. The Taynton Trail provides skiing egress from Taynton Bowl back to the resort (Photo 1).

A number of horse trails were also observed at various elevations in the study area. A local outfitter actively uses the trail system for guiding. The horseback riding activity includes both spring and fall hunting as well as limited recreational riding in the summer.

The upper ridge top of the study area bounds on the existing CRA of Panorama Mountain Village. According to anecdotal evidence, the study area is actively skied in the winter as an "out of bounds area".

Assessment of archaeological and First Nations cultural use falls outside the scope of this study.

Photo 1. Tayton Trail provides skiing access back to Panorama Mountain Village. Physical Environment

2.1.1 Climate

The study area lies in the Eastern Purcell Mountain Ecosection of the Columbia Mountain Highlands Ecoregion (Campbell et al., 1990). The ecosection is a mountainous area with high valleys located on the

leeward side of the Purcell Ranges. There is a distinct rain-shadow, with strong precipitation and temperature gradients. AES climate stations are lacking in the immediate area, and it is difficult to extrapolate from more distal stations such as Golden, Canal Flats and Kimberly as those stations tend to be at lower elevations in the Rocky Mountain trench. At the Kootenay National Park West Gate (935 m asl compared to 1150 m asl at Panorama), mean daily temperatures are lowest in January, with temperatures ranging from -5.2 to -11.3°C, and highest in July, ranging from 25.2 to 10.8°C. Precipitation peaks in May through August, mainly falling as rain. The precipitation distribution in the other months is fairly even. Total precipitation at this station ranges is 424.1 mm (Environment Canada, 2016).

Climatic data for Panorama Lodge (elevation 1572 m) is available for the period 1970 to 1990 from the Atmospheric Environment Service (AES) of Environment Canada. Mean annual precipitation for the period of record is 985 mm, of which 38% falls as rain (May to September) and 62% fall as snow (October to April).

2.1.2 Geology

Bedrock formations in the Taynton Creek drainage consist of Upper Proterozoic units (of the Hadrynian epoch – approximately 590 million years ago) of the Windermere Supergroup (Stanley, 1986). The deposits (including tillites) likely represent late Proterozoic glaciation. Two subgroups are represented in this region:

1. The Upper Horsethief Creek Group (uPHC): Slates, quartz pebble conglomerate, sandstone, siltstone and limestone, and;
2. Toby Formation (uPT): Conglomerate, siltstone and shale (MOELP Minfile 082KSE, 1996)

Within the study area, the uPHC formation occurs above 1770 m extending in a radial pattern that covers most of the Taynton Creek subdrainages. The lower section of the drainage consists of the uPT formation. Field observations confirmed those units listed above.

The abandoned Paradise and Silver Belt Mines in the same formation across valley showed occurrences of Lead/Zinc/Silver/Gold and Silver/Lead/Zinc, respectively. Adjacent mining claims (Green Ridge and Hat) in the same formation, across the valley indicate the occurrence of Copper/Gold/Silver and Barite/Copper, deposits respectively (Stanley, 1986).

Small pockets of exposed bedrock units are present in most locations of the study area. Highly fractured shales are ubiquitous units with lesser amounts of quartz conglomerates (sandstones) occurring around the site. The dip/strike of sedimentary units varies greatly across site showing its high degree of structural deformation.

2.1.3 Geomorphology & Surficial Materials

Overall, the site is comprised of thin blankets of weathered bedrock in the upper sections and thicker colluvial units in the lower, basin areas. The study area can be described as two bowl-shaped drainage basins, consisting of a series of bedrock-controlled gullies or depressional troughs.

Observed parent material included friable shales degrading into very angular moderately durable small gravels. Mineral soils consisted of thin veneers of sandy silts to silty gravels derived from weathered parent material. Surface erosion in steeper areas (> 35%) appears to be controlled by the coarse texture of the units. The majority of the surficial units are free draining depending on slope.

MOF 1:20 000 Terrain Stability Intensity Level D (TSIL-D) mapping was conducted recently based on air photo interpretation and subsequent field checks (Terratech, 1995). Approximately 80% of the study area contain polygons classified as “Unstable terrain”. This classification indicates evidence of natural landslide activity and a high likelihood of landslide initiation due to construction of roads or trails. The remaining 20% of the study area contain polygons that were unclassified.

Within these classified polygons, thirteen landslides are noted. The landslides in the mid- and lower sections occur as sloughing of morainal units along gully walls. The three noted landslides tend to be moderately sized (covering 0.1 to 1 ha), of varying age (recent to old) and occurring with initiation zones along gully walls of the secondary channels. These types of landslides also occurred along the channel walls of Taynton creek. The landslides in the upper sections (10 noted) tend to be moderately sized debris flows and rock falls, which are recently occurring with initiation zones near ridge tops.

The 20% of the study area containing polygons that were unclassified occurred in areas that were relatively flat or gently sloping either on rounded ridge tops or in the bottom of Taynton Bowl. Based on conversations with the terrain mappers (Terratech, per comm., 1997), the location of the polygons and their non-classified status, it is assumed that these polygons are considered "Stable Terrain' (i.e., are not initiation zones of landslides). However, some of these locations are downslope of steep areas and are likely deposition zones for both landslides and snow avalanches, and as such, are not considered "Hazard-Free" (Photo 2 to Photo 5).

Photo 2. Plot #9. Evidence of snow avalanche in deposition zones of stable terrain. June 27, 1997.

Photo 3. Proposed top chairlift station. Slump face between Plot #1 and Plot #6. June 27, 1997.

Photo 4. Plot #8. Head scarp of active slump block. June 27, 1997.

Photo 5. Plot #8. Side scarp of previous slump block. June 27, 1997.

Field Visits verify the unstable nature of the surficial materials and, to some extent, the upper bedrock units. The upper ridge wall to the west, near the proposed top chairlift station, shows evidence of large-scale slumping with large deposits downslope (Photo 4). These failures appear to be based in the upper units of the weathered sedimentary bedrock (typically shales). In the steep upper sections to the south (>45% slope), several recent slides were observed in the upper mineral layers. Existing slumps (blocks which had not yet released) head scarps were 2-3 m high, and blocks extended 20 m downslope and 60 m across slope (Photo 5). Tension cracks in the surrounding terrain extended 75 m in a up/downslope

orientation. Conical debris piles (2-5 m high) at the base of this steep terrain indicate previous episodes of mass movement.

The proposed bottom (onload) chairlift station is situated near the midsection of Taynton Creek, at the confluence of several side channels of the southeast arm. The confluence exists as a debris cone averaging 35%, which appears to be deposited by rapid mass movement. Material consists of 20% cobbles, 20 % large gravels and 60% smaller fractions. The area downstream of this confluence exhibits linear debris piles (5 m high, 5 m wide and 100 m long) along the channel floor (flood plain) which also appears to deposited by rapid mass movement.

2.1.4 Hydrology

The study area is located entirely within the Taynton Creek watershed. Taynton Creek flows into Toby Creek which in turn drains into the Columbia River approximately 20 km downstream, near Invermere B.C. Water Survey of Canada records indicate that a stream gauging station was maintained on Toby Creek at Athalmer (Station No. 08NA012) from 1912 to 1915 and 1943 to 1984. WSC stream-flow data for Taynton Creek is not available.

Taynton Creek

The Taynton Creek watershed/drainage covers an area of approximately 15.3 km^2. The study area falls exclusively within the Taynton Bowl portion of the upper Taynton Creek watershed, accounting for 44 % of the total watershed. The creek flows north-west for about 7 km, from its headwaters above the 2,350 m elevation level to its confluence with Toby Creek at approximately 1,140 m elevation. Taynton Creek has a gradient averaging 17.4% over its entire length. The creek rises steeply from its confluence with Toby Creek for approximately 70 to 100 m, with gradients measured at 22 to 26 %, before levelling off in its mid reaches for about 4.3 km, to gradients ranging from 9 to 16 %, averaging 14.7 %. Within its upper reaches the gradient of Taynton Creek ranges from 20 to 50 %.

The discharge from this drainage was measured at 0.48 m^3/s near its mouth during the site visit on June 23, 1997.

Toby Creek

Toby Creek, a tributary of the Columbia River, is a fairly large system with a drainage area of about 684 km^2. It flows in a north-east direction at the base of Panorama Mountain, outside of the study area. Over the 23 years of gauging by Water Survey of Canada near its mouth (WSC, 1991), Toby creek had a mean annual flow of 12.8 m^3/s. Flows usually peak in June and July, with mean monthly flows during those months of 42.1 and 39.5 m^3/s, respectively. Low flows typically occur during winter months, with a minimum mean monthly flow of 2.09 m^3/s recorded for February.

2.2 Terrestrial Environment

The terrestrial environment was described in the 1997 survey using an ecological approach used for Terrestrial Ecosystem Mapping. Information was gathered with the assistance of Describing Ecosystems in the Field (Luttmerding, et. al., 1990) and the rough draft of the Field Manual for Describing Terrestrial Ecosystems (RIC, 1996). Ecosystem Field Forms (FS 882(1) HRE 96/4 and Visual Inspection forms) were use to collect general site information as well as more detailed information on soils, vegetation, mensuration and wildlife.

In the 2016 survey, the team used the ESRI Collector application for direct input into ArcInfo GIS. The existing TEM data generated in the 1997 survey was transferred in ArcInfo as well.

2.2.1 Pedologic Soils

Soil and Landform mapping undertaken by the provincial government at a reconnaissance level as shown on Map 82 K/8 (Wittneben, 1979). This mapping indicates that the following soils are likely to occur within the study area:

Orthic Regosols O.R (Yahk Creek soils) – weakly developed soils with thin to moderate Ah horizons due to instability of materials (i.e., slope mass wasting); rapidly to well drained;

Orthic Eutric Brunisols O.EB (Spillimacheen soils) – moderately developed soils with a thin Ah and distinct Bm horizons; well to imperfectly drained;

Orthic Dystric Brunisol O.DYB (Brennan & Coubrey soils) – moderately developed soils with a thin Ah and distinct Bm/Bfj horizons; rapidly to well drained; and

Degraded Melanic Brunisols MB (Radium soils) – moderately developed soils with distinct Ah and Bm/Bfj horizons; well to imperfectly drained.

The Spillimacheen soils are found in the lower elevations (below 1675 m) in colluvium and glacial till (basal) in very steep terrain. The Coubrey soils are an intermediary between the Spillimacheen and Brennan soils and are found in the low and mid-elevations (below 1950 m) in glacial till and colluvium over bedrock in very steep to extremely steep terrain. The Brennan & Coubrey soils are found in the mid-elevations (1675-1950 m) in colluvium over bedrock in very steep to extremely steep terrain. The Radium and Yahk Creek soils are found in the upper portions of the drainage (above 1950 m) in thin colluvium and talus cone environments. Typical soil profiles are shown in the Photo 6 and Photo 7 below.

Photo 6. Plot #7. Orthic Regosol, Yahk Creek Grouping. June 27, 1997.

Photo 7. Plot #12. Dystric Brunisol, Coubrey Grouping. June 27, 1997.

These abovementioned soils were verified in several soil pits. Soil interpretations were developed based on field descriptions of soil morphology at non-random, representative sample sites. Apparent diagnostic processes and properties were noted and later interpreted using the Canadian Soil Classification System. Given the uncertainty associated with the taxonomic distinction (made in the field) between the Orthic Eutric Brunisolic soils and Orthic Dystric Brunisolic soils, there is the possibility that Spillimacheen and Coubrey soils were cross-identified in the field. The use of chemical analysis to differentiate between these morphologically similar soils is beyond the scope and budget of this study.

Table 1. Sample plot soils.

Sample Plot #	Soil Classification	Abbreviation	Soil Unit Symbol (See Map 1)
1	Degraded Melanic Brunisols	MB	RA
2	Orthic Dystric Brunisol	O.DYB	BB
3	Orthic Dystric Brunisol	O.DYB	CB
4	Orthic Dystric Brunisol	O.DYB	CB
5	Orthic Eutric Brunisol	O.EB	SP
6	Degraded Melanic Brunisols	MB	RA
7	Orthic Regosol	O.R	YK
8	Orthic Regosol	O.R	YK
9	Orthic Dystric Brunisol	O.DYB	CB
10	Orthic Dystric Brunisol	O.DYB	CB
11	Orthic Dystric Brunisol	O.DYB	BB
12	Orthic Dystric Brunisol	O.DYB	CB
13	Orthic Dystric Brunisol	O.DYB	CB

Soils of the Brunisolic order (Degraded Melanic, Orthic Dystric, and Orthic Eutric) are widely distributed in the study area, with Regosolic soils occurring in the upper alpine areas. Organic soils appear in this study area as both Humisols and Fibrisols. These are often referred as peat, muck, or bog. They occur in poorly drained depressions or level areas, and are saturated with water throughout much or all of the year.

Map 2. Existing Resource Inventory

2.3 Vegetation

Methodology

Preliminary bio-terrain polygons were identified using air photographs (July 17, 1995 at 1:10,000 and 1: 35,000 scale) Biogeoclimatic Subzone mapping (BCGS 82K.050 and 82K.049), and Forest Cover mapping (1995) prior to site investigations. The bio-terrain polygons were further subdivided into terrestrial ecosystem units following analysis of the Forest Cover map polygons. Vegetation condition including dominant and sub-dominant tree species was used to distinguish ecosystem unit boundaries. The vegetation of each unit is indicative of specific growing conditions, and therefore can be used to map subtle changes in the site ecology. These distinctions are referred to as site series. The terrestrial ecosystem and site series information is presented in the map appended to this report entitled Terrestrial Ecosystems of Taynton Bowl. A summary of the mapped ecosystem polygons and their respective areas is presented in Table 7.

Vegetation information was collected by the project team. Thirteen non-random sample plots of 20 m X 20 m (representing 1/25 ha) were selected from various locations in the study area. An attempt was made to represent each bio-terrain unit identified. A number of polygons could not be sampled due to difficulty of access and time constraints.

General vegetation and species identification information was included in the sample plot survey. A count of tree species within the A1, A2 and A3 strata was used to estimate tree density within the plots. Core samples were taken from representative trees to determine age and soundness. Crown closure and ground cover were estimated. Shrub layer coverage was estimated for B1 and B2. Ground cover plant coverage was estimated and species were identified. A list of all plant species observed is presented in Table 8.

Vegetation of the study area is typical of the vegetation expected in the MSdk2, ESSFdk2, ESSFdkw, ESSFdkp and associated IMA (previously referred to as AT) biogeoclimatic subzones. Map 2 contains summary information from existing resource inventories, including MOF Forest Cover Mapping.

2.3.1 Terrestrial Ecosystems

Terrestrial Ecosystem Mapping (TEM) is built on the foundation of the BEC system principles. TEM provides the framework in which biotic and abiotic elements can be integrated to provide information on the spatial distribution of ecological units on the ground. This approach is used to assist in the identification of significant environmental features such as, riparian zones, streams, wetlands, valued ecosystem components (e.g. wildlife trees) and environmentally sensitive areas.

TEM units are derived by combining terrain feature attributes with BEC unit information. TEM unit breakdown is described in Table 2. One vegetated TEM units was identified in the study area: **FV**. The two-letter TEM codes used in Table 2 describe the **site series** and structural stage of the subject property. For terrestrial ecosystems, these codes describe all land areas capable of producing the same late seral or climax plant community within a biogeoclimatic subzone or variant.

Site series in this classification system describe a ‘typical’ set of environmental conditions focusing specifically on important site, soils, and terrain characteristics. Site modifiers are used to describe atypical conditions for an ecosystem.

Site series can usually be related to a specified range of soil moisture and nutrient regimes within a subzone or variant, but other factors, such as aspect or disturbance history may influence site series as well. The site series derived from field investigations for study are explained below.

Table 2: TEM code explanations.

TEM Code Abbreviations					
7	FV	j	5	s	C

- **7** refers to the proportion of the ecosystem unit out of 10 found within a given polygon (the decile). A homogenous polygon is a 10.
- **FV** refers to the site series designation and can include microclimate and soil conditions (FV is the abbreviation for Subalpine fir - Rhododendron – Black huckleberry).
- **j** refers to a range of possible site modifiers for atypical conditions (up to 2 letters can describe particular site characteristics such as aspect, slope, and soil).
- **4** refers to the structural stage (age) of the tree cover. Values range from 1 – 7.
- **s** refers to the possible variability of cover and age classes within a given structural stage (s refers to a single storied) .
- **C** refers to the possible stand composition (C refers to >75% of the stand is coniferous).

