4 Measures to Protect Forest Ecosystems and Resources

4.1 Timber

The WLFMR requires an FDP to be based on an evaluation of forest health factors that are causing or may cause damage within the woodlot licence area. WLFMR requires that forest areas where timber values are threatened by insects, diseases, or physical damage should be priority areas for timber cutting.

We are not currently aware of any populations of timber damaging organisms which would cause levels of timber damage or tree mortality sufficient to result in a shift of timber cutting priorities within W1832. Endemic populations of bark beetles, mistletoe and root disease occur in the woodlot. Monitoring and reconnaissance for significant changes in population levels of timber damaging organisms will be carried out throughout the term of this Forest Development Plan.

Maintaining short and long term forest ecosystem health is one of the primary goals of ecologically responsible management in W1832. Ecosystem processes which lead to some tree mortality from insects, diseases, and other natural factors are expected. However, management practices should not lead to significant increases in tree mortality due to ecological processes, and management choices that limit the spread or efficacy of tree killing factors are generally regarded as desirable.

Approaches to limit losses to identified forest heath factors are discussed below.

4.1.1 Mountain Pine Beetle

Mountain pine beetle (Dendroctonus ponderosea) is present in W1832 in endemic levels. This insect can cause extensive tree mortality in lodgepole pine, white pine and ponderosa pine stands when epidemic populations arise in susceptible stands. Conditions which favor the growth of beetle populations include mild winters, and moderate to large diameter, low vigor, closed canopy pine stands. Susceptible stands occur in the upper crown portion of W1832. The private land portion of W1832 contains no pine stands.

Dead pine trees in varying states of decay which may have been killed by beetle attack are scattered throughout the woodlot. Gray trees are not involved in current beetle population dynamics. Red attack[6] trees are also found, but less frequently. The Arrow Forest District has recently noted this level of pine beetle activity, and has suggested that carrying out additional surveys may be called for.

No direct pine bark beetle control or salvage measures are planned for W1832 at this time because:

- We believe that beetle populations are at an endemic level. This assessment may be reviewed following field assessments.

[6] Recently killed trees which retain red, dead needles. Usually, trees which have been dead for one full growing season..

- Access required for mountain pine beetle control/salvage activities, if such activities are suggested by increased beetle activity and are judged to be suitable from a watershed management perspective, does not currently exist and will not be developed under this FDP. This FDP proposes developing access to the lower elevations of the woodlot. This is still a substantial distance from the areas of known endemic beetle activity and from most known susceptible lodgepole pine stands.

Overall pine beetle hazard will be slightly reduced by the proposed harvesting operations in mixed species forests which will:

- remove the majority of the lodgepole pine component from mixed species stands, where the pine is generally in poor health and is a priority for cutting regardless of insect populations, and
- encourage regeneration of other tree species by leaving mainly Douglas-fir and larch seed trees.

4.1.2 Douglas-fir Bark Beetle

The Arrow Forest District Forest Health office reports that Douglas-fir bark beetle (Dendroctonus pseudotsugea) is present in W1832. We had not noted the presence of this insect in our field reconnaissance. Red attack Douglas-fir trees were identified by MoF field crews along the north edge of the woodlot, and in one of the central rock bluff areas which are excluded from the woodlot. Two green attack trees were also found in the central rock bluff area. The Arrow District has suggested that carrying out additional surveys may be called for.

This insect can cause extensive tree mortality in Douglas-fir stands when epidemic populations arise in susceptible stands. Conditions which favor the growth of beetle populations include mild winters, and moderate to large diameter, closed canopy Douglas-fir stands. Douglas-fir stands older than 120 years with generally low tree vigor are most favorable to the beetle. The presence of recent Douglas-fir blowdown or large logging slash also contributes to population increases. The bark beetle populations can build up in fallen material until sufficient insects are available to overwhelm the chemical defenses of large, standing green trees. Douglas-fir bark beetle is most associated with old to old growth Douglas-fir stands in declining vigor.

Most forests in W1832 are about 90 years old, and many Douglas-fir stems are very vigorous. Deadfall density is variable, with no more than natural levels of recent windthrow observed. Areas of old, dry deadfall from natural mortality in overstocked younger stands do occur, but these are not suitable habitat for the beetle.

No Douglas-fir bark beetle control measures are planned for W1832 at this time because:

- We believe that current Douglas-fir bark beetle populations are at an endemic level, and that the hazard of substantial population increase is low to moderate. This assessment may be reviewed following field assessments.
- Access required for most beetle control/salvage activities, if such activities are required and are judged to be suitable from a watershed management perspective,

does not currently exist and will not be developed under this FDP. This FDP proposes developing access to the lower elevations of the woodlot, which is a substantial distance from the areas of known Douglas-fir bark beetle activity. Salvage and control operations in Douglas-fir forests along the planned access road will be possible, if beetle activity is found in this area, and if salvage / control activities are judged to be suitable from a watershed management perspective.

Overall Douglas-fir beetle hazard may be slightly reduced by the proposed harvesting operations which will remove many smaller, weaker individuals from the forests in question and which will lead to a general improvement in stand and individual stem vigor. This should result in an increase in individual tree resistance to beetle attack.

4.1.3 Larch Mistletoe

Control of, rather than eradication of, dwarf mistletoe is the management objective in W1832. Over time, we plan to achieve a mixed forest which includes larch regeneration from seed trees retained in partial cuts. Eradication of mistletoe sources will not be possible in this regime. The western larch component in some stands in W1832 has a moderate mistletoe infection level, but none of the areas where moderate infection has been noted are within harvest areas proposed in this Forest Development Plan.

Mistletoe control objectives will be considered in developing the silvicultural prescription for CP A Block 1, which contains larch stems. Larch with mistletoe will be cut where suitable alternative leave trees exist. No old growth larch (i.e. survivors of the 1912 fire) will be cut, if any are found in the proposed harvest areas.

4.1.4 Root Diseases

Root diseases are a natural ecological component occurring in most forests in southern British Columbia at endemic levels. Most tree species support these opportunistic root fungi. The effects of root diseases range from slower growth (due to root loss and diversion of resources to combat the infections) to tree death. Root diseases contribute to biological diversity by recruiting large high value snags and fallen trees, and by creating openings in the canopy for shrub development, and release of regenerating and overstory trees. The resulting ecosystem contributes to wildlife habitat, water protection, and soil building values.

Root diseases can become more effective at killing trees when ecosystems are disturbed or stressed. Factors which may lead to increased root disease activity include drought, overstocking, other diseases, insect attack, physical damage, and management practices which create large stumps. Accepting some losses to root disease while working to modify ecological conditions to be less favorable to root diseases is the only viable long term management approach. The Ministry of Forests[7] states:

> *Forest tree root pathogens are widespread throughout all forested ecosystems of British Columbia, occurring on many deciduous and coniferous hosts. Root pathogens are an integral part of these forested*

[7] Forest Practices Code *Root Disease Management Guidebook,* July 1995

> *ecosystems and can be viewed as both beneficial and detrimental to the health, function and productivity of forests. Root pathogens can reduce tree growth, lower wood quality and cause early mortality. They also function as important factors in the dynamics of forest disturbance; playing a role in nutrient cycling, ecological succession, and biodiversity. The biology of root pathogens is such that harvesting, regeneration, and stand management activities can affect the competitive behavior, and subsequent spread, of root pathogens in ecosystems.*
>
> *Ecosystem-based forest management strives to maintain the function of root pathogens while not creating conditions that favor these pathogens over other ecological site factors. An important principle of forest management is that the role of root pathogens must be recognized and understood in each ecosystem. Forest management objectives and prescriptions should be set in light of the constraints of pathogen biology and site ecology.*

W1832 lies within the ICHdw and ICHmw2 biogeoclimatic subzones. In the Root Disease Management Guidebook, *Armillaria ostoyae* is identified as a high hazard in ICH forests and requires attention in all plans and prescriptions. *Phellinus weirii* is identified as a high hazard in ICH Douglas-fir leading forests and also requires attention in all plans and prescriptions.

As expected, scattered occurrences of root disease infection have been noted in all portions of W1832. At a reconnaissance level, we looked for evidence of root diseases during field work in the area where logging is proposed. Proposed Blocks 1 and 2 contain infrequent patches of one or more dead trees which appear to be root disease related. A substantial area of root disease activity occurs just downslope of Block 2, in high value ungulate winter range. The species of root disease(s) present was not positively identified at all locations, but *Armillaria ostoyae* has been identified in Block 1 from fruiting bodies.

The following list describes a range of management activities that may be used to reduce losses to root disease. The most suitable strategy selected for an area will be determined during Site Plan development and will be based on specific site characteristics and values. The overall goal is to be proactive in treatment by recognizing and reducing increasing hazard. The strategies that may be implemented in areas with root disease infections include:

- Reserving root disease centers as wildlife tree patches due to diversity in snag classes and shrub layer providing hiding cover and browse.
- Improving overall forest vigor with partial cutting techniques which remove lower quality trees and retain trees with best vigor and resistance.
- Select silvicultural systems that manage hazard, e.g., thin forests in areas prone to drought to reduce overall stress.
- Encouraging the natural regeneration of and/or planting of less susceptible conifers within and along the edge of infected patches.
- Where appropriate, managing rotations of birch, which is tolerant of *Armillaria* and immune to *Phellinus*, and which alters soil conditions, in patches with significant

infection levels. The goal of this approach is to reduce the extent of live root disease fungi on a site by not introducing new food sources for fungal colonization.

- Utilizing available biological innoculants against root disease fungi to reduce the susceptibility of cut stumps on a trial basis.

We prefer to avoid root removal approaches (stumping or pushover logging) as these methods tend to lead to significant levels of soil disturbance.

4.2 Water

4.2.1 Introduction

W1832 is located within watersheds which are used as domestic and agricultural water sources. Portions of the Dumont Creek, Trozzo Creek, Winlaw Creek, Woodward Face, and Dunn Creek watersheds are within W1832. The watershed management objective for W1832 is to have no detrimental impact on the quantity, quality and/or timing of flow of water supplies in domestic use watersheds.

Operations proposed in this FDP are limited to the Winlaw Creek and Dumont Creek watersheds, and to the Woodward Face watershed between the two.

The keystones of our water management approach are to:

1. maintain functioning forest ecosystems,
2. maintain forest cover,
3. minimize site and soil disturbance, and
4. set a sustainable timber harvest rate which is balanced to the productive capacity of land within the woodlot and the needs of watershed management.

The KBLUP-IS also sets forth requirements for planning and implementation of forest development in domestic use watersheds. The following is excerpted from the KBLUP-IS:

Watershed Management

Introduction

The intent of the domestic watershed definition is to capture watersheds which support domestic licensing but where the water users have not incorporated themselves and frequently utilize individual water systems.

A **Domestic Watershed** is defined as the drainage area above the downstream point of diversion on a stream which is:

(a) licensed under the *Water Act* for human consumption;

(b) not classified as a community watershed under the *Forest Practices Code of British Columbia Act;*

(c) usually not more than 200 km^2 in drainage area.

(c) General Management Approach

Domestic watersheds: These guidelines define a level of management for forest activities on Crown land in domestic watersheds which lies between standard Forest Practices Code and management in community watersheds. It does this by providing:

a) a classification and mapping system for domestic watersheds;

b) a basic assessment of hazard related to forest activity;

c) a set of recommended forest practices;

d) a strengthened opportunity for public input to the forest development plan;

e) a contingency plan in case of damage to water supply.

For forest activities, the responsibility to implement the Domestic Watershed Guidelines rests with:

a) Environment and Lands, to develop and maintain the classification and mapping system and to provide advice during the forest development plan process on high risk/consequence areas on a priority basis;

b) the forest activity proponent to complete the assessment, modify the forest development plan (FDP) to address hazards, incorporate appropriate forest practices, notify water users of the opportunity for involvement, address water users concerns during the FDP process, and in general, to ensure that activities are conducted in such a manner that water quality, quantity and timing of flow will be maintained;

c) Ministry of Forests to review, recommend modifications and approve the forest development plan if it complies with the Forest Practices Code and the KBLUP objective of maintaining water quality, quantity and timing of flow in domestic watersheds;

d) water users to attend FDP presentations, review impact assessments and plans, propose constructive technical improvements to meet stated objectives, notify agencies if

problems are identified so that corrective action can be taken; to construct and maintain water works that are capable of handling natural water quality and flow levels;

e) all parties during emergencies requiring contingency plan implementation.

(d) Spatial Application of Guidelines

There are more than 2750 **domestic watersheds** within the Kootenay/Boundary region. At the time of writing this document, there is insufficient information to produce a map of domestic watersheds. Through application of these guidelines, domestic watersheds will be classified and mapped.

Operational Guidelines

(b) Domestic Watersheds

Classification of Watersheds

Domestic watersheds will be classified into three categories as follows:

Class 1 Watersheds

These watersheds are associated with springs and very small creeks which do not have clearly defined drainage or catchment areas. Often these small water sources are located on "face units" (populated areas between major streams). Face units may encompass many small streams and springs which support domestic licensing. Face units will often be mapped as one area because of the difficulty of defining these micro drainage areas without on-the-ground investigation. There may also be streams within the mapped face unit which are not licensed for domestic use. It will be important for the forest proponent to identify these early in the process so that unnecessary assessments and notification of water users can be avoided.

Class 2 Watersheds

These are small watersheds having drainage areas which are; definable on existing topographic mapping and, less than 500 ha (5 km^2).

Class 3 Watersheds

These are watersheds with a drainage area of 500 ha (5 km^2) to 200,000 ha (200 km^2). To aide in the assessment procedure in these larger watersheds, it may be necessary for MELP to delineate sub-drainages as part of the mapping exercise. Sub-drainages will be established using the methodology given in the Interior Watershed Assessment Procedure (IWAP) guidebook.

Mapping

Class 1, 2 and 3 domestic watersheds (and sub-drainages where applicable) will be mapped by Environment and Lands onto a 1:20000 base.

Assessment and Detailed Mapping for Forest Activities

When forest activities are proposed within known domestic watersheds, an assessment procedure will be completed by the proponent and submitted with the forest development plan (FDP). The objective of the assessment will be to ensure that the proposed forest activities do not pose an unacceptable risk to water quality, and the quantity and timing of flow at the point of intake.

Class 1 Watersheds

Areas defined as class 1 watersheds on the mapping will undergo a detailed procedure as systems described in the box below. The main objective is to maintain the integrity of recharge areas and channel. (Box omitted in this reproduction.)

Class 2 Watersheds

Areas defined as class 2 watersheds on the mapping will undergo a detailed procedure as described in the box below. (Box omitted in this reproduction.) The objective is to confirm channel and intake locations and to plan upstream activities such that new sediment sources are not created.

The procedure for class 2 watersheds requires less field work because these watersheds are topographically defined. A watershed report card (see Class 3 Watersheds) is required. Since results from the report card become less dependable with smaller watersheds, the report card should not be used by itself to define hazards in watersheds under 5 km^2(500 ha).

Class 3 Watersheds

Areas defined as class 3 on the mapping will undergo an assessment utilizing a domestic watershed report card. This is a reconnaissance level analysis intended to identify several broad categories of risk from past or planned forest harvesting. When high hazard levels are indicated, it is expected that these will be addressed in the forest development plan.

The domestic watershed report card is comprised of several key indicators which were developed for the Interior Watershed Assessment Procedure (IWAP). Larger class 3 watersheds may have sub-drainages delineated on the mapping. The report card indicators are to be generated for each sub-drainage.

The Ministry of Forests also sets out requirements for information which must be presented in an FDP in District Manager's 2001 Instruction Letter and Guidelines for developing Forest Development Plans.

