The Silva Forest Foundation

Creston Valley Forest Corporation
Initial Ecosystem-based Plan

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1 Report summary

In the fall of 2002, Creston Valley Forest Corporation (CVFC) and Silva Forest Foundation (SFF) agreed that SFF would work with CVFC to develop an initial ecosystem-based plan for the Creston Community Forest. This report summarizes SFF's initial analysis and planning work.

This plan provides an initial landscape-level ecological reserve network, referred to as a Protected Landscape Network, to help guide CVFC's ongoing operational forestry planning. This plan does not provide stand-level operational direction, but this plan is designed to complement, and to integrate with, CVFC stand-level operations. The expectation that CVFC will continue to reserve small (1 hectare to 10 hectare) areas, consisting of ecologically sensitive sties, unique habitats, and representative ecosystems within all potential operating areas is integral to this plan.

Results

This plan designates an initial Protected Landscape Network (PLN) for the CVFC Chart Area that consists of:

- areas unsuitable for timber management, and
- biodiversity nodes and reserves.

'*Areas unsuitable for timber management*' are defined as being either too ecologically sensitive, non-productive, and/or inoperable from the point of view of timber extraction. These areas include:

- riparian ecosystems,
- non-forested and non-productive areas,
- unstable terrain,
- very wet areas,
- very shallow/ very dry areas,
- very limited growth potential areas (low site index stands), and
- inoperable areas.

In total, 6,550 hectares (51%) of the CVFC Chart Area is classified as unsuitable for timber management. A further 1,387 hectares (11%) is classified as potentially unsuitable for timber management (*gray* areas), requiring further study.

'*Biodiversity nodes and reserves*' were designed by SFF to maintain or restore ecological integrity by meeting the following PLN reserve design objectives:

- representation of all ecosystem types,
- protection of existing old forest,
- riparian ecosystem protection,
- protection of mountain caribou core habitat,
- protection of rare ecosystems and species' habitats,
- connectivity, and

- good spatial distribution of biodiversity nodes and reserves throughout the CVFC Chart Area.

SFF designed 3 reserves in the CVFC Chart Area:

- Arrow Creek core reserve,
- Headwaters East reserve, and
- Caribou reserve.

The Arrow Creek core reserve provides protection for the riparian ecosystems and upland forests of the main stem of Arrow Creek. This 1,803 hectare reserve is the key component of the Protected Landscape Network for Arrow Creek—all of the biodiversity nodes connect to this central reserve.

The Headwaters East reserve protects the drainage basin of the east fork of the headwaters of Arrow Creek. This 620 hectare reserve was designed as part of the PLN to emphasize its need for protection, notwithstanding the fact that the entire headwaters has also been mapped by the Ministry of Water, Land, and Air Protection as a reserve for core caribou habitat.

SFF also designed 17 biodiversity nodes throughout the CVFC Chart Area, ranging in size from 13 ha to 174 ha, to meet the reserve design objectives listed above.

Representation analyses

To assess whether the PLN achieved the protection objectives stated above, we analyzed the representation of biogeoclimatic subzones/ site series, forest types as defined by leading species, and old forest in the PLN.

The representation analyses demonstrate that a minimum of 59% of each biogeoclimatic subzone is protected in the PLN, including a minimum of 40% of all site series within each subzone. The analyses further show that, with the exception of spruce-balsam forests which are 77% protected, all forest types have between 43% and 57% protection.

The representation analysis of old forest by biogeoclimatic subzone and site series suggests that the majority of existing old forest is protected by the PLN in each subzone. PLN protection of old forest by subzone ranges from 57% to 98%. Representation of old forest by site series is consistently high, with >70% protection of old forest on all but three site series. Old forest in the zonal ICHdm/01 site series has the lowest level of representation in the PLN, at just over 40% protection.

This analysis suggests that revisions to the PLN may require the inclusion of more zonal old forest in the ICHdm subzone. When developing new operating areas, CVFC should capture potentially under-represented zonal old forest in the ICHdm subzone through inclusion of representative zonal old forest in stand-level reserves. The portion of old forest in the CVFC Chart Area will increase over time as the early and mid-seral forests in the biodiversity nodes and reserves age. This is good not only for the maintenance of ecological integrity, including biodiversity, but also is good for water, because old growth forests produce the highest quality water.

CVFC potential timber management landbase

The CVFC potential timber management landbase outside of the PLN includes:

- 3625 hectares of potential timber management landbase, and
- 835 hectares of areas requiring further study (*gray* areas).

There are 1,532 hectares of previously logged areas in the CVFC Chart Area and 579 hectares of CVFC planned cutblocks (2003-2006). Previously logged areas in the CVFC Chart Area vary widely in current stand age and stocking levels.

The current age class distribution of the unlogged portion of the CVFC potential timber management landbase is as follows:

- 55% (1269 hectares) is between 40 and 80 years old,
- 27% (625 hectares) is between 80 and 100 years old, and
- 18% (431 hectares) is over 100 years old.

It was beyond the scope of the current project to assess short-term and long-term sustainable cut levels for this landbase.

Next steps

This project contributes to an early phase of landscape-level planning for CVFC, and much work remains to be done to refine the interpretations and the Protected Landscape Network design presented here.

Due to time and budget constraints, the current project has synthesized existing ecological and forestry information only, and did not involve any detailed air photo interpretation or field work. Detailed air photo interpretation and field work will be required to confirm the interpretations of the data sets used, and to refine the initial Protected Landscape Network.

Following the completion of Martin Carver's riparian management plan in the spring of 2004, the initial Protected Landscape Network presented here will need to be reconciled with Carver's riparian plan results.

Future collaboration between SFF and CVFC could potentially include field assessment and design of stand-level protected ecosystem networks (PENs) in CVFC operating areas, to complement the initial PLN. In conjunction with these steps, SFF and CVFC could collaborate on developing an appropriate method to calculate a short-term and a long-term AAC for the CVFC Chart Area.

Future collaboration could also include the establishment of a practical system to monitor ecological integrity, which is the foundation for the production of high quality water in the Creston Community Forest.

2 Introduction

2.1 Project scope

In the fall of 2002, Creston Valley Forest Corporation (CVFC) and Silva Forest Foundation (SFF) agreed that SFF would work with CVFC to develop an initial ecosystem-based plan for the Creston Community Forest. This report summarizes SFF's initial analysis and planning work.

CVFC has five shareholders—the Town of Creston, the Regional District of Central Kootenay, the Creston Area Economic Development Commission, the Lower Kootenay Indian Band, and the East Kootenay Environmental Society. CVFC's first goal and objective is "to develop an ecosystem-based, ecologically responsible philosophy of forest stewardship that respects all forest values and functions". In keeping with this primary objective, this initial ecosystem-based plan attempts to integrate landscape-level ecological concerns with ongoing CVFC operational forestry planning. This plan suggests a landscape-level reserve network, referred to as a Protected Landscape Network, for the CVFC Chart Area.

Due to time and budget constraints, the current project has synthesized existing ecological and forestry information only, and did not involve any detailed air photo interpretation or field work. Detailed air photo interpretation and field work will be required to confirm the interpretations of the data sets used, and to refine the initial Protected Landscape Network. Suggested next steps are discussed in Section 9.

Social and cultural information and values, and First Nations knowledge and values were beyond the scope of the current project, and will need to be accommodated before this plan is finalized.

Concurrent with this project, Martin Carver is developing a riparian management plan for Arrow Creek. Following the completion of Carver's project in the spring of 2004, the initial Protected Landscape Network presented here will need to be reconciled with Carver's riparian plan results.

2.2 Relationship to larger landscape values and Higher Level Plans

The 12, 800 hectare CVFC Chart Area is a relatively small part of the larger landscape of the South Purcell mountains, and of the Ministry of Forests' Landscape Unit K-25. Nonetheless, the initial PLN for the CVFC Chart Area considers many larger landscape planning issues, including those documented in the Kootenay Boundary Land Use Plan Implementation Strategy (KBLUP – IS).

The KBLUP – IS provides direction on a number of landscape level planning issues, including Old Seral Patch requirements, caribou habitat areas, and regional connectivity corridors. This initial ecosystem-based plan addresses many of these Higher Level Plan requirements.

2.2.1 Old Seral Patch requirements

Old Seral Patch (OSP) requirements are addressed in detail through the initial Protected Landscape Network (PLN) discussed in detail in Section 6. The PLN biodiversity nodes and reserves protect over 4,400 hectares in the contiguous Arrow Creek core reserve, Headwaters reserve, Caribou reserve, and biodiversity nodes (See Map 3). 36% of the CVFC Chart Area is in designated biodiversity nodes and reserves, and over 50% of the existing old forest in the CVFC Chart Area is protected in the designated biodiversity nodes and reserves. In total, 68% of the CVFC Chart Area and 71% of existing old forest are protected in the PLN. The PLN provides more old forest (and more old forest recruitment area) in each BEC subzone than the OSP's previously recommended by the Ministry of Forests and Ministry of Environment[1].

2.2.2 Caribou habitat

Caribou habitat is discussed in detail in Sections 4.6 and 6.2 below. All mapped core caribou habitat is included in the PLN.

2.2.3 Regional connectivity

The KBLUP – IS has a mapped connectivity corridor for grizzly bear migration in the headwaters of Arrow Creek. With the entire headwaters of Arrow Creek protected under core caribou habitat guidelines, regional connectivity through this area is protected.

2.3 Relationship to CVFC stand-level operations

This plan provides an initial Protected Landscape Network to help guide CVFC's ongoing operational forestry planning. The initial PLN does not provide stand-level operational direction, but is designed to complement, and to integrate with, CVFC stand-level operations.

This plan is a landscape-level overview only and is based on the expectation that CVFC will continue to make cautious decisions based on detailed site-level assessments of all potential operating areas, particularly in all areas designated in Map 2 as areas requiring further study (*gray* areas). It is for this reason that we refer to the *potential* timber management landbase (PTML) only. Ecological and operational constraints on this potential landbase have not been fully assessed.

This plan is based on the expectation that CVFC will continue to reserve small (1 hectare to 10 hectare) areas, consisting of ecologically sensitive sties, unique habitats and representative ecosystems within all potential operating areas, much as it has through the designation of Wildlife Tree Patches on Arrow Mountain and in Arrow Lower West. Maintenance of stand-level connectivity is also an important component of these stand-level reserve areas, which are an integral part of a multiple spatial scale ecosystem-based approach. SFF refers to stand-level reserves as Protected Ecosystem Networks.

[1] These are KLFD Landscape Unit K-25 OSP's #7, 8, 9, 12, and 14.

It was beyond the scope of this project to assess the impact of stand-level reserves on the PTML, but we expect that approximately 5–10% of the PTML will be required for stand-level reserves.

In addition, we expect that CVFC will continue to provide for permanent stand-level retention on all cutblocks by leaving full-cycle trees. Full-cycle trees are single trees or small clumps of trees, representative of the site and well dispersed through a cutblock, that are permanently retained to complete their life cycle and contribute to stand composition and structure.

2.4 Report structure

This report provides the methods, rationale, and results for the initial Protected Landscape Network for the CVFC Chart Area. This report is structured as follows:

- Section 3—The CVFC Chart Area provides a description of the CVFC Chart Area in terms of natural ecosystem character and current ecosystem condition. It shows the results of Map 1: Tree Species and Age.
- Section 4—Methods and data provides an overview of the data sets used in this report and how they were used in the analyses to develop a Protected Landscape Network.
- Section 5—Results: Landbase Unsuitable for Timber Management describes how Map 2: Landbase Unsuitable for Timber Management was developed, and describes the results of this map.
- Section 6—Results: Initial Protected Landscape Network explains the PLN design objectives and describes each biodiversity node and reserve that is included as part of the PLN. This section discusses the development and results of:
    - Map 3: Protected Landscape Network Emphasizing Biodiversity Nodes and Reserves,
    - Map 4: Protected Landscape Network and Potential Timber Management Landbase, and
    - Map 5: Protected Status of Old Forest.
- Section 7—Representation analyses describes the results of analyses of the representation (i.e., percent protected in PLN) of biogeoclimatic subzones/ site series, Ministry of Forests' forest types as defined by leading species, and old forest.
- Section 8—Past and planned logging and potential timber management landbase provides the results of Map 6: Past and Planned Logging, and describes the CVFC potential timber management landbase.
- Section 9—Next steps describes the work that remains to be done to refine the interpretations and the Protected Landscape Network design presented in this report. It also provides options for future collaboration between CVFC and SFF for ongoing development of ecosystem-based management in the Creston Community Forest.
- Section 10—References provides references for the documents cited in this report.

This report is accompanied by a set of six 1:30,000 scale maps:

- Map 1: Tree Species and Age
- Map 2: Landbase Unsuitable for Timber Management
- Map 3: Protected Landscape Network Emphasizing Biodiversity Nodes and Reserves
- Map 4: Protected Landscape Network and Potential Timber Management Landbase
- Map 5: Protected Status of Old Forest
- Map 6: Past and Planned Logging

Miniature versions of these maps are included as fold-out figures in this report.

3 The CVFC Chart Area

Figure 1: Arrow Creek and Big Bear Creek drainages
This photo, taken from the north side of Arrow Mountain, shows the Arrow Creek drainage basin on the right, with the Big Bear Creek drainage visible on the left.

