Note to 2007 Draft: Field Guide for Site Identification and Interpretation for the Rocky Mountain Trench portion of the Prince George Forest Region

This draft of the update to Land Management Handbook 15 Field Guide for Site Identification and Interpretation for the Rocky Mountain Trench contains current information as far as the biogeoclimatic ecosystem classification (BEC) units, their identification and management interpretations are concerned, yet is out of date with regard to regional names, the currency of silviculture practices, and course availability. Since the ecological classification and interpretation information is very useful to assist the user in classifying sample sites in the field and to provide interpretations for these site units that will assist the user in preparing management prescriptions, we have decided to make this draft available while the update is being completed.
Field and wall maps of the biogeoclimatic unit maps referenced in this guide may be found at; <http://www.for.gov.bc.ca/hre/becweb/resources/maps/map_download.html>.
1 INTRODUCTION

1.1 Objectives and Scope

This guide presents site identification and interpretation information for forest ecosystems of the Rocky Mountain Trench portion of the Prince George Forest Region\(^1\) (Figure 1).

\[\text{FIGURE 1 } \text{Biogeoclimatic units of the Rocky Mountain Trench portion of the Prince George Forest Region.}\]

\(^1\) Please note that the names of forest regions and districts, as well as of certain policies and course offerings, mentioned throughout this guide may be out of date since it is a reprint of an existing guide. These items will be revised or included when a new guide is completed for the area.
The classification system used follows the Biogeoclimatic Ecosystem Classification (BEC) developed for the province by the B.C. Ministry of Forests (Pojar et al. 1987). The principles have evolved from the work of V.J. Krajina (1965, 1969) and are described in Section 2. The objectives of this classification are:

- to provide a framework for organizing ecological information and management experience about ecosystems;
- to promote further understanding of identified relationships among them;
- to supply resource managers with a common language to describe forest sites; and
- to improve the user’s ability to prescribe and monitor treatment regimes on a site-specific (ecosystem) basis.

The guide has two main goals:

- to assist the user in classifying sample sites in the field; and
- to provide interpretations for these site units that will assist the user in preparing management prescriptions.

This version of the guide results from the recent completion of an inter-regional correlation of the BEC system. The correlation project was completed to ensure the consistency and quality of the ecological information base across the province. This guide replaces the 1988 version of Land Management Handbook 15, A Field Guide for Identification and Interpretation of Ecosystems of the Rocky Mountain Trench, Prince George Forest Region (Meidinger et al. 1988). Appendix 1 presents the correlation between the previous site and biogeoclimatic units and this classification.

All sites slated for harvest are required by law to be classified according to the biogeoclimatic classification system, under the 1988 Silviculture Regulations for Pre-Harvest Silviculture Prescriptions (PHSPs) approved prior to April 1, 1994 and pursuant to the current Silviculture Practices Regulation for PHSPs approved on or after April 1, 1994. The new Silviculture Practices Regulation also requires a biogeoclimatic map that includes any site-specific variation within the area (i.e., site series) (Silviculture Practices Regulation 1994).
1.2 Other Sources of Information

Numerous reports on vegetation, soils, wildlife, and ecosystem description and classification exist for the Rocky Mountain Trench portion of the Prince George Forest Region and adjoining area. A list of these references can be found in Appendix 2.

A more comprehensive discussion of the BEC system and information at the biogeoclimatic zone level is available in Ecosystems of British Columbia (Meidinger and Pojar 1991) or Biogeoclimatic Ecosystem Classification for British Columbia (Pojar et al. 1987).

An excellent reference for plant identification is Plants of Northern British Columbia (MacKinnon et al. 1992). Page numbers for plants used in site unit identification keys found in each biogeoclimatic unit subsection refer to this publication. It is available at major book stores or from Lone Pine Publishing in Edmonton, Alberta.

1.3 Guide Contents

This guide consists of five sections. Following the introduction is a brief discussion of the classification system (Section 2). Section 3 provides procedures for site description, identification, mapping, and interpretation. Section 4 contains information about the biogeoclimatic units described, tools for identification of biogeoclimatic and site units, descriptions of the site units, and direct management interpretations for the identified site units. Section 5 presents indirect interpretations for silviculture systems and site preparation, and direct interpretation tables for some wildlife species of management concern.

Biogeoclimatic unit maps (1:250 000 scale) to be used in conjunction with this guide are available from appropriate Ministry of Forests district offices or from the Forest Sciences Section, Prince George Forest Region.

The classification is based on approximately 650 plots located in the Rocky Mountain Trench portion of the Prince George Forest Region and in shared biogeoclimatic units in the Cariboo, Nelson, and Kamloops forest regions. The plots are generally well distributed geographically (proportional to the size of the biogeoclimatic

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2 Sections 5, 5.1, and 5.2 are referenced but they are not included in this report. These sections will be included when a new guide is completed for the area.
unit) except in units with difficult access, such as those within the ESSF zone. Most site units are characterized by at least 10 plots, although certain less common sites (i.e., very dry and wet sites) are typically characterized by a smaller number of plots.

1.4 Training Courses

It is assumed that the user of this guide is familiar with the basic concepts and methods of site, soil, and vegetation evaluation and has completed the training programs offered by the B.C. Ministry of Forests, Forest Sciences Section. These courses are offered annually in various locations within the region. For information about such training courses, please contact the Forest Sciences Section, Prince George Forest Region.
2 THE BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION (BEC)

This section briefly describes the biogeoclimatic classification system. For a more complete description refer to Ecosystems of British Columbia (Meidinger and Pojar 1991) or Biogeoclimatic Ecosystem Classification for British Columbia (Pojar et al. 1987).

2.1 Classification System

The BEC system is a hierarchical classification scheme that combines three classifications: climatic (or zonal), vegetation, and site. For practical purposes, users need only be concerned with the zonal and site classifications (Figure 2). The information presented in this guide will allow the user to apply BEC in the field.

2.2 Zonal (Climatic) Classification

Biogeoclimatic units are the result of zonal (climatic) classification and they represent groups of ecosystems under the influence of the same regional climate. There is a hierarchy of climatic units, with the biogeoclimatic subzone as the basic unit. Subzones are grouped into zones, and divided into variants.

Data from long- and short-term climate stations have been used to help characterize subzones. Because climate stations are not well distributed within and among subzones, climax vegetation on zonal sites must serve as an indicator of the long-term climate of the area.

Each biogeoclimatic subzone has a distinct climax (or near-climax) plant association on zonal sites. Zonal sites have deep, broadly loamy soils and occupy midslope positions with mesic moisture regimes. The zonal climax vegetation is thought to best reflect the regional climatic conditions of the subzone.

Ecosystems within a subzone are influenced by this one type of regional climate. Edaphic (soil) and topographic conditions influence the climax vegetation of sites either drier or wetter than the zonal condition. Thus, subzones have distinctive sequences of related ecosystems ranging from dry to wet sites. For example, in a wet cool subzone of the Interior Cedar-Hemlock (ICH) zone, zonal sites are dominated by a western redcedar and western hemlock.

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3 Zonal sites are sites that best reflect the mesoclimate or regional climate of an area.
FIGURE 2  Hierarchical relationship between climatic-level (zonal) and site-level classifications (taken from Pojar et al. 1987). The highlighted classifications are described in this guide.
canopy with a diverse, moderately well-developed understorey of shrubs and herbs; dry sites are dominated by a variety of tree species including lodgepole pine and Douglas-fir and have an understorey dominated by false azalea, black huckleberry, and lichens; and wet sites in the same subzone (climate) have hybrid white spruce in the overstorey with an understorey dominated by devil’s club, oak fern, lady fern, and/or horsetail species.

The biogeoclimatic variant was defined because subzones contain considerable geographic variation. Variants reflect further differences in regional climate and are generally recognized for areas that are slightly drier, wetter, snowier, warmer, or colder than other areas in the subzone. For example, the Wells Gray Wet Cool variant (ICHwk1) of the ICH is wetter and has a longer frost-free period than the Goat Wet Cool variant (ICHwk3) of the ICH. These climatic differences result in corresponding differences in vegetation, soil, and ecosystem productivity. The differences in vegetation are evident as distinct zonal climax plant subassociations. Subzones with similar climatic characteristics and zonal ecosystems are grouped into biogeoclimatic zones. A zone is a large geographic area with a broadly similar type of climate. A zone has typical patterns of vegetation and associated similarities in nutrient cycling and soil climate. Zones also have one or more typical zonal climax species of tree, shrub, herb, or moss.

Zones are usually named after one or more of the dominant climax species in zonal ecosystems and a geographic or climatic modifier (e.g., Interior Cedar-Hemlock zone). Zones are given a two- to four-letter code that corresponds to the name. For example, the Interior Cedar-Hemlock zone code is ICH.

Subzone names are derived from classes of relative precipitation and temperature. Subzone codes correspond to the climatic modifiers (Table 1). For example, the ICHmm refers to the Moist Mild (mm) subzone of the Interior Cedar-Hemlock (ICH) zone. Variants are named by geographic area and ordered by number from south to north and from west to east. Hence, the ICHwk1 variant is more southerly than the ICHwk3 variant.
2.3 Site Classification

Site series are the most commonly used units of site classification (Figure 2). Site series occur within a biogeoclimatic subzone or variant. They are defined by using late seral or climax vegetation and result in site units having similar environmental properties and vegetation. The potential vegetation and selected environmental properties are used in this guide to characterize site series.

Each biogeoclimatic unit has a characteristic sequence of site series according to soil moisture regime (smr) and, to a lesser degree, soil nutrient regime (snr). \(^4\) Soil moisture regime is a relative scale of “available water” for plant growth within the climate of the biogeoclimatic unit. An eight-class scale is used; it ranges from 0 or very xeric (bare rock) to 7 or subhydric (water tables at or near the surface year round). Soil nutrient regime is a relative scale of “available nutrients” for plant growth. A five-class scale ranging from A (very poor) to E (very rich) is used. Typical sites where different combinations of smr and snr would occur on generic landscapes within the guide area are presented in figures 3 and 4.

Common names of one to four species are used to name site series, and tree species codes are usually substituted to shorten the name (e.g., CwHw – Devil’s club – Lady fern site series). Similar plant communities can occur in different biogeoclimatic units, but the relative moisture regime that they represent may differ between subzones. These communities belong to the same

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\(^4\) The site identification section (Section 3.4) contains soil moisture and soil nutrient regime identification information.
grouping of site series that is collectively called a site association. For example:

ICHvk2/CwHw – Devil’s club – Lady fern site series# = ICHvk2/01
ICHwk3/CwHw – Devil’s club – Lady fern site series# = ICHwk3/05
ICHwk4/CwHw – Devil’s club – Lady fern site series# = ICHwk4/07

All three of these site series belong to the same site association, so their climax vegetation is similar, but their occurrence in the landscape, site conditions, and seral vegetation patterns may differ among the three biogeoclimatic units.

Each site series is given a two-digit numeric code that relates to its position on the relative moisture and nutrient scales. Within a biogeoclimatic unit, the forested units are numbered as follows: the 01 site series is the zonal or mesic site, with the rest ranked from driest (02) to wettest (generally 09 to 12) and, secondarily, poorest to richest. Non-forested units use higher-order numbers to keep them distinct from the forested units. For example, non-forested wetlands are numbered from 31 to 49.

Site series may be divided into phases. The site phase is used to allow better site differentiation and identification for operational considerations, although it is not a formal category in B Ec. Site phases are differentiated by edaphic characteristics. For example, recognizing two distinct differences in particle size classes (typically coarse and fine) within a widespread site series gives much more meaning to silvicultural interpretations for these sites. A site phase may also be established on the basis of slope class, aspect, parent material, soil climate, humus form, soil chemistry, or bedrock geology.

Management interpretations are often made directly at the site series level. In some cases, however, interpretations are most efficiently dealt with at broader or finer levels of the classification, such as those less sensitive to site-level differences (e.g., wildlife) or those affected more by variations in site and soil conditions than by climate or vegetation (e.g., site preparation).

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5 Site associations are not used in the classification presented in this manual. They are defined by Pojar et al. (1987).
Figure 3. Typical sequence of combinations of relative soil moisture and soil nutrient regime found on steep slopes within the guide area.
Figure 4: Typical sequence of combinations of relative soil moisture and soil nutrient regime found on subdued topography within the guide area.

**Moisture Regime**

- 0 – very xeric
- 1 – xeric
- 2 – subxeric
- 3 – submesic
- 4 – mesic
- 5 – subhygric
- 6 – hygric
- 7 – subhydric

**Nutrient Regime**

- A – very poor
- B – poor
- C – medium
- D – rich
- E – very rich
3 PROCEDURES FOR SITE DESCRIPTION, IDENTIFICATION, MAPPING, AND INTERPRETATION

3.1 Introduction

Ecological site identification consists of collecting accurate site, soil, and vegetation information, and then using the various tools and descriptive material presented in the guide to identify the site unit that best fits the information collected. The development of an appropriate management prescription depends on accurate site description and other site-specific data (e.g., slope gradient, soil texture), as well as correct site unit identification. Combining site identification with the collection of site, soil, and vegetation data provides the most complete ecological description of the site.

The guide user must understand that there is much more natural variability in the forests than is portrayed in this field guide; thus, not every ecosystem encountered will be easily “pigeonholed” into an existing classification unit. The “cookbook” approach to site identification and interpretation is not encouraged. This field guide is intended to promote ecological thinking and a better understanding of forest ecosystems.

The guide assumes that the user has a basic knowledge of ecosystem classification concepts, soils description, and plant identification. Field courses co-ordinated by regional Forest Sciences staff are held in most forest districts (depending on demand) in the Prince George Forest Region every summer. PHSP and silviculture survey courses, which have an ecological classification component, are also held annually. Regional Forest Sciences staff are available to assist with problems associated with field descriptions, identification, and management interpretations. Once on-site information has been gathered, a site can be identified using the step-by-step procedures outlined in the Site Identification section (Section 3.4). The two sections that follow provide a complete description of tools for site and biogeoclimatic unit identification. Information for mapping site units and using the interpretations portions of the guide are discussed in Sections 3.6 and 3.7, respectively.
3.2 Identifying Biogeoclimatic Units (Subzone/Variant)

The following is a list of the tools available for assisting the user in identifying and describing biogeoclimatic units.

Biogeoclimatic maps
Available at a scale of 1:250 000 from the regional Forest Sciences Section or from district offices, these maps provide a relatively detailed portrayal of geographic distribution of the biogeoclimatic units. This information will also be available in digital format within the inventory database so that it can be accessed in a variety of ways using a Geographic Information System (GIS). The biogeoclimatic map should be referred to before leaving the office, but should not be relied on totally, especially if the area is near biogeoclimatic unit boundaries, in complex, mountainous terrain, or in remote areas where access and sampling occurred solely via helicopter.

Biogeoclimatic/Vegetation summary table
This table displays important vegetative differences between the biogeoclimatic units described, as well as between the units described and bordering units not described in the guide. This table compares vegetation that is found on zonal sites (refer to Section 2.2). Once a zonal site has been identified, this table can be used either to identify or to reaffirm the identification of a biogeoclimatic unit.

Biogeoclimatic unit summary page
This page, located at the front of each biogeoclimatic unit subsection, contains a brief summary of geographic location, elevation range, climate, vegetation features that assist in distinguishing between adjoining biogeoclimatic units, soils, forests, and ecosystem management. The distinguishing features, location, and elevation range information can assist in the identification of a biogeoclimatic unit. The remainder of the information is useful as background material in documents related to the particular biogeoclimatic unit.
3.3 Identifying Site Units

The following is a list of the tools available to assist in identifying site units.

Edatopic grid
The edatopic grid displays how the site series relate to each other along the relative gradients of moisture and nutrient regime. Once relative moisture and nutrient regimes are determined (see Section 3.4), the unit(s) generally associated with that moisture and nutrient regime can be identified from the grid.

Vegetation table
This table indicates the prominence of widespread diagnostic species by site series for each biogeoclimatic unit. Prominence values are derived by multiplying the square root of species constancy by mean cover. For example, when a species is present in 100% of sample plots (i.e., constancy = 100) and has a mean cover of 5%, the prominence equals 50. Five prominence value classes are displayed by different-sized bars within the tables.

<table>
<thead>
<tr>
<th>Prominence Value</th>
<th>Prominence Class</th>
<th>Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–4</td>
<td>0</td>
<td>![Schematic for prominence class 0]</td>
</tr>
<tr>
<td>5–15</td>
<td>1</td>
<td>![Schematic for prominence class 1]</td>
</tr>
<tr>
<td>16–50</td>
<td>2</td>
<td>![Schematic for prominence class 2]</td>
</tr>
<tr>
<td>51–100</td>
<td>3</td>
<td>![Schematic for prominence class 3]</td>
</tr>
<tr>
<td>101–200</td>
<td>4</td>
<td>![Schematic for prominence class 4]</td>
</tr>
<tr>
<td>201+</td>
<td>5</td>
<td>![Schematic for prominence class 5]</td>
</tr>
</tbody>
</table>

In general, the vegetation tables contain species that are useful in differentiating between site units. The actual abundance of plant species on any given site depends on several factors, including the successional status of the site and the type and degree of disturbance that initiated succession. The table values are derived from plots in mature forests (80 years or older). These tables should not be used in seral (i.e., early successional) stands that do not have a closed canopy (see Section 3.5). A possible solution is to find a mature stand adjacent to the seral stand, but the user must be fairly certain that this stand represents the same ecological unit as the site being assessed (e.g., same slope position and soil texture).
Site series key
The dichotomous key uses a series of paired statements containing a combination of site, soil, and vegetation features to direct the user to a site series identification. Since the lead statements often refer to the tree canopy and any understorey vegetation comments relate to mature sites, the keys work best on sites that have achieved crown closure. When attempting to use the keys on disturbed sites, the user must have some knowledge of the canopy dominance prior to disturbance and must not rely on the understorey vegetation features described in the key. Alternatively, an adjacent mature stand could be used, though the user must be fairly certain that the stand represents the same ecological unit as the site being assessed (e.g., same slope position and soil texture).

Site series summary page
For each site series there is a one-page summary of vegetation, site, and soil features. The vegetation list contains species that are found consistently (>60% constancy) and develop reasonable cover (>1%). They are listed in order of constancy, and then in order of percent cover within the same level of constancy. Species in square brackets do not occur consistently (i.e., <60% constancy), but when they do occur they have high cover (often >5%). Three plants that generally characterize the unit are illustrated along the left-hand margin. For each site and soil feature, the range in conditions encountered during BEC sampling is indicated. Note that the range indicated may not express the true range of variability that may be encountered. Soil texture classes refer to those displayed on the soil texture triangle in Figure 6. Features preceded by an asterisk (*) are ones that can generally be relied on to differentiate or characterize the site.
3.4 Site Identification

This section outlines a step-by-step procedure to identify a site series. This procedure should be used until the user becomes intimately familiar with the site identification process and the site units in his or her area of operation.

**Step 1**
Locate an area for your assessment that appears to be representative of the unit being sampled, and is as homogeneous in plant cover and overstorey canopy condition as possible. Avoid locating the sample area on sites that have recently received significant natural or artificial disturbance (e.g., landings).

**Step 2**
Determine and record site and soil information important for site identification and the prescription process. Table 2 lists some of the more important site and soil factors to be collected. (Note that more detailed site and soil information may be required for certain purposes.) Tools that will help you assess some of the factors include mesoslope position (Figure 5), soil texture (Section 3.4.1), and humus form (Table 5).

### 3.4.1 Hand texturing guides
Soil texture refers to the relative proportions of the sand, silt, and clay separates within a soil. These separates have their own distinctive properties of “feel,” allowing one to estimate their proportions in a sample of soil by hand texturing. To obtain accurate results, texturing must be done with a sample that has the correct moisture content as described below. Both a table (Table 3) and a key procedure (Figure 6) are provided. The user should become familiar with both and use the procedure that feels most comfortable.
<table>
<thead>
<tr>
<th>Factor</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope gradient (%)</td>
<td>measure of a slope’s incline; equals vertical rise divided by horizontal distance (100% slope = 45° angle).</td>
</tr>
<tr>
<td>Aspect (°)</td>
<td>the compass direction a slope is facing.</td>
</tr>
<tr>
<td>Slope position</td>
<td>relative position of sampling site within a catchment area (e.g., between slope breaks affecting surface water flow; see Figure 4).</td>
</tr>
<tr>
<td>Soil texture</td>
<td>relative proportion of sand, silt, and clay; defined proportions comprising textural classes (see Section 3.4.1).</td>
</tr>
<tr>
<td>Coarse fragments (%)</td>
<td>percent by volume of mineral soil fragments greater than 2 mm in diameter.</td>
</tr>
<tr>
<td>Effective rooting depth (cm)</td>
<td>subjective assessment indicating the greatest depth to which root systems of forest trees freely penetrate; depth at which rooting abundance classes drop to “few” (see Luttmerding et al. 1990).</td>
</tr>
<tr>
<td>Depth to a restricting layer (cm)</td>
<td>depth to a soil layer or condition that severely restricts root penetration (e.g., compact parent material or bedrock).</td>
</tr>
<tr>
<td>Depth to seepage water (gleying) (cm)</td>
<td>depth to area in soil profile from which water is seeping out; evidence of periodic seepage during the growing season may be indicated by gleying (orange-coloured mottles within a generally olive- to blue-coloured soil matrix).</td>
</tr>
<tr>
<td>Humus depth (cm)</td>
<td>depth of group of horizons located at the soil surface that have formed primarily from organic materials, and that may include mineral soil intermixed with organic material.</td>
</tr>
<tr>
<td>Humus form</td>
<td>the quality of the humus layer classed into three main orders (mor, moder, mull) based on the rate and mode (fungal vs. animal) of decomposition within the layer (Table 5).</td>
</tr>
</tbody>
</table>
Procedures for Hand Texturing Using Table 3

1. Crush a small handful of soil in the hand, and remove coarse fragments (particles greater than 2 mm in diameter).
2. Gradually add water to the soil and, with a soil knife or fingers, work it into a moist putty. The correct moisture content is important. If the putty flows with the force of gravity it is too wet. If it crumbles when rolled it is too dry. It should have the consistency of filler putty.
3. Determine stickiness of the soil putty by working it between the thumb and forefinger, pressing and then separating the digits. An estimate of clay content can be made in this way. (Clay limits below are approximate.)
   - **non-sticky**: Practically no soil material adheres to the thumb and forefinger (less than 10% clay).
   - **slightly sticky**: Soil material adheres only to one of the digits and comes off the other rather cleanly. The soil does not stretch appreciably when digits are separated (10–25% clay).
   - **sticky**: Soil material adheres to both digits and stretches slightly before breaking when digits are pulled apart (25–40% clay).
   - **very sticky**: Soil putty adheres strongly to both digits and stretches distinctly before breaking (greater than 40% clay).
4. Determine the graininess of the soil putty by rubbing it between thumb and forefinger. An estimate of sand content can be made in this way. (Sand limits below are approximate.)
   - **non-grainy**: Little or no graininess can be felt (less than 20% sand).
   - **slightly grainy**: Some graininess is felt, but non-grainy material (silt and clay) is dominant (20–50% sand).
   - **grainy**: Sand is felt as the dominant material. Some non-grainy material can be felt between sand grains (50–80% sand).
   - **very grainy**: Sand is the only material felt. Little or no non-grainy material is present (>80% sand).
5. After stickiness and graininess have been determined, use the texturing table as an approximate guide to the textural class of the soil. The textural triangle found in Figure 6 can be used for more accurately determining the textural class and it also displays the textural class used in the site unit descriptions.
### Hand texturing guide

<table>
<thead>
<tr>
<th></th>
<th>Non-grainy (&lt;20% sand)</th>
<th>Slightly grainy (20–50% sand)</th>
<th>Grainy (50–80% sand)</th>
<th>Very grainy (&gt;80% sand)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very sticky</strong> (&gt;40% clay)</td>
<td>Silty clay</td>
<td>Clay</td>
<td>Sandy clay</td>
<td>–</td>
</tr>
<tr>
<td><strong>Sticky</strong> (25–40% clay)</td>
<td>Silty clay loam</td>
<td>Clay loam</td>
<td>Sandy clay</td>
<td>–</td>
</tr>
<tr>
<td><strong>Slightly sticky</strong> (10–25% clay)</td>
<td>Silt loam or silt</td>
<td>Loam b</td>
<td>Sandy loam</td>
<td>–</td>
</tr>
<tr>
<td><strong>Non-sticky</strong> (&lt;10% clay)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Loamy sand or sand</td>
</tr>
</tbody>
</table>

*a Sand and clay limits are approximate.

*b A loam is a textural class exhibiting physical properties intermediate between those of sand, silt, and clay.

### Properties of soil separates

#### Properties of Fine Fraction

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>very hard when dry; feels smooth and is very sticky when wet; feels smooth when placed between teeth.</td>
</tr>
<tr>
<td>Silt</td>
<td>slightly hard to soft when dry; powder is floury when dry; feels slippery and slightly sticky when wet; silt cannot be felt as grains between thumb and forefinger, but can be felt as a fine graininess when placed between teeth.</td>
</tr>
<tr>
<td>Sand</td>
<td>loose grains when dry; very grainy when felt between thumb and forefinger; non-sticky when wet.</td>
</tr>
</tbody>
</table>
FIGURE 5  
*Slope position (mesoslope) (from Lloyd et al. 1990).*
Description of Soil Texturing Tests

1. **Organic matter test:** Well-decomposed organic matter (humus) imparts silt-like properties to the soil. It feels floury when dry and slippery or spongy when moist, but not sticky and not plastic. However, when subjected to a taste test (see below), it feels non-gritty. It is generally very dark when moist or wet, and stains the hands brown or black.

2. **Graininess test:** Rub the soil between your fingers. If sand is present, it will feel “grainy.” Determine whether sand comprises more or less than 50% of the sample. Sandy soils often sound gritty when worked in the hand.

3. **Moist cast test:** Compress some moist (not wet) soil by clenching it in your hand. If the soil holds together (i.e., forms a “cast”), then test the durability of the cast by tossing it from hand to hand. The more durable it is (e.g., like plasticine), the more clay is present.

4. **Stickiness test:** Wet the soil thoroughly and compress between thumb and forefinger. Determine the degree of stickiness by noting how strongly the soil adheres to the thumb and forefinger when you release the pressure, and by how much it stretches. Stickiness increases with clay content.

5. **Taste test:** Work a small amount of soil between your front teeth. Silt particles are distinguished as fine “gritiness” (e.g., like driving on a dusty road), unlike sand, which is distinguished as individual grains (i.e., graininess). Clay has absolutely no grittiness.

6. **Soapiness test:** Slide thumb and forefinger over wet soil. Degree of soapiness is determined by how soapy/slippery it feels and how much resistance to slip there is (i.e., from clay and sand particles).

7. **Worm test:** Roll some moist soil on your palm with your finger to form the longest, thinnest “worm” possible. The more clay there is in the soil, the longer, thinner, and more durable the worm will be. Try with wetter or drier soil to ensure that you have the correct moisture content (best worm).
Soil texturing key (from Braumandl and Curran 1992).