Table 2 shows the distribution of proposed logging activity by watershed unit. The complex set of information and analysis requirements stipulated by KBLUP-IS, KBHLP, and Arrow District policy, combined with the number of domestic use watersheds in W1832, and the variety of watershed classes development is proposed in, results in a complex watershed data set.

Watershed Name	Watershed Class	Total Watershed Area (hectares)	Watershed Area in W1832 (hectares)	Area of Proposed Harvesting (hectares)	Percentage of Watershed in Proposed Harvest Areas	Length of Road Development in Watershed (meters)
Dumont Creek	Class 2	589	265	3.1	0.52%	32
North Fork Creek	Class 3 Sub-Basin	798	131	24.4	3.05%	1,547
Woodward Face	Class 1	180	30	0	0	1,228
Lower Main Winlaw Creek	Class 3 Sub-Basin	271	51	0	0	1,308
Lower Trozzo Creek	Class 3 Sub-Basin	1,194	124	0	0	0
Dunn Creek	Not Defined	Not Defined	21	0	0	0
Totals (excluding Dunn Ck):		3,031	600	27.5	n/a	n/a

Table 2: Proposed Logging Developement by Watershed Sub-Basin.

4.2.2 Watershed Mapping

All development proposed in this FDP is within the Winlaw Creek, Dumont Creek, and Woodward Face watersheds.

The Winlaw Creek watershed is divided into sub-drainage watershed units by MELP. Activities within the Winlaw Creek watershed are proposed in two Class 3 sub-units (hereinafter called the Lower Main watershed and the North Fork watershed). Figure 3 shows the boundaries of the watershed units and location of proposed developments.

The Trozzo Creek watershed is also divided into sub-drainage units by MELP. No development is proposed within the Trozzo Creek watershed in this FDP. Therefor, no watershed mapping or analysis was carried out for the Lower Trozzo Creek watershed sub-unit.

No development is proposed within the Dunn Creek watershed in this FDP. Therefor, no watershed mapping or analysis was carried out for the Dunn Creek watershed unit. The boundaries of the Dunn Creek sub-basin have not been adequately defined at this time, so limited information is presented for the Dunn Creek watershed.

Watershed and sub-basin boundary mapping was obtained for the W1832 area from the MELP ftp server. These watershed boundaries were developed at 1:50,000 scale for the KBLUP. Some sections of the boundaries varied significantly from known, field verified watershed boundaries in W1832. Therefore, the following KBLUP watershed boundaries were modified:

- boundary between Lower Trozzo and Dumont Creek watersheds
- boundary between North Fork and Dumont Creek watersheds
- boundary between North Fork and Lower Main Winlaw watersheds
- boundary between Lower Main Winlaw and Woodward Face watersheds

Point of Diversion (POD) mapping was also obtained from the MELP ftp server. Points of Diversion are shown on the FDP map, with point of diversion codes. Data obtained from the MELP water licence web site which correlates the POD codes to water licensees is included in Appendix 2.

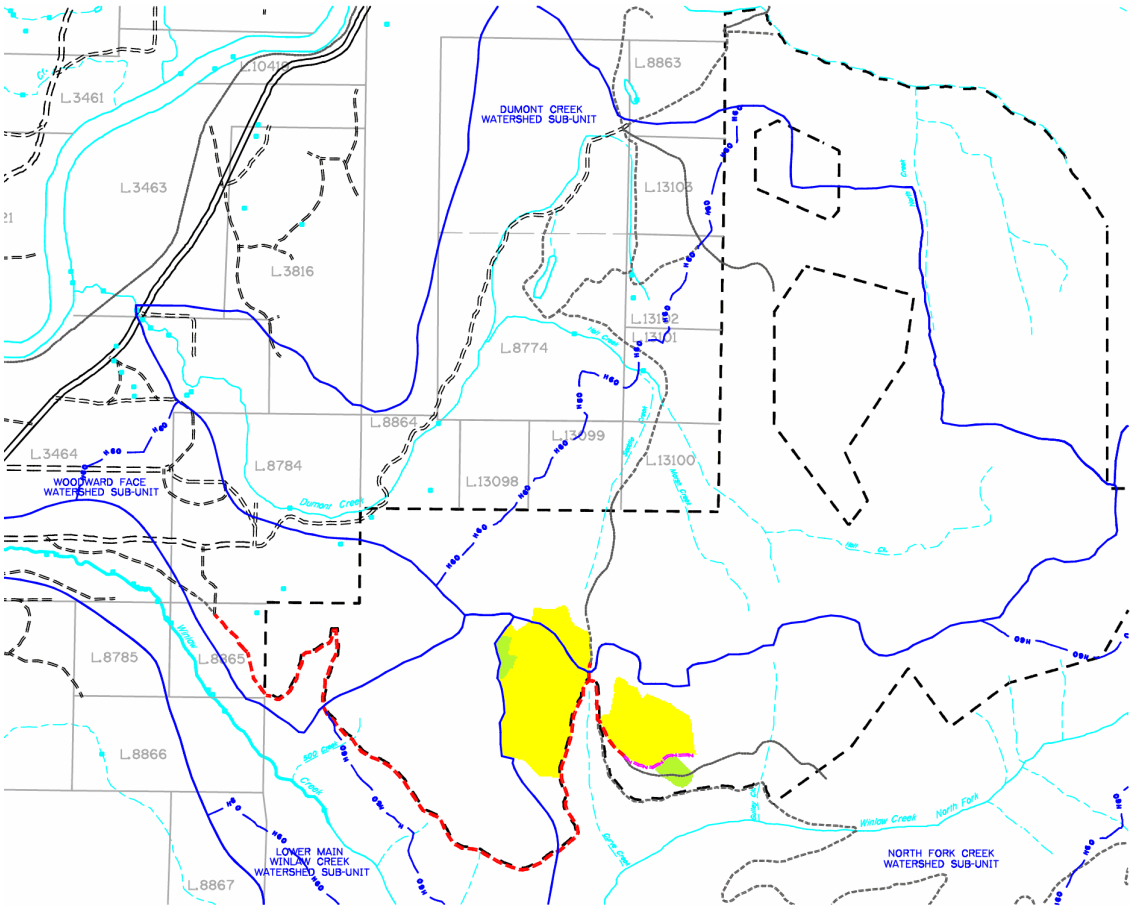

Figure 3: Watershed Boundaries and Proposed Development in W1832 Crown Portion.
Watershed boundaries shown in dark blue. Proposed road upgrade shown in red, proposed new road construction shown in magenta. Proposed partial cutting shown in yellow, proposed wildlife tree patches in green.
W1832 boundary is black dashed line.

4.2.3 Watershed Assessments

The following subsections present the results of the watershed assessments performed for this Forest Development Plan by watershed unit. The following general comments apply to all units:

- The complete watershed assessments prepared for this FDP are contained in Appendix 3.
- The *Watershed Assessment of Winlaw Creek* prepared by Henderson Environmental Consulting Ltd. (1999) was reviewed. This document focussed on the Winlaw Creek watershed as a whole, whereas the assessments performed for this FDP focus on individual sub-basins, per current policy.

- All of the watershed units under consideration are relatively small, ranging in size from 180 to 798 hectares. Results from the Interior Watershed Assessment Procedure (IWAP) become less dependable in smaller watersheds, and KBLUP-IS notes that they should not be used by themselves to define hazards in watersheds under 500 hectares.[8]
- Both private and crown land are included in the watershed assessments performed for this FDP.
- A large part of the work proposed in this FDP is upgrading the existing Silica Mine Road for logging truck traffic. The Silica Mine Road was originally built to access a Silica Mine in the upper part of the North Fork watershed. We do not know the exact date of construction of the road. It is not shown on 1939 air photos of the area, but is visible on 1958 air photos, leading to the conclusion that it was build some time between 1939 and 1958. The existing road is thus at least 43 years old.
- The general purposes of the IWAP are to
    - identify watersheds in which further removal of forest cover will increase the risk of higher peak flows during spring runoff, which may lead to increased erosion, sediment yield, and creek channel destabilization.
    - identify watersheds where road densities suggest a high risk of increased sediment yield from surface erosion along roads.
    - identify areas where road density and harvesting density on potentially unstable slopes may lead to increased risk of landslides and resultant sediment yield and/or creek channel damage.
- The IWAP differentiates between development above and below the H60 line, which is the elevational band or contour which 60% of the watershed area lies above. As Henderson (1999) notes "There is some evidence that the H60 line generally defines the area above which snow typically covers a watershed at peak flow in the spring freshet. Differences in snow accumulation and melt exist between physiographic regions. Factors include climate, elevation, terrain type, and cutblock orientation." The theory is that the volume of snow above the H60 line, and the rate of melt of that snow, will determine the spring peak flow volume, and thus the impacts on stream channel form and stability.

  Given the relatively low elevation of and shallow snowpack in W1832, the small areas of the watersheds in question, and the substantial impacts of topography and aspect on snow melt in the woodlot area, the significance of the H60 line is open to discussion in this case.
- The IWAP process assesses hazards associated with development on "unstable terrain" and terrain with high surface erosion potential. Where possible, the assessment of terrain stability and erosion potential should be based on Terrain Stability mapping. However, terrain stability mapping was only available for a portion of the watersheds in question when this analysis was carried out. Terrain stability mapping was used where available, and the suggested surrogate of terrain

[8] KBLUP IS Chapter 3 Page 36

with slopes over 60%, as determined from the TRIM Digital Elevation Model, was used to estimate the extent of unstable terrain and terrain with high surface erosion potential where terrain stability mapping is not available.

- KBLUP-IS suggests that a subset of IWAP variables on a Watershed Report Card be interpreted using the parameters set out in Table 3.

Impact Indicators	Hazard rating		
	low	medium	high
a) peak flow index	<0.3	0.3-0.42	>0.42
b) road density for entire sub-basin (km/km^2)	<1.5	1.5-2.1	>2.1
c) no. of stream crossings (no./km^2)	<0.4	0.4-0.6	>0.6
d) no. of landslides (no./km^2)	<0.1	0.1-0.18	>0.18
e) roads on unstable slopes (km/km^2)	<0.15	0.15-0.25	>0.25

Table 3: Interpretation Guide for IWAP Report Card Scores.

4.2.3.1 Woodward Face Watershed

The development activity proposed in this FDP within the Woodward Face watershed is upgrading 1,228 meters of the existing Silica Mine Road.

The Woodward Face watershed, show in Figure 4, is a low elevation, low slope gradient, 560 hectare sub-unit of the main Slocan River watershed. It lies between the lower reaches of Winlaw Creek and Dumont Creek watersheds. Most of the settlement of Winlaw is located within this watershed unit, which is 81% privately owned. As a result, the watershed is impacted by extensive suburban development and associated road construction and clearing. The upper 30 hectares of this watershed are within W1832.

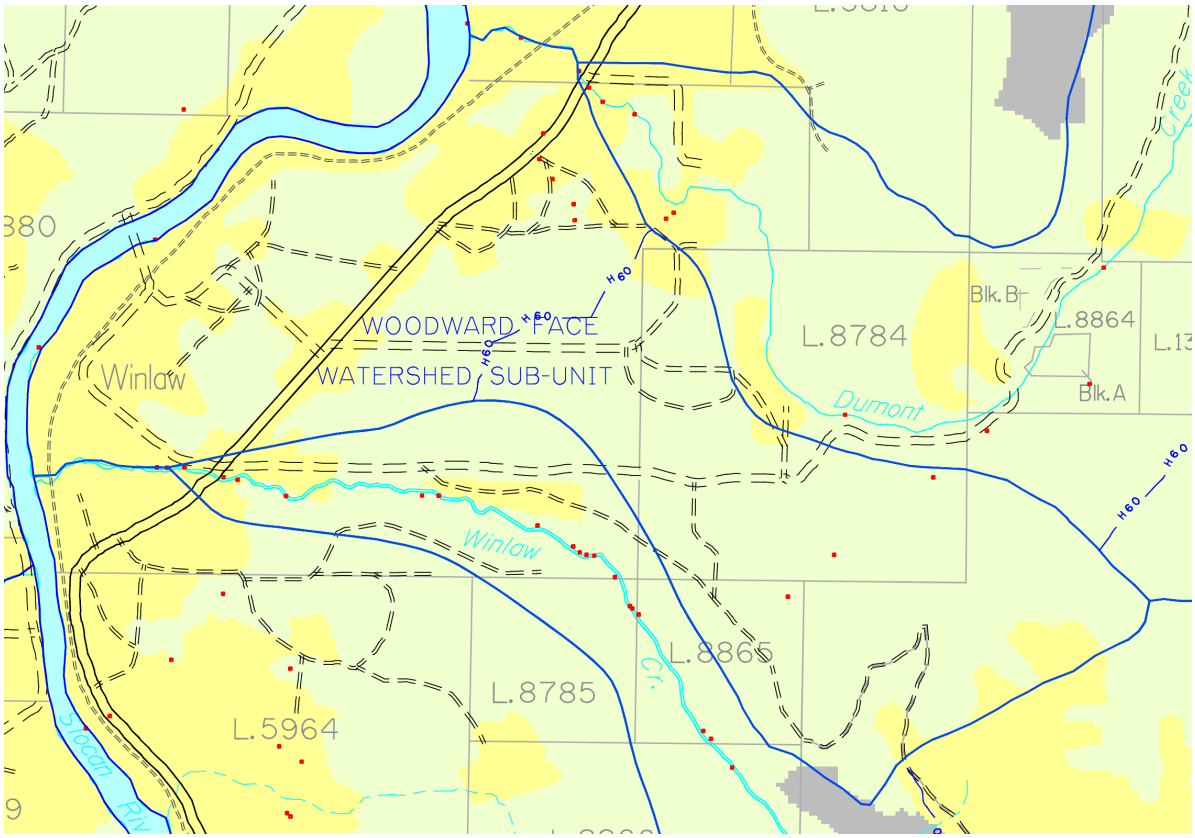

Figure 4: Location of and Hydrologic Cover Classes in Woodward Face watershed.
Non-forested areas are gray, cleared and/or logged areas are yellow, and hydrologically intact forest is green.
H60 line and watershed boundaries are dark blue, water intake points of diversion are red points.

Figure 5 shows the concentration of clearing for settlement and road building in the lower portion of the watershed.

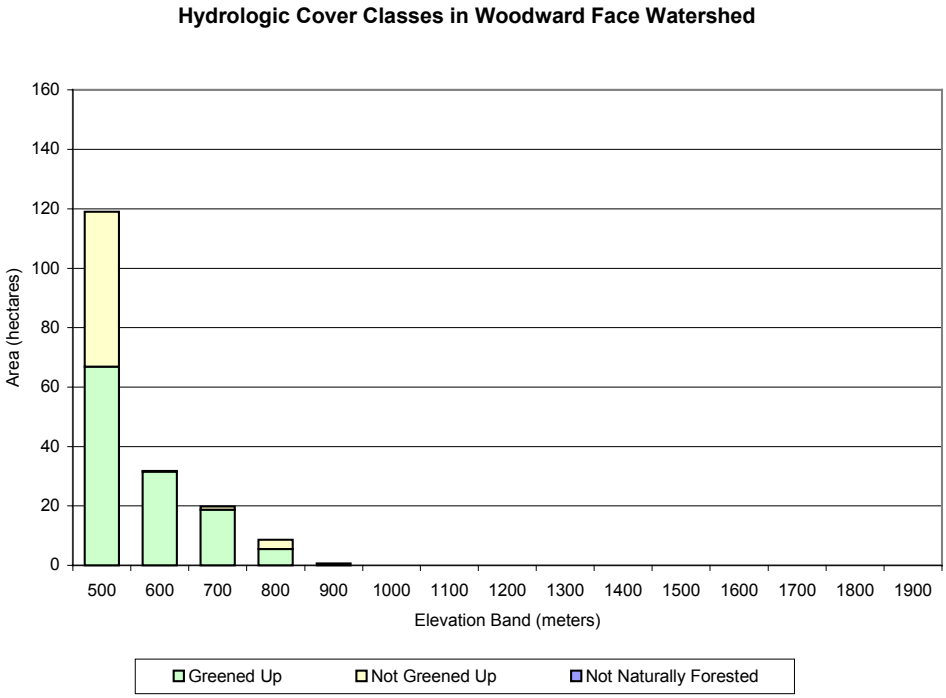

Figure 5: Hydrologic Cover Classes in Woodward Face sub-unit.