Definitions and Descriptions

- Table 3 provides a breakdown of the TEM code, site series and structural stage.
- An explanation of structural stage is in Table 4.
- TEM site modifiers are explained in Table 5.
- Structural stage modifiers are explained in Table 6.

Table 3. TEM codes and structural stage for the subject site.

TEM Code Designation	BEC Site Series	Interpretation (typical conditions – assumed modifiers)	Structural stage
FV	03	significant slopes; middle slope position; deep medium - textured soils	3a,4,5,6,7

Structural stages in Table 3 describe the existing dominant stand appearance or physiognomy for the ecosystem unit. Tree ages are sampled from representative trees with an increment borer

Table 4: Vegetation structural stage found on subject site.

Structural Stage Code	Interpretation
5 Young Forest	Self-thinning has become evident and the forest canopy has begun to differentiate into distinct layers (dominant, main canopy and overtopped); vigorous growth and a more open stand than in the Pole/Sapling stage; begins as early as age 30 and extends to 50 – 80 years.

Site series have assumed situations with respect to landscape position, soils, and moisture regimes. If a site series is atypical for any of the possible conditions, site modifiers are assigned. Table 4 describes the atypical conditions that exist on the site.

Table 5: TEM site modifiers for subject site.

Abbreviation	Criteria
j	gentle slope – the site series occurs on gently sloping topography (less than 35% in the CWH zone)

Table 6: TEM structural stage modifiers.

Abbreviation	Interpretation
s	Single storied – closed forest stand dominated by the overstorey crown class (dominant and co-dominant trees); intermediate and suppressed trees account for <20% of all crown classes combined; advance understorey regeneration is generally sparse.

Vegetation Associations

The section below summarizes the vegetation associations found on the subject property. These describe the variations in ecological site potential and current vegetation associations within biogeoclimatic subzones and variants. See Map 3 for locations of each plot study site.

The TEM code breakdown is described below.

TEM Code Modifiers					
7	FV	j	5	s	C

For the purposes of this study, TEM codes are limited to decile, site series code and structural stage and would typically be presented as: 7FV5.

Terrestrial Ecosystem Mapping - Polygon Descriptions by Biogeoclimatic subzone

The study area falls within the Southern Interior Mountains Ecoprovince, the Columbia Mountains and Highlands Ecoregion, and the Eastern Purcell Mountains Ecosection (EPM). The study area includes three biogeoclimatic subzones; MSdk, ESSFdk and IMA (woodland, parkland, alpine). The subzones have been further refined as ESSFdk2 and MSdk2 in the lower elevations of the Taynton Bowl study area, ESSFdkw in the mid elevations and ESSFdkp in the parkland zone just below the IMA subzone above tree line at the top of the bowl (MacKillop, 2012).

Map 3. Terrestrial Ecosystem Mapping

Table 7. Terrestrial ecosystem polygon classification.

Name		BGC Zone	Subzone	Area (m^2)	Total Area	Site Series	TEM Code
1		MS	dk2	57729.69		05 07	6SS6 4SB3
2		MS	dk2	167282.4	225012.0514	07 03 01	6LJ6 2SB3 2SG6
4		ESSF	dk2	236382.8		03 02 77	6FV5 2FH5 2AC3
5		ESSF	dk2	352990.6		04	FS6
6		ESSF	dk2	336652.7		77 04	6AC3 4FS3
7		ESSF	dk2	237516.8		04 03 07	5FS4 3FV5 2WS3a
8		ESSF	dk2	336938.5		4	FS6
8	b	ESSF	dk2	82308.38		4	FS6
9		ESSF	dk2	261529.9		77 88 01	5AC3 3AR3 2FP3
10		ESSF	dk2	86985.22		02	FH6
11		ESSF	dk2	49032.11		03	FV5
12		ESSF	dk2	76393.24		03	FV4
14		ESSF	dk2	136453		04	FS5
14	b	ESSF	dk2	160780.9		04 03 07	5FS5 3FV5 2WS3
19	e	ESSF	dk2	13954.31		88	AR
21		ESSF	dk2	91622.91		03	6FV5 4FV3a
22		ESSF	dk2	219885.9		03	FV5
24		ESSF	dk2	239457.9		03	FV5
29	b	ESSF	dk2	11425.43		88 04	7AR 3FS7
29	c	ESSF	dk2	1983.889	2926164.171	04 88	5FS7 5AR
6	b	ESSF	dkw	72996.83		03	FV3
9	b	ESSF	dkw	31788.29		77	AC3
10	b	ESSF	dkw	16104.44		02	FH6
12	b	ESSF	dkw	15068.56		03	FV4
13		ESSF	dkw	107572.3		03	FV5
14	c	ESSF	dkw	51481.96		03	FV5
15		ESSF	dkw	342767.6		04	FS5

Name		BGC Zone	Subzone	Area (m^2)	Total Area	Site Series	TEM Code
16		ESSF	dkw	179198.9		04	FS5
17		ESSF	dkw	353306.8		03	FV5
18		ESSF	dkw	193069.3		03	FV6
19	b	ESSF	dkw	65402.8		77	AC
19	c	ESSF	dkw	25527.87		88	AR
19	d	ESSF	dkw	43549.72		88	AR
20		ESSF	dkw	97597.61		03	FV6
22	b	ESSF	dkw	5226.003		03	FV5
23		ESSF	dkw	130057.7		03	FV7
26		ESSF	dkw	88109.44		04	FS5
27		ESSF	dkw	8199.764		04	FS7
28		ESSF	dkw	70183.65		03	FV5
29		ESSF	dkw	360079.9		04 88	6FS7 4AR
30		ESSF	dkw	27138.56		04	FS7
31		ESSF	dkw	6096.2		03	FV7
34		ESSF	dkw	116036.3		88	AR
35	b	ESSF	dkw	6356.436	3002192.282	03	FV7
17	b	ESSF	dkp	67297.66			FH7
18	b	ESSF	dkp	68327.08			7XA7,3LM6
19		ESSF	dkp	589275.4			AC
23	b	ESSF	dkp	28267.39			LM7
26	b	ESSF	dkp	163624.9			WF7
30	b	ESSF	dkp	18512.42			WF7
31	b	ESSF	dkp	25365.8			LM7
32		ESSF	dkp	60441.59			WF5
33		ESSF	dkp	45089.88			WF6
35		ESSF	dkp	34788.93	511715.6458		LM7
25		IMA	un	123098.8	123098.8334	n/a	n/a
				Total	6788182.984		

Additional site specific species information can be found on the Ecosystem Field forms (Appendix A) and are cross referenced with the Plant Species List (Table 8). The following sections contain general descriptions of the map polygons organized by biogeoclimatic (BGC) subzone.

Biogeoclimatic Subzone MSdk2

In the intervening period since the 1999 report, the province re-defined the ecological subzone mapping. As such, the Montane Spruce Dry Cool (MSdk) subzone is classified as Montane Spruce Columbia Dry Cool (MSdk2) subzone (MacKillop, 2012). The MSdk2 subzone generally occurs on lower slopes on the eastern slopes of the Purcell Mountains. The elevational range of the MSdk2 subzone is 1100 to 1650 m (Braumandl and Curran, 1992). Zonal (BEC site series 01, TEM symbol: SG, name: Sxw-Soopolallie-Grouseberry) MSdk is described as hybrid white spruce and subalpine fir dominated forest with minor occurrences of Douglas-fir. Seral stands of lodgepole pine are common. The shrub understorey consists primarily of false azalea, Utah honeysuckle, and soopolallie. No sample plots were taken from the MSdk subzone. However, the terrestrial ecosystem units were traversed on June 25, 1997 and are described herein. The MSdk2 subzone is approximately 22.5 ha in the study area.

Polygon 1

Polygone 1 and 2 are differentiated by the presence of a terrain unit that contains colluvial material, rather than specific variation in vegetation. Both the zonal site series described above and the moister, cooler site series 05 (TEM symbol: SS, name: Sxw-Soopolallie-Snowberry) are evident in these polygons. Site series 05 occurs on lower slopes in receiving areas. Observed forest vegetation was dominated by lodgepole pine, but included sub-dominant hybrid white-Engelmann spruce with and Douglas-fir. In addition to snowberry, soopolallie and tall Oregon-grape, twinflower was noted in abundance. Yellow columbine was also noted.

A number of minor vegetation associations were observed, but the units were too small for inclusion in the mapping. Groves of trembling aspen were encountered. Douglas maple was observed in avalanche and landslide paths. Red osier dogwood, typically associated with site series 07 (TEM symbol: SB, name: Sxw-Scrub birch-Sedge), was periodically noted in moist draws.

Photo 8. Ecosystem Polygon 1, MSdk2, TEM code SS6. June 26, 1997.

Polygon 2

In the 2016 update, Polygons 2 and 3 are combined due to an adjustment of the MSdk2 boundary by the BC Forest Service (MacKillop, 2012). Polygon 2 is located on a steep, northeastern slope with a number of wet gullies acting as receiving areas for the uplands. The wetlands were classified as site series 07 (TEM symbol SB, name: Sxw-Scrub birch-Sedge), while the drier component was classified as site series 03 (TEM symbol LJ, name: Pl-Juniper-Pinegrass). The polygon has an open canopy of lodgepole pine and Engelmann spruce dominated forest. The wet receiving areas have a dense shrub layer of scrub birch, and willows. The drier portions of the site contained Douglas maple in the forest canopy openings. Ground cover contained sphagnum moss in the wetter locations, as well as, sedges, roundleafed orchids, and Labrador tea. The drier areas between the receiving sites were described as zonal 01 (TEM symbol SG, name: Sxw–Soopolallie-Grouseberry).

Biogeoclimatic Subzone ESSFdk2

The Engelmann Spruce / Sub-alpine Fir Columbia Dry Cool subzone generally ranges from 1550 - 2100 m in the eastern Purcell Mountains. Climax forest in zonal plant communities (BEC site series 01, TEM symbol: FP, name: Bl-Black huckleberry-Red-stemmed feathermoss) is typically subalpine fir and Engelmann spruce (http://www.env.gov.bc.ca/ecology/tem/list.html, 2006). The shrub understorey consists dominantly false azalea, with lesser occurrences of black huckleberry and black gooseberry. A third of the study area is composed of ESSFdk2 (approximately 292 ha).

Polygon 4

Polygon 4 is located uphill of Polygon 2 and is geomorphologicly separated by the absence of colluvium. Vegetation is similar in that the forest is dominantly young lodgepole pine. This higher, drier ecosystem polygon is composed of site series 03 (TEM Symbol FV, name: Bl-Rhododendron-Black huckleberry) and 02 (TEM symbol FH, name: Bl–False azalea-Horsetail). In addition, a significant portion of the polygon is classified by MOF Forest Cover (see Map 3) mapping as non-forested. The non-forested portion is the result of significant gully erosion and is avalanche chutes, representing a disclimax plant community of low shrubs grasses and forbs. The avalanche chutes are classified as site series 77 (TEM symbol AC, name: Avalanch Chute).

Polygon 5

Polygon 5 occupies the lower flank of the prominent shoulder in the Taynton Bowl study area. This shoulder is characterized by thin morainal soil over bedrock. The soils yield drier site series and a reduced forest canopy. Forest cover is dominated by lodgepole pine with significant occurrence of Engelmann spruce on the upper levels and Douglas-fir in the Taynton Creek riparian zone.

Visual sample plot # 5 was located in an avalanche chute in Terrestrial Ecosystem Polygon 5, of the ESSFdk2 subzone at approximately 1655 m asl. Site series for the plot was assessed as 04 (TEM symbol FS, name: Bl-Azalea-Soopolallie). The plot was situated midslope on a moderate (30%) SE aspect slope. The site had well drained silty soils over weathered shale yields a sub-xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was a mature forest with a structural stage class of 6 (80 – 140 years), with a crown closure of approximately 5%. Dominant tree species was lodgepole pine, with Douglas-fir, Engelmann spruce and occasionally trembling aspen also occurring. Sitka alder and false azalea were the dominant shrubs, but willow red elderberry, and kinnikinnick was noted as well.

Photo 9: Ecosystem Polygon 5, ESSFdk2, TEM code FS6. June 26, 1997.

Polygon 6

Polygon 6 is a predominantly non-forested gully; site series 77 (AC). Thin soils on steep slopes have resulted in unstable conditions that will not support forest cover. This disclimax vegetation unit is classified as site series 04 (FS). Vegetation is limited to willow, mountain alder, and red elderberry. Surrounding the gully on more stable soils is the lodgepole pine forest, with Engelmann spruce on the lower gully walls and whitebark pine occurring above the headwall.

Polygon 7

Polygon 7 is differentiated from Ecosystem Polygon 5 by the presence of colluvium in the overburden. The vegetation community is a continuation of that found in Polygon 5 as corroborated by information gathered at three sample plots, presented below:

Detailed sample plot # 2 was located in Ecosystem Polygon 7, of the ESSFdk subzone at approximately 1970 m asl. Site series for the plot was assessed as 03 (FV). The plot was situated on the convex upper slope of a moderately steep (45%) NE aspect slope. A thin layer (30 cm) of fine soils over weathered shale produced imperfect drainage and a sub-zeric to sub-mesic moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was open with a crown closure of approximately 10%, with a young seral forest with a structural stage class of 5 (40 – 80 years). Dominant tree species was lodgepole pine, up to 15 m in height with no other trees in the plot. Estimated age of the largest tree in the plot, based on a core sample, was 45 years. Emergent lodgepole pine, whitebark pine, subalpine fir and Engelmann spruce were noted in the tall shrub layer. Low shrubs included common juniper, white-flowered rhododendron, and false azalea, with black huckleberry and grouseberry. Ground cover was sparse but heart-leaved arnica, fireweed, one-sided wintergreen, yarrow and aster observed. Lichens were uncommon, but noted. Wildlife habitat trees in the plot were on the ground.

Photo 10. Cow moose in Polygon 7, ESSFdk2, FS4. June 26, 2016.

Visual sample plot # 3 was located in Terrestrial Ecosystem Polygon 7, of the ESSFdk subzone at approximately 1825 m asl. Site series for the plot was assessed as 04 (FS). The plot was situated midslope on a moderate (25%) N aspect slope. A moderately well drained, thin layer (19 cm) of silty loam soils over weathered shale yields a sub-mesic moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was a young seral sapling pole forest with a structural stage class of 4 (20 – 80 years), with a crown closure of approximately 30%. Dominant tree species was lodgepole pine, up to 15 m in height with no other trees in the plot. Willow spp. and Sitka alder were noted in the tall shrub layer. Low shrubs included common false azaela, soopolallie, white-flowered rhododendron, black gooseberry, black huckleberry, Utah honeysuckle and grouseberry, with emergent Engelmann spruce. Ground cover was sparse but included heart-leaved arnica, fireweed, pink wintergreen, and showy aster.

Visual sample plot # 4 was located in Terrestrial Ecosystem Polygon 7, of the ESSFdk subzone at approximately 1775 m asl. Site series for the plot was assessed as 07 (TEM symbol WS, name: Willow-Sedge). The plot was situated midslope on a moderate (25%) N aspect slope. A poorly drained, layer of silty loam soils, with up to 60% coarse fragment content, yields a sub-hydric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was a disclimax low shrub thicket with a structural stage class of 3a. Dominant tall shrub species was Sitka alder although emergent Engelmann spruce and lodgepole pine were noted. Low shrubs included common trapper's tea, Labrador tea, tea-leaved willow, scrub birch, crowberry. Ground cover was composed of sedges, common horsetail, and white marsh marigold.

Photo 11. View up proposed lift alignment from the base in Polygon 7. August 4, 2016.