3.1 Natural ecosystem character

The 12 800 hectare CVFC Chart Area includes Arrow Creek, the west side of Arrow (Goat) Mountain, Sullivan Creek, Camp Run Creek, and the Skimmerhorn area. This area includes a wide range of ecosystem types in 5 biogeoclimatic subzones, ranging from the Very Dry Warm Interior Cedar – Hemlock Subzone (ICHxw) in the Kootenay River valley to the Dry Mild Engelmann Spruce – Subalpine Fir Subzone (ESSFdm), which is transitional to subalpine parkland at upper elevations (see Figure 2).

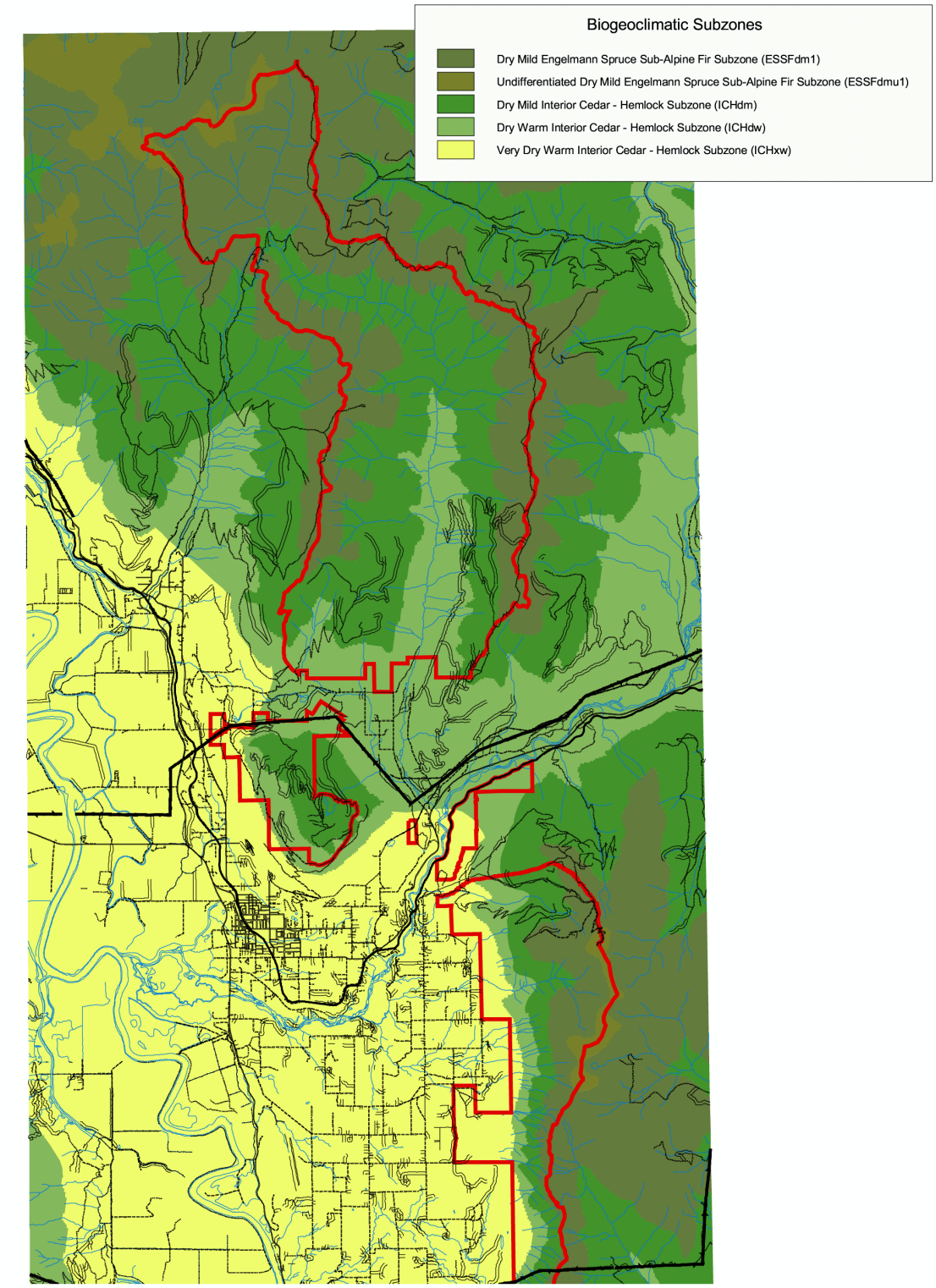

Figure 2 Biogeoclimatic subzones in the CVFC Chart Area

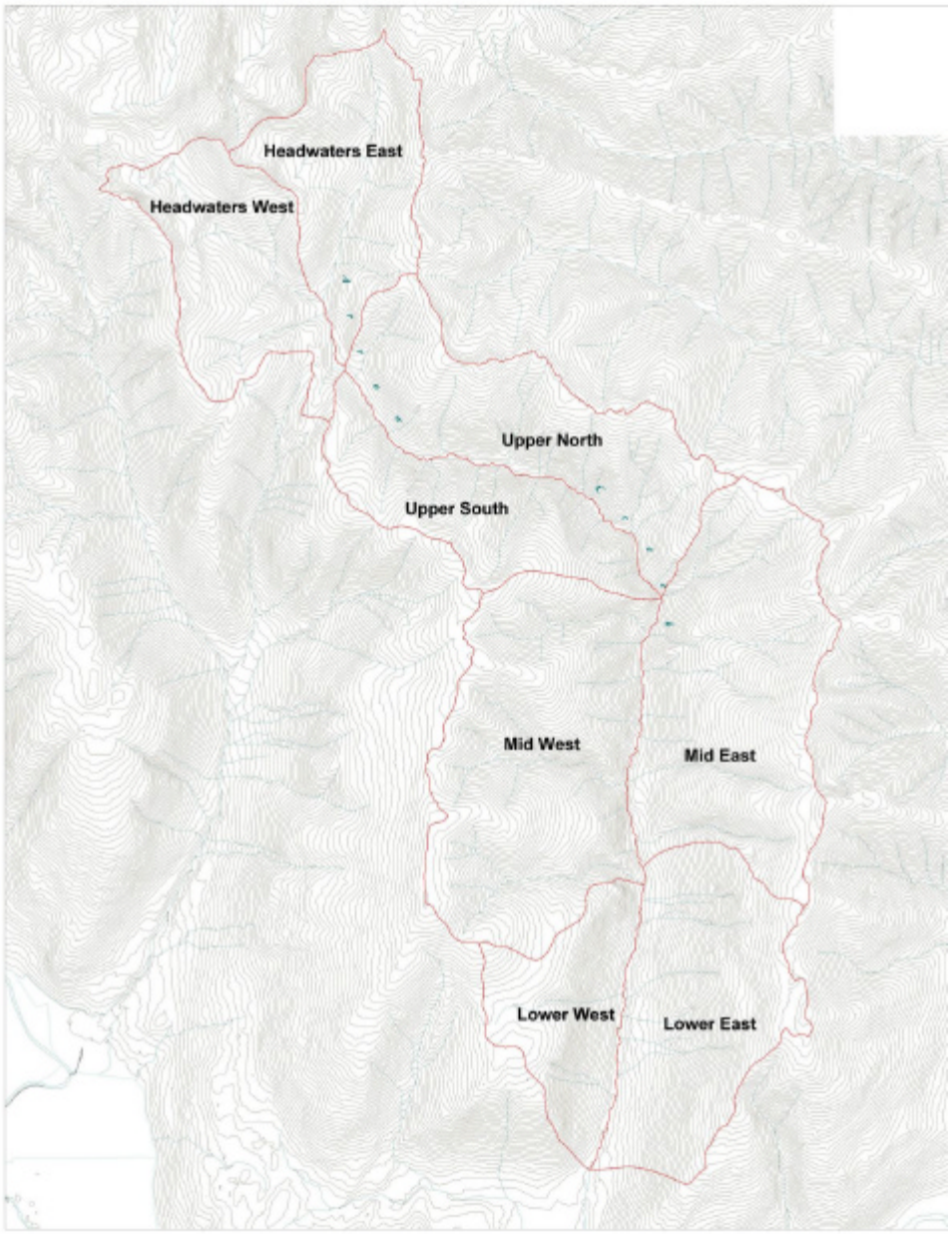

Figure 3 Arrow Creek hydrologic subunits in the CVFC Chart Area
The hydrologic subunits are from Martin Carver's and Greg Utzig's hydrologic assessment of Arrow Creek. (1999).

3.1.1 Interior Cedar – Hemlock Zone

The CVFC Chart Area includes three Interior Cedar – Hemlock (ICH) subzones: the Very Dry Warm Subzone (xw); the Dry Warm Subzone (dw); and the Dry Mild Subzone (dm)[2].

According to Braumandl and Curran (1992), the ICHxw has very hot, dry summers, and very mild winters with very light snowfall. Zonal sites are characterized by stands of Douglas-fir and ponderosa pine, with sporadic regeneration of western cedar, western hemlock, and grand fir. Snowberry, ocean-spray, mock-orange, Saskatoon berry, and hazelnut are common in the understory. Drier ICHxw sites historically had open stands with large, old Douglas-fir, ponderosa pine, and lodgepole pine. The ICHxw was maintained with this structure by frequent stand-maintaining fires that historically consumed woody fuels, thinned younger stands, and raised the height of live tree crowns. These fires were the result of indigenous peoples' management systems and lightening caused fires. Much of the ICHxw was thus historically maintained in a 'fire-climax' state.

Just upslope from the ICHxw, the ICHdw has very hot, moist summers, and very mild winters with light snowfall. Zonal sites are characterized by old growth stands of cedar and hemlock, or mixed seral stands of Douglas-fir and western larch. Falsebox, Douglas maple, twinflower, prince's pine, queen's cup, and sarsaparilla are common in the understory.

Disturbance in the ICHdw is characterized both by the death of single trees and small groups of trees, which creates small canopy gaps, and by fires of varying intensity and extent. Natural burns usually left unburned old forest patches, resulting in a diverse forest landscape. Remnant patches of large fire-scarred ponderosa pine, larch, and Douglas fir in the ICHdw attest to the varying fire regimes that characterized this subzone prior to modern fire suppression (see Figure 4).

[2] The new ICHdm subzone has replaced the ICHmw2 subzone variant in this area.

Figure 4 Large old ponderosa pine and Douglas fir on Arrow Mountain
This natural patch of large old fire-resistant trees in the ICHdw subzone became established prior to modern fire suppression. This type of stand composition and structure is representative of natural ecosystem character in drier portions of this subzone.

Upslope from the ICHdw, the ICHdm is a new subzone that does not yet have a provincially approved classification. Prior to the designation of the ICHdm, this portion of the CVFC Chart Area was mapped as the ICHmw2. According to Braumandl and Curran (1992), the ICHmw2 has hot, moist summers, and very mild winters with light snowfall. Zonal sites are characterized by old growth stands of cedar and hemlock, or mixed seral stands of Douglas-fir, larch, Engelmann spruce, hemlock, and cedar. Falsebox, black huckleberry, prince's pine, and feathermoss are common in the understory of these stands.

Disturbance in the ICHmw2 is characterized by the death of single trees and small groups of trees, which creates small canopy gaps. Fires in the ICHmw2 were less frequent than in the ICHxw and ICHdw, and were typically of moderate size with numerous unburned areas (Braumandl and Curran 1992). However, the new ICHdm subzone is defined by being generally drier than the ICHmw2.

3.1.2 Engelmann Spruce – Subalpine Fir Zone

The Engelmann Spruce – Subalpine Fir (ESSF) zone has two subzones in the CVFC Chart Area: the Dry Mild Subzone (dm), and the Dry Mild undifferentiated subzone (dmu) that is transitional to parkland ecosystems.

The ESSFdm is a new subzone that does not yet have a provincially approved classification. Prior to the designation of the ESSFdm, this portion of the CVFC Chart Area was mapped as ESSFwm. The ESSFwm is characterized by warm, moist or wet summers, and relatively mild winters with heavy snowfall. Zonal sites in the ESSFwm are characterized by old growth and mixed seral spruce-balsam stands. False azalea, black huckleberry, oak fern, mountain arnica, and one-leaved foamflower are common understory plants. Disturbance in the ESSFwm is characterized by small canopy gaps resulting from the death single trees or small groups of trees, and by infrequent stand-replacing fires.

According to Braumandl (personal communication), the new ESSFdm subzone was created to recognize the drier climate and shorter fire return interval in this area, as compared to the ESSFwm. The fire history in the ESSFdm has led to a prevalence of early and mid-seral stands in this area. According to Braumandl, the current age of ESSFdm stands and the current distribution of lodgepole pine more closely resemble the drier ESSFdk subzone than the ESSFwm[3]. However, there is some debate regarding how the *current* age class and species distribution in this area compares with the range of natural variability for the past 2000 years. Along with small patch openings, stand-replacing fire appears to have played an important role in the natural disturbance regimes of this area[4]. However, the fire history of the past 100-200 years—and hence the current age class and species distribution in this subzone—may not be representative of natural ecosystem character over longer time periods.

3.2 Current ecosystem condition

3.2.1 Interior Cedar – Hemlock Zone

The ICHxw subzone is heavily impacted by human settlement, agriculture, and range use. Forested ICHxw areas have also been subject to decades of highgrade logging and fire suppression which has caused many former fire-climax Ponderosa pine and Douglas-fir stands to fill in with young trees. In the CVFC Chart Area, just 4% (43 hectares) of the ICHxw subzone currently supports old forests (see Table 10). The change from more open, older fire-climax stands to more closed canopy young stands has increased fuel loads, increased risk of crown fires, and increased moisture stress in these now overstocked stands. Overall, these forests are stressed, which can lead to tree and stand mortality from various organisms, such as defoliating insects and root decaying fungi. There are very few ICHxw ecosystems that are within their range of natural variability in terms of forest composition and structure. As a result, all of the ICHxw needs to be considered as a restoration zone.