This is a hydrologically complex watershed unit, dominated by gently sloping terrain of deep, post-glacial alluvial and glaciofluvial deposits with varying textures and permeabilities. We do not know of any scoured creek beds within this watershed, and signs of any surface water movement are limited. Ground water movement patterns in this watersheds are not well understood. Many wells have been drilled or dug in the middle and lower elevation areas of Woodward Face watershed to attempt to provide domestic water; few have been successful. We classify this area as a Class 1 watershed, but it is better described as a set of Class 1 watersheds and groundwater recharge areas

Eight water licence PODs are mapped within this unit. Three are located in small seeps in the upper portion of the watershed on moderately steep terrain immediately below W1832. Each of these seeps is fed by a separate Class 1 watershed. Inappropriate development in W1832 could affect these three water sources. The remaining five PODs are located in a low elevation moist swale 1 km northwest of W1832. These water sources are not likely closely associated with the land within W1832, and do not pose as significant a constraint on development as the three upper PODs.

The IWAP Watershed Report Card presents a picture of severe risk in the Woodward Face watershed, which is not fully reflected by field observation, and which may ignore issues which are significant concerns.

The peak flow hazard index, which assesses the potential impacts of vegetation removal on stream channels through increased spring peak flows, is 0.85. This is in the high hazard range. The high hazard rating is due to extensive clearing below the H60 line for settlement, and to high road density throughout the watershed.

Road density for the entire sub-basin is 6.12 km/km^2, an extremely high density. This is largely due to suburban development, and does not even count the many unmapped driveways and access roads in the watershed. Such high road densities result in high risk of sedimentation of surface water supplies, and increased risk of slope failure due to redirection of surface drainage. Standard recommendations in this situation are to halt further road development, and to rehabilitate existing sediment sources. Clearly, these standard recommendations will not be followed as subdivision and development proceed without benefit of community planning on private land within the watershed.

The sedimentation and peak flow hazards are also likely overstated as there is limited surface water flow in this watershed. Most of the Woodward Face watershed does not feed surface flow stream channels.

There are no recorded stream crossings in the watershed, likely because there are no mapped streams, so the hazard of sediment input from stream crossings is low.

The Report Card hazard for landslide density is "off the scale" with a landslide density of 0.56 landslides per km^2. This rating is attributable to one large landslide originating from Silica Mine Road at the edge of this small watershed. The specific landslide is significant feature, but the high hazard rating is a spurious metric in a watershed where 68% of the terrain has a slope gradient of less than 20%, and 83% has a slope gradient of less than 40%.

The hazard rating for roads on unstable slopes is moderately high, with a density of 0.27 km of road on unstable slopes per km^2 of watershed. While the road sections identified are areas of concern, the moderately high hazard rating per unit area again reflects the small area of the watershed more than the prevalence of roads on unstable terrain.

The road sections in question are located in areas identified as Class IV Terrain Stability by Klohn Crippen (1998). This is an area which geoscientists believe "contains areas with a moderate likelihood of landslide initiation following harvesting or road construction." The key concept here is "contains areas". The entire polygon is not necessarily unstable, and Class IV terrain polygons may also contain areas which are stable and suited to road construction.

The sections of road in question, as illustrated in Figure 6, are:

- A 180 meter section of Paradise Valley Road rising across a Terrain Class IV polygon with steep slopes as it begins the steep climb to Paradise Valley.

  Stability problems have occurred along Paradise Valley Road in the past, but we infer that the community prefers to retain this road route for domestic access to homes and settlement. This area is outside of W1832, but may provide access to portions of W1832 in the future.
- A 200 meter section of the Silica Mine Road from approximately 0+170 to 0+370 which rises across a Terrain Class IV polygon with steep slopes and sandy soil.

  This section of Silica Mine Road crosses a steep side slope as it climbs the face of an old glaciofluvial terrace to reach the flat top of the terrace. Soils in the area are very deep, dry and well drained, and the road location shows no signs of recent slope failures.

A flat bench separates the road location from Winlaw Creek across half of this terrain polygon. The remainder of the terrain polygon slopes directly into Winlaw Creek, across a Terrain Class V polygon (contains areas with a high likelihood of landslide initiation). This area is obviously of concern, but does not contain indications of inherent slope instability or impending failure. The road upgrade on this site will involve removing brush and coniferous vegetation which have encroached on the existing road running surface, smoothing the running surface, and maintaining drainage structures as required. Widening the road running surface is not planned.

- A 100 meter section from approximately 1+230 to 1+330 of Silica Mine Road which crosses a Terrain Class IV polygon with steep, rocky slopes near the upper watershed subunit boundary.

  The existing road in this section is partially cut into solid rock, and partially build on fill of massive colluvial boulders and angular colluvial material. Hill side slopes above the road location and fill slopes below the road are very steep – from 60% to 80% gradient. However, the very dry hillside, lack of surface water flow, ideal construction materials, and long life of the existing road with no maintenance suggest that the current location is stable. The current road is sufficiently wide for truck traffic, and requires only brushing and surfacing with gravel to be reopened.

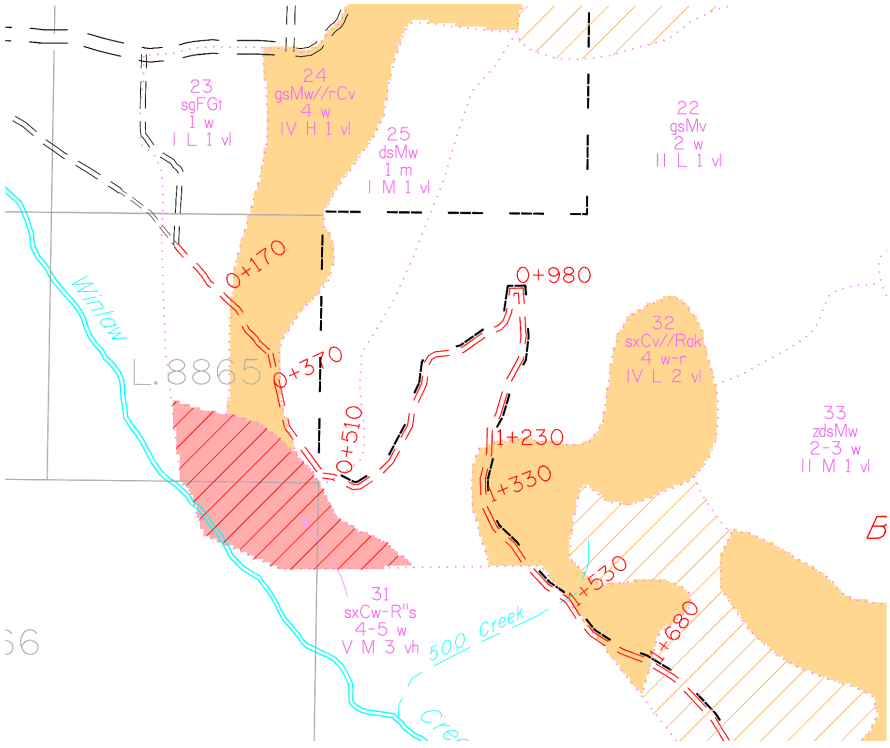

Figure 6: Class IV and V Terrain and Silica Mine Road location in Woodward Face and Lower Main watershed sub-units.

Another interesting metric from the IWAP process is that this watershed has a very high hazard rating due to roads located close to (within 100 meters of) streams, yet the

watershed contains no mapped surface water channels. The IWAP process reports that there is a density of 1.25 km/km^2 of such roads. This turns out to be because Winlaw Bridge Road and the old CPR rail grade are within 100 meters of the Slocan River in the lower part of the watershed.

In summary, the IWAP produces a set of interesting metrics for this small, low elevation, heavily settled watershed. Some of the hazards identified by the IWAP are significant issues, such as the roads located on Class IV terrain. Other identified hazards appear spurious, especially given the dearth of surface water flow in the Woodward Face watershed. Other hazards, such as pollution of domestically utilized groundwater supplies from ubiquitous rural residential septic systems, old fuel storage tanks, and/or old garbage dump sites are not addressed.

Moving on to water management issues in the Woodward Face watershed identified outside of the IWAP process, two items are evident:

1. the large old landslide originating at 0+500 m on the Silica Mine Road, and
2. the potential for water interception and diversion impacts to the three water PODs in the upper portion of the Woodward Face watershed from development activities.

4.2.3.1.1 Old Landslide

The landslide at 0+500 m on the Silica Mine Road occurred in 1971. The slide occurred when an unusually high volume of water was delivered to the site and discharged onto the slope leading down into Winlaw Creek. At this location, Winlaw Creek has cut deeply (50 meters vertical elevation or more) through a glaciofluvial terrace. Water was discharged from the Silica Mine Road ditch onto the long, steep, gravel slope into the creek valley, which failed dramatically. The slide originated on crown land, but involved and damaged privately owned land downslope, and deposited a large amount of material in the Winlaw Creek channel.

The landslide has been examined and discussed several times over the years.

The Slocan Valley Community Forest Management Project (1975) included a picture of the failure, and identified the landslide as a soil saturation slump caused by inadequate road drainage and water diversion.

EBA Engineering Consultants Ltd. (2000) provides a summary of earlier work on the landslide. They note:

> ***Winlaw Creek FSR: Station 0+000 to Station 1+220***
>
> *The road base appears to be stable and in good condition with the exception of a slide located at Station 0+510, which occurred in 1971. The failure appears to be the result of poor road construction practices as concluded in the Terrain Survey and Management Interpretations for the Winlaw Planning Area report (1988), prepared by Greg Utzig… The lack of culverts/crossditches likely contributed to the slide at 0+500. It is probable that runoff from the swales (above the slide area) was diverted along the*

> *(road) ditchline for approximately 300 meters to the initiation zone of the slide.*
>
> *There is considerable revegetation of the slide and only the top 2 to 3 meters of the slide continues to ravel. The hazard of another deep-seated failure similar to the slide in 1971 appears low.*
>
> *Relocating approximately 100 meters of the road base onto more stable terrain directly top the east (of the top) of the slide would reduce the hazard of disturbance of the slide scarp and slope failure. A geometric road design is recommended for the section of road from Station 0+510 to Station 0+610.*
>
> *The hazard of a major failure of the magnitude of the 1971 slide is considered low. However, the consequence of such an event is considered high as debris could reach Winlaw Creek…*

Apex Geoscience Consulting Ltd. re-examined the slide in 2001 while preparing a Detailed Drainage Plan for Silica Mine Road[9]. Will Halleran of Apex noted that the upper portion of the slide scar is a deep V erosional gully, not a typical rotational failure headwall. This suggested the possibility that the base of the old road prism was undercut by erosion prior to the failure, rather than being saturated by runoff and failing in a rotational slump. However, what was not clear was where the volume of water required to create this erosional feature had come from.

Subsequent investigation, as discussed in the Drainage Plan, led Apex to the conclusion that the slide originated when a large volume of water was produced by unique circumstances and directed to the slide site. The water originated from a mining excavation which intersected a perched water table 400 meters upslope of the slide site. The water was retained at the excavation site for a period of time, either by damming or capping the hole. When the water broke free, it ran down to Silica Mine Road, along the road, and then overland to the slide site, where it eroded the V gully which precipitated the slope failure. There is a low likelihood of this sequence of events reoccurring, as the "water gathering" feature is no longer present. Apex notes that the slide site is stable, and that the road does not need to be relocated.

In conclusion, all assessments we have knowledge of agree that the 1971 landslide was caused by water diversion onto the steep slope, not by inherent instability of the slope. The slope which failed shows no evidence of deeply buried clay or sand horizons, subsurface water flow, or other failure plane. Revegetation on the landslide scar indicates that the slope has been stable since the 1971 failure. We regard the 1971 landslide as a prominent reminder of the need for careful drainage management and road maintenance, but not as the site of a future water quality management disaster waiting to happen.

Given that a coherent explanation for the previous landslide has been presented by Apex, that the factors believed to have caused the slide are not related to the road location at that point, and that the current road location is judged stable, we do not plan to relocated the

[9] See Appendix 4.

road in the area above the slide. Relocating the road would cause significant additional soil disturbance, and result in an undesirably steep road grade to rejoin the existing road grade above the slide site.

4.2.3.1.2 Risk of Water Diversion Impacts

Three water intakes which access small springs or seeps are located close to the westernmost boundary of the crown portion of W1832. No timber harvesting is planned in this portion of the woodlot under his FDP. However, Silica Mine Road crosses the upper portion of several small Class 1 watersheds which may supply the southernmost two PODs. Silica Mine Road will be upgraded to provide access to W1832 under this FDP.

The uncertainty above ("may supply") is due to the complex drainage pattern in the area. Silica Mine Road rises across a 25% to 55% slope from 0+550 to 0+980, crossing several ephemeral drainage channels or swales. Beneath the road, these swales debouch onto a broad, kettled, glaciofluvial terrace. The PODs are on the steep slope beneath this intermediary terrace. Glaciofluvial terraces are laid down by running or ponded water trapped between valley sidewalls and melting valley glaciers. The texture of the material within the terrace varies depending on the rate of movement and sediment content of the water which deposited the material. Textures can range from coarse, highly permeable sands and gravels to fine, almost impermeable silts. Layers within the terrace are not necessarily continuous or level – ground water may flow through the terrace downhill or sideways, at depth or near the surface. There are no distinct surface features or channels linking the end of the swales at the upper edge of the terrace with the water sources below the terrace. In short, there is no way to plot the path of water through this area. The safe course is to ensure that development does not alter the current system of inputs and soil water flows.

The road upgrade is expected to have no detrimental effects in the water regime of the this hillside. The current road location and road bed will be maintained. Natural drainage patterns will be maintained by placing cross drains in all identified natural water flow channels which are crossed by the road. EBA Engineering identified a set of 5 small natural swales which will require culverting; Apex Geoscience concurs that the 5 swales defined the natural drainage pattern and will require culverts. There is no current evidence of surface water flow in the 5 swales, but culverting will ensure that any current drainage patterns which may feed water intakes will be maintained.

4.2.3.2 Lower Main Winlaw Creek Watershed

The development activity proposed in this FDP within the Lower Main Winlaw Creek watershed is upgrading 1,308 meters of the existing Silica Mine Road which runs across the upper slopes of the northern branch of the watershed.

The Lower Main Winlaw Creek watershed, shown in Figure 7, is a lower elevation 271 hectare sub-unit of the Winlaw Creek watershed. It is a variable unit, which contains:

- extensive areas of moderately steep to steep south and north facing slopes on both sides of the lower Winlaw Creek valley, and

- a 250 to 400 meter wide corridor of flat land surrounding the low gradient lower reaches of Winlaw Creek as it crosses a large post-glacial alluvial fan on the Slocan Valley floor.

Only 51 hectares of the upper northern slopes of this sub-basin are within W1832. This area is dominated by grassy slopes and open forest on dry, south facing slopes. Some denser forest stands occur in moist swales. This area has high ungulate range values.

This watershed unit contains a mixture of forested crown land and settled private land (20% of the unit is privately owned). Combining these two disparate land use classes in one watershed unit results in unusual IWAP hazard ratings.