Polygon 8, 8b

Ecosystem Polygon 8 is a receiving site for colluvial deposits from upslope. Site series for this polygon is assessed as 04 (FS). Forest cover is dominantly lodgepole pine, with Douglas-fir sub-dominant. The lower half of the polygon is mature forest (see Map 3); possibly indicating it was not affected by the last major fire event in Taynton Bowl. This forest unit is the largest contiguous mature forest in the study area. Polygon 8b is a similar forest unit but is differentiated by a slightly different terrain unit that is generating colluvial material.

Photo 12. View downslope of an avalanche track in Polygon 8b, TEM code FS6.

Photo 13. Taken from Plot #4 across Ecosystem Polygon 9, ESSFdk2, TEM code AR, with Polygon 8, ESSFdk2, TEM code FS6 in background. June 26, 2016.

Polygon 9, 9b

Polygon 9 occupies the lower portion of the main gully of the south branch of Taynton Creek. The site series assessed to this polygon is 01 (FP), with occurrences of 07 (WS) in the wetter bottom of the gully. This non-forested disclimax unit occupies the landslide/avalanche chute site series 77 (AC), with runout and deposition zones for this major gully system classified as site series 88 (TEM symbol AR, name: Avalanche runout zone). Vegetation cover is sparse on the drier gully walls with shrubs dominating in the gully floor. Shrub species include Sitka alder, willows, and false azalea.

Polygon 9b is located upslope of Polygon 9 but within the ESSFdkw subzone. As such, it is classified as site series 77 (AC).

Polygon 10, 10b

Polygon 10 is defined by a steeply sloping, large bedrock outcropping with variable thin soils and sparse forest cover. Site series for this edaphic ecological unit is assessed as 02 (FH). Ground cover consists of grouseberry, pink heather, mosses, lichens, grasses and northwestern sedge. Shrubs are sparse and limited to juniper and false azalea. This ecosystem unit is best presented by .

Polygon 10b is separated from Polygon 10 by the creation of the ESSFdkw subzone. It shares the same classification as 02 (FH).

Polygon 11

Polygon 11 occupies the ridgetop of the shoulder above the avalanche chutes described in Polygon 6. Polygon 11 occupies the upslope extents of the ESSFdk2 subzone. Site series for this unit is assessed as 03 (FV). Forest cover is dominantly young lodgepole pine with occasional Engelmann spruce, subalpine fir and whitebark pine emerging in the understory. Ground cover is sparse with shrubs dominating in the form of grouseberry and black huckleberry.

Polygon 12

Polygon 12 occupies the upper reaches of the gully system of the south fork of Taynton Creek. Two deeply incised gullies provide warm and cool slopes with assessed site series 03 (FV). The vegetation conditions encountered on the cool slopes may be an edaphic response to the steep slopes and thin soils of the site, which contrasting with the increased solar exposure of the warm slopes of Polygon 9. The following sample plot summaries describe the conditions encountered on the cool slopes typical of Polygon 12.

Detailed sample plot # 12 was located in the ESSFdk subzone at approximately 2035 m asl. Site series for the plot was assessed as 03 (FV). The plot was situated midslope on a steep (60%) N aspect slope. A moderately well drained, layer (40 cm) of silty loam soils over weathered shale yields a sub-xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was a young seral sapling pole forest with a structural stage class of 4 (20 – 80 years), with a crown closure of approximately 10%. Dominant tree species was lodgepole pine (up to 14 m in height, 24 cm dbh, and 45 years old). While the lodgepole pine dominated the canopy, whitebark pine dominated the tall shrub layer and is emerging as the climax forest species. Alpine larch, subalpine fir, Engelmann spruce and lodgepole pine were also noted in the shrub layers. Low shrubs included false azalea, white-flowered rhododendron, black huckleberry, and grouseberry. Ground cover was 85% covered with mosses and lichens. No forbes, grasses or sedges were observed within the plot.

Polygon 12b is a portion of the same forest unit extending into the ESSFdkw subzone.

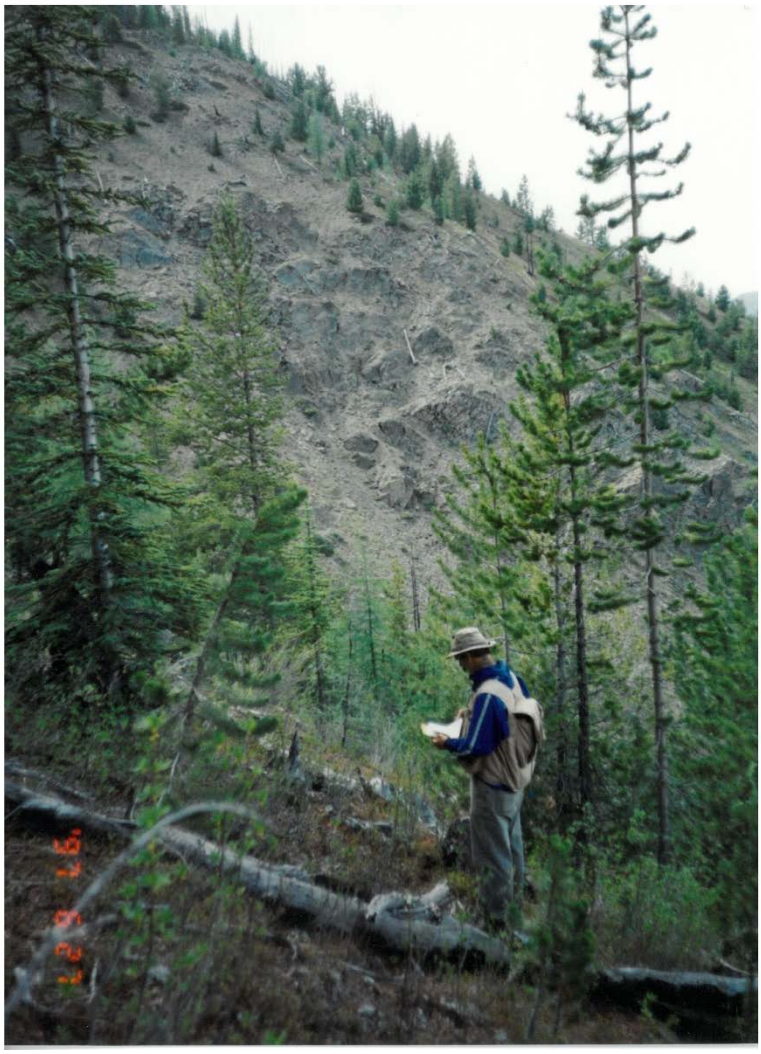


Photo 14. View from Plot #12, Polygon 12, TEM code FV4, across the gully to Polygon 10, TEM code FH6. June 27, 1997.

Photo 15. View down the main gully of Polygon 12, TEM code FV4. June 27, 1997.

Polygon 14

Polygon 14 is an area of steep cool lower slopes of Taynton Bowl. As a result, Polygon 14 marks the upslope extent of Douglas-fir as a forest component. most of the site is non-forested disclimax shrubland. Shrub species include Sitka willow, Sitka alder, False azalea, white-flowered rhododendron, and juniper. Site series for the plot was assessed as 04 (FS) during the 2016 site investigation.

Upslope in Polygon 14b, the ground steepens and the forested portions of the site are discontinuous, but dominated by lodgepole pine and subalpine fir, with whitebark pine beginning to appear. Site series was assessed as 07 (WS) in the wet gullies and depressions; 04 (FS) in the lower forested portions of the site; and 03 (FV) on upper forest units.

Detailed sample plot # 10 was located in Terrestrial Ecosystem Polygon 14b, of the ESSFdk2 subzone at approximately 1950 m asl. Site series for the plot was assessed as 04 (FS). The plot was situated midslope on a level, flat plateau. A well drained, thin layer (24 cm) of silty loam soils over weathered shale yields a xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic and described as orthic dystric brunisol. The sample plot represented a young seral sapling pole forest with a structural stage class of 4 (20 – 80 years), and a crown closure of approximately 5%. The dominant tree species was lodgepole pine (up to 35 cm dbh, 47 years old and 15 m in height), with alpine larch sub-dominant. Emergent tree species in the shrub layers were limited mainly to lodgepole pine, with minor occurrences of subalpine fir and Douglas-fir. Low shrubs included common false azaela, white-flowered rhododendron, black huckleberry, common juniper, black gooseberry, soopolallie, western mountain ash, black twinberry, Saskatoon, kinnikinnick, and grouseberry. Ground cover forbs included heart-leaved arnica, fireweed, common paintbrush, yarrow, pearly everlasting, wild strawberry, northwestern sedge, and pinegrass. Lichens and mosses were observed within the plot, but were not plentiful.

Photo 16. View across Polygon 14 to Plot #10 (TEM code FS4), located beyond and to the right of snow patches. June 27, 1997.

Polygon 14c is an upslope component of the Polygon 14 forest unit, but it occurs in the ESSFdkw subzone. Site series is assessed as site series 03 (FV).

Polygon 22, 22b

Polygon 22 is a steep northerly aspect coniferous forest dominated by lodgepole pine, but also containing Engelmann spruce and whitebark pine. Similar to much of the forest in the ESSFdk2 subzone, this forest is assessed as site series 03 (FV) and ranges in age from 40 to 80 years.

An ecosystem Site Visit Form was complete for Plot #15

Photo 17. Polygon 22, Plot #15, TEM code FV5. August 4, 2016.

Polygon 24

Polygon 24 is a steeply sloping forested unit composed almost exclusively of 40 to 80-year-old lodgepole pines. It is assessed site series 03 (FV).

Photo 18. Lodgepole pine forest in Polygon 24, TEM code FV5. August 4, 2016.

Biogeoclimatic Subzone ESSFdkw

The Dry Cool Woodland Engelmann Spruce Subalpine Fir subzone generally ranges from 1550 - 2100 m in the eastern Purcell Mountains. Climax forest in zonal plant communities (BEC site series 01, TEM symbol: FP, name: Bl-Black huckleberry-Red-stemmed feathermoss) is typically subalpine fir and Engelmann spruce in the ESSFdk2. However, no site series or units have been defined for the ESSFdkw (http://www.env.gov.bc.ca/ecology/tem/list.html, 2006). For the purposes of this assessment, site series classification from the ESSFdk2 will be used, recognizing that zonal ESSFdk2 conditions will not be likely to occur at the elevation occupied by the ESSFdkw. A third of the study area is composed of ESSFdkw (approximately 300 ha).

Polygon 13

Polygon 13 represents a small extension of the forest unit characterized by Polygons 10 and 12 that extends up into the ESSFdkw subzone. The ecosystem polygon is composed of a warm slope forest unit (similar to Polygon 10) and a cool slope forest unit (similar to Polygon 12. The warm slope is characterized by an open, young, mixed coniferous forest of whitebark pine, alpine larch, subalpine fir and Engelmann spruce. The cool slope is characterized by an old growth subalpine fir, alpine larch, Engelmann spruce forest. Both units were assessed a site series of 03 (FV), although it should be noted that the ESSFdkw subzone has not had specific site series designations making accurate TEM classification difficult.

The Visual sample plot # 13 was located in the ESSFdkw subzone at approximately 2125 m asl. The plot was situated on a steep (70%) NE aspect upper slope. A moderately well drained, variable layer (0 – 200 cm) of silty loam soils over weathered shale yields a sub-xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was young seral transitional sapling pole to young forest with a structural stage class of 4 - 5 (20 – 80 years). Crown closure was estimated to be approximately 5%. Dominant tree species was whitebark pine, with minor occurrences of lodgepole pine and alpine larch. No discernible understorey was observed. Low shrubs were limited to common juniper and grouseberry (60% of total ground cover). Ground cover was sparse but included heart-leaved arnica, yarrow, common paintbrush, pink heather, lichens, grasses and northwestern sedge.

Polygon 15

Polygon 15 is large open canopied forest unit occupying a north-south oriented ridge and its upper slopes on both sides. A site visit form was completed at Plot #14 to verify the site conditions (see Appendix A). The young forest is dominated by whitebark pine, with subalpine fir, lodgepole pine and larch (site series 04 (FS)).

Photo 19. View of the Polygon 15 ridge, TEM code FS5, from Polygon 19 TEM code AV. August 4, 2016.

Photo 20. Polygon 15, Plot #14. August 4, 2016.

Polygon 16

Polygon 16 occupies a sparsely-forested vegetation unit located downslope of Polygon 15, on the eastern slopes of the ridge. It is characterized by steep rocky thin soils. Shrub vegetation cover dominates but is discontinuous. The forest is dominated by lodgepole pine, but minor occurrence of whitebark pine persists and is assessed as site series 04 (FS).

Photo 21. Polygon 16, looking up slope, TEM code FS5. June 27, 1997.

Polygon 17, 17b

Polygon 17 occupies the headwall of the eastern branch of the south Taynton Creek gully system. It contains two sample plots, which provide a description of the conditions occurring within.

Visual sample plot # 8 was located in the ESSFdkw subzone at approximately 2225 m asl. The plot was situated on a steep (70%) NE aspect upper slope. A rapidly to well drained, variable layer (0 –200 cm) of silty loam soils over weathered shale yields a xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was a young forest with a structural stage class of 5 (40 – 80 years), with a crown closure of less than 5%. Dominant tree species was whitebark pine, with occasional lodgepole pine noted. This site is assessed as site series 03 (FV).

Photo 22. Polygon 17b, ESSFdkp subzone, TEM code FH7. View down to Polygon 17 on left TEM code FV5. Polygons 34 and 9 below, TEM code AR. June 27, 1997.

Low shrubs included common juniper, grouseberry, white-flowered rhododendron, and black huckleberry. Ground cover was sparse but included heart-leaved arnica, common red paintbrush, white and pink heathers.

Detailed sample plot # 7 was located in Polygon 17b in the ESSFdkp subzone at approximately 2325 m asl. The plot was situated on the upper slope of a steep (70%) N aspect windswept slope. A moderately well drained, thin layer (45 cm) of silty loam soils over weathered shale yields a xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was a remnant alpine larch dominated old growth forest with a structural stage class of 7 (300+ years of age, 46 cm dbh, 14 m tall), with a crown closure of approximately 5%. Emergent trees occupying the tall shrub layer consisted of alpine larch, whitebark pine, and subalpine fir, ranging in age to 60 years (12 – 14 cm dbh, 6 – 7 m tall). A significant number of fire burned standing alpine larch snags were assessed as wildlife trees. Ground cover is dominated by grouseberry with mosses and lichens also common. Globeflower was recorded within the sample plot. This site is assessed as site series 02 (FH).

Photo 23. View from Plot #7, ESSFdkp, downslope to Polygon 17, ESSFdkw, TEM code FV5. June 27, 1997.

Polygon 18, 18b

Polygon 18 represents the ESSFdkw subzone and is an upslope extension of ESSFdk2 ecosystem Polygon 9. It occupies the headwall of the western branch of the south Taynton Creek gully system.

Visual sample plot # 1 was located in Polygon 18b the ESSFdkp subzone at approximately 2360 m asl. The plot was situated on the crest of a steep (60%) NE aspect slope. Fine soils of variable thickness over weathered shale produced imperfect drainage and a sub-zeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was open with a crown closure of approximately 10%, with a mature forest structural stage of class 6 (80 – 140 years). Dominant tree species was alpine larch with minor occurrences of whitebark pine and subalpine fir. Ground cover was dominated by heathers and lichens with grasses and sedges commonly occurring. Grouseberry was observed, but scarce. Forbs observed within the plot were limited to bracted lousewort, alpine pussytoes and northwestern goldenrod. This site is described as TEM code LM, name: Bl-Alpine larch–White mountain-heather.

Photo 24. Polygon 18, view of cliffs with potential goat habitat. June 27, 1997.

Photo 25. Polygon 18, ESSFdkw TEM code FV6, view up slope toward Polygon 18b, ESSFdkp, TEM code XA7. June 27, 1997.