As a result of settlement and mining activities, much of the ICHdw and ICHdm subzone ecosystems in this area were burned by large, high-intensity fires in the first half of the 20th

[3] According to Braumandl, the ESSFdm understory vegetation is quite similar to the ESSFdk.

[4] For example, the upland areas of the Arrow Creek headwaters probably burned sometime in the second half of the 19th century.

century. Young and mid-aged larch and Douglas-fir stands are prevalent in much of the ICHdw and young lodgepole pine stands are prevalent in much of the ICHdm (see Figure 5 and Figure 9: Map 1—Tree Species and Age).

Figure 5 Young larch and lodgepole pine stands in Arrow Mid West
Much of the forest on the gentle slopes of Arrow Mid West was burned during the 1942 fire. Early seral stands of larch and lodgepole pine such as those shown here are common.

In upper Arrow Creek, portions of the ICHdm and ESSFdm subzones have still not fully regenerated following the 1942 fire (see Figure 6).

Figure 6 Regenerating forest on The Iron Range and Upper Arrow Creek

The Iron Range is in the foreground, with Arrow Mid West and Upper West in the background. Much of this area is still regenerating from the 1942 fire. Old forest remnants that escaped the fire can be see near the valley bottom in Arrow Upper South.

Portions of the ICHdw and ICHdm subzones on Arrow Mountain and lower Arrow Creek have been highgrade logged; portions of Arrow Mountain, Sullivan Creek, and Big Bear Creek have been clearcut (see Figure 25: Map 6—Past and Planned Logging). As a result, there are few natural old growth stands in these areas. In the CVFC Chart Area, just 12% (287 hectares) of the ICHdw subzone and 14% (626 hectares) of the ICHdm subzone currently support old forests (see Table 10).

CVFC logging in the ICHdw and ICHdm subzones has generally involved thinning and/or partial cutting which retains significant stand composition and structure, including large trees where they occur (see Figure 7).

Figure 7 Thinned ICHdw stand on Arrow Mountain

CVFC logging on the west side of Arrow Mountain has thinned crowded young stands and begun to restore more natural forest composition and structure.

3.2.2 Engelmann Spruce – Subalpine Fir Zone

Fires burned much of the ESSF in the CVCF Chart Area in the past century and a half, with the 1942 fire being the most recent. As a result, the ESSF zones has a broad distribution of stand ages, ranging from regenerating and young stands in the mid and upper reaches of Arrow Creek, to mature and old growth stands in the headwaters of Arrow Creek (see Figure 9: Map 1—Tree Species and Age).

In contrast to the surrounding landscape where extensive areas have been fragmented by clearcut logging, relatively little of the ESSFdm subzone in the CVFC Chart Area has been logged (see Figure 25: Map 6—Past and Planned Logging). The headwaters of Arrow Creek thus support some of the most intact, old spruce-balsam forests in the landscape. In the CVFC Chart Area, 23% (1003 hectares) of the ESSFdm subzone currently supports old forests (see Table 10).

CVFC logging in the ESSFdm to date has been limited to salvage of snow damaged pine stands in an area that is transitional with the ICHdm subzone (see Figure 8). CVFC has four planned logging blocks in the ESSFdm subzone in Arrow Mid West.

Figure 8 Thinned lodgepole pine stand in Arrow Lower West
This area adjacent to upper Big Bear Creek is transitional between the ICHdm and the ESSFdm subzones. CVFC thinned this stand after it incurred significant snow breakage.

3.3 Map 1: Tree Species and Age

Map 1: Tree Species and Age shows the current leading tree species and stand age class distribution in the CVFC Chart Area, which provides a good overview of the condition of the landscape. Map 1 is shown in Figure 7; the results of this map are summarized in Table 1.

This map is derived exclusively from the Ministry of Forests' (MoF) Forest Cover species composition and age class data. The forest cover data was *not* updated using FDP data, so any recent logging is not represented on this map.

All forest stands were stratified by MoF leading tree species and MoF age class. All stands were classified as 'young' if they were <=60 years old. Pine leading and deciduous leading stands were classified as 'old' beginning at age class 7 (121+ years old)[5]. All other stands (i.e., cedar, hemlock, Douglas-fir, larch, and spruce-balsam leading) were classified as 'old' beginning at age class 8 (141+ years old).

[5] Definitions of old forest are the same as those used in the old forest representation analysis described in Section 0.

Figure 9 Map 1: Tree Species and Age

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Table 1 Distribution of leading species and age classes

Pine leading stands include lodgepole pine, white pine, and ponderosa pine leading stands. In most circumstances, white pine and ponderosa pine stands would not be included with lodgepole pine in defining "old forests". Because of the shorter life cycle for lodgepole pine, it tends to reach "old forest" status earlier (121+ years old) and white pine and ponderosa pine (141+ years old). However, the vast majority of the stands in the area are lodgepole pine leading. There are no ponderosa pine leading stands in the CVFC Chart Area. There are two stands classified as white pine leading in the CVFC Chart Area: one is an age class 3 stand regenerating after the 1942 fire, and the other is a small highgraded age class 5 stand in Arrow Lower East. Thus, the lack of white pine and ponderosa pine leading stands in the CVFC Chart Area permitted grouping of these three species to simplify map colour themes on Map 1.

4 Methods and data

The primary objective of this study was to develop a Protected Landscape Network (PLN) that maintains or restores ecological integrity in the CVFC Chart Area. This section describes the data sets used in this study.

A PLN is developed based on the principles of conservation biology and landscape ecology. PLN development requires taking an ecological approach to determining which areas need to be protected at the landscape level to maintain or restore ecological integrity, including biological diversity.

A PLN consists of:

- biodiversity nodes and reserves,
- ecologically sensitive areas, and
- low productivity and inoperable areas that are unsuitable for timber management.

'Biodiversity nodes and reserves' are designed to protect ecological integrity and biological diversity through meeting the following design objectives:

- representation of all ecosystem types,
- protection of existing old forest,
- riparian ecosystem protection,
- protection of mountain caribou core habitat,
- protection of rare ecosystems and species' habitats,
- connectivity, and
- good spatial distribution of biodiversity nodes and reserves throughout the study area.

The designation of PLN biodiversity nodes and reserves is described in detail in Section 6.

Ecologically sensitive areas include riparian ecosystems, unstable terrain, very wet areas, and very shallow/ very dry areas that need to be protected for ecological reasons. Together with low productivity and inoperable areas, these areas are removed from the potential timber management landbase as shown on Map 2: Landbase Unsuitable for Timber Management, and are included in the PLN.

For this project, we worked with existing data sets to define ecologically sensitive, low productivity and inoperable areas (i.e., the landbase unsuitable for timber management). The data sets used included forest cover data from the Ministry of Forests, terrain studies, 1:70 000 scale aerial photographs, and hydrologic studies. These data sets are briefly described in this section. The development and results of the determination of the landbase unsuitable for timber management are discussed in Section 5.

This section thus briefly describes each data set and how it was used to develop and analyze the PLN, and to develop the maps that accompany this report.

4.1 Ministry of Forests forest cover

The Ministry of Forests (MoF) forest cover data was used exclusively to produce Map 1—Tree Species and Age[6]. It was also used extensively for portions of Map 2—Landbase Unsuitable for Timber Management (see Section 5). MoF classes that are included in the landbase unsuitable for timber management include wetlands, alpine or rock (non-forest), non-productive forest or brush, alpine forest, low site index, and inoperable areas. MoF non-productive areas and inoperable areas are somewhat problematic and thus are discussed briefly below.

4.1.1 Non-productive areas

The MoF has classified many of the burned stands in Arrow Upper North as non-productive. While there is ample evidence that many of these areas are productive sites (Utzig, personal communication; Carver, personal communication), there is no alternative data set available that classifies this area systematically into productive and non-productive sites. As a result, for this project we have accepted the MoF non-productive classification, despite its major limitations.

4.1.2 Inoperable areas

The 1994 MoF operability line was provided as part of the forest cover data. We examined this line and discovered a few locations in the CVFC Chart Area where the line was not consistently drawn. Most obviously, the very accessible and gentle terrain in Lister Creek was classified as inoperable. Further examination suggested that there were a few locations in Arrow Creek where the MoF had classed relatively gentle, productive and accessible areas as inoperable. All of these areas are adjacent to large operable areas and do not appear to be inoperable.

We discussed the issue with CVFC forester Jim Smith and then edited the MoF operability line to improve its consistency in a few areas (see Figure 10). As a result we increased the operable area by at total 714 hectares or 5.6% (see Table 2). None of the edits present fundamental departures from the MoF's approach to operability. Instead, they were an attempt to make the operability line more consistent across the CVFC Chart Area. Consistent with the MoF, we did not map any of Arrow Upper North as operable, because this area is dominated by steep, complex terrain that is difficult to access.

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Table 2 CVFC operable/ inoperable area

[6] We used Ministry of Forests (MoF) forest cover map sheets 082F008, 009, 018, 019, 028, 029, and 038, dated 1997 – 2000.

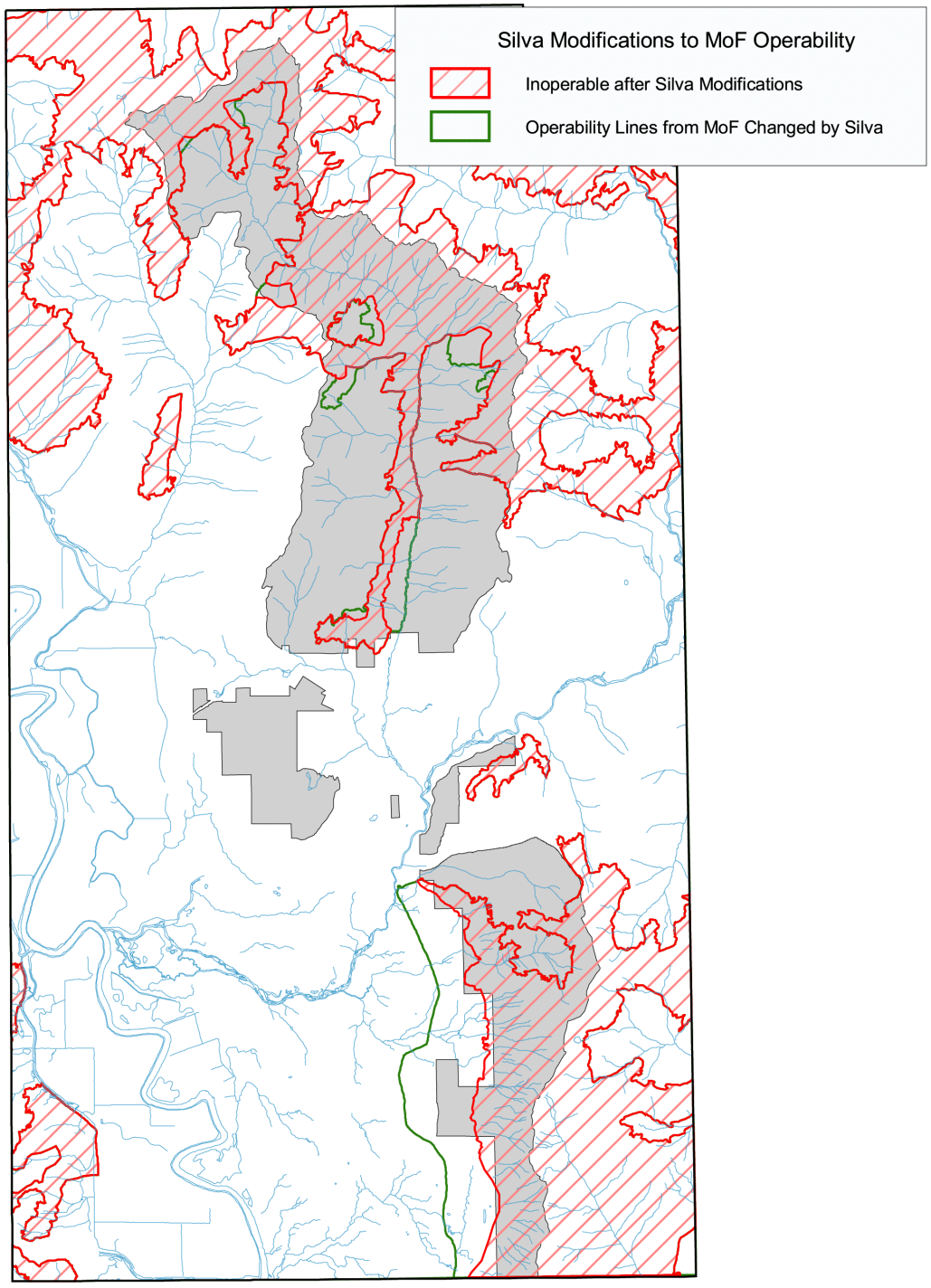

Figure 10 Ministry of Forests operability with SFF changes

Inoperable areas are crosshatched. Green lines show all Ministry of Forests operability lines that were changed by SFF. In total, SFF added 714 hectares of operable area.

4.2 Terrain studies

Terrain studies provide detailed information on soils, moisture regimes, slope gradients and configuration, geomorphological processes, and potential terrain instabilities. Terrain studies were used to identify ecologically sensitive areas that are too unstable, too wet, too dry, too shallow to bedrock, and/or too steep to be suitable for timber management.