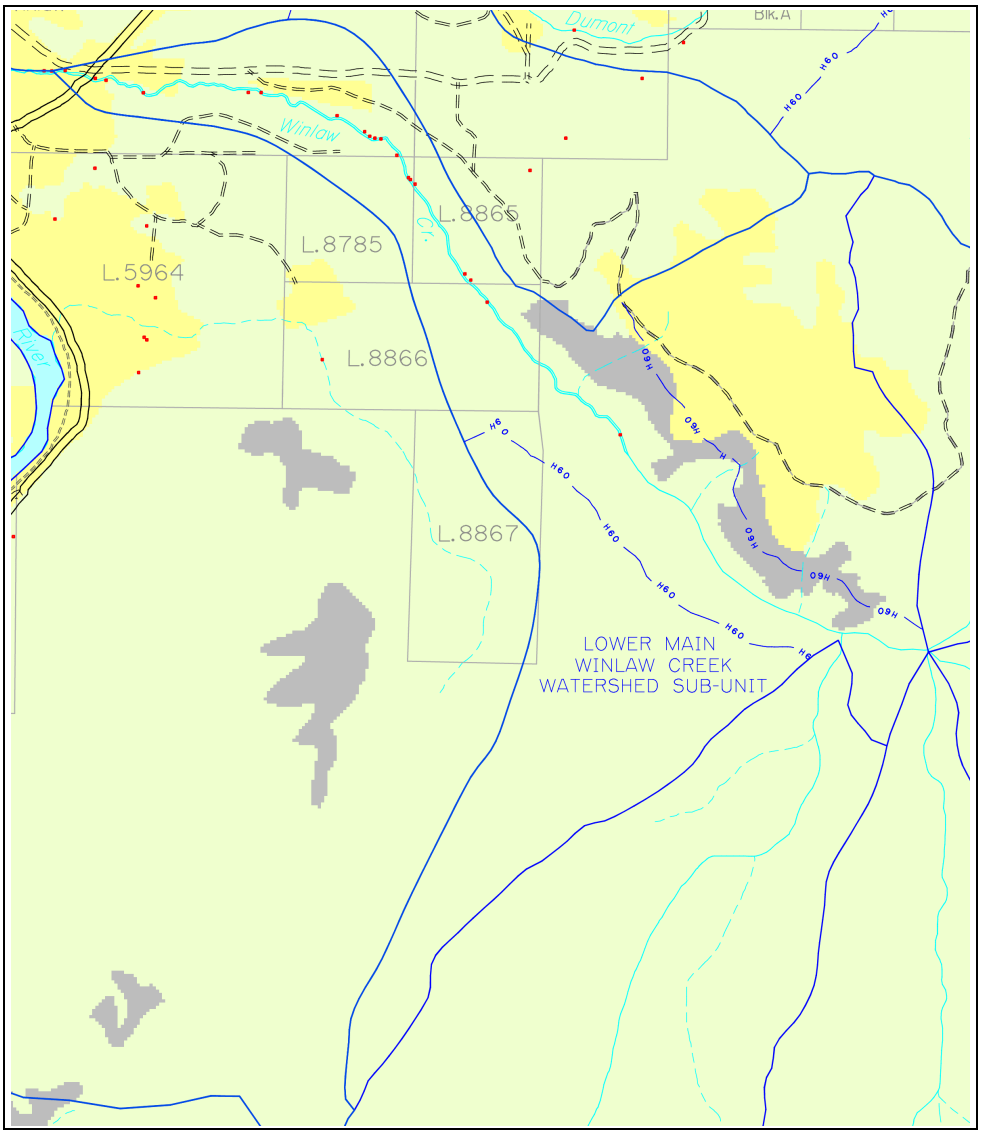

Figure 7: Location of and Hydrologic Cover Classes in Lower Main Winlaw Creek watershed.

Non-forested areas are gray, cleared and/or logged areas are yellow, and hydrologically intact forest is green.

H60 line and watershed boundaries are dark blue, water intake points of diversion are red points.

Figure 8 shows the relatively even distribution of the watershed across elevational bands, as well as the extensive non-forested slopes between 600 and 800 meters elevation. The large "not greened up" area between 800 and 100 meters elevation is the deer range area in W1832. This area is described in the forest cover data as an old forest fire which is currently not sufficiently restocked. This does not appear to be a completely accurate description – the area may never have been "fully stocked" with coniferous trees due to growing site limitations, and may currently be fully occupied by deciduous shrub and scattered coniferous tree vegetation at close to the site carrying capacity. We regard this

area as important wildlife range, especially for ungulates, and have no management plans to increase coniferous tree stocking to "green up" the area.

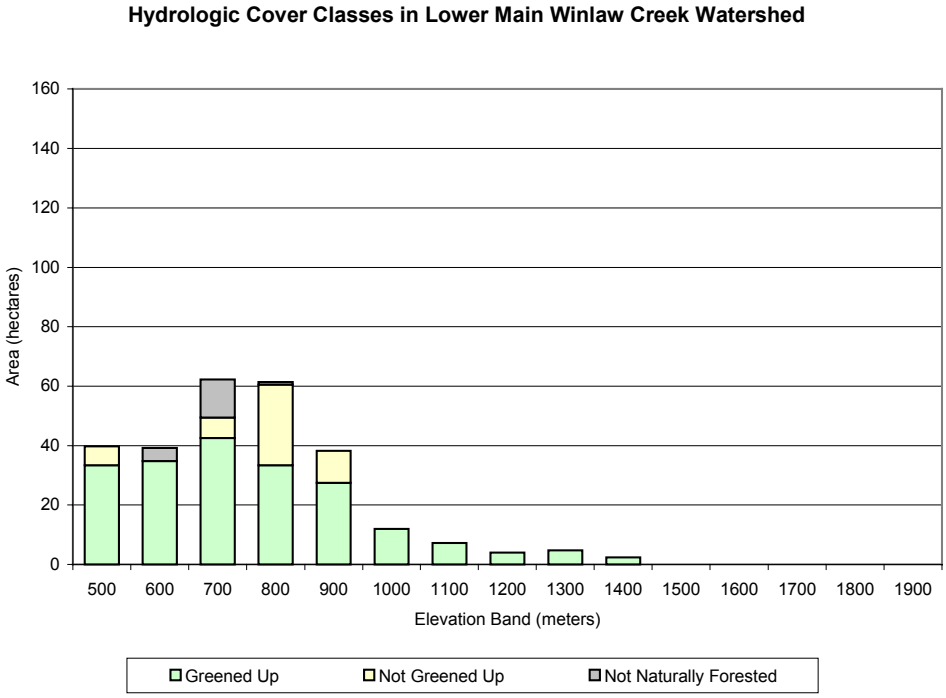

Figure 8: Hydrologic Cover Classes in Winlaw Lower Main sub-unit.

Nineteen water licence PODs are mapped within this unit, along the lower mainstem of Winlaw Creek. The portion of this watershed within W1832 has little to no potential to impact peak flows or late season low flows at these water intakes, as these factors are controlled by other, larger portions of the Winlaw watershed. As well, approximately 60% of the portion of the Lower Main watershed which is within W1832 is within the woodlot Deer Management Area, and will be managed to maintain cover and forage for ungulates. Significant changes to vegetation cover and/or hydrologic regime are not expected.

The water management issue in the Lower Main sub-unit raised by development activities in W1832 is the potential impact of the Silica Mine Road upgrade on slope stability and sediment delivery to water sources.

The IWAP Watershed Report Card presents a picture of varying degrees of risk in the Lower Main watershed, which are not entirely born out by observation.

The peak flow index, which assesses the potential impacts of vegetation removal on stream channels due to increased spring peak flows, is 0.46, in the high hazard range. This assessment does not include the impact of recent clearing for settlement development in the Hoodikoff Road area, and is thus understated.

This high hazard rating is based upon:

- not greened-up area above the H-60 line,

- road density above the H60 line, and
- overall road density.

The high hazard rating is not entirely born out by observation.

First, the high hazard rating associated with not greened up areas above the H60 line is due to the old forest fire in the northern part of the watershed, discussed above. This old fire is important wildlife range, and it is unlikely that the area was ever densely forested. The IWAP process identifies it as a disturbed area contributing to increased peak flows, but it can also be seen as a natural vegetation patch of mixed grassland and forest in normal hydrologic condition.

Road density above the H60 line is also high. This is due to the segment of the Silica Mine Road which crosses the north slope of the watershed above the H60 line. However, the significance of the H60 line in a very small, low elevation watershed with such varied topography is not well established. The hydrological significance of this road section on a dry, south aspect slope is not likely affected by its relation to the H60 line.

Road density for the entire sub-basin is 1.32 km/km^2, which contributes to a high peak flow hazard rating.

About 64% of the roads in the watershed are related to development on private land. This road density presents a low to moderate risk of sedimentation of surface water supplies, as most roads are well separated from Winlaw Creek and/or are below most water intakes. The risk of slope failure due to redirection of surface drainage is low in most cases, as most roads in the sub-basin are on flat valley bottom slopes.

The remaining 36% of the road in the Lower Main sub-basin is of course the Silica Mine Road. It is an old mining access road located on moderately steep to steep slopes on crown land, above most water intakes. Upgrading the Silica Mine Road will not increase the total length or density of road in the sub-basin, but careful planning and drainage management are required to ensure that the risks of slope failures and/or significant increase in water borne sediment levels are minimized.

There are three known stream crossings in the watershed: the Highway 6 culvert, an access bridge near Sutherland's gravel pit, and a location where Silica Mine Road crosses a mapped ephemeral creek in the upper watershed. Together, these three crossings in this small watershed result in a crossing density of 1.11 crossing/km^2. This is interpreted as an extremely high hazard rating, but is more a reflection of small sub-basin area than exceptional hazard.

The Report Card hazard rating for landslide density is very high with a landslide density of 0.37 landslides per km^2. This density based rating is attributable to one old landslide originating from Silica Mine Road in a small watershed. The specific landslide is significant feature, but the report card likely overstates the hazard rating by converting to a "per unit of area" metric.

The hazard rating for roads on unstable slopes is very low, with a road on unstable slope density of 0.09 km/km^2 . This low metric is also misleading. There are significant but manageable slope stability issues along part of Silica Mine Road in the sub-basin.

The IWAP process reports that there is a density of 0.87 km/km^2 of roads located close to (within 100 meters of) streams, a high hazard rating. This is largely because Paradise Valley Road and the gravel pit access road are within 100 meters of Winlaw Creek in the lower part of the watershed. These roads do not pose a high risk of sediment delivery or slope failure.

Moving on to water management issues in the Lower Main sub-unit identified outside of the IWAP process, the water management issue in the Lower Main sub-unit raised by development activities in W1832 is the potential impact of the Silica Mine Road upgrade on slope stability and sediment delivery to water sources.

Most of the existing Silica Mine Road within the Lower Main sub-basin is located on stable slopes less than 60% gradient, in many places on slopes less than 40% gradient. However, a stretch of road from approximately 1+330 meters to 1+680 meters is located in an area identified as Class IV Terrain Stability by Klohn Crippen (1998), as shown in Figure 6. This is an area which geoscientists believe "contains areas with a moderate likelihood of landslide initiation following harvesting or road construction." The key concept here is "contains areas". The entire polygon is not necessarily unstable, and Class IV terrain polygons may also contain areas which are stable and suited to road construction.

The existing road from 1+330 to 1+530 is partially cut into solid rock, and partially built on fill of massive colluvial boulders and angular colluvium. Hill side slopes above the road location and fill slopes below the road are very steep – from 60% to 80% gradient. However, the very dry hillside, little or no surface water flow in the area, ideal construction materials, and long life of the existing road with no maintenance suggest that the current location is stable. The current road is sufficiently wide for truck traffic, and requires only brushing and surfacing with gravel to be reopened.

The existing road from 1+530 to 1+680 is constructed on side slopes with gradients from 20 to 40%, and is set back 30 meters of more from steeper slopes which drop into Winlaw Creek. The low gradient slopes beside the road do not pose a stability risk, but water accumulation and drainage diversion onto the steep slopes beneath the road location must be prevented. This is identified by the Arrow Forest District as a "Flat Over Steep" situation, and a drainage plan is recommended to ensure water accumulation and/or diversion do not occur. Apex Geoscience has prepared a Detailed Drainage Plan for Silica Mine Road which sets out culvert locations and dimensions to ensure that current water flow patterns in small drainage basins are maintained, and that water accumulation and/or diversion do not occur.

The situation at 1+530 is exceptional. Many years ago, miners left the road at this point and pushed a cat trail almost straight uphill to a small moist valley about 100 meters above the road. This feature is linked to the large landslide at 0+500 discussed in Section 4.2.3.1.1. The trail followed an existing moist swale, which is visible on the "pre-road" 1939 air photos of the area. The miners dug two small diameter test pits in the valley, which apparently penetrated to a perched water table. The pits are now seasonal springs, and a small volume of water from the pits runs back down the cat trail, which is now a small creek bed, to the Silica Mine Road. It is not known if this location had surface water

flow prior to the mining activity, but some per-mining seasonal surface flow seems likely based on the terrain features visible on the 1939 air photos.

When the water flow down the trail/creek reaches Silica Mine Road, it is diverted about 10 meters westward along the road, and then crosses the road and is discharged onto a steep slope beneath the road. A moderately sized old slope failure scar is visible beneath the road beside the channel where surface water used to flow, before the diversion down the road was established. The best management choice is to direct the water flow back into the previously existing stream bed, rather than continuing to divert the flow down the road and discharge it onto a steep slope, from whence it rejoins the old channel.

The road at 1+530 appears to have been constructed using logs buried in the fill. The road is currently settling and cracking as the buried logs decompose in response to seasonal wetting and drying.

Required activities at this site include excavating the existing road prism to remove buried organic material, reconstruction with stable material at a reduced fillslope, and installation of a 500 mm culvert which will direct the surface flow into the most well defined available water channel.

We interpret this location as presenting a risk of slope failure due to the discharge of water onto a steep slope which may not have been a site of surface water flow prior to the mining activity. Fortunately, the volume of water is low, and likely seasonal.

Apex Geoscience notes that:

> *If additional slides occur along here it is highly unlikely that they would reach Winlaw Creek Channel. Subsequent sediment delivery to the stream channel would be minor. Although the hazard is high, the consequence is low resulting in a moderate risk.*

4.2.3.3 North Fork Creek Watershed

The development activities proposed in this FDP for the North Fork watershed are:

- upgrading 1177 meters of the existing Silica Mine Road,
- upgrading 40 meters of the Old Woodlot Trail spur road,
- construction of 330 meters of new road, and
- partial cutting harvesting of 24.4 hectares of forest in 2 cut blocks.

The North Fork watershed, shown in Figure 9, is a mid to upper elevation 798 hectare sub-unit of the Winlaw Creek watershed. North Fork Creek is the main tributary of Winlaw Creek. This sub-basin is long narrow unit, with an elevational range from 700 to 1900 meters. The watershed is mostly well forested, except about 55 hectares of dry, steep, sparsely forested, south facing slopes in the mid elevations. Approximately 23% of the sub-basin is occupied by potentially unstable slopes. All of the sub-basin is crown land.