**FIGURE 6** Soil texturing key (from Braumandl and Curran 1992).
**FIGURE 6 Continued.**

**SANDY CLAY LOAM**  
SCL  
non- to s. gritty  
s.course to sticky  
worm: 3–1.5 mm dia  
(45–65% sand)

**SANDY CLAY**  
SC  
non-gritty  
s.course to v.sticky  
worm: 3–1.5 mm dia  
(45–65% sand)

**SILTY CLAY**  
SiC  
s.gritty to s. gritty  
s.soapy to s. soapy  
worm: strong; 1.5 mm dia  
(0–20% sand)

**CLAY or HEAVY CLAY**  
Cor or H C  
non-gritty to s. gritty  
non-soapy to s. soapy  
worm: strong; 1.5 mm dia  
(0–45% sand)

**>30% organic matter**  
ORGANIC  
(no texture)

---

* Silt feels slippery or soapy when wet; fine sand feels stiffer, like grinding compound or fine sandpaper.

**Key to Abbreviations**
- **s** = slightly
- **v** = very
- **dia** = diameter

**Measurement Conversions**
- 3.0 mm = 1/8”
- 1.5 mm = 1/16”

**Fine Fraction**
- SAND ...........................(S)
- SILT .............................(Si)
- CLAY ............................(C)
- HEAVY CLAY ............(HC)
- LOAM ...........................(L)
- mix of sand, silt, and clay

**Particle Diameter**
- 2–0.05 mm
- 0.05–0.002 mm
- <0.002 mm
- >60% clay
### Identification of upland humus forms

<table>
<thead>
<tr>
<th>Form</th>
<th>Description</th>
</tr>
</thead>
</table>
| Mors  | - matted F horizon<sup>a</sup>  
- common fungal mycelium  
- little or no intermixing of organic and mineral materials  
- abrupt boundary between organic and mineral horizons |
| Moders | - loosely arranged F horizon  
- friable  
- insect droppings  
- fungal mycelium and soil organisms (arthropods and occasional earthworms)  
- intermixing of organic and mineral horizons  
- gradual transition between mineral and organic horizons |
| Mulls  | - often no F or H horizons<sup>c</sup> (thin if present)  
- insect droppings abundant  
- usually many soil organisms, but may form from decomposition of a dense network of roots (usually abundant earthworms)  
- considerable intermixing of mineral and organic layers, with incorporation of organic matter into surface mineral soil (Ah horizon<sup>d</sup>) |

---

<sup>a</sup> F horizon: horizon in which partial (rather than entire) macroscopically recognizable vegetative structures are dominant (i.e., the horizon is partially decomposed).

<sup>b</sup> Residues break down upon rubbing.

<sup>c</sup> H horizon: horizon of highly decomposed organic matter in which original plant vegetative structures are no longer identifiable.

<sup>d</sup> Ah horizon: surface mineral horizon enriched with organic matter (characteristically darker in colour than lower soil layers).

### Step 3

Using the site and soil factors recorded, determine the relative moisture regime and relative nutrient regime using the keys provided (Figures 7 and 8), and then proceed to Step 4.
<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ridge crest</td>
<td>– height of land; usually convex slope shape.</td>
</tr>
<tr>
<td>Upper slope</td>
<td>– the generally convex-shaped, upper portion of a slope.</td>
</tr>
<tr>
<td>Middle slope</td>
<td>– the portion of a slope between the upper and lower slopes; the slope shape is usually straight.</td>
</tr>
<tr>
<td>Lower slope</td>
<td>– the area towards the base of a slope; the slope shape is usually concave. It includes toe slopes, which are generally level areas located directly below and adjacent to the lower slope.</td>
</tr>
<tr>
<td>Flat</td>
<td>– any level area (excluding the slopes); the surface shape is generally horizontal with no significant aspect.</td>
</tr>
<tr>
<td>Alluvium</td>
<td>– post-glacial, active floodplain deposits along rivers and streams in valley bottoms; usually a series of low benches and channels.</td>
</tr>
<tr>
<td>Depression</td>
<td>– any area that is concave in all directions; usually at the foot of a slope or in flat topography.</td>
</tr>
<tr>
<td>Soil depth</td>
<td>– depth from the mineral soil surface (mineral/organic interface) to a restricting layer, such as bedrock, strongly compacted materials, or strongly cemented materials (e.g., “hardpan”).</td>
</tr>
<tr>
<td>Gleyed</td>
<td>– soils that have orange-coloured mottles indicative of a fluctuating water table. Permanently gleyed soils are dull yellowish, blue, or olive in colour.</td>
</tr>
<tr>
<td>Soil particle size coarse</td>
<td>– sandy with &gt;35% volume of coarse fragments, or loamy with &gt;70% volume of coarse fragments.</td>
</tr>
<tr>
<td>Soil particle size fine</td>
<td>– silty or clayey with &lt;20% volume of coarse fragments.</td>
</tr>
</tbody>
</table>

a Adapted from Lloyd et al. (1990) and Green et al. (1984).

b Sandy – ls, s; loamy – sl, l, scl; clayey – scl, cl, sc, sic, c; silty – sil, si.

**Relative soil moisture regimes:** Figure 7 is intended to assist the user in identifying relative soil moisture regimes using readily observable environmental features. It should be applied with caution on ridge crests, upper slopes, and middle slopes that have soils with thick (>20 cm) organic layers, and on steep, northerly facing...
FIGURE 7  A key to the identification of relative soil moisture regimes.

a  Generally moister if aspect is N or NE
b  Generally drier if aspect is S or SW
slopes. Moisture regime in these cases will generally be higher than indicated. The soil moisture regime classes 0–7, shown in the key, correspond to the terms very xeric (0) to subhydric (7) (see Figures 3 and 4). Table 6 provides definitions for the categories used in the key shown in Figure 7.

1a Coarse textured

2a High coarse fragments (>50%), very shallow soil (<30 cm), and/or shallow rooting depth (<15 cm)

3a Mor humus form Very Poor

3b Moder humus form Poor–Medium

2b Moderate to low coarse fragments without restricted rooting depth

4a Mor humus form Poor

4b Moder humus form Medium

4c Mull humus form Rich–Very Rich

1b Moderately coarse and medium textured

5a High coarse fragments (>50%), very shallow soil (<30 cm), and/or shallow rooting depth (<15 cm)

6a Mor humus form Poor

6b Moder humus form Medium

5b Moderate to low coarse fragments without restricted rooting depth

7a Mor humus form Poor–Medium

7b Moder humus form Medium–Rich

7c Mull humus form Very Rich

1c Moderately fine and fine textured

8a High coarse fragments (rare), very shallow soil (<30 cm), and/or shallow rooting depth (<15 cm)

9a Mor humus form Poor–Very Poor

9b Moder humus form Poor–Medium

9c Mull humus form Rich

8b Moderate to low coarse fragments without restricted rooting depth

10a Mor humus form Medium

10b Moder or Mull humus form Rich

FIGURE 8 Key for estimating relative soil nutrient regimes. Note: presence of base-rich parent materials (limestone, shale, basalt) may improve nutrient status. Refer to soil textural triangle for derivation of soil textures.
Step 4
From a plot area of at least 0.04 ha (20 × 20 m), identify and record as many of the plant species (including tree species) in the plot as possible. Estimate the percent cover of each of the dominant species (i.e., species covering >5% of the plot). Attempt to adjust the list and coverage estimates according to what you have seen over the remainder of the area covered by the same unit.

Step 5
If the biogeoclimatic unit has previously been determined, proceed to the appropriate biogeoclimatic unit subsection (Table 7). If not, use Figure 9 to determine it. Note that the vegetation used in Figure 9 is that occurring on zonal sites (e.g., edatopic grid 4–C) (see Section 2.2). If the site unit is other than zonal, try to locate a zonal site in the area and note the general floristic features (e.g., dominant tree and understorey species), and compare this information to that found in Figure 9. If the area in question is near a subzone boundary and doubt remains after the verification step using Figure 9, then identify the site unit for both possible biogeoclimatic units. The descriptions and interpretations for both units should then be compared, and the most appropriate information applied.

<table>
<thead>
<tr>
<th>Biogeoclimatic unit</th>
<th>Section</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICHmm</td>
<td>4.1</td>
<td>39</td>
</tr>
<tr>
<td>ICHwk1</td>
<td>4.2</td>
<td>62</td>
</tr>
<tr>
<td>ICHwk3</td>
<td>4.3</td>
<td>86</td>
</tr>
<tr>
<td>SBSdh</td>
<td>4.4</td>
<td>118</td>
</tr>
<tr>
<td>ESSFmm1</td>
<td>4.5</td>
<td>142</td>
</tr>
<tr>
<td>ESSFwc2</td>
<td>4.6</td>
<td>164</td>
</tr>
</tbody>
</table>
**FIGURE 9** Zonal vegetation of biogeoclimatic units within and adjacent to the area covered by the guide.
### Herbs and Dwarf Shrubs

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>SBS dh</th>
<th>ICH mm</th>
<th>ESSF mm1</th>
<th>SBS wk1</th>
<th>ICH wk4</th>
<th>ICH wk1</th>
<th>ESSF wk1</th>
<th>ESSF wk2</th>
<th>ESSF wc2</th>
<th>ESSF wc3</th>
<th>SBS vk</th>
<th>ICH vk2</th>
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</thead>
<tbody>
<tr>
<td>Calamagrostis rubescens</td>
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<td>Chimaphila umbellata</td>
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<tr>
<td>Cornus canadensis</td>
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<tr>
<td>Aralia nudicaulis</td>
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<td>Streptopus lanceolatus var. curvipes</td>
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<tr>
<td>Rubus pedatus</td>
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<tr>
<td>Tiarella spp.</td>
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<tr>
<td>Gymnocarpium dryopteris</td>
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<td>Dryopteris expansa</td>
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<tr>
<td>Arnica latifolia</td>
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<tr>
<td>Valeriana sitchensis</td>
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<tr>
<td>Athyrium filix-femina</td>
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</table>
### Mosses

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>SBS dh</th>
<th>ICH mm</th>
<th>ESSF mm1</th>
<th>SBS wk1</th>
<th>ICH wk4</th>
<th>ICH wk1</th>
<th>ESSF wk1</th>
<th>ESSF wk2</th>
<th>ESSF wc2</th>
<th>ESSF wc3</th>
<th>SBS vk</th>
<th>ICH vk2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleurozium schreberi</td>
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<tr>
<td>Hlycomium splendens</td>
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<tr>
<td>Barbilophozia lycopodioides</td>
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<tr>
<td>Rhytidiadelphus triquetrus</td>
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<tr>
<td>Rhytidiadelphus robusa</td>
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<tr>
<td>Brachythecium spp.</td>
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<tr>
<td>Mnium spp.</td>
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</table>

**FIGURE 9**  Continued.
3.5 Identifying Seral Ecosystems

The biogeoclimatic classification was developed based on samples of climax and late seral vegetation (forest stands older than 80 years). Because of this, environmental features must be more heavily relied upon when attempting to assess recently disturbed or seral sites. Since there can be considerable overlap in environmental features among site series, disturbed sites are often difficult to identify. Remnant climax vegetation found in portions of the site not subjected to burning or heavy mechanical site preparation may help in the assessment. Otherwise, vegetation found in an adjacent mature stand with similar environmental features (e.g., same slope position and soil texture) can be used.

3.6 Mapping Site Units

An ecosystem map is an extremely useful tool for effective integrated planning within a management area. It provides a permanent record of the location and distribution of ecosystems, and thus a basic framework for developing site-specific management prescriptions that can be prepared for many resource values. A map also provides a means of monitoring prescriptions in the long term, and of refining interpretations. PHSPs legally require biogeoclimatic classification of proposed cutblocks. Having done this, the extra effort required to produce a map of a small management area during an ecological stand survey is minimal. If the survey is initiated with mapping in mind, a more systematic, efficient, and thorough survey will result.

The steps involved in producing an ecosystem (or treatment unit) map at a scale of 1:5000 to 1:20 000 for a relatively small management unit (less than 500 ha) are outlined below. More complex ecosystem maps of large study areas (watersheds or local resource use planning areas) are generally produced by mapping specialists. Several consultants with experience in these larger projects are available throughout the province. Mitchell et al. (1989) outline standard methods and terminology for ecosystem mapping used by the Ministry of Forests, and Courtin et al. (1989) describe an approach to woodlot management that incorporates ecological stand mapping. The user should refer to these publications for more detail on mapping concepts and procedures. The major steps required to produce an ecological stand map are: (1) production of...
a preliminary legend, (2) pre-stratification (typing) of aerial photographs, (3) systematic field survey, (4) refinement of photo typing and labelling of map polygons, and (5) production of the final map.

3.6.1 Producing a preliminary legend

In its simplest form, a legend is a listing and explanation of abbreviations (numbers, letters, symbols) used to denote the site units that occur within the map area. For the most part, the listing of site units described for each of the biogeoclimatic units will serve as a preliminary legend. Other stand or site attributes can also be added, depending on the requirements of the survey. For example, symbols for stand age, tree species composition, or percentage of slope might supplement the site unit numbers or letters. Such a legend will enable you to place a preliminary label on polygons (map delineations) outlined on the aerial photos.

3.6.2 Typing aerial photographs

Assuming that aerial photographs of an appropriate scale are available (preferably 1:10 000 colour, but 1:20 000 or 1:15 840 black-and-white are also used), the next step is to delineate (using a stereoscope and grease pencil) logical, homogeneous units on the photos that reflect ecological site characteristics. Many features visible on aerial photos provide clues to identifying ecological site units. Important features to note are landform, slope position and degree, slope shape (concave versus convex), aspect, drainage pattern, and canopy characteristics (based on tone and texture) that will reflect crown closure, species composition, and relative growth or productivity. Skills improve with practice and with ground truthing of photo typing to calibrate the eyes. Use the various tools in the guide, and your experience, to predict which site units occur in each of your types (polygons). Then, put a tentative label (using site series numbers or other abbreviations from your legend) on each. Complex polygons comprised of two or three units can only be identified on the ground. Polygons should not generally be smaller than 1 cm², which represents 0.25 ha and 1 ha at 1:5000 and 1:10 000 scales, respectively. Exceptions to this would be small, easily recognizable features such as wetlands and clearings, which aid in orientation and/or may require special consideration.
3.6.3 Field surveys (ground truthing)
Accurately typed photos facilitate efficient field sampling. Once the typing is complete, compile a sampling plan, ensuring that at least two plots are present in each type. Complex types may require more plots. After establishing plots, sample and describe each of the types as outlined in Section 3.4, and identify site units as outlined in Section 3.3. Transects through the area should be walked with a compass and hip chain, in order to cover all the polygons that were pre-stratified. Take care to locate your plots and transects accurately on the photo. In addition to recording the plot information, take notes as you walk, and record changes that occur at specified distances along the transects.

3.6.4 Refining and labelling map polygons
The next step is to refine the map polygon boundaries and labels on the aerial photos, based on the results of the field survey. As the transects and sample plots are completed in the field, type lines and labels are modified while the information is fresh in your mind. The legend may have to be modified to accommodate previously undescribed units. Once back in the office, finalize the linework, polygon labels, and legend. It may be desirable to combine similar polygons into “treatment units” if you feel that the units are not significantly different ecologically to warrant different operational treatments. It is preferable, however, to maintain as much detail as possible on the original map. From this, more generalized interpretive maps can be produced for specific applications.

3.6.5 Producing the final map
The exact form of the final map will depend on its proposed use and the resources available to produce it. The final product may range from a simple sketch map to a sophisticated colour-themed digital (computer-generated) map. For small settings, where the topography does not vary much and the map is not very complex, it may be adequate to trace the photo linework and some of the important planimetric detail (streams, lakes, roads) onto a mylar in order to produce the final map. For larger maps encompassing more than two aerial photos, or where the topography is variable and steep, the linework will have to be transferred to a base map using special plotting equipment (e.g., a Kail plotter, zoom transfer scope, or epidiascope) that corrects for distortion of scale on the photos. There are several mapping firms throughout the province.
that specialize in Geographic Information Systems (GIS) and the production of digital map products, either directly from aerial photos or from a plotted map. Digital maps are extremely useful for permanent storage of a large number of field data by map polygon. They are ideal for producing interpretive maps and monitoring long-term treatments tied to specific map units.

3.7 Management Interpretations

Interpretations are provided in two areas of the guide. Within the biogeoclimatic unit subsections (4.1–4.6) are direct interpretations. These relate to specific site units and are contained on the page facing the appropriate unit. Section 5 contains interpretations that can be made at a more general level than the site series, or those that are best handled by indirect interpretation methods that incorporate factors other than moisture and nutrient regime.

3.7.1 Direct interpretations

On the page facing each site unit description is a variety of direct interpretations that have been grouped under the subheadings described below.

Site limitations: This section contains statements about ecological conditions that may place limitations on forest productivity or forest operations. The limitations may be either generally applicable to the site unit, or specific to sites with a particular, identified ecological condition. For example, the phrase “sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant” refers only to sites within the site unit whose soils contain greater than 70% coarse fragments. After each site limitation listed there are recommended solutions to deal with the limitation. This information is in bold italic text.

Silviculture system: This section contains, or directs the user to a section that contains, information on silviculture system options. Harvesting recommendations or cautions are also contained here.

Site preparation: This section contains site preparation options or directs the user to site preparation keys in Section 5.2. Occasionally, specific comments relating to site preparation are also found here.
Species choice: This section contains species selection information that has been correlated at the site series level across the province. General-use species are shown in normal type. Species that have one or more restrictions are in **bold italic**. The restrictions relating to species in **bold italic** are found in one of three sections: site limitations, reforestation, or concerns. When users encounter a species in **bold italic**, restrictions applicable to that species should be determined by examining these sections. Species found in square brackets (e.g., [Sb]) are species of secondary choice due to a lower ranking of reliability, productivity, or silvicultural feasibility. Species indicated with round brackets (e.g., (Sw, Fs)) are generally significantly less productive than other ecologically acceptable species on the site unit. These species are restricted to comprising a minor proportion (e.g., 20–30%) of the stand or area. These species could be used in only a few localities or blocks within an area, as a minor component of all plantations, or only in test trials. The most recent version of the correlated tree species selection guidelines was used to compile the species choice lists. Minor discrepancies may surface, however, so the user of the guide should attempt to get the most up-to-date guidelines before making final choices.

Vegetation potential: This section subjectively rates the potential of the site to produce non-crop vegetation that may pose a risk to the survival and target growth of the crop tree. Vegetation species posing the greatest potential threat to the crop tree are listed in round brackets when the potential is rated moderate or greater.

Reforestation: This section contains specific instructions related to reforestation on the site unit (e.g., plant Fd only on south-facing, coarse-textured sites within its natural range).

Concerns: This section contains concerns of which the user should be aware when preparing a prescription or carrying out forestry operations on a site. Potential solutions to alleviate these concerns are indicated in **bold italic** text where appropriate.

3.7.2 Indirect and general interpretations
Indirect and general interpretations are contained within the following sections; Silviculture Systems (Section 5.1), Site Preparation (Section 5.2), and Ecosystem Management (Section 5.3). Users should familiarize themselves with this information when using the guide.
The southeastern corner of the Prince George Forest Region lies primarily within the Rocky Mountain Trench, and is bordered by the Cariboo Mountains to the west and the Rocky Mountains to the east. This area is characterized by great variation in temperature, precipitation, and length of growing season. The portions of the guide area in the Engelmann Spruce–Subalpine Fir (ESSF) (in particular the ESSFwc2) are the coldest, have the greatest annual snowfall, and the shortest growing season. In contrast, those areas found within with the Sub-Boreal Spruce (SBS) (in particular the SBSdh) are the driest, and Interior Cedar-Hemlock (ICH) subzones are the warmest (Table 8).

The study area contains climax forests dominated by a variety of tree species. These include hybrid white spruce (Picea engelmannii × glauca), Engelmann spruce (Picea engelmannii), subalpine fir (Abies lasiocarpa), western hemlock (Tsuga heterophylla), and/or western redcedar (Thuja plicata). Douglas-fir (Pseudotsuga menziesii) and lodgepole pine (Pinus contorta) are important seral species, especially in biogeoclimatic units characterized by stand-replacing wildfires. Black spruce (Picea mariana) is relatively common in wetland areas at lower elevations. Other tree species’ ranges are restricted within the guide area and are discussed within the introductory comments for each biogeoclimatic unit. Figure 9 compares characteristic vegetation of the different biogeoclimatic units described and can be a useful tool in determining units in the field, especially near unit boundaries. Table 9 provides lists of important wildlife species that use the biogeoclimatic units described.

Four biogeoclimatic zones are represented in this region: ICH and SBS zones on the valley floor and lower mountain slopes; and ESSF and Alpine Tundra (AT) zones at higher elevations. Six biogeoclimatic units are included and have been described within this field guide: three in the ICH (ICHmm, ICHwk1, ICHwk3); one in the SBS (SBSdh); and two in the ESSF (ESSFmm1, ESSFwc2). Other biogeoclimatic units that occur within the guide area include the SBSvk, ESSFwk1, ESSFwk2, ESSFwc3, and ICHwk4. Information on these units may be obtained from Land Management Hand-book 51 (SBSvk and ESSFwk1), from Land Management...
<table>
<thead>
<tr>
<th>Climatic characteristics</th>
<th>ICH mm</th>
<th>ICH wk1</th>
<th>ICH wk3</th>
<th>SBS dh</th>
<th>SBS wk(^b)</th>
<th>ESSF mm1</th>
<th>ESSF wk1(^b)</th>
<th>ESSF wc3(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual precipitation (mm) Mean</td>
<td>N/A</td>
<td>1214.1</td>
<td>N/A</td>
<td>609.4</td>
<td>1249.6</td>
<td>N/A</td>
<td>1043.9</td>
<td>1408.5</td>
</tr>
<tr>
<td>Range</td>
<td>N/A</td>
<td>867.7–1725.4</td>
<td>N/A</td>
<td>503.1–678.5</td>
<td>989.7–1635.5</td>
<td>N/A</td>
<td>N/A</td>
<td>1177.1–1624.7</td>
</tr>
<tr>
<td>Growing-season precipitation (mm) Mean</td>
<td>280.5</td>
<td>385.4</td>
<td>382.5</td>
<td>237.3</td>
<td>472.0</td>
<td>354.3</td>
<td>426.1</td>
<td>510.3</td>
</tr>
<tr>
<td>Range</td>
<td>232.7–328.2</td>
<td>325.0–460.5</td>
<td>280.9–479.1</td>
<td>177.4–289.1</td>
<td>404.6–583.4</td>
<td>339.4–369.1</td>
<td>378.5–490.9</td>
<td>401.6–631.0</td>
</tr>
<tr>
<td>Annual snowfall (cm) Mean</td>
<td>N/A</td>
<td>587.6</td>
<td>N/A</td>
<td>210.5</td>
<td>N/A</td>
<td>N/A</td>
<td>538.4</td>
<td>782.1</td>
</tr>
<tr>
<td>Range</td>
<td>N/A</td>
<td>374.8–1090.0</td>
<td>N/A</td>
<td>180.3–234.8</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Annual temperature (°C) Mean</td>
<td>N/A</td>
<td>4.4</td>
<td>4.8</td>
<td>3.7</td>
<td>2.6</td>
<td>N/A</td>
<td>-0.1</td>
<td>-1.0</td>
</tr>
<tr>
<td>Range</td>
<td>N/A</td>
<td>2.3–6.9</td>
<td>3.2–6.2</td>
<td>2.8–4.2</td>
<td>1.3–4.0</td>
<td>N/A</td>
<td>-1.5–1.4</td>
<td>-3.1–1.1</td>
</tr>
<tr>
<td>Growing degree-days (&gt;5°C) Mean</td>
<td>N/A</td>
<td>1364</td>
<td>n/a</td>
<td>1237</td>
<td>N/A</td>
<td>N/A</td>
<td>748</td>
<td>671</td>
</tr>
<tr>
<td>Range</td>
<td>N/A</td>
<td>991–1808</td>
<td>n/a</td>
<td>1134–1332</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Frost-free period (days) Mean</td>
<td>N/A</td>
<td>121</td>
<td>N/A</td>
<td>92</td>
<td>N/A</td>
<td>N/A</td>
<td>48</td>
<td>75</td>
</tr>
<tr>
<td>Range</td>
<td>N/A</td>
<td>104–149</td>
<td>N/A</td>
<td>76–116</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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b The SBSwk, ESSFwk1, and ESSFwc3 are included for comparison. No long-term climate data exist for the ICHwk4 and ESSFwc2 biogeoclimatic units.
Handbook 29 (ESSFwk2, ESSFwc3), or from the Cariboo Region field guide (ICHwk4). The Alpine Tundra zone is not covered within this field guide as site units have not as yet been described.

**TABLE 9** Some important wildlife species that use biogeoclimatic units in the Rocky Mountain trench guide area

<table>
<thead>
<tr>
<th></th>
<th>ICH mm</th>
<th>ICH wk1</th>
<th>ICH wk3</th>
<th>SBS dh</th>
<th>ESSF mm1</th>
<th>ESSF wc2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moose (winter range)</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Mule deer (winter range)</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>White-tailed deer</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>M</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Elk</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>L</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Caribou(^b)</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>–</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Grizzly bear(^b)</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>VH</td>
<td>VH</td>
</tr>
<tr>
<td>Furbearers</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

a  \(L = \text{Low}; M = \text{Medium}; H = \text{High}; \text{vh} = \text{Very High}\)

b  Denotes species “blue listed” in 1989 by the Ministry of Environment. Because of major declines in their populations, they are considered sensitive and/or deserving of management attention.
4.1 Moist Mild Interior Cedar-Hemlock

Location

The ICHmm occurs on the lower valley walls above Kinbasket Reservoir from Hugh Allen Creek to Valemount, on the southwest side of the valley between Albreda and Dunster, and again on both walls of the Rocky Mountain Trench between Dunster and the McKale River.

Elevation range

750–1250 m

Climate

The ICHmm is the driest of the ICH subzones in the Prince George Region (Table 8). Although the seasonal precipitation is only slightly less than that of the ICHwk1, the annual precipitation is much less because of much lower snow accumulations. The ICHmm is also drier than the ICHwk3 because it occurs in an area of greater rainshadow due to the Premier Range to the west. In comparison to the ESSFwc2 and ESSFmm1, the ICHmm is drier, has a longer growing season, and has warmer temperatures.

Forests

The dominant climax tree species in the ICHmm are western red-cedar and western hemlock. They are co-dominant in most stands with minor components of hybrid white spruce and subalpine fir. Douglas-fir, lodgepole pine, and trembling aspen are the most common seral species. Western white pine is uncommon, reaching its northern limit in the southern portion of this unit. Paper birch is scattered throughout the subzone while cottonwood is relatively uncommon.

There are more seral stands in this subzone of the ICH than any other in the region for two possible reasons: the drier climate leads to drier forest fuel during the summer lightning season; and a number of fires were lit during the railroad construction approximately 70 years ago.
Soils, geology, and landforms
Much of this subzone is underlain by deep unconsolidated deposits in the Rocky Mountain Trench and major tributary valleys. Bedrock is seldom exposed, and consists mostly of Precambrian metamorphic and sedimentary rocks. Surficial deposits and soils consist predominantly of sandy colluvial and morainal deposits (Humo-Ferric Podzols), although at lower elevations, this subzone includes sediments and soils typical of the floor of the Trench: clayey glaciolacustrine (Gray Luvisols) and sandy glaciofluvial terraces (Humo-Ferric Podzols).

Distinguishing the ICHmm from adjoining biogeoclimatic units

ESSFmm1 has:
• Engelmann spruce present in the canopy;
• no western hemlock or western redcedar present in the canopy;
• white-flowered rhododendron present on submesic sites; and
• less devil’s club present on wet sites.