Visual sample plot # 6 was located on the ridge in the ESSFdkp subzone at approximately 2360 m asl. The plot was situated on a steep (70%) NE aspect upper slope. A well drained, variable layer (0 – 200 cm) of silty loam soils with up to 90% coarse fragments over weathered shale yields a sub-xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was an old growth forest with a structural stage class of 7 (>140 years), with a crown closure of approximately 5%. Dominant tree species was alpine larch (core samples exceeding 300 years of age) and Douglas-fir. Shrubs were limited to grouseberry. Ground cover was dominantly heathers, mosses, and lichens, on predominantly exposed mineral soils and loose shale. Groundcover forbs included yarrow, dwarf hawksbeard, sub-alpine daisy, western groundsel, wooly pussytoes, and bracted lousewort. This site is described as TEM code XA, name: BlLa–White mountain-heather, Subalpine daisy-Sitka valerian.

Polygon 20

Polygon 20 is an ESSFdkp extension of the pine forest unit described for Ecosystem Polygon 11. The primary difference is that this mature forest unit is dominated by whitebark pine with lodgepole pine also co-dominant, instead of reversed order as occurs in Polygon 11, at lower elevation. This site is assessed as site series 03 (FV).

Polygon 21

Polygon 21 also occupies the head of two major gullies associated with the south Taynton Creek gully system. Two sample plots were included in the survey of this ecosystem unit and are described herein.

Visual sample plot # 9 was located in the ESSFdk2/ESSFdkw transitional subzone at approximately 2010 m asl. The plot was situated midslope on a moderately steep (40%) N aspect slope. A well drained, variable layer (0-200 cm) of silty loam soils with up to 80% coarse fragment content over weathered shale yields a sub-mesic moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot represented a shrub thicket community with a structural stage class of 3a (20 – 100 years), with a crown closure of approximately 2%. Dominant tree species were whitebark pine, alpine larch and subalpine fir ranging in height from 4 to 8 m. Low shrubs included common juniper, false azalea, white-flowered rhododendron, and grouseberry. Ground cover was sparse but included heart-leaved arnica, fireweed, northwestern sedge, and sub-alpine buttercup.

Visual sample plot # 11 was located in the ESSFdkw subzone at approximately 1950 m asl. Site series for the plot was assessed as 03 (FV). The plot was situated midslope on a steep (70%) NE aspect slope. A moderately well drained, variable layer (0 - 200 cm) of silty loam soils with 80% coarse fragment content, over weathered shale yields a sub-xeric moisture regime. Soil nutrient regime was estimated to be permesotrophic. The sample plot was a young forest with a structural stage class of 5 (40 – 80 years), with a crown closure of approximately 40%. Dominant tree species was lodgepole pine, with sub-dominant whitebark pine and occasional Douglas-fir as well as alpine larch. Shrubs included willows, false azaela, white-flowered rhododendron, black huckleberry, and grouseberry. Ground cover included heart-leaved arnica, yarrow, and lichens.

Polygon 23, 23b

Polygon 23 occupies and diverse forested unit composed of old growth subalpine fir, Engelmann spruce, alpine larch and whitebark pine. It is assessed as 03 (FV).

Polygon 23b extends up into the ESSFdkp and as such is classified as LM.

Polygon 26, 26b

Polygon 26 is a mid-slope bench forest unit in the upper portion of Taynton Bowl. The young forest is dominated by whitebark pine and lodgepole pine. As such, it is assessed as 04 (FS).

Polygon 26b is a continuation of the same forest as it transitions upslope into an old growth forest in the subalpine zone of the ESSdkp. While the forest continues to be dominated by whitebark pine, lodgepole

pine yields to Engelmann spruce, alpine larch and subalpine fir. Polygon 26b is assessed as WF (Whitebark pine -Subalpine fir).

Polygon 27

Polygon 27 is the same old growth forest unit as 26b, but it is within the ESSFdkw subzone. As such, it is assessed as site series 04, (FS).

Polygon 28

Polygon 28 is associated with the Polygon 22 forest unit located in the ESSFdk2 subzone. Species composition is similar as a young lodgepole pine forest with Engelmann spruce and whitebark pine also present. Polygon 28 is assessed as site series 03 (FV).

Polygon 29, 29b, 29c

Polygon 29 is an upper Taynton Bowl, valley bottom receiving area. Photo 26, below, shows the current conditions at Polygon 29. The site was dominated by lodgepole pine with lesser occurances of whitebark pine, Engelmann spruce and Douglas-fir offering 30% crown closure. The shrub layer contained willow, falsebox, elderberry and white flowered rhododendron. Ground cover consisted of bunchberry, grouseberry, billberry, kinnikinnick, pinegrass and one-sided wintergreen. Polygons 29b and 29c are extensions of the avalanche modified site extending into the ESSFdk2 subzone.

Photo 26. View north from the lower, steep slopes of Polygon 15, looking across Polygon 29

Polygon 30, 30b

Polygon 30 is an old growth forest unit that extends into the ESSFdkp (Polygon 30b). Dominated by whitebark pine, the tree composition also includes subalpine fir, alpine larch, and Engelmann spruce. Polygon 30 is assessed as site series 4 (FS). Polygon 30b is corrected for the ESSFdkp and assessed as WF.

Polygon 31, 31b

Polygon 31 is a remnant old growth forest unit that extends across the ESSFdkw/ESSFdkp subzone boundary. It is composed almost entirely of alpine larch with a minor component of subalpine fir on a steep, north aspect slope. The ESSFdkw portion (Polygon 31) is assessed as site series 03 (FV). The ESSFdkp portion (Polygon 31b) is corrected to LM.

Polygon 34

Polygon 34 is an avalanche receiving area with little vegetation other than ground cover and low shrubs. It is assessed as AR.

Polygon 35, 35b

Polygon 35 and 35b are a single old growth forest unit extending across the ESSFdkw/ESSFdkp subzone boundary. This alpine larch dominated forest shares characteristics with Polygon 31, except that it is more diverse with minor components of Engelmann spruce and whitebark pine, in addition to subalpine fir. Polygon 35b is assessed as 03 (FV). Polygon 35 is assessed as LM.

Biogeoclimatic Subzone ESSFdkp

The Dry Cool Parkland Engelmann Spruce Subalpine Fir subzone generally ranges from 1550 - 2100 m in the eastern Purcell Mountains. Although TEM codes have been developed, no site series have been defined for the ESSFdkp (http://www.env.gov.bc.ca/ecology/tem/list.html 2006), In an effort to correlate the ground conditions encountered in the ESSFdkp subzone with the TEM codes, 3 sample plots were established and are described in Polygons 18b and 17b in the previous section. Approximately 51 ha of the study area is composed of ESSFdkw.

Polygon 19, 19b, 19c, 19d

Polygon 19 occupies the primarily unvegetated area below the peak of Mt. Goldie and extending to the east along the ridgeline. It is an area of steep, unstable slopes that are prone to rock fall and colluvial deposition. Polygon 19 and 19b extend downslope into the ESSFdkw subzone but share the common TEM classification as AV (Avalanche chute) and Polygons 19c and 19d are classified as AR (Avalanche runouts).

Photo 27. Polygon 19, ESSFdkp, TEM code AV. August 4, 2016.

Photo 28. Colluvial deposition at the ecosystem interface between Polygon 19, 15 and 32. August 4, 2016.

Polygon 32

Polygon is an upslope extension of Polygon 15, occurring within the ESSFdkp subzone. As such, it is assessed as WF, Whitebark pine – Subalpine fir.

Polygon 33

Polygon 33 is and upslope extension of the avalanche modified forest unit described previously as Polygon 15. The forest canopy is open and the forest composition is dominated by mature whitebark pine with minor occurrence of subalpine fir and alpine larch. Polygon 33 is assessed as WF.

Biogeoclimatic Subzone IMAun

The Woodland, Parkland Alpine subzone is one of the most extensive in the Nelson Forest Region and it occupies a significant portion of the study area. However, due to the relatively low elevation of the summit ridge of the study area (2365 m), much of the area previously identified as AT on the Forest Service mapping is re-classified as ESSFdkp (parkland or krummholz). Rock, talus, snow and ice generally characterize the IMA subzone. Vegetation consists of willows, stunted western larch, whitebark pine, buttercups, saxifrages, pussytoes, Sitka valerian, and mountain heathers. The IMA biogeoclimatic subzone occupies approximately 12 ha in the study area. Unfortunately, IMA is not yet classified by site series and is therefore not coded for Terrestrial Ecosystem Mapping. Approximately 12.3 ha of the study area is classified as !Maun.

Polygon 25

Polygon 25 captures the peak of Mt. Goldie and as such is a largely unvegetated extension of Polygon 19. It is not classified by TEM. This site is barren of vegetation and was not visited during the 2016 site investigation.

2.3.2 Plants and Plant Communities

Rare and Threatened B.C. Conservation Data Center (CDC) does not list any rare plant communities for the subject area (accessed Sept 3, 2016. http://a100.gov.bc.ca/pub/eswp/search.do?method=reset).

With the exception of whitebark pine (*Pinus albicaulis*), which is locally common within the study area, and sheep cinquefoil (*Potentilla ovina* var*. ovina*), which occurs in the headwaters of Hopeful Creek, no known rare, endangered or threatened (Red Listed), or vulnerable (Blue Listed) plant species were listed by the CDC as occurring near the study area (CDC Sept. 3, 2016). However, based on the documented occurrence of several species in ESSFdk it is possible the following red listed plants may occur within the study area (CDC, 2016):

- Androsace buckwheat (*Eriogonum androsaceum*) Red List
- Dwarf poppy (*Papaver pygmaeum*) Red List
- Limber pine (*Pinus flexilis*) Red List
- Mountain bog gentian (*Gentiana calycosa*) Red List
- Sheep cinquefoil (*Potentilla ovina* var*. ovina*) Red List
- Standley's selaginella (*Selaginella standleyi*) Red List
- Parry's townsendia (*Townsendia parryi*) Red List
- Payson's sedge (*Carex paysonis*) Red List
- Prairie golden bean (*Thermopsis rhombifolia*) Red List
- Purple meadowrue (*Thalictrum dasycarpum*) Red List
- Rocky Mountain willowherb (*Epilobium saximontanum*) Red List
- Wolf's trisetum (*Graphephorum wolfii*) Red List

In addition to the plants listed above, the following red listed plant may occur in the IMAun subzone of the study area:

◊ Buff daisy (*Erigeron ochroleucus*) Red List

Table 8. Plant species list for portion of Taynton Bowl

Code	Latin Name	Common Name
	TREES	
Bl	*Abies lasiocarpa*	Subalpine Fir
La	*Larix lyallii*	Alpine Larch
Se	*Picea engelmannii*	Engelmann Spruce
Sxw	*Picea engelmannii x glauca*	Hybrid White Spruce
Pa	*Pinus albiculis*	Whitebark Pine
Pl	*Pinus contorta*	Lodgepole Pine
At	*Populus tremuloides*	Trembling Aspen
Fd	*Pseudotsuga menziesii*	Douglas-fir
	SHRUBS	
AcGl	*Acer glabrum*	Douglas Maple
ALIN	*Alnus incana*	Mountain Alder
AlSi	*Alnus sitchensis*	Sitka Alder
AmAl	*Amelanchier alnifolia*	Saskatoon
ARUV	*Arctostaphylos uva-ursi*	Kinnikinnick
BeGl	*Betula glandulosa*	Scrub Birch
CaMe	*Cassiope mertensiana*	White Mountain-heather
ChUm	*Chimaphila umbellata*	Prince's Pine
CoSt	*Cornus stolonifera*	Red-osier Dogwood
EMNI	*Empetrum nigrum*	Crowberry
JUCO	*Juniperus communis*	Common Juniper
LeGl	*Ledum glandulosum*	Trapper's Tea
LEGR	*Ledum groenlandicum*	Labrador Tea
LiBo	*Linnaea borealis*	Twinflower
LoIn	*Lonicera involucrata*	Black Twinberry
LoUt	*Lonicera utahensis*	Utah Honeysuckle
MAAQ	*Mahonia aquifolium*	Tall Oregon-Grape
MEFE	*Menziesia ferrunginea*	False Azalea
PhEm	*Phyllodoce empetriformis*	Pink Mountain-heather
RhAl	*Rhododendron albiflorum*	White-flowered Rhododendron
RiLa	*Ribes lacustre*	Black Gooseberry
RiVi	*Ribes viscosissimum*	Sticky Currant
SaBr	*Salix brachycarpa*	Short-fruited Willow
SaSc	*Salix scouleriana*	Scouler's Willow
SAPL	*Salix plantifolia*	Tea-leaved Willow
SARA	*Sambucus racemosa*	Red Elderberry
ShCa	*Sheperdia canadensis*	Soopolallie
SOMU	*Solidago multiradiata*	Northern Goldenrod
SoSc	*Sorbus scopulina*	Western Mountain-Ash
SPBE	*Spiraea betulifolia*	Birch-leaved Spiraea
VaMe	*Vaccinium membranaceum*	Black Huckleberry
VaSc	*Vaccinium scoparium*	Grouseberry
	HERBS	
AcMi	*Achilla millefolium*	Yarrow

Code	Latin Name	Common Name
AmRo	*Amerorchis rotundifolia*	Round-leaved Orchis
AnMa	*Anaphalis margaritacea*	Pearly Everlasting
AnAl	*Antennaria alpina*	Alpine Pussytoes
AnLa	*Antennaria lanata*	Wooly Pussytoes
AqFl	*Aqilegia flavescens*	Yellow Columbine
ArCo	*Arnica cordifolia*	Heart-leaved Arnica
AsCo	*Aster conspicuus*	Showy Aster
CaRu	*Calamagrostis rubescens*	Pinegrass
Ca	*Carex spp.*	Sedges
CaCo	*Carex concinnoides*	Northwestern Sedge
CaLe	*Caltha leptosepala*	White Marsh Marigold
CaMi	*Castilleja miniata*	Common Red Paintbrush
ClOc	*Clematis occidentalis*	Blue Clematis
CoCa	*Cornus canadensis*	Bunchberry
CrNa	*Crepis nana*	Dwarf Hawksbeard
CyMo	*Cypripedium montanum*	Mountain Ladyslipper
EpAn	*Epilobium angustifolium*	Fireweed
Erpe	*Erigeron peregrinus*	Sub-alpine Daisy
FrVi	*Fragaria virginiana*	Wild Strawberry
GoOb	*Goodyera oblongifolia*	Rattlesnake Plantain
HeLa	*Heracleum lanatum*	Cow-parsnip
OrSe	*Orthilia secunda*	One-sided Wintergreen
PeBr	*Pedicularis bracteosa*	Bracted Lousewort
PoPr	*Poa pratensis*	Kentucky Bluegrass
PyAs	*Pyrola asarifolia*	Pink Wintergreen
RaEs	*Ranunculus eschscholtzii*	Subalpine Buttercup
SaLy	*Saxifraga lyallii*	Red-stemmed Saxifrage
SeIn	*Senecio integerrimus*	Western Groundsel
SeTr	*Senecio triangularis*	Arrow-leaved Groundsel
TaOf	*Taxaxacum officinale*	Common Dandelion
ThOc	*Thalictrum occidentale*	Western Meadowrue
	FERNS, HORSETAILS	
Eq	*Equisetum spp.*	Horsetail (Common)
	MOSSES, LICHENS, LIVERWORTS	
	Sphagnum spp.	Sphagnum spp.
PeAp	*Peltigera aphthosa*	Freckle Pelt
StPa	*Sterocaulon paschale*	Common Coral Lichen

2.3.3 Wildlife and Wildlife Habitat

Methodology

A reconnaissance level wildlife and wildlife habitat inventory was conducted which focused on wildlife species of regional concern, namely ungulates (moose, elk, mountain goat, white-tailed deer and mule deer), both species of bear (grizzly and black), small carnivores (lynx and pine marten) and squirrels (the *Selkirki* subspecies of the least chipmunk - *Tamias minimus selkerki*), amphibians, cavity nesters, and bats. The methodology involved collecting information on wildlife use during site traverses and terrestrial ecosystem mapping plots. Direct contacts with wildlife and evidence of wildlife occurrence (i.e., 'sign' such as scats, tracks, trails, burrows, nests, bones, feathers, and various kinds of feeding sign) were recorded. Wildlife were observed with the aid of 8X36 binoculars. The primary objective of the surveys was to identify valued ecosystem components (VECs) such as important nest sites, wildlife trees and feeding areas, and environmentally sensitive areas including habitats of high value to wildlife.