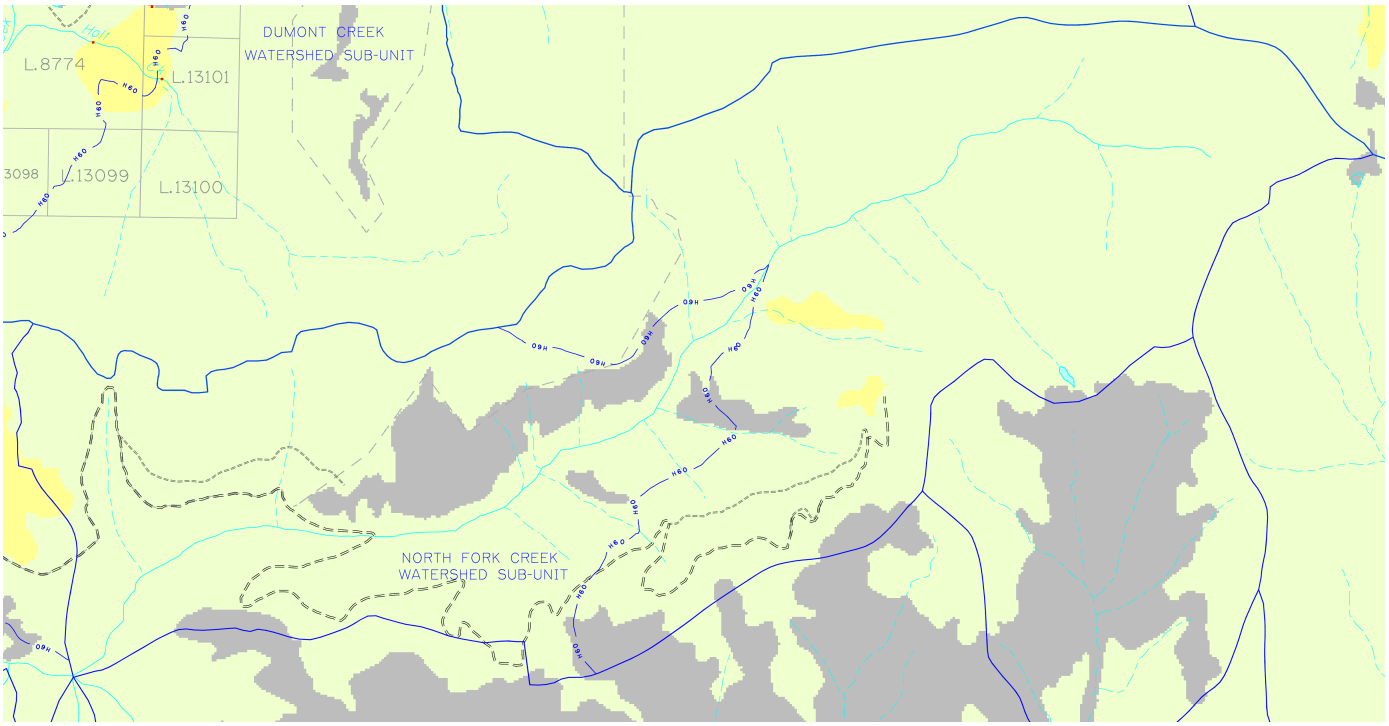

Figure 9: Location of and Hydrologic Cover Classes in North Fork watershed.
Non-forested areas are gray, cleared and/or logged areas are yellow, and hydrologically intact forest is green.
H60 line and watershed boundaries are dark blue, water intake points of diversion are red points.

Figure 10 shows the relatively even area distribution across elevational bands in the North Fork sub-unit. The broad elevational range of non forested terrain, mainly south facing steep slopes, is also illustrated, as is the dearth of disturbed areas.

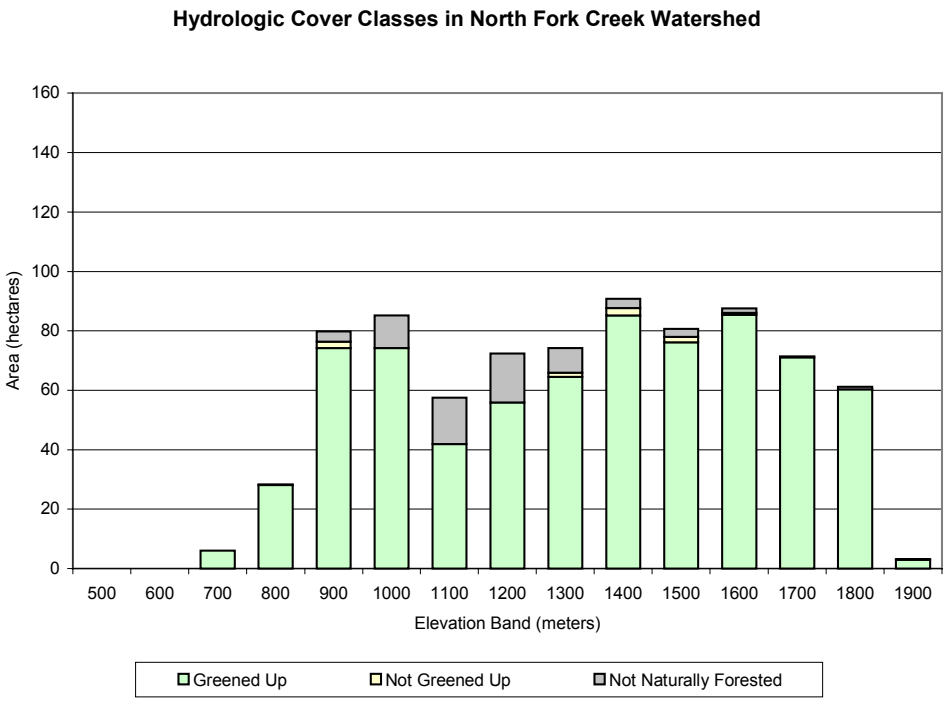

Figure 10: Hydrologic Cover Classes in North Fork Creek sub-unit.

The Silica Mine Road winds through the sub-basin, rising to the old Silica Mine site in the mid upper basin.

Approximately 131 hectares of the middle elevation slopes of this sub-basin are within W1832. Much of this area is productive land suited for timber management.

The North Fork Creek has no licensed water users, but does flow into Winlaw Creek above all known PODs and provides a significant proportion of the water flow in Winlaw Creek.

The water management issues in this sub-basin raised by development activities in W1832 are:

- the potential impact of the road upgrade and construction on slope stability and potential sediment delivery to water sources, and
- the potential impacts of timber harvesting on water quality, quantity and timing of flow.

The IWAP Watershed Report Card suggests that risks will be low.

The current peak flow index, which assesses the potential impacts of vegetation removal on stream channels due to increased spring peak flows, is 0.31, which is on the cusp between medium and low hazard. This sub-basin has very little clearing or human caused forest disturbance, but it is impacted by the old Silica Mine Road. The moderate peak flow index is attributable to road density, not disturbed areas.

Increasing the disturbed area with 24.4 hectares of partial cutting beneath the H60 line results in an increase in the peak flow index to 0.32, which is not a significant change.

This illustrates the degree to which the peak flow index is, in this case, related to road density not disturbed area. The proposed harvesting is not expected to have an impact on spring flow levels or channel stability.

Road density for the entire sub-basin is 1.28 km/km^2, a low hazard rating. Construction of 330 meters of new forest road in W1832 under this Forest Development Plan, and construction of further road under future Forest Development Plans, will raise the density to 1.32 km/km^2, which is still within the low hazard rating class.

High road densities pose hazards due to increased potential sediment yield from surface erosion, and due to increased water diversion potential. The additional road to be constructed in W1832 is located on a well drained hillside with no evidence of surface water movement. The potential for increased sediment yield from newly exposed road surfaces entering water supplies is minimal, as the new road will be well removed from surface water movement channels.

Silica Mine Road crosses mapped water features within the North Fork sub-unit in four locations: three ephemeral creek crossings, and a crossing of the main North Fork Creek. These locations, except for one ephemeral creek crossing, are beyond W1832. The IWAP process assesses the impact of active creek crossings, that is, creek crossings by actively used haul roads. At this time, the Silica Mine road above W18932 is not an active road, but it may be reopened in the future for forestry purposes outside of and not involved with W1832. In such a case, the four crossings would result in a crossing density of 0.50 crossings/km^2, a moderate hazard level. No additional creek crossings within the North Fork watershed are proposed within W1832 in this FDP.

Four old landslide scars are visible in the North Fork watershed on air photos, all associated with the existing, unmaintained Silica Mine road grade beyond W1832. This results in a landslide density of 0.50 landslides per km^2, and a very high Report Card hazard rating for landslide density. Plans for deactivation and hazard mitigation in the affected locations have been prepared by Appropriate Forestry Services Ltd. in 1996 and by EBA Engineering Consultants Ltd. in 2000. This high hazard rating directly concerns an area outside of and above W1832, but also highlights again the importance of responsible road planning, road construction, and road and drainage maintenance practices.

The hazard rating for roads on unstable slopes is moderate, with a road on unstable slope density of 0.23 km/km^2. This density and hazard rating is again based largely on conditions outside of and above W1832. However, upgrading is proposed for the lengths of Silica Mine Road shown in Figure 11 which cross or border areas identified as Class IV terrain by Klohn Crippen (1998). These are areas which geoscientists believe "contain areas with a moderate likelihood of landslide initiation following harvesting or road construction." The key concept here is "contains areas". The entire polygon is not necessarily unstable, and Class IV terrain polygons may also contain areas which are stable and suited to road construction.

The alleged neck of unstable terrain which the road crosses at 3+000 is not an observed phenomenon in the field. This terrain polygon identifies a very dry slope with some steep areas and shallow soils, and open grass and shrub vegetation. However, the unstable portions of the polygon do not extend down to or across the road.

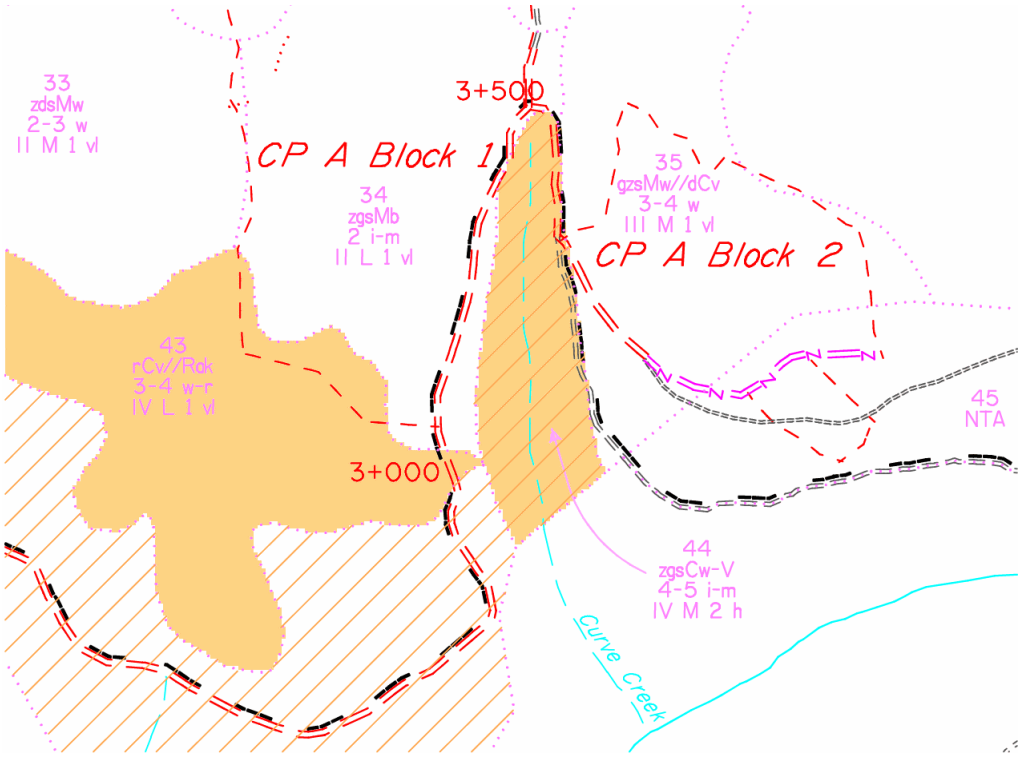

Figure 11: Class IV Terrain and Silica Mine Road location near proposed cut blocks.

The potentially unstable terrain near the 3+500 curve[10] is a concern. The area southwest of the curve, where the road location just touches the Class IV polygon beneath the road, is an area of high soil moisture and steep side slopes in the 50 to 60% slope gradient range. The existing road crosses these steep slopes to reach and then cross the valley bottom. The steep slopes in this location are short, extending for up to 10 meters above the road to a flat bench, and from 20 to 30 meters below the road to a flat valley bottom. Water emerges from the cut slope and collects on the existing road running surface. Water volume and flow rate are small. Tension cracks are visible on the road surface.

Fortunately, the road prism in this location has not failed to date. Field crews have improved drainage in the area with hand tools, but establishing a proper drainage ditch and culvert to prevent seepage water from collecting on the road surface are required. This will allow the road subgrade to dry and greatly reduce the likelihood of road failure. If a slope failure does occur at this location, impacts on water quality will be minimal. There is no continuous surface water channel from this area to the POD's on Winlaw Creek – the noted seepage is the first sign of surface water flow in this small side drainage. While heavy rains or spring melt may result in a small volume of surface water flow from this area to Winlaw Creek, surface water from this location would usually percolate back into the soil in the adjacent valley bottom before reaching Winlaw Creek, and suspended sediments would be filtered out by this process. The TSIL B terrain map indicates that the

[10] We do not refer to this site as a creek crossing because there is no creek or sign of surface water flow at the point where the road crosses the valley.

terrain polygon beneath the road is an area with high potential for sediment delivery to streams from surface erosion. While this assessment may apply to other portions of the polygon, it does not appear valid for this specific area.

There are signs of previous instability at 3+670, where the access road to CP A Block 2 leaves the main Silica Mine Road on an existing spur road. Apex Geoscience made the following observations about the terrain beneath the main Silica Mine Road just past the junction:

> *A series of slumps and slides below station 0+487[11] are associated with the stacked trail system constructed on ~80% slopes of zsrCb//Rs[12]. The slumps initiate on a trail between the lower trail and road. The road likely sidecast onto the middle trail (which is cut into rock), overloaded it and caused the trail to slump onto the lower trail. The scarp is 2 meters high and is still unstable.*
>
> *The slides below 0+487 is the result of cutslope/fillslope failures on the old stacked trail/road system. The bottom of the draw (Curve Creek valley) below the slides is wide with no stream channel. Construction of the road will not significantly increase the likelihood of landslide initiation. Presently there is a high hazard, low consequence and moderate risk of impacts to the North Fork of Winlaw Creek resulting from road related instability.*

There are no other stability issues along section of road from the 3+500 switchback to 3+670. Slopes in the area are steep, from 45 to 60 % gradient beneath the road. However, this is a dry southwest aspect hillside, with no significant surface water flow and no seepage along the cut slope of the existing road. Road construction materials were coarse textured, angular colluvium.

At 3+670, the proposed new road construction to access CP A Block 2 begins. The road location leaves the existing Silica Mine Road, and also leaves the mapped Class IV terrain polygon.

The proposed upgrade to the Old Woodlot Trail road to create a Block Road access spur leaves the Silica Mine Road at 3+500 and proceeds north across level terrain to the edge of the watershed. This area is at the watershed divide. No slope stability or drainage issues are present.

The main water management issue in the North Fork sub-unit identified outside of the IWAP process is the current condition of and suitable management approach to the existing Silica Mine Road. A series of studies of the road beyond W1832 have been carried out between 1996 and the present. These studies have recommended that activities to properly deactivate the road or restore the road and drainage structures to safe, usable

---

[11] The Apex traverse and our road traverse shown on the maps start at opposite ends of the road. Apex 0+487 = our 3+600.

[12] Surficial geology: Approximately 75% of area occupied by a silt sand rubble Colluvial blanket, 25% occupied by bedRock steeply sloped.

status be carried out at the North Fork crossing and in several locations with drainage or slope stability problems. These activities are outside of the management of W1832.