For the portion of the CVFC Chart area north of the Goat River, we used Level B and C terrain mapping (Utzig 1999). The complete Utzig data set was provided to us in digital form by the author, and this data was classified as described in Section 5.2. In this section of the report, reference is often made to Utzig terrain polygons numbers. These polygons, and the complete terrain data for these polygons can be found in Utzig's 1999 report and map set (see Section 10: References).

For Sullivan Creek, we used Level C terrain mapping (Wallace and Putt 2000). We digitized the terrain polygons from the 1:20 000 maps included with the report, and manually classified the polygons as described in Section 5.2.

For Lister Creek, we reviewed the Level B terrain inventory (Putt 2002). This area is all Terrain Stability Class I with no terrain-related concerns, so no further analysis was required. For the Lipsett area (i.e., CP2 – Block 2), we reviewed the Level A terrain stability assessment (Putt 1999).

No detailed terrain information was available to us for the remaining portions of the CVFC Chart area—Camp Run Creek, the Skimmerhorn, and the Lipsett area northeast of CP2 – Block 2. We thus digitized the potentially unstable 'H' (medium likelihood of landslide initiation) polygons from the available Level D Reconnaissance Terrain Stability study (Jordan 1996)[7]. The potentially unstable polygons were mapped as Terrain Class IV polygons for the purposes of our project[8].

4.3 Aerial photographs

We used 1995 black and white air photos with an approximate scale of 1: 70 000 to provide a general overview of the landscape ecology of CVFC Chart Area and to check terrain interpretations from the terrain studies referenced in Section 4.2. It was beyond the scope of this study to complete any detailed air photo interpretation of larger scale aerial photography. Detailed photo interpretation of larger scale aerial photography would be used by SFF to develop our own detailed interpretations of terrain and ecosystem type, and to examine key areas of interest in greater detail.

4.4 Hydrologic assessments

We reviewed Carver and Utzig's 1999 hydrologic assessments for Arrow Creek, Arrow Mountain, and Associated Lands, and were provided with some of this information in

[7] Jordan's 'H' polygons are labelled 'P' on CVFC FDP maps.

[8] Almost none of this area is operable.

digital form. We used Carver and Utzig's hydrologic subunit boundaries (see Figure 3) to stratify and help describe the Arrow Creek drainage basin. We used Carver and Utzig's detailed road and trail mapping to augment and update the MoF Forest Cover road mapping.

We also reviewed Carver's regional hydrologic assessment of Arrow Creek (2001), paying particular attention to the equivalent clearcut area (ECA) maps for 1949, 1975, and 1998. These maps show how portions of Arrow Creek are recovering from fires in the past century. Carver's 1998 ECA map was used to in check MoF interpretations of current canopy closure in previously logged areas, which were used in Map 6—Past and Planned Logging.

Carver is currently working on a Riparian Management Plan for Arrow Creek, which will ultimately be integrated with this initial ecosystem-based plan.

4.5 BEC subzone and predictive ecosystem mapping

Biogeoclimatic ecological classification (BEC) subzones and predictive ecosystem mapping were used to describe the natural ecosystem character of the CVFC Chart Area, and to set targets for ecosystem representation in the PLN. Following the development of the initial PLN, BEC data was used in our representation analyses (see Section 7).

We used the current BEC subzone mapping for the Kootenay Lake Forest District (KLFD). The new subzone mapping makes significant changes to the original BEC mapping and also identifies two new subzones in the Creston area—the ICHdm and the ESSFdm (see Figure 2)[9]. These new subzones replace, respectively, the ICHmw2 and the ESSFwm in this area.

The new subzone mapping was used for the KLFD predictive ecosystem mapping (PEM). The PEM uses new tentative site series that have been allocated to the ICHdm and ESSFdm subzones. The reliability of the PEM data is questionable since very limited field checks of site series have been done. There are 1,136 hectares of forested land in the CVFC Chart Area that the PEM was not able to code as a unique site series[10]. Nonetheless, we used the available PEM data set to conduct our site series representation analysis (see Section 7).

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Table 3 Forested site series used in PEM

4.6 Caribou mapping

Caribou mapping was used to define core caribou habitat for the design of a PLN caribou reserve (see Sections 6.1.1 and 6.2.1.3).

[9] A complete description of the new BEC subzones and their tentative site series is not yet available.

[10] These areas are codes as combinations of possible site series.

We used the new habitat mapping that is now available for the endangered South Purcell population of mountain caribou. This habitat mapping was provided to us by Guy Woods (B.C. Ministry of Water, Land and Air Protection, Kootenay Region) in March 2003, and is based on a set of detailed 1:50 000 habitat maps produced by Kinley and Utzig (2001). The extent of core caribou habitat in the CVFC area is shown in Map 3—Protected Landscape Network. This mapping is undergoing a public review process and will soon replace the older KBLUP-IS caribou habitat mapping (Guy Woods, personal communication).

4.7 Forest Development Plans

We used the CVFC 2001 – 2006 Forest Development Plan (FDP) to develop the Past and Planned Logging map (Map 6). We also digitized three new proposed CVFC cutblocks in Big Bear Creek to provide a complete current picture of CVFC planned logging.

We also obtained a 1:250 000 scale paper map of the KLFD 2002 Consolidated FDP. Using this map, we digitized the outlines of recent and/or proposed logging blocks but were not able to differentiate these areas further. This digitized information was used to map areas adjacent to the CVFC Chart Area that have recently, or will soon be affected by logging activity (see Figure 25: Map 6—Past and Planned Logging).

5 Results: Landbase Unsuitable for Timber Management

Map 2: Landbase Unsuitable for Timber Management is shown in Figure 12. The results of this map are summarized in Table 4 and Figure 11.

The purpose of this map is to synthesize the data sets described in Section 4 to identify the landbase that is unsuitable for timber management in the CVFC Chart Area.

The 'landbase unsuitable for timber management' is defined as being either too ecologically sensitive, non-productive, and/or inoperable from the point of view of timber extraction. These areas will not be part of the potential timber management landbase. Some of these areas may be managed for non-timber objectives, however. Some areas (e.g., dry sites where ecological composition and structure have been significantly altered by fire suppression) may also require ecological restoration. Restoration may involve some incidental logging activity (e.g., to decrease fuel loading prior to prescribed burning).

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Figure 11 Landbase unsuitable for timber management

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Table 4 Landbase unsuitable for timber management

Figure 12 Map 2: Landbase Unsuitable for Timber Management

5.1 Ministry of Forests netdowns

The following MoF Forest Cover classes were removed from the potential timber management landbase (PTML):

- rock, alpine, alpine forest, clearing, open range, non-commercial cover, non-productive brush, non-productive forest;
- low site index (less than 8 m^3/ha/yr); and
- inoperable areas.

5.2 Terrain study netdowns for ecologically sensitive areas

Level B/C terrain mapping is available both for Arrow Creek/ Arrow Mountain, and for Sullivan Creek (Utzig 1999; Wallace and Putt 2000). We used the terrain and soil attributes provided by these studies to identify areas that are not likely to be suited to timber management. We also did our own preliminary air photo interpretation to cross reference the attributes and interpretations provided by the terrain studies with our interpretations of areas likely unsuitable for timber management.

Terrain polygons were classified as either:

1. *Areas unsuitable for timber management*—these areas are dominated by ecologically sensitive terrain where timber management is inappropriate.
2. *Areas requiring further study (gray areas)*—these areas are likely to have a significant component of ecologically sensitive terrain where timber management is inappropriate.
3. *Areas potentially suitable for timber management*—these areas do not appear to have a significant component of ecologically sensitive terrain.

Terrain Stability Class V polygons were classified as unsuitable for timber management. Utzig identified 5 Class V polygons, totaling 34 ha—all are on steep slopes (>60%) on incised reaches of Arrow Creek. Wallace and Putt identified 2 small Class V polygons on steep slopes adjacent to Sullivan Creek. As well as being unstable, all of these Class V polygons have a very high potential for landslide induced steam sedimentation.

Terrain Stability Class IV polygons are classified as *gray* areas. Class IV terrain is defined as "expected to contain areas with a moderate likelihood of landslide initiation following timber harvesting… a field inspection by a qualified terrain specialist, to assess the stability of the affected area, should occur prior to road or trail construction …". All *gray* areas require field based assessments, such as a Level A terrain assessment, by a qualified specialist prior to any proposed development. It is expected that a Level A terrain assessment will in most cases recommend that portions of these areas be reserved from timber management due to ecological sensitivities. Other portions may be suitable for timber management, or for timber management with certain restrictions (e.g., aerial access, cable yarding, light partial cutting, and/ or seasonal restrictions).

5.2.1.1 Polygon classification using subunit terrain attributes

Utzig and Wallace calculated a unique Terrain Stability class for each terrain polygon. However, polygon classification is complicated by the fact that the terrain polygons may contain up to three subunits. Terrain polygons are broken down by decile (i.e., 10% increments). For these complex terrain polygons, terrain attributes such as terrain labels, depth to restricting layer, and moisture regime are attached to subunits that are not spatially located within the terrain polygon.

We identified three terrain subunit profiles that indicate areas unsuitable for timber management:

- very wet soils: average moisture regime >4.5 (subhygric, hygric, or subhydric),
- very dry soils: average moisture regime < 1.5 (xeric or very xeric)[11], and
- very shallow soils: depth to restricting layer <50 cm and surficial material classified as bedrock [12].

As a first step in terrain polygon classification:

- where 60% or more of a polygon was identified as either very wet, very dry, or having very shallow soils, the polygon was classified as unsuitable for timber management;
- where 20% to 50% of a polygon was identified as very wet, very dry, or very shallow, the polygon was classified as a *gray* area; and
- where 10% or less of a polygon was classified as very wet, very dry, or very shallow, the polygon was classified as potentially suitable for timber management.

This first step classified very few polygons as unsuitable (>= 60% very wet or very shallow/ very dry), but identified many more polygons as *gray* areas (20% - 50% very wet or very shallow/ very dry). This is due to the fact that the very wet and very shallow/ very dry attributes are generally identified in the polygons' second and/or third subunit (i.e., not in the dominant subunit).

There were some differences between the terrain classification approach used by Utzig, and by Wallace and Putt. Utzig's terrain study provides a complete set of terrain attributes for each polygon subunit, while Wallace and Putt's study breaks fewer polygons into subunits, and does not provide a complete set of terrain attributes for each subunit identified (i.e., it provides terrain labels and drainage for the second and third polygon

[11] Almost all very dry soils are also very shallow soils, and vice versa. There is only one polygon subunit classified as very shallow that is not also classified as very dry (i.e., Utzig polygon #2 on predominantly non-productive bedrock at the extreme western edge/ lower slope of Arrow Mountain). There are only 6 small polygons (totaling 26 hectares) in the study area identified very dry that are not also classified as very shallow. These six polygon subunits all have a depth to restricting of 299 cm with loamy sands or sandy loams on slopes >= 55% with a very high percentage of coarse fragments (i.e., 95% surface coarse fragments, 85% subsurface coarse fragments).

[12] There are no very shallow/ dry subunits identified in the study area with a depth to restricting >10 cm and <50 cm. So, in effect, all identified very shallow/ dry soils have an assigned subunit depth to restricting of 10 cm. All 10 cm depth soils are given a surficial material label of "R" (bedrock).

subunits, but provides moisture regime and depth to restricting layer for the polygon as a whole only). Therefore, for Sullivan Creek, very wet areas were identified where the composite moisture regime for the polygon includes a subhygric component (i.e., polygons #22, 23, 25, 26, 37, 38, 45, and 47)[13]. Very shallow/ very dry areas were identified where subunit terrain labels list bedrock (i.e., polygons #2, 3, 4, 5, 31, 46). Otherwise, Sullivan Creek terrain polygons were handled in the same manner as Utzig terrain polygons, as explained below.

After this initial classification using the terrain study data, we checked the initial results against our own air photo interpretation. We found that there was a good match between those areas that we determined were likely unsuitable for timber management due to ecological sensitivities and those areas that were identified as very wet, very shallow/ very dry, or potentially unstable in the terrain studies. However, there were a number of very shallow/ very dry *gray* areas that we felt deserved to be classified as unsuitable for timber management. We investigated these areas to determine if they possessed a consistent 'signature' in their assigned terrain subunit attributes. We determined that these very shallow/ very dry *gray* areas were all steep (>60% slope in the very shallow/ very dry subunit). Therefore, as a second step in identifying areas unsuitable for timber management, we re-classified *gray* very shallow/ very dry polygons with slopes > 60% as unsuitable for timber management.

This re-classification resulted in a very good match with our air photo interpretation of areas unsuitable for timber management. However, a handful of complex polygons now classified as steep very shallow/ very dry included discreet areas that clearly were not particularly steep or very shallow/ very dry. Using air photos and a triangle network slope map (TIN) generated from 1:20 000 TRIM data showing all slopes > 60%, we were able to delineate the portions of Utzig terrain polygons #136, 111, 213, 366, 361, 265, 339, and 336 that clearly are not steep very shallow/ very dry areas[14]. Thus as a third step in identifying areas unsuitable for timber management, we manually removed these areas from the steep very shallow/ very dry class.

As a final step to verify that all areas classified as unsuitable for timber management or as *gray* areas were appropriately classified, we systematically checked all of the terrain attributes of the classified polygons' subunits (soil texture, surficial materials, surface expression, geomorphological processes, coarse fragments, drainage, as well as moisture regime and depth to restricting layer). We also double checked each classified polygon on our air photos to ensure that no obvious mistakes had been made.

The results of this analysis are shown in Figure 13 and Figure 14.

[13] These polygons all have a surface seepage geomorphological process label. These 8 polygons were all classified as *gray* wet areas; no polygons were identified as unsuitable wet in Sullivan Creek.