The Conservation Data Centre was contacted to investigate known rare wildlife occurrences within Taynton Bowl. However, no rare wildlife occurrences are currently mapped in the study area. Wildlife observed on the subject property, and wildlife that is expected to occur, are described in more detail below.

Birds

Because of the late summer timing of the field survey, many of the breeding birds expected to occur on the site were not observed. Table 9 provides a list of bird species known or expected to occur on the site. Because a full bird survey was not completed, the attached list is based on general habitat associations and may not cover all species that may occur in the Taynton Bowl.

Species observed during the survey included American robin (see Table 9 for scientific names), boreal chickadee, common raven, ruby-crowned kinglet, ruffed grouse, mountain bluebird, Clark's nutcracker, hairy woodpecker and white-crowned sparrow.

No rare or endangered bird species are expected to occur within the study area.

Table 9. Bird species known or expected to occur in the study area.

Common Name	Scientific Name
DUCK OR GEESE (Not expected)	
HAWKS	
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Northern Goshawk	*Accipiter gentilis*
Red-tailed Hawk	*Buteo jamaicensis*
Golden Eagle	*Aquila chrysaetos*
Merlin	*Falco columbarius*
GROUSE	
White-tailed Ptarmigan	*Lagopus leucurus*
Blue Grouse	*Dendragapus obscurus*
Ruffed Grouse	*Bonasa umbellus*
Spruce Grouse	*Dendragapus canadensis*
OWLS	
Great Horned Owl	*Bubo virginianus*
Northern Hawk-Owl	*Surnia ulula*
Northern Pygmy-Owl	*Glaucidium gnoma*
Barred Owl	*Strix varia*

Common Name	Scientific Name
Boreal Owl	*Aegolius funereus*
Great Gray Owl	*Strix nebulosa*
Northern Saw-whet Owl	*Aegolius acadicus*
HUMMINGBIRDS	
Calliope Hummingbird	*Stellula calliope*
Rufous Hummingbird	*Selasphorus rufus*
WOODPECKERS	
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Three-toed Woodpecker	*Picoides tridactylus*
Black-backed Woodpecker	*Picoides arcticus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
FLYCATCHERS	
Say's Phoebe	*Sayornis saya*
Olive-sided Flycatcher	*Contopus borealis*
Western Wood-Pewee	*Contopus sordidulus*
Hammond's Flycatcher	*Empidonax hammondii*
CORVIDS	
Steller's Jay	*Cyanocitta stelleri*
Gray Jay	*Perisoreus canadensis*
American Crow	*Corvus brachyrhynchos*
Clark's Nutcracker	*Nucifraga columbiana*
Common Raven	*Corvus corax*
CHICKADEES	
Black-capped Chickadee	*Parus atricapillus*
Boreal Chickadee	*Parus hudsonicus*
Mountain Chickadee	*Parus gambeli*
NUTHATCHES/CREEPERS	
Red-breasted Nuthatch	*Sitta canadensis*
Brown Creeper	*Certhia americana*
WRENS	
Winter Wren	*Troglodytes troglodytes*
KINGLETS/THRUSHES	
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Townsend's Solitaire	*Myadestes townsendii*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Mountain Bluebird	*Sialia currucoides*
Varied Thrush	*Ixoreus naevius*
PIPITS	
American Pipit	*Anthus rubescens*
WAXWINGS	
Bohemian waxwing	*Bombycilla garrulus*
Cedar Waxwing	*Bombycilla cedrorum*

Common Name	Scientific Name
VIREOS	
Solitary Vireo	*Vireo solitarius*
Warbling Vireo	*Vireo gilvus*
WARBLERS	
Orange-crowned Warbler	*Vermivora celata*
Yellow-rumped Warbler	*Dendroica coronata*
Townsend's Warbler	*Dendroica townsendii*
MacGillivray's Warbler	*Oporornis tolmiei*
SPARROWS	
Western Tanager	*Piranga ludoviciana*
Chipping Sparrow	*Spizella passerina*
Song Sparrow	*Melospiza melodia*
Fox Sparrow	*Passerella iliaca*
Brewer's Sparrow	*Spizella breweri*
SPARROWS (Continued)	
White-crowned Sparrow	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*
FINCHES	
Pine Grosbeak	*Pinicola enucleator*
Rosy Finch	*Leucosticte arctoa*
Red Crossbill	*Loxia curvirostra*
White-winged Crossbill	*Loxia leucoptera*
Pine Siskin	*Carduelis pinus*
Evening Grosbeak	*Coccothraustes vespertinus*

*** References include Campbell *et al.* 1990.**

Mammals

Rare or endangered wildlife that may occur on the site include wolverine (*Gulo gulo*) (blue-listed), grizzly bear (*Ursus arctos*) (blue-listed), woodland caribou (*Rangifer tarandus*) (blue listed), least chipmunk (*Tamias minimus selkerki*) (red listed) and badger (*Taxidea taxus*) (blue-listed). Habitat preferences and distribution of these and other mammal species known or expected to occur on the site are described in more detail below.

Bear sign observed on the field surveys included diggings, tree scrapes, and feeding sign. Some lower bark stripping on lodgepole pine, indicative of bears feeding on the soft cambium layer, was noted. Because both species of bear, grizzly and black bear (*Ursus americanus*) are believed to utilize Taynton Bowl, it was difficult to distinguish what species was responsible for the above mentioned sign, unless associated with tracks.

Black bears are expected to be common residents of the study area, especially in the spring when forbs and herbs are attractive food sources. Huckleberries, oval-leafed blueberry, thimbleberry and soopallalie provide foraging opportunities in the fall. Black bear have been regularly seen on Panorama Mountain. This fall (1997), a black bear became habituated to garbage in Panorama Village, within two kilometres of the study area. A black bear den is located along the horse trail in the lower Taynton drainage.

Grizzly bear, a blue-listed species, is known to occur regularly in Taynton Bowl (anecdotal information from a number of local hunters). Grizzly tracks were sighted on the first field day along the horse trail and in the lower riparian area of the Taynton Bowl. A grizzly was sighted by the hunting-guide outfitter, Lyle Barsby, in mid-September, 1997 and by Scott Barsby on October 22, 1997. Recent evidence of foraging on gooseberries was observed in Taynton Bowl riparian habitats, along with fresh tracks. Ground

squirrels in the slide paths and a variety of berries throughout the Taynton Bowl area provide foraging opportunities for grizzly bear. Fresh grizzly bear excavations (i.e., in ground squirrel area) were observed in the Bowl in summer 1994. Grizzly have been sighted on Panorama Mountain over the years (anecdotal information from local residents) and in Panorama Village in May 1992.

Photo 29. Grizzly bear excavation site in Polygon 15. August 4, 2016.

Moose (*Alces alces*) pellet groups and tracks were noted throughout one of the small wetlands and on ridges. In one area, where excellent foraging opportunities existed for both elk and moose, recent, congealed large ungulate droppings were observed. However, it was difficult to determine if they were from elk or moose. Moose are expected to occur throughout the year. A cow moose was sighted near Sample Plot 3 on June 26, 1997. The sighting occurred at approximately 1825 m asl and was near a small wetland. Although not seen during these field surveys, a bull moose was sighted in the Taynton Bowl in July 1995. On October 22, 1997, Scott Barsby, of Toby Creek Outfitters, reported sighting a grizzly bear feeding on a bull moose near Sample Plot 3. Dense shrub vegetation adjacent to wetlands provides good spring, summer, fall and early winter foraging opportunities. Willow (*Salix* spp.) in the Taynton riparian and in the upper wetland areas showed evidence of heavy browse activity, both recent and old. Late winter foraging opportunities may be limited by significant slide activity.

Elk (*Cervus canadensis*) tracks and pellets were noted throughout the study area, with a greater concentration of activity in the lower riparian zone and wetlands. Two “group” bedding areas were noted in the grassy areas at the base of two separate avalanche chutes. Nearby shrubs showed evidence of recent browse, presumably from the elk. Ungulate antler rubs of various ages were noted throughout the study area.

Numerous tracks were observed at the base of one of the cliff bands that occur on the upper slopes of Taynton Bowl. The tracks were in shale so it was impossible to distinguish what animal species was responsible, however, due to the terrain, it is likely that of mountain goat (*Oreamnos americanus*). A mineral lick, frequented by mountain goats, is apparently located along the Taynton Ridge (Scott Barsby,

Toby Creek Outfitters, pers. comm. 1997). Mountain goat have been observed recently walking along the Taynton Ridge (Scott Barsby, Toby Creek Outfitters, pers. comm. 1997). Significant goat populations are found just west of Taynton, along the Brewer-Mineral King Ridge (Trevor Kinley, Sylvan Consulting, pers. comm. 1997). Brewer-Mineral King Ridge is contiguous with Taynton Ridge and would be easily accessible.

Mule deer (*Odocoileus hemionus hemionus*) are common residents of the study area. High snow depths likely limit utilization of the site in the winter. Forbs found in the run out zones of the slide paths would provide excellent grazing opportunities. Deer tracks were noted on some of the game trails in the forested areas. A fresh deer antler rub was noted in one of the plots (tracks visible in surrounding soil). Due to the habitat and elevation, the rub was likely created by a mule deer.

White-tailed Deer (*Odocoileus virginianus*) are not as abundant as mule deer on the site. White-tailed deer typically inhabit dense areas adjacent to creeks or in valley bottoms whereas mule deer are more typically found in open, higher elevation areas in summer.

Photo 30. Deer track in Polygon 19. August 4, 2016.

The nearest known mountain caribou (*Rangifer tarandus*) populations are on the slopes west of the Bugaboos and in the Findlay Creek drainage (Trevor Kinley, Sylvan Consulting. pers comm. 1997). There are no known sedentary populations in the Toby and Horsethief Creek drainage, however, sporadic sightings have been reported which allows for the possibility that a yet undiscovered herd exists (Trevor Kinley, Sylvan Consulting. pers comm. 1997). The most recent local sighting occurred in the summer of 1996 and was approximately 17 kilometers west of Panorama Mountain Village, on the Toby Creek Road (Alison Candy, Osprey Communications, pers. comm. 1996).

Red squirrel (*Tamiasciurus hudsonicus*) sign and individuals were observed on numerous occasions. Sign included cone scales, large and extensive middens and calls. The predominance of cone-bearing trees on the site provides an abundance of foraging opportunities. Columbian groundsquirrel (*Spermophilus columbianus*) occur in open, disturbed areas on the site (they are common at Panorama Village nearby). Northern flying squirrel (*Glaucomys sabrinus*), a nocturnal squirrel, likely inhabits forested

regions. In addition, several chipmunks were sighted in the upper extremities of Taynton Bowl. These may have been the red listed *Selkirki* subspecies of the least chipmunk, which is vulnerable due to its restricted range, or the more widely distributed yellow-pine chipmunk (*Tamias amoenus*). Hoary marmots (*Marmota caligata*) are expected to occur in subalpine and alpine habitats of the subject property. Common pika (*Ochotona princeps*) was heard calling from the talus slopes on the property.

Photo 31. Chipmunks commonly observed in Polygon 19, near the ridge top. August 4, 2016.

Water shrews (*Sorex palustris*) are expected to occur in creek and wetland habitats throughout the site. However, some of the creeks dry up in the summer and would not be suitable for this species. Other shrew species expected to occur on the site include common (*Sorex cinereus*) and dusky shrew (*S. monticolus*).

The availability of snags and wetlands on the site provides roosting and foraging opportunities for bats. Panorama falls within the known distribution of several bat species. These species include California myotis (Myotis californicus), western long-eared myotis (M. evotis), little brown myotis (M. lucifugus), long-legged myotis (M. volans), hoary bat (Lasiurus cinereus), silver-haired bat (Lasionycteris noctivagans) and big brown bat (Eptesicus fuscus). However, with the exception of the little brown myotis that has been found to 2300 m, most records for other bat species listed above are from below approximately 1200 m (Nagorsen and Brigham 1993). Generally, very little is known of the altitudinal distribution of bats in the province.

Although snowshoe hares (*Lepus americanus*) were not observed during the field survey, they are expected to be relatively common on the site, especially in denser, mature forests.

Porcupine (*Erethizon dorsatum*) was not observed during the field survey but lodgepole pine, located in the lower elevations of the study area, exhibited bark scrapings indicative of porcupine feeding sites. Scat was observed.

Southern red-backed vole (*Clethrionomys gapperi*) is expected to inhabit forested regions whereas deer mouse (*Peromyscus maniculatus*) likely occurs in most habitats. Other small rodent species that may occur include bushy-tailed woodrat (*Neotoma cinerea*), northern bog-lemming (*Synaptomys borealis*), water vole (*Microtis richardsoni*), heather vole (*Phenacomys intermedius*), meadow vole (*Microtis pennsylvanicus*) and western jumping mouse (*Zapus princeps*). Fresh tracks of microtines were observed in the snow (fallen from the night before the field survey day) at the higher elevation plots. Lower elevation plots were below the snow line so tracks were not visible.

Habitats of the subject property are suitable for canid species. Coyote (*Canis latrans*) is likely the most abundant species followed by gray wolf (*Canis lupus*) and red fox (*Vulpes vulpes*). Gray wolves are expected to be of occasional occurrence within the study area.

Cougars (*Felis concolor*) may be occasional predators on the ungulates found in the bowl. Lynx (*Lynx canadensis*) have been sighted on the Panorama Golf Course in winter 1995/96. Since it is expected that snowshoe hare would be found in the lower elevation forests of the Taynton Bowl, it is likely that lynx may be found there too. Bobcat (*Lynx rufus*) have been sighted on the lower reaches of the "Toby Canyon", approximately 8 km east of the Resort along the main road. It is unlikely they would be found in Taynton Bowl during winter due to high snow levels.

Marten (*Martes americana*) prefer closed mature forest stands but may be found in the lower elevations of the Taynton Bowl. A marten has been observed on the Champagne T-bar (approximately 2316 m asl), which cuts through an open lodgepole pine forest. Apparently, a marten was accepting food from staff at the upper Patrol Hut and this may explain why it was found in less typical marten habitat. Ermine (*Mustela erminea*) are expected to be relatively common residents of the subject property, and long-tailed weasel (*Mustela frenata*) also likely occur. Red squirrels, pika and small rodents provide an abundance of prey. Wolverine have been sighted in the Toby drainage, approximately nine kilometers upstream from Panorama Mountain Village (Chris Wrazej, Panorama Mountain Village, pers. comm. 1994). Therefore, it is likely that wolverine utilize Taynton Bowl. Occurrence of striped skunk (*Mephitis mephitis*) is not known.

Although Panorama occurs within the known range of badger, a species blue-listed by BC Environment, the status of this species on the subject property is not clearly understood. One of the key prey items of badgers are Columbian groundsquirrels which are present in large colonies nearby. An informal oral history study, completed by Kootenay National Park, notes badger sightings at Panorama Mountain Village. Although considered montane-grassland predators, a radio-tagged badger has been tracked at 2400 m asl in the Skookumchuck drainage, south of Invermere (Nancy Newhouse, Sylvan Consulting, pers. comm. 1997).

Amphibians

Several frogs, tentatively identified as the spotted frog (Rana pretiosa), were observed in wetlands at lower elevations on Panorama Mountain Village lands. In addition, western toad (Bufo boreas), Pacific treefrog (Hyla regilla), and wood frog (Rana sylvatica) may also occur around wetlands and in adjacent habitats at lower elevations. Within the subject site, however, the steep terrain generally precludes the formation of ponds required by these species. The subject site is within the known range of the red listed northern leopard frog (Rana pipiens) (Green and Campbell 1984), however, as previously mentioned, there is a generally lack of pond habitat within Tayton Bowl, that is required by this species. The only salamander species that may occur on the site is long-toed salamander (Ambystoma macrodactylum)(Green and Campbell 1984).

Reptiles

A common garter snake (*Thamnophis sirtalis*), was observed during the June site investigations. Western terrestrial garter snake (*T. elegans*) may also occur at the site. Although Panorama is within the known distribution of the blue-listed rubber boa (Charina bottae), it is not known whether this species occurs at this elevation (Gregory and Campbell 1984).