4.2.3.4 Dumont Creek Watershed

The development activity proposed in this FDP for the Dumont Creek watershed is the partial cutting harvesting of 3.1 hectares of forest in 1 cut block, and the upgrading of 32 meters of the Old Woodlot Trail to be used as a block access road. This proposed harvest area is the northern part of CP A Block 1, 83% of which is in the North Fork watershed. The portion of CP A Block 1 within Dumont Creek forms a logical harvest unit in conjunction with the portion of the block in the North Fork subunit.

The Dumont Creek watershed, shown in Figure 12, is a small, varied, 589 hectare watershed with extensive settlement and development in lower elevation areas, and high domestic and irrigation water demands. Paradise Valley Road provides access to elevated, flat bench land in the middle portion of the watershed. This flat terrain is occupied by a small rural community, which draws its water from individual water licences on Dumont Creek and it's tributaries. Dumont Creek also provides water to lower elevation water licences, and replenishes groundwater sources tapped by domestic wells.

The land within the Dumont Creek watershed is 28% privately owned. The upper 265 hectares of this watershed are within W1832.

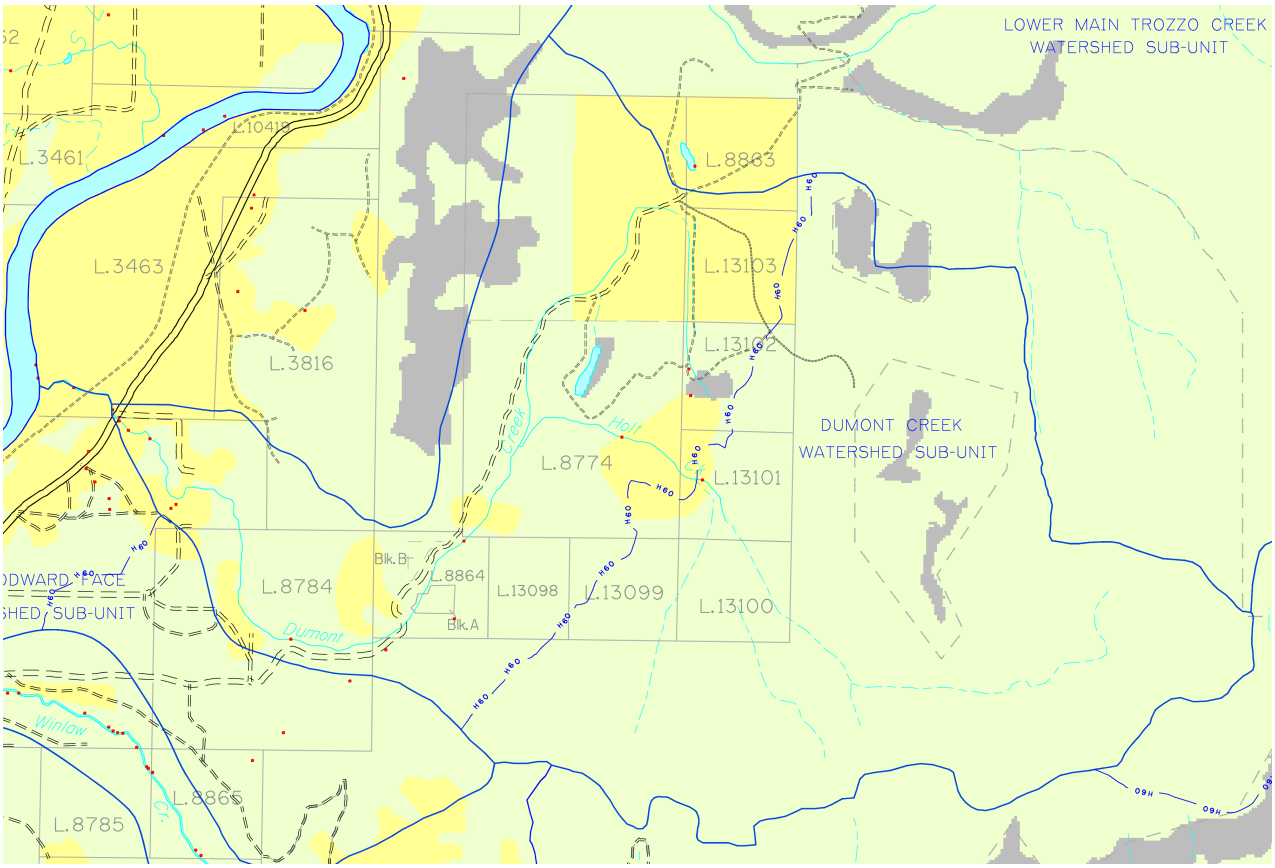

Figure 12: Location of and Hydrologic Cover Classes in Dumont Creek watershed.

Non-forested areas are gray, cleared and/or logged areas are yellow, and hydrologically intact forest is green.

H60 line and watershed boundaries are dark blue, water intake points of diversion are red points.

Figure 12 and Figure 13 illustrate the current settlement and land use policies on the Dumont Creek watershed. The watershed area/elevation profile is dominated by land in the 700 to 1000 meter elevation band. This elevation band has been extensively impacted by clearing, most dramatically by a single 66 hectare clearing for pasture development in upper Paradise Valley, but additionally by 16 ha and 5 ha patches of older logging which are currently identified as Not Sufficiently Restocked in the forest cover data files. The portions of the watershed above 1000 meters are largely within W1832, and are undisturbed at this time.

The H60 line in the Dumont Creek watershed is at 840 meters elevation, and most of the existing disturbance is below this elevation (see Figure 12). However, the significance of the H60 line in a small, low elevation watershed is open to discussion.

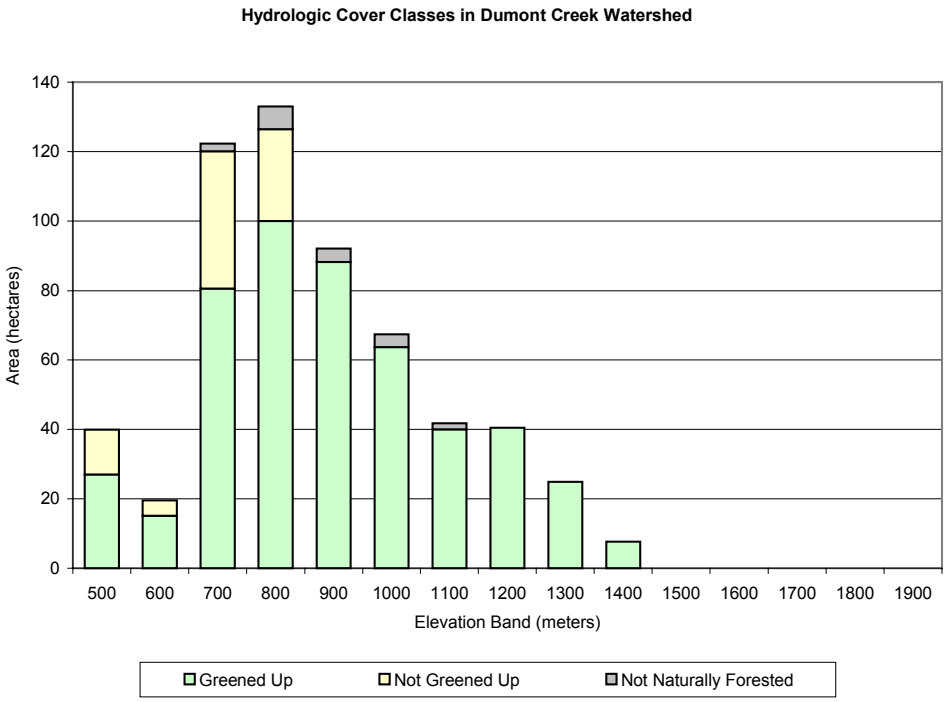

Figure 13: Hydrologic Cover Classes in Dumont Creek watershed.

There are 15 POD's mapped by MELP in the Dumont Creek watershed. These water intakes are located on the mainstem creek, on small tributaries, on unmapped seeps, and in small lakes.

The IWAP Watershed Report Card presents a picture of moderate hazard in the Dumont Creek, with a significant degree of uncertainty surrounding the issue of equivalent clearcut area (ECA).

The peak flow hazard index, which assesses the potential impacts of vegetation removal on stream channels through increased spring peak flows, is 0.24. This is in the low hazard range.

However, Dumont Creek has a weighted ECA of 0.146 , based on 13.3% of the watershed being not greened up below the H60 line, and 0.9%[13] not greened up above. Of the 14.6% weighted ECA, 13.1% is on private land and 1.5% is on crown land. Private land occupies 28% of the watershed.

The Arrow Forest District *Guidance for Domestic Watersheds* states:

> ***ECA Limits in Watersheds with >15% Private land in watershed.***
>
> *If under present conditions total ECA (private and crown) exceeds 20% then a field review and detailed watershed analysis must be conducted to*

[13] 13.3 + (0.9 * 1.5) = 14.6

assess the feasibility of additional harvesting with the constraints of maintaining water management objectives.

If under present conditions total ECA (private and Crown) is less than 20%, harvesting can proceed to a limit of 15% ECA on the Crown land portion. Assessments on the suitability of the private land for timber harvesting should be conducted to determine if higher ECA limits could be set on the Crown land portion.

The proposed development of 3.1 ha of partial cutting above the H60 line in the Dumont Creek watershed will increase the ECA by 0.8% to 15.4% total and 2.1% on Crown land, still well under the caution limit for private and crown land combined, and much less than the suggested limit on the Crown land portion. We do not expect that a partial cut of this size, which will retain over 50% of stand volume and which will retain the larger trees on the forest site, will have discernable impacts on water quality, quantity, and timing of flow in Dumont Creek

Road density for the entire sub-basin is 1.15 km/km^2, a relatively low density with a low hazard rating. These roads are generally located in the lower to mid elevation portions of the basin. This assessment is based on mapped roads. Some smaller roads have likely been omitted from the maps, but some mapped roads may no longer be active or may have limited hydrological impacts.

There are 5 mapped stream crossings in the watershed, resulting in a density of 0.85 crossings/km^2, and a very high hazard. These crossings are the result of settlement development and old road construction in Paradise Valley. At this time we assume that all of the mapped crossings are active and should be included in the assessment; further examination may show that some are inactive. As no additional creek crossings in the Dumont watershed are proposed under this FDP, the status of mapped crossings is not a current planning concern. However, further development of access to W1832 will require additional creek crossings in the upper Dumont watershed. The conventional approach to addressing this high crossing density issue would be to remove some of the crossings and restore the stream banks in the area. Whether such activities will be required, or will be possible, at the currently mapped creek crossings is not known at this time.

The Report Card hazard for landslide density is moderate, with a landslide density of 0.17 landslides per km^2. This rating is attributable to one small landslide originating from a private driveway beside Paradise Valley Road. The driveway leaves the main road via a switchback constructed in fine textured sediments on a steep, moist, lower slope. Such locations, which have a inherently high risk of slope failure, will be avoided as road locations and will not be used as switchback sites in W1832.

The hazard rating for roads on unstable slopes is low, with a density of 0.08 km of road on unstable slopes per km^2 of watershed. The road section in question is located in steep terrain near the above noted landslide. Most existing road in the Dumont watershed is built in level to gently sloping, stable terrain.

In summary, the IWAP suggests that current hazard levels in Dumont Creek are low, but that there are areas of concern. The overall disturbed or cleared area in the watershed is

high, although disturbance is currently concentrated in mid to lower elevations. The number of creek crossings, including old crossings in unknown condition, is high.

Moving on to water management issues in the Dumont Creek watershed identified outside of the IWAP process, two items are evident:

- Potential deposition of deleterious substances in water supplies. Significant lengths of Dumont Creek are directly beside Paradise Valley Road, or private driveways. To date, water quality has generally been maintained. However, a simple traffic accident could lead to spillage of fuel or other undesirable material into the water supply. Livestock waste or domestic waste also could inadvertently enter the water supply.
- Potential of further clearing on privately owned land. Government standards, the Woodlot Management Plan, and community standards greatly influence the extent to which the forest cover of upper Dumont Creek watershed within W1832 can be altered. No legal restrictions affect vegetation management choices on private land. While outside of the mandate of the W1832 FDP, private land forest management is clearly a significant impact on the hydrology of Dumont Creek.

4.2.4 Flat Over Steep

The Arrow Forest District identifies areas of "flat over steep" terrain as locations which have an elevated hazard of landslides. The hazard typically occurs on steep or potentially unstable slopes that are located downslope of gentle terrain where forest development has occurred. Road construction on the gentle terrain can either:

1. collect water from small, discrete subbasins and channel the collected water into drainage channels on the potentially unstable slopes below the road,
2. divert water flow from established drainage channels onto other locations, or
3. both of the above

Altering the location of and/or volume of water flow can lead to slope failures.

None of the harvesting proposed in this Forest Development Plan is located in a "flat over steep" situation, but a proportion of the old Silica Mine Road location, which will be upgraded to become a low impact haul road under this Forest Development Plan, is located on stable terrain above steeper, possibly unstable slopes. In order to prevent drainage diversions, the Licencees have retained by Apex Geoscience Consultants Ltd. to prepare a Detailed Drainage Plan for Silica Mine Road. This plan is included in Appendix 4. The plan identifies the small drainage sub-basins crossed by the road location, and specifies culvert locations which will prevent accumulation of water from multiple sub-basins by the road ditch and/or diversion of water from established channels to other points on the hillside.

4.2.5 Contingency Plan for Domestic Watersheds

The Arrow Forest District notes that if a domestic water supply or the water works are damaged or made unusable by forest development activity, the forest licensee (or MOF if

applicable) will immediately take steps to correct the damage and restore the water supply. The responsible party will provide the water licensee with potable water until the water supply is restored. Normally these situations will be resolved between the forest licensee and water licensees, however, when that is not possible, MOF and MELP will jointly determine a solution.

A formal contingency plan sets out actions to help provide for the supply of emergency water and for the rehabilitation of the water system should damage occur. A contingency plan is a negotiated document. If requested by domestic water users, the Licencees will make reasonable efforts to develop a mutually agreed upon contingency plan with the representatives of domestic water users who may be affected by developments proposed in this FDP, specifically water users of Winlaw and Dumont Creeks.

4.3 Fisheries

The northern boundary of the crown portion of W1832 runs along the south bank of Trozzo Creek for a length of 150 meters. This area has not been explored in the field, but this reach of Trozzo Creek is likely fishbearing. No development activities are proposed in this FDP within the Trozzo Creek watershed.

A corner of W1832 crosses the middle reach of Dumont Creek. The stream in this area is less than 1 meter wide, steep, and surface flow may cease in dry seasons. This reach has been inspected in the field, and is not believed to be a fish bearing stream.

There are no other fishbearing streams within W1832.

Winlaw Creek is a fishbearing stream, and areas which drain into Winlaw Creek will be affected by proposed developments. The management approaches used to maintain forest ecosystems, and to maintain water quality, quantity and timing of flow in Winlaw Creek for domestic water users, are expected to also maintain and protect water quality, quantity and timing of flow for fish.

4.4 Riparian Ecosystem Management

The portion of W1832 affected by developments proposed in this FDP does not contain permanent creeks, but does contain creeks with seasonal water flow and several small seasonal wetlands.

Policy under the KBHLP Strategies calls for a 30 meter both sides riparian management zone (RMZ) on streams directly related to domestic water intakes. This RMZ is to be managed to the best management practices for Class S4 streams set out in the Forest Practices Code *Riparian Management Area Guidebook.* Among other things, the Guidebook calls for a maximum overall retention level of 25% of forest basal area in the RMZ.