SBSdh has:
• prickly rose present on most sites;
• velvet-leaved blueberry present on dry sites;
• Douglas-fir present in the canopy of subxeric to mesic sites;
• no western hemlock or western redcedar present in the canopy on mesic sites;
• no devil’s club or false azalea present in the shrub layer on mesic sites; and
• little or no oak fern present in the herb layer on mesic sites.

ICHwk3 has:
• less falsebox present on dry sites;
• more Douglas maple present in the shrub layer of wet sites;
• more lady fern present on subhygric to hygric sites; and
• less false azalea present on wet sites.

ICHwk1 has:
• more red-osier dogwood present on wet sites;
• more oval-leaved blueberry present on dry sites; and
• more falsebox present on submesic sites.
ESSFw2 has:
- Engelmann spruce present in the canopy of most sites;
- no western hemlock or western redcedar present in the canopy;
- white-flowered rhododendron present on subxeric to mesic sites; and
- little or no devil’s club on all sites.

**Ecosystem management**
These forest ecosystems were historically usually even-aged but extended post-fire regeneration periods produce stands that are uneven-aged and possess multi-storeyed canopies. Stand-destroying wildfires were often of moderate size (20–1000 ha) with patches of unburned areas due to chance, sheltering terrain features, or higher site moisture. Many larger fires occurred after periods of extended drought but the landscape was dominated by extensive areas of mature forest surrounding patches of younger forest. Return cycles for stand-initiating events were approximately 200 years.
FIGURE 10  Edatopic grid displaying site units in the ICHmm subzone.
<table>
<thead>
<tr>
<th>Site Series</th>
<th>02</th>
<th>03</th>
<th>01</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
<th>08</th>
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<tbody>
<tr>
<td><strong>Trees</strong></td>
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<tr>
<td>Pseudotsuga menziesii</td>
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<tr>
<td>Picea glauca × engelmannii</td>
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<tr>
<td>Thuja plicata</td>
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<tr>
<td>Tsuga heterophylla</td>
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<tr>
<td>Picea mariana</td>
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<td><strong>Shrubs</strong></td>
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<tr>
<td>Paxistima myrsinoides</td>
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<tr>
<td>Vaccinium membranaceum</td>
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<tr>
<td>Menziesia ferruginea</td>
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<tr>
<td>Rubus parviflorus</td>
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<tr>
<td>Oplopanax horridus</td>
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<tr>
<td>Ledum groenlandicum</td>
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<tr>
<td>Vaccinium ovalifolium</td>
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<tr>
<td><strong>Herbs and Dwarf Shrubs</strong></td>
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<td>Chimaphila umbellata</td>
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<tr>
<td>Clintonia uniflora</td>
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<td>Cornus canadensis</td>
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<td>Aralia nudicaulis</td>
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<tr>
<td>Tiarella spp.</td>
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<tr>
<td>Gymnocarpium dryopteris</td>
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<td>Equisetum arvense</td>
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<tr>
<td>Lysichiton americanus</td>
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<tr>
<td>Carex spp.</td>
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</tr>
<tr>
<td><strong>Mosses and Lichens</strong></td>
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<td>Dicranum polysetum</td>
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<td>Pleurozium schreberi</td>
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<td>Ptilikum crista-castrensis</td>
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<tr>
<td>Rhytidium triciduum</td>
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<tr>
<td>Sphagnum spp.</td>
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</tr>
</tbody>
</table>

**Prominence class:** 1 2 3 4 5
**ICHmm SITE SERIES KEY**

1a Black spruce in canopy; organic soil; water table close to surface.  

ICHmm/07

1b Black spruce low cover or absent; mineral soil; water table variable.

ICHmm/02

2a Canopy dominated by Douglas-fir; mid- to upper slope; slope greater than 50%; south to west aspect; *Paxistima myrsinites* (falsebox) (p. 44)\(^6\) moderate to high cover (>10%).

ICHmm/02

2b Canopy dominated by western redcedar, western hemlock, or a mixed canopy; mid- to lower slope or, if upper slope, canopy dominated by western hemlock; slopes usually less than 40%; aspect variable; *Paxistima myrsinites* low cover (<1%) or absent.

ICHmm/08

3a Tree canopy (western hemlock, western redcedar, hybrid white spruce) poorly developed and low cover (<30%); water table close to surface; *Lysichiton americanus* (p. 224) moderate to high cover (>10%).

ICHmm/08

3b Tree canopy well developed and moderate to high cover (>50%); water table not close to surface; *Lysichiton americanus* low cover (<1%) or absent.

ICHmm/06

4a Lower to toe slope; *Oplopanax horridus* (devil’s club) (p. 36) moderate to high cover (>15%).

ICHmm/06

5a Canopy primarily western redcedar; humus thickness greater than 30 cm; permanent seepage; *Equisetum* spp. (horsetails) (pp. 281–284) moderate to high cover (usually >10%).

ICHmm/06

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\(^6\) Page numbers refer to the publication *Plants of Northern British Columbia* (MacKinnon et al. 1992).
5b Canopy a mixture of western redcedar and western hemlock; humus thickness less than 30 cm; temporary seepage; *Equisetum* spp. low cover (usually <1%) or absent.

ICHmm/05

4b Mid- to lower slope; *Oplopanax horridus* low cover (<5%) or absent.

6a Mid- to lower slope; *Gymnocarpium dryopteris* (oak fern) (p. 293) moderate to high cover (>15%).

ICHmm/04

6b Usually mid- to upper slope, or level; *Gymnocarpium dryopteris* low cover (usually <5%) or absent.

7a Canopy of Hw, Cw, Sx, and Bl, often with a minor component of Fd or Pl; herb layer moderately developed (>15% cover), with *Clintonia uniflora* (queen's cup) (p. 131) present, and *Gymnocarpium dryopteris* often present.

ICHmm/01

7b Canopy of Hw, sometimes with a minor component of Cw; herb layer poorly developed (<10% cover), with some *Clintonia uniflora*; *Gymnocarpium dryopteris* absent.

ICHmm/03
VEGETATION

Tree Layer: 75% cover
- western hemlock, western redcedar, hybrid white spruce, subalpine fir, [Douglas-fir]

Shrub Layer: 25% cover
- *Vaccinium membranaceum* (black huckleberry)
- *Menziesia ferruginea* (false azalea)
- *Oplopanax horridus* (devil’s club)
- *Spiraea betulifolia* (birch-leaved spirea)
- *Rubus parviflorus* (thimbleberry)
- [*Ribes lacustre* (black gooseberry)]
- western redcedar
- western hemlock

Herb Layer: 20% cover
- *Cornus canadensis* (bunchberry)
- *Clintonia uniflora* (queen’s cup)
- *Orthilia secunda* (one-sided wintergreen)
- *Linnaea borealis* (twinflower)
- *Maianthemum racemosum* (false Solomon’s-seal)
- *Chimaphila umbellata* (prince’s pine)
- *Goodyera oblongifolia* (rattlesnake-plantain)
- *Tiarella spp.* (foamflowers)
- *Gymnocarpium dryopteris* (oak fern)
- *Streptopus lanceolatus var. curvipes* (rosy twistedstalk)
- *Aralia nudicaulis* (wild sarsaparilla)

Moss Layer: 75% cover
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Ptilium crista-castrensis* (knight’s plume)
- *Rhytididiaphus triquetrus* (electrified cat’s-tail moss)
- *Hylocomium splendens* (step moss)

SOIL AND SITE

- Moisture Regime: 3–4 (submesic–mesic)
- Nutrient Regime: B–C (poor–medium)
- Slope Gradient (%): 19 (0–42)
- * Slope Position: usually mid
- Parent Material: (glacio) fluvial, morainal
- * Soil Texture: medium–coarse
- Coarse Fragments (%): 29 (0–87)

COMMENTS: coarse-textured soils receive some seepage during the growing season

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Fd, Pl, Sx, [Cw, Hw, Bl].

Vegetation potential: – low/moderate (thimbleberry, fireweed).

Reforestation: – young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– if Fd stems are present, conduct a stand evaluation to assess whether a partial-cutting system is feasible.
– if a partial-cutting system is used and abundant advance Fd regeneration is present, attempt to log in a manner that protects this regeneration.
– under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).

Concerns: – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
VEGETATION

Tree Layer: 70% cover
   Douglas-fir, lodgepole pine, hybrid white spruce, western redcedar, paper birch

Shrub Layer: 50% cover
   * Paxistima myrsinites (falsebox)
   * Menziesia ferruginea (false azalea)
   * Shepherdia canadensis (soopolallie)
   * Vaccinium membranaceum (black huckleberry)
   * Acer glabrum (Douglas maple)
   * Amelanchier alnifolia (saskatoon)
   * western redcedar
   * subalpine fir
   * hybrid white spruce

Herb Layer: 8% cover
   * Chimaphila umbellata (prince's pine)
   * Orthilia secunda (one-sided wintergreen)
   * Linnaea borealis (twinflower)
   * Goodyera oblongifolia (rattlesnake-plantain)
   * Oryzopsis asperifolia (rough-leaved ricegrass)
   * Cornus canadensis (bunchberry)

Moss Layer: 50% cover
   * Pleurozium schreberi (red-stemmed feathermoss)
   * Barbilophozia spp. (leafy liverworts)
   * Rhytidiadelphus triquetrus (electrified cat's-tail moss)
   * Dicranum polysetum (wavy-leaved moss)
   * Peltigera spp. (peltigera lichens)

SOIL AND SITE

Moisture Regime: 1 (xeric)
Nutrient Regime: A–B (very poor–poor)
   * Aspect: W to SSW
   * Slope Gradient (%): 64 (50–70)
   * Slope Position: upper–mid
   * Parent Material: usually colluvial
   * Soil Texture: coarse
   * Coarse Fragments (%): 70 (50–80)

COMMENTS: there is often a fairly high cover of cobbles and stones on the surface although most of them are covered with bryophytes or lichens; limited data because of the rarity of the ecosystem

DISTRIBUTION: uncommon
INTERPRETATIONS

Site limitations: - sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: - see Section 5.1.

Site preparation: - see Section 5.2.
- minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Species choice: - Fd, Pl, [Hw], (Cw, Sx, Bl).

Vegetation potential: - low.

Reforestation: - young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
- if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
- if a partial-cutting system is used and abundant advance Fd regeneration is present, attempt to log in a manner that protects this regeneration.
- fill-planting may be required after partial cutting.

Concerns: - sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
- full tree harvesting will lead to nutrient depletion and seriously reduce cones; woody debris and cones should be distributed across these sites (i.e., lop and scatter).
- site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; leave a shelterwood overstorey to reduce the severity of the drought hazard, or prescribe natural regeneration, which is generally more adapted to surviving these conditions, especially during establishment.
**VEGETATION**

Tree Layer: 85% cover  
- western hemlock, western redcedar, [subalpine fir, Douglas-fir]

Shrub Layer: 30% cover  
- *Menziesia ferruginea* (false azalea)  
- *Vaccinium membranaceum* (black huckleberry)  
- western hemlock  
- western redcedar  
- [subalpine fir]

Herb Layer: 10% cover  
- *Cornus canadensis* (bunchberry)  
- *Orthilia secunda* (one-sided wintergreen)  
- *Chimaphila umbellata* (prince’s pine)  
- *Rubus pedatus* (five-leaved bramble)  
- *[Linnaea borealis]* (twinflower)

Moss Layer: 100% cover  
- *Pleurozium schreberi* (red-stemmed feathermoss)  
- *Hylocomium splendens* (step moss)  
- *Ptilium crista-castrensis* (knight’s plume)  
- *Peltigera spp.* (peltigera lichens)

**SOIL AND SITE**  
- Moisture Regime: 2–3 (subxeric–submesic)  
- Nutrient Regime: B (poor)  
- Slope Gradient(%): 35 (0–75)  
- * Slope Position: variable, commonly mid–crest  
- Parent Material: variable  
- * Soil Texture: coarse–moderately coarse  
- Coarse Fragments (%): 0–74 (usually greater than 20)

**DISTRIBUTION:** fairly common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation: – see Section 5.2.

Species choice: – Fd, Hw, Pl, (Cw, Sx, Bl).

Vegetation potential: – low/moderate (thimbleberry, fireweed).

Reforestation: – if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
– if a partial-cutting system is used and abundant advance Fd regeneration is present, attempt to log in a manner that protects this regeneration.
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– Bl, Cw, and Sx will be significantly less productive than Fd, Hw, or Pl on these sites.
– fill-planting may be required after partial cutting.

Concerns: – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
– full tree harvesting will lead to nutrient depletion and seriously reduce cones; woody debris and cones should be distributed across these sites (i.e., lop and scatter).
– Pw will be subject to blister rust-induced mortality; Pw should only be considered on a trial basis or as a minor component.
ICHmm/04

CwHw – Oak fern

VEGETATION

Tree Layer: 75% cover
western hemlock, western redcedar, [hybrid white spruce, subalpine fir]

Shrub Layer: 25% cover
Menziesia ferruginea  (false azalea)
Vaccinium membranaceum (black huckleberry)
Oplopanax horridus  (devil’s club)
western hemlock
western redcedar
subalpine fir

Herb Layer: 55% cover
Gymnocarpium dryopteris  (oak fern)
Cornus canadensis  (bunchberry)
Tiarella spp.  (foamflowers)
Clintonia uniflora  (queen’s cup)
Streptopus lanceolatus  var. curvipes  (rosy twistedstalk)
Moneses uniflora  (single delight)
Rubus pedatus  (five-leaved bramble)
[Aralia nudicaulis]  (wild sarsaparilla)

Moss Layer: 60% cover
Hylocomium splendens  (step moss)
Ptilium crista-castrensis  (knight’s plume)
Pleurozium schreberi  (red-stemmed feathermoss)
Brachythecium spp.  (brachythecium mosses)

SOIL AND SITE

Moisture Regime: 4 (mesic)
Nutrient Regime: B–D (poor–rich)
* Slope Gradient (%): 23 (8–39)
* Slope Position: usually mid
Parent Material: variable
Soil Texture: variable (moderately fine, medium, and moderately coarse)
Coarse Fragments (%): 41 (0–91)
* Seepage Water: may be present

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; plant stock that will achieve better lateral root development (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Sx, Cw, Hw [Pl, Bl, Fd], (Pw).

Vegetation potential: – moderate (fireweed, thimbleberry, red raspberry).

Reforestation: – advance Cw, Hw, and Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– Fd should only be planted on sites with coarse-textured soils and low frost hazard.
– fill-planting may be required after partial cutting.

Concerns: – site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.
– sites within this unit with fine-textured soils are vulnerable to compaction under wet conditions; restrict traffic to winter operations or dry soil conditions.
– sites within this unit with silty soils are susceptible to frost heaving; bareroot stock will likely resist frost heaving better than plug stock.
– Pw will be subject to blister rust-induced mortality; Pw should only be considered on a trial basis or as a minor component.
CwHw – Devil’s club – Oak fern

VEGETATION

Tree Layer: 70% cover
western redcedar, western hemlock, [hybrid white spruce, subalpine fir]

Shrub Layer: 60% cover
- *Oplopanax horridus* (devil’s club)
- *Ribes lacustre* (black gooseberry)
- *Menziesia ferruginea* (false azalea)
- *Rubus parviflorus* (thimbleberry)
western hemlock
western redcedar

Herb Layer: 45% cover
- *Gymnocarpium dryopteris* (oak fern)
- *Tiarella spp.* (foamflowers)
- *Streptopus spp.* (twistedstalks)
- *Cornus canadensis* (bunchberry)
- *Maianthemum racemosum* (false Solomon’s-seal)
- *Orthilia secunda* (one-sided wintergreen)
- *Dryopteris expansa* (spiny wood fern)
- *Clintonia uniflora* (queen’s cup)
- *Rubus pedatus* (five-leaved bramble)

Moss Layer: 40% cover
- *Mnium spp.* (leafy mosses)
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Ptilium crista-castrensis* (knight’s plume)
- *Hylocomium splendens* (step moss)
- *Rhytidiadelphus triquetrus* (electrified cat’s-tail moss)

SOIL AND SITE

- Moisture Regime: 5–6 (subhygric–hygric)
- Nutrient Regime: B–D (poor–rich)
- * Slope Gradient (%): 26 (4–75)
- * Slope Position: commonly lower–toe
- Parent Material: (glacio) fluvial and morainal
- Soil Texture: predominantly medium and coarse-textured
- Coarse Fragments (%): 36 (0–80)
- Seepage Water: may be present

COMMENTS: coarse-textured soils compensated by seepage; all sites receive some seepage during the growing season

DISTRIBUTION: very common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally and/or preserve advance regeneration.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Sx, Cw, Hw, [Bl, Fd, Pl].

Vegetation potential: – high (thimbleberry, fireweed, lady fern).

Reforestation: – advance Cw, Hw, and Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.

Concerns: – site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.
– sites with thick organic horizons reduce spring soil temperatures, slowing root development; attempt to reduce organic horizon thickness during site preparation.
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
VEGETATION

Tree Layer: 70% cover
western redcedar, [hybrid white spruce, subalpine fir, western hemlock]

Shrub Layer: 40% cover
Oplopanax horridus (devil's club)
Acer glabrum (Douglas maple)
Viburnum edule (highbush-cranberry)
Ribes lacustre (black gooseberry)
[Rubus parviflorus (thimbleberry)]
western redcedar
subalpine fir

Herb Layer: 75% cover
Equisetum arvense (common horsetail)
Gymnocarpium dryopteris (oak fern)
Cornus canadensis (bunchberry)
Mitella nuda (common mitrewort)
Equisetum scirpoides (dwarf scouring-rush)
Actaea rubra (baneberry)
Maianthemum racemosum (false Solomon's-seal)
Galium triflorum (sweet-scented bedstraw)
[Equisetum pratense (meadow horsetail)]
[Rubus pubescens (trailing raspberry)]

Moss Layer: 50% cover
Rhytidiadelphus triquetrus (electrified cat’s-tail moss)
Hylocomium splendens (step moss)
Pleurozium schreberi (red-stemmed feathermoss)
Ptilium crista-castrensis (knight’s plume)

SOIL AND SITE

Moisture Regime: 6 (hygric)
Nutrient Regime: D–E (rich–very rich)
* Slope Gradient (%): 15 (0–30)
* Slope Position: lower–toe
Parent Material: lacustrine, or organic over fluvial
Soil Texture: variable
Coarse Fragments (%): usually 0
* Seepage Water: present

COMMENTS: limited data because of the rarity of the ecosystem

DISTRIBUTION: uncommon
INTERPRETATIONS

Site limitations:  
- very difficult sites to manage; *serious consideration should be given to managing these sites as wildlife corridors.*  
- sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; *plant stock that will achieve better lateral root development (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.*  
- sites with saturated soils are poorly aerated, which slows root development; *plant seedlings on naturally or artificially raised microsites.*

Silviculture system:  
- see Section 5.1.

Site preparation:  
- see Section 5.2.  
- creating an excessive number of microsites (e.g., >300/ha) should be avoided, especially on sites with a water table <30 cm from the surface.

Species choice:  
- *Cw, Hw, Pl, Sx, [Bl].*

Vegetation potential:  
- high (fireweed, black twinberry, thimbleberry).

Reforestation:  
- advance regeneration should be preserved and supplemented by planting sturdy stock in groups rather than evenly across the site.  
- young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.  
- advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria.

Concerns:  
- site conditions may lead to frost damage of regeneration, especially in any naturally or artificially created depressions; *leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.*  
- these units represent important wildlife habitat; *discuss prescription with fish and wildlife personnel.*  
- windthrow risk after partial cutting will be high on sites where root-restricting layers occur at depths of <25 cm.  
- water table will likely rise above the ground surface in the spring, causing seedling mortality.  
- sites with thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.*
VEGETATION

Tree Layer: 25% cover
black spruce, lodgepole pine

Shrub Layer: 20% cover
Ledum groenlandicum (Labrador tea)
Vaccinium myrtilloides (velvet-leaved blueberry)
western hemlock
lodgepole pine
black spruce
western redcedar
subalpine fir

Herb Layer: 75% cover
Carex spp. (sedges)
Cornus canadensis (bunchberry)
Kalmia microphylla spp. occidentalis (western bog-laurel)
Equisetum sylvaticum (wood horsetail)
Oxycoccus oxyccocos (bog cranberry)
Coptis trifolia (three-leaved goldthread)
Empetrum nigrum (crowberry)
Gaultheria hispidula (creeping-snowberry)

Moss Layer: 90% cover
Sphagnum spp. (sphagnums)
Aulacomnium palustre (glow moss)
Pleurozium schreberi (red-stemmed feathermoss)

SOIL AND SITE

Moisture Regime: 7 (subhydric)
Nutrient Regime: A–B (very poor–poor)
Slope Gradient (%): 1
depression
* Slope Position:
* Parent Material: organic
* Water Table (cm): 0–30
Coarse Fragments (%): 0

COMMENTS: bog and poor fen ecosystems are very rare in this subzone; nutrient-poorer bogs have a lower cover of sedges; limited data because of the rarity of the ecosystem

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations: – site and soil conditions of this unit result in marginal forest productivity; serious consideration should be given to excluding logging from this unit.

Silviculture system: – avoid logging.
VEGETATION

Tree Layer: 25% cover
western hemlock, hybrid white spruce, [subalpine fir]

Shrub Layer: 60% cover
- *Vaccinium ovalifolium* (oval-leaved blueberry)
- *Menziesia ferruginea* (false azalea)
- *Vaccinium membranaceum* (black huckleberry)
- *Oplopanax horridus* (devil’s club)
- western hemlock
- western redcedar
- hybrid white spruce

Herb Layer: 50% cover
- *Lysichiton americanus* (skunk cabbage)
- Carex spp. (sedges)
- *Rubus pedatus* (five-leaved bramble)
- *Cornus canadensis* (bunchberry)
- *Gymnocarpium dryopteris* (oak fern)
- *Streptopus spp.* (twistedstalks)
- *Dryopteris expansa* (spiny wood fern)
- *Equisetum sylvaticum* (wood horsetail)
- *Lycopodium annotinum* (stiff club-moss)

Moss Layer: 95% cover
- *Sphagnum spp.* (sphagnums)
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Mnium spp.* (leafy mosses)
- *Barbilophozia lycopodioides* (common leafy liverwort)
- *Ptilium crista-castrensis* (knight’s plume)

SOIL AND SITE
- Moisture Regime: 7 (subhydric)
- Nutrient Regime: B (poor)
- *Slope Gradient (%):* 1
- *Slope Position:* depression
- Parent Material: usually organic
- Coarse Fragments (%): usually 0
- *Seepage Water (cm):* 0–30

COMMENTS: limited data because of the rarity of ecosystem; seepage water moves very slowly through these sites

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations:  – site and soil conditions of this unit result in marginal forest productivity; *serious consideration should be given to excluding logging from this unit.*

Silviculture system:  – avoid logging.
4.2 Wells Gray Wet Cool Interior Cedar-Hemlock

Location
The ICHwk1 occurs on slopes above McNaughton Lake, near the southern end of Canoe Reach. On the western side of the lake it occurs as far north as Howard Creek and on the eastern side as far north as Dawson Creek. This biogeoclimatic unit extends well into both the Nelson and Kamloops Forest Regions.

Elevation range
432–1515 m

Climate
This unit is considerably moister than the other ICH biogeoclimatic units found within the area covered by this field guide (see Table 8). Increased moisture is largely attributable to the high snowfall received. Seasonal (May–Sept.) precipitation is greater than that received by the SBSdh and the ESSFmm, presumably less than that of the ESSFwc2 (for which no long-term data exist), and comparable to that of other ICH biogeoclimatic units within the guide area.

Forests
The dominant climax tree species in the ICHwk1 are western redcedar and western hemlock. Subalpine fir and hybrid white spruce are common in many ecosystems, tending to dominate sites influenced by cold air. Douglas-fir is an important seral tree species, primarily on drier sites. Western white pine incidence is much reduced due to blister rust, but mature trees and regeneration are still found on drier sites. Cottonwood is commonly found on fluvial flood plains. Western yew is scattered in the understorey of submesic to subhygric sites.

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This unit was described as the ICHvk1 in Land Management Handbook 15.
**Soils, geology, and landforms**

Most of this subzone is underlain by Precambrian metamorphic and sedimentary rocks, with the predominant Humo-Ferric Podzolic soils having formed on sandy colluvial and morainal deposits.

**Distinguishing the ICHwk1 from adjoining biogeoclimatic units**

ICHmm has:
- less red-osier dogwood on wet sites;
- less oval-leaved blueberry on dry sites;
- Douglas-fir present in the canopy of dry sites;
- less falsebox present on submesic sites; and
- more devil’s club present on subhygric to hygric sites.

ESSFwc2 has:
- white-flowered rhododendron present on mesic sites;
- little or no devil’s club present in the shrub layer;
- Engelmann spruce present in the canopy of most sites; and
- no western hemlock or western redcedar present in the canopy.

ESSFmm1 has:
- Engelmann spruce present in the canopy of most sites;
- no western hemlock or western redcedar present in the canopy;
- white-flowered rhododendron present on mesic sites; and
- little or no devil’s club present in the shrub layer.

**Ecosystem management**

Historically, mature stands within these forest ecosystems were usually uneven-aged or multistoreyed even-aged, with regeneration occurring in gaps created by the death of individual trees or small patches of trees. When disturbances such as wind, fire, and landslides occurred they were generally small and resulted in irregular edge configurations and landscape patterns. Return cycles for stand-initiating events were in the neighbourhood of 250 years.
**FIGURE 12** Edatopic grid displaying site units in the ICHwk1 variant.
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<th>Site Series</th>
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<td>Tiarella spp.</td>
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<td>Gymnocarpium dryopteris</td>
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<td>Athyrium filix-femina</td>
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<td>Pyrola spp.</td>
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<td>Pleurozium schreberi</td>
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<td>Rhytidiopsis robusta</td>
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<td>Mnium spp.</td>
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Prominence class: 1 2 3 4 5
ICHwk1/SITE SERIES KEY

1a Bedrock and steep talus slopes; *Racomitrium* spp. (Racomitrium mosses) (p. 306)\(^8\) and *Cladonia* spp. (cladonia mosses) (p. 321–324) abundant (>25% cover); tree layer absent.

ICHwk1/02

1b Not on bedrock or talus slopes; *Racomitrium* spp. and *Cladonia* spp. very low cover (<1%) or absent; tree layer almost always present.

2a Crests and steep upper slope positions; tree layer dominated by lodgepole pine; herb layer poorly developed (<5% cover).

ICHwk1/03

2b Slope position variable; tree layer dominated by other than lodgepole pine; herb layer well developed (>5% cover).

3a Water table present at or near surface; organic or mineral soils; slope gradient <5%; hygric–subhydric moisture regime.

4a Water table within 30 cm of surface; organic soils; *Carex* spp. (sedges) (pp. 258–274) and *Trichophorum caespitosum* (tufted clubrush) (p. 276) abundant (>15% cover); *Lysichiton americanus* (skunk cabbage) (p. 224) rare or absent (<1% cover).

ICHwk1/09

4b Water table depth variable; organic or mineral soils; *Trichophorum caespitosum* and *Carex* spp. rare or absent (<1% cover); *Lysichiton americanus* usually moderate to high cover (>5%).