2.3.4 Wildlife Capability and Suitability Ratings

Wildlife capability and suitability ratings for all ecosystem units and structural stages located on the subject property are summarized in Appendix C. Comments on habitat capability for each of the species or species groups of concern are provided below.

Grizzly Bear

Taynton Bowl is likely utilized by grizzly bear in the spring, summer and fall for foraging. In a biophysical capability classification, Demarchi (1990) rates the Taynton Bowl with high summer and fall capability for grizzly. Avalanche and rock slide paths and open wetland areas are abundant with berry-producing shrubs such as grouseberry, huckleberry, soopallalie, black gooseberry, and elderberry creating high suitability habitat for both grizzly and black bear. The open, dry habitat of the upper slide paths, which had Columbian groundsquirrel colonies along with herbs and forbs, is rated moderate to high for grizzly bear habitat. Small cliff bands and large boulders may offer denning opportunities.

Black Bear

Because of the presence of herbs, grasses and berry-producing shrubs in early seral stages and disclimax stands, these habitats were rated moderately high. Drier sites received lower ratings, with the exception of sites with a good cover of berry producing shrubs such as soopolallie and grouseberry. Wetlands were also rated highly because of the presence of sedges and other herbaceous plants which are preferred forage items for bears.

Least chipmunk

A British Columbia red-listed sub-species of the least chipmunk *(Tamias minimus selkerki*) was identified at Paradise Mine in a McTaggart-Cowan study in the 1940's. Paradise Mine is located at elevations ranging from 2377 m – 2500 m asl, directly north of Toby Creek from the Taynton drainage. Habitat conditions of Paradise Mine are similar to Taynton Bowl and elevations are similar (2134 m – 2438 m asl). Chipmunks were observed on all three field survey days in the Taynton study area. However; it is impossible to determine if the chipmunks were *T. minimus selkerki* or the common and more widely distributed yellow-pine chipmunk (*Tamias amoenus)* by simple field observations. A live trapping program would be required to determine if the least chipmunks in Taynton Bowl are *T. minimus selkerki*.

Moose

Dense shrub (mainly *Salix spp*.) and herb layers bordering Taynton Creek are of high value to moose in late spring, summer, fall and early winter. Small stands of shrubs were found in the avalanche paths, particularly in the run out zones. Upper slide paths were of low suitability due to the lack of a shrub layer. Shrub development was also absent along the edge of the mature lodgepole pine stands bordering the avalanche paths. Significant avalanche activity in the upper Taynton Creek riparian zone in late winter may reduce the capability of the habitat for moose at that time of year.

Elk

Elk track and sign were visible throughout Taynton Bowl. Along the Taynton Creek riparian zone, a well developed herb and shrub layer made this area of high value to elk in late spring, summer and fall. Run out areas of the slide paths and the wetlands are abundant with grasses and would be of high value to elk in the summer and fall. During winter, elk migrate down to the Columbia Wetlands and would not utilize Taynton Bowl.

Mule and White-tailed Deer

Mule and white-tailed deer are widespread on the subject property. Early seral stage habitats generally have well developed herb and shrub layers and are of moderate to high value to deer, especially in spring and summer. Both dry and moist sites were suitable for deer because of an extensive herb layer in moister sites, and the dominance of ground forage species on drier sites. Mid-aged forest stands (i.e.,

age class 4 and 5) were generally of low suitability for deer because of reduced understorey shrub and herb vegetation. Older seral stage forests were rated moderate due to the limited extent of herbaceous plant species available in the understorey. Demarchi et al. (1983) provides detailed information on the wildlife capability classification system for ungulates in British Columbia.

Bats

Bats are known to forage extensively over open areas such as wetlands and cleared areas (i.e. early seral stages). Open, dry forest sites may also be utilized by bats for foraging. Since habitats with a high abundance of snags and large trees provide roosting opportunities for bats, later seral stage forests were also considered to be important. Open wetlands with adjacent mature forests are the most suitable for bats because they provide both highly productive foraging sites and adjacent forested habitats for roosting.

Cavity Nesters

Cavity nesters such as woodpeckers, chickadees, nuthatches and brown creeper require snags or mature trees for nesting. Snags of the study area are dominated by alpine larch with the occasional mature Douglas fir, balsam and pine. Older growth forests also provide excellent foraging opportunities for woodpeckers. Small owls such as northern saw-whet owl and northern pygmy-owl have similar nesting habitat requirements to woodpeckers. Thus, older forests received the highest suitability ratings.

Amphibians

Wetland habitats are extremely important for many breeding amphibians. Mature, moist forests with a good volume of course woody debris are also utilized by pond-breeding amphibians at other times of the year. These habitats receive the highest suitability ratings.

2.3.5 Valued Ecosystem Components

Bear Denning

Rocky cliff bands and outcrops in Taynton Bowl would provide suitable denning sites for bears. With the high summer and fall habitat rating for the Taynton Bowl for bears, denning is a possibility. As noted, a grizzly was sighted feeding on a moose kill in late October. The site was close to suitable denning habitat.

Ungulate Rutting

Many lodgepole pines exhibited bark scrapes indicative of ungulate antler rubs, both old and recent (current season). The open forest with dense shrub and herb layers appears to be utilized as spring and summer foraging areas by all the ungulates. It is not clear whether deer, elk and moose make use of the subject site during the rutting season. Availability of forage and cover are generally the most important habitat features required during the rutting season.

Wildlife Corridors

Mountain goats may use the Taynton ridge in winter to access a mineral lick. Activity from the ski development may deter goats from using the ridge during the construction phase and once the winter ski operation commences. However, it should be noted that there is presently a ski lift and associated trail system utilizing a small section of the ridge top and west face.

Based on anecdotal information from hunters, it is unknown if Taynton is part of the migration route used by elk in the spring and fall. Further discussion with guide outfitters and local hunters may assist in the determination of the value of the Taynton drainage as a migration corridor.

Far-ranging carnivores, such as the grizzly, probably move from the Taynton drainage to adjacent high and moderate capability drainages such as Brewer and Hopeful.

Ephemeral streams and associated riparian habitats are potentially important wildlife movement corridors. The most significant corridor appears to be the main stem of Taynton Creek. Deer and elk may utilize Taynton to ultimately access the Rocky Mountain Trench winter habitat. Corridors become increasingly important as upland forests are disturbed by development activity.

Game trails were noted throughout the study area. From some of the trails, it appears that large mammals (such as elk and bear) wander between Taynton Bowl and adjacent high capability habitat drainages, such as Brewer and Hopeful Creeks (Demarchi *et al*., 1983) Mountain goat travel along the Taynton Ridge to access a mineral lick. Lynx tracks have been sighted along the Taynton Ridge in winter 1995/96.

Diversity of Habitat

Due to the significant slide and avalanche activity in Taynton Bowl, the area is a natural, disturbed forest with a variety of habitats.

Wildlife Trees

Wildlife trees include significant standing snags, veteran trees, and trees with broken tops. A dead wildlife tree could be considered to be of greater habitat value than a living tree. These trees are important as perching areas for raptors such as red-tailed hawk, and foraging and nesting sites for woodpeckers, small owls and other cavity nesters. Snags are also important habitat for small mammals such as mice, voles, chipmunks and squirrels. Larger trees provide dens for pine marten, weasel and ermine (Alison Candy, Osprey Communications, pers. comm. 1997). The majority of the subject property is dominated by second growth forest as a result of fire and important wildlife snags are scattered throughout.

Clark's nutcracker and hairy woodpeckers were frequently observed throughout the study area utilizing alpine larch snags. Large snags may also be used as roosting areas for bats, especially adjacent to important foraging areas over wetlands, ridge crests and other open habitats.

Ephemeral Streams and Riparian Areas

A portion of Taynton Creek and its tributaries, many of which are dry during the summer months, occur within the subject site. Riparian and ravine habitats associated with these watercourses are dominated by vegetation such as willows, alders, scrub birch and lodgepole pine. These habitats provide high structural heterogeneity and plant species diversity compared to the more adjacent uniform coniferous forests, and are attractive to numerous bird, mammal and amphibian species. Ephemeral streams are also natural wildlife movement corridors.

Ephemeral stream and pool habitats are utilized as drinking and preening areas for wildlife, and possibly breeding areas for frogs, toads and salamanders.

Wetlands

Wetlands not only provide breeding habitats for amphibians such as spotted frog and western toad, but also provide foraging opportunities for ungulate species and bear. Bear and ungulate sign was evident in wetlands surveyed during the site reconnaissance. Wetlands are utilized as foraging areas for bats and songbirds, which are attracted to the open nature of the site and the high insect populations. Snags adjacent to these wetlands are utilized as roost sites by bats.

2.4 Aquatic Environment

2.4.1 Aquatic Biophysical

Methodology

An aquatic biophysical inventory and fisheries survey was conducted for the waters draining Taynton Bowl and eastern portions of Panorama Mountain. The inventory and survey, conducted by Mike Nelson, R.P. Bio. and Mike Cole, P.Eng., conforms to the criteria set out in Fish-Stream Identification Guidebook, Forest Practices Code of British Columbia (MOF, 1995a), the Stream Survey Field Guide (DFO/MOELP, 1989), and the Lower Mainland Region Stream Inventory/Assessment Methods, Fifth Draft (Bech, 1994), except as noted in the text.

Prior to conducting the field work, GEC reviewed available information concerning the fish presence and distribution in the drainages both within the project area and in the surrounding area. The fisheries records for Taynton Creek, which drains the study area, were not readily available, however, Toby creek into which Taynton Creek flows has been studied in some detail in the past (Fielden et al., 1993 & Carswell, 1979).

Taynton Creek

Taynton Creek consist of three reaches, plus five main tributaries including one that drains Taynton Bowl, the study area. From its confluence with Toby Creek, Taynton Creek's first reach rises steeply for a short distance out of the Toby Creek valley. The second reach has a moderate gradient, and forms the majority of the stream length. The third reach of Taynton Creek consists its steep, ephemeral headwaters.

Reach 1

This short reach, 70 m in length, rises steeply from Taynton Creek's confluence with Toby Creek, with gradients ranging from 22 to 26 % (average gradient 24%). The stream channel width averaged 3.5 m, as did the wetted width. Other than the relatively steep gradient, no barriers to fish migration were evident. There was approximately 40% fish stream cover provided primarily by over-stream vegetation, with lesser amounts of deep pool, boulder and cut-bank cover and a trace of large organic debris (L.O.D.). Riparian vegetation consisted of willow (*Salix sp*.), rose (*Rosa sp*.), Saskatoon (*Amelanchier alnifolia*), high-bush cranberry (*Viburnum edule*), thimbleberry (*Rubus parviflorus*), black twinberry (*Lonicera involucrata*), Sitka alder (*Alnus crispa*), and mountain alder (*A. incana*). The canopy closure was estimated at 30 % with examples lodgepole pine (*Pinus contorta latifolia*), Douglas fir (*Pseudotsuga menziesii*), and Engelmann spruce (*Picea engelmannii*). The substrate consisted mainly of cobbles and boulders with little gravel or fines. The water was quite clear with visibility greater than 100 cm. The conductivity was 295 µs/cm and the water temperature was 6°C on June 23, 1997 (other water quality conditions can be found in Section 2.4.2). Flow conditions were moderate to high, consisting overwhelmingly of riffle and small falls. The stream's discharge was measured as 0.5 m^3/s. Electrofishing was not conducted on this reach, as Toby Creek at its confluence with Taynton Creek is known to support bull trout (*Salvelinus confluentus*), and the elctrofishing program in Reach 2 upstream yielded numerous bull trout. Therefore, even though this reach is fairly steep, it is presumed to be passable for fish. Under the Forest Practices Code of B.C. (MOF, 1995a), this reach of Taynton Creek is classified as a S3 fish stream based on its width and presumed presence of fish.

Reach 2

Taynton Creek's second reach is 4.3 km long, forming the majority of the stream's length. This reach had gradient measurements ranging from 9 to 16 %, with an average gradient of 14.7 %. The stream channel and wetted widths both averaged 4.6 m. There were small debris controlled falls though the section of stream surveyed, none of which posed a barrier to fish movement. Stream fish cover was estimated at 30 %, provided mainly by over-stream vegetation, with some deep pool, LOD and cut-bank cover also

present. Riparian vegetation was similar to that observed downstream, and included red-osier dogwood (*Cornus stolonifera*), willow (*Salix sp*.), oval-leaved blueberry (*Vaccinium ovalifolium*), rose (*Rosa sp*.), Saskatoon (*Amelanchier alnifolia*), thimbleberry (*Rubus parviflorus*), Sitka alder (*Alnus crispa*), Douglas maple (*Acer glabrum*), bunchberry (*Cornus canadensis*), wild strawberry (*Fragaria virginiana*), common horsetail (*Equisetum arvense*), and fireweed (*Epilobium angustifolium*). The canopy over the stream was fairly open, with the canopy closure was estimated at 15 %. Trees within the canopy were mostly lodgepole pine (*Pinus contorta latifolia*), with lesser amounts of trembling aspen (*Populus tremuloides*). The substrate consisted of gravels, with lesser quantities of fines and cobbles. Boulders were generally lacking in the lower portions of this reach. Water quality paramters were the same as for Reach 1. Flow conditions (during the site visit on June 23, 1997) were moderate to high. Flows were characterized as 60 % riffle, 20 % pool and 20 % run. The stream's discharge was measured as 0.6 m^3/s.

Electrofishing was conducted on the lower 500 m of this reach. Eleven bull trout were captured during a single pass electrofishing effort, with 5 of those fish being captured in then lower 100 m section of this reach. Within this small sample, there appears to be two age classes, with 10 bull trout ranging in fork length from 95 to 114 mm, averaging 102.4, and one larger fish 163 mm in fork length. Fielden et al. (1993) found that bull trout captured from Toby, Dutch and Horsethief Creeks, and several of their tributaries, had similar growth rates. If this hypothesis holds true for the fish captured in Taynton Creek, then the fish represent age classes 2+ and 3+. Taynton creek's second reach is classified as a S3 fish stream based on its width and confirmed presence of fish, under the Forest Practices Code of B.C. (MOF, 1995a).

Reach 3

Taynton Creek's third reach is located upstream of the study area. This portion of the stream consists of the creek's headwaters, draining the north flank of Mount Goldie, the south-west flank of Mount Taynton, and the ridge joining those peaks. This reach has an average gradient of 23%, with ephemeral flows at its upper end. Because of the steep gradients and ephemeral nature of the upstream flows, reach 3 is assumed to be non-fish bearing. The reach is classified as a S5 non fish bearing stream under the Forest Practices Code of B.C. (MOF, 1995a).

Taynton Bowl Tributary

Drainage from Taynton Bowl enters Taynton Creek via a tributary stream at the 1640 m level. This tributary consists of a braided channel obscured by a dense growth of Sitka alder, Barclay's willow (*Salix barclayi*) and other willow species. The tributary has a gradient of 20% for its first (lower) 500 m before splitting into two sub-tributaries. These sub-tributaries have gradients of up to 50% and greater. As with the main tributary, their downstream portions are braided and obscured by dense riparian vegetation. Upstream of the 1950 m elevation level, both sub-tributaries and their many inlet drainages were dry at the time of the site visit.

Due to their ephemeral nature, the high altitude, and their steep gradient, a fish sampling program was not conducted on these headwater drainages, as they are assumed to be non-fish bearing. The tributary and sub-tributaries are considered to be S5 and S6 non fish bearing streams, respectively, under the Forest Practices Code of B.C. (MOF, 1995a).

Toby Creek

Toby Creek, a tributary of the Columbia River, is a fairly large system with a drainage area of about 684 km^2. It flows in a north-east direction at the base of Panorama Mountain outside the study area. This creek was not surveyed as part of this investigation, as it lies outside the study area and has been studied by others (Fielden et al., 1993 & Carswell, 1979). In the most recent study, Fielden et al. (1993), divided Toby Creek into 12 reaches, with the portion nearest the study area, into which Taynton Creek flows, being reach 5. Toby Creek's second reach, located approximately 8.9 km downstream of Taynton Creek's mouth, consists of a canyon with a series of cascades that the authors of that report believe form a barrier to upstream fish movements, with the possible exception of bull trout.