[14] These areas are all the upper slope portion of complex Utzig terrain polygons. In these polygons, the lower slope portion of the polygon is significantly steeper with more exposed bedrock than the gentler upper slope portion.

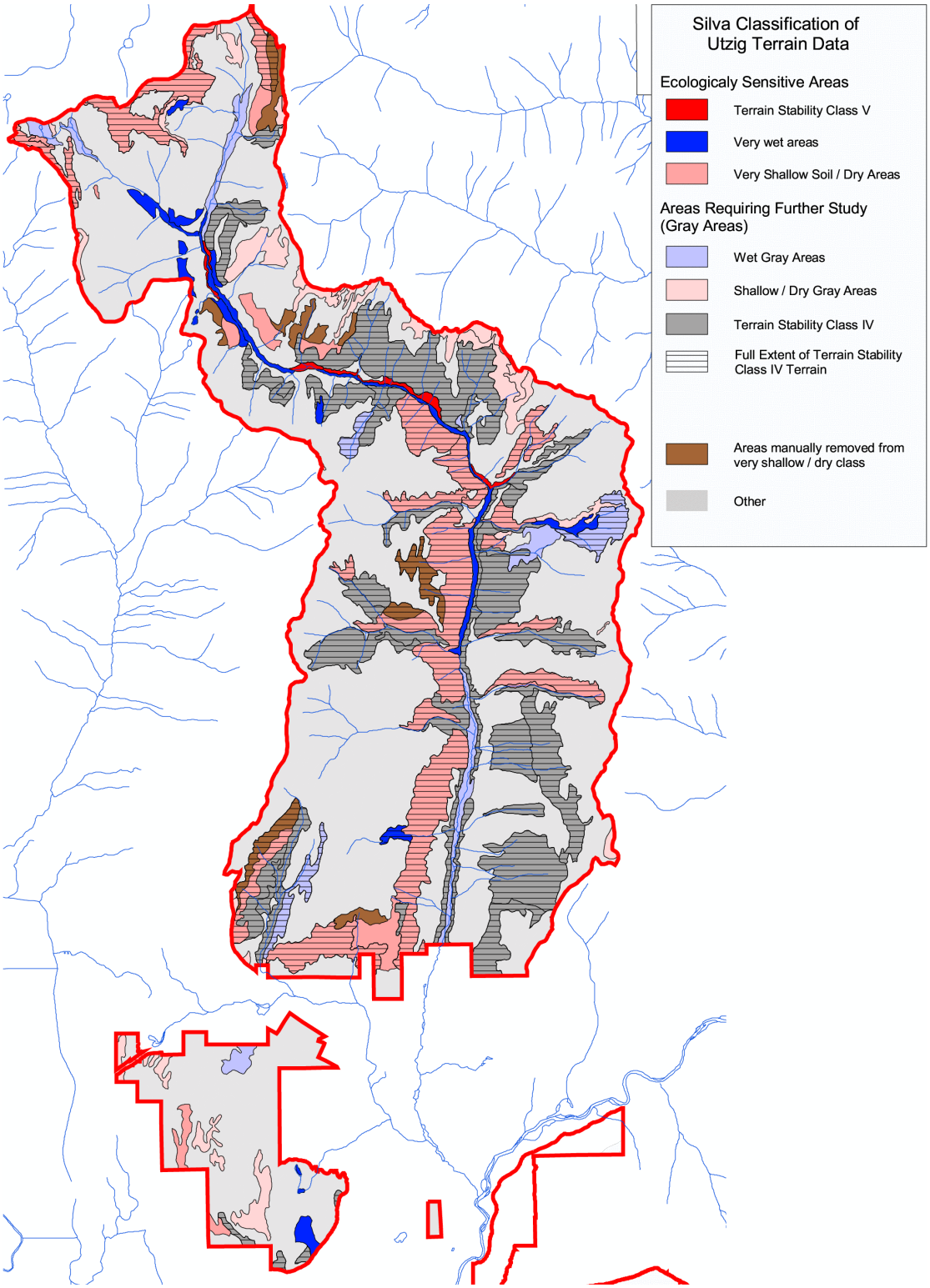

Figure 13 SFF classification of Utzig terrain data

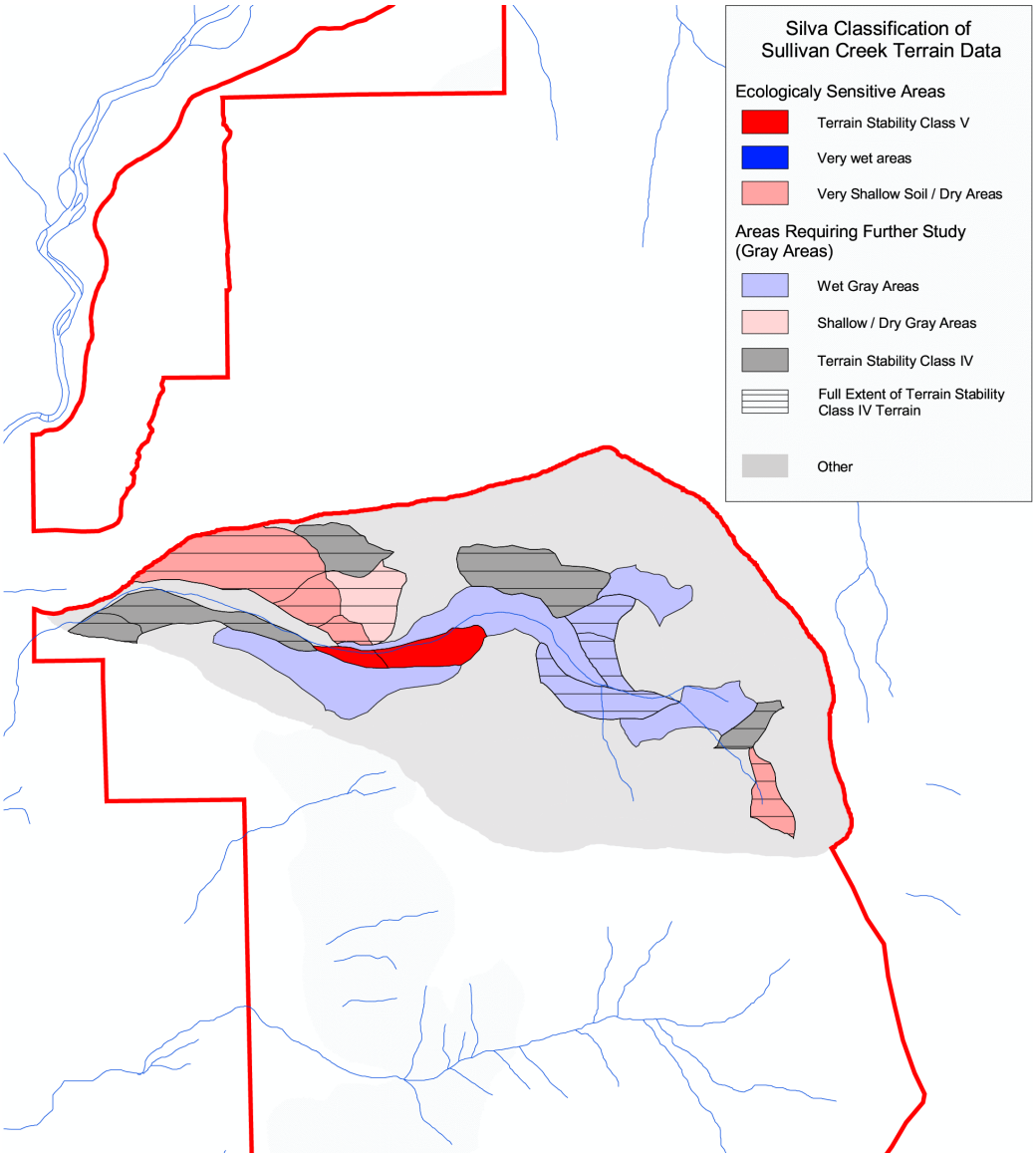

Figure 14 SFF classification of Sullivan Creek terrain data

5.2.2 Riparian reserves

Martin Carver is developing a detailed Riparian Management Plan for the Arrow Creek watershed, which will provide riparian reserves for each stream reach in the drainage. In anticipation of Carver's work, we have simply applied 30m reserves on both sides of all TRIM water features in order to model the impact of a riparian reserve network. We expect that these modeled riparian reserves will be revised based on Carver's riparian analysis.

The issue of riparian management and riparian reserves for the CVFC Chart Area should be revisited in 2004, once Carver's project is complete.

6 Results: Initial Protected Landscape Network

The Protected Landscape Network (PLN) is developed to protect ecological integrity in the CVFC Chart Area. The PLN includes all ecologically sensitive, inoperable and non-productive for timber areas (see Map 2—Landbase Unsuitable for Timber Management). The PLN also includes biodiversity nodes and reserves that were designed by SFF. The following section describes the main objectives for the design of biodiversity nodes and reserves, and the results of this design.

6.1 Biodiversity node and reserve design objectives

The CVFC initial PLN includes both biodiversity reserves and nodes.

Reserves are the anchors of the CVFC PLN: they are relatively large (>500 ha) protected areas that encompass a wide spectrum of ecosystem types. They are designed to meet larger landscape objectives, like landscape-level connectivity and the maintenance of hydrological functions in the Arrow Creek watershed. They are located in key areas—in this case, along the main stem and in the headwaters of Arrow Creek.

Biodiversity nodes are smaller (10 ha to 250 ha) protected areas that are designed to include specific representative, ecologically sensitive, and unique forest areas. They are often designed to include existing old forest. They need to be well distributed across the landscape, and are often they placed in key areas for connectivity.

The objectives for the design of biodiversity nodes and reserves are discussed below.

6.1.1 Large landscape objectives: caribou habitat and connectivity

The PLN for the CVFC Chart Area is embedded in larger landscape reserve considerations that include measures to protect caribou habitat and measures to ensure landscape/ subregional connectivity.

The entire Arrow Creek headwaters (total 1761 hectares), which includes all of the old spruce-balsam stands north of the 1942 fire, has been mapped as core caribou habitat (Kinley and Utzig 2001, Woods 2003). Caribou habitat guidelines are still under review for this area, but are likely to require that the core caribou habitat in the Arrow Creek headwaters become a 100% reserve area. We have thus mapped the core caribou habitat area as a reserve area and included this area as part of the PLN.

The Arrow Creek headwaters are also part of a regional connectivity corridor under KBLUP. This corridor is intended to provide connectivity (e.g., for grizzly bears) between Kianuko Provincial Park and the landscapes to the north and east of Arrow Creek, and the southern end of Kootenay Lake. With the entire headwaters of Arrow Creek in a core caribou habitat reserve area, regional connectivity through this area is assured.

In addition, many of the CVFC PLN objectives and measures discussed below (e.g., representation of old forest, connectivity) contribute to larger landscape objectives.

6.1.2 Representation of ecosystem types

A key component of any reserve design is representation of ecosystem types. This 'coarse filter' approach to biodiversity protection ensures that the natural range of ecosystems and species' habitats are included in a reserve network. The PLN must include representation of ecosystems at all elevations and slope positions, and with all moisture and nutrient regimes, within each BEC subzone.

Our target for ecosystem representation was to ensure that at least 50% of each subzone and that at least 40% of each site series within each subzone was reserved from timber management. To ensure that each site series was well represented in the PLN, we used the site series modeling provided in the KLFD PEM data set to conduct a site series representation analysis (see Section 0) [15].

6.1.3 Representation of existing old forest

Old forest is currently uncommon in much of the CVFC Chart Area, occupying just

- 4% of the ICHxw subzone (43 hectares) ,
- 12% of the ICHdw subzone (287 hectares) ,
- 14% of the ICHdm subzone (626), and
- 23% of the ESSFdm subzone (1,003 hectares) .

These are likely below natural levels of old forest for this area (see Section 3). Thus, protecting existing old forest from timber management in the short to medium term, until old forest can develop on other portions of the protected landbase, is very important. Given current conditions in the CVFC Chart Area, our target for representation of old forest was to protect at least 60% of existing old forest in all subzones.

Existing old forests are located in areas that escaped the extensive fires of the past century and a half, and are often found on north aspects and in positions that receive moisture from upslope areas. Existing old forest is often found adjacent to creeks. In the ICHdw, ICHdm, and ESSFdm subzones in the CVFC Chart Area, mesic and subhygric site series have consistently higher levels of existing old forest than xeric site series (see Table 10). Existing old forest was targeted for inclusion in the PLN on all site series, but was specifically targeted where it occurs in mesic to subhygric locations that historically would have supported old forests.

To ensure that existing old forest is well represented in the PLN, we have used the MoF forest cover and the KLFD PEM to conduct old forest representation analyses by subzone/ site series and by leading species (see Section 7.3).

Eventually, old forests will develop on much of the PLN as existing young and mid-aged forests grow older, and old forest representation will be significantly greater than currently is the case.

[15] Field-based terrestrial ecosystem mapping is required to confirm PEM site series mapping and hence site series representation in the PLN.

6.1.4 Riparian protection

Riparian protection is a cornerstone for the maintenance of ecological integrity, and specifically for ensuring high quality water. In large measure, the PLN is focused on riparian protection and is structured by watershed topography. The main stems of major creeks—Arrow Creek, Big Bear Creek, Sullivan Creek—are key areas for biodiversity and connectivity, as well as for physical hydrology, and as such were protected in biodiversity nodes and reserves. Mesic and subhygric terrain adjacent to creeks was also targeted for protection in biodiversity nodes and reserves.