ICHwk1/08

3b Water table not usually present within 50 cm of soil surface; mineral soils; slope gradients variable; moisture regime variable.

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\(^8\) Page numbers refer to the publication *Plants of Northern British Columbia* (MacKinnon et al. 1992).
5a Tree layer dominated by *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) (p. 25) (>25% cover); fluvial parent materials; 0% slope gradient.

**ICHwk1/07**

5b Tree layer not dominated by *Populus balsamifera* ssp. *trichocarpa*; parent materials variable; slope gradient variable.

**ICHwk1/04**

6a Tree layer dominated by western hemlock (p. 22).
   7a *Gymnocarpium dryopteris* (oak fern) (p. 293) high cover (>10%).

**ICHwk1/01**

7b *Gymnocarpium dryopteris* low cover or absent (usually <2%).

6b Tree layer not dominated by western hemlock.

8a Tree layer dominated by western redcedar (p. 23); *Oplopanax horridus* (devil’s club) (p. 36) cover usually very high (>25%).

**ICHwk1/05**

8b Tree layer dominated by hybrid white spruce (p. 19); *Rubus parviflorus* (thimbleberry) (p. 36) usually moderate to high cover (>5%).

**ICHwk1/06**
VEGETATION

Tree Layer: 80% cover
- western hemlock, western redcedar, [hybrid white spruce]

Shrub Layer: 40% cover
- **Vaccinium membranaceum** (black huckleberry)
- **Vaccinium ovalifolium** (oval-leaved blueberry)
- **Oplopanax horridus** (devil’s club)
- **[Lonicera utahensis** (Utah honeysuckle)]
- **[Paxistima myrsinites** (falsebox)]
- western hemlock
- western redcedar

Herb Layer: 55% cover
- **Gymnocarpium dryopteris** (oak fern)
- **Clintonia uniflora** (queen’s cup)
- **Tiarella spp.** (foamflowers)
- **Rubus pedatus** (five-leaved bramble)
- **Streptopus lanceolatus** var. curvipes (rosy twistedstalk)
- **Cornus canadensis** (bunchberry)
- **Goodyera oblongifolia** (rattlesnake-plantain)
- **Dryopteris expansa** (spiny wood fern)
- **Orthilia secunda** (one-sided wintergreen)
- **Linnaea borealis** (northern twayblade)
- **Viola spp.** (violets)
- **[Aralia nudicaulis** (wild sarsaparilla)]

Moss Layer: 80% cover
- **Pleurozium schreberi** (red-stemmed feathermoss)
- **Rhytidiopsis robusta** (pipecleaner moss)
- **Mnium spp.** (leafy mosses)
- **[Ptilium crista-castrens** (knight’s plume)]
- **[Hylocomium splendens** (step moss)]

SITE AND SOIL

- **Moisture Regime:** 3–5 (submesic–subhygric)
- **Nutrient Regime:** B–D (poor–rich)
- **Slope Gradient (%):** 20 (0–55)
- **Slope Position:** mid–lower
- **Parent Material:** variable
- **Soil Texture:** medium
- **Coarse Fragments (%):** 42 (0–78); often >40

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Cw, Hw, Sx, Fd, [Bl], (Lw, Pl, Pw).

Vegetation potential: – moderate (fireweed, pin cherry, thimbleberry).

Reforestation: – consider Fd on southern aspects at lower elevations within this biogeoclimatic unit.
– consider Bl on northern aspects at higher elevations within this biogeoclimatic unit.
– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).

Concerns: – Lw is extended beyond its normal northern geographical range; plant Lw on southern aspects at lower elevations within this biogeoclimatic unit.
– heavy snowpack may cause stem deformity of Pl, especially on steep slopes.
– sites within this unit with thick organic horizons (>10 cm) have reduced spring soil temperatures, which slows root development; reduce organic horizon thickness during site preparation.
– Pw will be subject to blister rust-induced mortality; Pw should only be considered on a trial basis or as a minor component.
VEGETATION

Tree Layer: <1% cover
[paper birch]

Shrub Layer: 0% cover

Herb Layer: <1% cover
[Cryptogramma crispa] (parsley fern)

Moss Layer: 45% cover
Racomitrium spp.
Cladonia spp.
Cladina spp.

SITE AND SOIL

Moisture Regime: 0–2 (very xeric–subxeric)
Nutrient Regime: A–B (very poor–poor)
Slope Gradient (%): 75
Slope Position: crest–mid
Parent Material: colluvial, mixed bedrock
Soil Texture: not applicable
Coarse Fragments (%): >95

COMMENTS: restricted to talus or bedrock outcrops

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations: – these sites are non-forested and subject to drought; no attempt should be made to establish a forest on these sites.

Silviculture system: – avoid logging.
**VEGETATION**

**Tree Layer:** 35% cover  
lodgerpole pine, [Engelmann spruce, western white pine]

**Shrub Layer:** 50% cover  
- *Vaccinium myrtilloides* (velvet-leaved blueberry)  
- *Spiraea betulifolia* (birch-leaved spirea)  
- *Paxistima myrsinites* (falsebox)  
- *Amelanchier alnifolia* (saskatoon)  
- *Shepherdia canadensis* (soopolallie)  
  - [western white pine]  
  - [western hemlock]

**Herb Layer:** 70% cover  
- *Chimaphila umbellata* (prince's pine)  
- *Melampyrum lineare* (cow-wheat)  
- *Linnaea borealis* (twinflower)  
- *Hieracium albiflorum* (white-flowered hawkweed)  
- *[Cornus canadensis]* (bunchberry)  
  - [Vaccinium caespitosum] (dwarf blueberry)

**Moss Layer:** 55% cover  
- *Pleurozium schreberi* (red-stemmed feathermoss)  
- *Racomitrium canescens* (grey rock-moss)  
- *[Peltigera aphthosa]* (freckle lichen)

**SITE AND SOIL**

- **Moisture Regime:** 1–2 (xeric–subxeric)  
- **Nutrient Regime:** C–D (medium–rich)  
- **Slope Gradient (%):** 35 (0–70)  
- **Slope Position:** upper–crest; mid on steep slopes  
- * Parent Material: glacifluvial, fluvial  
- * Soil Texture: coarse–very coarse  
- * Coarse Fragments (%): 75 (64–82)

**DISTRIBUTION:** uncommon and localized
INTERPRETATIONS

Site limitations: – sites with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation: – light scarification for seedbed preparation or summer logging with no site preparation.

Species choice: – Fd, Pl, (Bl, Cw, Hw, Sx, Pw)

Vegetation potential: – low

Reforestation: – Bl, Cw, Hw, and Sx will be significantly less productive than Fd and Pl on these sites.
– if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
– if a partial-cutting system is used, attempt to log in a manner that protects advance Fd regeneration.
– maintain Fd component, especially veterans that are valuable for wildlife and seed production.
– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).

Concerns: – sites with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
– site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; natural regeneration is generally more adapted to surviving these conditions, especially during establishment; also, leaving a shelterwood overstorey can reduce the severity of the drought hazard.
– full tree harvesting will lead to nutrient depletion and seriously reduce cones; woody debris and cones should be distributed across these sites (i.e., lop and scatter).
– Pw will be subject to blister rust-induced mortality; Pw should only be considered on a trial basis or as a minor component.
VEGETATION

Tree Layer: 75% cover
western hemlock, western redcedar, [Douglas-fir, western white pine]

Shrub Layer: 30% cover
\[Vaccinium membranaceum\] (black huckleberry)
\[Paxistima myrsinites\] (falsebox)
\[Vaccinium ovalifolium\] (oval-leaved blueberry)
\[Menziesia ferruginea\] (false azalea)
western hemlock
western redcedar
[western yew]

Herb Layer: 30% cover
\[Clintonia uniflora\] (queen's cup)
\[Orthilia secunda\] (one-sided wintergreen)
\[Cornus canadensis\] (bunchberry)
\[Goodyera oblongifolia\] (rattlesnake-plantain)
\[Tiarella spp.\] (foamflowers)
\[Chimaphila umbellata\] (prince's pine)
\[Linnaea borealis\] (twinflower)
\[Streptopus lanceolatus\]
var. curvipes (rosy twistedstalk)
Viola spp. (violets)
[\[Gymnocarpium dryopteris\]] (oak fern)

Moss Layer: 65% cover
\[Pleurozium schreberi\] (red-stemmed feathermoss)
\[Hylocomium splendens\] (step moss)
\[Rhytidiopsis robusta\] (peltigera lichens)
\[Peltigera spp.\]
\[Ptilium crista-castrensis\] (knight's plume)

SITE AND SOIL

| Moisture Regime: | 2–3 (subxeric–submesic) |
| Nutrient Regime: | A–B (very poor –poor) |
| Slope Gradient (%): | 34 (0–80) |
| * Slope Position: | variable; usually mid |
| Parent Material: | morainal, colluvial, fluvial |
| Soil Texture: | variable |
| * Coarse Fragments (%): | 62 (33–89); often >70 |

DISTRIBUTION: common; often found in conjunction with ICHwk1/01
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; **attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.**

Silviculture system: – see Section 5.1
  – minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation: – see Section 5.2

Species choice: – Fd, [Sx], (Cw, Hw, Lw, Pl, Pw, Bl)

Vegetation potential: – low.

Reforestation: – if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
  – if a partial-cutting system is used and abundant advance Fd regeneration is present, attempt to log in a manner that protects this regeneration.
  – plant Fd and Lw on southern aspects at lower elevations within this biogeoclimatic unit.
  – advance Cw, Hw, and Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
  – plant Sx and Bl on northern aspects at higher elevations within this biogeoclimatic unit.

Concerns: – Lw and Pl are extended beyond their normal range; **consider only on a trial basis or as a minor component.**
  – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
  – Pw will be subject to blister rust-induced mortality; **Pw should only be considered on a trial basis or as a minor component.**
  – heavy snowpack may cause stem deformity of Pl, especially on steep slopes; **obstacle planting is advised.**
VEGETATION

Tree Layer: 70% cover
western redcedar, western hemlock, [hybrid white spruce]

Shrub Layer: 65% cover
Oplopanax horridus (devil’s club)
Vaccinium ovalifolium (oval-leaved blueberry)
Vaccinium membranaceum (black huckleberry)
[Rubus parviflorus (thimbleberry)]
[Ribes lacustre (black gooseberry)]
western redcedar
western hemlock

Herb Layer: 80% cover
Gymnocarpium dryopteris (oak fern)
Tiarella spp. (foamflowers)
Athyrium filix-femina (lady fern)
Galium trifidum (small bedstraw)
Clintonia uniflora (queen’s cup)
Streptopus lanceolatus var. curvipes (rosy twistedstalk)
Cornus canadensis (bunchberry)
Viola spp. (violets)
Dryopteris expansa (spiny wood fern)
Rubus pedatus (five-leaved bramble)

Moss Layer: 35% cover
Mnium spp. (leafy mosses)
[Brachythecium spp.] (brachythecium mosses)
[Rhytidopsis robusta (pipecleaner moss)]
[Pleurozium schreberi (red-stemmed feathermoss)]

SITE AND SOIL

Moisture Regime: 2–4 (subxeric–mesic)
Nutrient Regime: B–D (poor–rich)
Slope Gradient (%): 25 (0–90); usually <30
Slope Position: lower
Parent Material: morainal, fluvial, colluvial
Soil Texture: medium–moderately coarse
Coarse Fragments (%): 46 (20–90)

COMMENTS: seepage present between 40 and 100 cm

DISTRIBUTION: common
INTERPRETATIONS

Site limitations:  – sites with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system:  – see Section 5.1.

Site preparation:  – see Section 5.2.

Species choice:  – Sx, Cw, [Bl, Fd, Hw, Lw], (Pl, Pw).

Vegetation potential:  – very high (lady fern, fireweed, red raspberry).

Reforestation:  – Pw will be subject to blister rust-induced mortality; Pw should only be considered on a trial basis or as a minor component.
  – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
  – try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.
  – advance Cw, Hw, and Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
  – supplement advance regeneration by planting sturdy stock in groups, using available microsites.
  – plant Fd and Lw only on elevated microsites with southerly aspects at lower elevations within this biogeoclimatic unit.

Concerns:  – heavy snowpack may cause stem deformity, especially on steep slopes; obstacle planting is advised.
  – advance regeneration Hw and Cw have a high risk of heart rot.
  – site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy or planting on raised microsites is advised.
  – Pl and Lw are extended beyond their normal geographical range; consider only on a trial basis or as a minor component.
  – sites with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
VEGETATION

Tree Layer: 55% cover
- hybrid white spruce, western redcedar, [western hemlock, subalpine fir, balsam poplar]

Shrub Layer: 65% cover
- Rubus parviflorus (thimbleberry)
- Vaccinium ovalifolium (oval-leaved blueberry)
- Oplopanax horridus (devil’s club)
- Lonicera involucrata (black twinberry)
- Cornus stolonifera (red-osier dogwood)
- Ribes lacustre (black gooseberry)
- Vaccinium membranaceum (black huckleberry)
- [Viburnum edule (highbush-cranberry)]
- Lonicera involucrata (western redcedar)

Herb Layer: 60% cover
- Gymnocarpium dryopteris (oak fern)
- Streptopus lanceolatus var. curvipes (rosy twistedstalk)
- Tiarella spp. (foamflowers)
- Equisetum arvense (common horsetail)
- Cornus canadensis (bunchberry)
- Galium trifidum (small bedstraw)
- Athyrium filix-femina (lady fern)
- Rubus pedatus (five-leaved bramble)
- Maianthemum racemosum (false Solomon’s-seal)
- [Aralia nudicaulis (wild sarsaparilla)]

Moss Layer: 30% cover
- Mnium spp. (leafy mosses)
- [Rhytidiopsis robusta (pipecleaner moss)]
- [Pleurozium schreberi (red-stemmed feathermoss)]

SITE AND SOIL
- Moisture Regime: 5 (subhygric)
- Nutrient Regime: B–C (poor–medium)
- Slope Gradient (%): 3 (0–12)
- Slope Position: toe and level
- Parent Material: fluvial
- Soil Texture: variable
- Coarse Fragments (%): 32 (0–64)

COMMENTS: high bench positions adjacent to watercourses

DISTRIBUTION: uncommon
INTERPRETATIONS

Site limitations: – sites with saturated soils are poorly aerated, which slows root development; *plant seedlings on naturally or artificially raised microsites.*

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.
  – creating an excessive number of microsites (e.g., >300/ha) should be avoided, especially on sites with a water table <30 cm from the surface.

Species choice: – *Bl, Cw, Sx, [Hw], (Pl, Pw).*

Vegetation potential: – very high (black twinberry, thimbleberry, lady fern).
  – silvicultural prescription must address vegetation competition.

Reforestation: – advance Cw, Hw, and Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
  – plant stock in groups, using available raised microsites, rather than evenly across the site.
  – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
  – fill-planting may be required after partial cutting.
  – determine stocking levels by assessing the number of plantable and preparable raised microsites.
  – consider reducing inter-tree spacing to take advantage of available raised microsites.

Concerns: – water table will likely rise above the ground surface in the spring, causing seedling mortality.
  – sites with thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.*
  – sites with thick organic horizons reduce spring soil temperatures, slowing root development; *attempt to reduce organic horizon thickness during site preparation.*
  – site conditions may lead to frost damage of regeneration, especially in any naturally or artificially created depression; *leaving a partial canopy or planting on raised microsites is advised.*
  – heavy snowpack may cause stem deformity, especially on steep slopes; *obstacle planting is advised.*
  – Pw will be subject to blister rust-induced mortality; *Pw should only be considered on a trial basis or as a minor component.*
VEGETATION

Tree Layer: 45% cover
black cottonwood, Engelmann spruce, [paper birch]

Shrub Layer: 75% cover
Cornus stolonifera (red-osier dogwood)
Lonicera involucrata (black twinberry)
Viburnum edule (highbush-cranberry)
Mahonia aquifolium (tall Oregon-grape)
Symphoricarpos albus (common snowberry)
western redcedar

Herb Layer: 40% cover
Rubus pubescens (trailing raspberry)
Orthilia secunda (one-leaved wintergreen)
Pyrola asarifolia (pink wintergreen)
Galium trifidum (small bedstraw)
Equisetum spp. (horsetails)
Calamagrostis canadensis (bluejoint)
Maianthemum stellatum (star-flowered false Solomon’s-seal)

Moss Layer: 20% cover
Pleurozium schreberi (red-stemmed feathermoss)

SITE AND SOIL

Moisture Regime: 5 (subhygric)
Nutrient Regime: C–E (medium–very rich)
Slope Gradient (%): 0
Slope Position: level, depression
Parent Material: fluvial
Soil Texture: medium–coarse
Coarse Fragments (%): 0

COMMENTS: small and localized

DISTRIBUTION: restricted to active fluvial landforms at mid-bench level
INTERPRETATIONS

Site limitations: – sites with saturated soils are poorly aerated, which slows root development; *plant seedlings on naturally or artificially raised microsites.*

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.
– creating an excessive number of microsites (e.g., >300/ha) should be avoided, especially on sites with a water table <30 cm from the surface.

Species choice: – Sx, *Cw, [Bl, Hw], (Pw).*

Vegetation potential: – high (black cottonwood, mountain alder, red-osier dogwood).

– retain Act veterans where possible for wildlife.
– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– plant stock in groups, using available raised microsites, rather than evenly across the site.

Concerns: – sites with thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.*
– Pw will be subject to blister rust-induced mortality; *Pw should only be considered on a trial basis or as a minor component.*
– site conditions may lead to periodic flooding and frost damage of regeneration, especially in any naturally or artificially created depression; *leaving a partial canopy and/or planting on raised microsites is advised.*
– sites with thick organic horizons (>10 cm) have reduced spring soil temperatures, which slows root development; *reduce organic horizon thickness during site preparation.*
– these units represent important wildlife habitat; *discuss prescription with fish and wildlife personnel.*
– this unit is critical to the control of runoff streamflow.
– water table will likely rise above the ground surface in the spring, causing seedling mortality.
**VEGETATION**

**Tree Layer:** 40% cover  
- western hemlock, western redcedar, [hybrid white spruce, subalpine fir]

**Shrub Layer:** 55% cover  
- *Vaccinium ovalifolium* (oval-leaved blueberry)  
- *Oplopanax horridus* (devil’s club)  
- *Menziesia ferruginea* (false azalea)  
- [western redcedar]  
- [western hemlock]

**Herb Layer:** 90% cover  
- *Lysichiton americanus* (skunk cabbage)  
- *Athyrium filix-femina* (lady fern)  
- *Streptopus spp.* (twistedstalks)  
- *Cornus canadensis* (bunchberry)  
- *Viola spp.* (violets)  
- [Rubus pedatus] (five-leaved bramble)  
- [Gymnocarpium dryopteris] (oak fern)  
- [Equisetum arvense] (common horsetail)

**Moss Layer:** 85% cover  
- [Mnium spp.] (leafy mosses)  
- [Sphagnum spp.] (sphagnums)  
- [Pleurozium schreberi] (red-stemmed feathermoss)  
- [Hylocomium splendens] (step moss)

**SITE AND SOIL**

- **Moisture Regime:** 6 (hygric)  
- **Nutrient Regime:** C–E (medium–very rich)  
- * Slope Gradient (%): 3 (0–25); usually <5  
- * Slope Position: level, depression  
- Parent Material: organic over fluvial or morainal  
- Soil Texture: variable  
- * Coarse Fragments (%): 12 (0–38); usually <5  
- * Seepage Water: generally present within 50 cm

**DISTRIBUTION:** uncommon
INTERPRETATIONS

Site limitations:  – these sites are very difficult to manage and represent important wildlife habitat; serious consideration should be given to excluding logging from this unit.

Silviculture system:  – avoid logging.
VEGETATION

Tree Layer: 5% cover
[lodgepole pine]

Shrub Layer: 10% cover
[Ledum groenlandicum (Labrador tea)
Spiraea pyramidata (pyramid spirea)]
[lodgepole pine]

Herb Layer: 95% cover
Carex spp. (sedges)
Trichophorum cespitosum (tufted clubrush)
Erigeron peregrinus (subalpine daisy)
Platanthera dilatata (white bog-orchid)
Rubus arcticus (dwarf nagoonberry)
Viola glabella (stream violet)
Tridentis arctica (northern starflower)

Moss Layer: 35% cover
Sphagnum spp. (sphagnums)
Campylium stellatum (campylium moss)

SITE AND SOIL

Moisture Regime: 6–7 (hygric–subhydric)
Nutrient Regime: A–C (very poor–medium)
Slope Gradient (%): 0 level
Slope Position: level
* Parent Material: organic
* Soil Texture: organic
* Coarse Fragments (%): 0
* Seepage Water: within 30 cm of surface

DISTRIBUTION: small and uncommon
INTERPRETATIONS

Site limitations: – site and soil conditions of this unit result in marginal forest productivity; **serious consideration should be given to excluding logging from this unit.**

Silviculture system: – avoid logging.
4.3 Goat Wet Cool Interior Cedar-Hemlock

Location
The ICHwk3 occurs on the lower walls and in the valley floor of the Rocky Mountain Trench between McBride and Dome Creek, except on the lowest terraces of the major rivers. It also enters the valleys of most drainages flowing into the Fraser River.

Elevation range
670–1225 m

Climate
The climate of the ICHwk3 is moister than the ICHmm, but drier than the ICHvk2. Precipitation differences between the ICHwk3 and ICHmm may be compounded by the lower evaporative demand that plants would experience in the ICHwk3. This is most likely due to increased cloud cover and humidity, as well as increasing latitude.

The ICHwk3 has a longer growing season, less snowpack, and warmer temperatures than all ESSF units it borders (ESSFmm1, ESSFwk1, ESSFwk2). That part of the SBSvk that borders the ICHwk3 has a similar climate but, as it occupies the lowest valley bottoms, it is influenced by cold air drainage.

Forests
Western redcedar and western hemlock are the dominant climax tree species. They often occur as co-dominants, with minor components of hybrid white spruce and subalpine fir. Douglas-fir is a long-lived seral species that is occasionally present on mesic or drier sites. Seral stands are rare in this subzone. Trembling aspen, paper birch, and Douglas-fir are the main seral species. Lodgepole pine is occasionally present as a seral species, but is primarily found in the very driest and wettest ecosystems. Lodgepole pine and black spruce are present in the bogs in this variant.
Soils, geology, and landforms
Much of this subzone is underlain by deep unconsolidated deposits in the Rocky Mountain Trench and major tributary valleys. Bedrock is seldom exposed, and consists mostly of Precambrian metamorphic and sedimentary rocks. Surficial materials and soils consist of clayey glaciolacustrine sediments (Gray Luvisols), some of which have been deeply gullied (e.g., Morkill River valley), gullied sandy glaciofluvial deposits (Humo-Ferric Podzols), and terraced sandy fluvial deposits of the Fraser River (Brunisolic Gray Luvisols).

Distinguishing the ICHwk3 from adjoining biogeoclimatic units

SBSdh has:
- prickly rose present on most sites;
- velvet-leaved blueberry present on dry sites;
- Douglas-fir present in the canopy of subxeric to mesic sites;
- no western hemlock or western redcedar;
- no devil’s club or false azalea present in the shrub layer; and
- little or no oak fern in the herb layer of most sites.

ESSFmm1 has:
- white-flowered rhododendron present on mesic sites;
- Engelmann spruce present in the canopy of most sites;
- no western hemlock or western redcedar present in the canopy; and
- no lady fern present in the herb layer of most sites.

SBSvk has:
- hybrid white spruce present in the canopy of most sites;
- more thimbleberry present on mesic sites; and
- more bunchberry present in the herb layer of most sites.

ESSFwk1 has:
- Engelmann spruce present in the canopy of most sites;
- no western hemlock or western redcedar present in the canopy;
- white-flowered rhododendron and thimbleberry present on mesic sites; and
- less devil’s club present on most sites.
ICHvk2 has:
- less black huckleberry and false azalea on submesic to subhygic sites;
- more devil’s club and less oak fern present on subxeric sites; and
- more cloudberry and less bog-rosemary on subhydric sites.

ICHmm has:
- falsebox present on dry sites;
- less Douglas maple on wet sites;
- more false azalea on wet sites; and
- less lady fern on hygic sites.

ESSFwk2 has:
- Engelmann spruce present in the canopy of most sites;
- no western hemlock or western redcedar present in the canopy;
- white-flowered rhododendron present on mesic sites;
- less devil’s club present on most sites; and
- Indian hellebore present on wet sites.

Ecosystem management
These forest ecosystems were historically usually even-aged, but extended post-fire regeneration periods produced stands that are uneven-aged and possess multistoreyed canopies. Stand-destroying wildfires were often of moderate size (20–1000 ha) with patches of unburned areas due to chance, sheltering terrain features, or higher site moisture. Many larger fires occurred after periods of extended drought, but the landscape was dominated by extensive areas of mature forest surrounding patches of younger forest. Return cycles for stand-initiating events were approximately 200 years.
Figure 14  Edatopic grid displaying site units in the ICHwk3 variant.
<table>
<thead>
<tr>
<th>Site Series</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
<th>08</th>
<th>09</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| *Pinus contorta*      |    |    |    |    |    |    |    |    | lodgepole pine
| *Pseudotsuga menziesii* |    |    |    |    |    |    |    |    | Douglas-fir
| *Tsuga heterophylla*  |    |    |    |    |    |    |    |    | western hemlock
| *Thuja plicata*       |    |    |    |    |    |    |    |    | western redcedar
| *Picea glauca x engelmannii* |    |    |    |    |    |    |    |    | hybrid white spruce
| **Shrubs**            |    |    |    |    |    |    |    |    |
| *Vaccinium membranaceum* |    |    |    |    |    |    |    |    | black huckleberry
| *Menziesia ferruginea* |    |    |    |    |    |    |    |    | false azalea
| *Vaccinium ovalifolium* |    |    |    |    |    |    |    |    | oval-leaved blueberry
| *Ophiopanax horridus*  |    |    |    |    |    |    |    |    | devil’s club
| *Lonicera involucrata* |    |    |    |    |    |    |    |    | black twinberry
| *Alnus tenuifolia*     |    |    |    |    |    |    |    |    | mountain alder
| *Ledum groenlandicum*  |    |    |    |    |    |    |    |    | Labrador tea
| **Herbs and Dwarf Shrubs** |    |    |    |    |    |    |    |    |
| *Empetrum nigrum*      |    |    |    |    |    |    |    |    | crowberry
| *Chimaphila umbellata* |    |    |    |    |    |    |    |    | prince’s pine
| *Aralia nudicaulis*    |    |    |    |    |    |    |    |    | wild sarsaparilla
| *Cornus canadensis*    |    |    |    |    |    |    |    |    | bunchberry
| *Rubus pedatus*        |    |    |    |    |    |    |    |    | five-leaved bramble
| *Gymnocarpium dryopteris* |    |    |    |    |    |    |    |    | oak fern
| *Dryopteris expansa*   |    |    |    |    |    |    |    |    | spiny wood fern
| *Equisetum sylvaticum* |    |    |    |    |    |    |    |    | wood horsetail
| *Lysichiton americanus* |    |    |    |    |    |    |    |    | skunk cabbage
| *Carex spp.*           |    |    |    |    |    |    |    |    | sedges
| **Mosses and Lichens** |    |    |    |    |    |    |    |    |
| *Cladina spp.*         |    |    |    |    |    |    |    |    | cladina lichens
| *Hylocomium splendens* |    |    |    |    |    |    |    |    | step moss
| *Rhytidium tridactylum* |    |    |    |    |    |    |    |    | electrified cat’s-tail moss
| *Mnium spp.*           |    |    |    |    |    |    |    |    | leafy mosses
| *Sphagnum spp.*        |    |    |    |    |    |    |    |    | sphagnums

Prominence class: 1 2 3 4 5
<table>
<thead>
<tr>
<th>Site Series Key</th>
<th>Site Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICHwk3/09</td>
<td>1a Black spruce in canopy; organic soils; <em>Ledum groenlandicum</em> (Labrador tea) (p. 40) and/or <em>Betula glandulosa</em> (scrub birch) (p. 39) moderate to high cover (&gt;5%); water table close to surface; bogs.</td>
</tr>
<tr>
<td></td>
<td>1b Black spruce absent from canopy; mineral soils; <em>Ledum groenlandicum</em> and/or <em>Betula glandulosa</em> low cover (&lt;1%) or absent; water table variable.</td>
</tr>
<tr>
<td></td>
<td>2a Lodgepole pine and western hemlock in canopy; crest slope position; moderate to high cover (&gt;30%) of ground lichens.</td>
</tr>
<tr>
<td></td>
<td>2b Lodgepole pine is absent; slope position variable; ground lichens low cover (&lt;10%) or absent.</td>
</tr>
<tr>
<td></td>
<td>3a Narrow drainage channel; very uneven, open canopy; moderate to high cover of <em>Lysichiton americanus</em> (skunk cabbage) (p. 224); water table close to surface.</td>
</tr>
<tr>
<td></td>
<td>3b Not a narrow drainage channel; well-developed canopy; <em>Lysichiton americanus</em> low cover (&lt;1%) or absent; water table variable.</td>
</tr>
<tr>
<td></td>
<td>4a Usually mid- to lower slope or level; <em>Oplopanax horridus</em> (devil's club) (p. 36) present and usually moderate to high cover (&gt;10%).</td>
</tr>
<tr>
<td></td>
<td>5a Level slope position; lacustrine parent material; <em>Sphagnum</em> spp. (sphagnums) (pp. 312–314) moderate to high cover (&gt;10%); canopy often stunted and with poor form.</td>
</tr>
</tbody>
</table>

9 Page numbers refer to the publication *Plants of Northern British Columbia* (MacKinnon et al. 1992).
5b Slope position variable; parent materials variable; *Sphagnum* spp. low cover (<1%) or absent; canopy well developed.