None of the watercourses in the affected portion of W1832 meet the parameters used to define streams which are directly related to domestic water intakes. However, proposed management practices will meet or exceed the requirements for S4 streams.

The riparian management goal set out in the Management Plan for W1832 is to direct 50% of timber yield within Riparian Management Zones (RMZ) to the creation and maintenance of old growth habitat and coarse woody debris. Leave trees, old growth structures, and coarse woody debris will be concentrated in the riparian ecosystem within the Riparian Management Zone.

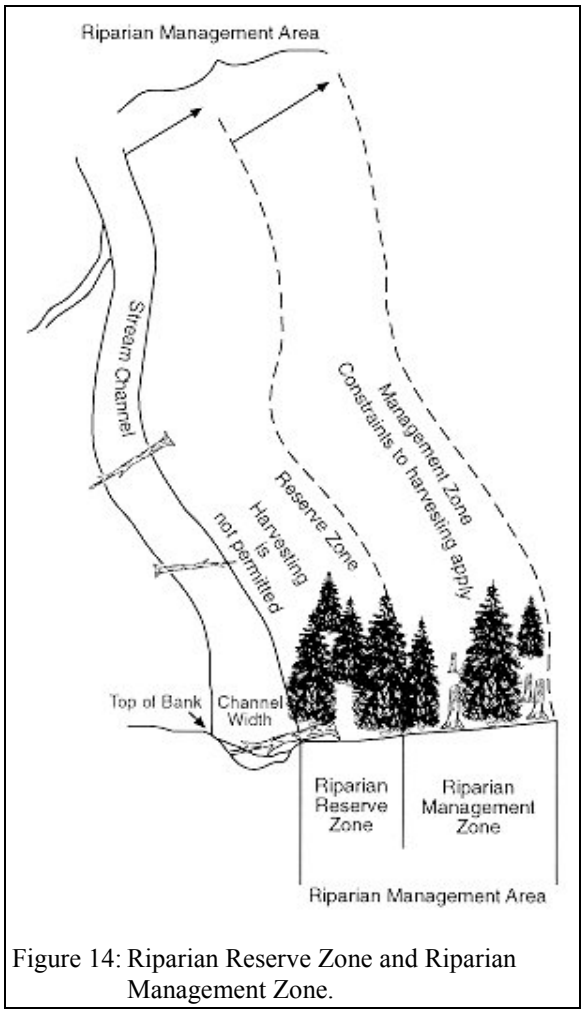

Figure 14: Riparian Reserve Zone and Riparian Management Zone.

This management goal will be implemented by establishing a 10 meter Riparian Reserve Zone (RRZ) around all creeks and wetlands, regardless of adjacency to water intakes, and by partial cutting in the remaining 20 meter width of the Riparian Management Zone

The management objective for the RRZ is no timber cutting and no machine traffic, except for:

1. Designated skid trail or road crossings. The number of crossings will be minimized, and trails or roads will cross the RRZ as by as directly a route as possible.
2. Falling unstable danger trees which threaten worker safety in the RMZ or surrounding area. If such action is required, the felled trees will be left on site to contribute to CWD.

The 10 meter riparian reserve zone alone will result in approximately 30% basal area retention in a 30 meter RMZ. The remainder of the forest in the RMZ, as well the forest in the cutblocks, will be managed using partial cutting approaches which maintain functioning forest ecosystems and forest structures. This will result in additional tree retention within the RMZ, with total retention within the 30 meter RMZ likely exceeding 50%. This significantly exceeds the KBLUP Strategies target level of 25% retention.

Tree species retained will be representative of the current species distribution in the area. Retained trees will be a mixture of Douglas-fir, larch, hemlock, cedar, white pine. Lodgepole pine will not be a favored riparian management area leave tree species.

Excerpts from the Forest Practices Code *Riparian Management Area* Guidebook are contained in Appendix 5. The guidance provided in this publication will govern forest management activities in the RMZ.

4.5 Wildlife and Biological Diversity

4.5.1 Species at Risk

The MELP Kootenay Region Wildlife Branch[14], the MELP Conservation Data Center[15], and the Living Landscapes[16] web sites were used to assemble a list of identified species at risk which may occur in W1832. This list is shown in Table 4.

English Name	Latin Name	Status
Birds		
Bald Eagle	*Haliaeetus leucocephalus*	Yellow Listed
Cooper's Hawk	*Accipter cooperii*	Yellow Listed
Lewis's Woodpecker	*Melanerpes lewis*	Blue Listed
Northern Goshawk	*Accipter gentilis*	Yellow Listed
Pileated Woodpecker	*Dryocopus pileatus*	Yellow Listed
Short-eared Owl	*Asio flammeus*	Blue Listed
Turkey Vulture	*Cathartes aura*	Blue Listed
Vaux's Swift	*Chaetura vauxi*	Yellow Listed
Reptiles and Amphibians		
None		
Mammals		
Fisher	*Martes pennanti*	Blue Listed
Grizzly Bear	*Ursus arctos*	Blue Listed
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Blue Listed
Wolverine	*Gulo gulo*	Blue Listed

Table 4: Wildlife Species at Risk Possibly Found in W1832.

The Blue list includes vulnerable indigenous species or subspecies (taxa) that are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. It also includes species that are generally suspected of being vulnerable, but for which information is too limited to allow designation in another category.

The Ministry also lists taxa considered to be secure in British Columbia on the Yellow List. These taxa are managed at the habitat level by managing for a diversity of habitats in the province.

We are not aware of denning or breeding activity by any of the above listed species in W1832. However, the identified bird and bat species all depend on large trees with wildlife tree characteristics (see Section 4.5.3) for many aspects of their life cycle. These habitats will be provided in W1832 in designated wildlife trees, full cycle trees, wildlife tree patches, and as part of a functioning forest ecosystem.

Fisher and wolverine are reclusive animals which also use large trees for denning. Simple human presence in W1832 may discourage their use of the area for periods during active

[14] Web site removed during government reorganization

[15] http://srmwww.gov.bc.ca/cdc/table_vertebrates.htm

[16] http://www.livingbasin.com/endangered/Birds/

timber management operations. Maintenance of wildlife trees and coarse woody debris should provide some habitat values for these animals, and other non-listed small mammals, throughout W1832.

W1832 does not contain any exceptional habitat resources for grizzly bear. Bears may pass through the area, but these our extensive reconnaissance in the woodlot has not identified any food resources or habitat resources which would support seasonal residence by bears.

While no specifically identified amphibians at risk are expected in W1832, all amphibians in Canada appear currently "at risk" to some degree. The area impacted by development proposed in this plan contains a number of small, seasonally flooded wetlands at mid elevations which serve as amphibian breeding areas. These seasonal ponds are critical resources for the local amphibian population, and will be protected from deleterious impacts which would reduce their habitat suitability for amphibians. Ponds and wetlands will be surrounded by Riparian Reserve Zones and Riparian Management Zones as discussed in Section 4.4.

4.5.2 Coarse Woody Debris

The following edited citation is drawn from the March 2000 MoF paper *A Short-term Strategy for Coarse Woody Debris Management in British Columbia's Forests* and defines the policy environment under which coarse woody debris is currently managed in crown forests:

> *1. Background*
>
> *Coarse woody debris (CWD) is an important component of forests and is linked to biodiversity and ecosystem processes. CWD provides centers of biological interaction and energy exchange, symbolizing in many ways the complexity of forest ecosystems. Long-term management of this resource is vital to maintain ecosystem integrity. For operational purposes CWD is defined as material greater than 10 cm in diameter, in all stages of decay and consists of above-ground logs, exposed roots and large fallen branches.*
> *....*
>
> *Wood below utilization standards is available for CWD... CWD or high stumps, above standard timber utilization requirements that are left on a block (as specified in a silviculture prescription) will be charged to cut control but monetary penalties will not apply.*
>
> *2. General considerations for CWD management*
>
> *2.1 Guiding principles*
>
> *The following are principles that provide a decision-making framework for CWD management.*
>
> 1. *Minimize CWD accumulations, especially on landings and roadsides, bearing in mind that some accumulations will be inevitable for reasons of safety and operations. Some small CWD*

piles dispersed in cutblocks may be appropriate to provide valuable habitat for some mammals.

2. *Larger pieces of CWD are more valuable than smaller pieces — they last longer, hold more moisture, are useable structures for a greater number of organisms.*
3. *Ecologically, it is advantageous to maintain the full range of decay and diameter classes of CWD on every site — different functions and ecosystem processes require CWD in different stages of decay.*
4. *Coniferous material lasts many times longer than deciduous material and therefore remains part of the useable structure of a stand for a much longer period of time. However, the faster decay rate of deciduous CWD likely provides significant short-term ecological benefits. Retention of a diversity of species is advantageous.*
5. *CWD can be managed in conjunction with wildlife trees and other constrained or reserve areas. Standing live and dead trees and/or stubs retained on cutblocks represent important sources of CWD recruitment.*
6. *CWD has additional value in riparian areas, which are a valuable habitat resource for many species of wildlife. CWD entering or falling across a stream produces habitat for fish, invertebrates and vegetation. Most importantly, it contributes to stream geomorphology. Excessive amounts of fine woody debris can have negative effects on stream biology.*
7. *Manage the composition and arrangement of CWD within acceptable levels of risk of wildfire, insect pest and forest disease outbreaks.*

CWD management approaches which maintain a volume and quality of CWD sufficient to maintain CWD related ecological functions and to provide CWD related habitats are feasible under this policy framework.

The volume and quality of current coarse woody debris (CWD) populations in W1832 are variable. Some small areas contain concentrations of large standing and dead material that predate the 1912 fire which provide pockets of old growth wildlife trees and CWD. There are also areas with concentrations of smaller second growth snags and fallen timber. However, in most locations, the current CWD population is different from that found in older Douglas-fir forests in the Interior Cedar Hemlock zone – the average piece size is smaller, and the total volume per hectare is lower. Restoration of a more natural CWD population will be a long term process. The largest second growth trees in current stands are still smaller than large CWD from natural forests, and 50 to 100 more years will be required to grow trees the size of even moderately large CWD.

Short and medium term CWD inputs within the timber management landbase will be from:

1. natural decay and fall of snags, and
2. from actively falling snags and poor quality live stems which are unsafe to work near in harvest areas, per the Wildlife Tree Committee of B.C. standards (http://www.for.gov.bc.ca/hfp/wlt).

Most direct inputs from management at this time will be in the form of medium sized, unstable snags. Significant management inputs of green tree CWD are not expected, as most stable green trees destined for CWD in the future will be maintained as wildlife stems at this time.

As significant quantities of green CWD are not expected, Douglas-fir bark beetle habitat in green Douglas-fir CWD is not expected to be an issue. Any concentrations of three or more green Douglas-fir trees fallen and left for CWD input will be identified on a post harvest map and monitored annually for beetle activity until no longer suitable bark beetle habitat.

Long term CWD management will be addressed through the designation and management of full cycle trees, as discussed in Section 4.5.3. These stems will remain on the site permanently, and will eventually contribute large CWD to the forest. The Management Plan for W1832 sets a target of 15% of net timber management site productivity diverted to full cycle trees.

The initial intermediate cutting proposed in this FDP will leave ample candidates for full cycle trees and CWD on every cut block.

Snags and CWD will also be contributed to the general forest ecosystem in areas outside of the timber management landbase, in riparian reserves, ecologically sensitive terrain, and wildlife tree patches within W1832. These will augment the snag and CWD population maintained within the timber management landbase, and will likely develop some large piece size CWD concentrations over time.

4.5.3 Wildlife Trees

Wildlife trees are trees with specific features or groups of features which make them suitable and desirable for wildlife habitat. Typical features include, but are not limited to:

- large stem diameter,
- large spreading limbs,
- loose, sloughing bark,
- stem cracks and splits,
- decay,
- nesting cavities, and
- mistletoe brooms.

Large, old stems generally provide more and better wildlife habitat features than small or young stems.

Old growth wildlife trees are not common in W1832, but scattered large veteran stems and groups of large old stems do occur. Retention of these ecological structures is important,

as is a management plan to replace them over time. Second growth wildlife trees are more common, but are still not abundant.

The wildlife tree management strategy for W1832 is:

- Retain existing old growth patches. Where required for worker safety, designate no work zones around old growth patches.
- Retain individual old growth stems and snags inside logging blocks, or fall to produce CWD, based on the specific situation. If the old growth stem is assessed to be stable per the Wildlife Tree Committee of B.C. standards, it will be retained. If the old growth stem is assessed as unstable and dangerous to workers but has specific high value wildlife habitat features, it will be retained, with a no work zone as required. If the old growth stem is highly unstable and deemed likely to fall in the near future regardless of human activity, and/or has no or few high value wildlife habitat features, it will be cut and left on site to create CWD.
- Avoid felling unstable old growth stems during the breeding season for birds and mammals. Stems which are observed to contain active nests or dens will not be felled.
- Abundant large diameter codominant and dominant leave trees will remain on logged sites after initial intermediate cutting operations. After initial harvesting, a subset of the leave trees will be identified as full cycle trees[17]. The number of stems per hectare of full cycle trees has not yet been determined, but, per Section 9.4.9 of the Management Plan, the objective is to capture 15% of net timber management site productivity to create and maintain full cycle trees. The full cycle trees will remain on site in perpetuity, to reach maturity, die, and fall to provide large live and large dead stem habitat.

  The management goal is to create a population of well distributed large, old trees for wildlife habitat, and eventual creation of coarse woody debris. These structures will benefit cavity nesting birds, bats, small mammals and large perching birds. Full cycle tree spacing and management options will be refined over time as experience in this management approach is gained.

4.5.4 Wildlife Tree Patches

W1832 is located in the Pedro Landscape Unit, within the Interior Cedar Hemlock moist warm(2) and dry warm biogeoclimatic subzones. The Arrow Forest District indicates that the retention rate for wildlife tree patches in these subzones in the Pedro landscape unit is 8% of total area under prescription.

By MoF policy, wildlife tree patches are to be designed on a site specific basis to meet the following strategies:

- Wildlife tree retention should, as a first priority, protect trees with valuable wildlife tree attributes. Where there are few trees with valuable attributes, retention should focus on areas with potential for wildlife tree recruitment.

[17] See Appendix 1.

- A diversity of wildlife tree retention strategies will result in more diverse habitat options. However, larger patches containing trees with valuable wildlife tree attributes generally serve a greater number of ecological functions
- It is particularly important to retain uncommon species, unusual stand characteristics, and other elements of stand level biodiversity.
- Wildlife tree retention areas will be chosen to minimize windthrow risk, and/or surrounding forest areas in the timber management landbase will be harvested to manage windthrow risk in designated wildlife tree patches.
- The dynamic nature of both individual trees and forest stands will be considered during planning and management of wildlife trees. Due to change and disturbance, designated wildlife trees may not continue to provide the planned and desired habitat attributes. This may result in modification to wildlife tree management areas.

Trees chosen for wildlife tree retention are planned to be retained in W1832 permanently, and contribute to CWD to the forest site after their death.

A Comprehensive Plan for Wildlife Tree Retention (CPWTR) has been prepared for W1832. This plan shows the location of wildlife tree patches which are proposed at this time, and reiterates the approach to individual wildlife tree management set out in Section 4.5.3. The CPWTR may be revised as additional information becomes available.

Wildlife tree patch requirements within W1832 will be met by:

- Undisturbed forests on areas within W1832 which are outside of the timber management landbase. These include forested ecologically sensitive terrain and riparian reserve zones.
- Development of managed old growth forests with characteristics suitable for ungulates and many other wildlife species in the ungulate management areas (see Section 4.5.5).
- By designated Wildlife Tree Patches. Forested areas which will be included in designated wildlife tree patches or which are on ecologically sensitive terrain occupy 22.9% of the woodlot. These areas contain a variety of wildlife tree features and densities, as discussed in the CPWTR.