Martin Carver's Riparian Management Plan will address riparian protection and management in detail and will need to be integrated into the initial PLN proposed in this plan.

6.1.5 Red and blue listed ecosystems and species' habitats

The Conservation Data Centre lists two rare natural plant associations that may be present in the CVFC Chart Area:

1. The *CwFd – Mock-orange* plant community (ICHxw/RM site series) is provincially blue listed. This site series has a mesic moisture regime. However, the KLFD PEM did not use the ICHxw/RM site series, and has assigned the ICHxw/01 mesic site series to the Fd – Prince's pine (DP) site series. Since we do not have access to adequate information on the CwFd – Mock-orange plant community, we were not able to focus on this blue listed ecosystem in this project. Nonetheless, we consider the entire ICHxw subzone to be a priority for ecological restoration, and have also attempted though the design of nodes and reserves to ensure that there is adequate representation of all ICHxw site series. However, field assessments need to be undertaken to determine if this plant community is present. Where CwFd – Mock-orange is present it needs to be protected.
2. The *FdPy – Oregon-grape – Parsley fern* plant community (ICHdw/DO site series) is provincially red listed. According to the provincial TEM database, this xeric – subxeric site series is expected to occur on significant slope warm aspects with deep soils. We do not have access to field-verified information on the actual occurrence of this site series in the CVFC Chart Area. However, our site series representation analysis using the PEM data set suggests that 84% of this site series is protected, mostly through the identification of very dry/shallow terrain as unsuitable for timber management. Restoration may be required for this site series where fire suppression has significantly altered its composition and structure. As with CwFd – Mock-orange, field assessments are required to locate and protect this rare plant community.

With the exception of habitat for mountain caribou, we were not able to address red and blue listed animal species' habitats in this phase of the project. (See Section 9.)

6.1.6 Connectivity

Connectivity in the Arrow Creek drainage from the headwaters south to the private land boundary was a major design objective that was addressed by the Arrow Creek core

reserve. All Arrow Creek biodiversity nodes were designed to connect to the Arrow Creek core reserve, and in many cases to connect the core reserve with adjacent drainages. Connectivity was also an objective that we addressed with biodiversity nodes on Arrow Mountain and in Sullivan Creek.

6.1.7 Spatial distribution

Ecosystem representation must also be well distributed spatially, with biodiversity nodes and reserves located throughout the CVFC chart area. The PLN thus includes biodiversity nodes and reserves in each major hydrologic unit in the CVFC Chart Area:

- Arrow Headwaters West and East;
- Arrow Upper North and South;
- Arrow Mid West and East;
- Arrow Lower West and East;
- Big Bear Creek;
- Arrow Mountain North
- Arrow Mountain South;
- Sullivan Creek; and
- Camp Run Creek.

The biodiversity nodes and reserves in each of these hydrologic units were designed to include a wide range of elevations and site series, and to include existing old forest where old forest is present[16].

6.2 Map 3: Protected Landscape Network Emphasizing Biodiversity Nodes and Reserves

Map 3: Protected Landscape Network Emphasizing Biodiversity Nodes and Reserves (Figure 16) shows the Protected Landscape Network for the CVFC Chart Area. Table 5 and Figure 15 summarize the information on this map.

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Table 5 Protected Landscape Network

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Figure 15 Protected Landscape Network

[16] Big Bear Creek and Arrow Mountain North currently have no old forest.

Figure 16 Map 3: Protected Landscape Network Emphasizing Biodiversity Nodes and Reserves

6.2.1 Biodiversity nodes and reserves

6.2.1.1 Arrow Creek core reserve

The Arrow Creek core reserve provides protection for the riparian ecosystems and upland forests of the main stem of Arrow Creek from the private land boundary south of the water intake up to the headwaters. This 1,803 hectare reserve is the key component of the Protected Landscape Network for Arrow Creek—all of the biodiversity nodes described below connect to this central reserve.

This reserve includes all subhygric terrain adjacent to Arrow Creek, and includes significant areas of steep slopes and unstable terrain—the majority of the core reserve is Terrain Class IV and Class V. In Arrow Lower West and in the headwaters, the reserve also includes gentle terrain adjacent to Arrow Creek. The core reserve also includes significant areas of remnant old forest that escaped the fires of the past century. Hence, the Arrow Creek core reserve not only protects the spectrum of riparian functions, but also encompasses a significant portion of the ecosystem types found in the Arrow Creek drainage basin.

The Arrow Creek core reserve was designed to:

- follow the slope break in Arrow Lower West, Mid West, and Upper South, capturing significant areas of steep shallow dry Terrain Class IV;
- follow the upper boundary of Utzig Terrain Class IV polygons #185 and 429 in Arrow Lower East and Arrow Mid East, capturing all the faces of the steep terraces above the Arrow Creek floodplain;
- widen to include the majority of steep Terrain Class IV slopes, and the lower and middle reaches of creeks that run through areas of very high waterborne erosion sediment yield potential (Utzig polygon #370) in Arrow Upper North; and
- include the mesic to subhygric lower slopes in Arrow Headwaters East and West, capturing a significant portion of the headwaters' old spruce-balsam forests.

6.2.1.2 Headwaters East reserve

The drainage basin of the east fork of the headwaters of Arrow Creek has been placed in a large headwaters protection area. This 620 hectare reserve ensures protection for a large portion of the headwaters in the reserve network. The headwaters of Arrow Creek must be adequately protected to ensure high quality water is continuously available for Arrow Creek water users. Undisturbed old forests produce the highest quality water.

This headwaters reserve encompasses extensive natural old spruce-balsam forests on a wide range of terrain types. The Arrow headwaters' east fork has forest stand composition and structure that is very similar to the headwaters' west fork, but has more significant ecologically sensitive areas than the more gentle and accessible terrain of the headwaters' west fork (see Figure 17).

This headwaters reserve was designed as part of the PLN to emphasize its need for protection, notwithstanding the fact that the entire headwaters has been mapped as a reserve for core caribou habitat.

6.2.1.3 Caribou reserve

As discussed in Section 6.1.1, the entire Arrow Creek headwaters (total 1761 hectares), has been mapped as core caribou habitat (Kinley and Utzig 2001, Woods 2003). Caribou habitat guidelines are still under review for this area, but are likely to require that the core caribou habitat in the Arrow Creek headwaters become a 100% reserve area. We have thus mapped the core caribou habitat area as a reserve area and included this area as part of the PLN.

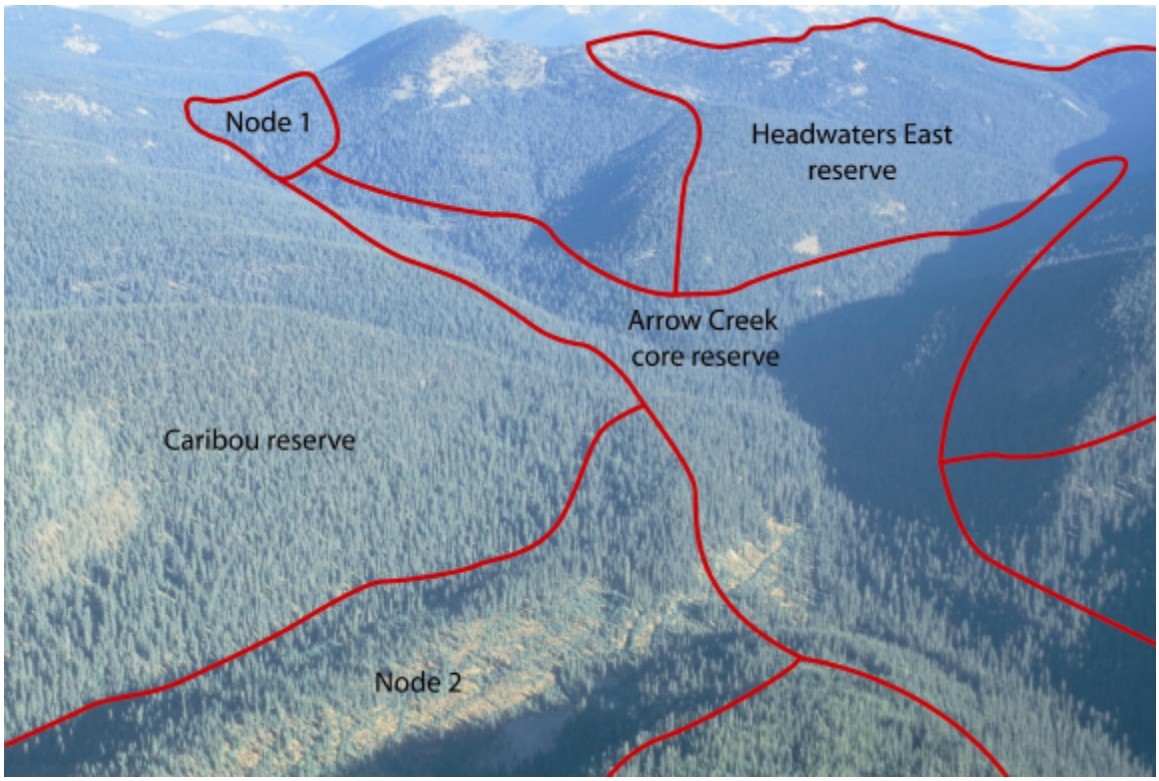

Figure 17 Arrow Creek headwaters with PLN biodiversity node and reserve locations
The relatively gentle terrain of the west branch of the Arrow headwaters is visible on the left. The Headwaters East reserve is on the right. Node 1 is in the top left corner of the image. Node 2, including the clearcut on the Duck – Arrow pass is in the foreground. This entire area is mapped as core caribou habitat, and is included for this reason in a Caribou reserve.

6.2.1.4 Biodiversity node 1

This 44 hectare node includes old forest in the upper portion of the Arrow Headwaters West (see Figure 17). It provides connectivity on gently sloping terrain from the Arrow core reserve over a pass to the Skelly Creek drainage to the north of the CVFC chart area.

6.2.1.5 Biodiversity node 2

This 43 hectare node protects gentle terrain in a key location for connectivity: the Duck-Arrow pass. This node includes subhygric to subhydric areas including a small wetland. The southern portion of this node was clearcut in the 1970's while the northern portion is

old spruce-balsam forest. The southern boundary of this node coincides with the southern boundary of mapped core caribou habitat.

6.2.1.6 Biodiversity node 3 and Biodiversity node 4

These two small nodes (24 hectares and 31 hectares) protect small remnant old spruce-balsam stands on north aspects in Arrow Upper South (see Figure 18). Node 4 is immediately north of CVFC proposed Block 39 (see Map 3—Protected Landscape Network). The surrounding landscape was burned in the 1942 fire, and only a few old stands remain in this area. Both nodes have subhygric areas, which helps explain why they were missed by the fire.

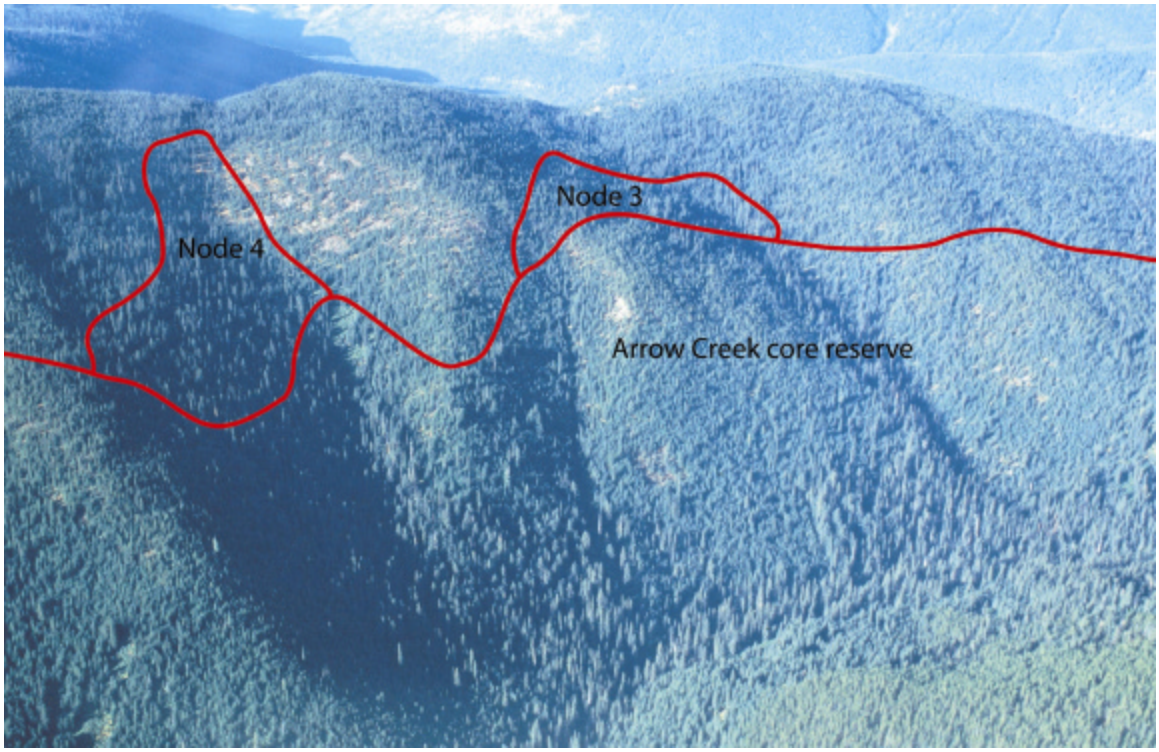

Figure 18 Approximate locations of PLN nodes 3 and 4 in Arrow Upper South
The Arrow Creek core reserve includes the steep slopes and the lower elevation old forest visible as taller trees and more complex canopy texture in the foreground. PLN node 3 and node 4 include old forest adjacent to the core reserve.