6a Hybrid white spruce and subalpine fir greater than 50% of tree canopy; water table usually within 50 cm of surface; *Equisetum* spp. (horsetails) (pp. 281–284) moderate to high cover (>5%).

ICHwk3/06

6b Western redcedar and western hemlock dominate canopy; water table variable; *Equisetum* spp. low cover (<1%) or absent.

7a Lower slope to level; seepage water often present; *Oplopanax horridus* high cover (>20%).

ICHwk3/05

7b Slope position variable; seepage water rarely present; *Oplopanax horridus* low to moderate cover (<20%).

ICHwk3/01

4b Often upper slope; *Oplopanax horridus* absent.

8a Occurring on steep (>50%) slopes; aspect usually SE to SW; *Gymnocarpium dryopteris* (oak fern) (p. 293) present.

ICHwk3/03

8b Occurring on gentle slopes (<10%); aspect variable; *Gymnocarpium dryopteris* low cover (<1%) or absent.

ICHwk3/04
VEGETATION

Tree Layer: 70% cover
western redcedar, western hemlock, [subalpine fir, hybrid white spruce]

Shrub Layer: 30% cover

- **Oplopanax horridus** (devil’s club)
- **Vaccinium membranaceum** (black huckleberry)
- **Menziesia ferruginea** (false azalea)
- **Vaccinium ovalifolium** (oval-leaved blueberry)
- western hemlock
- western redcedar
- subalpine fir

Herb Layer: 70% cover

- **Gymnocarpium dryopteris** (oak fern)
- **Cornus canadensis** (bunchberry)
- **Rubus pedatus** (five-leaved bramble)
- **Clintonia uniflora** (queen’s cup)
- **Streptopus lanceolatus var. curvipes** (rosy twistedstalk)
- **Orthilia secunda** (one-sided wintergreen)
- **Tiarella spp.** (foamflowers)
- **Moneses uniflora** (single delight)
- **Goodyera oblongifolia** (rattlesnake-plantain)
- **Lycopodium annotinum** (stiff club-moss)
- **Maianthemum racemosum** (false Solomon’s-seal)
- **Aralia nudicaulis** (wild sarsaparilla)
- **Dryopteris expansa** (spiny wood fern)

Moss Layer: 70% cover

- **Hylocomium splendens** (step moss)
- **Pleurozium schreberi** (red-stemmed feathermoss)
- **Ptilium crista-castrensis** (knight’s plume)
- **Rhytidiadelphus triquetrus** (electrified cat’s-tail moss)
- **Mnium spp.** (leafy mosses)

SOIL AND SITE

- **Moisture Regime:** 3–5 (submesic–subhygric)
- **Nutrient Regime:** B–C (poor–medium)
- **Slope Gradient (%):** 18 (0–67)
- **Slope Position:** usually mid
- **Parent Material:** morainal or fluvial
- **Soil Texture:** medium–moderately coarse
- **Coarse Fragments (%):** 25 (0–54)
- **Seepage Water (cm):** rarely present

DISTRIBUTION: very common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Sx, [Bl, Cw, Fd, Hw, Pl].

Vegetation potential: – low to moderate (thimbleberry, fireweed, red raspberry).

Reforestation: – advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria.
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– fill-planting may be required after partial cutting.

Concerns: – heavy snowpack may cause stem deformity, especially on steep slopes; obstacle planting is advised.
– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
# VEGETATION

**Tree Layer:** 70% cover  
- western redcedar, western hemlock, [subalpine fir, hybrid white spruce]

**Shrub Layer:** 30% cover  
- *Oplopanax horridus* (devil’s club)  
- *Vaccinium membranaceum* (black huckleberry)  
- *Menziesia ferruginea* (false azalea)  
- *Vaccinium ovalifolium* (oval-leaved blueberry)  
- western hemlock  
- western redcedar  
- subalpine fir

**Herb Layer:** 70% cover  
- *Gymnocarpium dryopteris* (oak fern)  
- *Cornus canadensis* (bunchberry)  
- *Rubus pedatus* (five-leaved bramble)  
- *Clintonia uniflora* (queen’s cup)  
- *Streptopus lanceolatus var. curvipes* (rosy twisted stalk)  
- *Orthilia secunda* (one-sided wintergreen)  
- *Tiarella spp.* (foam flowers)  
- *Moneses uniflora* (single delight)  
- *Goodyera oblongifolia* (rattlesnake-plantain)  
- *Lycopodium annotinum* (stiff club-moss)  
- *Maianthemum racemosum* (false Solomon’s-seal)  
- *Aralia nudicaulis* (wild sarsaparilla)  
- *Dryopteris expansa* (spiny wood fern)  

**Moss Layer:** 70% cover  
- *Hylocomium splendens* (step moss)  
- *Pleurozium schreberi* (red-stemmed feather moss)  
- *Ptilium crista-castrensis* (knight’s plume)  
- *Rhytididiophalus triquetrus* (electrified cat’s-tail moss)  
- *Mnium spp.* (leafy mosses)

### SOIL AND SITE

- **Moisture Regime:** 4–5 (mesic–subhygric)  
- **Nutrient Regime:** C–D (medium–rich)  
- **Slope Gradient (%):** 7 (0–11)  
- *Slope Position:* usually mid  
- *Parent Material:* lacustrine  
- **Soil Texture:** medium–fine  
- *Coarse Fragments (%):* usually 0  
- **Seepage Water (cm):** rarely present

**DISTRIBUTION:** very common
INTERPRETATIONS

Site limitations: – sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; plant stock that will achieve better lateral root development (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Sx, [Bl, Cw, Fd, Hw, Pl].

Vegetation potential: – moderate (thimbleberry, red raspberry, fireweed).

Reforestation: – advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria.
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.

Concerns: – sites within this unit with silty soils are susceptible to frost heaving; bareroot stock will likely resist frost heaving better than plug stock.
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
– sites within this unit with fine-textured soils are vulnerable to compaction under wet conditions; restrict traffic to winter operations or dry soil conditions.
– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.
### VEGETATION

**Tree Layer:** 35% cover  
western hemlock, lodgepole pine  

**Shrub Layer:** 65% cover  
- *Menziesia ferruginea* (false azalea)  
- *Vaccinium membranaceum* (black huckleberry)  
- *Vaccinium ovalifolium* (oval-leaved blueberry)  
western hemlock  
lodgepole pine  
subalpine fir

**Herb Layer:** 5% cover  
- *Empetrum nigrum* (crowberry)  

**Moss Layer:** 100% cover  
- *Pleurozium schreberi* (red-stemmed feathermoss)  
- *Cladina spp.* (reindeer lichens)  
- *Cladonia spp.* (cladonia lichens)  
- *Stereocaulon paschale* (common coral lichen)  
- *Dicranum polysetum* (wavy-leaved moss)  
- *Barbilophozia spp.* (leafy liverworts)  
- *Peltigera spp.* (peltigera lichens)

### SOIL AND SITE

- **Moisture Regime:** 1 (xeric)  
- **Nutrient Regime:** A–B (very poor–poor)  
- **Slope Gradient (%):** 2  
- **Slope Position:** crest  
- **Parent Material:** bedrock, and shallow  
  veneer over bedrock  
- **Soil Texture:** medium–coarse  
- **Coarse Fragments (%):** 4 (0–10)

### COMMENTS:  
high cover (approx. 35%) of exposed bedrock; limited data because of the rarity of the ecosystem

### DISTRIBUTION:  
very rare
INTERPRETATIONS

Site limitations: – site and soil conditions of this unit result in marginal forest productivity; *serious consideration should be given to excluding logging from this unit.*

Silviculture system: – avoid logging.
**VEGETATION**

**Tree Layer:** 50% cover
- western redcedar, western hemlock, subalpine fir,
- hybrid white spruce, [Douglas-fir]

**Shrub Layer:** 15% cover
- *Acer glabrum* (Douglas maple)
- *Amelanchier alnifolia* (saskatoon)
- *Ribes lacustre* (black gooseberry)
- *Spiraea betulifolia* (birch-leaved spirea)
- western redcedar
- subalpine fir
- western hemlock

**Herb Layer:** 15% cover
- *Chimaphila umbellata* (prince's pine)
- *Gymnocarpium dryopteris* (oak fern)
- *Maianthemum racemosum* (false Solomon's-seal)
- *Clintonia uniflora* (queen's cup)
- *Orthilia secunda* (one-sided wintergreen)
- *Proseres hookeri* (Hooker's fairybells)
- *Cornus canadensis* (bunchberry)
- *Aralia nudicaulis* (wild sarsaparilla)

**Moss Layer:** 50% cover
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Hylocomium splendens* (step moss)
- *Rhytidiadelphus triquetrus* (electrified cat's-tail moss)
- *Ptilium crista-castrensis* (knight's plume)
- *Peltigera* spp. (peltigera lichens)

**SOIL AND SITE**

- **Moisture Regime:** 2 (subxeric)
- **Nutrient Regime:** B–D (poor–rich)
- **Aspect:** usually SE–SW
- **Slope Gradient (%):** 72 (55–82)
- **Slope Position:** upper
- **Parent Material:** colluvial and steep lacustrine
- **Soil Texture:** moderately fine–moderately coarse
- **Coarse Fragments (%):** 28 (0–84; greater than 50 if non-lacustrine)

**COMMENTS:** this ecosystem could occur on other parent materials within the subzone

**DISTRIBUTION:** uncommon
INTERPRETATIONS

Site limitations: – sites with high coarse fragment contents (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; **attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.**

Silviculture system: – see Section 5.1.

Site preparation: – light scarification for seedbed preparation or summer logging with no site preparation.

Species choice: – Fd, \([Cw, Hw, Pl]\), \((Sx, Bl)\).

Vegetation potential: – low.

Reforestation: – avoid clearcutting, because stand establishment would likely be difficult due to high surface soil temperatures and drought.

– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria.

– Bl and Sx will be significantly less productive on these sites than Douglas-fir.

– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.

– if Fd stems are present, conduct a stand evaluation to assess whether partial cutting is feasible.

– preserve advance Fd regeneration when partial cutting.

Concerns: – heavy snowpack may cause stem deformity, especially on steep slopes; **obstacle planting is advised.**

– sites with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; **site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.**

– site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; **natural regeneration is generally more adapted to surviving these conditions, especially during establishment.**

– full tree harvesting will lead to nutrient depletion and seriously reduce cones; **woody debris and cones should be distributed across these sites (i.e., lop and scatter).**
VEGETATION

Tree Layer: 80% cover
western hemlock, Douglas-fir

Shrub Layer: 35% cover
- *Menziesia ferruginea* (false azalea)
- *Vaccinium ovalifolium* (oval-leaved blueberry)
- *Amelanchier alnifolia* [saskatoon]
- *Vaccinium membranaceum* (black huckleberry)
western hemlock
western redcedar
[subalpine fir]

Herb Layer: 10% cover
- *Cornus canadensis* (bunchberry)
- *Chimaphila umbellata* (prince's pine)
- *Orthilia secunda* (one-sided wintergreen)
- *Clintonia uniflora* (queen's cup)
- *Gaultheria hispidula* (creeping-snowberry)
- *Goodyera oblongifolia* (rattlesnake-plantain)
- *Rubus pedatus* [five-leaved bramble]

Moss Layer: 100% cover
- *Hylocomium splendens* (step moss)
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Peltigera spp.* (peltigera lichens)
- *Cladina spp.* (cladina lichens)
- *Dicranum polysetum* (wavy-leaved moss)

SOIL AND SITE

- Moisture Regime: 2–3 (subxeric–submesic)
- Nutrient Regime: B–D (poor–rich)
- Slope Gradient (%): 6 (5–8)
- * Slope Position: crest–upper
- * Parent Material: lacustrine veneer or blanket over bedrock
- * Soil Texture: fine–moderately fine
- Coarse Fragments (%): 9 (3–15)

COMMENTS: limited data because of the rarity of the ecosystem; usually found in conjunction with 01b site series phase

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations: – sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; *plant stock that will achieve better lateral root development (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.*

Silviculture system: – see Section 5.1.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation: – see Section 5.2.

Species choice: – Fd, Pl, [Hw], (Sx, Bl, Cw).

Vegetation potential: – low.

Reforestation: – manage to maintain Fd.
– attempt to regenerate naturally if potential exists.
– if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
– preserve advance Fd regeneration when partial cutting.
– Bl, Cw, and Sx will be significantly less productive than Fd and Pl on these sites.
– fill-planting may be required after partial cutting.
– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria.

Concerns: – full tree harvesting will lead to nutrient depletion and seriously reduce cones; *woody debris and cones should be distributed across these sites (i.e., lop and scatter).*
– windthrow risk after partial cutting will be high on sites where root-restricting layers occur at depths <25 cm.
– site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; *leaving a shelterwood overstorey can reduce the severity of the drought hazard.*
– sites with fine-textured soils are vulnerable to compaction under wet conditions; *restrict traffic to winter operations or dry soil conditions.*
VEGETATION

Tree Layer: 65% cover
western hemlock, western redcedar, hybrid white spruce, [subalpine fir]

Shrub Layer: 75% cover
Oplopanax horridus  (devil's club)
Ribes lacustre  (black gooseberry)
Acer glabrum  (Douglas maple)
western redcedar  [western hemlock]

Herb Layer: 75% cover
Gymnocarpium dryopteris  (oak fern)
Tiarella spp.  (foamflowers)
Cornus canadensis  (bunchberry)
Dryopteris expansa  (spiny wood fern)
Rubus pedatus  (five-leaved bramble)
Streptopus spp.  (twistedstalks)
Clintonia uniflora  (queen's cup)
Goodyera oblongifolia  (rattlesnake-plantain)
Maianthemum racemosum  (false Solomon's-seal)
Galium trifidum  (small bedstraw)
Circaea alpina  (enchanter's-nightshade)
Athyrium filix-femina  (lady fern)
Aralia nudicaulis  (wild sarsaparilla)

Moss Layer: 75% cover
Hylocomium splendens  (step moss)
Ptilium crista-castrensis  (knight's plume)
Mnium spp.  (leafy mosses)
Rhytididelphus triquetrus  (electrified cat's-tail moss)
Pleurozium schreberi  (red-stemmed feathermoss)

SOIL AND SITE

Moisture Regime: 5 (subhygric)
Nutrient Regime: B–D (poor–rich)
Slope Gradient (%): 13 (0–54)
* Slope Position: lower–level
Parent Material: fluvial, colluvial, and morainal
* Soil Texture: medium–coarse
Coarse Fragments (%): 38 (0–65)

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Sx, Fd, [Bl, Cw, Hw, Pl].

Vegetation potential: – high (lady fern, thimbleberry, fireweed).

Reforestation: – advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.

Concerns: – site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.
– heavy snowpack may cause stem deformity, especially on steep slopes; obstacle planting is advised.
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
**VEGETATION**

Tree Layer: 65% cover  
western hemlock, western redcedar, hybrid white spruce,  
[subalpine fir]

Shrub Layer: 75% cover  
- *Oplopanax horridus* (devil’s club)  
- *Ribes lacustre* (black gooseberry)  
- *Acer glabrum* (Douglas maple)
western redcedar  
western hemlock

Herb Layer: 75% cover  
- *Gymnocarpium dryopteris* (oak fern)  
- *Tiarella spp.* (foamflowers)  
- *Cornus canadensis* (bunchberry)  
- *Dryopteris expansa* (spiny wood fern)  
- *Rubus pedatus* (five-leaved bramble)  
- *Streptopus spp.* (twistedstalks)  
- *Clintonia uniflora* (queen’s cup)  
- *Goodyera oblongifolia* (rattlesnake-plantain)  
- *Maianthemum racemosa* (false Solomon’s-seal)  
- *Galium trifidum* (small bedstraw)  
- *Circaea alpina* (enchanter’s-nightshade)  
- *Athyrium filix-femina* (lady fern)  
- *Aralia nudicaulis* (wild sarsaparilla)

Moss Layer: 75% cover  
- *Hylocomium splendens* (step moss)  
- *Mnium spp.* (leafy mosses)  
- *Ptilium crista-castrensis* (knight’s plume)  
- *Rhytididiadelphus triquetrus* (electrified cat’s-tail moss)  
- *Pleurozium schreberi* (red-stemmed feathermoss)

**SOIL AND SITE**

- Moisture Regime: 5 (subhygric)  
- Nutrient Regime: B–D (poor–rich)  
- Slope Gradient (%): usually 0  
  * Slope Position: lower–level  
  * Parent Material: lacustrine  
- Soil Texture: medium–fine  
- Coarse Fragments (%): usually 0

**COMMENTS:** limited data for fine-textured phase

**DISTRIBUTION:** common
INTERPRETATIONS

Site limitations: – sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; *plant stock that will achieve better lateral root development (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.*

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Sx, Fd, [Bl, Cw, Hw, Pl].

Vegetation potential: – high (devil’s club, thimbleberry, fireweed, lady fern).

Reforestation: – advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.

Concerns: – sites within this unit with silty soils are susceptible to frost heaving; *bareroot stock will likely resist frost heaving better than plug stock.*
– heavy snowpack may cause stem deformity, especially on steep slopes; *obstacle planting is advised.*
– sites within this unit with fine-textured soils are vulnerable to compaction under wet conditions; *restrict traffic to winter operations or dry soil conditions.*
– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; *leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.*
### VEGETATION

**Tree Layer: 70% cover**
- hybrid white spruce, subalpine fir, paper birch,
  - [western redcedar, western hemlock, black cottonwood, trembling aspen]

**Shrub Layer: 60% cover**
- *Oplopanax horridus* (devil’s club)
- *Lonicera involucrata* (black twinberry)
- *Rubus parviflorus* (thimbleberry)
- *Ribes lacustre* (black gooseberry)
- *Viburnum edule* (highbush-cranberry)
- subalpine fir
- western redcedar

**Herb Layer: 65% cover**
- *Athyrium filix-femina* (lady fern)
- *Gymnocarpium dryopteris* (oak fern)
- *Aralia nudicaulis* (wild sarsaparilla)
- *Equisetum spp.* (horsetails)
- *Dryopteris expansa* (spiny wood fern)
- *Cornus canadensis* (bunchberry)
- *Rubus pubescens* (trailing raspberry)
- *Mitella nuda* (common mitrewort)
- *Galium trifidum* (small bedstraw)
- *Equisetum sylvaticum* (wood horsetail)
- *Tiarella spp.* (foamflowers)
- *Circaea alpina* (enchanter’s-nightshade)

**Moss Layer: 80% cover**
- *Rhytidiadelphus triquetrus* (electrified cat’s-tail moss)
- *Mnium spp.* (leafy mosses)
- *Hylocomium splendens* (step moss)
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Ptilium crista-castrensis* (knight’s plume)

### SOIL AND SITE

- **Moisture Regime:** 6 (hygric)
- **Nutrient Regime:** C–D (medium–rich)
- **Slope Gradient (%):** o
- **Slope Position:** level
- **Parent Material:** fluvial
- **Soil Texture:** medium–coarse
- **Seepage Water:** may be present; fluctuating water table

### DISTRIBUTION:
uncommon
INTERPRETATIONS

Site limitations: – sites within this unit with saturated soils are poorly aerated, which slows root development; **plant seedlings on naturally or artificially raised microsites.**

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.
– creating an excessive number of microsites (e.g., >300/ha) should be avoided, especially on sites within this unit with a water table <30 cm from the surface.
– careful assessment of plantable and preparable raised microsites should be made to determine target stocking levels.
– under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.

Species choice: – **Sx, [Bl, Cw, Hw, Pl].**

Vegetation potential: – very high (devil’s club, black twinberry, thimbleberry, lady fern).

Reforestation: – young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– preserve advance regeneration where feasible.
– plant stock in groups, using available raised microsites, rather than evenly across the site.
– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).

Concerns: – sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; **block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.**
– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; **leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.**
– these units represent important wildlife habitat; **discuss prescription with fish and wildlife personnel.**
– water table will likely rise above the ground surface in the spring, causing seedling mortality.
**VEGETATION**

**Tree Layer:** 70% cover
- hybrid white spruce, subalpine fir, paper birch,
  [western redcedar, western hemlock, black cottonwood,
  trembling aspen]

**Shrub Layer:** 60% cover
- *Oplopanax horridus* (devil’s club)
- *Lonicera involucrata* (black twinberry)
- *Rubus parviflorus* (thimbleberry)
- *Ribes lacustre* (black gooseberry)
- *Viburnum edule* (highbush-cranberry)
- subalpine fir
- western redcedar

**Herb Layer:** 65% cover
- *Athyrium filix-femina* (lady fern)
- *Gymnocarpium dryopteris* (oak fern)
- *Aralia nudicaulis* (wild sarsaparilla)
- *Equisetum spp.* (horsetails)
- *Dryopteris expansa* (spiny wood fern)
- *Cornus canadensis* (bunchberry)
- *Rubus pubescens* (trailing raspberry)
- *Mitella nuda* (common mitrewort)
- *Equisetum sylvaticum* (wood horsetail)
- *Tiarella spp.* (foamflowers)

**Moss Layer:** 80% cover
- *Rhytidiadelphus triquetrus* (electrified cat’s-tail moss)
- *Mnium spp.* (leafy mosses)
- *Hylocomium splendens* (step moss)
- *Pleurozium schreberi* (red-stemmed feathermoss)

**SOIL AND SITE**
- **Moisture Regime:** 6 (hygric)
- **Nutrient Regime:** D–E (rich–very rich)
- **Slope Gradient (%):** 4 (0–7)
- * Slope Position: lower–level
- * Parent Material: lacustrine
- **Soil Texture:** moderately fine–fine
- **Coarse Fragments (%):** 0
- * Seepage Water: usually present

**COMMENTS:** these ecosystems usually occur near boundaries with the lower-elevation SBSvk subzone

**DISTRIBUTION:** uncommon
INTERPRETATIONS

Site limitations: – sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; *plant stock that will achieve better lateral root development (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.*

– sites with saturated soils are poorly aerated, which slows root development; *plant seedlings on naturally or artificially raised microsites.*

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

– creating an excessive number of microsites (e.g., >300/ha) should be avoided, especially on sites with a water table <30 cm from the surface.

Species choice: – *Sx, [Bl, Cw, Hw, Pl].*

Vegetation potential: – very high (devil’s club, black twinberry, thimbleberry, lady fern).

Reforestation: – young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.

– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).

Concerns: – water table will likely rise above the ground surface in the spring, causing seedling mortality.

– sites with silty soils are susceptible to frost heaving; *bare root stock will likely resist frost heaving better than plug stock.*

– sites with thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.*

– sites with fine-textured soils are vulnerable to compaction under wet conditions; *restrict traffic to winter operations or dry soil conditions.*

– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; *leaving a partial canopy or planting on raised microsites is advised.*

– these units represent important wildlife habitat; *discuss pre-scription with fish and wildlife personnel.*

– heavy snowpack may cause stem deformity of Pl.
VEGETATION

Tree Layer: 65% cover
subalpine fir, western hemlock, hybrid white spruce,
[western redcedar, paper birch]

Shrub Layer: 25% cover
Vaccinium ovalifolium (oval-leaved blueberry)
Vaccinium membranaceum (black huckleberry)
Menziesia ferruginea (false azalea)
[Oplopanax horridus (devil's club)]
western hemlock
subalpine fir

Herb Layer: 60% cover
Equisetum sylvaticum (wood horsetail)
Rubus pedatus (five-leaved bramble)
Gymnocarpium dryopteris (oak fern)
Cornus canadensis (bunchberry)
Orthilia secunda (one-sided wintergreen)
Streptopus spp. (twistedstalks)
Lycopodium annotinum (stiff club-moss)
Athyrium flex-femina (lady fern)
Dryopteris expansa (spiny wood fern)
Linnaea borealis (twinflower)
Tiarella spp. (foamflowers)

Moss Layer: 95% cover
Sphagnum spp. (sphagnums)
Hylocomium splendens (step moss)
Ptilium crista-castrensis (knight's plume)
Pleurozium schreberi (red-stemmed feathermoss)

SOIL AND SITE
Moisture Regime: 6–7 (hygric–subhydric)
Nutrient Regime: B–C (poor–medium)
* Slope Gradient (%): 1 (0–5)
* Slope Position: level
* Parent Material: lacustrine
* Soil Texture: moderately fine–fine
Coarse Fragments (%): 3 (0–16)
* Seepage Water: present

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; *plant stock that will achieve better lateral root development* (*e.g.*, Cu-treated), *prescribe natural regeneration, or protect advance regeneration*.
– sites with saturated soils are poorly aerated, which slows root development; *plant seedlings on naturally or artificially raised microsites*.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.
– creating an excessive number of microsites (*e.g.*, >300/ha) should be avoided, especially on sites within this unit with a water table <30 cm from the surface.

Species choice: – *P. l.*, [*Hw*], (*Cw*, *Sx*).

Vegetation potential: – low.

Reforestation: – plant sturdy stock in groups on available microsites.
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– advance Cw and Hw regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– Cw and Sx will be significantly less productive than Pl on these sites.