Taynton Creek's fifth reach is located 19.9 km to 29.7 km upstream of the creek's confluence with the Columbia River. This reach is 9.8 km long and has an average gradient of 0.9 %. The substrate is predominantly boulder (63%), with approximately 12 % gravel. Flows are characterized as riffle (80 %) with lesser amounts of run (20 %). Total cover is estimated at 6 %, overwhelmingly provided by boulder cover. On August 18, 1992, the average velocity was 1.9 m/s, with a water temperature of 10 °C and visibility of about 10 cm (Fielden et al., 1993). During a site visit on May 7, 1996, by the study team, the water temperature was found to be 2 °C, with water clarity greater than 1 m.

2.4.2 Water Quality

A water-quality sampling program was initiated to elucidate baseline water quality flowing out of the study area. A single sampling station was established on Taynton Creek at the 1210 m elevation level, with the water sample collected on June 27, 1997. The site was selected at this lower elevation due to accessibility problems for future sampling (if the sample site was located further upstream on the creek).

Parameters sampled for include pH, electrical conductivity, total dissolved solids, calcium, magnesium, sodium, potassium, iron, manganese, sulphate, total phosphorus, phosphate, chloride, nitrate, carbonate, bicarbonate, alkalinity and hardness.

All of the water sample met the guidelines for drinking water for the parameters sampled (Health Canada, 1996) and meet the suggested guidelines for the protection of aquatic life (Pommen, 1991). The waters can be considered moderately hard, with moderate alkalinity. The waters were clear, with visibility greater than 100 cm. Nutrient concentrations (nitrogen, phosphorus and potassium) are generally fairly low.

2.5 Wetland Environment

2.5.1 Delineation

A number of small wetlands were identified within the study area. Generally, the wet areas were associated with streams and are considered either spring swamps or stream swamps according to the Canadian Wetland Classification System (NWWG, 1987) sphagnum moss was prevalent). Formation of the stream swamp type wetlands appears to be a function of reduced gradients on alluvial fans. Permeable soils forming the stream banks allow exfiltration of waters. Spring swamps are typically found in lower slope depressions in the study area.

2.5.2 Functionality

The wetlands were subjected to a cursory assessment of functionality using a 7 point system of evaluation that includes the following functions (Bond et al. 1992):

Life-support

◊ Regulation / Absorption
◊ Ecosystem Health

Social / Cultural

◊ Science / Information
◊ Aesthetic / Recreational
◊ Cultural / Psychological

Production

◊ Subsistence Production
◊ Commercial Production

The primary functions provided by these small wetlands appear to include aesthetics, recreation (nature viewing), and ecosystem health as it applies to habitat biodiversity and subsistence production for wildlife. Of secondary significance although of potentially equal importance is the potential for the occurrence of red or blue listed plants. No Red or Blue Listed species were identified; however, there remains some potential for occurrence within these wetlands.

Low value functions and functions not provided by these wetlands include commercial production, regulation / absorption, science / information, and cultural / psychological functions.

3 ENVIRONMENTAL CONSTRAINTS

3.1 Cultural Environment

Constraints due to heritage interests in the area are currently unidentified. Based on cursory observations made in the field, there appear to be no development constraints associated with archeological or heritage interests in the study area.

3.1.1 Recreation and Land Use

The main identified constraint to recreational development in the study area is the propensity for avalanches in the winter. Panorama Mountain Village intends to mitigate this risk through industry standard, active management practices.

3.2 Physical Environment

3.2.1 Climate

Climatic conditions are well documented from the ski activities occurring at Panorama Mountain Village. No climatic constraints are noted.

3.2.2 Geology

Exposed bedrock across the study area occurs frequently in steep areas and does pose a geologic hazard such related to slope failures from weathered, highly fractured units. Constraints, therefore, are noted in relation to the stability of these units.

3.2.3 Geomorphology & Surficial Materials

The study site includes many areas of observed landslide and snow avalanche activity. Constraints, therefore, are noted in relation to the stability of these materials.

3.2.4 Hydrology

The study area lies within the mid- and upper reaches of Taynton Creek. There are several major side channels within this area that exhibit steep terrain with high snow loading and are likely associated with mass movement events during spring runoff. Consequently, hydrologic constraints exist.

3.3 Terrestrial Environment

3.3.1 Pedologic Soils

The widely distributed Brunisols and Regosols in the study area are generally well drained soils which are associated with no known constraints to recreational development. The limited organic soils, which occur in poorly drained areas, however, are associated with wetlands. Development constraints associated with wetlands are discussed in Section 3.4.

3.3.2 Vegetation

Much of the forest in the study area is less than 100 years old due historic natural wildfire events. However, occasional veterans, particularly alpine larch, were observed near the summit ridge. Two sample plots (Plot #6 and Plot #7) were identified as structural stage 7 with cores taken from alpine larch exceeding 300 years of age. Plot #5 was estimated to be a structural stage 6 forest with an age range from 80 to 140 years. Ecosystem Polygons 13 and 17 contain an old growth forest component, while Polygons 1, 8, 17, and 21 have mature forests. Older trees are less tolerant of the potential impacts that may arise from development. Accordingly, any forested polygon of structural stage 6 or 7 should be considered constraining to development. However, it should be noted that the age range covered by the mature forest class (structural stage 6) is 80 to 140 years, and as a result site specific conditions will affect the degree of impact.

No specific constraints are associated with the various tree or plant species noted within the study area. With the exception of whitebark pine, no rare, endangered, or threatened terrestrial plants or plant communities were observed within the study area. It should be assumed that red and blue listed species may occur within the site and as such all sites entailing ground disturbance should be subjected to a detailed survey prior to construction approval.

Vegetation associated with the IMAun and the ESSFdkp subzones are by nature fragile and sensitive to impacts associated with development. Therefore, the vegetation found in the alpine (IMAun) subzone and the upper elevations of the ESSFdkp subzone, should be considered constraining to some types of development. It should be noted that development of the high alpine for ski resort use could be conducted in an environmentally sensitive manner, with limited adverse impact.

While no rare or endangered plants were identified within the wetlands during the 1997 and 2016 visits, the reconnaissance level of survey precluded identification of all plants to the level of species. Consequently, wetland vegetation should be considered constraining due to the potential presence of rare or endangered plant species.

3.3.3 Wildlife and Valued Ecosystem Components

Species at Risk

The following table lists potentially occurring species at risk in the area.

Table 10. Potential Endangered, Threatened and Special Concern wildlife species.

Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
Ascaphus montanus	Rocky Mountain Tailed Frog	Clear, cold swift-moving mountain streams with coarse substrates in older forest sites.	Unlikely	Red	1-E
Charina bottae	Northern Rubber Boa	Dry/mesic coniferous forests	Unlikely	Yellow	1-SC

Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
Taxidea taxus	American Badger	Grassland, shrub, meadows	Unlikely	Red	1-E
Rangifer tarandus pop. 1	Caribou (southern mountain population)	Old forests with abundant arboreal lichen	Unlikely	Red	1-T
Contopus cooperi	Olive-sided Flycatcher	Various forest and woodland habitats.	Possible	Blue	1-T
Hirundo rustica	Barn Swallow	Open areas, fields, ponds with vertical nesting habitat, especially buildings.	Observed in Panorama Village	Blue	
Melanerpes lewis	Lewis's Woodpecker	Dry coniferous forests	Unlikely	Blue	1-T
Megascops kennicottii macfarlanei	Western Screech-Owl, *macfarlanei* subspecies	Coniferous or mixed forests.	Possible	Blue	1-E
Myotis septentroionalis	Northern Myotis	Associated with old growth forest habitat but not restricted to, old growth.	Possible	Blue	
Myotis lucifungus	Little Brown Myotis	Wide range of habitats: caves, hollow trees and human-made structures. Foraging usually occurs in woodlands near water	Possible	Yellow	1-E
Sphyrapicus thyroideus nataliae	Williamson's Sapsucker, *nataliae* subspecies	Coniferous forests.	Possible		1-E
Plethodon idahoensis	Coeur d'Alene Salamander	Riverine/riparian areas	Unlikely	Yellow	1-SC
Psiloscops flammeolus	Flammulated Owl	Open forest stands with large trees and snags for nesting and foraging, nearby clusters of thick understory vegetation for roosting and calling.	Unlikely	Blue	1-SC
Euphagus carolinus	Rusty Blackbird	Coniferous and mixed lowland forests near water.	Unlikely	Blue	1-SC
Anaxyrus boreas	Western Toad	Proximity to wetlands.	Unlikely	Blue	1-SC
Kootenaia burkei	Pygmy Slug	Moist mixed riparian forests.	Unlikely	Blue	

Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
Magnipelta mycophaga	Magnum Mantleslug	Moist/wet coniferous forests.	Unlikely	Blue	
Zacoleus idahoensiss	Sheathed Slug	Moist wet coniferous forest	Unlikely	Blue	
Ursus arctos	Grizzly Bear	Non-forested or partially forested sites with a wide range of foraging behaviours and choice of habitats.	Observed	Blue	

Source: Conservation Data Centre for the Rocky Mountain Forest District and MS and ESSF Biogeoclimatic Zone (BC CDC, 2016)

Diversity of Habitat

In a closed canopy lodgepole pine forest that is managed to prevent natural disturbances such as fire, it may be argued that cutting ski runs can enhance foraging habitat for ungulates and other animals. However, due to the significant slide and avalanche activity, Taynton Bowl is a natural, disturbed forest with a variety of habitats. In developing and maintaining ski runs, densely shrubbed areas, generally located in moister soils, are cleared by hand (Brad Brush, Panorama Mountain Village Mountain Operations, pers. comm. 1997). In recent years, Panorama Mountain Village has conducted a series of glading programs in Taynton Bowl. The programs have increased skiable terrain while minimizing disturbance to ground cover and the surrounding forests.

Continual compacting of snow due to skier use may suppress future tall shrub growth. Typically, these shrub areas are composed of a variety of plant species and are of very high value to birds and many animals, including moose, elk and bear. Mitigation of impacts to habitat may be difficult as the base of the proposed ski area encompasses the highest capability habitat.

Photo 32. View across Taynton Bowl of gladed slopes.

Bear Denning

Rocky cliff bands and outcrops would provide suitable denning sites for bears. With the high summer and fall habitat rating for the Taynton Bowl, denning is a possibility and should be considered constraining. Potential sites should be identified and any development in these areas should be avoided from the planning stage.

Ungulate Rutting

Because utilization of the subject property by ungulates (namely moose, elk and deer) during the rutting season is poorly understood, it is difficult to recommend options for mitigating potential impacts. Ski operations may overlap with the ungulate rut (October - mid-December) and should be considered constraining to anthropogenic activity.

Wildlife Trees

Areas with high snag densities need to be retained to maintain nesting, denning and foraging opportunities for woodpeckers, small owls, bats, cavity nesting passerines and small mammals. Large snags in upland areas with known nesting activity should not be removed unless absolutely necessary from a development design perspective. Care must be taken in cutting new ski runs to provide adequate forested buffers along the runs, so that important nest and forage trees/snags are less vulnerable to windthrow. Approximately 60-70% of resident bird species in British Columbia are cavity nesters and use cavities to roost in winter (Millikan 1994).

Ephemeral streams and Riparian Areas

Ephemeral streams and adjacent riparian areas should not be disturbed. These habitats are very important as feeding, drinking, and breeding sites for numerous wildlife species. These habitats also act as natural movement corridors for wildlife across the site, especially following intensive land use activities.

Open Wetlands

Because wetlands are relatively uncommon in upland ecosystems of Taynton Bowl, the integrity of all existing wetlands should be considered constraining to development. Wetlands are important foraging areas for many animals including bear, moose and bats and provide breeding areas for amphibians. Wetland areas attract an abundance of insects and are important habitat for songbirds.

Wildlife Movement Corridors

Drainages accessible to Taynton, such as Brewer and Hopeful, are rated by Demarchi *et al.* (1990) with moderate to high biophysical capability for ungulates and grizzly. Wildlife movement corridors maintain the connectivity of adjacent habitats and need to be provided for wildlife moving across or through the site. Ephemeral streams and riparian areas are natural corridors and should be maintained as such.

3.4 Aquatic Environment

3.4.1 Aquatic Biophysical

Taynton Creek

The aquatic biophysical assessment and fish sampling program conducted for this study indicates that the Taynton Creek tributary within Taynton Bowl is likely non fish bearing. This tributary does, however, flow into the second reach of Taynton Creek, which was found to support a population of bull trout. It is important, therefore, to retain the riparian vegetation to protect the stream banks from erosion which could lead to downstream siltation. In addition, the riparian vegetation helps maintain lower water temperatures in summer, and provides a potential food source for downstream fish (i.e. terrestrial insects falling into the stream). (see also section 3.2.3 and 3.2.4)

Toby Creek

While Toby Creek lies at some distance from the study area, it could be affected by development within Taynton Bowl should the waters of its tributary, Taynton Creek, not be protected. Measures taken to protect Taynton Creek will serve to protect Toby Creek as well.

3.4.2 Water Quality

Water quality of the Taynton Creek and its tributaries draining the study area is of particular concern to downstream water users, including Panorama Mountain Village itself, as they have a water intake on the creek. It is in the proponent's best interest, therefore, to protect the water quality in the creek and its tributaries, through appropriate siting of project components, and construction and operation techniques if the project proceeds.

3.5 Wetland Environment

3.5.1 Delineation

All wetlands and associated watercourses of the subject site should be considered constraining to development. Avoidance of wetlands and watercourses should be attainable through design of ski lifts, ski trails, and siting of ancillary facilities.

4 RECOMMENDATIONS AND CONCLUSIONS

4.1 General

1. Geotechnical data suggests that wide spread instabilities exist in the surficial deposits as well as the upper bedrock units. Rock and slope instabilities are not uncommon in ski resorts, particularly those

occupying the tops of mountains; however, these factors warrant further study prior to proceeding with lift and run design.
2. The integrity of the water quality, habitat values and downstream fisheries values of all water bodies should be protected by the establishment of riparian buffer zones. In general, buffers should be as specified in the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al., 1992), the Forest Practices Code Riparian Management Area Guidebook (MOF, 1995b), or the Riparian Area Regulation of the *BC Fish Protection Act*, whichever is more stringent.
3. The oldest and most significant forest vegetation in the study area is associated with the ESSFdkp and IMAun subzones near the summit ridge of Panorama Mountain. These subzones contain an abundance of whitebark pines. Any proposed development in this area should maximize preservation opportunities by avoiding destruction of plant communities and minimizing ground disturbance.
4. An attempt should be made to preserve all wetlands within the study area. In order to protect the functional values associated with the wetlands preservation buffers should be incorporated into the plans. Any wetlands potentially impacted by future developments should be subjected to detailed assessment to identify all plant species prior to development approval.
5. Retain an on-site environmental monitor to be present during all development activity.

4.2 Wildlife and Wildlife Habitat

4.2.1 Construction Windows

1. The study area may be used by moose, elk and deer during the fall rut. In the absence of further study, development activity and future use of the site should be restricted between October 15th and December 15th.
3. To avoid contravention of the Wildlife Act, land clearing activity should not be undertaken between May 1st and August 31st, the sensitive nesting period for breeding birds and other wildlife without specific permission from FLNRO or MOE. Under Section 34 of the *BC Wildlife Act*, it is an offense to destroy nests occupied by a bird, its eggs or its young.
4. The subject property maintains the high to moderately high habitat value in summer and fall. Construction should be sensitive to disturbance of all types of wildlife by reducing length of day worked and where possible, noise levels.

4.2.2 Habitat Protection

1. Areas with high densities of snags should be retained. A minimum 15 m vegetated buffer on either sides of creeks and wetlands should be retained. In areas where windthrow is a risk, wider buffer zones to 30 m should be set aside. Protection of these areas will retain wildlife trees, breeding and foraging areas for wildlife and provide corridors for wildlife moving or migrating through the site.
3. Large snags in upland areas should be retained within the development plan wherever possible. Widespread clearing of the subject property should not be permitted. Ski runs should be developed to utilize existing forest openings as much as possible to maintain closed second growth forest and alpine old growth forest.
4. Wetlands should be retained intact and undisturbed. Disturbances such as infilling or redirection of runoff into wetlands should not occur. A 30 m vegetated set-back should be established adjacent to wetlands to protect the unique plant and wildlife values of the wetland and adjacent riparian areas. Often wildlife trees important to bats and other wildlife species will are located within the 30 m setback area.
5. Wildlife movement corridors will be provided if retention zones along streams are designated as recommended above. Road and trail crossings of these ephemeral streams should be designed so that wildlife movement is not impeded or discouraged. The number of stream crossings should be minimized. Bridges rather than culverts or fords are preferred. Planting of additional native, riparian shrubs and trees may be necessary.