6.2.1.7 Biodiversity node 5

This 127 hectare node provides connectivity between the Arrow core reserve and the ridge that separates the Arrow and Duck Creek drainages. This node is on an open south-facing slope with younger forest, and ranges in elevation from a mid to upper slope position down to the riparian ecosystem of a major tributary of Arrow Creek.

6.2.1.8 Biodiversity node 6

This 174 hectare node includes the entire drainage basin of a major tributary of Arrow Creek in Arrow Mid East. This is the only Arrow Creek tributary drainage basin with

significant mapped subhydric terrain. It also has significant areas of Terrain Class IV. The north aspects of this drainage can be expected to support mesic to subhygric old forests in the future. This node provides cross-elevation connectivity from the Arrow Creek core reserve to alpine areas on the Iron Range, encompassing an elevational transect from valley floor to ridge top.

6.2.1.9 Biodiversity node 7

This 43 hectare node protects a stand of north aspect hemlock old forest on Class IV terrain, just north of CVFC Block 37. This node in Mid West Arrow Creek includes two creek junctions in an area with reported springs and seepage areas.

6.2.1.10 Biodiversity node 8

This 120 hectare node includes mixed cedar, hemlock and larch old forest as well as younger forest on predominantly north aspect gentle terrain just north and west of CVFC Block 20 (see Figure 19). This area has been investigated in the field by Jim Smith, CVFC forester, and has been identified as having distinctive interior cedar-hemlock zone (ICH) old growth characteristics which are very rare in the lower portions of Arrow Creek and in the surrounding landscape.

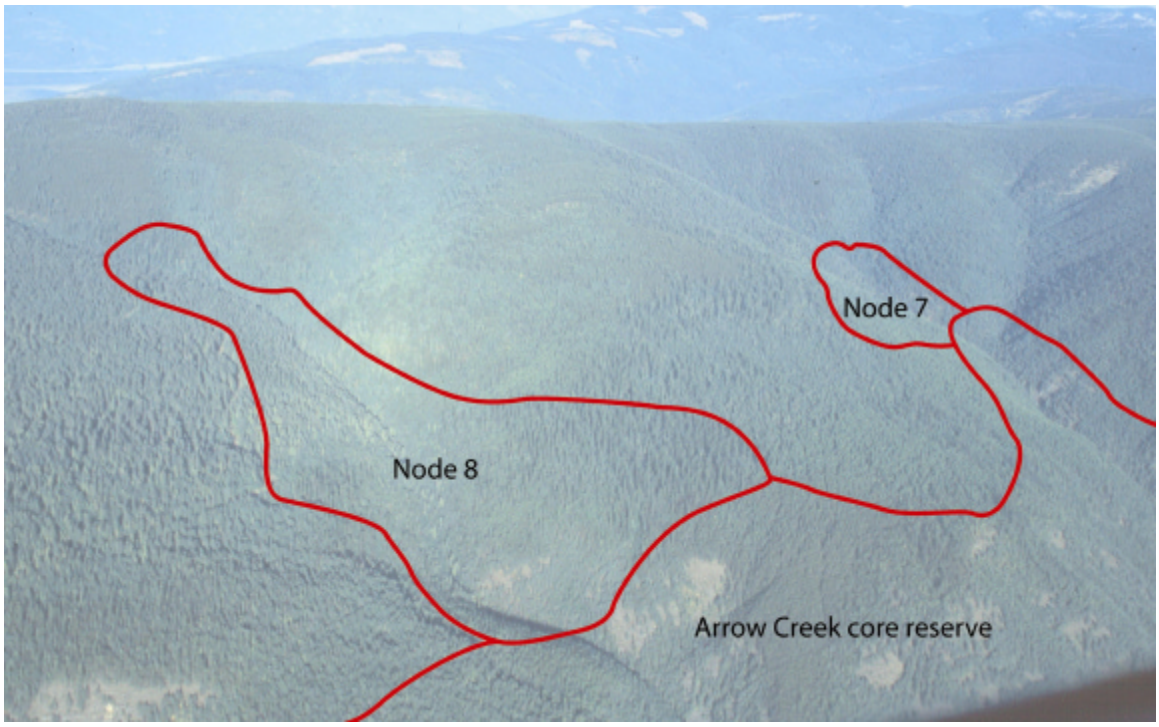

Figure 19 Approximate locations of PLN nodes 7 and 8 in Arrow Mid West
This photo shows the southern limit of the 1942 fire in Arrow Mid West. PLN node 8 includes old forest on the left of the photo, some younger forest closer to the tributary creek, and the lower portion of the old larch stand in the middle of the photo. PLN node 7 includes north aspect hemlock old forest.

6.2.1.11 Biodiversity node 9

This 149 hectare node in the northern portion of Arrow Lower East protects a series of creek drainages that include gullied Terrain Class IV with a very high Sediment Yield Potential. The mid slopes in the northern portion of the node were highgraded in the 1970's. The southern portion of the node includes a stand of old hemlock forest at lower to mid elevations. The upper elevations of this node include old spruce-balsam and pine forests. This node provides valley bottom to ridge top connectivity from the lower Arrow Creek floodplain up to the Iron Range.

6.2.1.12 Biodiversity node 10

This 13 hectare node connects the Arrow core reserve to a large CVFC Wildlife Tree Patch (WTP). This node in Arrow Lower West includes old larch and hemlock forest and subhygric areas on gentle terrain. The WTP to which it connects has imperfectly drained subhygric areas with old forest, and is surrounded by past and planned logging.

6.2.1.13 Biodiversity node 11

This 45 hectare node includes the middle and lower reaches of two creeks that drain Terrain Class IV areas with very high Sediment Yield Potential in Arrow Lower East. This node includes mid-aged larch, pine, and fir stands that are representative of the ICH dw subzone.

6.2.1.14 Biodiversity node 12

This 85 hectare node protects the Big Bear Creek main stem, which is surrounded by over 250 hectare of past and planned logging blocks. This main stem protected node includes Terrain Class IV and subhygric seepage areas. This node currently is forested with mid-seral fir and pine stands (61-100 years old) but the moist inner gorge of Big Bear Creek in particular would likely have supported late seral, old forests in the past.

6.2.1.15 Biodiversity node 13

This 35 hectare node in the Nancy Creek area on the north side of Arrow (Goat) Mountain has extensive subhygric areas with a very high sediment yield potential. Field surveys by Jim Smith, CVFC forester, indicate large quantities of skunk cabbage in this area. This node is surrounded by logging to the east and west. To the south, it connects to a CVFC Wildlife Tree Patch located on the main north-south ridge of Arrow Mountain, which includes a major elk trail.

6.2.1.16 Biodiversity node 14

This 18 hectare node protects a remnant old spruce-balsam stand and a series of wetlands in a spring recharge area on the top of Arrow Mountain. This node is surrounded by old clearcuts, and has road access. This node is in a Ministry of Forests' "Use, Recreation and Enjoyment of the Public" Reserve (U.R.E.P. #264671). Recreational use in this area is significant.

6.2.1.17 Biodiversity node 15

This 67 hectare node includes dry, shallow slopes in Utzig polygon #22. It also includes small spring recharge areas. This node protects mid-aged and old larch and pine stands

that are surrounded by cut blocks. This node connects to the CVFC Wildlife Tree Patch on the north-south main ridge of Arrow Mountain. In combination with this WTP and node 13 (Nancy Creek) on north Arrow Mountain, node 15 provides good north-south connectivity through CVFC's tenure on Arrow Mountain. The Lady Slipper trail runs through this node.

6.2.1.18 Biodiversity node 16

This 164 hectare node protects Sullivan Creek's main stem from the private land boundary to the ridge that separates Sullivan Creek and Thompson Creek. It thus crosses from the ICHxw through the ICHdw and ICHdm to the ESSF dm subzone. This node includes areas of Terrain Class IV and V, and includes both steep shallow/ dry lower slopes and mesic to subhygric mid-slope areas. Old fir-larch-hemlock forests that are uncommon in the landscape are found in this biodiversity node.. Upper elevations forests within this node have old spruce-balsam forests on gentle terrain.

6.2.1.19 Biodiversity node 17

This 53 hectare node protects a north aspect old spruce-balsam stand on in an isolated tributary valley in the headwaters of Camp Run Creek. The surrounding area was burned and supports mid-seral stands of lodgepole pine (61-80 years old).

6.2.1.20 CVFC Wildlife Tree Patches

CVFC Wildlife Tree Patches (WTP's) are included as a part of the PLN. Existing WTP's are effectively at two distinct spatial scales. The larger (>10 hectare) WTP's on Arrow Mountain and in Arrow Lower West are equivalent to small biodiversity nodes in purpose and in spatial scale. Biodiversity nodes # 10, 13 and 15 were designed in part to connect with two of these larger WTP's. Meanwhile, smaller WTP's provide stand-level reserves within cutblocks. These smaller WTP's provide finer spatial scale protection than that provided by the PLN biodiversity nodes and reserves and are part of protected ecosystem networks (PENs) that provide for protection of ecological integrity at the stand level.

These smaller WTP's will need to continue to be designated as part of PENs at the stand level, as CVFC operating areas are developed (see Section 2.3). The network of CVFC WTP's on Arrow Mountain provide a good example of components of the stand-level PENs required to complement the landscape-level PLN.

6.3 Map 4: Protected Landscape Network and Potential Timber Management Landbase

Map 4: Protected Landscape Network and Potential Timber Management Landbase (Figure 21) shows the PLN biodiversity nodes and reserves from Map 3: Protected Landscape Network with a summary of the analysis shown on Map 2: Landbase Unsuitable for Timber Management. Table 6 and Figure 20 summarize the information presented on Map 4. This map shows those portions of biodiversity nodes and reserves that include areas potentially suitable for timber management.

The biodiversity nodes and reserves break down according to the results of Map 2 as follows:

- 61% of node/reserve areas consist of landbase unsuitable for timber management;
- 12% of node/reserve areas consist of *gray* areas; and
- 27% of node/reserve areas consist of areas that are potentially suitable for timber management.

This biodiversity node/reserve breakdown by landbase unsuitable for timber management is fairly representative of CVFC Chart Area, albeit with a slightly higher proportion of landbase unsuitable for timber management and *gray* areas in the nodes/reserves. In the CVFC Chart Area, the landbase unsuitable for timber management comprises 51% of the total area; gray areas comprise 11%; and areas potentially suitable for timber management comprise 38% (see Table 4).

The higher proportion of landbase unsuitable for timber management in the nodes/reserves is largely due to the fact that the Arrow Core Reserve was designed to capture the majority of the steep slopes and very shallow/ very dry soils in Arrow Lower West, Mid West, Upper South and Upper North. The Arrow Core Reserve and some biodiversity nodes were also designed to capture *gray* areas.

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Table 6 PLN and Potential Timber Management Landbase

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Figure 20 PLN and Potential Timber Management Landbase

Figure 21 Map 4: Protected Landscape Network and Potential Timber Management Landbase

6.4 Map 5: Protected Status of Old Forest

Map 5: Protected Status of Old Forest shows where and how much currently existing old forest is protected in the PLN. Table 7 and Figure 22 summarize the information shown on Map 5. An old forest representation analysis is provided in Section 7.2, to which the reader can refer for a full discussion of representation of old forest in the initial PLN by subzone and site series, and by leading tree species. Section 7.2 shows that 71% of existing old forest is protected in the PLN.

Current old forest area in the CVFC Chart Area is likely at the lower end of the range of natural variability (see Section 3). For this reason it is important to protect most of the existing old forest in the CVFC Chart Area until existing early and mid-seral stands age. Many early and mid-seral stands, as well as old seral stands, are protected in the PLN. Most of these areas will develop into old forests over time. Where fire suppression has significantly impacted natural forest character (e.g., in the ICHxw subzone), some of these areas may need to be managed to restore natural old forest composition and structures. Thus over time the total percentage of old forest in the CVFC will increase significantly.

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Table 7 Protected status of old forest

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Figure 22 Protected status of old forest

Figure 23 Map 5: Protected Status of Old Forest

7 Representation analyses

To determine whether the Protected Landscape Network (PLN) achieved protection objectives stated in Section 6.1, we analyzed the representation of biogeoclimatic subzones/ site series, forest types as defined by leading species, and old forest in the PLN.

For the purposes of the representation analyses in this Section, we have assumed that one half of the *gray* areas outside of biodiversity nodes and reserves (418 hectares) will be found to be ecologically sensitive and become part of the landbase unsuitable for timber management, and thus contribute to protected areas in PLN.

7.1 Representation of subzones and site series

7.1.1 Representation of subzones

The representation analysis (Table 8) shows that the PLN protects

- 59% of the ICHxw,
- 64% of the ICHdw,
- 61% of the ICHdm,
- 79% of the ESSFdm, and
- 100% of the ESSFdmu.

These figures suggest that adequate and balanced representation of all subzones has been achieved in the PLN. While approximately equal representation of the ICH subzones has been achieved, a higher proportion of the ESSF is represented in protected areas. This is due to a number of factors, including:

- a higher proportion of the ESSF is low productivity or alpine forest, or is inoperable, and was thus removed from the potential timber management landbase in Map 2: Landbase Unsuitable for Timber Management;
- there is significant representation of the ESSF in the biodiversity nodes and reserves, particularly in the 620 hectare Headwaters East Reserve; and,
- the entire headwaters of Arrow Creek being is mapped core caribou habitat, which adds a further 755 hectares of protected area in the Arrow Creek headwaters.