Concerns: – this unit is critical to the control of runoff streamflow.
– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; *leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species* (*e.g.*, *Pl*) are advised.
– sites with fine-textured soils are vulnerable to compaction under wet conditions; *restrict traffic to winter operations or dry soil conditions*.
– sites with silty soils are susceptible to frost heaving; *bareroot stock will likely resist frost heaving better than plug stock*.
– sites with thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites*.
– heavy snowpack may cause stem deformity, especially on steep slopes; *obstacle planting is advised*.
VEGETATION

Tree Layer: 10% cover
[black spruce, lodgepole pine]

Shrub Layer: 30% cover
Ledum groenlandicum (Labrador tea)
Betula glandulosa (scrub birch)
[Kalmia microphylla spp. occidentalis] (western bog-laurel)
lodgepole pine
black spruce
western hemlock

Herb Layer: 50% cover
Carex spp. (sedges)
Oxycoccus oxyccos (bog cranberry)
Eriophorum chamissonis (Chamisso's cotton-grass)
Drosera rotundifoila (round-leaved sundew)
Andromeda polifolia (bog-rosemary)
[Menyanthes trifoliata] (buckbean)
[Gaultheria hispidula] (creeping-snowberry)

Moss Layer: 95% cover
Sphagnum spp. (sphagnums)
Pleurozium schreberi (red-stemmed feathermoss)

SOIL AND SITE

Moisture Regime: 7 (subhydric)
Nutrient Regime: A–C (very poor–medium)
Slope Gradient (%): 0
* Slope Position: level or depression
* Parent Material: organic and organic veneer over lacustrine

* Soil Texture: fibric and mesic organic
Coarse Fragments (%): 0
Water Table: close to surface

COMMENTS: these bog and poor fen ecosystems are variable, differing in the depth of organic material and the “richness” of the water moving through the site; most are in shallow depressions over lacustrine material

DISTRIBUTION: uncommon
INTERPRETATIONS

Site limitations: – site and soil conditions of this unit result in marginal forest productivity; *serious consideration should be given to excluding logging from this unit.*

Silviculture system: – avoid logging.
VEGETATION

Tree Layer: 30% cover
- hybrid white spruce, western redcedar, subalpine fir,
- western hemlock

Shrub Layer: 50% cover
- *Vaccinium ovalifolium* (oval-leaved blueberry)
- *Alnus tenuifolia* (mountain alder)
- *Lonicera involucrata* (black twinberry)
- *Menziesia ferruginea* (false azalea)
- *Ribes lacustre* (black gooseberry)
- *Viburnum edule* (highbush-cranberry)
- subalpine fir
- western redcedar
- western hemlock

Herb Layer: 50% cover
- *Glyceria elata* (tall mannagrass)
- *Thelypteris phegopteris* (beech fern)
- *Lysichiton americanus* (skunk cabbage)
- *Carex spp.* (sedges)
- *Equisetum spp.* (horsetails)
- *Cornus canadensis* (bunchberry)

Moss Layer: 95% cover
- *Mnium spp.* (leafy mosses)
- *Rhytidiadelphus triquetrus* (electrified cat’s-tail moss)
- *Calliergon spp.* (water mosses)
- *Sanionia uncinata* (sickle-moss)
- *Sphagnum spp.* (sphagnums)
- *Hylocomium splendens* (step moss)
- *Ptilium crista-castrensis* (knight’s plume)

SOIL AND SITE

- Moisture Regime: 7 (subhydric)
- Nutrient Regime: D–E (rich–very rich)
- * Slope Gradient (%): 1
- * Slope Position: depression
- Parent Material: glaciofluvial
- Soil Texture: coarse
- Coarse Fragments (%): 0
- * Seepage Water: present; water table near surface

COMMENTS: limited data as the ecosystem is rare; occurs in narrow drainage channels

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations:  – site and soil conditions of this unit result in marginal forest productivity; serious consideration should be given to excluding logging from this unit.

Silviculture system:  – avoid logging.
4.4 Dry Hot Sub-Boreal Spruce

Location
The SBSdh is found in the valley of the Rocky Mountain Trench between Alberta and McBride, and the lower elevations of the northeast wall of the Rocky Mountain Trench between Valemount and Dunster.

Elevation range
The elevation ranges from a minimum of about 700 m along the Fraser River to approximately 1225 m.

Climate
The SBSdh is, in relative terms for the Prince George Region, dry and hot. It is the driest subzone in the Rocky Mountain Trench (Table 8), being especially dry during the summer months. The primary reason for the relatively dry climate is that the subzone lies in the rainshadow of the high mountains to the west (the Premier Range).

Forests
Because of the extensive fire history of the subzone, the dominant trees are lodgepole pine and Douglas-fir. Although they are primarily seral species in this subzone, they do form the climax canopy on drier sites. Hybrid white spruce and subalpine fir, and possibly Douglas-fir, are the climatic-climax tree species. Douglas-fir tends to be a component of near-climax stands for some time due to its long life, but it is unknown whether it can reproduce in perpetuity under a dense canopy in the subzone. Because of the fire history in the area, hybrid white spruce and subalpine fir climax stands are rare, only occurring as pure stands on wetter sites or on cooler northeast aspects. Although fires are now being suppressed, true climax stands will continue to be rare due to the intensive forest management, and consequently from a forest management perspective, Douglas-fir and lodgepole pine are definitely important components of all forest stands except the wettest sites. Trembling aspen is often present as a seral component. Paper birch
and cottonwood are also seral components of some ecosystems. Black spruce is present on poorly to very poorly drained sites. Western redcedar occurs sporadically throughout the subzone, usually on wetter, cooler sites.

**Soils, geology, and landforms**

In this subzone, deep unconsolidated deposits cover the floor of the Rocky Mountain Trench and upper Fraser valley along the Yellowhead Highway. Surficial materials and soils consist predominantly of: clayey glaciolacustrine (Gray Luvisols), sandy terraced glaciofluvial (Ferro-Humic Podzols), sandy hummocky glaciofluvial (Dystric Brunisols), near Valemount and sandy morainal deposits (Humo-Ferric Podzols) east of Tete Jaune Cache along the Fraser Valley.

**Distinguishing the SBSdh from adjoining biogeoclimatic units**

ICHmm has:
- no prickly rose present in the shrub layer;
- less velvet-leaved blueberry present on dry sites;
- western hemlock and western redcedar present in the canopy of most sites;
- little or no Douglas-fir present in the canopy;
- devil’s club present on mesic to hygric sites; and
- false azalea present in the shrub layer of most sites.

ESSFmm1 has:
- white-flowered rhododendron present on submesic to subhygric sites;
- no prickly rose present in the shrub layer;
- Engelmann spruce present in the canopy of most sites; and
- no kinnikinnick present in the herb layer.

SBSvk has:
- less prickly rose present on most sites;
- no kinnikinnick present in the herb layer;
- less Douglas-fir present on dry sites;
- more hybrid white spruce present in the canopy of submesic sites; and
- devil’s club on mesic sites.
ICHwk3 has:

- devil’s club present on submesic to hygric sites;
- false azalea present on subxeric to mesic sites;
- no prickly rose present on most sites;
- western hemlock and western redcedar present in the canopy of most sites;
- no Douglas-fir present in the canopy; and
- oak fern present in the herb layer of most sites.

**Ecosystem management**

Historically, these forest ecosystems experienced frequent wild-fires that ranged in size from small spot fires to conflagrations that covered hundreds to thousands of hectares. Natural burns usually contained unburned patches of mature forest that were missed by fire. Consequently, these forests produced a landscape mosaic of even-aged regenerating stands ranging in size from hundreds to thousands of hectares with mature forest remnants embedded within. There were also frequent outbreaks of defoliating insects and extensive presence of root disease. The tree mortality resulting from these biotic agents provided a source of dead trees, decaying logs, and canopy gaps. The frequency of stand-initiating disturbances was approximately 125 years. The extensive presence of Douglas-fir in the unit led to the creation of many mature remnants, with the result that structural diversity was increased.
FIGURE 16  Edatopic grid displaying site units in the SBSdh subzone.
<table>
<thead>
<tr>
<th>Site Series</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
<th>08</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees</strong></td>
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<td>Pinus contorta</td>
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<td>2</td>
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<td>2</td>
<td>2</td>
<td>2</td>
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<td>2</td>
</tr>
<tr>
<td>Picea glauca × engelmannii</td>
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<td>1</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Populus balsamifera ssp. trichocarpa</td>
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<td>Picea mariana</td>
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<td><strong>Shrubs</strong></td>
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<td>Vaccinium myrtilloides</td>
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<td>Shepherdia canadensis</td>
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<td>Spiraea betulifolia</td>
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<td>Rubus parviflorus</td>
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<td><strong>Herbs and Dwarf Shrubs</strong></td>
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<td>Proseres hookerii</td>
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<td>Carex spp.</td>
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<td><strong>Mosses</strong></td>
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<td>Peltigera spp.</td>
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<td>Hylocomium splendens</td>
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<td>Sphagnum spp.</td>
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Prominence class: 1 2 3 4 5
### SITE SERIES KEY

<table>
<thead>
<tr>
<th></th>
<th>Black spruce dominant in canopy; organic soils; water table close to surface; <em>Sphagnum</em> spp. (p. 312–314)(^\text{10}) moderate to high cover (&gt;10%); bogs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Black spruce not dominant in canopy; mineral soils; water table variable; <em>Sphagnum</em> spp. absent.</td>
</tr>
<tr>
<td>1b</td>
<td>level, fluvial deposits close to streams; seepage water often present; hybrid white spruce or spruce-cottonwood canopy; <em>Equisetum</em> spp. (horsetails) (pp. 281–282) moderate to high cover (&gt;10%).</td>
</tr>
<tr>
<td>2a</td>
<td>Level, fluvial deposits close to streams; seepage water often present; hybrid white spruce or spruce-cottonwood canopy; <em>Equisetum</em> spp. (horsetails) (pp. 281–282) moderate to high cover (&gt;10%).</td>
</tr>
<tr>
<td>2b</td>
<td>Not on fluvial deposits close to streams; seepage water usually absent; canopy variable; <em>Equisetum</em> spp. absent.</td>
</tr>
<tr>
<td>3a</td>
<td>Canopy dominated by a single species.</td>
</tr>
<tr>
<td>4a</td>
<td>Main canopy all lodgepole pine or with minor (&lt;5%) Douglas-fir.</td>
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<tr>
<td>4b</td>
<td>Main canopy dominated by Douglas-fir or hybrid white spruce.</td>
</tr>
<tr>
<td>5a</td>
<td>Level; <em>Ledum groenlandicum</em> (Labrador tea) (p. 40) high cover (usually &gt;10%).</td>
</tr>
<tr>
<td>5b</td>
<td>Slope position variable; <em>Ledum groenlandicum</em> low cover (&lt;2%) or absent.</td>
</tr>
<tr>
<td>6a</td>
<td><em>Shepherdia canadensis</em> (soopolallie) (p. 49) moderate to high cover (&gt;5%); moss layer dominated by feathermosses.</td>
</tr>
<tr>
<td>6b</td>
<td><em>Shepherdia canadensis</em> low cover (&lt;2%) or absent, moss layer dominated by lichens.</td>
</tr>
</tbody>
</table>

\(^\text{10}\) Page numbers refer to the publication *Plants of Northern British Columbia* (MacKinnon et al. 1992).
8a Steep slope (>50%); mid- to upper slope; SE to SW aspect; lichens high cover (usually >10%).

SBSdh/03

8b Slope usually less than 50%; mid-slope, or lower to level and coarse-textured; lichens low cover (<2%) or absent.

SBSdh/01

7b Main canopy all hybrid white spruce (or may contain trembling aspen).

9a Lower slope to level; moderate to high shrub cover (>30%) dominated by *Rubus parviflorus* (thimbleberry) (p. 36), *Cornus stolonifera* (red-osier dogwood) (p. 48), *Viburnum edule* (high-bush-cranberry) (p. 35), and *Lonicera involucrata* (black twinberry) (p. 48).

SBSdh/06

9b Often mid-slope; low to moderate shrub cover (<30%) dominated by *Spiraea betulifolia* (birch-leaved spirea) (p. 46) and *Rosa acicularis* (prickly rose) (p. 27).

SBSdh/01

3b Main canopy mixed (lodgepole pine, Douglas-fir, hybrid white spruce, subalpine fir).

10a Steep slope (>50%), mid- to upper slope; SE to SW aspect; lichens high cover (>10%).

SBSdh/03

10b Slope usually less than 50%; slope positions variable; aspect variable; lichens low cover (usually <5%) or absent.

11a Level, or mid- to upper slope; moderate to high cover (usually >5%) of *Shepherdia canadensis*.

SBSdh/04
11b Level, or mid- to lower slope; *Shepherdia canadensis* low cover (<2%) or absent.

12a Lower slope to level; moderate to high shrub cover (>30%) dominated by *Rubus parviflorus*, *Cornus stolonifera*, *Viburnum edule*, and *Lonicera involucrata*.

SBSdh/06

12b Often mid-slope; low to moderate shrub cover (<30%) dominated by *Spiraea betulifolia* and *Rosa acicularis*.

SBSdh/01
VEGETATION

Tree Layer: 65% cover
   Douglas-fir, lodgepole pine, hybrid white spruce, [paper birch]

Shrub Layer: 20% cover
   Spiraea betulifolia (birch-leaved spirea)
   Rosa acicularis (prickly rose)
   Rubus parviflorus (thimbleberry)
   Viburnum edule (highbush-cranberry)
   Amelanchier alnifolia (saskatoon)
   [Vaccinium membranaceum (black huckleberry)]
   [Shepherdia canadensis (soopolallie)]
   subalpine fir

Herb Layer: 50% cover
   Orthilia secunda (one-sided wintergreen)
   Chimaphila umbellata (prince's pine)
   Linnaea borealis (twinflower)
   Goodyera oblongifolia (rattlesnake-plantain)
   Maianthemum racemosum (false Solomon's-seal)
   Pyrola chlorantha (green wintergreen)
   Cornus canadensis (bunchberry)
   Aralid nudicaulis (wild sarsaparilla)
   Oryzopsis asperifolia (rough-leaved ricegrass)
   Maianthemum canadense (wild lily-of-the-valley)

Moss Layer: 45% cover
   Pleurozium schreberi (red-stemmed feathermoss)
   Rhytididiadelphus triquetrus (electrified cat's-tail moss)
   Peltigera spp. (peltigera lichens)
   Hylocomium splendens (step moss)
   Dicranum polysetum (wavy-leaved moss)
   Ptilium crista-castrensis (knight's plume)

SOIL AND SITE
   Moisture Regime: 3–4 (submesic–mesic)
   Nutrient Regime: B–D (poor–rich)
   * Slope Gradient (%): 14 (0–55)
   Slope Position: variable
   Parent Material: commonly fluvial or morainal
   * Soil Texture: medium–coarse
   Coarse Fragments (%): 38 (0–77)

COMMENTS: toe to level slope positions have coarser-textured soils than mid-slope positions

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; **attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.**

Silviculture system: – see Section 5.1.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation: – light scarification for seedbed preparation or summer logging with no site preparation.

Species choice: – Fd, Pl, Sx, [Bl].

Vegetation potential: – low/moderate (thimbleberry, fireweed).

Reforestation: – if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
– if a partial-cutting system is used and abundant advance Fd regeneration is present, attempt to log in a manner that protects this regeneration.
– maintain Fd component, especially veterans that are valuable for wildlife and seed production.
– attempt to preserve advance Fd regeneration when partial cutting.
– fill-planting may be required to meet stocking requirements if a partial-cutting system is used.
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.

Concerns: – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; **site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.**
– full tree harvesting will lead to nutrient depletion and seriously reduce cones; **woody debris and cones should be distributed across these sites (i.e., lop and scatter).**
VEGETATION

Tree Layer: 35% cover
  lodgepole pine

Shrub Layer: 15% cover
  * Vaccinium myrtilloides (velvet-leaved blueberry)
  * Shepherdia canadensis (soopolallie)
  * lodgepole pine
  * [subalpine fir]

Herb Layer: 20% cover
  * Arctostaphylos uva-ursi (kinnikinnick)
  * Melampyrum lineare (cow-wheat)
  * [Cornus canadensis (bunchberry)]
  * Chimaphila umbellata (prince's pine)

Moss Layer: 60% cover
  * Cladina spp. (reindeer lichens)
  * Peltigera spp. (peltigera lichens)
  * Cladonia spp. (cladonia lichens)
  * Dicranum polysetum (wavy-leaved moss)
  * Pleurozium schreberi (red-stemmed feathermoss)
  * Stereocaulon spp. (coral lichens)

SOIL AND SITE

  Moisture Regime: 1–2 (xeric–subxeric)
  Nutrient Regime: A–B (very poor–poor)
  Slope Gradient (%): 7 (0–15)
  Slope Position: variable
  * Parent Material: glaciofluvial or aeolian
  * Soil Texture: coarse
  Coarse Fragments (%): 16 (0–80)

COMMENTS: moss layer of these sites is dominated by lichens

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – site and soil conditions of this unit result in marginal forest productivity; *serious consideration should be given to excluding logging from this unit.*

Silviculture system: – avoid logging.
VEGETATION

Tree Layer: 50% cover
Douglas-fir, lodgepole pine

Shrub Layer: 15% cover
Spiraea betulifolia (birch-leaved spirea)
Shepherdia canadensis (soopolallie)
Rosa acicularis (prickly rose)
[Alnus crispa ssp. sinuata (Sitka alder)]
Douglas-fir

Herb Layer: 20% cover
Calamagrostis rubescens (pinegrass)
Arctostaphylos uva-ursi (kinnikinnick)
Solidago spathulata (spike-like goldenrod)
Aster conspicuus (showy aster)
Campanula rotundifolia (common harebell)
[Leymus innovatus (fuzzy-spiked wildrye)]
[Piptatherum pungens (short-awned ricegrass)]

Moss Layer: 35% cover
Pleurozium schreberi (red-stemmed feathermoss)
Dicranum polysetum (wavy-leaved moss)
Ptilium crista-castrensis (knight's plume)
Polytrichum juniperinum (juniper haircap moss)
Cladina spp. (cladina lichens)

SOIL AND SITE

Moisture Regime: 1–2 (xeric–subxeric)
Nutrient Regime: B (poor)
* Aspect: southerly
* Slope Gradient (%): 66 (56–75)
* Slope Position: mid- to upper
Parent Material: colluvial or glaciofluvial
* Soil Texture: coarse–medium
Coarse Fragments (%): 52 (0–80)

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; **attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.**

Silviculture system: – see Section 5.1.

– avoid clearcutting, because stand establishment would likely be difficult due to high surface soil temperatures and drought.

Site preparation: – light scarification for seedbed preparation or summer logging with no site preparation.

Species choice: – *Fd, Lw, (Pw).*

Vegetation potential: – low.

Reforestation: – manage to maintain Fd component.

– fill-planting may be required after partial cutting.

Concerns:

– these units represent important wildlife habitat; **discuss prescription with fish and wildlife personnel.**

– site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; **natural regeneration is generally more adapted to surviving these conditions, especially during establishment.**

– site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; **leaving a shelterwood overstorey can reduce the severity of the drought hazard.**

– sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; **site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.**

– Pw will be subject to blister rust-induced mortality; **Pw should only be considered on a trial basis or as a minor component in the southern portion of the subzone.**

– Lw is extended beyond its normal range and should be used only on a trial basis.
VEGETATION

Tree Layer: 45% cover
lodgepole pine, [Douglas-fir]

Shrub Layer: 35% cover
Shepherdia canadensis  (soopolallie)
Spiraea betulifolia  (birch-leaved spirea)
Vaccinium myrtilloides  (velvet-leaved blueberry)
Rosa acicularis  (prickly rose)
Amelanchier alnifolia  (saskatoon)
Douglas-fir  [subalpine fir]
[hybrid white spruce]

Herb Layer: 50% cover
Linnaea borealis  (twinflower)
Chimaphila umbellata  (prince's pine)
Cornus canadensis  (bunchberry)
Maianthemum canadense  (wild lily-of-the-valley)
Orthilia secunda  (one-sided wintergreen)
Goodyera oblongifolia  (rattlesnake-plantain)
Arctostaphylos uva-ursi  (kinnikinnick)
Leymus innovatus  (fuzzy-spiked wildrye)
Melampyrum lineare  (cow-wheat)
Oryzopsis asperifolia  (rough-leaved ricegrass)
[Calamagrostis rubescens]  (pinegrass)]

Moss Layer: 80% cover
Pleurozium schreberi  (red-stemmed feathermoss)
Dicranum polysetum  (wavy-leaved moss)
Peltigera spp.  (peltigera lichens)
Hylocomium splendens  (step moss)

SOIL AND SITE
Moisture Regime:  2–3 (subxeric–submesic)
Nutrient Regime:  B–C (poor–medium)
Slope Gradient (%):  3 (0–14)
* Slope Position:  mid- to upper, or level
Parent Material:  fluvial, morainal
* Soil Texture:  moderately coarse–coarse
Coarse Fragments (%):  38 (0–85)

DISTRIBUTION:  very common
INTERPRETATIONS

Site limitations:  – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system:  – see Section 5.1.

Site preparation:  – light scarification for seedbed preparation or summer logging with no site preparation.

Species choice:  – Fd, Pl, (Sx).

Vegetation potential:  – low (fireweed, pinegrass).

Reforestation:  – if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
– if a partial-cutting system is used and abundant advance Fd regeneration is present, attempt to log in a manner that protects this regeneration.
– fill-planting may be required after partial cutting.
– if natural regeneration is not feasible, plant Pl.
– Sx will be significantly less productive than Fd or Pl on these sites.

Concerns:  – full tree harvesting will lead to nutrient depletion and seriously reduce cones; woody debris and cones should be distributed across these sites (i.e., lop and scatter).
– site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; natural regeneration is generally more adapted to surviving these conditions, especially during establishment.
– sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
– Pl may be at high risk to dwarf mistletoe infection.
VEGETATION

Tree Layer: 50% cover
lodgepole pine

Shrub Layer: 65% cover
Ledum groenlandicum (Labrador tea)
Vaccinium myrtilloides (velvet-leaved blueberry)
Shepherdia canadensis (soopolallie)
Salix spp. (willows)
Rosa acicularis (prickly rose)
Spiraea betulifolia (birch-leaved spirea)
lodgepole pine
trembling aspen
hybrid white spruce

Herb Layer: 50% cover
Vaccinium vitis-idaea (lingonberry)
Cornus canadensis (bunchberry)
Arctostaphylos uva-ursi (kinnikinnick)
Linnaea borealis (twinflower)
Diphasiastrum complanatum (ground-cedar)
Maianthemum canadense (wild lily-of-the-valley)
Oryzopsis asperifolia (rough-leaved ricegrass)
Lathyrus ochroleucus (creamy peavine)

Moss Layer: 95% cover
Pleurozium schreberi (red-stemmed feathermoss)
Dicranum polysetum (wavy-leaved moss)
Peltigera spp. (peltigera lichens)
Hylocomium splendens (step moss)

SOIL AND SITE

Moisture Regime: 2–5 (subxeric–subhygric)
Nutrient Regime: A–B (very poor–poor)
Slope Gradient (%): 1 (0–2)
* Slope Position: level
* Parent Material: fluvial
* Soil Texture: coarse
Coarse Fragments (%): 1 (0–2)

DISTRIBUTION: uncommon
### INTERPRETATIONS

<table>
<thead>
<tr>
<th>Site limitations:</th>
<th>– sites within this unit with coarse soils will have significantly reduced soil moisture and soil nutrient retention; <strong>attempt to regenerate naturally by retaining Pl cones on site.</strong></th>
</tr>
</thead>
</table>
| Silviculture system: | – see Section 5.1.  
  – minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard. |
| Site preparation: | – see Section 5.2. |
| Species choice: | – Pl, (Sb, Sx). |
| Vegetation potential: | – low. |
| Reforestation: | – attempt to regenerate naturally if potential exists.  
  – if natural regeneration is not feasible, plant Pl.  
  – Sx and Sb will generally be less productive than Pl on these sites. |
| Concerns: | – full tree harvesting will lead to nutrient depletion and seriously reduce cones; **woody debris and cones should be distributed across these sites (i.e., lop and scatter).**  
  – site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; **leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.**  
  – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; **site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.** |
VEGETATION

Tree Layer: 65% cover
- hybrid white spruce, trembling aspen, Douglas-fir, [lodgepole pine, subalpine fir, paper birch]

Shrub Layer: 45% cover
- *Rubus parviflorus* (thimbleberry)
- *Cornus stolonifera* (red-osier dogwood)
- *Viburnum edule* (highbush-cranberry)
- *Lonicera involucrata* (black twinberry)
- *Spiraea betulifolia* (birch-leaved spirea)
- *Amelanchier alnifolia* (saskatoon)
- *Rosa acicularis* (prickly rose)
- *Vaccinium myrtilloides* (velvet-leaved blueberry)
- Menziesia ferruginea (false azalea)
- subalpine fir
- hybrid white spruce

Herb Layer: 55% cover
- *Aralia nudicaulis* (wild sarsaparilla)
- *Linnaea borealis* (twinflower)
- *Orthilia secunda* (one-sided wintergreen)
- *Cornus canadensis* (bunchberry)
- *Maianthemum racemosum* (false Solomon’s-seal)
- *Maianthemum canadense* (wild lily-of-the-valley)
- *Galium triflorum* (sweet-scented bedstraw)
- *Prosartes hookeri* (Hooker’s fairybells)
- *Oryzopsis asperifolia* (rough-leaved ricegrass)
- *Chimaphila umbellata* (prince’s pine)

Moss Layer: 40% cover
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Rhytidiadelphus triquetrus* (electrified cat’s-tail moss)
- *[Ptilium crista-castrensis]* (knight’s plume)
- *[Hylocomium splendens]* (step moss)

SOIL AND SITE

- Moisture Regime: 4–5 (mesic–subhygric)
- Nutrient Regime: B–D (poor–rich)
- * Slope Gradient (%): 6 (0–13)
- * Slope Position: lower to level
- Parent Material: variable
- Soil Texture: variable
- Coarse Fragments (%): 16 (0–40)
- * Seepage Water: may be present

DISTRIBUTION: common, especially on sites that receive limited seepage
INTERPRETATIONS

Site limitations:  – sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; *plant stock that will achieve better lateral root development* (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.

Silviculture system:  – see Section 5.1.

Site preparation:  – see Section 5.2.

Species choice:  – Fd, Sx, [Pl, B1].

Vegetation potential:  – moderate (black twinberry, thimbleberry, fireweed).

Reforestation:  – if Fd stems are present, conduct a stand evaluation to assess if a partial-cutting system is feasible.
– if a partial-cutting system is used and abundant advance Fd regeneration is present, attempt to log in a manner that protects this regeneration.
– maintain Fd component, especially veterans that are valuable for wildlife and seed production.
– young B1 regeneration (<3 m tall) may be susceptible to heavy browsing by moose.