  As shown in Table 5 and on the Forest Development Plan maps, 2.2 hectares of wildlife tree patches have been delineated in association with the timber harvesting areas proposed in this FDP. These are:

  - a 0.8 hectare patch in CP A Block 1 in an area with high biodiversity between several seasonal wetlands, and
  - a 1.4 hectare patch south of CP A Block 2 which has a moderate to high root disease infection level. This location contains diverse coniferous stocking, open areas, diverse shrub cover, soft snags, and coarse woody debris concentrations

  Together, these areas equal 8% of the 27.5 hectares of harvesting proposed in this FDP.

The two large areas in the center of W1832 which are excluded from the woodlot may also contribute to wildlife tree needs. These areas contain patches of very good growing sites, which support large diameter second growth forests with a high density of old growth coarse woody debris. These areas currently have high value wildlife trees, and habitat quality and density will increase further over time. The MoF long term management goal for these areas is not yet clearly defined, but the two areas are not likely high priority timber harvesting areas for the Ministry of Forests. If they are retained as wildlife tree areas, they will contribute significantly to biodiversity in the Dumont Creek watershed.

4.5.5 Ungulate Winter Range

The south west portion of W1832 has been designated an ungulate range management area in the Management Plan. The outline of this area is shown in Figure 15. The W1832 ungulate range management area contains a mixture deciduous brush fields, dry site coniferous forests, and open grasslands. Extensive browsing of deciduous shrubs, well worn trails, and scat indicate that this area receives moderate to heavy use by deer.

The KLBUP-IS also delineated ungulate winter range areas. The KBLUP boundary is also shown in Figure 15. It is similar to the W1832 ungulate management area, but also takes in the westernmost portion of W1832.

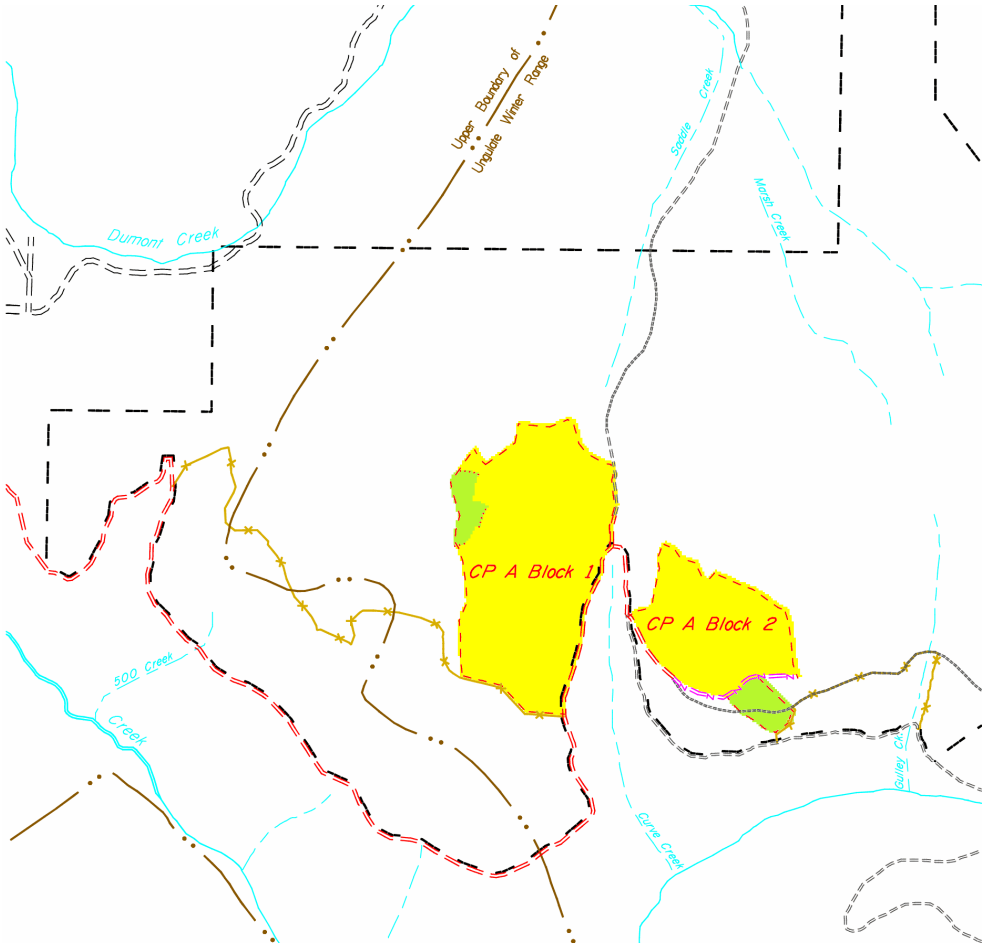

Figure 15: Ungulate Winter Range Management Boundaries in W1832.
Light brown boundary from W1832 Management Plan; dark brown boundary from KBLUP-IS.
Note small polygon of ungulate range south east of CP A Block 2, partially obscured by road.

Field work in spring 2001 supports the KBLUP-IS assertion that the moderately steep, west aspect, well forested slopes in the far western portion of W1832 do receive intensive winter usage by deer and elk. Significant usage levels are indicated by heavy browsing of shrubs, well worn trails and abundant scat.

This FDP proposes upgrading of the Silica Mine Road through the ungulate range area. The upgrade will not result in large scale habitat loss as the road corridor through the area has already been logged. Increased traffic may impact animal use, but overall traffic density on the road is expected to remain light. Ample hiding cover exists in the ungulate range area, so we do not expect animals to be seriously stressed by vehicle traffic on the road. No other disturbance of the ungulate winter range area is proposed in this FDP.

In the long term, the Licencees hope to work with the local community and wildlife biologists to develop and implement a habitat improvement plan for the ungulate winter range area, as discussed in the W1832 Management Plan.

4.6 Recreation

4.6.1 Recreation Inventory Results

Recreation Opportunity Spectrum (ROS) inventory information published for the Crown and private portions of W1832 identifies visual resources, coniferous forest, and wildlife diversity as the main biophysical attributes in the area which support recreation opportunities. These are the general attributes noted for the entire sidewall of the Slocan Valley and other main valleys in the region.

This ROS inventory recommends that the area be managed to a Partial Retention or Modification Visual Quality Objective (VQO), depending on the identified importance of the area to the main Slocan Valley viewscape. As discussed in Section 4.7, the partial cutting timber management approaches which will be used in W1832 will meet these objectives.

The ROS inventory identifies hiking, hunting, cross country skiing and gathering (wildcrafting) as recreational activities which do or could take place within W1832.

The Crown portion is rated as have a moderate recreation resource value (third of four classes, one grade up from lowest rating) while the private land portion has a common features assessment (fourth of four classes).

All areas are classed within the Sensitive feature management class, meaning that they require special management considerations beyond normal forest management practices. This is a reflection of the noted visual sensitivity, and will be addressed using partial cutting techniques.

The resultant ROS class for all portions of W1832 Roaded Resource Land, meaning that these areas present the usual recreation opportunity potential of accessible land within the provincial timber management landbase.

4.6.2 Observed Recreational Use

The following recreational activities are known to occur or to have occurred in W1832:

- dirt bike and ATV riding
- horseback riding
- hunting
- cross country skiing
- mounting biking
- hiking

At this time, W1832 receives limited recreational usage. The access to the crown portion of the Woodlot up Silica Mine Road has been blocked by private land for many decades. While the road access is now publicly owned, the general public is not aware of this fact, and does not use the road.

The only recreational activities observed in three seasons of field work in W1832 has been "dirt bike" riding on Silica Mine Road, and one hunter. Community members report having used the Silica Mine Road for as a horse or cross country ski trail in years past.

Access to the Dunn Creek portion of the woodlot is via a road easement which passes through the door yard of private dwellings, and functions as a private drive for residents. Public recreational access is not encouraged or appropriate.

The Silica Mine Road will be gated to control access, which is beneficial for forest and watershed management. Access management controls unplanned firewood cutting, which greatly assists in snag, wildlife tree, and full cycle tree management, and also reduces the risk of accidental fires. Access management also reduces the risk of deposition of deleterious substances in domestic water supplies.

However, access management reduces recreational potential While the area is classed as Roaded Resource Land in the inventory, the road has not been and will not be available for vehicle access. The Crown portion of W1832 is a long hike up a steep road from the gate site. Due to access limitations, recreational use of W832 is expected to remain light

4.6.3 Potential Recreation Activities

There are small, moderately significant eco-recreation features within W1832, such as old forest patches, deer habitat, wetlands, talus slopes, and grasslands. These features provide recreation opportunities for amateur botanists and ecologists. There are also several scenic points within the woodlot, with expansive views over the Slocan Valley. With community involvement, these features could become the focus of a network of trails.

Forest recreation can have an educational component, especially given the types of alternative silviculture which we plan to use. In the W1832 Management Plan, commitments were made to erect information signs describing various harvesting and silvicultural operations, and publish an information pamphlet to facilitate a self guided tour in the first five years of operations, once examples of partial cutting exist within the woodlot. Access management and limitations will reduce the effectiveness of these actions.

4.6.4 Management Implications

Development activities proposed in this FDP are not expected to have any negative impacts on recreation potential in the W1832 area. Indeed, improving access to the area would likely increase recreation usage. However, the improved access will have little impact on recreation usage levels because access management policies implemented to protect and maintain forest and water resources will exclude public vehicular traffic on the Silica Mine road.

4.7 Visual Resource Management

Maintaining the visual quality of the lower slopes of the Slocan Valley is a high priority for many residents, and is required by government policy. The visual management objective for W1832 to meet either Retention or Partial Retention visual quality objectives

by using a variety of partial cutting approaches to maintain visually significant forest canopies on the timber management landbase at all times.

No Visual Quality Objectives, Recommended Visual Quality Objectives, and/or Recommended Visual Quality Classes have been officially approved for the landscape which contains W1832 by the Ministry of Forests[18]. In this situation, the scenic area classes identified under the KBHLP Strategies are to be used as guidance for visual management.

Section 3.8 of the KBLUP-IS states that the intent of the front country visual management guidelines is that "Design of timber harvesting, forest management and mineral exploration should reflect the importance of front country landscapes to communities, recreation and tourism."

Three classes of landscape management for scenic areas are defined in KBLUP-IS and the KBHLP Strategies. All of the Slocan Valley visible from Highway 6 is contained in Class 1 polygons. No other scenic management classes are defined in the Slocan Valley.

The KBHLP Strategies Landscape Design Intent for Class 1 landscape management areas states that:

- In most visible foreground[19] areas and in important or prominent midground areas, disturbance may be discernible but should not be evident in the landscape.
- In less important or prominent foreground areas, most midground areas, and important or prominent background areas, visible disturbance should remain subordinate in the landscape.
- In most background areas and less important midground areas, landscape alterations may be visually apparent, but should be designed to blend into the landscape in form and color.

A copy of the Scenic Areas Class (SAC) boundaries in the W1832 area was transferred to the Forest Development Plan map from MOF digital data sources. As expected of data moved from a regional scale to a 1:10,000 operational planning scale, the KBHLP SAC boundaries show flaws. While the definition of Class 1 scenic management areas is "the area visible from Highway 6", the current Class 1 polygons include parts of W1832 which are completely hidden from Highway 6, and likely from all parts of the Slocan Valley floor, by terrain features. Visual quality management mapping at a scale more suited to operational planning will hopefully be generated in the next several years.

With regard to the developments proposed in this FDP:

---

[18] The Visual Sensitivity assessments and VQO's included in the ROS inventory discussed in Section 4.6.1 are not officially approved. It is notable that the visually sensitive recreation polygons closely resemble KBHLP visual class polygons.

[19] For the purposes of the operational guidelines, *Foreground* refers to landscape up to one kilometer away, *Midground* refers to landscape between one and five kilometers away, and *Background* refers to landscapes between five and twelve kilometers away.

- CP A Block 1 can not be seen from any lower slope position in the Slocan Valley, as it is on the east side of a low ridge.
- CP A Block 2 is not visible from the highway and most lower slope positions, as it is hidden by the same ridge. There may be sites in the Kazakoff and Drake Road areas on the west side of the Slocan Valley which can see the CP A Block 2 area.
- The Silica Mine Road is not visible from most lower slope areas or from Highway 6 due to intervening terrain features. Part of the Silica Mine Road location is visible from the Kazakoff and Drake Road areas.

The planned upgrading to Silica Mine Road should have minimal impacts to the viewscape of the areas it is visible from, as the existing road grade is largely concealed by 20 to 60 year old regeneration over most of its length. Road upgrading measures will include widening the road right of way in some places, but an intact visual screen will be retained in most locations on the downhill side of the road. Where required, widening and/or reconstruction of the road prism will be largely be carried out by further excavation on the inslope side of the existing road. Sidecasting of fresh material on visually sensitive slopes will be avoided.

All of the harvesting proposed in this FDP is intermediate partial cutting, which will retain at least 50% of the stand volume and forest canopy on the site following logging. Regardless of the visibility of the blocks in question, these cutting methods will result in low visual impacts, and will meet a retention or partial retention VQO. The KBHLP requirements for foreground areas in Class 1 scenic landscape management areas will also be met.

Figure 16: W1832 from near the bottom of Kazakoff Road, south of Winlaw.
The approximate extent of the woodlot is outlined in white. The low ridge on the right edge of the woodlot screens Bocks 1 and 2 from view. Silica Mine Road crosses the dry, open slope on the lower right edge of the Woodlot, but is well screened from view by established vegetation which will be retained.

4.8 Botanical Forest Products

General interest is growing in potential economic opportunities in the botanical forest products such as wild mushrooms, floral greens, and medicinal plants. However, these opportunities are still largely in the investigation and development stages. For example, the Harrop Procter Community Forest is actively developing sustainable harvest strategies, business models, and markets in this field. Current information on markets, species ecology, and growth rates is insufficient to develop specific botanical and wildcrafting resource management plans.

Our general approach to botanical forest products and wildcrafting is to retain future options. All of the cutting proposed in this plan is intermediate partial cutting, which will retain much of the forest canopy on the site and which has the objective of maintaining functioning forest ecosystems on the logged sites. We believe that this approach will maintain most current botanical and wildcrafting options within the timber management landbase.

4.9 Cultural Heritage Resources and Archaeological Sites

All parts of North America were inhabited by First Nations peoples prior to European expansion and settlement. W1832 is, like all of British Columbia, within the area formerly used by First Nations people.

An Archeological Overview Assessment completed by Kutenai West Heritage Consulting Ltd. in 1997 identified:

- 3 areas in or near proposed CP A Block 1 which had physiographic features which suggested that an Archeological Impact Assessment should be carried out, and
- 2 areas in or near proposed CP A Block 2 which had physiographic features which suggested that an Archeological Impact Assessment should be carried out.

The features in question are:

- the area of flat terrain in the saddle between Winlaw and Dumont watersheds which is partially within CP A Block 1 and which is bordered by CP A Block 2.
- the areas in CP A Block 1 near the elevated openings in the ungulate range management polygon just south of CP A Block 1.
- the low hill which forms a viewpoint just north of CP A Block 1.
- the hill which forms a viewpoint just northwest of CP A Block 2.

An Archeological Impact Assessment of these sites was carried out by the same investigator in the field in 1998. The areas near the elevated openings in the ungulate management area were not assessed. A field assessment was performed on small, slightly elevated landforms overlooking one of the open wetlands in CP A Block 1, a location not mentioned in the Overview Assessment. No evidence of precontact cultural remains or of significant postcontact cultural features was found.

Copies of the Archeological Overview Assessment and the Archeological Impact Assessment are contained in Appendix 6.