7.1.2 Representation of site series

The PEM site series data used in this representation analyses requires systematic field investigation before any management decisions based on these representation analyses are made. Nonetheless, the site series analysis below offers an initial but useful and systematic ecosystem-based approach to assessing ecosystem representation in protected areas.

Table 8 shows that there is generally adequate and balanced representation of all site series within each subzone. The site series representation analysis show that both dry and wet site series have significantly higher levels of protection than zonal site series. This result was expected since site series at the extremes of the range of moisture regimes have higher

percentages of ecologically sensitive areas than zonal site series. A minimum of 76% of the driest (xeric to subxeric) forested site series in each subzone is protected, while a minimum of 91% of the wettest (subhygric to hygric) forested site series in each subzone is protected. A minimum of 78% of the second wettest forested site series in each subzone is also protected. This suggests that our classification of the landbase unsuitable for timber management (Map 2) was successful in removing the majority of very wet and very dry sites from the potential timber management landbase prior to the design of biodiversity nodes and reserves.

As expected, zonal (submesic to mesic) site series have the lowest level of representation in protected areas for all subzones, largely due to their significantly lower proportion of areas unsuitable for timber management. Zonal site series are however well represented in the biodiversity nodes and reserves. Except for the ICHxw subzone, the zonal site series in all subzones have proportionally more area protected in nodes and reserves than area protected in the landbase unsuitable for timber management. In other words, while dry and wet site series are most strongly protected by the landbase unsuitable for timber management, zonal site series are most strongly protected by the PLN nodes and reserves.

Table 8 shows that a minimum of 31% of each site series in each subzone is represented in protected areas. The lowest levels of representation are in the zonal ICHdm/01 site series (31%), zonal ICHdw/01 site series (41%), and zonal ICHxw/01 site series (37%)[17]. However, we believe that actual representation of zonal site series in the PLN is somewhat higher than the previous figures suggest since the PEM site series category "other forested" in each subzone have higher levels of protection (56% to 87%). The combination site series in the "other forested" category are in most cases combinations of the zonal site series with another site series. As such, if half of the total area of the "other forested" site series were comprised of the zonal site series for each subzone, then at least 40% of the zonal site series in each subzone—and thus 40% of every site series in the CVFC Chart Area—would be protected.

This representation analyses suggests that subzone and site series representation in the PLN is, in general, very good. However, because these PEM site series are based on computer modeling with minimal field checking, these results need to be verified and/or revised with field assessments.

At the same time, this analysis suggests that, when developing new operating areas, CVFC should attempt to capture potentially under-represented zonal sites in the ICHdw and ICHdm in relatively large (5-10 hectare) Wildlife Tree Patches to augment representation in the initial PLN.

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Table 8 Subzone and site series representation in protected areas

[17] According to the PEM, the zonal ICHdm/01 site series, which has the lowest level of protection, is located primarily on upper Arrow Mountain, the gentle dissected plateau in Arrow Lower West and Mid West, and on gentle mid-slope positions in Arrow Mid East.

7.2 Representation of forest types by leading tree species

To check representation of the current distribution of forest types in the CVFC Chart Area, and to complement the PEM site series representation analysis, we did a representation analysis of forest types by leading tree species, from the forest cover data (Table 9). This analysis shows that, with the exception of spruce-balsam forests which are 77% protected, all leading species have between 43% and 57% protection. These results corroborate the results of the subzone/ site series representation analysis above.

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Table 9 Representation of forest type by leading tree species in protected areas.

7.3 Representation of old forest

7.3.1 Representation of old forest by subzone and site series

The representation analysis of old forest by subzone and site series (Table 10) suggests that the majority of existing old forest is protected by the PLN in each subzone. Protection is as follows:

- 98% of the 43 hectares of old forest is protected in the ICHxw;
- 74% of the 287 hectares of old forest is protected in the ICHdw;
- 57% of the 626 hectares of old forest is protected in the ICHdm[18]; and
- 76% of the 1003 hectares of old forest is protected in the ESSFdm.

Note that 74% of the protected old forest is protected by the biodiversity nodes and reserves, although the biodiversity nodes and reserves represent only 53% of the total protected area in the CVFC Chart Area. This demonstrates how the design of biodiversity nodes and reserves specifically targeted inclusion of old forest of each leading species and old forest in each subzone.

This analysis nonetheless suggests that future revisions to the PLN may require the inclusion of more existing old forest in the ICHdm subzone.

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Table 10 Representation of old forest by subzone and site series

[18] 145 hectares of zonal old forest in the ICHdm subzone consists of a hemlock stand that was highgrade logged approximately 30 years ago. Although technically 'old forest' in the Ministry of Forests' forest cover data, this stand is very different in ecology from natural old forests. Most of this stand is not in the PLN but in CVFC CP6 Block 20, and soon will be logged. As this stand is both already logged, and will soon be logged again, ideally it would not be simply grouped with other old forest as it has been for this analysis. If this stand were considered separately from more natural (i.e., unlogged) old forest, then the representation of natural ICHdm old forest in the PLN would be over 65%.

Table 10 shows that representation of old forest by site series follows the same general trends as the overall site series representation discussed in the Section 7.1.2. The wettest and driest site series have proportionally higher representation of protected old forest than zonal site series in each subzone. Representation of old forest is consistently high, with >70% protection of old forest on all but three site series. The three exceptions are the following zonal site series:

- the subxeric to mesic ICHdw/01 site series (60% old forest protected);
- the subxeric to submesic ICHdm/03 site series (42% old forest protected); and
- the submesic to mesic ICHdm/01 site series (32% old forest protected).

As discussed in Section 7.1.2 above, we believe that actual representation of old forest on zonal site series in the PLN is somewhat higher than the previous figures suggest since the "other forested" site series in each subzone have very high levels of old forest protection (85% to 97%). The combination site series are in most cases combinations of the zonal site series with another site series. As such, if half of the total area of combination site series with old forest were comprised of the zonal site series for each subzone, then over 40% of the old forest on zonal site series in each subzone would be protected[19].

Given the limits of the PEM data used, this analysis nonetheless suggests that more zonal old forest may warrant protection in the ICHdm subzone. Following careful field investigation of the reliability of the PEM site series classifications, further PLN protection of existing zonal ICHdm old forest may be necessary.

In the interim, when developing new operating areas, CVFC should capture potentially under-represented zonal old forest in the ICHdm subzone through designation of representative zonal old forest in relatively large (5-10 hectare) Wildlife Tree Patches, and other portions of protected ecosystem networks (PENs).

7.3.2 Representation of old forest by leading species

To check representation of the current distribution of existing old forest by leading species in the PLN as a percentage of the CVFC Chart Area, and to complement the old forest PEM site series representation analysis, we did a representation analysis of old forest by leading species in the PLN[20]. Table 11 shows that a minimum of 55% of existing old forest is protected for each leading species, with 78% representation of spruce-balsam old forests. These results corroborate the results of the old forest subzone/ site series representation analysis above.

[19] 145 hectares of predominantly zonal old forest in the ICHdm/01 site series consists of a hemlock stand that was highgrade logged approximately 30 years ago. Although technically 'old forest' in the Ministry of Forests' forest cover data, this stand is very different in ecology from natural old forests. Most of this stand is not in the PLN but in CVFC CP6 Block 20, and soon will be logged. As this stand is both already logged, and will soon be logged again, ideally it would not be simply grouped with other old forest as it has been for this analysis. If this stand were considered separately from more natural (i.e., unlogged) old forest, then the representation of natural ICHdm/01 old forest in the PLN would be well over 50%.

[20] Leading species and definitions of 'old' are the same as for Map 1.

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Table 11 Representation of old forest by leading tree species

8 Past and planned logging and potential timber management landbase

Figure 24 CVFC skid trail in thinned stand on the west side of Arrow Mountain

8.1 Map 6: Past and Planned Logging

Map 6: Past and Planned Logging is shown in Figure 25. The results of this map are shown in Table 12.

This map was derived in part from MoF forest cover's logging history and crown closure data. Any polygons in the CVFC Chart Area with a logging history tag in the forest cover data were mapped according to current crown closure class[21]. Crown closure was used as a surrogate indicator of residual forest following logging (e.g., recent clearcuts will have <10% crown closure while partial cuts that remove a third of stand volume will typically have >35% crown closure). The MoF crown closure classes were double-checked against air photos and against Carver and Utzig's (1999) map of current hydrologic recovery. Current crown closure was not assigned to logged areas outside of the CVFC Chart Area since there was no way to verify the accuracy of this information.

[21] This logging all occurred prior to CVFC's tenure.

For recent CVFC logging, we assigned current crown closure classes to each CVFC cutblock according to information provided in the 2001 – 2006 FDP. This information was then confirmed with Jim Smith. Planned CVFC logging is from the 2001 – 2006 FDP and from information provided by Jim Smith.

For recent and planned logging outside of the CVFC Chart Area, we used the KLFD 2002 consolidated FDP. The past and planned logging areas outside the CVFC Chart Area are displayed on Map 6 to depict the general condition of the larger landscape within which the CVFC Chart Area is situated, and is not summarized in Table 4.

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Table 12 Past and planned logging in the CVFC Chart Area

Figure 25 Map 6: Past and Planned Logging

8.2 CVFC potential timber management landbase

The CVFC potential timber management landbase (PTML) outside of the PLN, as shown on Map 4: Protected Landscape Network and Potential Timber Management Landbase and Table 6, includes:

- 3625 hectares of potential timber management landbase, and
- 835 hectares of areas requiring further study (*gray* areas).

For the purposes of the analyses in this report, we have assumed that one half of the *gray* areas (418 hectares) will be found to be suitable for timber management, and hence will become part of the potential timber management landbase. Thus the PTML in this analysis is 4,043 ha.

There are 1,532 hectares of previously logged areas in the CVFC Chart Area and 579 hectares of CVFC planned cutblocks (2003-2006).

Previously logged areas in the CVFC Chart Area vary widely in current stand age and stocking levels:

- 507 hectares of previously logged areas currently have <10% crown closure,
- 216 hectares have 10 – 35 % crown closure, and
- 809 hectares have >35% crown closure (see Table 12).

Table 13 shows the current age class distribution of the undeveloped portion (2,331 hectares) of the CVFC potential timber management landbase (PTML). Of the undeveloped PTML:

- 55% (1269 hectares) is between 40 and 80 years old,
- 27% (625 hectares) is between 80 and 100 years old, and
- 18% (431 hectares) is over 100 years old.

It was beyond the scope of the current project to assess short-term and long-term sustainable cut levels for this landbase. However, this is an important task.

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Table 13 Age class distribution on undeveloped portion of PTML

In addition to the 2,331 hectares of undeveloped CVFC potential timber management landbase, there are 1,532 hectares of previously logged areas and 579 hectares of CVFC planned cutblocks (2003-2006) in the CVFC Chart Area.

9 Next steps

This project contributes to an early phase of landscape-level planning for CVFC, and much work remains to be done to refine the interpretations and the Protected Landscape Network design presented here.

The current project has synthesized existing ecological information only, and did not involve any detailed air photo interpretation or field work. SFF needs to complete detailed air photo interpretation of 1:20 000 scale air photos and field work to confirm our interpretations of the data sets, especially the terrain interpretations. Terrain subunit boundaries for complex terrain polygons will need to be identified, and polygon boundaries may need to be refined. Areas requiring further study (*gray* areas) in particular need to be assessed in the field for their suitability for timber management.

Following the completion of Martin Carver's riparian management plan in the spring of 2004, the initial Protected Landscape Network presented here will need to be reconciled with Carver's riparian plan results.

Based on SFF field assessments and an analysis of Carver's results, some biodiversity node and reserves, especially biodiversity nodes in Arrow Lower and Mid East, and Arrow Mid and Upper North, need to be studied in more detail to determine if they are optimally located. The boundaries of all of the biodiversity nodes and reserves will likely need to be refined based on field assessments.

Ecosystem representation in the initial PLN needs to be assessed based on improved ecosystem mapping, preferably on field-based terrestrial ecosystem mapping for the CVFC Chart Area. However, in the absence of complete terrestrial ecosystem mapping, field assessments of the potential timber management landbase need to address those site series with relatively low levels of representation in the initial PLN. This information may be used to improve representation of these site series in the PLN.

Specific attention needs to be paid to identifying rare site series. Red and blue listed species' habitats need to be identified. Once these rare site series and habitats are identified, they need to be included in the PLN. Ungulate winter range requirements also need to be explicitly defined and incorporated within the PLN or within stand-level protected ecosystem networks (PENs).

The site productivity of certain areas in Arrow Upper North that are regenerating slowly following the 1942 fire remains an important issue. Forest cover mapping in this area needs to be improved. This information needs to be used to determine the potential long-term suitability for timber management of portions of Arrow Upper North.

We expect that the initial Protected Landscape Network presented here will be refined and improved, through collaboration between all parties, as more information becomes available and as some of the next steps outlined in this section are completed.

Future collaboration between SFF and CVFC could also potentially include field assessment and design of stand-level protected ecosystem networks (PENs) in CVFC operating areas, to complement the initial PLN. In conjunction with these steps, SFF and

CVFC could collaborate on developing an appropriate method to calculate a short-term and a long-term AAC for the CVFC Chart Area.

Future collaboration could also include the establishment of a practical system to monitor ecological integrity, which is the foundation for the production of high quality water in the Creston Community Forest.

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