6. Nests of raptors such as northern goshawk and great horned owl found during land clearing activity must be adequately protected by forested buffer while the nest is occupied.
7. All areas protected for wildlife habitat, should be flagged and enclosed by temporary fence or continuous 2" flagging along the protection boundary prior to initiation of work on the site. Panorama should take necessary steps to ensure that skiers and staff do not enter protected areas.
8. To protect the sub-nivian habitat from destruction by compacting of snow, skiers should be restricted to using the designated runs.
10. Recreational and ski operation maintenance should be greatly restricted during summer and fall when the subject property has the most significant habitat value to many wildlife species.
11. The recommendations of the Wildlife Management Plan for establishing a local wildlife patch in upper Taynton Bowl should be considered (Cascade, 2001).

4.3 Additional Studies

1. Grizzly bear is a blue listed species in the East Kootenay region of British Columbia. Further study into actual use and importance of Taynton Bowl for grizzly bear may be warranted.
2. A live trapping program should be conducted to determine if the species of chipmunk found on site is *T. minimus selkerki*.
3. In light of the fact that Taynton Bowl is an important part of a larger ecosystem, and that wildlife migration occurs from Taynton to adjacent high habitat capability drainages, further wildlife studies to assess the overall impact of the proposed development on wildlife movement studies on a larger area would be beneficial.
4. Further geotechnical studies are required to determine the feasibility of building a lift station in an area with such geologic hazards. These studies should incorporate an evaluation of the initiation zones of landslides and snow avalanches, the deposition zones from such events, the potential of deeper seated bedrock instabilities, and their association with the site hydrology.

5 REFERENCES

Arseneau, G.J., 1996. Minfile Map NTS 082KSE Lardeau. MEMPR, Victoria, B.C.

BC Outdoors. 1995. Freshwater Fishing Directory and Atlas. OP Publishing Ltd. Vancouver, B.C.

Bech, P. 1994. Lower Mainland Region Stream Inventory/Assessment Methods. Regional Fisheries Report No. LM 229. Fish & Wildlife Management, BC Environment. Surrey, B.C.

Bond, W.K., Cox, K.W., Heberlein, T., Manning, E.W., Witty, D.R., Young, D.A., 1992. Wetland Evaluation Guide. North American Wetlands Conservation Council (Canada), Issues Paper, No. 1992-1, Ottawa.

Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser and M.C.E. McNall, 1990. The Birds of British Columbia, Volumes I and II. Royal British Columbia Museum, Victoria.

Canada Soil Survey Committee, 1978. The Canadian System of Soil Classification. Canada Department of Agriculture publication 1646. Supply and Services Canada, Ottawa.

Canada West Ski Areas Association, 1992. Guidelines for Environmental Good Practices for Ski Areas.

Canadian Council of Resource and Environment Ministers. 1992. Canadian Water Quality Guidelines. Water Quality Objectives Division, Inland Waters Directorate, Environment Canada. Ottawa, Ont.

Carl, G.C., W.A. Clemens and C.C. Lindsey. 1977. The Fresh-water Fishes of British Columbia. British Columbia Provincial Museum. Victoria, B.C.

Cascade Environmental Resource Group Ltd. 1999. Wildlife Overview for Toby Creek – Draft. Memorandum, July 28, 1999. Panorama Mountain Village.

Cascade Environmental Resource Group Ltd. 2001. Panorama Wildlife Management Plan, Summary Report. March 9, 2001, Panorama Mountain Village.

Chilibeck, B., Chislett, G., and Norris, G., 1992. Land Development Guidelines for the Protection of Aquatic Habitat. Habitat Management Division of the Department of Fisheries and Oceans and the Integrated Management Branch of the Ministry of Environment, Lands and Parks.

Demarchi, D.A., B.Fuhr, B.A. Pendergast and A.C. Stewart. 1983. Wildlife capability classification for British Columbia: an ecological (biophysical) approach for ungulates. MOE Manual 4.

Demarchi, D.A., 1989. Wildlife (Ungulate) Biophysical Capability Classification For the Purcell Wilderness Conservancy and Adjacent Area. Mapsheets 82F/15 and 16, 82K/1, 2, 7 and 8, MOE, Surveys and Mapping Branch, Victoria, B.C.

Demarchi, D.A., 1990. Grizzly Bear Biophysical Capability Classification For the Purcell Wilderness Conservancy and Adjacent Area. Mapsheets 82F/15 and 16, 82K/1, 2, 7 and 8, MOE, Surveys and Mapping Branch, Victoria, B.C.

Department of Fisheries & Oceans and B.C. Ministry of Environment. 1989. Stream Survey Field Guide. Fish Habitat Inventory & Information Program. DFO and BC MOE.

Department of Fisheries and Oceans . 1990. Stream Information Summary. Department of Fisheries and Oceans, and BC Ministry of Environment, Lands and Parks. Vancouver, B.C.

Ecosystems Working Group, 1995. Standards for Terrestrial Ecosystems Mapping in British Columbia. Resources Inventory Committee, Victoria, B.C.

Environment Canada. 2000. Canadian Climate Normals, Temperature and Precipitation, 1971 - 2000, British Columbia. Atmospheric Environment Service, Canadian Climate Program. Downsview, Ont. Internet accesss August 25, 2016

http://climate.weather.gc.ca/climate_normals/results_e.html?searchType=stnProx&txtRadius=200&selCity=&selPark=&optProxType=custom&txtCentralLatDeg=50&txtCentralLatMin=27&txtCentralLatSec=37&txtCentralLongDeg=116&txtCentralLongMin=14&txtCentralLongSec=17&stnID=1199&dispBack=0&month1=0&month2=12.

Green, D.M. and R.W. Campbell. 1984. The Amphibians of British Columbia. Handbook No. 45. British Columbia Provincial Museum.

Gregory, P.T. and R.W. Campbell, 1984. The Reptiles of British Columbia. B.C. Provincial Museum. Ministry of Provincial Secretary and Government Services, Victoria.

Harding, L.E. and E. McCullum. 1994. Biodiversity in British Columbia: Our Changing Environment. Canadian Wildlife Service, Environment Canada. Ottawa, Ont.

Health Canada. 1996. Guidelines for Canadian Drinking Water Quality, Sixth Edition. Canada Communications Group. Ottawa, Ont.

Hosie, R.C., 1990. Native Trees of Canada, Fitzhenry & Whiteside.

Howes, D.E. and E. Kenk, 1988. Terrain Classification System for British Columbia. Revised Edition, MOE Manual 10, Victoria, B.C.

Krajina, V.J., 1965. Biogeoclimatic Zones and Biogeocoenoses of British Columbia. Ecology of Western North America, University of British Columbia.

Luttmerding, H.A., Demarchi, D.A., Lea, E.C., Meidinger, D.V., Vold, T., 1990. Describing Ecosystems in the Field. MOE Manual 11 (2nd Ed.). Queen's Printer, Victoria, BC.

Lyons, C.P., 1976. Trees, Shrubs and Flowers to know in British Columbia. J.M. Dent & Sons. Vancouver, B.C.

MacKillop, 2012. Kootenay – Boundary BEC Update. BC Forest Service, Nelson, BC. https://www.for.gov.bc.ca/hre/becweb/downloads/downloads_bec_updates/kootenay-boundary%20bec%20update%20march%202012.pdf

McTaggart-Cowan, Ian, and Charles J. Guiguet, 1978. The Mammals of British Columbia, British Columbia Provincial Museum, Victoria, BC.

Meidinger, Del and Jim Pojar (Eds.). 1991. Ecosystems of British Columbia. BC Ministry of Forests, Victoria, B.C.

Meidinger, D. (Ed.). 1996. Field Manual for Describing Terrestrial Ecosystems. Rough Draft, Ministry of Forests / BC Environment, Victoria, B.C.

Ministry of Environment, 2006. Terrestrial Ecosystem Map Codes. Database, http://www.env.gov.bc.ca/ecology/tem/list.html

Ministry of Forests. 1995a. Fish-Stream Identification Guidebook, Forest Practices Code of British Columbia (July 1995 ed.). Victoria, B.C.

Ministry of Forests. 1995b. Riparian Management Area Guidebook, also includes Marine Sensitive Zones and Fisheries Sensitize Zones, Draft 2 Guidebook, Forest Practices Code of British Columbia (March 30 1995 ed.). Victoria, B.C.

Ministry of Forests. 1995. Forest Cover Map Series. Mapsheets 82K.049 and 82K.050, Inventory Branch.

Ministry of Forests. 1997. Biogeoclimatic Subzone Mapping. Mapsheets 82K.049 and 82K.050, Invermere Forest District.

National Wetland Working Group. 1988. Wetlands of Canada. Ecological Land Classification Series No. 24. Sustainable Development Branch, Environment Canada, Ottawa, Ont. and Polyscience Publications Inc., Montreal P.Q.

National Wetland Working Group. 1987. The Canadian Wetland Classification System. Ecological Land Classification Series 21, . Lands Conservation Branch, Environment Canada, Ottawa, Ont.

Nagorsen, D.W. and R.M. Brigham. 1993. Bats of British Columbia. Royal British Columbia Museum. Memoir No.4, UBC Press.

Norris, G., 1983. Aquatics Biophysical. Mapsheet 82K/SE, MOE, Victoria, B.C.

Parish, Roberta, Ray Coupe, and Dennis Lloyd (Eds.) 1996. Plants of Southern Interior British Columbia. Lone Pine Publishing, Vancouver, B.C..

Pommen, L.W. 1991. Approved and Working Criteria for Water Quality. Ministry of Environment, Water Management Division, Water Quality Branch. Victoria, B.C.

Rahme, A.H., A.S. Harestad and F.L. Bunnell. Status of badger in British Columbia. Wildlife Working Report No. WR-72, Ministry of Environment, Lands and Parks, Wildlife Branch, Victoria.

Resources Inventory Committee. 1995. Standards for Terrestrial Ecosystem Mapping in B.C. Review Draft. Ecosystems Working Group, Resources Inventory Committee, Victoria, B.C.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Bulletin 184. Fisheries Research Board of Canada. Ottawa, Ont.

Stanley, S.M., 1986. Earth and Life through Time. Freeman and Company, New York

Merier, F.B., 2014 Panorama Mountain Village 2014 Glade spacing – cruise report. Summit Valley Contracting.

Tarnocai, C. 1980. Canadian Wetland Registry. In Proceedings, Workshop on Canadian Wetlands. C.D.A. Rubec and F.C. Pollett, editors. Lands Directorate, Environment Canada. Ecological Land Classification Series No. 12, Ottawa, Ont.

Terratech Consulting Inc. 1995 Terrain Stability Mapping and Report for 82K.049/050 Goldie/Brewer Map sheets. Salmon Arm, BC.

Water Survey of Canada. 1991. Historical Streamflow Summary, British Columbia. Environment Canada. Ottawa, Ont.

Wittenben, U., 1980. Soil and Landforms. Mapsheet 82K/8 E, MOE, Surveys and Mapping Branch, Victoria, B.C.

6 APPENDICES

Appendix A. 2016 Field Forms

Appendix B. Habitat Capability Rating Scheme

for three levels of knowledge about a species use of habitat. Ratings are based on the habitat's potential (i.e., the carrying capacity under optimal conditions) to support a particular species and reflect the animal's use of the best habitat (i.e., ecosection, biogeoclimatic unit or ecosystem unit) in the province. Species use is determined by the number of each species using one square kilometer of habitat for a month (# animals/km2/month).

Carrying Capacity (under optimal conditions)	**Detailed Knowledge** Mule Deer White-tailed Deer Black Bear		**Intermediate Knowledge** Amphibians Cavity Nesters		**Limited Knowledge** Bats	
	Rating	**Code**	**Rating**	**Code**	**Rating**	**Code**
100-75%	High	1	High	H	Present	P
75-50%	Moderately High	2	Moderate	M		
50-25%	Moderate	3				
25-5%	Low	4	Low	L		
5-0%	Very Low	5	Nil	N	Absent	A
0%	Nil	6				

Appendix C. Wildlife Capability Ratings

for ecosystem units and structural stages in Taynton Bowl at Panorama (Rating system based on Demarchi 1995 - see Appendix B above). Structural stages currently occurring are shaded.

MSdk – Ecosystem Units and Structural Stages

	SG (01) – Sxw – Soopolallie – Grouseberry							
Wildlife Species	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**
Elk	6	2	2	2	3	4	3	3
Moose	6	3	3	4	4	4	3	3
Grizzly Bear	6	2	2	3	5	5	4	4
Bats	X	U	U	U	X	X	X	U
Cavity Nesters	N	N	N	N	L	L	L	M
Amphibians	N	N	N	N	N	N	N	N

	SS (05) – Sxw – Soopolallie – Snowberry							
1	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**
6	3	3	4	4	4	3	3
6	2	2	3	4	4	3	3
6	4	4	4	5	5	4	4
X	U	U	U	X	X	X	U
N	N	N	N	L	L	L	M
N	N	N	N	N	N	N	N

	SB (07) – Sxw – Water Birch?							
Wildlife Species	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**
Elk	6	2	2	2	3	3	3	3
Moose	6	2	2	2	4	4	3	3
Grizzly	6	3	3	4	5	5	4	4
Bats	X	U	U	U	X	X	X	U
Cavity Nesters	N	N	N	N	L	L	L	M
Amphibians	N	N	N	N	N	N	N	N

ESSFdk – Ecosystem Units and Structural Stages

	FA (01) – Bl – Azalea – Foamflower								DM (02) - Fd – Douglas maple – Soopolallie							
Wildlife Species	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**
Elk	6	2	2	3	4	4	4	3	6	2	2	3	4	4	3	3
Moose	6	3	3	4	4	4	3	3	6	3	3	3	4	4	3	3
Grizzly Bear	6	3	3	3	4	4	4	4	6	4	4	4	5	5	5	5
Bats	X	U	U	U	X	X	X	U	X	U	U	U	X	X	U	U
Cavity Nesters	N	N	N	N	L	L	L	L	N	N	N	N	L	L	L	L
Amphibians	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

ESSFdk - Ecosystem Units and Structural Stages

	FG (03) – Bl – Azalea – Grouseberry								FS (04) – Bl – Azalea - Soopolallie							
Wildlife Species	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**
Elk	6	2	2	2	4	4	3	3	6	2	2	3	4	4	3	3
Moose	6	3	3	4	4	4	3	3	6	3	3	3	4	4	3	3
Grizzly Bear	6	3	3	3	4	4	4	4	6	2	2	2	3	3	3	3
Bats	X	U	U	U	X	X	X	U	X	U	U	U	X	X	U	U
Cavity Nesters	N	N	N	N	L	L	L	M	N	N	N	N	L	L	M	M
Amphibians	N	N	N	N	N	N	N	N	N	N	N	N	N	L	L	L

ESSFdk – Ecosystem Units and Structural Stages

	WS (07) – Willow Sedge							
Wildlife Species	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**
Elk	6	2	2	2	2	2	2	2
Moose	6	2	2	2	2	2	2	2
Grizzly Bear	6	2	2	2	2	2	2	2
Bats	X	U	U	U	X	X	U	U
Cavity Nesters	N	N	N	N	L	L	M	M
Amphibians	N	N	N	N	N	L	L	L

AT - Ecosystem Units and Structural Stages

	N/A							
Wildlife Species	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7**
Elk	6	2	2					
Moose	6	3	3					
Bear	6	2	2					
Bats	X	U	U	U	X	X	U	U
Cavity Nesters	N	N	N	N	L	L	M	M
Amphibians	N	N	N	N	N	L	L	L
Mountain Goat	2	2	2					

Appendix D. Wildlife Management Plan