Concerns:  – sites within this unit with fine-textured soils are vulnerable to compaction under wet conditions; *restrict traffic to winter operations or dry soil conditions.*
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.*
### VEGETATION

**Tree Layer:** 65% cover
- hybrid white spruce, black cottonwood, [subalpine fir]

**Shrub Layer:** 35% cover
- *Cornus stolonifera* (red-osier dogwood)
- *Viburnum edule* (highbush-cranberry)
- *Lonicera involucrata* (black twinberry)
- *Rosa acicularis* (prickly rose)
- *Rubus idaeus* (red raspberry)

**Herb Layer:** 60% cover
- *Galium triflorum* (sweet-scented bedstraw)
- *Equisetum arvense* (common horsetail)
- *Cornus canadensis* (bunchberry)
- *Aralia nudicaulis* (wild sarsaparilla)
- *Maianthemum racemosum* (false Solomon’s-seal)
- *Rubus pubescens* (trailing raspberry)
- *Petasites frigidus var. palmatus* (palmate coltsfoot)
- *Mitella nuda* (common mitrewort)
- *Orthilia secunda* (one-sided wintergreen)
- *Gymnocarpium dryopteris* (oak fern)

**Moss Layer:** 30% cover
- *Rhytidiadelphus triquetrus* (electrified cat’s-tail moss)
- *Hylocomium splendens* (step moss)
- *Ptilium crista-castrensis* (knight’s plume)
- *Mnium spp.* (leafy mosses)
- *Pleurozium schreberi* (red-stemmed feathermoss)

### SOIL AND SITE

- **Moisture Regime:** 5–6 (subhygric–hygric)
- **Nutrient Regime:** C–E (medium–very rich)
- **Slope Gradient (%):** 0 (0–2)
- **Slope Position:** level
- **Parent Material:** fluvial
- **Soil Texture:** medium–coarse
- **Coarse Fragments (%):** 18 (0–86)
- **Seepage Water:** often present

### COMMENTS:
these sites often have a fluctuating water table

### DISTRIBUTION:
common, but small in area; occurs along rivers and creeks
INTERPRETATIONS

Site limitations:  – very difficult sites to manage; serious consideration should be given to managing these sites as wildlife corridors.
– sites within this unit are subject to periodic flooding; plant seedlings on naturally or artificially raised microsites.

Silviculture system:  – see Section 5.1.

Site preparation:  – see Section 5.2.
– creating an excessive number of microsites (e.g., >300/ha) should be avoided, especially on sites with a water table <30 cm from the surface.

Species choice:  – *Fd*, *Pl*, *Sx*, [*Bl*].

Vegetation potential:  – very high (black twinberry, lady fern, fireweed).

Reforestation:  – careful assessment of plantable and preparable raised microsites should be made to determine target stocking levels.
– young Bl regeneration (<3 m tall) may be susceptible to heavy browsing by moose.
– advance regeneration should be preserved.
– supplement advance regeneration by planting sturdy stock in groups, using available microsites.

Concerns:  – site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., *Pl*) are advised.
– sites within this unit with thick organic horizons (>10 cm), in conjunction with high water tables, have increased windthrow hazard; block layouts must have wind-firm boundaries, or a wide buffer of standing timber must be left around such sites.
– this unit is critical to the control of runoff streamflow.
– these units represent important wildlife habitat; discuss prescription with fish and wildlife personnel.
– sites with thick organic horizons reduce spring soil temperatures, slowing root development; attempt to reduce organic horizon thickness during site preparation.
VEGETATION

Tree Layer: 15% cover
- black spruce, [lodgepole pine]

Shrub Layer: 65% cover
- *Ledum groenlandicum* (Labrador tea)
- *Betula glandulosa* (scrub birch)
- *Salix spp.* (willows)
- *Rosa acicularis* (prickly rose)
- black spruce

Herb Layer: 60% cover
- *Carex spp.* (sedges)
- *Oxycoccus oxyccos* (bog cranberry)
- *Drosera rotundifolia* (round-leaved sundew)
- *Smilacina trifolia* (three-leaved false Solomon's-seal)
- *Vaccinium vitis-idaea* (lingonberry)
- *Rubus arcticus* (dwarf nagoonberry)
- *[Calamagrostis canadensis]* (bluejoint)
- *[Potentilla palustris]* (marsh cinquefoil)

Moss Layer: 95% cover
- *Sphagnum spp.* (sphagnums)
- *Tomentypnum nitens* (golden fuzzy fen moss)
- *Aulacomnium palustre* (glow moss)
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Polytrichum strictum* (bog haircap moss)

SOIL AND SITE

Moisture Regime: 7 (subhydric)
Nutrient Regime: A–C (very poor–medium)
* Slope Gradient (%):
  0 (0–2)
* Slope Position: level or depression
Parent Material: organic
Coarse Fragments (%): 0
* Water Table: close to surface

DISTRIBUTION: common
INTERPRETATIONS

Site limitations:  – site and soil conditions of this unit result in marginal forest productivity; *serious consideration should be given to excluding logging from this unit.*

Silviculture system:  – avoid logging.
4.5  Raush Moist Mild Engelmann Spruce–Subalpine Fir

Location
The ESSFmm1 is the subalpine variant at middle to upper elevations in the Rocky Mountain Trench and adjacent side valleys from north of McBride (Morkill River, Dore River) to near Mica and Kinbasket reservoir (Hugh Allen Creek) The Robson variant (ESSFmm2), not described in this field guide, occurs only in Mount Robson Park.

Elevation range
990–1800 m

Climate
The moist subalpine climate of the ESSFmm1 is drier than the ESSF variants it borders to the north and south. This is due to the rainshadow effect of the Premier Range to the west of this area. The ESSFmm1 has higher precipitation, cooler temperatures, and, therefore, a shorter growing season than the ICH variants found at lower elevations.

There are only a few short-term climate stations to characterize the climate of this variant. These stations indicate that the mean seasonal (May–Sept.) precipitation is about 350 mm. Although all ESSF biogeoclimatic units are subject to severe and limiting temperature regimes, this variant is judged to be relatively “mild.”

Forests
Forests of the ESSFmm1 are dominated by subalpine fir and Engelmann spruce. These two species are a major component of most seral stands and are the climax species throughout the variant. At the upper elevations of this zone, where the climate becomes most severe, the forests become more open, and eventually form clumped, stunted stands (krummholz). This area is known as parkland and is designated as a parkland subzone (ESSFmm1p). Lodgepole pine is common on drier sites as a seral component of many ecosystems. At lower elevations of the variant, western hemlock can be quite frequent and the occasional Douglas-fir, western redcedar, or western white pine can be found.
Soils, geology, and landforms
East of the Rocky Mountain Trench, the Selwyn and Park ranges consist predominantly of diverse sedimentary and metamorphic rocks of the Precambrian Miette Group. West of the Trench, in the Cariboo Mountains, including the Premier Ranges, the Precambrian bedrock consists of sedimentary and metamorphic rocks of the Kaza Group (sandstone, conglomerate) and Isaac Formation (including phyllite, argillite, and schist). Soils consist predominantly of Humo-Ferric Podzols formed on steep, sandy colluvial or morainal deposits.

Distinguishing the ESSFmm1 from adjoining biogeoclimatic units

ICHmm has:
• western hemlock and western redcedar present in the canopy of most sites;
• no white-flowered rhododendron present in the shrub layer; and
• more devil's club present on subhygric to hygric sites.

SBSDh has:
• prickly rose present on most sites;
• no white-flowered rhododendron present in the shrub layer;
• Douglas-fir present in the canopy of subxeric to mesic sites; and
• kinnikinnick present on dry sites.

ICHwk3 has:
• western hemlock and western redcedar present in the canopy of most sites;
• no white-flowered rhododendron present in the shrub layer; and
• lady fern present on hygric sites.

ESSFwc2 has:
• falsebox present on dry sites;
• less false azalea present on wet sites;
• more oak fern present on wet sites; and
• little or no red-stemmed feathermoss present on wet sites.
ESSFw3c has:
• more oak fern present on dry sites;
• more black twinberry present on wet sites; and
• less bunchberry present in the herb layer of most sites.

ICHwki1 has:
• western hemlock and western redcedar present in the canopy of most sites;
• no white-flowered rhododendron present in the shrub layer; and
• devil’s club present on mesic sites.

ESSFwki1 has:
• more white-flowered rhododendron present on dry sites;
• more oval-leaved blueberry present on xeric to mesic sites;
• more black twinberry present on wet sites; and
• more oak fern present on dry sites.

**Ecosystem management**

These forest ecosystems were historically usually even-aged but extended post-fire regeneration periods produce stands that are uneven-aged and possess multistoreyed canopies. Stand-destroying wildfires were often of moderate size (20–1000 ha) with patches of unburned areas due to chance, sheltering terrain features, or higher site moisture. Many larger fires occurred after periods of extended drought but the landscape was dominated by extensive areas of mature forest surrounding patches of younger forest. Stand-destroying fires are more common on southern aspects, hence mature forest is more prevalent and widespread on northern aspects. Return cycles for stand-initiating events were approximately 200 years.
**Figure 1** Edatopic grid displaying site units of the ESSFmm1 variant.
## ESSFm1 vegetation table

<table>
<thead>
<tr>
<th>Site Series</th>
<th>02</th>
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<th>04</th>
<th>01</th>
<th>05</th>
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<tbody>
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<td><strong>Trees</strong></td>
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<td>Pinus contorta</td>
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<td>Abies lasiocarpa</td>
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<td>Vaccinium membranaceum</td>
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<td>Rhododendron albiflorum</td>
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<td>Menziesia ferruginea</td>
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<td>Ledum groenlandicum</td>
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<td><strong>Herbs and Dwarf Shrubs</strong></td>
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<td>Lycopodium annotinum</td>
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<td>Dryopteris expansa</td>
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<td>Gymnocarpium dryopteris</td>
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<td>Equisetum arvense</td>
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<td><strong>Mosses and Lichens</strong></td>
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<td>Cladonia spp.</td>
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<td>Pleurozium schreberi</td>
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<td>Sphagnum spp.</td>
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Prominence class: 1 2 3 4 5
Site Series Key

1a Organic soils, or thick humus (>15 cm) over wet, poorly drained mineral soils; *Ledum groenlandicum* (Labrador tea) (p. 40)¹¹ moderate to high cover (>5%).

**ESSFmm1/07**

1b Mineral soils, usually with thinner humus layer over better-drained soils; *Ledum groenlandicum* absent.

2a *Oplopanax horridus* (devil’s club) (p. 36) moderate to high cover (usually >2%), *Mnium* spp. (leafy mosses) (pp. 307–308) moderate to high cover (usually >2%); seepage water may be present.

**ESSFmm1/06**

2b *Oplopanax horridus* absent, *Mnium* spp. low cover (<1%) or absent; seepage water usually absent.

3a *Gymnocarpium dryopteris* (oak fern) (p. 293) moderate to high cover (usually >5%); *Dryopteris expansa* (spiny wood fern) (p. 292) moderate cover (usually >2%); lower to toe slope.

**ESSFmm1/05**

3b *Gymnocarpium dryopteris* low cover (<2%) or absent; *Dryopteris expansa* absent; mid- to upper slope.

4a *Vaccinium myrtilloides* (velvet-leaved blueberry) (p. 42) and *Cladina* spp. (reindeer lichens) (p. 334) high cover (>10%); colluvial veneer over bedrock.

**ESSFmm1/03**

4b *Vaccinium myrtilloides* and *Cladina* spp. low to moderate cover (usually <10% combined) or absent; various soil parent materials.

5a *Menziesia ferruginea* (false azalea) and *Rhododendron albiflorum* (white-flowered rhododendron) (p. 41) low cover (<1%) or absent; steep colluvial veneer over bedrock, or glaciofluvial.

**ESSFmm1/02**

¹¹ Page numbers refer to the publication *Plants of Northern British Columbia* (MacKinnon et al. 1992).
5b *Menziesia ferruginea* and *Rhododendron albiflorum* moderate to high cover (usually $>2\%$); various soil parent materials.

6a Herb layer reasonably well developed (>15% cover); *Orthilia secunda* (one-sided wintergreen) (p. 183), *Lycopodium annotinum* (stiff club-moss) (p. 287), and *Rubus pedatus* (five-leaved bramble) (p. 92) usually present; mid-to lower slope.  

ESSFmm1/01

6b Herb layer poorly developed (<10% cover); two or more of *Orthilia secunda*, *Lycopodium annotinum*, and *Rubus pedatus* absent; upper slope position.  

ESSFmm1/04
VEGETATION

Tree Layer: 50% cover
   Engelmann spruce, subalpine fir, lodgepole pine

Shrub Layer: 65% cover
   Menziesia ferruginea (false azalea)
   Vaccinium membranaceum (black huckleberry)
   Ribes lacustre (black gooseberry)
   [Rhododendron albiflorum (white-flowered rhododendron)]

   subalpine fir

Herb Layer: 25% cover
   Orthilia secunda (one-sided wintergreen)
   Lycopodium annotinum (stiff club-moss)
   Cornus canadensis (bunchberry)
   Rubus pedatus (five-leaved bramble)
   Listera cordata (heart-leaved twayblade)

Moss Layer: 75% cover
   Pleurozium schreberi (red-stemmed feathermoss)
   Ptilium crista-castrensia (knight’s plume)
   Barbilophozia lycopodioides (common leafy liverwort)
   Hylocomium splendens (step moss)

SOIL AND SITE

   Moisture Regime: 3–4 (submesic–mesic)
   Nutrient Regime: B–D (poor–rich)
   Slope Gradient (%): 29 (0–67)
   * Slope Position: mid–lower
   Parent Material: variable
   * Soil Texture: medium–coarse
   Coarse Fragments (%): 45 (1–75)

DISTRIBUTION: common
INTERPRETATIONS

Site limitations:  – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system:  – see Section 5.1.
 – minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation:  – see Section 5.2.

Species choice:  – Bl, Se, [Pl].

Vegetation potential:  – moderate (false azalea, red raspberry, thimbleberry, fireweed).

Reforestation:  – plant stock with large caliper and low shoot-to-root ratio immediately after harvest.
 – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
 – log on firm snowpack to protect advance regeneration.
 – heavy snowpack may cause stem deformity of Pl, especially on steep slopes.
 – planting Pl may be an option on these sites below 1100 m, but provenances from high-elevation, high-snowpack areas must be used.

Concerns:  – trafficability may be a problem on these sites during the summer.
 – spruce beetle may infest partial-cut stands after harvesting; minimize blowdown and avoid mechanical damage to residuals.
 – heavy snowpack may cause stem deformity, especially on steep slopes; obstacle planting is advised.
 – sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
 – this unit is critical to the control of runoff streamflow.
VEGETATION

Tree Layer: 25% cover
   Engelmann spruce, subalpine fir, lodgepole pine

Shrub Layer: 50% cover
   Vaccinium membranaceum  (black huckleberry)
   Amelanchier alnifolia  (saskatoon)
   Sorbus scopulina  (western mountain-ash)
   subalpine fir
   hybrid white spruce

Herb Layer: 5% cover
   Chimaphila umbellata  (prince's pine)

Moss Layer: 90% cover
   Pleurozium schreberi  (red-stemmed feathermoss)
   Dicranum scoparium  (broom-moss)
   Aulacomnium palustre  (glow moss)
   Barbilophozia spp.  (leafy liverworts)
   Cladina mitis  (green reindeer lichen)
   Hylocomium splendens  (step moss)
   Peltigera aphthosa  (freckle lichen)

SOIL AND SITE

Moisture Regime: 1 (xeric)
Nutrient Regime: A–B (very poor–poor)
* Aspect southerly
* Slope Gradient (%): steep
Slope Position: mid- to upper
* Parent Material: colluvial veneer
Soil Texture: coarse
Coarse Fragments (%): high

COMMENTS: limited data because of the rarity of the ecosystem

DISTRIBUTION: rare and dispersed
INTERPRETATIONS

Site limitations:  – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; **attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.**

Silviculture system:  – see Section 5.1.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation:  – see Section 5.2.

Species choice:  – **Bl, Pl, Se.**

Vegetation potential:  – low.

Reforestation:  – plant Bl and Se on moister microsites.
– heavy snowpack may cause stem deformity, especially on steep slopes; **obstacle planting is advised.**

Concerns:  – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; **site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.**
– full tree harvesting will lead to nutrient depletion and seriously reduce cones; **woody debris and cones should be distributed across these sites (i.e., lop and scatter).**
– site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; **natural regeneration is generally more adapted to surviving these conditions, especially during establishment.**
VEGETATION

Tree Layer: 25% cover
  lodgepole pine, [Engelmann spruce, subalpine fir]

Shrub Layer: 55% cover
  * Vaccinium myrtilloides  (velvet-leaved blueberry)
  * Menziesia ferruginea  (false azalea)
  * Vaccinium membranaceum  (black huckleberry)
  subalpine fir
  lodgepole pine

Herb Layer: 5% cover
  * Cornus canadensis  (bunchberry)
  * Linnaea borealis  (twinflower)

Moss Layer: 80% cover
  * Pleurozium schreberi  (red-stemmed feathermoss)
  * Cladonia spp.  (cladonia lichens)
  * Peltigera aphthosa  (freckle lichen)
  [Cladina mitis  (green reindeer lichen)]

SOIL AND SITE

  Moisture Regime: 1–2 (xeric–subxeric)
  Nutrient Regime: A–B (very poor–poor)
  Slope Gradient (%): 12 (6–18)
  Slope Position: mid
  * Parent Material: glaciofluvial
  * Soil Texture: coarse or moderately coarse
  Coarse Fragments (%): 65 (54–75)

COMMENTS: limited data because of the rarity of the ecosystem

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations:  – sites with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.
– very difficult sites to manage; serious consideration should be given to managing these sites as wildlife corridors.

Silviculture system:  – see Section 5.1.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation:  – see Section 5.2.

Species choice:  – Pl, (Bl, Se).

Vegetation potential:  – low.

Reforestation:
– Bl and Se will be significantly less productive than Pl on these sites.
– advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.

Concerns:  – site and soil conditions of this unit result in drought hazard for a significant portion of the growing season; natural regeneration is generally more adapted to surviving these conditions, especially during establishment.
– full tree harvesting will lead to nutrient depletion and seriously reduce cones; woody debris and cones should be distributed across these sites (i.e., lop and scatter).
– sites with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
– these units represent important wildlife habitat; discuss prescription with fish and wildlife personnel.
VEGETATION

Tree Layer: 35% cover
subalpine fir, Engelmann spruce, [lodgepole pine]

Shrub Layer: 85% cover
*Menziesia ferruginea* (false azalea)
*Rhododendron albiflorum* (white-flowered rhododendron)
*Vaccinium membranaceum* (black huckleberry)
subalpine fir

Herb Layer: 5% cover
[Cornus canadensis] (bunchberry)

Moss Layer: 90% cover
*Pleurozium schreberi* (red-stemmed feathermoss)
*Dicranum fuscescens* (curly heron’s-bill moss)
*Barbilophozia lycopodioides* (common leafy liverwort)
*Cladonia spp.* (cladonia lichens)
*Ptilium crista-castrensis* (knight’s plume)
[Barbilophozia floerkei] (mountain leafy liverwort)

SOIL AND SITE

Moisture Regime: 2 (subxeric)
Nutrient Regime: B–C (poor–medium)
Slope Gradient (%): 45 (22–60)
* Slope Position: upper
Parent Material: morainal or colluvial
* Soil Texture: coarse
Coarse Fragments (%): 62 (39–75)

COMMENTS: often shallow soils over bedrock

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation: – see Section 5.2.

Species choice: – Bl, Se, [Pl].

Vegetation potential: – moderate (false azalea, fireweed).

Reforestation: – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– reduce spruce beetle hazard by avoiding high stumps and shaded slash >15 cm diameter.
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.
– advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– if heavy equipment is used in summer, during or after partial cutting, every attempt should be made to avoid disturbing roots of standing trees.
– trafficability may be a problem on these sites during the summer.
– fill-planting may be required to meet stocking requirements if a partial-cutting system is used.

Concerns: – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
– heavy snowpack may cause stem deformity of Pl, especially on steep slopes; obstacle planting is advised.
– spruce beetle may infest partial-cut stands after harvesting; minimize blowdown and avoid mechanical damage to residuals.
– this unit is critical to the control of runoff streamflow.
**VEGETATION**

**Tree Layer:** 40% cover
- subalpine fir, Engelmann spruce

**Shrub Layer:** 85% cover
- *Menziesia ferruginea* (false azalea)
- *Vaccinium membranaceum* (black huckleberry)
- *Ribes lacustre* (black gooseberry)
- *Vaccinium ovalifolium* (oval-leaved blueberry)
- [*Rhododendron albidiflorum* (white-flowered rhododendron)]

**Herb Layer:** 40% cover
- *Rubus pedatus* (five-leaved bramble)
- *Tiarella spp.* (foamflowers)
- *Lycopodium annotinum* (stiff club-moss)
- *Gymnocarpium dryopteris* (oak fern)
- *Dryopteris expansa* (spiny wood fern)
- *Orthilia secunda* (one-sided wintergreen)
- *Listera cordata* (heart-leaved twayblade)
- *Cornus canadensis* (bunchberry)
- [*Valeriana sitchensis* (Sitka valerian)]

**Moss Layer:** 90% cover
- *Pleurozium schreberi* (red-stemmed feathermoss)
- *Ptilium crista-castrensis* (knight's plume)
- *Barbilophozia* spp. (leafy liverworts)
- [*Hylocomium splendens* (step moss)]

**SOIL AND SITE**
- **Moisture Regime:** 5 (subhygric)
- **Nutrient Regime:** B–D (poor–rich)
- **Slope Gradient (%):** 30 (14–64)
  - **Slope Position:** lower–toe, or mid-
    - with northerly aspect
  - **Parent Material:** variable
  - **Soil Texture:** variable
- **Coarse Fragments (%):** 42 (12–80)

**DISTRIBUTION:** common
**ESSFmm1/05**  
**BL – Oak fern – Bramble**

**INTERPRETATIONS**

**Site limitations:**  
- sites with medium- to fine-textured lacustrine soils often have poor soil structure, leading to poor root growth; *plant stock that will achieve better lateral root development* (e.g., Cu-treated), prescribe natural regeneration, or protect advance regeneration.

**Silviculture system:**  
- see Section 5.1.

**Site preparation:**  
- see Section 5.2.

**Species choice:**  
- Bl, Se, [Pl].

**Vegetation potential:**  
- very high (false azalea, red raspberry, fireweed).

**Reforestation:**  
- under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.  
- reduce spruce beetle hazard by avoiding high stumps and shaded slash >15 cm diameter.  
- try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.  
- advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).  
- if heavy equipment is used in summer, during or after partial cutting, every attempt should be made to avoid disturbing roots of standing trees.  
- plant stock with large caliper and low shoot-to-root ratio immediately after harvest.

**Concerns:**  
- sites within this unit with silty soils are susceptible to frost heaving; *bareroot stock will likely resist frost heaving better than plug stock.*  
- sites unit with thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have wind-firm boundaries, or a wide buffer of standing timber must be left around such sites.*  
- sites with fine-textured soils are vulnerable to compaction under wet conditions; *restrict traffic to winter operations or dry soil conditions.*  
- heavy snowpack may cause stem deformity of Pl, especially on steep slopes; *obstacle planting is advised.*  
- trafficability may be a problem on these sites during the summer.  
- this unit is critical to the control of runoff streamflow.
BI – Devil’s club – Lady fern

VEGETATION

Tree Layer: 45% cover
Engelmann spruce, subalpine fir

Shrub Layer: 75% cover
Oplopanax horridus (devil’s club)
Menziesia ferruginea (false azalea)
Ribes lacustre (black gooseberry)
Vaccinium membranaceum (black huckleberry)
Rubus idaeus (red raspberry)
[Vaccinium ovalifolium (oval-leaved blueberry)]
[Rubus parviflorus (thimbleberry)]
subalpine fir

Herb Layer: 55% cover
Gymnocarpium dryopteris (oak fern)
Rubus pedatus (five-leaved Bramble)
Dryopteris expansa (spiny wood fern)
Cornus canadensis (bunchberry)
Lycopodium annotinum (stiff club-moss)
Tiarella spp. (foamflowers)
Streptopus amplexifolius (clasping twistedstalk)
Athyrium filix-femina (lady fern)
Equisetum spp. (horsetails)

Moss Layer: 60% cover
Mnium spp. (leafy mosses)
Pleurozium schreberi (red-stemmed feathermoss)
Ptilium crista-castrensis (knight’s plume)
Barbilophozia lycopodioides (common leafy liverwort)
Hylocomium splendens (step moss)

SOIL AND SITE

Moisture Regime: 5–6 (subhygric–hygric)
Nutrient Regime: B–D (poor–rich)
Slope Gradient (%): 28 (7–52)
* Slope Position: lower–toe
Parent Material: variable
Soil Texture: variable
Coarse Fragments (%): 49 (10–83)

COMMENTS: this association is very similar to the
ESSFmm1/05, although it is more productive and tends to be
found at lower elevations within the variant

DISTRIBUTION: fairly common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Bl, Se, [Pl].

Vegetation potential: – very high (red raspberry, fireweed, devil’s club).

Reforestation: – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– reduce spruce beetle hazard by avoiding high stumps and shaded slash >15 cm diameter.
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.
– advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– if heavy equipment is used in summer, during or after partial cutting, every attempt should be made to avoid disturbing roots of standing trees.
– trafficability may be a problem on these sites during the summer.
– plant stock with large caliper and low shoot-to-root ratio immediately after harvest.
– fill-planting may be required after partial cutting.

Concerns: – water table will likely rise above the ground surface in the spring, causing seedling mortality.
– this unit is critical to the control of runoff streamflow.
– sites within this unit with fine-textured soils are vulnerable to compaction under wet conditions; restrict traffic to winter operations or dry soil conditions.
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
### VEGETATION

**Tree Layer:** 20% cover  
hybrid white spruce, subalpine fir

**Shrub Layer:** 75% cover  
- *Ledum groenlandicum* (Labrador tea)  
- *Lonicera involucrata* (black twinberry)  
- *Ribes lacustre* (black gooseberry)  
- *Menziesia ferruginea* (false azalea)  
- *Salix spp.* (willows)  
- subalpine fir  
hybrid white spruce

**Herb Layer:** 65% cover  
- *Equisetum arvense* (common horsetail)  
- *Carex spp.* (sedges)  
- *Calamagrostis canadensis* (bluejoint)  
- *Petasites frigidus var. palutinus* (palmate coltsfoot)  
- *Rubus pedatus* (five-leaved bramble)  
- *Pyrola asarifolia* (pink wintergreen)  
- *Lycopus canadensis* (stiff club-moss)  
- *Cornus canadensis* (bunchberry)  
- *Epilobium angustifolium* (fireweed)  
- *Gymnocarpium dryopteris* (oak fern)  
- *Leptarrhena pyrolifolia* (leatherleaf saxifrage)  
- *Vaccinium caespitosum* (dwarf blueberry)

**Moss Layer:** 65% cover  
- *Sphagnum spp.* (sphagnums)  
- *Pleurozium schreberi* (red-stemmed feathermoss)  
- *Hylocomium splendens* (step moss)  
- *Mnium spp.* (leafy mosses)  
- *Aulacomnium palustre* (glow moss)  
- *Ptilium crista-castrensis* (knight’s plume)  
- *Marchantia polymorpha* (green-tongue liverwort)

### SOIL AND SITE

**Moisture Regime:** 7 (subhydric)  
**Nutrient Regime:** A–B (very poor–poor)  
* Slope Gradient (%): 8 (3–13)  
* Slope Position: lower–toe  
* Parent Material: fluvial, sometimes with organic capping  
**Soil Texture:** medium–fine or organic  
**Coarse Fragments (%):** 14 (0–35)

### DISTRIBUTION:

rare and small in area
INTERPRETATIONS

Site limitations: – site and soil conditions of this unit result in marginal forest productivity; *serious consideration should be given to excluding logging from this unit.*

Silviculture system: – avoid logging.
4.6 Northern Monashee Wet Cold Engelmann Spruce–Subalpine Fir

Location
The ESSFwc2 occurs in the southern end of the area covered by this guide. It occurs as far north as Baker Creek on the eastern side of the valley and Windfall Creek on the western side.

Elevation Range
1150–1845 m

Climate
Although no long-term climate data exist for the ESSFwc2, this unit is most likely wetter than the ESSFmm1 due to greater precipitation in the form of rain and snow.

Forests
Climax forests are dominated by subalpine fir and Engelmann spruce. Lodgepole pine and Douglas-fir are found on drier sites. Western hemlock occurs as a scattered component of lower canopy and shrub layers on submesic and mesic sites. Extensive older climax stands are frequent in this unit because of the high level of precipitation and concomitant infrequency of wildfire occurrence. At upper elevations, where the climate becomes most severe, the forest becomes more open and eventually forms clumped, stunted stands (krummholz). This area is referred to as parkland and can be designated as a parkland variant (i.e., ESSFwcp2).

Soils, geology, and landforms
In the Selwyn Range, east of the Rocky Mountain Trench, this subzone is underlain by Cambrian quartzites and limestones, while west of the Trench, Monashee Range is composed of a variety of metamorphic rocks of the Kaza Group, including quartzite, phyllite, schist, and gneiss. Soils consist predominantly of Humo-Ferric Podzols formed on steep, sandy colluvial or morainal deposits.

12 This unit was described as the ESSFb in Land Management Handbook 15.
Distinguishing the ESSFwc2 from adjoining biogeoclimatic units

ICHmm has:
- western hemlock and western redcedar present in the canopy of most sites;
- no white-flowered rhododendron present in the shrub layer; and
- devil’s club present on mesic sites.

ICHwk1 has:
- western hemlock and western redcedar present in the canopy of most sites;
- devil’s club present on mesic sites; and
- no white-flowered rhododendron present in the shrub layer.

ESSFmm1 has:
- no falsebox present in the shrub layer;
- more false azalea present on wet sites;
- less oak fern present on wet sites; and
- more red-stemmed feathermoss present on wet sites.

Ecosystem management
Historically, these forest ecosystems were usually uneven-aged or multi-storeyed even-aged, with regeneration occurring in gaps created by the death of individual trees or small patches of trees. When disturbances such as wind, fire, and landslides occurred they were generally small and resulted in irregular edge configurations and landscape patterns. Return cycles for stand-initiating events were in the neighbourhood of 350 years. Extended intervals between stand-destroying events has led to the overwhelming majority of forests within this unit attaining an old-growth condition.
**Figure 20** Edatopic grid displaying site units of the ESSFwc2 variant.
**FIGURE 21**  
ESSFwc2 vegetation table.
ESSFwc2  SITE SERIES KEY

1a  Non-forested; flats and depressions; water table within 25 cm of soil surface; Carex spp. (sedges) (pp. 258–274)\textsuperscript{13} or Calamagrostis canadensis (bluejoint) (p. 239) high cover (>10%).

ESSFwc2/10

1b  Forested; slope position variable; water table variable; Carex spp. or Calamagrostis canadensis cover variable, usually <10%.

2a  Canopy dominated by lodgepole pine

3a  Crests and steep upper slopes; Douglas-fir often present in canopy; Vaccinium membranaceum (black huckleberry) (p. 42) high cover (>10%); Vaccinium caespitosum (dwarf blueberry) (p. 84) low cover (<1%) or absent.

ESSFwc2/02

3b  Level slope positions; Douglas-fir absent; Vaccinium membranaceum absent; Vaccinium caespitosum very high cover (>20%).

ESSFwc2/09

2b  Canopy dominated by Engelmann spruce and/or subalpine fir

4a  Middle slopes to depression; herb layer well developed (usually >30% cover).

5a  Middle to lower slopes and depressions; moderate to high cover (>5%) of two or more of Athyrium filix-femina (lady fern) (p. 291), Equisetum spp. (horsetails) (pp. 281–284), Senecio triangularis (arrow-leaved groundsel) (p. 107), or Oplopanax horridus (devil’s club) (p. 36).

6a  Middle, lower, and level slopes; Oplopanax horridus high cover (>10%) and Athyrium filix-femina high cover (>20%); Senecio triangularis low cover (<2%) or absent.

ESSFwc2/07

\textsuperscript{13} Page numbers refer to the publication Plants of Northern British Columbia (MacKinnon et al. 1992).
6b Toe slopes, flats, and depressions; *Oplopanax horridus* and *Athyrium filix-femina* low cover (<2%) or absent; *Senecio triangularis* moderate to high cover (usually >5%).

ESSFwc2/08

5b Slope position variable but not to depressions; two or more of *Athyrium filix-femina*, *Equisetum* spp., *Senecio triangularis*, and *Oplopanax horridus* low cover (<2%) or absent.

7a Shrub layer well developed with one or more of *Rhododendron albiflorum* (white-flowered rhododendron) (p. 41), *Vaccinium membranaceum*, or *Menziesia ferruginea* (false azalea) (p. 41) having high cover (>15%); seepage water usually absent.

ESSFwc2/01

7b Shrub layer poorly developed (<15% cover); seepage water may occur.

ESSFwc2/06

4b Middle to upper slopes and crest; herb layer poorly developed with low cover (often <20%).

8a Crest and steep upper slopes; shrub layer dominated by *Vaccinium membranaceum* (usually >20% cover), with *Rhododendron albiflorum* cover low (<5%) or absent.

ESSFwc2/03

8b Slope position variable; shrub layer not dominated by *Vaccinium membranaceum*, *Rhododendron albiflorum* cover frequently extremely high (>50%).

9a Crests and upper slopes; *Menziesia ferruginea* cover very high (usually >40%); slope gradient usually <15%.

ESSFwc2/05

9b Middle and upper slopes; *Menziesia ferruginea* cover low (<2%) or absent; slope gradient usually >15%.

ESSFwc2/04
VEGETATION

Tree Layer: 35% cover
subalpine fir, Engelmann spruce

Shrub Layer: 70% cover
Vaccinium membranaceum (black huckleberry)
Rhododendron albiflorum (white-flowered rhododendron)
Vaccinium ovalifolium (oval-leaved blueberry)
Menziesia ferruginea (false azalea)
Ribes lacustre (black gooseberry)
subalpine fir
Engelmann spruce

Herb Layer: 70% cover
Streptopus lanceolatus var. curvipes (rosy twistedstalk)
Valeriana sitchensis (Sitka valerian)
Tiarella spp. (foamflowers)
Gymnocarpium dryopteris (oak fern)
Rubus pedatus (five-leaved bramble)
Arnica latifolia (mountain arnica)
Veratrum viride (Indian hellebore)
Viola spp. violets
Clintonia uniflora (queen’s cup)
Lycopodium annotinum (stiff club-moss)

Moss Layer: 60% cover
Brachythecium spp. (ragged mosses)
Barbilophozia lycopodioides (common leafy liverwort)
Mniium spp. (leafy mosses)
Rhytidiopterys robusta (pipecleaner moss)
[ Pleuroziunm schreberi (red-stemmed feathermoss)

SOIL AND SITE

Moisture Regime: 3–4 (submesic–mesic)
Nutrient Regime: B–C (poor–medium)
Slope Gradient (%): 28 (0–60)
* Slope Position: mid (−upper)
Parent Material: variable (typically morainal veneers and blankets)
Soil Texture: medium–moderately coarse
Coarse Fragments (%): 50 (15–88)

DISTRIBUTION: very common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Bl, Se, (Pl).

Vegetation potential: – moderate (white-flowered rhododendron, fireweed, false azalea).

Reforestation: – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.
– advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– preserve vigourous advanced Sx regeneration.
– log on firm snowpack to protect advance regeneration.

Concerns: – heavy snowpack may cause stem deformity, especially on steep slopes; obstacle planting is advised.
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard, in combination with shallow soils; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
– spruce beetle may infest partial-cut stands after harvesting; minimize blowdown and avoid mechanical damage to residuals.
– trafficability may be a problem on these sites during the summer.
– Pl should only be used on a trial basis until its success can be determined.
VEGETATION

Tree Layer: 30% cover
  lodgepole pine, subalpine fir, Douglas-fir

Shrub Layer: 40% cover
  * Vaccinium membranaceum (black huckleberry)
  * Paxistima myrsinites (falsebox)
  * Spiraea betulifolia (birch-leaved spirea)
  * [Menziesia ferruginea (false azalea)]
  * subalpine fir
  * Engelmann spruce

Herb Layer: 10% cover
  * Hieracium albiflorum (white hawkweed)
  * Chimaphila umbellata (prince's pine)
  * Goodyera oblongifolia (rattlesnake-plantain)
  * [Orthilia secunda (one-sided wintergreen)]
  * [Linnaea borealis (twinflower)]

Moss Layer: 60% cover
  * Cladonia spp. (cladonia lichens)
  * Dicranum fuscescens (curly heron's-bill moss)
  * Peltigera spp. (peltigera lichens)
  * Dicranum scoparium (broom-moss)
  * Pleurozium schreberi (red-stemmed feathermoss)
  * Racomitrium canescens (grey rock-moss)

SITE AND SOIL

  Moisture Regime: 1–2 (xeric–subxeric)
  Nutrient Regime: A–B (very poor–poor)
  Slope Gradient (%): 20 (0–33)
  * Slope Position: upper (–crest)
  Parent Material: colluvial, morainal
  * Soil texture: moderately coarse–coarse
  Coarse Fragments (%): 60 (42–80)
  * Aspect: usually southerly

COMMENTS: based on limited data

DISTRIBUTION: small and rare
INTERPRETATIONS

Site limitations:  – site and soil conditions of this unit result in marginal forest productivity; *serious consideration should be given to excluding logging from this unit.*

Silviculture system:  – avoid logging.
VEGETATION

Tree Layer: 45% cover
  Engelmann spruce, subalpine fir, [lodgepole pine]

Shrub Layer: 50% cover
  *Vaccinium membranaceum* (black huckleberry)
  *Rhododendron albiflorum* (white-flowered rhododendron)
  *[Paxistima myrsinites* (falsebox)]
  subalpine fir

Herb Layer: 40% cover
  *Arnica latifolia* (mountain arnica)
  *Orthilia secunda* (one-sided wintergreen)
  *Tiarella spp.* (foamflowers)
  *Lycopodium annotinum* (stiff club-moss)
  *Streptopus lanceolatus* var. *curvipes* (rosy twistedstalk)
  *Valeriana sitchensis* (Sitka valerian)
  *Rubus pedatus* (five-leaved bramble)

Moss Layer: 50% cover
  *Dicranum fuscescens* (curly heron’s-bill moss)
  *Rhytidiopsis robusta* (pipecleaner moss)
  *Brachythecium spp.* (brachythecium mosses)
  *Pleurozium schreberi* (red-stemmed feathermoss)
  *Cladonia spp.* (cladonia lichens)

SITE AND SOIL

  Moisture Regime: 2–3 (subxeric–submesic)
  Nutrient Regime: A–C (very poor–medium)
  Slope Gradient (%): 17 (0–50)
  Slope Position: upper–crest
  Parent Material: morainal, colluvial
  Soil Texture: medium–coarse
  Coarse Fragments (%): 55 (41–80)

DISTRIBUTION: based on limited data
INTERPRETATIONS

Site limitations:  – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; *attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.*

Silviculture system:  – see Section 5.1.

Site preparation:  – see Section 5.2.

Species choice:  – Se, (Bl, Pl).

Vegetation potential:  – low.

Reforestation:  – Bl and Pl will be significantly less productive than Se on these sites.
  – preserve vigorous Sx advance regeneration.
  – log on firm snowpack to protect advance regeneration.
  – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.

Concerns:  – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; *site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.*
  – Pl should only be used on a trial basis until its success can be determined.
  – heavy snowpack may cause stem deformity, especially on steep slopes; *obstacle planting is advised.*
VEGETATION

Tree Layer: 40% cover
   Engelmann spruce, subalpine fir, [lodgepole pine]

Shrub Layer: 70% cover
   *Rhododendron albiflorum* (white-flowered rhododendron)
   *Vaccinium membranaceum* (black huckleberry)
   *Menziesia ferruginea* (false azalea)
   subalpine fir
   Engelmann spruce

Herb Layer: 15% cover
   *Rubus pedatus* (five-leaved bramble)
   [*Arnica latifolia* (mountain arnica)]
   [*Lycopodium annotinum* (stiff club-moss)]
   [*Orthilia secunda* (one-sided wintergreen)]

Moss Layer: 45% cover
   *Dicranum fuscescens* (curly heron’s-bill moss)
   *Pleurozium schreberi* (red-stemmed feathermoss)
   [*Barbilophozia lycopodioides* (common leafy liverwort)]
   [*Brachythecium* spp. (brachythecium mosses)]

SITE AND SOIL

Moisture Regime: 2–3 (subxeric–submesic)
Nutrient Regime: B–C (submesic–mesic)
Slope Gradient (%): 30 (13–50)
Slope Position: (mid–) upper
Parent Material: morainal or fluvial
Soil Texture: medium–coarse
Coarse Fragments (%): 69 (43–77)

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Species choice: – Bl, Se, (Pl).

Vegetation potential: – moderate (false azalea, white-flowered rhododendron).

Reforestation: – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.
– advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– if heavy equipment is used in summer, during or after partial cutting, every attempt should be made to avoid disturbing roots of standing trees.
– fill-planting may be required after partial cutting.

Concerns: – sites within this unit with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.
– Pl should only be used on a trial basis until its success can be determined.
– spruce beetle may infest partial-cut stands after harvesting; minimize blowdown and avoid mechanical damage to residuals.
– windthrow risk after partial cutting will be high on sites where a root-restricting layer occurs at depths of <25 cm.
VEGETATION

Tree Layer: 35% cover
subalpine fir, Engelmann spruce

Shrub Layer: 80% cover
Menziesia ferruginea (false azalea)
Vaccinium membranaceum (black huckleberry)
Vaccinium ovalifolium (oval-leaved blueberry)
[Rhododendron albiflorum (white-flowered rhododendron)]
subalpine fir
Engelmann spruce

Herb Layer: 35% cover
Rubus pedatus (five-leaved bramble)
Cornus canadensis (bunchberry)
Streptopus lanceolatus var. curvipes (rosy twistedstalk)
[Clintonia uniflora (queen's cup)]

Moss Layer: 90% cover
Pleurozium schreberi (red-stemmed feathermoss)
Peltigera spp. (peltigera lichens)
Ptilium crista-castrensis (knight's plume)
Brachythecium spp. (brachythecium mosses)
Cladonia spp. (cladonia lichens)
Barbilophozia lycopodioides (common leafy liverwort)

SITE AND SOIL

Moisture Regime: 2–3 (subxeric–submesic)
Nutrient Regime: B–C (poor–medium)
Slope Gradient (%): 16 (5–70); usually <20
Slope Position: upper–crest
Parent Material: morainal, occasionally colluvial
Soil Texture: medium–coarse
Coarse Fragments (%): 51 (25–76); often >50

DISTRIBUTION: common
INTERPRETATIONS

Site limitations: – sites with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; **attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.**

Silviculture system: – see Section 5.1.
– minimize or align large slash accumulations when logging to help meet site preparation objectives and reduce fire hazard.

Site preparation: – see Section 5.2.

Species choice: – Bl, Se, (Pl).

Vegetation potential: – moderate (false azalea, fireweed, white-flowered rhododendron).

Reforestation: – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.
– advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– if heavy equipment is used in summer, during or after partial cutting, every attempt should be made to avoid disturbing roots of standing trees.
– fill-planting may be required after partial cutting.
– log on firm snowpack to protect advance regeneration.

Concerns: – heavy snowpack may cause stem deformity, especially on steep slopes; **obstacle planting is advised.**
– spruce beetle may infest partial-cut stands after harvesting; **minimize blowdown and avoid mechanical damage to residuals.**
– sites with thick organic horizons (>10 cm) have increased windthrow hazard, in combination with shallow soils; **block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.**
– sites with shallow and/or coarse-textured soils are vulnerable to nutrient deficiency if forest floors are reduced; **site preparation methods that reduce forest floor thickness, such as slashburning or brushblading, must be avoided.**
– windthrow risk after partial cutting will be high on sites where the root-restricting layer occurs at depths of <25 cm.
BI – Valerian – Oak fern

VEGETATION

Tree Layer: 35% cover
subalpine fir, Engelmann spruce

Shrub Layer: 20% cover
- *Vaccinium membranaceum* (black huckleberry)
- *Ribes lacustre* (black gooseberry)
- *Vaccinium ovalifolium* (oval-leaved blueberry)
- *Menziesia ferruginea* (false azalea)
- *[Rhododendron albiflorum](white-flowered rhododendron)*
  subalpine fir
  Engelmann spruce

Herb Layer: 90% cover
- *Valeriana sitchensis* (Sitka valerian)
- *Streptopus lanceolatus* var. *curvipes* (rosy twistedstalk)
- *Gymnocarpium dryopteris* (oak fern)
- *Tiarella spp.* (foamflowers)
- *Arnica latifolia* (mountain arnica)
- *Mitella brevire* (Brewer’s mitrewort)
- *Rubus pedatus* (five-leaved bramble)
- *Veratrum viride* (Indian hellebore)
- *Osmorhiza chilensis* (mountain sweet-cicely)
  - *[Thalictrum occidentale](western meadowrue)*

Moss Layer: 50% cover
- *Brachythecium spp.* (brachythecium mosses)
- *Mnium spp.* (leafy mosses)
- *Barbilophozia lycopodioides* (common leafy liverwort)

SITE AND SOIL

- Moisture Regime: 4–5 (mesic–subhygric)
- Nutrient Regime: (B–C) (poor–medium)
- Slope Gradient (%): 19 (11–30)
- Slope Position: mid
- Parent Material: morainal
- Soil Texture: moderately coarse–coarse
- Coarse Fragments (%): 48 (34–60)

DISTRIBUTION: uncommon
INTERPRETATIONS

Site limitations: – sites within this unit with high coarse fragment content (>70%) will have significantly reduced soil moisture retention and will be extremely difficult to plant; attempt to regenerate naturally by retaining Pl cones and/or leaving Fd seed trees on site.

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – Bl, Se, (Pl).

Vegetation potential: – moderate (Sitka valerian, fireweed).

Reforestation: – advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.
– trafficability may be a problem on these sites during the summer.

Concerns: – site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.
– sites within this unit with thick organic horizons (>10 cm) have increased windthrow hazard; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites.
– heavy snowpack may cause stem deformity, especially on steep slopes; obstacle planting is advised.
– spruce beetle may infest partial-cut stands after harvesting; minimize blowdown and avoid mechanical damage to residuals.
– Pl should only be planted on a trial basis until its success can be demonstrated.
VEGETATION

Tree Layer: 45% cover
- subalpine fir, Engelmann spruce

Shrub Layer: 50% cover
- Vaccinium membranaceum (black huckleberry)
- Ribes lacustre (black gooseberry)
- Vaccinium ovalifolium (oval-leaved blueberry)
- Oplopanax horridus (devil’s club)
- Rhododendron alboflorum (white-flowered rhododendron)
- [Menziesia ferruginea (false azalea)]

Herb Layer: 90% cover
- Gymnocarpium dryopteris (oak fern)
- Tiarella spp. (foamflowers)
- Athyrium filix-femina (lady fern)
- Valeriana sitchensis (Sitka valerian)
- Streptopus lanceolatus var. curvipes (rosy twistedstalk)
- Veratrum viride (Indian hellebore)
- Rubus pedatus (five-leaved bramble)
- Mitella breweri (Brewer’s mitrewort)
- Viola spp. (violets)
- Galium trifidum (small bedstraw)
- [Dryopteris expansa (spiny wood fern)]

Moss Layer:
- Brachythecium spp. (brachythecium mosses)
- Mnium spp. (leafy mosses)
- [Pleurozium schreberi (red-stemmed feathermoss)]

SITE AND SOIL

Moisture Regime: (4)–5 ((mesic)–subhygric)
Nutrient Regime: C–D (medium–rich)
Slope Gradient (%): 26 (5–50)
Slope Position: mid (~lower)
Parent Material: morainal, occasionally fluval
Soil Texture: medium
Coarse Fragments (%): 44 (15–75)

DISTRIBUTION: common
### INTERPRETATIONS

<table>
<thead>
<tr>
<th>Site limitations</th>
<th>– sites with thick organic horizons (&gt;10 cm) have reduced spring soil temperatures, which slows root development; reduce organic horizon thickness during site preparation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silviculture system</td>
<td>– see Section 5.1.</td>
</tr>
<tr>
<td>Site preparation</td>
<td>– see Section 5.2.</td>
</tr>
<tr>
<td>Species choice</td>
<td>– Bl, Se, (Pl).</td>
</tr>
<tr>
<td>Vegetation potential</td>
<td>– very high (lady fern, devil’s club, fireweed).</td>
</tr>
</tbody>
</table>
| Reforestation | – log on firm snowpack to protect advance regeneration.  
– under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.  
– reduce spruce beetle hazard by avoiding high stumps and shaded slash >15 cm diameter.  
– try to preserve advance regeneration if it is abundant and likely to release and form an acceptable stand.  
– advance Bl regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).  
– plant stock with large caliper and low shoot-to-root ratio immediately after harvest. |
| Concerns | – spruce beetle may infest partially cut stands after harvesting; minimize blowdown and avoid mechanical damage to residuals.  
– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; leaving a partial canopy, planting on raised microsites, and/or choosing a frost-resistant species (e.g., Pl) are advised.  
– heavy snowpack may cause stem deformity, especially on steep slopes; obstacle planting is advised.  
– if heavy equipment is used in summer, during or after partial cutting, every attempt should be made to avoid disturbing roots of standing trees.  
– trafficability may be a problem on these sites during the summer.  
– sites with thick organic horizons (>10 cm) have increased windthrow hazard, in combination with shallow soils; block layouts must have windfirm boundaries, or a wide buffer of standing timber must be left around such sites. |
VEGETATION

Tree Layer: 30% cover
Engelmann spruce, subalpine fir

Shrub Layer: 50% cover
Vaccinium membranaceum (black-huckleberry)
Vaccinium ovalifolium (oval-leaved blueberry)
Rhododendron albiflorum (white-flowered rhododendron)
Ribes lacustre (black gooseberry)
Menziesia ferruginea (false azalea)
subalpine fir
Engelmann spruce

Herb Layer: 70% cover
Gymnocarpium dryopteris (oak fern)
Valeriana sitchensis (Sitka valerian)
Senecio triangularis (arrow-leaved groundsel)
Athyrium filix-femina (lady fern)
Streptopus spp. (twistedstalks)
Equisetum arvense (common horsetail)
Rubus pedatus (five-leaved bramble)
Tiarella spp. (foamflowers)
Mitella breweri (Brewer’s mitrewort)
Viola spp. (violets)
[Equisetum sylvaticum (wood horsetail)]
[Veratrum viride (Indian hellebore)]

Moss Layer: 85% cover
Mnium spp. (leafy mosses)
Sphagnum spp. (sphagnums)
Pleurozium schreberi (red-stemmed feathermoss)

SITE AND SOIL

Moisture Regime: 5–6 (subhygric–hygric)
Nutrient Regime: (C)–D ((medium)–rich)
* Slope Gradient (%): 9 (0–32); often 0
* Slope Position: lower–toe
* Parent Material: fluvial, organic
Soil Texture: variable
Coarse Fragments (%): 35 (19–62)

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations: – sites with thick organic horizons (>10 cm) have reduced spring soil temperatures, which slows root development; *reduce organic horizon thickness during site preparation.*
– sites with saturated soils are poorly aerated, which slows root development; *plant seedlings on naturally or artificially raised microsites.*

Silviculture system: – see Section 5.1.

Site preparation: – see Section 5.2.

Species choice: – *BL, Se, (PL).*

Vegetation potential: – high (Sitka valerian, lady fern, white-flowered rhododendron).

Reforestation: – under a partial-cutting system, spruce regeneration requires mineral soil exposure and/or planting.
– log on firm snowpack to protect advance regeneration.
– plant stock with large caliper and low shoot-to-root ratio immediately after harvest.
– preserve advance regeneration if it is abundant and likely to release to form an acceptable stand.
– advance BL regeneration should only be preserved if it meets size and acceptability criteria (Section 5.1).
– PL should only be planted on a trial basis until its success can be demonstrated.

Concerns: – heavy snowpack may cause stem deformity, especially on steep slopes; *obstacle planting is advised.*
– sites with high water tables and thick organic horizons (>10 cm) have increased windthrow hazard; *block layouts must have windfirm boundaries.*
– site conditions may lead to frost damage of regeneration, especially in any naturally occurring or artificially created depression; *leaving a partial canopy or planting on raised microsites is advised.*
– water table will likely rise above the ground surface in the spring, causing seedling mortality.
– this unit is critical to the control of runoff streamflow.
– these units represent important wildlife habitat; *discuss prescription with fish and wildlife personnel.*
VEGETATION

Tree Layer: 20% cover
lodgepole pine

Shrub Layer: 25% cover
[Sorbus sitchensis](Sitka mountain-ash)
lodgepole pine
subalpine fir
Engelmann spruce

Herb Layer: 80% cover
Vaccinium caespitosum (dwarf blueberry)
Rubus pedatus (five-leaved bramble)
Carex spp. (sedges)
Vahlodea atropurpurea (mountain hairgrass)
Danthonia spicata (poverty oatgrass)
Equisetum arvense (common horsetail)
Epilobium angustifolium (fireweed)
[Lupinus arcticus](arctic lupine)

Moss Layer: 85% cover
Sphagnum spp. (sphagnums)
Timmia austriaca (false-polytrichum)
Polytrichum juniperinum (juniper haircap moss)
Stereocaulon spp. (coral lichens)
[Pleurozium schreberi](red-stemmed feathermoss)

SITE AND SOIL

Moisture Regime: 6–7 (hygric–subhydric)
Nutrient Regime: B–C (poor–medium)
Slope Gradient (%): 0–5
Slope Position: level
Parent Material: fluvial, morainal
Soil Texture: medium
Coarse Fragments (%): 53 (43–62)

COMMENTS: based on limited data

DISTRIBUTION: rare
INTERPRETATIONS

Site limitations: – site and soil conditions of this unit result in marginal forest productivity; serious consideration should be given to excluding logging from this unit.

Silviculture system: – avoid logging.
Sedge – Sphagnum

VEGETATION

Tree Layer: 1% cover
[ lodgepole pine ]

Shrub Layer: 10% cover
[ Engelmann spruce ]

Herb Layer: 90% cover
Carex spp. (sedges)
Calamagrostis canadensis (bluejoint)
Potentilla palustris (marsh cinquefoil)
[Eriophorum angustifolium (narrow-leaved cotton-grass)]

Moss Layer: 60% cover
Sphagnum spp. (sphagnums)

SITE AND SOIL

Moisture Regime: 7 (subhydric)
Nutrient Regime: B–C (poor–medium)
Slope Gradient (%): 0
* Slope Position: level or depression
* Parent Material: organic
* Soil Texture: organic
Coarse Fragments (%): 0

DISTRIBUTION: rare